ACGM. Engineering & Consulting
Est. 2014

TYRO MILL PA/SI PROJECT PROPOSAL

Final Proposal
December 12, 2018

CENE 476 Capstone Prep

Prepared By:
Caitlin Adams
Joy Crutchfield
Eryn Guevara
Hamad Mohammad

GI/TA:
Dr. Bridget Bero

Table of Contents

List of Figures

List of Tables

List of Equations

NA

List of Abbreviations

ASTM- American Society for Testing and Materials
AZ- Arizona
BLM- Bureau of Land Management
CDI- Chronic Daily Intake
CERCLA- Comprehensive Environmental Response, Compensation, and Liability Act
EPA- Environmental Protection Agency
FLAA- Flame Atomic Absorption Spectrometry
GI- Grading Instructor
ICP-AES- Inductively Coupled Plasma Mass Spectrometry
PA- Preliminary Assessment
QA/QC- Quality Assurance/Quality Control
SI- Site Inspection
TA- Technical Advisor
XRF- X-ray Fluorescence

1.0 Project Understanding

1.1 Project Purpose

The Preliminary Assessment and Site Investigation of Tyro Mill is necessary to identify the contamination present on site in order for the Bureau of Land Management to move forward with any necessary remedial design. While some analysis of the site has been conducted in the past and various contaminants of concern have been identified on site, there is not enough relevant information to fully characterize the current site conditions. Through the development of a PA/SI report, BLM will be made aware of the contaminants that are present on site and where these contaminants are located on and around the site.

1.2 Project Background

The Tyro Mill site is located in Mohave County, AZ, approximately 15 miles from Bullhead City. The latitude and longitude of the site is 13° 13’ 29.68” N and 114° 27’ 32.33” W. The site is located off of a dirt road that is a popular destination for overnight camping and off-roading that can be accessed by car from AZ-Highway 68. The site location can be seen in Figure 1-1.

The Tyro Mine and Mill site operated illegally starting in 1980, for approximately 20 years and was abandoned in 1999. The mine never submitted its paperwork to BLM which caused BLM to close down the milling operation in the 1970s. Both the mining and milling sites have since been abandoned and all buildings have been completely demolished since 2003 [1]. A repository to contain the mine and mill tailings was constructed by Red J Environmental in 2004 to contain the leftover mine tailings on the site [2]. Figure 1-2 shows a satellite image of the current site conditions annotated with information on the locations of important components of the site. The cover of the repository that contains the mine tailings is held in place by large boulders. Some of these boulders have been moved, allowing the mine tailings to escape from the repository. The repository is also being affected by erosion. These conditions have allowed the contaminants of concern found in the mine tailings to migrate around the site and be carried off site along the nearby access road. Sampling was done on site in April of 2018 by BLM where elevated levels of uranium, arsenic, copper, nickel, manganese, and antimony were discovered near the access road to the west of the repository [3].

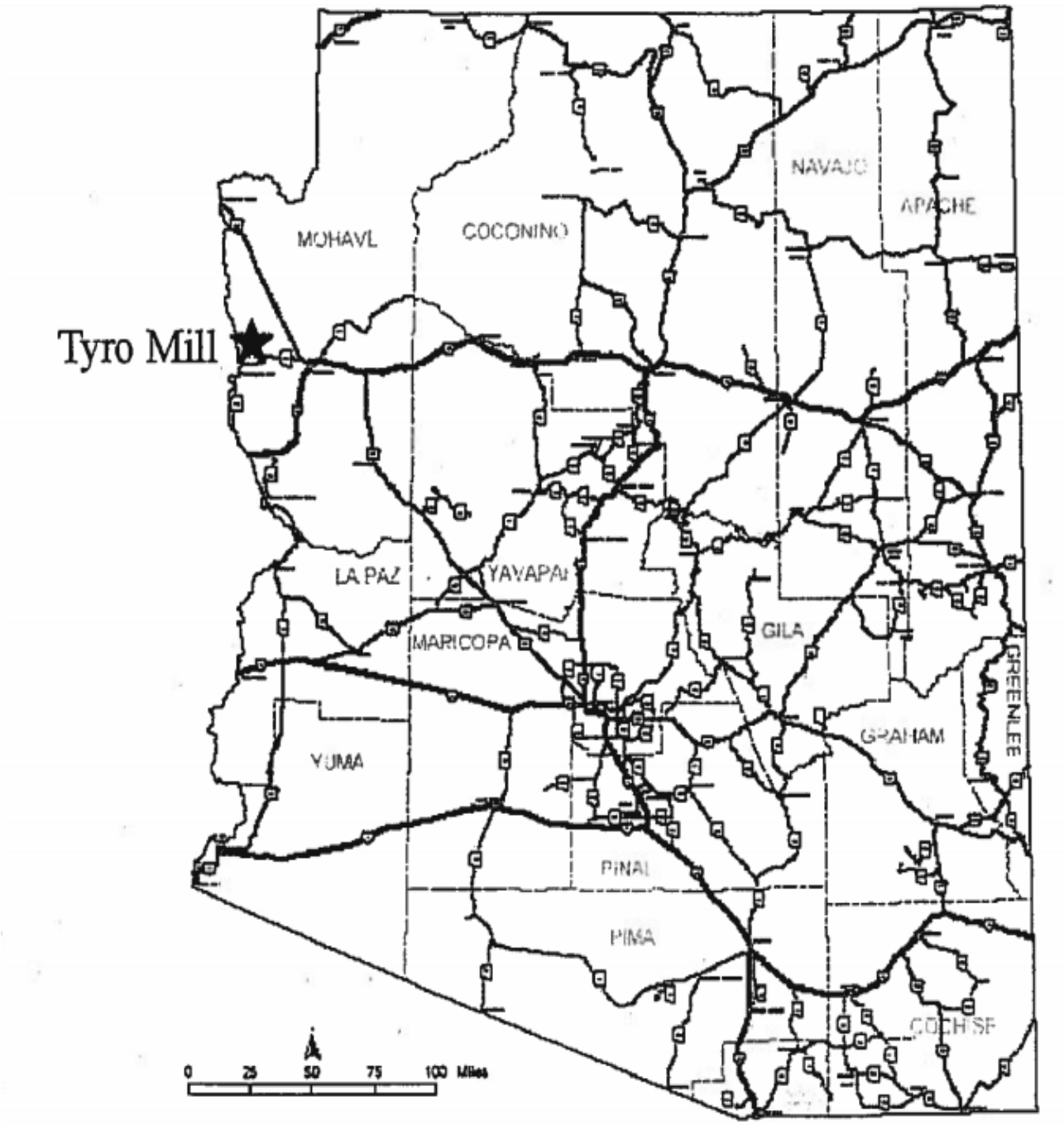


Figure 1- 1 Tyro Mill Site Location on Map of Arizona[3]

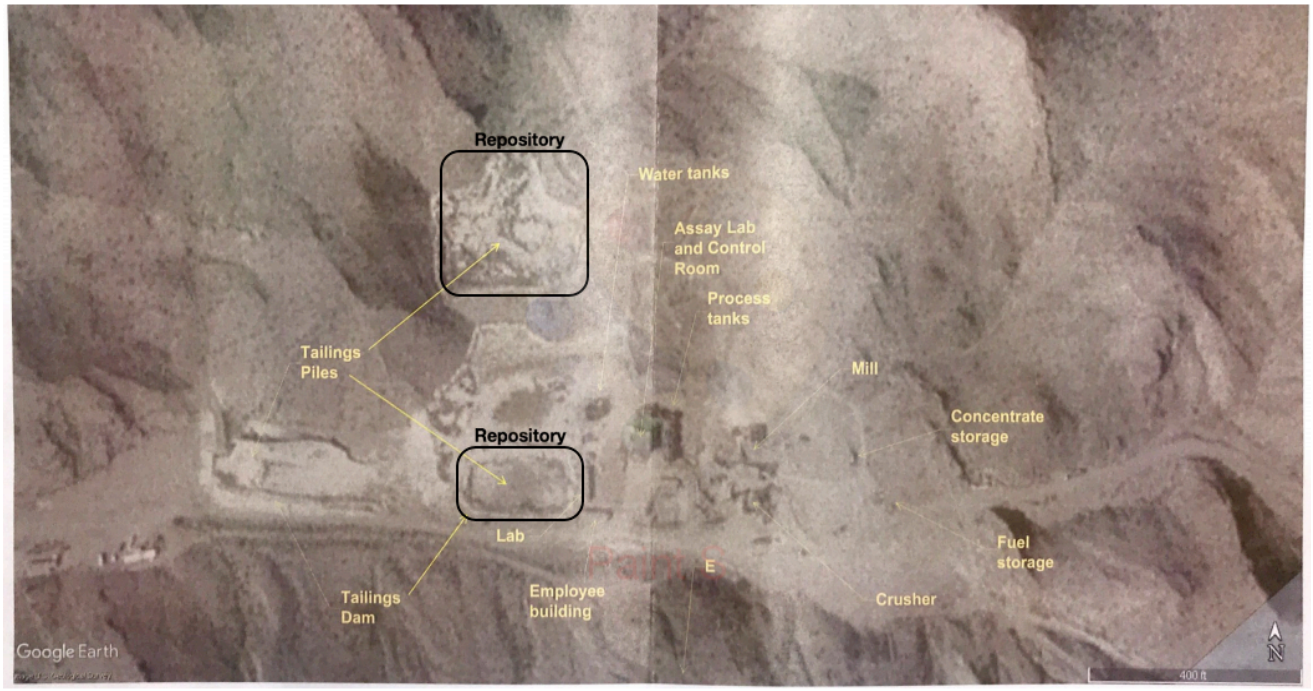


Figure 1- 2 . Satellite View of Current Site Conditions at Tyro Mill [2].

The sampling results and maps from the April 2018 Sampling Event performed by BLM can be seen in Table 1-1 and Figure 1-3 respectively. The red sections in Table 1 indicate a non-residential exceedance and yellow indicates a concentration between the Arizona Residential and Non-Residential Soil Remediation Standards [4].

Table 1- 1 XRF Samples with Exceedances from April 2018 Sampling Event [4]

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	81.00.91	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

1.3 Technical Considerations

For completion of the project, the technical work required includes sampling, and analyzing the soil samples collected using X-Ray Fluorescence (XRF Analysis) to identify the presence of other contaminants of concern. Due to XRF analysis errors, discussed in section 1.4.2, flame atomic absorption spectrometer (FAAS analysis) will be performed as QA/QC in order to identify the contaminants of concern and confirm the data collected with XRF analysis. Performing FAAS analysis will require the performance of acid digestion were the collected soil samples are turned into solutions.

1.4 Potential Challenges

1.4.1 Weather

The primary potential challenge that may occur during the project are weather events (such as thunderstorms, frosts, excessive wind, etc.) during the time devoted to sampling. This is a potential challenge because the weather events can not be controlled or predicted with 100% accuracy. The team is planning on completing the sampling over a weekend in January. The project site is located in a dry desert terrain and thus weather is

not predicted to interfere with the sampling; however, there is still the possibility that it could cause a potential challenge.

1.4.2 XRF Analysis Errors

Another potential challenge that may occur is within the XRF analysis of the soil samples. This is a potential challenge because within an XRF analysis there are often random and systematic errors. Such as if the team is using a handheld XRF system, for example the handheld XRF has challenges detecting elements that have weak fluorescent energies or overlapping. Thus the errors produced by the XRF present a challenge within gauging the accuracy of the results.

1.5 Stakeholders

The main stakeholder for the Tyro Mill Site project is the Bureau of Land Management (BLM) under the United States Department of the Interior. The abandoned mill site is located on public land and is managed by BLM. Stakeholders for the project also include nearby residents residing in the surrounding areas of the site, as well as recreational users.

2.0 Scope of Services

The subsections below discuss the tasks to be completed by ACGM Engineering while completing the PA/SI of the Tyro Mill project site.

2.1 Task 1: Work Plan

ACGM Engineering will design a work plan to be used and followed when taking samples in the field at the Tyro Mill site. The Work Plan will include the following items:

- Project Management
- Site Background Information
- Investigative Approach
- Field Investigation Methods and Procedures
- Sample Collections Procedures and Analysis
- Deviations from the Work Plan

The Work Plan will also include two appendices, a Sampling Analysis Plan (SAP) and a Health and Safety Plan (HASP).

2.1.1 Task 1.1 Sampling Analysis Plan (SAP)

The SAP will include:

- QA/QC Methods: QA/QC methods will be outlined in Section 2.2.1 of the Sampling and Analysis Plan during field sampling will help ACGM provide high quality, legitimate data throughout the data collection process.
- Sampling Rationale: The process ACGM will use to select sampling methods that will be outlined in Section 3 of the Sampling and Analysis Plan. Rationale for the grid sampling, hotspot sampling, background sampling, and field decisions will be discussed.
- Sample Analysis Design: Section 4 of the SAP will discuss the analysis process that ACGM will follow to analyze the soil samples collected. The analysis will include sample sieving, XRF analysis, acid digestion, and atomic absorption spectrophotometry.
- Field Methods and Procedures: The field methods and procedures Section 2.2 of the SAP will discuss the supplies and equipment that will be needed for field sampling, how this equipment will be calibrated, the surface soil sample collection methods, soil sampling locations, and the containers in which field samples will be stored.
- Disposal of Residual Materials: Section 7 of the SAP will discuss how contaminated materials such as clothing, gloves, wash water, and equipment will be stored or disposed of while in the field.
- Procedures for Deviations From the Work Plan: This section of the SAP will discuss how the ACGM team will manage problems or setbacks that will require a

change in the Work Plan. This includes rescheduling the remaining tasks and staying on track with the project completion date.

- Field Health and Safety Procedures: ACGM will develop a set of procedures to follow in the HASP that will detail the safety equipment, potential hazards that may be encountered in the field (animal bites, heat exhaustion, adverse weather conditions, etc.) and locations to the nearest hospital or medical facility. The HSAP includes more detail.

2.1.2 Task 1.2 Health and Safety Plan (HASP)

The HASP will include:

- Hazard Assessments: Based on the provided information by the client and the site location, physical and chemical hazards are considered for the safety plan. Due to the site contamination, ACGM Engineering will consider the PPE discussed in the Work Plan in section 3. Based on the location and time of the sampling, the effects of the weather will also be discussed.
- Training Requirements: ACGM Engineering members will complete the following training:
    - HAZWOPER training
    - NAU safety training
    - XRF training
- Site Control and Operating Procedures: Safety will be managed on site according to the HASP developed in the appendix B of the Work Plan. Eryn Guevara of ACGM Engineering is the designated Safety Officer who will ensure all ACGM team members will follow all safety procedures set out in the HASP. Eryn will also ensure that all ACGM team members are wearing the appropriate PPE at all time while the team is collecting samples at the Tyro Mill site and during lab analysis.
- 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. Personal decontamination will require PPE such as boots and gloves, proper removal methods for disposable garments, and cleaning measures needed to complete prior to leaving site. Equipment decontamination procedures will be performed for each individual sample and upon departure from the Tyro Mill site. Designated waste disposal containers will be used on site to prevent contamination during sampling and transportation.
- Emergency Response Procedures: In the event of an emergency ACGM personnel will follow the action plan developed for both field work and lab work. Information regarding nearby health facilities and emergency contact information can be found in Section 8 of the HASP.

2.2 Task 2: Sampling

Field sampling will follow the methods outlined in the SAP and HASP as discussed in Task 1. The completed Work Plan will contain all specific information on the sampling processes selected by ACGM and the rationale behind each of the chosen sampling methods.

2.3 Task 3: Analysis

Analysis methods will follow the steps outlined in the SAP discussed in Task 1. The analysis performed on the samples collected in the field will include XRF, acid digestion, and flame atomic absorption spectroscopy analyses.

2.3.1 Task 3.1: Sieving and Drying of Samples

Methods used to sieve and dry soil samples will be further detailed in Section 4.1 of the SAP. Information regarding equipment and implementation of QA/QC will also be outlined in the Work Plan.

2.3.2 Task 3.2: XRF Analysis

The Section 4.2 of the SAP will include detailed analysis methods and equipment needed to complete the XRF Analysis following the QA/QC methods presented in Section 2.2.2.1 of the Work Plan.

2.3.3 Task 3.3: Acid Digestion

Detailed information regarding acid digestion design will be found in Section 4.3 of the SAP portion of the Work Plan. QA/QC will be implemented throughout the analysis process to ensure samples are ready for ICP and FAAS testing.

2.3.4 Task 3.4: ICP and FAAS Testing

The SAP Section 4.4 will detail the analysis methods and subcontract information needed to complete the ICP and FAAS testing.

2.3.5 Task 3.5: XRF and FAAS Correlation

Data from XRF and FAAS analysis will be correlated. A statistical analysis will be performed to identify the 50 and 90% concentrations for the COCs. ACGM Engineering will provide mapping of the correlating XRF data and FAAS data. The mapping of the correlated data will show target mapping within the Tyro Mill site, corresponding concentrations of the contaminants in specific areas, and the if the concentration meets AZ Soil Remediation standards [5]. Correlation of data on the maps will affect the analysis method used to identify the 50% and 90% concentrations. A common statistical analysis used is the T-Test.

2.4 Task 4: Risk Assessment

Based on the collected data a risk assessment will be reformed for a human risk assessment and an ecological risk assessment. The following sections describe the tasks in detail.

2.4.1 Task 4.1: Human Risk assessment

The human risk assessment will be performed in four stages that are generally used when performing a risk assessment. The four stages include:

- Hazard Identification: the contaminants of concern will be identified.
- Exposure Assessment: measuring and estimating the exposure point concentrations, magnitude, frequency, and duration of contaminants of concern. Different scenarios of exposures (for example the exposure of a worker or a resident). The average and maximum CDIs will be developed for each exposure scenario.
- Toxicity Assessment: Reference Doses (RfD) and Slope Factors (SF) for the obtained Contaminants Of Concern (COC) from the Integrated Risk Information System (IRIS)
- Risk Characterization: using the information from the three previous steps, numerical values based on the hazard identification, exposure assessment, and the toxicity assessment, of carcinogenic and non-carcinogenic risks are found to characterize the site of the project. [6]

2.4.2 Task 4.2: Ecological

The ecological risk assessment will be completed by the ACGM members in order to determine the effect the contamination at the Tyro Mill site has on the surrounding environment. the ecological risk assessment will the effects on plants and animals that may be endangered. In accordance with the Environmental Protection Agency (EPA) the ecological risk will be evaluated in three phases:

- Phase 1 Problem Formulation: information on what plants and animals may be at risk is gathered and native endangered species are identified
- Phase 2 Analysis: Provides the determination of what plants and animals are exposed, the levels of exposure, and if the exposure will cause harmful effects
- Phase 3 Risk Characterization: Risk estimation and risk description will describe information on exposure profiles, exposure effects, and harmful effects of exposure to the identified plants and animals

The three phases involve determining what is at risk and to what degree the subjects in question are in risk. Furthermore, the risk characterization includes two parts: risk estimation and risk description. The results of the two parts will provide the level of risk that the environment is exposed too. [7]

2.5 Task 5: Project Impacts

Direct social, economical, and environmental impacts of the project will be discussed. Based on the risk assessment, the impacts will be discussed. The environmental impacts will be discussed in the final report based on the ecological risk assessment. Due to the conditions of the site, economic impacts may affect the site.

2.6 Task 6: Project Management

This Task explains the project management activities for the Tyro Mill project site. The following subsections detail the various tasks included within project management.

2.6.1 Task 6.1: Meetings

Meetings will be scheduled with the client, technical advisor (TA), grading instructor (GI), and team members throughout the project when necessary. Client meetings will be scheduled in order to maintain a good company-to-client relationship and to ensure that the work needed to be done on the project in accordance with the client is understood and met. Meetings will also be scheduled with the grading administrator and technical advisor in order to review the work that has been done before it is finalized and to affirm the technical information and methods that are to be used in the project.

When meeting are scheduled a meeting agenda will be emailed to all participants in the meeting. During the meeting one participant (a member of ACGM) will be recording meeting minutes of the topics discussed during the meeting as well as the next tasks to be completed before the next meeting. Once the meeting has concluded the meeting minutes will be emailed to all participants of the meeting. Documentation of meeting minutes will be kept in a memo binder for reference.

2.6.2 Task 6.2: Correspondence

Correspondence between the client and ACGM Engineering will be completed primarily through email and secondarily through phone when necessary. In contrast, correspondence between the TA, GA, and team members will be done primary in person and secondarily over email.

Joy Crutchfield from ACGM Engineering will be used as the primary client contact for the project. The contact information for Joy Crutchfield will be provided to the client, TA, GA and to others when necessary. Correspondence will be documented by archiving emails and noting when phone calls are made and what they pertained.

2.6.3 Task 6.3: Schedule Management

ACGM Engineering will have weekly team meetings to evaluate our progress on the project and if we are on track according to the schedule in section 3.0. In the event that the team is not on track an emergency meeting will be held to redevelop a new schedule with a new critical path. ACGM members may also work overtime on the project in order to remain on or return to the proper schedule.

2.6.4 Task 6.4: Project Deliverables

The project deliverables are described in the following subsections

2.6.4.1 Task 6.4.1: Website

A website will be created that is well organized and contains the team contact information, project information, photos, and documents. However, per the client's request the website will not be made public and only the client, ACGM members, GI, and TA will have access to the website.

2.6.4.2 Task 6.4.2: 30% Report

The 30 percent report will be the first draft of the final report that will be submitted. It will include the following completed task:

- Task 1: Work Plan
- Task 2: Sampling

It is estimated that the 30% report will be completed on February 6th, 2018.

2.6.4.3 Task 6.4.3: 60% Report

The 60 percent report will be the second draft of the final report that will be submitted. The 60% report will be completed on March 6th, 2018. The 60% report will include the following completed task:

- Task 1: Work Plan
- Task 2: Sampling
- Task 3: Analysis

At this time the risk assessment will have been started but not completely analyzed.

2.6.4.4 Task 6.4.4: Final PA/SI Report

The PA/SI report will include all the required elements of the report and will also consider the feedback provided from the GI in the 30% and 60% reports.

2.6.4.5 Task 6.4.5: Final Presentation

A final presentation will be prepared in order to present in a brief description of the project. The presentation shall include but not limited to, background

information of the project, the followed plan, the results obtained by the team, a risk assessment of the project, and a future recommendation.

2.7 Exclusions

Project exclusions are described in the subsections. These exclusions are made so that the ACGM Engineering can meet the request of BLM in the allotted 16-week time frame.

2.7.1 Exclusions

2.7.1.1 Hydrology

Hydrological analysis of the site to evaluate cap erosion are excluded from the scope of this project.

2.7.1.2 Inhalation and Dermal Risk Assessment

Both inhalation and dermal exposure routes will be excluded from the scope of the project. This exclusion is due to the lack of equipment and time required to collect usable data. Performing an inhalation risk assessment would require usable air quality data that are unavailable.

2.7.1.3 Water Sampling

Water Sampling for the Tyro Mill Site area will also be excluded due to the time availability in the field.

2.7.1.4 Soil Sampling at a Depth

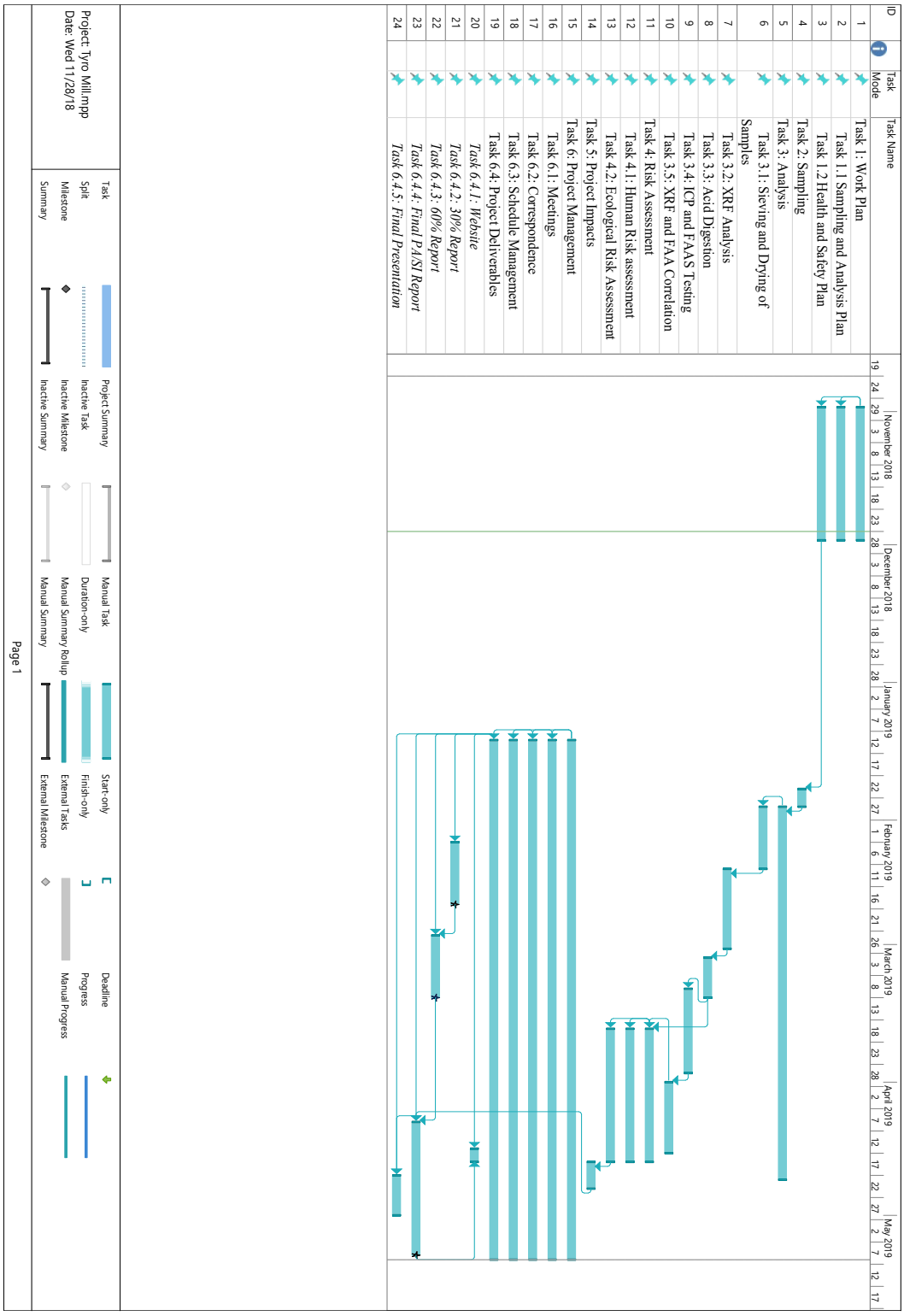
Soil samples at a depth are excluded for the PA/SI of the Tyro Mill Site per client request.

3.0 Schedule

The total duration of the schedule for the project is 25 weeks. The project's start date is set to be October 31st and the project end date is set to be May 10th. During the 25-week period, ACGM will complete all major and subtasks of the project. Refer to the Gantt chart to see the timeline for each task.

The critical path of the project will span 25 weeks from the beginning of the semester when the Work Plan is completed, and sampling is conducted to the end of the semester when the PA/SI report, website, and presentation are completed. Almost all tasks in the Tyro Mill project after sampling are Start-to-Start tasks, meaning once one task is started the consecutive tasks may also be started. This makes it difficult to determine a specific critical path through the required tasks. The final deliverables are dependent on the completion of all sampling and analysis tasks with project management tasks incorporated into each task.

Gantt Chart:


ID
Task Mode
Task Name
1 Task 1: Work Plan
2 Task 1.1 Sampling and Analysis Plan
3 Task 1.2 Health and Safety Plan
4 Task 2: Sampling
5 Task 3: Analysis
6 Task 3.1: Sieving and Drying of Samples
7 Task 3.2: XRF Analysis
8 Task 3.3: Acid Digestion
9 Task 3.4: ICP and FAAS Testing
10 Task 3.5: XRF and FAA Correlation
11 Task 4: Risk Assessment
12 Task 4.1: Human Risk assessment
13 Task 4.2: Ecological Risk Assessment
14 Task 5: Project Impacts
15 Task 6: Project Management
16 Task 6.1: Meetings
17 Task 6.2: Correspondence
18 Task 6.3: Schedule Management
19 Task 6.4: Project Deliverables
20 Task 6.4.1: Website
21 Task 6.4.2: 30% Report
22 Task 6.4.3: 60% Report
23 Task 6.4.4: Final P.I.S.I Report
24 Task 6.4.5: Final Presentation
November 2018
December 2018
January 2019
February 2019
March 2019
April 2019
May 2019
Project: Tyro Mill.mpp
Date: Wed 11/28/18
Task
Split
Milestone
Summary
Project Summary
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Progress
Manual Progress
Page 1

4.0 Staffing Plan

Table 4-1 below displays the employees of ACGM Engineering and the code that will be used to reference them throughout.

Table 4- 1 ACGM Employee Classifications and Shortened Codes

Classification	Code
Senior Engineer	SENG
Engineer	ENG
Lab Technician	LAB
Engineering Intern	INT

The qualifications of each employee are as follows:

- SENG: PE Licenses, master's degree, 15 years experience
- ENG: PE or has their EIT and are working towards a PE, bachelor's degree, 4 years experience
- LAB: OSHA Certification, ASTM Certifications, 1 year experience
- INT: Working towards a B.S. in Engineering

Table 4- 2 Work Hours by Task for ACGM Employees

Task	**SENG**	**ENG**	**LAB**	**INT**
	Hour	**Hour**	**Hour**	**Hour**
Task 1: Work Plan	40			
Task 1.1 Sampling and Analysis Plan	3	8	3	6
Task 1.2 Health and Safety Plan	3	8	3	6
Task 2: Sampling	1	120	16	32
Task 3: Analysis	327			
Task 3.1: Sieving and Drying of	0.5	10	45	40

Samples				
Task 3.2: XRF Analysis	0.5	10	45	40
Task 3.3: Acid Digestion	0.5	10	45	40
Task 3.4: ICP and FAAS Testing	0.5	10	3	0
Task 3.5: XRF and FAA Correlation	2	14	0	14
Task 4: Risk Assessment	116			
Task 4.1: Human Risk assessment	3	20	0	10
Task 4.2: Ecological Risk Assessment	3	20	0	10
Task 5: Project Impacts	3	20	0	10
Task 6: Project Management	34			
Task 6.1: Meetings	4	10	3	5
Task 6.2: Correspondence	5	0	0	2
Task 6.3: Schedule Management	5	0	0	0
Task 6.4: Project Deliverables	74			
Task 6.4.1: Website	1	2	0	3
Task 6.4.2: 30% Report	1	14	0	3
Task 6.4.3: 60% Report	1	10	0	2
Task 6.4.4: Final PA/SI Report	1	20	0	5
Task 6.4.5: Final Presentation	3	4	1	3
Subtotal	38	320	164	215
Total (Hours)	746			

All ACGM employees will work a total of 622 hours on the Tyro Mill PA/SI Project. The lab technician will work the hours that pertain to sampling and lab analysis. The Engineer will work 320 hours, as they will be conducting most of the analysis and writing all reports. The Senior Engineer 38 hours will be handling most of the Project Management tasks and reviewing all

other work. The Intern will assist the Engineer and the Lab Tech for a total of 215 hours in collecting samples, conducting analysis, and assembling all reports.

5.0 Cost of Engineering Services

ACGM Engineering estimates the total cost of engineering services for the Tyro Mill Site project to be around $810,000. Table 5-1 shows the personnel, travel, supplies, and subcontracts from the start to end of the project.

Travel costs are based on the 2 days ACGM Engineering will be collecting samples at the site and are NAU standard per diem. The budgeted cost for the analytical lab subcontractors are subject to change based on samples containing contaminants of concern during analysis.

Table 5- 1 Total Cost of ACGM Engineering Services for Tyro Mill Site PA/SI Report

1.0 Personnel							
Classification			**Hours**		**Rate $/hr**		**Cost**
SENG			41		$194		$7,954
ENG			216		$134		$28,944
LAB			156		$48		$7,488
INT			212		$22		$4,664
Total Personnel			625		N/A		$49,050
2.0 Travel							
Item	**Quantity**	**Days**	**$/Day**			**$/Mile**	**Mileage**	**Cost**
Vehicle	1	2	60			0.445	400	$298
Hotel	3	1	98			N/A		$294
Per Diem	6	2	**Breakfast**	**Lunch**	**Dinner**	N/A		$492
			$9	$11	$21			
Total Travel			N/A					$1,084
3.0 Supplies							

Item	Cost	Unit	Quantity	Cost
Gloves	$9.70	2	100	$19
Ziploc Bags	$7.99	5	28	$40
measuring tape	$24.95	2	1	$50
Surveying Flags	$10.97	2	100	$22
Hazmat Suits	$11.35	12	1	$136
5 gal buckets	$55.00	3	20	$165
Trowels	$3.58	4	1	$14
Trashbags	$14.97	1	50	$15
Decontamination Supplies	$50.00	4	1	$200
GPS Unit Rental	$65.00	1	1	$65
Safety Glasses	$12.26	3	2	$25
Dust Mask	$7.88	50	1	$8
Notebooks/Pens	$8.09	1	4	$32
27 Gal. Plastic Storage Bins	$8.98	4	1	$36
Total Supplies	N/A			$827
4.0 Subcontract				
Sample Quantity	**Cost/Sample**			**Cost**
Western Technologies: 20	$150			$3,000
NAU Chemistry Lab: 20	$15			$300
Total				$54,261

6.0 References

[1] Golder Associates Inc., and Science Applications International Corporation, "Final Report for Earthwork Regarding Plan for Surface Reclamation", Golder Associates Inc., Denver, 2018.

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

[3] 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.

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

[5] J. Suh, H. Lee and Y. Choi, "A Rapid, Accurate, and Efficient Method to Map Heavy Metal-Contaminated Soils of Abandoned Mine Sites Using Converted Portable XRF Data and GIS", *International Journal of Environmental Research and Public Health*, vol. 13, no. 12, pp. 16-17, 2016.

[6] United States Environmental Protection Agency, "Conducting a Human Health Risk Assessment," EPA, 20 June 2017. [Online]. Available: https://www.epa.gov/risk/conducting-human-health-risk-assessment. [Accessed 09 October 2018].

[7] United States Environmental Protection Agency, "Ecological Risk Assessment," EPA, 23 September 2016. [Online]. Available: https://www.epa.gov/risk/ecological-risk-assessment. [Accessed 09 October 2018].