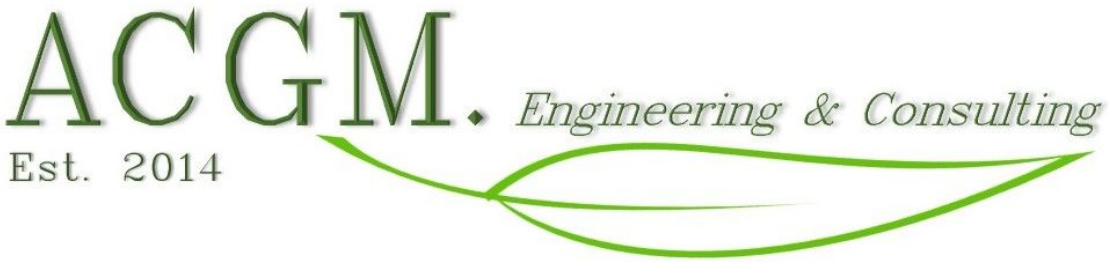
Tyro Mill Work Plan



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1.0 Introduction

1.1 Project Objectives

The main objectives of the Tyro Mill project are to complete a Preliminary Assessment and Site Investigation report and a Risk Assessment of Tyro Mill. The risk assessment will contain both a human and ecological risk assessment. The following sections detail the Work Plan for the Tyro Mill project and provide a Sampling and Analysis Plan and a Health and Safety Plan for the Tyro Mill project.

1.2 Project Scope

The project scope was completed which outlines the work that will completed for the Tyro Mill project. The sections of the scope are as follows:

1.0 Work Plan
2.0 Field Sampling
3.0 Analysis
    3.1 Sieving and Drying of Samples
    3.2 XRF Analysis
    3.3 Acid Digestion
    3.4 ICP and FAAS Testing
    3.5 XRF and FAA Correlation
4.0 Risk Assessment
5.0 Project Impacts
6.0 Project Management

1.3 Work Plan Schedule

In accordance with the project schedule located within section 3.0 Scope of the project proposal, the development of the Work Plan will start in October of 2018 and will be completed in 22 days the entire project will take a total of 25 weeks. The schedule for the project can be viewed in section 10.

2.0 Project Management

Project Management is a crucial portion of the completion of the Tyro Mill PA/SI project. The following sections will address the project management approach, procedures, QA/QC methods,

and subcontract management procedures followed by ACGM Engineering to ensure prompt and accurate completion of the Tyro Mill project.

2.1 Project Management Approach

To properly manage the Tyro Mill project, ACGM will conduct weekly team meetings to keep team members up to date on every aspect of the project and maintain the number of days allotted to each task according to the project schedule as developed in Section 3 of the proposal document. Joy Crutchfield of ACGM Engineering shall act as the project manager who will be the designated point of contact for the client to contact with questions. All interactions between the client and the ACGM Engineering team will go through Joy to remain consistent and keep all client contact organized. The ACGM team will meet with the project Technical Advisor at the end of each major task to review the results or analysis of the task ensure all crucial elements have been accounted for.

2.2 Project Procedures

Correspondence outside of weekly ACGM team meetings will be conducted via email or telephone. This correspondence may include updates on certain project tasks, changes that need to be made to the work plan, and schedule adjustments. Team meetings will be scheduled at least three days prior to the deadline for a certain task to ensure enough time is left for review and editing of the task deliverable. ACGM will schedule meetings with the Technical Advisor a week in advance to allow time for preparation by both the team and the advisor to fully understand the task deliverable being reviewed. A meeting agenda will be provided for all meetings to cover all necessary topics and stay on a scheduled pace during the meeting to respect the time commitments of all meeting attendees.

At the end of each meeting one of the members of the ACGM Engineering team will compile a meeting minutes to be sent to all meeting attendees for review of the discussion that occured at the meeting. A meeting memo binder will be kept by ACGM Engineering to properly document discussion throughout the Tyro Mill project.

2.3 Quality Management

Maintaining quality work is an important aspect of project management in all ACGM Engineering projects. To ensure quality data is being presented, the ACGM team will follow appropriate QA/QC methods. QA/QC procedures for project management include meetings with the project technical advisor, team review of each task deliverable, and maintenance of the project schedule. Field sampling and analysis QA/QC methods are in section 2.2 of the Sampling and Analysis Plan in Appendix A. If it is determined that additional QA/QC methods are needed to maintain the integrity of the project, new methods may be developed and added to this Work Plan.

2.4 Subcontract Management

When necessary, ACGM Engineering may employ subcontractors or third party labs to complete portions of analyses. For the Tyro Mill PA/SI project, ACGM engineering will subcontract portions of the sample lab analysis to the NAU Chemistry Lab and Flagstaff engineering firm Western Technologies. Contracts and schedules will be developed between ACGM Engineering and all subcontractors to ensure analysis is completed in a timely fashion, following the Tyro Mill project schedule. Subcontractors must provide their QA/QC and safety methods to ACGM Engineering to ensure all analysis is completed to ACGM Engineering standards. A clear communication path via telephone will also be developed with any subcontractors and ACGM Engineering to keep work transparent on both sides.

3.0 Site Background Information

A brief description of the Tyro Mill location, current conditions, and previous operations and analysis will be discussed below.

3.1 Site Location

Tyro Mill is located in Mohave County, AZ approximately 25 minutes east of Bullhead City. The latitude and longitude of the site is 35° 13’ 29.68” N and 114° 27’ 32.33” W. The site is located north of the intersection of Katherine Mine Road and AZ HWY-68.

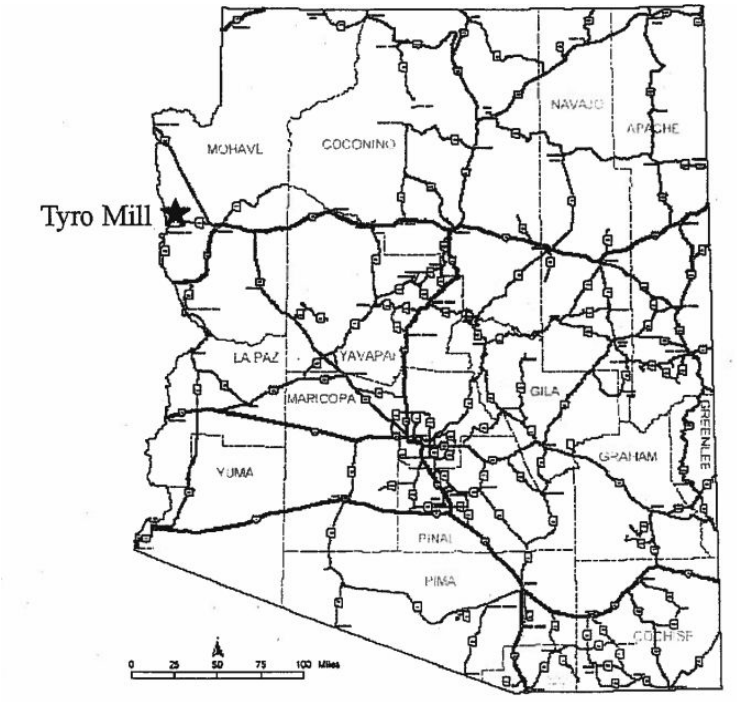


Figure 1-1. Tyro Mill Site Location on Map of Arizona [1]

3.2 Site Description

All former milling and mining operations at Tyro Mill have been suspended and all buildings have been demolished. The site currently contains two large tailings repositories, one directly along the access road and the other to the North of the road. The covers of both repositories are held down with large boulders. The Tyro Mill site is located in an area that is popular for outdoor recreation and camping, which has resulted in the movement of several of the boulders holding down the cover of the tailings repositories. Hazardous contaminants are more easily transported from the repository when the cover is not in place. Both tailings repositories are also being compromised by erosion, allowing hazardous contaminants to escape and move across the site. The entire site will be included in the sampling to properly identify the contaminants across the site. Areas of high concern are around the repositories, in the nearby wash, and along the recreational access road.

Figure 1-2. Satellite View of Current Site Conditions at Tyro Mill [2].

3.3 Previous Operations and Investigations

The Tyro Mine and Mill began operation in the late 70s and operated for approximately 20 years. The mine/mill never submitted the proper paperwork to the BLM and because of this operated illegally. The mine and mill sites were abandoned in 1999. After abandonment, BLM brought in Red J Environmental to close down the site and check for hazardous contaminants. Red J constructed the tailings repositories and conducted a preliminary assessment that was never permanently documented for BLM. Now that the

repositories are failing due to human interaction and erosion issues, a site assessment is necessary to determine the next steps on the site.

The most recent sampling event was conducted in April of 2018. The sampling locations and results have been provided in Table 1-1. Elevated levels of uranium, arsenic, copper, nickel, manganese, and antimony were discovered near the access road to the west of the repository. The red sections in the results table indicate a non-residential exceedance and yellow sections indicate a concentration between the Arizona Non-Residential and Residential Soil Remediation Standards.

Table 1-1 XRF Samples with Exceedances from April 2018 Sampling Event [3]

Reading No	Time	Site	Latitude	Longitude	U	U Error	As	As Error	Cu	Cu Error	Ni	Ni Error	Mn	Mn Error	Sb	Sb Error
381	4/13/18 1	Tyro Mill	35.22511	-114.4596	<LOD	151.46	<LOD	87.66	13440.75	817.98	24717.64	1133.52	2341.07	689.09	126.82	41.43
382	4/13/18 1	Tyro Mill	35.22519	-114.4601	301.95	71.58	180.07	45.57	23249.77	621.16	39557.13	836.88	2849.13	456.19	4179.94	637.77
383	4/13/18 1	Tyro Mill	35.22518	-114.4603	453.42	91.76	129.36	53.8	28977.64	782.98	52754.04	1078.74	3789.62	578.02	39772.89	6309.97
385	4/13/18 1	Tyro Mill			<LOD	300000	160.71	25.44	8100.91	225.79	13017.14	302.58	1606.86	160.92	416.78	50.02
386	4/13/18 1	Tyro Mill					0.011	0.002	0.616	0.019	1.026	0.026	0.132	0.016	<LOD	0.008
387	4/13/18 1	Tyro Mill	35.22407	-114.4610	275.37	74.48	67.03	40.99	24115.28	642.76	42397.95	875.26	2822.97	466.89	1660.16	248.03
388	4/13/18 1	Tyro Mill	35.22393	-114.4613	378.4	100.69	194.88	58.71	32453.7	865.64	58117.01	1186	2747.87	571.95	1925.38	356.72
389	4/13/18 1	Tyro Mill					0.004	0.002			1.366	0.039	0.113	0.018	<LOD	0.009
390	4/13/18 1	Tyro Mill	35.22426	-114.4619	149.09	54.57	118.73	33.41	16420.65	445.82	29259.8	610.95	2332.11	354.22	196	59.57
394	4/13/18 1	Tyro Mill	35.22405	-114.4623	215.85	61.05	122.16	37.63	18973.83	508.56	34260.5	699.2	2479.15	383.23	259.35	69.36
395	4/13/18 1	Tyro Mill	35.22400	-114.4632	234.94	60.66	169.22	40.03	18586.7	505.67	32635.55	688.81	3410.19	429.33	501.21	94.74
396	4/13/18 1	Tyro Mill	35.22394	-114.4634	191.82	48.13	103.43	29.5	14496.71	392.13	26250.74	540.1	2219.68	319.44	181.63	55

Figure 1-3. April 2018 Sampling Event Map with Sample Locations. [3]

4.0 Investigative Approach

The following sections will discuss the objectives and general approach that will be used by ACGM Engineering in order to create a final PA/SI report.

4.1 Site Investigation Objective

The objective for the Tyro Mill site investigation is to ensure that all soil samples have been collected and properly documented so that further analysis can be done for the site. The validity of the soil samples will help support the findings reported later in the PA/SI report.

4.2 Site Investigation General Approach

ACGM Engineering will follow EPA guidelines for surface soil sampling collection procedures. Approximately eighty percent of the expected eighty total soil samples taken will be based on a grid sampling map found in Appendix A Section 3. The remaining samples will be collected based on previous investigations provided by BLM, and determined in the field based on tailing hotspots and background. Rationale for soil sample collection is further detailed in Appendix A Section 3.

5.0 Field Investigation Methods and Procedures

Field investigation methods and procedures will be detailed in Appendix A Sampling and Analysis Plan. The sampling and analysis plan will include all the field equipment, calibration techniques, and surface soil sampling methods that will be implemented by ACGM Engineering.

6.0 Investigation-Derived Waste Management

Management of investigation derived waste (IDW) in the field and lab will be completed in accordance with EPA regulations as seen in Section 7.1 of the SAP developed in Appendix A. Items that may be or become IDW are as follows:

- Personal protective equipment (PPE)
- Disposable equipment
- Cleaning fluids: spent solvents and wash water
- Packing and shipping materials [4]

The generated IDW will be divided between non-hazardous and hazardous waste and will be date marked and stored and discarded of separately. The generation of hazardous waste will be minimized in order to lessen the potential risk. All hazardous waste can be contained for a maximum of 90 days before they must be disposed of. Furthermore, for non-hazardous liquid and soil IDW can be placed on the ground or

returned to the original source as long as no risk is presented to the public or environment per the EPA. Note that Wash water is not allowed to be placed back in any water bodies. [4]

7.0 Sample Collections Procedures and Analysis

For samples collected in the field, specific containers, methods of preservation, and methods of storage will be consistently used. The methods used to transport the samples from the Tyro Mill site to the storage location are also discussed. The documentation procedures of all collected samples and how the samples will be prepared to be shipped to third party subcontractors is explained below.

7.1 Sample Containers, Preservations, and Storage

Information on the sample containers, preservation, and storage methods can be found in Section 6 of the Sampling and Analysis Plan. These procedures will discuss the equipment necessary to hold all samples and how the samples will be contained until they are transported from the field location to ACGM storage.

7.2 Sample Documentation and Shipment

Information on the sample documentation performed in the field and how all samples that will be shipped to a third party lab will be prepared can be found in Section 8 of the Sampling and Analysis plan. This documentation includes the development of field logs and proper labeling and packing of samples that need further analysis.

7.3 Field Quality Assurance and Quality Control

The QA/QC methods that will be used by ACGM Engineering during field sampling are detailed in Section 2.2 of the Sampling and Analysis plan. By following the procedures set out in Section 2.2 of the SAP, the ACGM team will ensure the legitimacy of the samples and results obtained.

8.0 Deviations from the Work Plan

Delays to the project schedule in section 10.0 may affect the duration of the SAP tasks. Depending on the situation a few tasks may need to be done in a shorter time. Any final decisions that include changes to the project will be decided by BLM representative or the project lead. Any changes to the the schedule will be documented in the project's log, and reported in the final report. Refer to section 9.0 in SAP for more details.

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

Based on the sampling results, ACGM members will produce a Preliminary Assessment and Site Investigation (PA/SI) report for the Tyro Mill site.

10.0 Project Schedule

The project schedule set for the project is based on estimates. Durations of each task may be adjusted and changed based on the needs of the project to meet the deadline. A detailed project schedule showing each task and its duration is shown in the Scope of the project section 4.0 Staffing Plan Cost of Engineering Services.

11.0 References

[1] Bureau of Land Management , "Draft Final Engineering Evaluation/Cost Analysis Tyro Mill Site Kingman Field Office, Arizona," U.S. Department of Interior Bureau of Land Management Kingman Field Office, Kingman, 2002.

[2] E. Zielske, Interviewee, *CENE 476 Client Meeting.* [Interview]. 7 September 2018.

[3] D. and R., "Tyro Mill Site Summary," Bureau of Land Management, Flagstaff, 2018

[4] *Management of IDW*. EPA, 2014.

[5] *Sampling and Analysis Plan Guidance and Template.* EPA, 2014.

[6] American Society for Testing and Materials , *Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates Active Standard ASTM C136/C136M,* Conshohocken : ASTM International , 2018.

[7] American Society for Testing Materials , *Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass,* Conshohocken: ASTM International, 2018.

[8] Environmental Protection Agency , *Method 6200 Field Portable X-Ray Fluorescence Spectrometry For The Determination of Elemental Concentrations in Soil and Sediment,* Washington : Environmental Protection Agency , 2007.

[9] Environmental Protection Agency, *Method 3050B: Acid Digestion of Sediments , Sludges, and Soils,* Washington: Environmental Protection Agency, 1996.

[10] American Society for Testing and Materials , *Standard Practices for Extraction of Elements from Ores and Related Metallurgical Materials by Acid Digestion1,* Conshohocken: American Society for Testing and Materials , 2018.

[11] United States Environmental Protection Agency, *Method 7000B Flame Atomic Absorption Spectrometry*, Washington: Environmental Protection Agency, 2007.

[12] United States Environmental Protection Agency. (2018). *Soil Sampling*. [online] Available at: https://archive.epa.gov/region9/toxic/web/pdf/ee-soilsampling-sop-env-3-13.pdf [Accessed 27 Nov. 2018].

[13] *HASP Template*. EPA, 2018.

Appendices

Appendix A: Sampling and Analysis Plan

1.0 Introduction

The Tyro Mill site has been contaminated by processes of mining and milling. ACGM engineering will be collecting soil samples to identify any contaminants of concern based on the scope of the project. A Preliminary Assessment and Site Investigation report will be produced based on the findings in the soil sampling.

1.1 Responsible Agency

The responsible agency, Bureau of Land Management, has hired ACGM Engineering to collect and analyze the surface soil samples at the Tyro Mill site. ACGM Engineering is a group of senior undergraduate level environmental engineering student that have been selected for the project based on their qualifications for completing the projects.

1.2 Project Organization Table

Table A1-2 Shows the Title, Name, Contact Information, and Responsibility Needed for the Project Organization

Title	Name	Phone Number Email Address	Responsibility
ACGM member	Joy Crutchfield	928-970-1546 jkc232@NAU.edu	Project Manager/Client Correspondent
ACGM member	Caitlin Adams	480-299-3135 cra232@NAU.edu	QA/QC officer
ACGM member	Eryn Guevara	602-930-1452 erg95@NAU.edu	Safety Officer
ACGM member	Hamad Mohammad	541-829-2292 hem83@NAU.edu	Sampler/Photographer
ACGM Project Lead	Bridget Bero	928-607-2516	Project Lead

		Bridget.Bero@nau.edu	
BLM Representative	Eric Zielske	602-417-9223 ezielske@blm.gov	Supervise work/ approve changes
ACGM member	Josue Juarez	928-580-1985 jj669@nau.edu	Sampler

1.3 Sampling Details

The sampling will occur in the Tyro Mill site location in Mohave County, AZ, The latitude and longitude of the site is 35° 13’ 29.68” N and 114° 27’ 32.33” W. ACGM engineering will collect grid samples, hotspot samples, and background samples. 80% of the 80 samples collected shall be grid samples, 20% shall be hotspot samples. The hotspot samples location will be based in the locations of the repositories and milling sites, other hotspot samples may be determined during sampling based on the existing conditions. Further descriptions of the sampling method is discussed in Section 3.1.

2.0 Project Data Quality Objectives

2.1 Project Objectives and Problem Definition

The purpose of the environmental investigation at the Tyro Mill site is to determine the contaminants and their concentrations at the site. The data will be used to create a PA/SI Report for the client as well as to complete ecological and human risk assessments.

2.2 Data Quality Objectives (DQO) and Quality Control

The data quality objectives are the data that is representative of the site and compared to the Arizona Soil Remediation Standards which will determine the decisions that will be made based upon the data obtained after analyzing the samples.Potential contaminants of concern are as follows:

- Uranium
- Arsenic
- Nickel
- Copper
- Magnesium
- Antimony

If the concentrations are not detected or are above the Arizona Non-residential Soil Remediation Standards no further action will be taken, but if concentrations are detected above the Arizona Non-residential Soil Remediation Standards it will be recommended to the client that further sampling and remediation efforts are evaluated.

2.2.1 Field Quality Control

Field quality control samples will be taken in order to determine the accuracy of the samples taken in the field. The accuracy of the samples will be evaluated with the use of blanks and taking into account the potential error in sampling technique by the use of duplicate samples. Both QC methods are detailed below.

The QA/QC officer will be responsible for making sure that the QA/QC procedures are followed in the field. In order to ensure that all samples are labeled properly two members of the team will review the label to ensure it is written correctly. Furthermore, the samples will be taken systematically, grid by grid, and the QA/QC officer will check to make sure each sample is taken and that the proper steps are taken by the team members when decontaminating the trowels with wash water.

2.2.1.1 Field Blanks

Blank samples will be collected in the field to verify the accuracy and contamination of the samples received. Blank samples will be taken in the same area as Tyro Mill but far enough away that the soil should not be contaminated with the mine tailings. The blank samples will assess if any contamination was added to the samples during the sampling or from any of the equipment throughout the transit of the samples and in the laboratory. Per the EPA a minimum of one blank will be taken for every 10 samples.

The field blanks will be analyzed in the same manner as all of the samples and will be analyzed for the presence of metals and of the contaminants found in the mine tailings.

2.2.1.2 Field Duplicates

Duplicate soil samples will be taken in the field. The duplicates samples will be collected by taking a 2 gallon sample at 2 of the sampling locations and splitting the sample into a 1 gallon sample and a 1 gallon duplicate to ensure an exact duplicate is being used.

The soil samples will be analyzed for the contaminants found in the mine tailings and will be taken in the same manner. The samples will be retrieved, stored and analyzed in the same manner as all other samples. The duplicate samples will be labeled following the labeling system in section 8.2.1 and will be submitted blind to the laboratory.

2.2.1.3 Background Samples

Background samples will be taken at the site in order to determine the ambiente contaminant levels, especially for elements such as arsenic which are known to occur naturally in the area. The location and rationale for the background samples can be viewed in section 3.0.

Background samples shall be taken in areas that are near the project location but are far enough removed that there is no risk of contamination from the mine tailings on the site.

2.2.2 Laboratory Quality Control

Laboratory quality control protocols will be implemented to maintain and determine the accuracy of the samples. The sections presented below detail the quality control that will be used for each of the analyses that will be completed on the samples.

2.2.2.1 XRF Quality Control

The quality control for the XRF will follow the manufacturer's instructions for the specific model and the proper techniques which the team will learn during the XRF training. To ensure quality control the XRF machine will be calibrated before each use and the samples will be logged and monitored as they are being sampled. The samples will be logged using their identified label so the results and samples are not confused amongst each other.

2.2.2.2 Data Analysis Quality Control

The data analysis will be completed in accordance with the standards and procedures detailed in section 4.0 in order to maintain quality control throughout the analysis. The team will organize the results in both an excel spreadsheet and in the lab notebook in order to provide backup locations of the results.

2.2.2.3 Correlating Samples (XRF and FAAS) Quality Control

The team will create a correlation graph between the XRF analysis results and the FAAS results that will be provided by a third party lab. In order to maintain quality control the same method will be used throughout and outlier results will be discarded when possible.

2.2.2.4 Cross-contamination Precautions

In order to maintain quality assurance and control measures will be taken to reduce cross-contamination of the samples. In order to minimize cross-contamination each sample will be stored separately in 1 gallon freezer ziploc bags and only one sample will be analyze at a time and returned to it’s bag prior to opening the next sample. Lab spaces and equipment will also be decontaminated as necessary and all areas will be kept clean. When taking and analyzing the samples the sampler will also change gloves prior to the start of each sample to minimize cross-contamination between samples.

2.3 Data Review, Validation and Management

Continuously, as data is being produced it will be reviewed by the QA/QC officer in order to verify its accuracy. Data will also be compared to past results from the April 2018 sampling in order to verify it's accuracy and any errors or major outliers in the results will be document and discussed.

3.0 Sampling Rationale

The collection of 80 soil samples will be determined by grid sampling surface soils and hotspots. The methods provide unbiased sampling techniques and will be further detailed in the following sections.

3.1 Soil Sampling

For a complete analysis of the Tyro Mill site, eighty grid surface soil samples will be collected. During soil sampling, data on vegetation and animal communities present on the site will be collected and documented in the field notes to be used in the ecological risk assessment and impacts analyses performed for the site. The following sections will discuss the rationale used to determine the grid sampling map, hot spot sampling, background sampling, and criteria used for making field decisions for the eighty soil samples.

3.1.1 Grid Sampling Overview and Rationale

Grid sampling provides a uniform interval across the Tyro Mill site and surrounding area. Figure __ shows 80 soil sample locations that ACGM Engineering intends to collect from. The sampling locations cover the repository, area near the main road, and surrounding area near the repository that are subject to runoff.

Figure A 3-1

3.1.2 Hot Spot Sampling Overview and Rationale

Hot spot sampling will be used, with specific locations determined on site by ACGM Engineering. Visual buildup of tailings will be the main indicator that an area will need further testing. Based on previous research completed by the BLM, ACGM Engineering anticipates hot spots on and near the repository area. More soil samples using the hot spot sampling method must taken as needed.

3.1.3 Background Sampling Overview and Rationale

Background sampling will be used to determine concentrations of contaminants that are naturally occuring at the site. Five background surface soil samples will be taken in areas identified once the ACGM Engineering team arrives at the site to begin sampling. The areas in which background samples are taken will act as a guideline for ACGM Engineering to

determine the severity of the contamination caused by the former milling activities on the site. Location for background samples will most likely be based on the site's topography and public accessibility. Background concentrations should have no risk of contamination from the site and should represent the soils naturally occurring elements.

3.1.4 Field Decision Criteria

All decisions made in the field will be discussed and decided on by the team with the final decisions coming from the Project Lead. The client will also be contacted about changes that need to be made in the field that may have significant effects on the project. Field decisions include things like where the background and hotspot samples will be taken and any changes that may need to be made to the work plan based on the site conditions upon the team's arrival at the Tyro Mill site.

4.0 Sample Analysis Design

The necessary ASTM and EPA testing methods for the analysis of the soil samples is detailed in the following sections. The required equipment needed to complete each test according to the ASTM or EPA guidance will be acquired to ensure the team is prepared to begin testing once the samples are collected. The storage of the samples in the lab will be consistent with all QA/QC requirements.

4.1 Sample Drying and Sieving

The samples collected in the field will first be dried and sieved in the NAU Environmental Engineering Lab to remove any large particles/debris and to remove for any moisture that may be present in a sample. The team will confirm with the lab that the appropriate sieve sizes (all sieve sizes up to No. 200) are available. The use of a scale, mechanical shaker, and drying oven will also be required to properly dry the samples. The sieve analysis testing method followed in the lab will be ASTM C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates. For drying and moisture content ASTM 2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass will be used. Once the samples have been properly dried and sieved, the lab analysis necessary to determine potential contaminants in the soil may be conducted. [6][7]

4.2 XRF Spectrophotometry

Once the samples have been properly dried and sieved, an XRF analysis will be conducted in the NAU Environmental Engineering Lab. This analysis will be completed following EPA Method

6200: Field Portable X-Ray Fluorescence Spectrometry for the Determination of of Elemental Concentrations for Soil and Sediment. This method was developed to provide a preliminary identification of elements present in a soil sample to be used in conjunction with additional confirmatory testing. To complete this analysis, each sample will be divided into 3” by 3” sections by drawing grid lines on the bags each sample is stored in and analyzed with a hand-held XFR device. The sample will be properly positioned in front of the XRF probe window and the probe will be activated, causing the electrons in the soil samples to shift and emit light waves specific to each element present in the sample. All necessary equipment and training for the XRF analysis will be provided by the client. Confirming that the XRF probes have been provided before the samples are collected will ensure that analysis may begin as soon as the samples are prepped in the lab. The results of the XRF analysis will be downloaded onto a computer and stored in an Excel sheet to be used for analysis in conjunction with the acid digestion, ICP, and FAAS results.

[8]

4.3 Acid Digestion

The confirmatory analysis of the elements detected in the soil sample during XRF analysis will be completed through an acid digestion. Approximately 20 samples that showed high contamination levels from XRF analysis will be further analyzed using Acid Digestion. The testing methods that will be used for acid digestion are EPA Method 3050B: Acid Digestion of Sediments, Sludges, and Soils and ASTM E2941: Standard Practices for Extraction of Elements from Ores and Related Metallurgical Materials by Acid Digestions. The ASTM methods will be particularly important in the analysis because they were created specifically for testing of mine soil, waste rock, and mine tailings. Nitric acid and hydrogen peroxide will be periodically added to the samples to digest any environmentally available elements, leaving behind only potential contaminants. The acid digestion acts as a preparation of the samples to be further analyzed. [9][10]

4.4 Atomic Absorption Spectrophotometry

The FAAS will be subcontracted to two third party labs chosen by ACGM Engineering. Western Technologies Inc. will receive soil samples to test for arsenic, and the Northern Arizona University Chemistry Lab will be testing samples that have been digested by ACGM Engineering members. EPA Method 7000B Flame Atomic Absorption Spectrophotometry will most likely be used by the third party labs. [11]

5.0 Field Methods and Procedures

The following methods and procedures will be followed by all ACGM team members in the field. Information on the field equipment and surface soil sampling procedures are discussed.

5.1 Field Equipment

ACGM Engineering will prepare for field sapling by obtaining and preparing the field equipment listed below.

- 140 Heavy duty gallon ziplock bags
- 60 Storage buckets for soil samples to be transported
- 4 Sharpies
- 4 Trowels
- 4 Shovels
- 1 Field logbook per person
- Work Plan
- 2 GPS tracking devices (one back-up) to document sample locations with extra batteries for each device
- PPE/Decontamination equipment- water, soap, brushes, trash bags, gloves, paper towels, etc.
- Measuring Tape
- Surveying Flags

5.1.1 Calibration of Field Equipment

The GPS device will need to be calibrated in the field, all other equipment will be ready or prepared for use before the team arrives at the sampling location. The ACGM team will follow the necessary steps to calibrate the GPS device used to measure the locations of each field sample. Depending on the GPS device used in the field the proper calibration methods will be used before locations are taken on the device.

5.2 Surface Soil Sampling Methods to be Used

Surface soil samples at the Tyro Mill site will be collected following EPA guidance. All samples will be taken using decontaminated trowels and stored into large gallon-sized plastic baggies. The topsoil will be brushed away and the surface soil samples taken and placed into the baggies. More information on containers and sample locations is discussed below.

5.2.1 Containers

Once soil samples are taken at each specified location, they will be stored in gallon-sized ziplock baggies and properly labeled according to Section 8.2 of the SAP. All samples will be double-bagged with two plastic baggies to prevent loss or contamination of the sample via tears in the storage baggie. Each sample stored in a double-bagged gallon baggie will be placed in a 5 gallon bucket for storage while sampling on-site. Soil samples will remain in containers to follow proper COC procedures until samples are moved to a permanent storage area.

5.2.2 Sample Locations

Samples will be taken according to the grid sampling map presented in Section 3.1.1. A sample will be taken in each grid or at the node and GPS locations will be obtained at each point to ensure the grid sampling plan is followed. Uniform distances between samples will be measured and used. In addition to the surface samples taken at each specified grid location, hot spot samples will be taken in areas where tailings are present and areas may be particularly contaminated. These locations will be determined by the ACGM Engineering team in the field. Background samples will be taken in an area where contamination from the mill process is highly unlikely to be used as a comparison to the samples analyzed by the team. Background samples will allow for background concentrations to be identified and their locations will be determined by the ACGM team in the field. [12]

6.0 Sample Containers, Preservation, Packing and Transportation

Once the soil samples have been collected at the Tyro Mill site, ACGM Engineering is responsible for transporting them in appropriate containers and making sure they are properly preserved. The subsections below provide more information of proper packing, containers, and preservation of soil samples collected at Tyro Mill.

6.1 Soil Samples

As stated above, all soil samples will be stored in gallon-sized ziplock baggies and double bagges to protect from tears and wear. Soil samples are not commonly preserved using chemical preservatives, therefore if the samples require special preservative measures when they arrive back at ACGM property, they will be refrigerated if need be. If refrigeration of the samples is not necessary, the samples will be stored in a large bin out of the view of the public to prevent them from being tampered with or contaminated. Chain on custody documents will remain with the samples at all times. Samples will be stored in the Environmental Engineering lab where only

authorized students are allowed to be. To keep samples safe, they will be stored in an area where only the lab manager will have access.

6.2 Packing and Transportation

Certain samples determined by the XRF analysis will need to be transported to a subcontracted lab for further analysis. The samples requiring transportation will go to Western Technologies in Flagstaff or the NAU Chemistry lab. The samples will be transported by car to Western Tech. and the samples going to the NAU lab will be walked there by an ACGM team member. Chain of custody is important during transportation and the subcontracted lab will be required to sign off on the pre-existing chain of custody documents for each sample upon the arrival of the samples. The samples are expected to be transported back to ACGM Engineering in a similar fashion sealed off with a chain of custody document for each sample that was sent for additional analysis. [5][12]

7.0 Disposal of Residual Materials

Waste materials will be generated both during the Tyro Mill site sampling event and throughout the lab analysis portion of the project. The subsections below discuss how ACGM Engineering plans on properly disposing of all generated wastes.

7.1 IDW Disposal Procedures for Sites with Low Levels of Contamination

The IDW generated on site will be disposed of as follows:

- Disposable PPE will be placed in trash bags and then disposed in a dumpster back at Northern Arizona University. If the waste is deemed hazardous it will be sealed in a five gallon bucket, dated, identified and will return to Northern Arizona University for proper disposal.
- Reusable PPE will be decontaminated with a wash water on site. If the waste is deemed hazardous it will be decontaminated per EPA and Science and Ecosystem Support Division Operating Procedure. If the waste can not be decontaminated it will be sealed in a five gallon bucket, labeled and disposed of.
- Wash/decontamination water will be dumped on site.
- ACGM Engineering will transport all wastes from the Tyro Mill site.
- Trash will be placed in trash bags and then disposed in a dumpster back at Northern Arizona University.

7.2 Laboratory Waste Disposal

Waste generated in any lab space used by ACGM team will be properly disposed of. ACGM team members will discuss waste disposal procedures with all lab managers before beginning any lab work. Potential wastes that may need to be disposed of in the lab include the portions of the samples that will not be used in analysis as determined by sieve analysis and the samples themselves once all analysis is complete.

8.0 Sampling Documentation and Shipment

8.1 Field Notes

8.1.1 Field Logbooks

Each member working in the field for ACGM Engineering will record the information taken in the field in a logbook. Specifically the logbook will contain the following information for each field event:

- Location
- Team members and their responsibilities
- Other personnel on site
- Deviations from sampling plan
- Levels of safety protection
- Location and description of each sample
- Sample identification number
- Date and Time
- Equipment Used
- Sampler
- The type of sample being taken (grid, hot-spot, background)
- The weather on the day of sampling (temperature, conditions)
- Sketch of site
- Notes and observations
- Information collected for animal/vegetation survey

The log entries shall be written in black ink, have the pages consecutively written in the corner, and be signed by the one taking the notes.

8.1.2 Photographs

Photographs will be taken at the project location, sampling locations, and other areas of interest as deemed necessary. The locations of photographs will be decided upon in the field at the discretion of ACGM Engineering. For each photograph taken the following information will be entered into the log book:

- Time and date
- Location
- Weather Conditions
- Description of item being photographed
- Name of the person taking the photograph.

8.2 Labeling

All samples will be labeled in a clear manner for identification purposes in the field and in the lab. The sample labels at a minimum will included the information below:

- Location (GPS Coordinates)
- Date of collection
- Type of sample
- Project name
- Initials of sampler
- Number

An example of how the samples will be labeled can be viewed in section 8.2.1 below.

8.2.1 Labeling System

Each sample will be labeled using the following layout:
[Project_Date_Type-Number_Initials of sampler]. The type of sample will specify if it is a Grid, Hot-Spot or Background sample. Below is an example of the layout for a hot-spot sample. The sample location will be noted in the field notes.

Tyro Mill_02/02/19_HS-001_JC

8.3 Sample Chain-of-Custody Forms and Custody Seals

Samples will have a chain-of-custody when they are shipped or change possession between different parties. A form will be sent with each shipment. The chain of custody form details the contents of the shipment and maintains a record of the movement of the samples between parties. In the chain of custody the date, time, relinquished by and accepted by will be detailed. Furthermore, a custody seal will be placed on the lid of each of the sampler prior to shipment.

Each seal will be signed and dated. An example of the chain-of-custody form can be seen as follows.

Left Blank on Purpose. Will insert chain of custody here. I just put in the blank page so it won't mess up our page numbers.

9.0 Deviation from Work Plan

All decisions to deviate from the Work Plan will be made by the BLM representative or the project lead. Depending on the delays that occur some tasks may have to be done in a shorter time. Shortening the time of tasks will allow ACGM members to have more time in order to stay on track of the project schedule. Any changes that are decided to be made will be reported in the final report.

10.0 Field Health and Safety

ACGM engineering will follow a Health and Safety Plan (HASP) that describes the procedures that will be followed in the field. The HASP includes all the safety equipment required, potential hazards that maybe encountered, and the location and route to the nearest hospital or medical facility. Further description is in Appendix B.

Appendix B: Health and Safety Plan

1.0 Job Name and Location

The job name is Tyro Mill and the project is located approximately 18 miles outside of Bullhead City. The exact location can be viewed in Figure 1-1 in section 3.0 of the Work Plan.

2.0 Safety and Health Administration

The safety and health regulations will be monitored by the team safety officer. Safety and health administration will follow the regulations of the EPA and OSHA. These standards will be implemented through training for each team member and by the administration of the project manager.

3.0 Hazard Assessment

Prior to work, ACGM Engineering will evaluate physical and chemical hazards at the Tyro Mill site. Assessment for theses hazards are based on previous documented work from BLM which indicated which elements were found on and near the site. The following sections below will detail how each potential hazard will be documented.

3.1 Physical Hazards

Physicals hazards will be identified for both fieldwork and laboratory task identified in the scope document created by ACGM Engineering. Table B3-1 has been modified using the EPA HASP guidance and will be used as a reference for future task. In addition to the table each task analyzed for physical hazards will have a corresponding task description that includes a time estimate. [13]

Table B3-1

Physical Hazards	
Types of Physical Hazard	Exposure Potential During Task
Heat Exhaustion Vegetation Sunburn Animals Slip/Trip/Fall	Low
Ionizing Radiation Neutrons Gamma Rays Beta Particles Alpha Particles	Low
Control Measures	

Work Practices	Certification for HAZWoper and NAU Safety Procedures
PPE:	Proper field work clothing, closed toed shoes, Hazmat suits, gloves
Work/Site Role: ACGM member Eryn Guevara will be the Safety Officer ACGM member Caitlin Adams will be QA/QC Officer	

3.2 Chemical Hazards

Chemical hazards will also be identified for both fieldwork and laboratory task identified in the scope document created by ACGM Engineering. Table B3-2 list characteristics, state/concentration of chemical hazard, and the level of exposure potential during task. This table will also be referenced prior to completion of future task dealing with soil samples. In addition to the table each chemical hazard form filled out will have a corresponding task description that includes a time estimate.

Table B3-2 Chemical Hazards for Field Work

Chemical Hazards			
Chemical Hazard	Characteristics	State/Concentration	Exposure Potential During Task
Tailings	Fine Powder	Solid	Low
Control Measures			
Work Practices: HAZWoper Certification			
PPE: Proper field clothing			
Work/Site Role: ACGM member Eryn Guevara will be the Safety Officer			

Table B3-3 Chemical Hazards for Lab

Chemical Hazards			
Chemical Hazard	Characteristics	State/Concentration	Exposure Potential During Task
Tailings	Fine Poder	Solid	Low
Control Measures			
Work Practices: Northern Arizona University Lab and Safety and XRF Training			

PPE: Gloves, eyewear, closed toed shoes, proper lab clothing
Work/Site Role: ACGM member Caitlin Adams will be QA/QC Officer ACGM member Eryn Guevara will be the Safety Officer

4.0 Training Requirements

To maintain health and safety for ACGM Engineering members along with essential personnel the following training certifications will need to be completed and verified.

4.1 HAZWOPER

Any members participating in the soil sample collection process will have completed a 40 hour HAZWOPER training provided by Online Training Systems. This certification is required due to the known contaminants found at the site such as lead, uranium, and antimony. Verification will be done prior to any field work.

4.2 NAU Safety Training

Since ACGM Engineering is affiliated with NAU members will need to complete an online field safety training specific to the university. Verification of certification will be checked prior to fieldwork at the Tyro Mill site.

4.3 XRF Training

ACGM Engineering is contracted out by BLM and will use XRF field methods followed by the organization. BLM representative Eric Zielske will be providing ACGM Engineering with the proper XRF training prior to laboratory analysis within the first weeks of February.

5.0 Personal Protective Equipment

All ACGM members will have to be prepared for the field sampling procedure by having the personal protective equipment (PPE) required for the health and safety of each member. Following is a list of the PPE required for the sampling procedure:

- Latex Gloves
- Hazmat Suites
- Glasses
- Dust Mask
- Closed toe shoes

Having the PPE will protect ACGM members from being exposed to possible contaminant in the

sampling location.

6.0 Site Control and Operating Procedures

Contact information will be available during the sampling procedure. The contact information is shown in section 1.1 in the SAP. During the sampling process, ACGM members will also communicate using hand signs. The following table describes the hand signs that will be used with their meanings.

Table B6-1

Hand signs used to communicate among ACGM members	
Thumbs up	I'm OK/I agree
Cross both arms	I don't agree
Wave with one hand	Come with me
Wave with both hand	I need assistance

7.0 Decontamination Procedures

Decontamination of ACGM Engineering team members and sampling equipment is a crucial part of ensuring the safety of the team and validity of the samples collected in the field. The Tyro Mill site is contaminated with several dangerous heavy metals, therefore the decontamination of all objects that pass through the site is critical to prevent the spread of contaminants off site.

7.1 Personal Decontamination

The ACGM team will follow the decontamination process listed below at the conclusion of the Tyro Mill Sampling event. All team members will wear two sets of latex protective gloves at all times and dispose of the top glove after each sample is collected. After all sampling has concluded the team will begin the decontamination process. The steps of the personnel decontamination process are:

- Upon returning to the van, decontaminate all sampling equipment and store in a van
- Remove outer PPE like boots and gloves and dispose of in proper receptacle
- Remove any remaining PPE and disposable garments and dispose of in properly labeled receptacles
- Remove inner gloves and place in the proper disposal area
- Wash hands and face with soap and water in the field
- Shower as soon as possible after leaving the contaminated area
- Wash all clothes worn during sampling as soon as possible

This decontamination process will be followed after each day of sampling at the Tyro Mill site. If materials are not able to be properly decontaminated they will be disposed of with other contaminated wastes.

7.2 Equipment Decontamination

Decontamination of sampling equipment must be performed after each sample is taken. Decontamination of sampling trowels will be performed by removing leftover debris from the trowel, washing the trowel with a chemical-water decontaminant mixture, and scrubbing wiping the decontaminated trowel with a clean paper towel. The decontaminant mixture will be contained in one of the 5 gallon buckets to allow it to be transported to the location of each sample for trowel disinfection. Used towels will be properly disposed of. If the GPS equipment is somehow contaminated, it may need to be cleaned following special procedures that will not harm the device. ACGM team members documenting GPS locations with the GPS device will wear gloves and the GPS device will be stored in a plastic bag during transportation. GPS device will be decontaminated upon departure from the Tyro Mill site if deemed necessary. At the conclusion of the sampling event all sampling equipment will be placed on a clean cloth and properly decontaminated using w washing process before being placed in plastic bags and loaded into the van for transport. Disposable gloves and other PPE will be changed after each sample and properly disposed of at the conclusion of the sampling event.

7.3 Waste Disposal

All contaminated wastes will be placed into designated trash bags and marked as contaminated. These bags will be kept in separate containers from the samples and decontaminated tools during transportation. The contaminated wastes will be properly disposed of according to Section 7.1 of the SAP [13].

8.0 Emergency Response Procedures

In the event of an emergency, during either field work or lab work, despite the precautions taken above, the situation will be assessed by senior personnel and 911 will be contacted if necessary. If a non-life threatening injury occurs, the nearest healthcare facility will be contacted and the affected personnel will be transported via ambulance or by a designated team member for treatment. Once the injured team member has been safely transported for treatment, senior personnel will fill out the appropriate injury or illness form provided by NAU in the Field Safety Manual. The closest healthcare facilities to both lab and field work locations are provided below. Each ACGM team member has provided an emergency contact in the event on an on-site injury. The name and contact information for each team members emergency contact have been listed below in Table B8-1.

Closest hospital to field work- Western Arizona Regional Medical Center

Phone: (928) 763- 2273

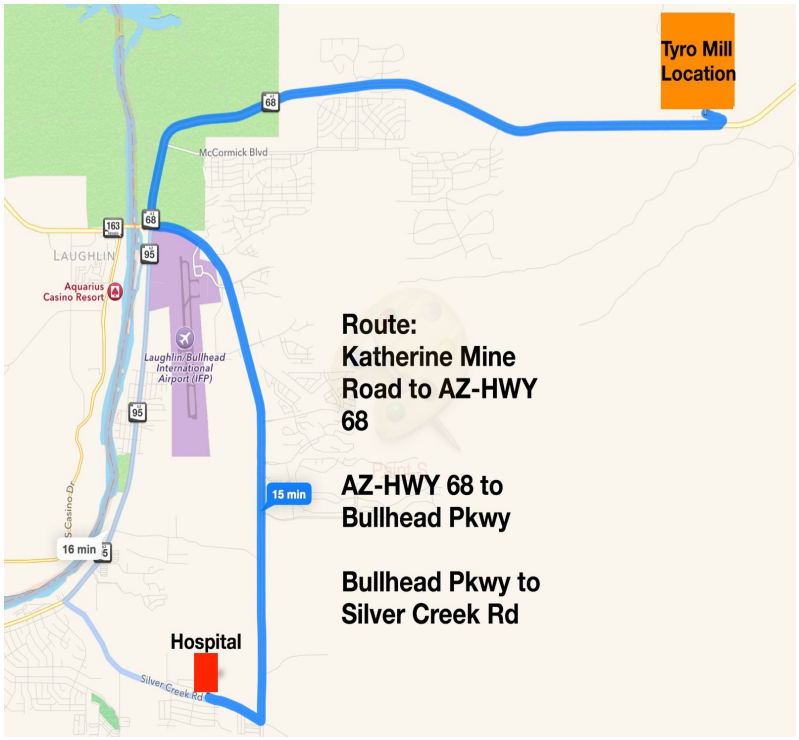
Address: 2735 Silver Creek Rd

Bullhead City, AZ 86442

United States

Transportation Route: Take Katherine Mine Road South to AZ-HWY 68. Merge onto AZ HWY 68 heading West. Exit AZ-HWY 68 at Bullhead Parkway. Take Bullhead Parkway south to Silver Creek Road. Turn right on Silver Creek Road. Hospital on right.

Image:



Closest Hospital to Lab- Flagstaff Medical Center

Phone: (928) 779-3366

Address: 3118, 1200 N Beaver St, Flagstaff, AZ 86001

Transportation Route: Take Beaver Street North from NAU Campus to Flagstaff Medical Center

Image:

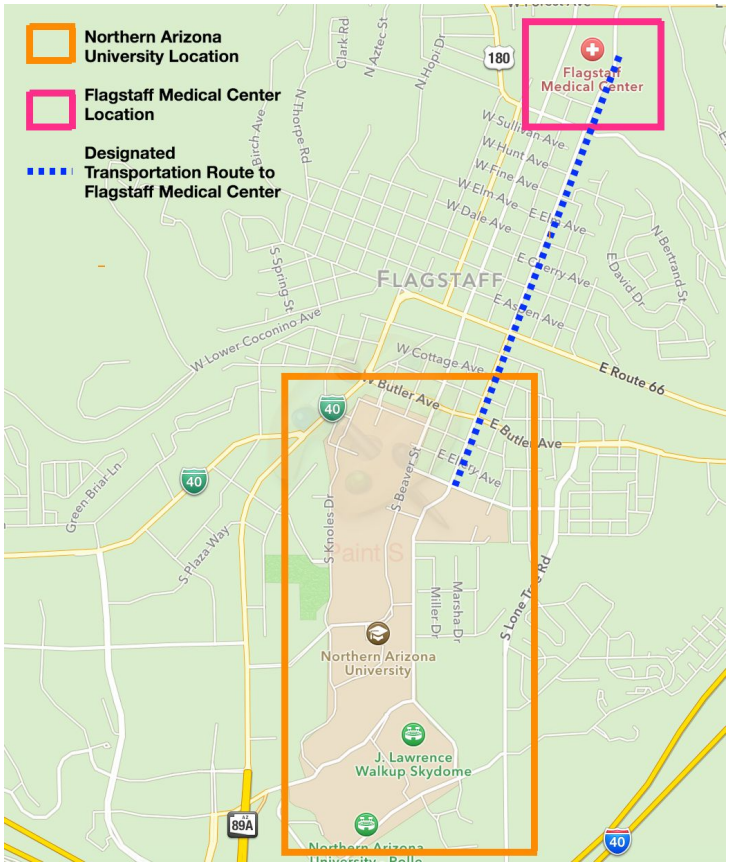


Table B8-1. Emergency Contact Information for ACGM Team Members.

Team Member	Emergency Contact Name	Emergency Contact Phone Number	Relationship to Team Member
Caitlin Adams	Scott Adams	602-763-3959	Father
Eryn Guevara	Graciela Guevara	602-430-7208	Mother
Hamad Mohammad	Ahmad Mohammad	480-544-4949	Brother
Joy Crutchfield	Sharon Sifling	928-607-8503	Mother
Bridget Bero	Charlie Beadles	928-607-8688	Husband
Josue Juarez	Alfredo Juarez	928-261-6772	Father