PILGRIM MINE SITE WASTE EVALUATION

WORK PLAN

FINAL DRAFT

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List of Acronyms

AAS Atomic Absorption Spectroscopy

BLM Bureau of Land Management

DQO Data Quality Objectives

E&E Ecology and Environment

EPA Environmental Protection Agency

GPS Global Positioning System

HASP Health and Safety Plan

HAZWOPER Hazardous Waste Operations and Emergency Response

HRS Hazard Ranking System

ID Identification

MCL Maximum Contaminant Level

NRC National Response Center

PPE Personal Protective Equipment

QA Quality Assurance

QAPP Quality Assurance Procedure Plan

QC Quality Control

SAP Sampling and Analysis Plan

XRF X-ray Fluorescence

Executive Summary

Ecovestor will complete a preliminary assessment and site investigation at the Pilgrim Mine Site to determine if contaminants at the site present a risk to human and ecological health. Soil samplings will be collected on site prepared and analyzed to determine concentration levels and if migration is occurring. A mix of grid, hot spot and background sampling will be used to accurately represent conditions at the site. X-ray fluorescence spectroscopy and atomic absorption spectroscopy will be the two methods used to determine concentrations and correlate data. A human health and ecological health risk assessment will be carried out for the site using multiple exposure scenarios. At the end of this analysis recommendations will be made on whether remedial actions are required at the site. This work plan details the tasks that will be carried out to complete this project and includes a health and safety plan and a sampling and analysis plan located in the appendices.

1.0 Introduction

Ecovestor has prepared a Pilgrim Mine Site Evaluation Work Plan to assist in the preliminary assessment and site investigation (PA/SI) of the Pilgrim Mine Site as requested by the Bureau of Land Management (BLM). This work plan specifies soil sampling procedures and techniques, a health and safety plan for field sampling, and analytical methods used to analyze samples.

1.1 Project Objectives

The goal of this project is to determine if conditions at the Pilgrim Mine Site present risk to human or ecological health and if remedial actions or further investigation is required at this site.

1.2 Project Scope

A PA/SI will be completed for this site. To complete the PA/SI field sampling, sample analysis including XRF spectrophotometry and atomic absorption will be performed to determine what contaminants are present at the site, their concentrations, and if migration is occurring. After sample analysis a human and ecological risk assessment will be completed to determine if remediation actions are required at this site.

1.3 Work Plan Schedule

The work plan must be completed before field sampling or any task following sampling can occur. The work plan will be completed by December 15, 2016.

2.0 Project Management

Project management will occur throughout the entire project to ensure the team works effectively, that high quality work is produced, and that all deadlines are met to maximize success of the project.

2.1 Project Management Approach

Project management will include weekly team meetings to collaborate on tasks, discuss upcoming deliverables, and address any problems that arise. Client communication will occur periodically to update the client on progress made.

2.2 Project Procedures

The health and safety plan (HASP) and sampling and analysis plan (SAP) outline all of the procedures that will be used throughout the project. The HASP is located in Appendix B and the SAP is located in Appendix A.

2.3 Quality Management

Measures will be taken to ensure that the data collected is unbiased and accurately represents conditions at the site. Data quality objectives and quality control measures are detailed in Appendix A, in Section 2.2.

2.4 Subcontract Management

Twenty samples will be sent to Jeffery Propster for Atomic Absorption Spectroscopy. The Quality Assurance manager will oversee the transportation of samples and ensure proper sampling techniques are being followed. More information can be found in Appendix A, section 2.4.

3.0 Site Background Information

This section will present information regarding the site's background information, this will include the site location relative to the State of Arizona and with respect to neighboring cities, as well as specific coordinates; further, a brief site description and previous site investigations and operations are outlined.

3.1 Site Location

Pilgrim Mine is located 21 miles north of Kingman, Arizona; and 10 miles west of the town of Chloride, AZ on Bureau of Land Management property. The latitude and longitude of the site is N 35 degrees 23 minutes 18 seconds (35.388333 degrees) and W 114 degrees, 21 minutes, and 32 seconds (114.358889 degrees); and the topographical map name is Grasshopper Junction, 7.5 minutes. The location of the site with respect to Arizona can be seen in Figure 3.1 (Arizona map)

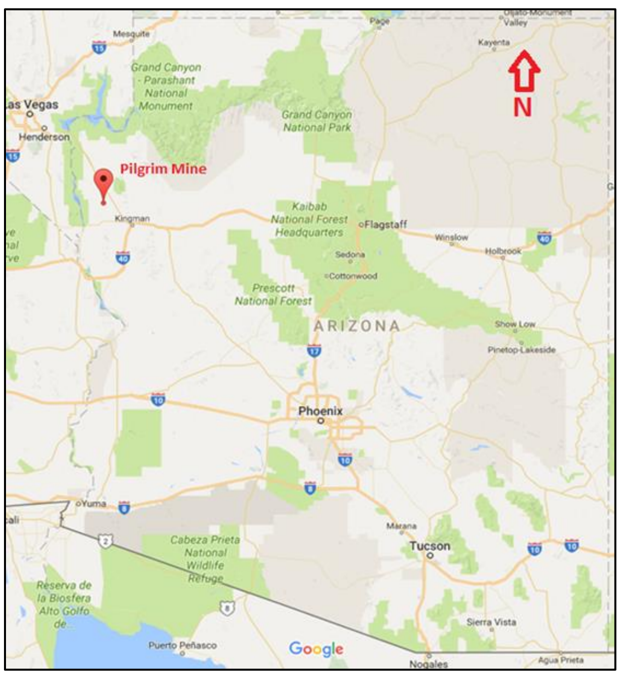

Figure 3.1 - Pilgrim Mine Site Location in Arizona

3.2 Site Description

The site or sampling area occupies approximately 12 acres (without considering potential pollutant migration) in an undeveloped, federal lands area. The site or sampling area is bordered on the north by undeveloped federal lands, on the west by undeveloped private land, on the south and the east by undeveloped federal land and dirt roads. The specific location of the site or sampling area is shown in Figure 3.2.

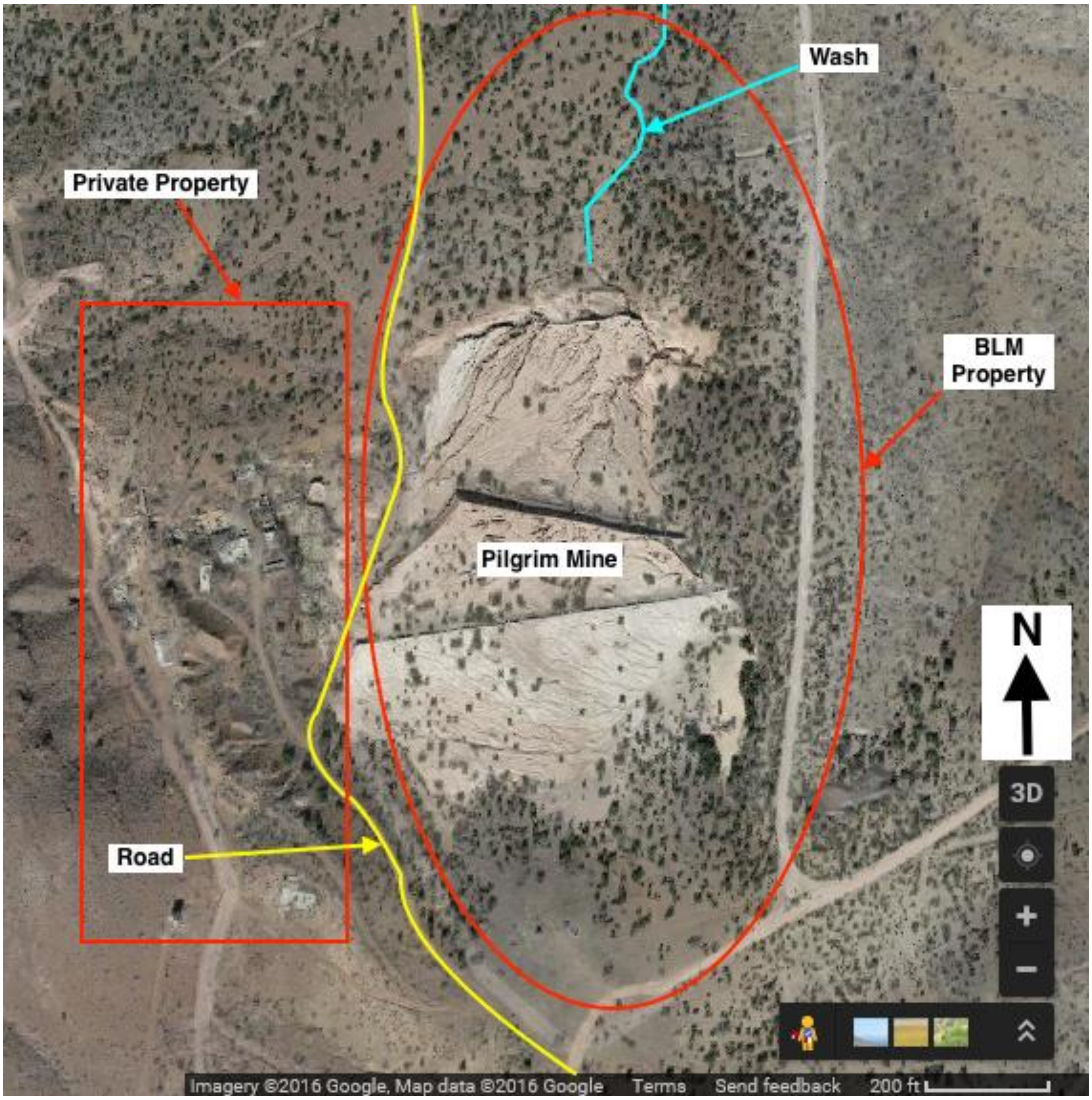

Figure 3.2 – Overview of the Pilgrim Mine Site

3.3 Previous Operations and Investigations

Pilgrim Mine is an abandoned mine that was previously mined for gold, lead, iron, copper, and sulfide. The site was previously operated under the name of the Pioneer Gold Mining Co., Mine, the Katherine Treasure Vault Mine and the Al Smith Producer Mill Mine. Flotation mills. cyanidation, heap leaching, tank leaching carbon-in-pulp, and carbon-in-leach are methods that were previously used at the site.

4.0 Investigative Approach

A site investigation will be completed for the Pilgrim Mine site. The methods used for this investigation are detailed throughout the Work Plan.

4.1 Site Investigation Objective

The site investigation will involve field sampling, sample analysis, and a human health and ecological health risk assessment. The goal is to determine if site conditions present risk to human or ecological health and if the site requires remediation or further investigation.

4.2 Site Investigation General Approach

Several sampling methods, lab analyses, and modeling will be used throughout this investigation. The approach used for this site investigation is detailed in full in the SAP in Appendix A.

5.0 Field Investigation Methods and Procedures

Field sampling will be completed on January 28th and 29th during daylight hours. The field methods and procedures are described in Appendix A section 5.0.

6.0 Investigation-Derived Waste Management

Waste will be generated throughout field and laboratory work. The waste will be treated as hazardous waste and handled accordingly. Waste management procedures are detailed in Appendix A section 7.0.

7.0 Sample Collections Procedures and Analysis

A combination of hot spot, grid and background samples will be collected for this project. Soil sampling methods are listed in Appendix A section 5.2. Soil sample analysis design is detailed in Appendix A section 4.0.

7.1 Sample Containers, Preservations, and Storage

Half-gallon zip lock bags will be used to collected samples. The samples will be stored in large plastic containers. The methods used to contain, preserve and store samples and listed in Appendix A section 5.0.

7.2 Sample Documentation and Shipment

A labeling system will be used to make sample bags and a logbook will be used to document samples. The processes used to document and ship samples are outlined in Appendix A section 8.0.

7.3 Field Quality Assurance and Quality Control

Precautions will be taken in the field to ensure sample quality and prevent cross contamination. Field quality assurance measures are described in Appendix A section 2.2.5.

8.0 Deviations from the Work Plan

All deviations from the work plan will be documented in the logbook. Methods used to handle deviations from the work plan are detailed in Appendix A section 11.0.

9.0 Preliminary Assessment and Site Investigation (PA/SI) Reporting

The PA/SI will complete the project and present detailed conclusions for contaminants of concern found at the Pilgrim Mine site. These conclusions will consist of ecological and human health risk assessments, and will provide field screening level analysis for the BLM, defined by Arizona's Residential Soil Remediation action levels; such that future site investigations and/or remediation can take place.

10.0 Project Schedule

The project schedule is outlined within the project Gantt chart, displayed in Figure 10.0, below, which outlines major milestones (defined by the diamonds within the Gantt chart) and deliverables. The project deliverables and their dates are as follow:

- 50% PA/SI, December 15, 2016
- 100% PA/SI, May 5, 2017
- Final Presentation, May 5, 2017
- Project Website, May 5, 2017

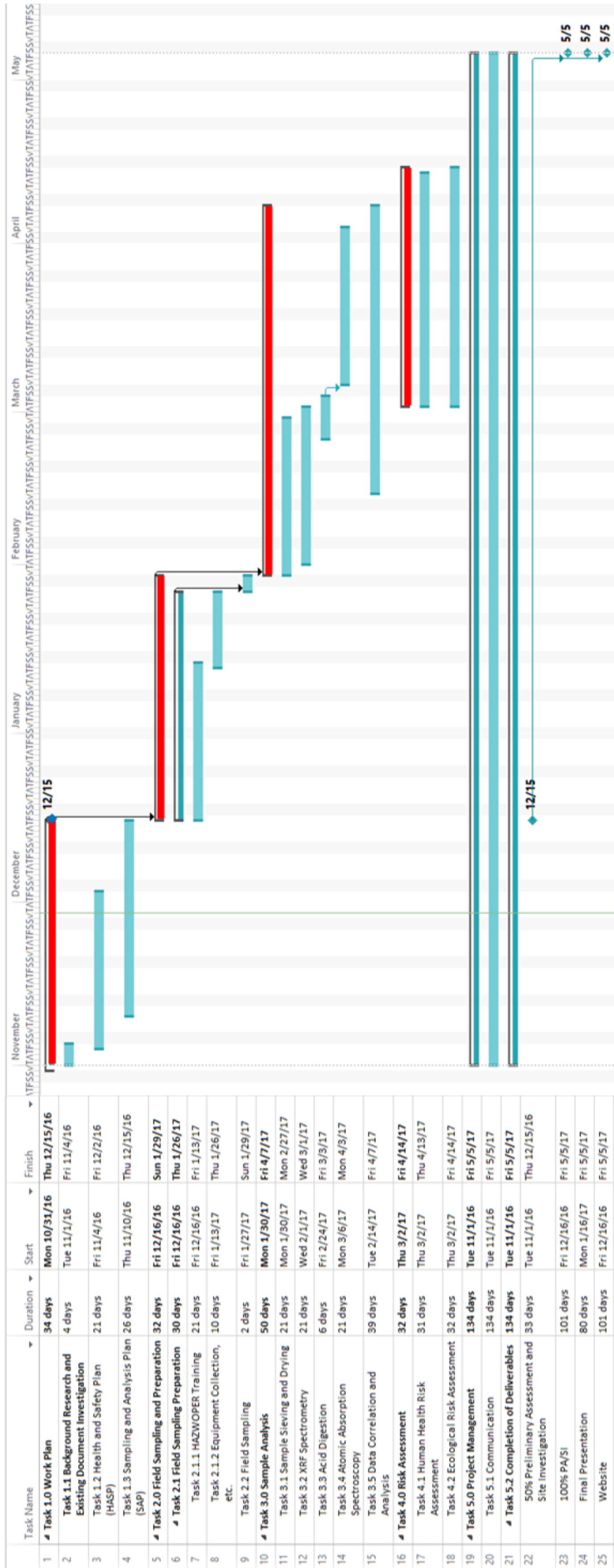

Figure 10.1 - Project Gantt Chart

11.0 References

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Appendix A Sampling and Analysis Plan

1.0 Introduction

The Sampling and Analysis Plan (SAP) for the Pilgrim Mine near Kingman, Arizona, where an initial site investigation, in conjunction with the Bureau of Land Management (BLM) will be conducted to determine if further action is required. The site was first discovered in 1904 and has had an extensive history with several different gold and silver extraction methods including flotation mills, cyanidation, heap leaching and tank leaching. After a mine is no longer economically feasible operations are discontinued and clean-up of these sites can vary in completeness. Abandoned mines can contain high levels of hazardous chemicals, unstable structures, open shafts, and poorly ventilated areas with toxic gases [BLM 2015]. Risks to human health, water quality, public safety, and the environment can be found in areas surrounding abandoned mines [BLM 2015]. With increased use of public lands for outdoors recreation, there is increased exposure to these environments [BLM 2015]. Soil sampling will be conducted at the site using hot spot, background and gridded sampling methods. The concentrations of the site's contaminants of concern will be analyzed using both x-ray fluorescence (XRF) spectrometry and atomic absorption spectroscopy (AAS).

1.1 Responsible Agency

The Pilgrim Mine site is located on BLM land, and as such, the BLM is currently outsourcing the initial sampling investigation to Ecovestor Inc., who will conduct the site sampling investigation with oversight and guidance from Eric Zielske of the BLM.

For a site to have a funded investigation and remediation, it must first go through a process to determine its toxicity and danger to human health.

1.2 Project Organization Table

Table A1.1, below, outlines the major roles and the people who are undertaking those roles, with respect to the project. Contact information is also provided in the table.

Table A1.1 – Project Organization and Responsibilities

Title	Name	Phone Number Email Address	Role
Project Manager	**Eric Zielske**, P.E., BLM	(602) 417-9223 ezielske@blm.gov	Client and Project Lead
Grantee Project Manager	**Bridget Bero** Ph.D., P.E., NAU	Bridget.Bero@nau.edu	Technical Advisor
Student	**JC Acuna**	jma424@nau.edu	Student Team (Ecovestor)
Student	**Michelle Kuhn**	mlk355@nau.edu	
Student	**Khaled Alali**	Ka664@nau.edu	

Student	**Ryne Flanagan**	rjf77@nau.edu	
Laboratory Quality Assurance Officer	**Jeff Propster, NAU Labs**	Jeffrey.Propster@nau.edu	Subcontractor

1.3 Sampling Details

Sampling will happen in four phases. Phase one consists of flagging sample locations, preparing the sample collection, recording station, and the decontamination station. Phase two will entail completion of the grid sample locations, photographing locations, documenting GPS coordinates, and recording ecological observations. Phase three will consist of hot spot and background sample demarcating, photographing, and data recording of hot spot and background sample locations. The fourth phase will be dedicated to sample collection.

Phase One: One team member will be in charge of the GPS unit and finding the predetermined GPS sampling point. A second team member will work with the first team member to mark the grid points using blue flags, and a tape measure. One person will write the sample ID on the flag. The labeling format for sample ID numbers will be followed as per Section 8.2.1. While this is occurring the remaining two team members will be setting up the sample collection station and decontamination station.

Phase Two: While the staking of points is underway, another team member will begin to take pictures of the flagged sample locations and record the corresponding flag ID number to the picture number in the photo logbook; the GPS coordinate will be recorded as photographs are taken, as the camera is equipped with GPS location technology. At this time, the remaining members will begin recording data of vegetation, etc. to complete the ecological risk assessment.

Phase Three: Once the gridding is complete, two team members will begin recording GPS coordinates and flagging hot spot and background sample locations; yellow flags to demarcate hot spot samples and white flags for background samples. One person will record sample IDs on the flag. Once the grid photographing and recording is completed, two team members will begin taking pictures and recording the sample ID numbers for each hot spot and background sample location in the photo logbook. At the end of phase three sample location demarcation, photographing and initial data collection will be completed.

Phase Four: Two or three team members will begin collecting samples. Each individual sampling event will begin by labeling the sample bag with a sharpie. At this time, the recorder will take down information as per Section 8.1.1. Once the sample has been collected, the sample will be taken to the member responsible for sample collection who will have a checklist of sample IDs, and will confirm the sample ID with both the sampler and the recorder. The same team member will direct the sampler(s) to the correct bin for sample collection and the sampler(s) will move on to the decontamination station. The decontamination process will involve cleaning the trowel, and disposing of their gloves. After decontamination, the sampler(s) will put on a new pair of gloves and return to collecting samples; and a team member will then identify the next sample to be taken. This process will be repeated until all the flags have been removed.

2.0 Project Data Quality Objectives

This section introduces the purpose of the environmental investigation and how the data will be used. It will cover topics including the project objectives, problem definition, data quality objective and quality control measures, data review, data validation and data management, and finally assessment oversight.

2.1 Project Objectives and Problem Definition

The primary objective of this SAP is to identify the contaminants of concern and identify if contaminant concentrations exceed federal or state action levels; those results will then be used to address further action, if necessary. Testing for all metals will occur since there are no previous site investigations. However, lead and arsenic are currently considered the main COCs. Table A2.1, below, defines the Arizona nonresidential action levels for both analytical parameters.

A secondary objective is to identify possible migration pathways for contaminants and contaminant threat levels to humans and the environment for multiple exposure scenarios.

Table A2.1 – Contaminants of Concern and Action Levels (Matrix = Soil)

Analytical Parameter (COCs)	Action Levels
	State (non-residential), mg/kg [ADEQ]
Lead	800
Arsenic	10

2.2 Data Quality Objective (DQO) and Quality Control

The Data Quality Objective is to provide quality data to BLM, that is acceptable for screening level analysis. The Quality Control objective is to reduce cross contamination risk by following proper protocols illustrated in the sampling design and field sampling plan. To ensure the success of the DQO, frequent communication on proper protocols to follow, with project manager Dr. Bero and Eric Zielske of the BLM are required. To reduce the risk of improper sampling and analysis techniques, all team members have taken a 4 hour XRF training. The Pilgrim Mine project will also have lab results from a third party technician to validate the quality of the XRF results.

2.2.1 Field Quality Control

A background sampling regime of 3-8 samples will be taken up gradient from the contaminated area to determine the typical conditions of the soil; and will provide a standard for comparison of on-site contaminant concentration levels [Ecology and Environment].

Field, equipment, temperature, and trip blanks will not be used during the sampling regime, due to the nature of the site investigation.

2.2.2 XRF Quality Control

The XRF will be set to soil mode for concentrations under 6000 ppm. If the readings exceed 6000 ppm, then the samples will fall outside the acceptable limits of screening levels and the XRF will be switched to mining mode to obtain more accurate data. At least two standard reference materials will be analyzed at the beginning and end of the day, as well as every 3 hours and after every battery swap to validate the instrument readings. If the results do not fall under the certified values, the instrument is not functioning properly and will be sent for repair.

The portable XRF has a memory storage that can be downloaded into excel spreadsheets for further analysis. Each sample will have a sample ID labelled on their containers, as per section 8.2.1 of Appendix A. Before the samples undergo XRF analysis, sample ID entry will be prompted. After entering the information on the sample bag into the XRF, the XRF is ready to take the reading. The data collected from the reading will be assigned to the sample ID. As each sample is entered and analyzed, those samples are marked and separated from samples that have not undergone XRF analysis.

Water attenuates the fluorescent x-rays when soil moisture exceeds 20%. Low correlation values are expected in these conditions so if soil moisture exceeds 20%, the fieldwork will be postponed.

2.2.3 Data Analysis Quality Control

The soil samples will be homogenized and nine different readings will be taken for each sample collected in the field. While analyzing the nine XRF result readings for one sample, the high and low concentrations will be thrown out and the remaining seven will be averaged, providing one representative contaminant concentration for that sample. This process will be repeated for every sample.

The Quality Assurance Manager will analyze the standard reference materials to validate the XRF reading at the beginning and end of the day, as well as every 3 hours and after every battery swap to validate the instrument readings. If the results do not fall under the certified values, the instrument is not functioning properly and the QA Manager will send it for repair. The QA Manager will assure that all procedures are properly followed, and see that the employees are properly trained and complying with necessary rules and regulations.

2.2.4 Correlating Samples (XRF and AAS)

Another important factor in quality control and data assurance is the process of split sampling, where the team will complete XRF analysis on the samples before sending them to Jeffrey Propster at Northern Arizona University Labs, where he will perform Atomic Absorption Spectroscopy. Approximately 20% of the soil samples collected, (20 samples) covering the range of concentrations found, will be sent to the NAU Labs for Atomic Absorption Spectroscopy. The split sampling will allow up to compare data sets and correlate the data.

2.2.5 Cross-contamination Precautions

In the field, precautions will be taken to avoid contamination of samples by continually decontaminating the trowel after each and every sample. Similarly, the sampler(s) gloves will be changed after every sample.

In the lab, cross-contamination precautions will take the form of thoroughly cleaning and washing sieves, to ensure no soil will be left to potentially contaminate subsequent samples.

2.3 Data Review, Validation and Management

After all the samples have been collected, downloading the information from the XRF is required. The original spreadsheet will be saved with edit protection, that do not allow anyone to accidentally edit portions of the spreadsheet. The spreadsheet will then be saved under new setting that will allow edits and changes. The new spreadsheet is then organized from high to low concentration by arsenic and lead levels. Any levels that exceed the Arizona non-residential remediation standards will be highlighted and the physical sample marked with the contaminate level and separated into a new group of exceeding the Arizona non-residential remediation standards. To ensure that the spreadsheet is not changed while manipulation occurs, the original downloaded spreadsheet will be unchanged, and checked to verify that new spreadsheet did not changed sample IDs and coordinates with other data providing incorrect results.

The lab data report provided by the lab technician Jeffery will also be saved immediately as the original data with edit protections applied to the spreadsheet. Any data that is referenced in the PA/SI report will be verified by the original spreadsheet as acceptable.

3.0 Sampling Rationale

The scope of the sampling effort will consist of approximately 100 grab-bag, surface soil samples. Three techniques will be used to sample the site, beginning with unbiased, evenly spaced grid sampling over the three tailings piles. Hot spot sampling will be utilized just north of the tailings piles, following a wash that runs north, away from the site; which has the potential for pollutant migration. The third sampling technique to be used is background sampling, to identify the natural concentration of contaminants in the surrounding soil. The soil samples will be sieved and the lab analyses will consist of X-ray fluorescence spectrophotometry followed by atomic absorption spectroscopy; which will be correlated to find contaminants of concern and their concentrations.

A larger grid will be used on the three tailings piles. The grid shown in Figure A3.2 and is 243 feet by 243 feet (74 meters by 74 meters). The area of contamination is homogenous across each of the 3 tailing piles because it is believed that each tailing pile was processed using the same procedure, so the soil contamination is expected to have similar ranges.

Since the wash does not have a consistent form and poor pixel clarity on google earth, gridding the wash was not feasible. A sampling transect method (modified grid) will be performed on the unnamed wash north of the tailing piles, approximately 150 feet down the wash. The wash will transect following Figure A3.1’s design. The width of the wash, from bank to bank will be divided into thirds and may be adjusted in the field as the wash becomes wider or narrower. The width of each grid in the transect is approximately 3 feet by 3 feet.

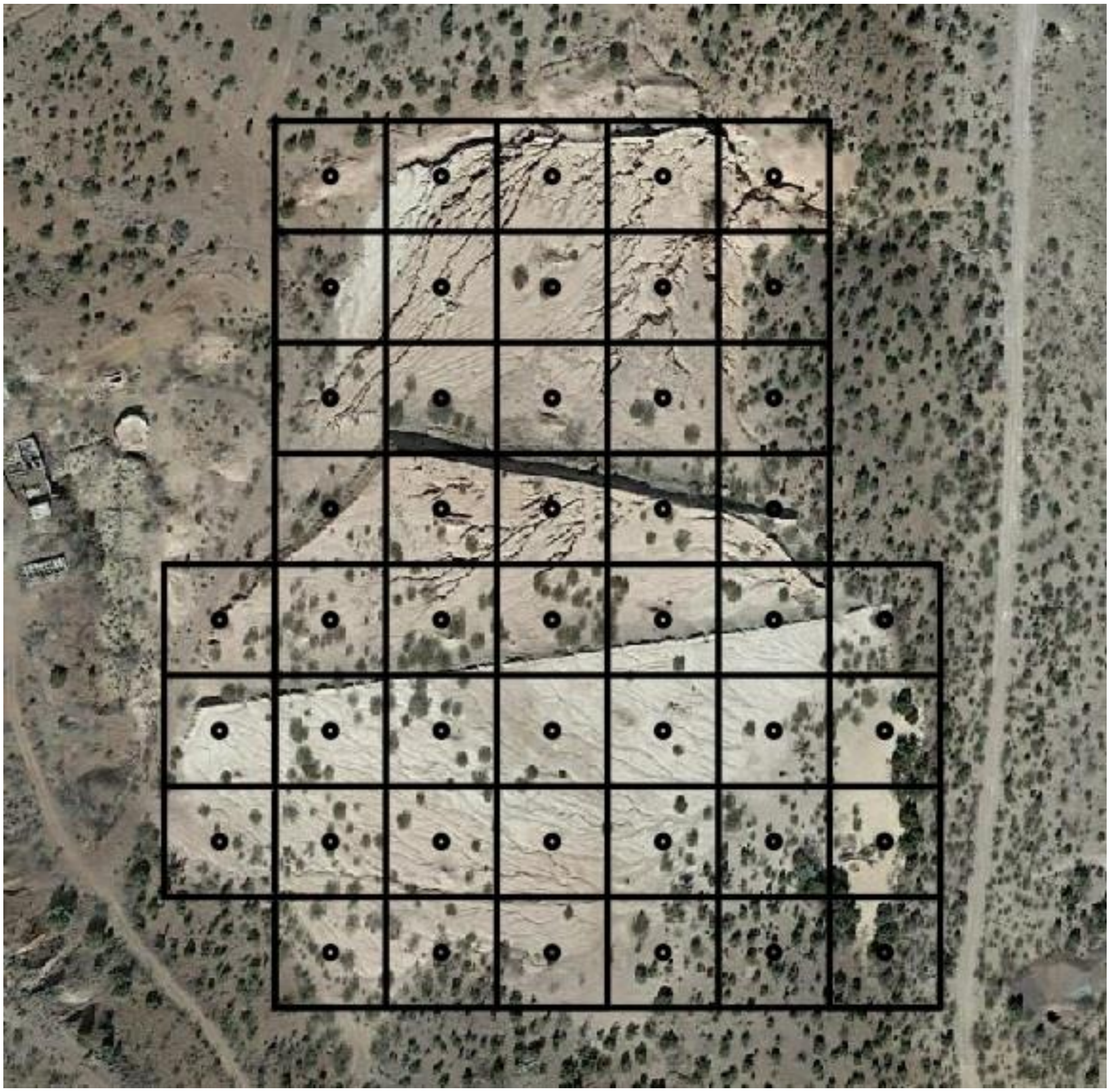

Figure A3.1 – Tailings Pile Grid Sampling locations

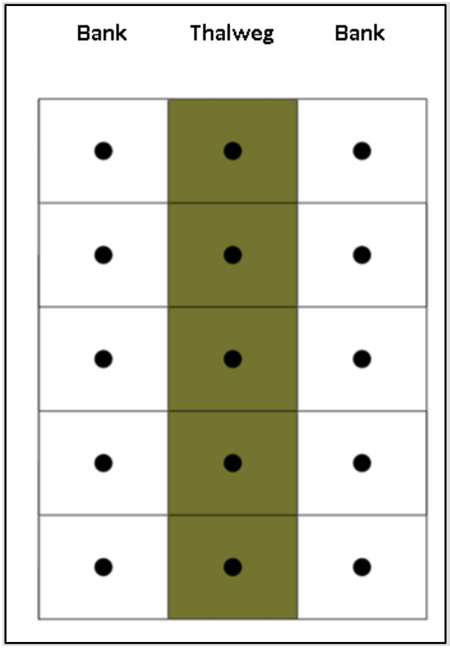

Figure A3.2 – Grid Wash Points of Sampling

3.1 Soil Sampling

Soil sampling will consist of surface soil samples, 0-4 inches in depth, for all sampling methods. Approximately 100 surface soil samples will be collected.

3.1.1 Grid Sampling Overview and Rationale

The approximate, preliminary location of the gridded sampling locations will be provided in the next draft of this report. The gridding sampling method was chosen to sample the area where the wash begins, and down through the wash, about 200 feet or until mine tailings are no longer visible, because it is the preferred method for the determining the extent of contamination and for confirming site-cleanup. Further, grid sampling is an acceptable method for establishing the on-site threat of contamination, identifying sources of contamination, and for evaluating treatment and disposal options [Ecology and Environment]. Lastly, no previous site investigations have occurred, leaving the team with very little evidence to determine potential COC concentrations within the mine site.

3.1.2 Hot Spot Sampling Overview and Rationale

The hot spot sampling methodology will be used in the wash to find high concentrations of pollutants and track pollutant migration. The hot spot method was chosen to identify areas of high concentrations that grid sampling might miss, and to track potential pollution migration in the wash because it is the preferred method for determining the extent of pollution contamination as well as confirming whether contaminant concentrations exceed cleanup standards, as higher concentrations are more readily identified [Ecology and Environment]. Further hot spot sampling location information is discussed below, in Section 4.1.4.

3.1.3 Background Sampling Overview and Rationale

Background samples will be taken from undisturbed areas away from the area of interest to determine the typical conditions of the soil; and will provide the team with a standard for comparison of on-site contaminant concentration levels [Ecology and Environment]. Background sample locations will be discussed further in Section 4.1.4.

3.1.4 Field Decision Criteria

The hot spot sampling locations will be determined in the field, based solely on the visible migration of mine tailings within the wash. The hot spot samples for the wash will occur within the area north of the site, and down gradient into the wash that runs north, away from the site [Ecology and Environment]. The background sample locations will be determined in the field by the supervisor. The background samples will ideally come from up gradient, or south of the site, at a distance of 200 feet or more from any visible tailings [Ecology and Environment].

4.0 Sample Analysis Design

This section will discuss the methods and procedures that will be used to complete the sample analysis; the process includes sample sieving, XRF spectrophotometry, subsample selection, acid digestion, and atomic absorption spectroscopy. As previously discussed above, and displayed in Table 3-1, only two contaminants of concern have been identified; however, the team will test samples for all metals that are higher than the residential concentration levels.

4.1 Sample Sieving

Before the samples are to be sieved, they will be adequately dried to remove whatever excess liquid is within the samples. The sieve stack will consist of sieve sizes including 0.5 inch, 3/8 inch, #4, #10, #40, and finally the #200 sieve, and the collection pan. The sieving process will consist of the following procedure (adapted from ASTM C 136-01):

1. Soil samples will half to ¾ of a one-gallon plastic bag
    a. (If samples are not dry):
        i. Using a convection oven dry the sample in a clay bowl.
        ii. Dry for 2 to 4 hours in the convection oven at a temperature equal to or less than 150 C.
        iii. The drying process is complete when the net weight is constant.
2. The sample will be placed in the 0.5-inch sieve, the lid will be placed on top, and the 0.5-inch sieve will be placed on the sieve stack
3. The mechanical sieve shaker will be run for approximately 5 to 10 minutes, with 10 minutes representing the upper threshold.
4. The sieves will be removed, and each sieve will be decontaminated, and the waste soil will be appropriately cared for.
5. The collection pan holds the sample to be analyzed, this sample will be collected in a new plastic bag, and analyzed according to section 4.2, below.

4.2 XRF Spectrophotometry

The initial analysis of the soil samples will be conducted with XRF analysis. The procedures discussed mirror the process outlined in the EPA method 6200.

XRF Testing Methods:

1) Use a blank sample during these measurements calibrate the XRF gun

2) The bag with the sample will be evenly flatten and gridded three by three with a marker using a stencil as a guide.
3) The nine areas will be approximately two inches by two inches.
4) Each area will be analyzed with the XRF gun.
5) Once all nine shots are made with the XRF gun, the sample is marked as completed.
6) The sample is stored for later confirmation analysis.

4.3 Acid Digestion

Acid digestion will be done by the Pilgrim Team following the EPA Method 3052: Microwave Digestion. Only 20 samples (20%) will be selected for Acid Digestion and Atomic Absorption Spectroscopy; based on the range of values that best represent the soil sample concentrations.

Microwave Digestion Procedures:

1) A 0.25 to 1.0 g sample is weighed out in the reaction vessel.
2) 9 mL of nitric acid are then added to each vessel.
3) Then depending on the matrix the proper amount of hydrofluoric and/or hydrochloric acids are then added.
4) Finally, the hydrogen peroxide is added.
5) The vessel is allowed to react for approximately one minute prior to sealing the vessels.
6) Vessels should then be placed in the rotor and placed in the microwave.
7) The vessels should then be heated to at least 180 °C, over 5.5 minutes and then held at 180 °C for at least 9.5 minutes.

4.4 Atomic Absorption Spectrophotometry

Jeffrey Propster at the Northern Arizona University Analytical Laboratory will be subcontracted to perform atomic absorption spectroscopy. EPA method 7010 will be followed.

Graphite Furnace Atomic Absorption Spectrophotometry Procedure, EPA Method 7010:

1) Turn on the power switch for the PE 5100 ZL Zeeman Furnace Module and the lamp power supply. Lamp requires a 15-minute warm-up time. Lamp alignment is pre-set.
2) Turn on the computer and printer. Cooling water should be on at this point. Turn on the Argon gas.
3) Open the WinLab software and identify the GFAAS computer program for contaminant.
4) Clean the graphite tube with Q-tips and Kimwipes or replace the tube if necessary. Check the windows of the furnace to make sure they are clean.
5) All instrument settings are computer controlled. The wavelength is set at 283.3 nm.
6) Enter sample positions and identities on the computer following the standard run order for calibration standards, samples, blanks and QC checks. The instrument is programmed to add the matrix modifier and analyze samples for duplicates and recoveries.
7) Load the auto-sampler and check the HCL lamp energy reading. The energy should range between 70 and 73. Check the alignment of the sampling tip.
8) Start the program for analysis of samples to begin.
9) Calibration check samples analyzed outside of the established limits will initiate instrument re-calibration.

5.0 Field Methods and Procedures

This section will outline the equipment taken into the field, the sampling methods and calibration procedures to be used for the soil sampling regime.

5.1 Field Equipment

Table A5.1 provides a list of equipment as well as the quantity and purpose of each equipment that will be needed in order to complete field sampling.

Table A5.1 List of Equipment Needed

Equipment	Description/Material	Quantity	Purpose
Trowel	10” Stainless Steel	3	Digging up samples, disturbing soil
Gloves	Large size, latex	5 boxes of 100 gloves	Preventing cross-contamination and to prevent accidental ingestion and reduce dermal contact
HAZMAT Suits	Polyprolene coveralls with hood	10	Reduce dermal contact and prevent contamination migration via clothes
Sample Bags	Low Density Polyethylene Ziploc gallon size bags	150	Collecting and storing soil
Sharpie Markers		4	Recording information on sample bags
Containers	40 gallon storage box	4	Storing and separating samples
GPS		1	Recording GPS coordinates of sample locations
5-Gallon Buckets	Plastic	3	These are to hold water for the decontamination of tools, etc.
Tape Measure	1”x100’	1	Distance measurements
Logbooks	8.5”x11” paper notebook	2	Photograph information logging and sample information logging

Stake Flags	4" H x 5" W with 30" Rod	100 blue, 50 white, 50 yellow	Staking sample locations
Compass		1	Determining directions
Chain-of-Custody Forms	8.5” x 11 pieces of paper	8	Determine the chain of custody of the samples and sample containers
Cleaning Water		25 gallons	Washing
Soap		1	Washing
Brushes		1	Washing
Drinking Water		5 gallons	Drinking
Sample Location Map and sample checklist	2 sheets of 11”x17” paper	2-3	Determining general sample locations and to keep track of samples already taken
Camera		1	Photographing
Paper Towels		4 rolls	Decontamination station, cleaning
Pens	Ballpoint	5	Logbook notes
Tape	Duct tape	2 rolls	Sealing plastic bins carrying samples
Trowel	5-oz candy/ice scoop	5	Transferring samples from the ground to the bags
Trash bags	13 gallon plastic bags	1 box	Disposable waste collection

5.1.2 Calibration of Field Equipment

There will be a preliminary calibration of the GPS unit before the sampling event takes place.

5.2 Surface Soil Sampling Methods to be Used:

Soil samples are to be collected using the following procedure:

1) Carefully remove the surface debris and take the top layer of soil to the desired sample depth with a pre-cleaned trowel.
2) Transfer the sample into an appropriate container using a trowel. Place the soil samples into labeled containers;
3) Each one-gallon Ziploc bag will be filled to approximately 50-75% of the bag's volume, higher volumes of soil will be taken when soil consists of high amounts of small rocks, sandy soils, etc.
4) Decontaminate equipment between samples in wash buckets, using soapy water with the sampler's gloves still on, the trowels will be scrubbed with wire brushes until no more soil can be seen. The trowel will then be rinsed with DI water and placed in a clean bucket. At this point the sampler can remove their gloves, and proceed with further soil sampling.

5.2.1 Containers

Samples will be placed into a half a gallon Ziploc plastic bags, appropriately documented and labeled, per section 8.2 in Appendix A, the sample labels will be handwritten on the bags with the following information: sample code (location code and sample type code - sample #), sampler, notes (date and time will be recorded here), and the sample's corresponding photo ID #.

5.2.2 Sample Locations

Grid samples will be mapped out before the sampling regime occurs; A3.1 in Section 3.0 above, displays the grid sample locations. Similarly, a general outline of the transect sampling is outlined in Figure A3.2, in section 3.0.

Exact soil sampling locations for hot spot and background samples will be determined in the field based on accessibility, visible signs of potential contamination (e.g., stained soils), and topographical features which may indicate the location of hazardous substance disposal (e.g., depressions that may indicate a historic excavation). Soil sample locations will be recorded in the field logbook as sampling is completed. A sketch of the sample location will be entered into the logbook and any physical reference points will be labeled. If possible, distances to the reference points will be given.

6.0 Sample Containers, Preservation, Packaging and Shipping

This section will detail the methods and procedures that will be used to store, transport and protect the soil samples once the sampling program has been completed.

6.1 Soil Samples

The number and type of sample containers, volumes, and preservatives are listed in Table A5.1, in Section 5.2.1, above. Preservatives will not be used. New plastic Ziploc bags will be used for each sample and prior cleaning is not required.

The bags may be labeled with each individual sample ID# prior to going into the field to collect samples, if the team so-chooses to use this method.

6.2 Packaging and Shipping

All samples will be placed in a plastic bin container. The following outlines the packaging procedures that will be followed for soil samples.

1) Samples packed in zip-locked, plastic bags will be placed into three bins.
2) Each bin will have a complete custody list of the samples inside.
3) Each bin will have a secure container top sealed with clear tape and custody form.
4) Place the bins in the transport vehicle.

7.0 Disposal of Residual Materials

In the process of collecting environmental samples, the sampling team will generate different types of potentially contaminated investigation derived waste (IDW) that include the following:

- Used personal protective equipment (PPE)
- Disposable sampling equipment
- Decontamination fluids

The EPA's National Contingency Plan (NCP) requires that management of IDW generated during sampling comply with all applicable or relevant and appropriate requirements (ARARs) to the extent practicable. The sampling plan will follow the Office of Emergency and Remedial Response (OERR) Directive 9345.3-02 (May 1991), which provides the guidance for the management of IDW. In addition, other legal and practical considerations that may affect the handling of IDW will be considered.

7.1 IDW Disposal Procedures for Sites with Low Levels of Contamination

Used PPE and disposable equipment will be double bagged and placed in a municipal refuse dumpster. These wastes are not considered hazardous and can be sent to a municipal landfill. Any PPE and disposable equipment that is to be disposed of which can still be reused will be rendered inoperable before disposal in the refuse dumpster.

Decontamination fluids that will be generated in the sampling event will consist of deionized water, residual contaminants, and water with non-phosphate detergent. The volume and concentration of the decontamination fluid will be sufficiently low to allow disposal at the site or sampling area. The water (and water with detergent) will be poured onto the ground.

7.2 Laboratory Waste Disposal

Samples that are not contaminated such as background samples will be disposed of as solid waste. Any samples that have contaminants will be handled as hazardous waste. The waste generated will be collected in orange five gallon buckets and disposal will be completed by the team with assistance from NAU’s Environmental Engineering Laboratory manager, Gerjen Slim, per NAU protocols.

8.0 Sampling Documentation and Shipment

This section will discuss the required documentation including field notes, (using sample and photograph logbooks) photographs, sample labeling requirements, as well as chain of custody forms required for shipment of sample containers.

8.1 Field Notes

The field notes are defined by thorough record keeping in the field. The field notes will consist of a combination of logbooks, preprinted forms, photographs, and other documentation. Information to be maintained is provided below.

8.1.1 Field Logbooks

At a minimum, the following information will be recorded during the collection of each sample:

- Sample location and description (sample ID#; hot spot, grid or background, tailings pile number)
- Sampler's name(s)
- Date and time of sample collection
- Type of sampling equipment used
- Field instrument readings (GPS reading)
- Field observations and details related to analysis or integrity of samples (e.g., weather conditions, noticeable odors, colors, etc.)
- Preliminary sample descriptions (e.g., for soils: clay loam, very wet)
- Lot numbers of the sample containers, sample identification numbers and any explanatory codes, and chain-of-custody form numbers

In addition to the sampling information, the following specific information will also be recorded in the field logbook for each day of sampling:

- Team members and their responsibilities
- Time of arrival/entry on site and time of site departure
- Other personnel on site
- Summary of any meetings or discussions with BLM personnel
- Deviations from sampling plans, site safety plans, and Quality Assurance Procedure Plan (QAPP) procedures
- Changes in personnel and responsibilities with reasons for the changes
- Levels of safety protection
- Calibration readings for any equipment used and equipment model and serial number

8.1.2 Photographs

Photographs will be taken at the sampling locations and at other areas of interest on the site or sampling area. They will serve to verify information entered in the field logbook. For each photograph taken, the following information will be written in the logbook or recorded in a separate field photography log:

- Time, date, location, and weather conditions
- Description of the subject photographed
- Name of person taking the photograph

8.2 Labeling

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory. The samples will have pre-assigned, identifiable, and unique numbers. At a minimum, the sample labels will be handwritten on the bags with the following information: sample code and the sample’s corresponding photo ID #.

8.2.1 Labeling System

All samples will have the (PG) initials denoting the site as Pilgrim, reducing sample confusion with other users of the laboratory. The next identifiers will follow a specific and unique sample ID system to denote each sample, it will consist of a location "code", followed by a sample number (1-100). The following scheme will be used:

- Hot Spot - HS
- Background - BG

Similarly, the sample location codes will be as follows:

- Tailings Pile S (southernmost) - TPS
- Tailings Pile C (central) - TPC
- Tailings Pile N (northernmost) - TPN
- Wash - WA

For example, if a sample came from the central tailing pile and the grid number assigned to it is 45, the sample ID will be "PG-TPC-45". Similarly, the third hot spot sample obtained will be identified as "PG-HS-3".

Once the samples are returned to the lab and sieved, the samples will receive another number denoting the XRF reading (1-9). For example, the third hot spot sample, which was XRF reading 4, will be identified as "PG-HS-3-4".

8.3 Sample Chain-of-Custody Forms and Custody Seals

All sample shipments for analyses will be accompanied by a chain-of-custody record. A copy of the forms is found in Figure A8.3 and A8.4. Form(s) will be completed and sent with the samples for each shipment (i.e., each day). If multiple coolers are sent to a single laboratory on a single day, form(s) will be completed and sent with the samples for each cooler.

The chain-of-custody form will identify the contents of each shipment and maintain the custodial integrity of the samples. Generally, a sample is considered to be in someone's custody if it is either in someone's physical possession, in someone's view, locked up, or kept in a secured area that is restricted to authorized personnel. Until the samples are shipped, the custody of the samples will be the responsibility of Ecovestor. The sampling team leader or designee will sign the chain-of-custody form in the "relinquished by" box and note date, time, and air bill number.

Chain of Custody Record

Project: ____________________

Date of Collection: ____________________ **Page ____ of ____**

No. of Samples: ____________________

Contact: ____________________

Field Sampler (print)	**Signature**

Sample ID	**Time**	**Sample Type**	**Site/Location**	**Remarks**

Relinquished by (*print and signature*)	**Date**	**Time**	**Sealed: (Y/N)**	**Shipping Information**

Received by (*print and signature*)	**Date**	**Time**	**Sealed: (Y/N)**	**Reason for Change of Custody**

Figure A8.3 – Chain of Custody Field Form

The shipping containers in which samples are stored (usually a sturdy plastic container) will be sealed with custody seals any time they are not in someone's possession or view before shipping. All custody seals will be signed and dated.

<table>
<tr><th colspan="6">Chain of Custody Record</th></tr>
<tr><th colspan="2">Project No.</th><th colspan="3">Project Title</th><th>Organization</th></tr>
<tr><td colspan="6">Laboratory/Plant: ______________________________</td></tr>
<tr><td>Sample Number</td><td>Number of Container</td><td colspan="4">Sample Description</td></tr>
<tr><td></td><td></td><td colspan="4"></td></tr>
<tr><td></td><td></td><td colspan="4"></td></tr>
<tr><td></td><td></td><td colspan="4"></td></tr>
<tr><td></td><td></td><td colspan="4"></td></tr>
<tr><td colspan="4">Person responsible for samples</td><td>Time:</td><td>Date:</td></tr>
<tr><td>Sample Number</td><td>Relinquished By:</td><td>Received By:</td><td>Time:</td><td>Date:</td><td>Reason for change in custody</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Figure A8.4 – Chain of Custody Laboratory Form

9.0 Deviation from Work Plan

As conditions in the field may vary, it may become necessary to implement minor modifications to sampling as presented in this plan. When appropriate, Eric Zielske will be notified and a verbal approval will be obtained before implementing the changes. Modifications to the approved plan will be documented in the sampling project report and field logbooks.

10.0 Field Health and Safety

Describe any agency-, program- or project-specific health and safety procedures that must be followed in the field, including safety equipment and clothing that may be required, explanation of potential hazards that may be encountered, and location and route to the nearest hospital or medical treatment facility. A copy of the organization Health and Safety Plan is included in the Appendix B.

Appendix B Health and Safety Plan

1.0 Job Name and Location

Pilgrim Mine Site Waste Evaluation

Location: N 35.388333, W 114.358889

Table B1.1 - Contact Information for Field Sampling Participants

Title	Name	Phone Number	Organization
Student	Michelle Kuhn	(845) 853-3448	Northern Arizona University
Student	Ryne Flanagan	(602) 295-5086	Northern Arizona University
Student	Khaled Alali	(928) 380-7578	Northern Arizona University
Student	JC Acuna	(602) 736-5142	Northern Arizona University
Project Manager	Eric Zielske, P.E.	(602) 417-9223	Bureau of Land Management
Grantee Project Manager	Dr. Bridget Bero, Ph.D., P.E.	Bridget.Bero@nau.edu	Northern Arizona University

2.0 Safety and Health Administration

Dr. Bridget Bero will be the Site Supervisor for this project and will be responsible for directing all hazardous waste operations. The Site Supervisor's responsibilities include:

- Ensuring a safety meeting is held prior to field sampling and that all members are aware or hazards and risk present at the site.
- Ensuring that all activities on site are conducted in accordance with the HASP and making modifications if needed.
- Ensuring everyone on site has done the required training prior to working in the field
- Notified if any emergency assistance is needed.
- Monitor all activities on site and stopping any unsafe activity.
- Ensuring every person in the field is completing the task that they are responsible for.

3.0 Hazard Assessment

This project requires soil sampling at an abandoned mine site. At this site chemical and physicals hazards may be encountered. Below tables B3.1 and B3.2 address the chemical and physicals hazards that could be found at this site.

3.1 Physical Hazards

This section addresses the physical hazards that could be encountered at the Pilgrim Mine Site. Table B3.1 lists the hazard, the source of the hazard, and control measures that should be taken to minimize risk.

Table B3.1 – Physical Hazards at the Pilgrim Mine Site

Hazard	**Source**	**Control Measures**
Adverse Weather	Rain and lightning	Monitor weather and reschedule fieldwork if necessary.
Slips/Trips/Falls	Crevasses and uneven terrain	Closed toed shoes, with high gripping capabilities
Snake Bite	Snakes in area	Inspect area before stepping. kneeling, or sitting
Heat Stress	High temperatures and sun exposure	Wear proper clothing,
Dehydration	Lack of fluids	Allowing for water and food break, bringing electrolytes

3.2 Chemical Hazard

This section addresses the chemical hazards that could be encountered at the Pilgrim Mine Site. Table B3.2 lists the chemical, where the chemical is found, route of entry and control measures that will be used to prevent exposure.

Table B3.2 – Chemical Hazards at the Pilgrim Mine Site

Chemical	**Media**	**Route of Entry**	**Control Measures**
Lead	Soil/Dust	Inhalation, Ingestion, Contact	Tyvek Suits, gloves, dust mask, long sleeves and pants
Copper	Soil/Dust	Inhalation, Ingestion, Contact	Tyvek Suits, gloves, dust mask, long sleeves and pants
Arsenic	Soil/Dust	Inhalation, Absorption, Ingestion, Contact	Tyvek Suits, gloves, dust mask, long sleeves and pants
Zinc	Soil/Dust	Inhalation	Dust Mask
Mercury	Soil/Dust	Inhalation, Absorption, Ingestion, Contact	Tyvek Suits, gloves, dust mask, long sleeves and pants

4.0 Training Requirements

Every person sampling in the field and working in the laboratory must complete the following requirements prior to participating in any field or lab activity.

4.1 HAZWOPER

Prior to sampling each member must complete the 40-hour HASWOPER training. The training takes an in-depth look at work safety at cleanup and remediation sites involving hazardous materials as required by OSHA.

4.2 NAU Safety Training

Prior to sampling each member of the team will complete the Field Safety Training and Chemical Hygiene Training offered by Northern Arizona University. The field safety training covers potential hazards encountered during fieldwork, how to avoid hazards and what to do in the event of an emergency. The chemical hygiene training covers hazards due to chemicals and how to safely work with, store and transport chemicals.

4.3 XRF Training

Each member of the team must complete XRF training, prior to using the device. The training will detail background, use of the device and data processing.

5.0 Personal Protective Equipment

Personal protective equipment will be acquired prior to sampling and equipment will be transported to the site by the team. PPE will be put on prior to any fieldwork.

5.1 Safety Equipment List

The following PPE will be brought to the site and utilized by persons sampling:

- Gloves
- Protective eyewear
- Work boots
- Boot covers
- Tyvek suits
- Long sleeves and pants

6.0 Site Control and Operating Procedures

Below is a list of field safety procedures that will be followed throughout field sampling:

- PPE equipment must be put on prior to fieldwork and remain on at all times in the field
- Before sampling begins an initial investigation around the area will be done to assess any hazards
- Eating and drinking only allowed in designated areas
- Work must be done in groups of two or more
- Personal items and equipment must be decontaminated at site or transported in a sealed container.
- Hands and face must be washed prior to leaving the site and returning to Kingman

7.0 Decontamination Procedures

All equipment and items used at the site will require decontamination. Contamination will be done at the site using washing stations. Items that cannot be decontaminated at the site will be brought back in sealed containers and decontaminated when we return.

7.1 Personal Decontamination

Coveralls, clothes and any other personal items exposed to soil during sampling will be removed and bagged on site, this procedure will occur every day that soil samples are collected. Each team member will have a second pair of clean clothing with them at the site to change into. The contaminated items will be transported to Flagstaff and cleaned.

7.2 Equipment Decontamination

Washing stations will be set up on site to wash the equipment used. Five gallon buckets, soap and water will be used to decontaminate equipment and the water and soap will be brought on site. Decontamination will be done on equipment in between sampling.

7.3 Waste Disposal

Waste collected from decontamination will be disposed of on site. Samples that are not contaminated such as background samples will be disposed of as solid waste. Any samples that have contaminants will be handled as hazardous waste. The waste generated will be collected in orange five gallon buckets and disposal will be completed by the team with assistance from NAU's Environmental Engineering Laboratory manager, Gerjen Slim, per NAU protocols.

8.0 Emergency Response Procedures

In the event of an emergency the site supervisor will be notified and anyone requiring medical attention will be transported to the nearest hospital.

Nearest Hospital:
Kingman Regional Medical Center 928-757-2101
3269 Stockton Hill Rd
Kingman, AZ 86409
Directions:

1) Head towards US-93 S
2) Turn right onto US-93 S
3) Use the left two lanes to turn left to merge onto I-40E/US-9 towards Phoenix/Flagstaff
4) Take exit 51 for Stockton Hill Rd.
5) Use the middle land to turn left onto Stockton Hill Rd.
6) Continue straight to stay on Stockton Hill Rd.
7) Make a U-turn at Sycamore Ave

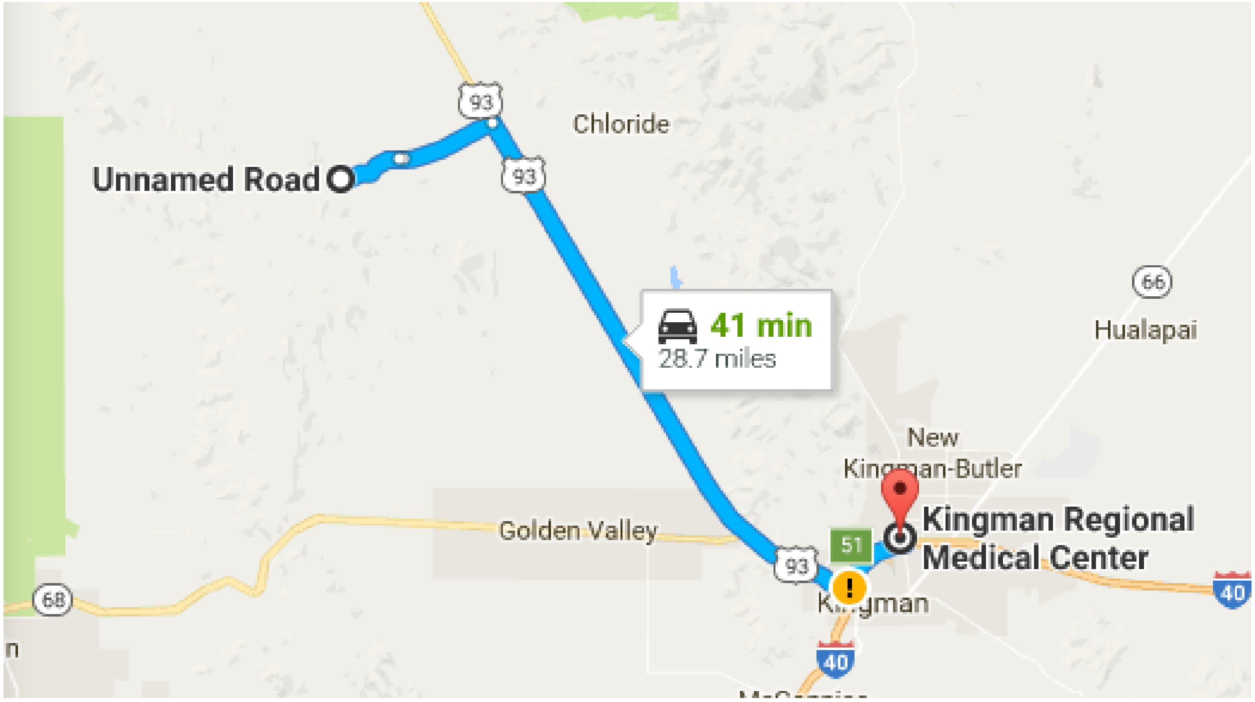

Figure B8.0 - Map with directions to Kingman Regional Medical Center

Additional Emergency Numbers

Center for Disease Control	404-488-4100
National Response Center	800-424-8802

8.1 Emergency Contacts

At least one emergency contact will be required for every person working on site. In the event of an emergency this person will be notified.

Table B8.1 - Emergency Contact Information for Field Sampling Participants

Name	Emergency Contact	Relationship	Contact Number
Michelle Kuhn			
Ryne Flanagan			
Khaled Alali			
JC Acuna			
Bridget Bero			
Eric Zielske			