GOLD MEMBER INCORPORATED
2112 S Huffer Lane, Flagstaff, AZ, 86011
Nicolas Boon | Audrey Lang | Nicole Stanczak

Wednesday, December 10, 2014

Matt Plis
Mining Engineer
Abandoned Mines & HAZMAT Coordinator
BLM Lower Sonoran Field Office
21605 N. 7th Avenue
Phoenix, AZ 85027-2929

Bill Harris, PhD, PE
Chief, Engineering Services
BLM Arizona State Office
One North Central Avenue, Ste. 800
Phoenix, AZ 85004-4427

Dear Mr. Matt Plis and Dr. Bill Harris:

Gold Member Incorporated is writing in response to the Vulture Mine Tailings project. Our team would like this opportunity to work along side the Bureau of Land Management to examine and assess the risks that accompany the migration of mine tailings. Attached is the project proposal, which contains the project understanding, scope of services, project schedule, and cost of engineering services.

Thank you for your time,

Sincerely,

GOLD MEMBER INCORPORATED

Nicolas Boon
Audrey Lang
Nick Stanczak

ENCLOSURES

Proposal: Vulture Mine Tailings

December 10, 2014

Nicolas Boon
Audrey Lang
Nicole Stanczak

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1.0 Project Understanding

This section will discuss the project understanding, which includes the project description, background information, stakeholders, existing conditions of the site, technical considerations, and potential challenges.

1.1 Project Description

The purpose of this project is to examine and assess the risks that accompany the migration of mine tailings produced from the Vulture Mine. This mine is located in Wickenburg, Arizona, northwest of Phoenix (see figure 1). The main objective for examining and assessing the risks of the Vulture Mine tailings is to produce a preliminary assessment and site inspection (PA/SI). The PA/SI will follow the Comprehensive Environmental Response and Liability Act (CERCLA), and will help the Bureau of Land Management (BLM) determine if they should proceed with further CERCLA actions to pursue the responsible party or begin a remedial investigation.

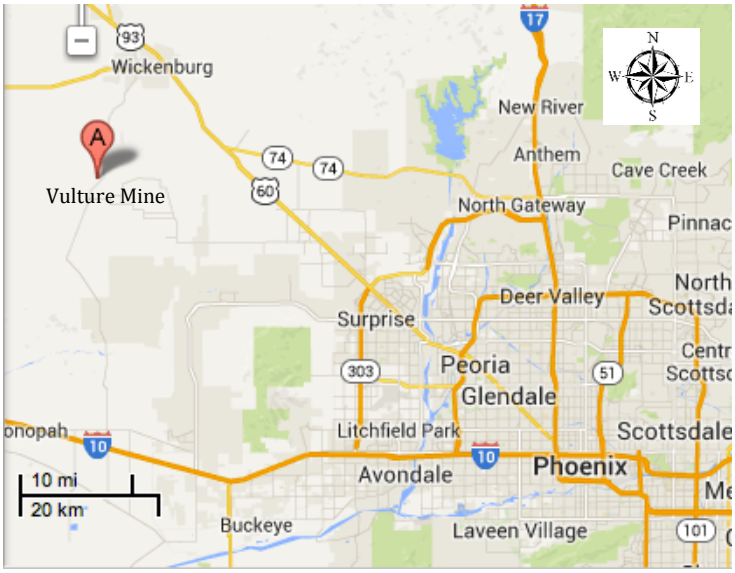

Figure 1: Point A on this map is the location of Vulture Mine with respect to Wickenburg and Phoenix [1]

1.2 Background Information

Henry Wickenburg discovered Vulture Mine in 1863. Between 1866 and 1931, Vulture Mine became the largest gold mine in Arizona, has had multiple owners, and was operated by eight different companies [2]. The property consists of amalgamation mills, a campsite, cyanide leaching plant, and a concentrating plant. This site was mainly mined by open-cut methods and the mine ore was treated using cyanide leaching and flotation [2]. In 1935 hard-rock mining was discontinued and the cyanide leaching plant and concentrating plant were taken over by D. R. Finlayson and A. B. Peach respectively [2]. Mine tailings from the first operations were washed into a nearby channel south of the mine. Today, there are a few thousand tons of mine tailings that still exist in the wash and may present metal contaminant levels that could be of concern. Mine tailings are the waste effluent from processing ore.

Vulture Mine, the mill facilities, and the first 1/3 of a mile of the wash south of the mine, are on private land. The sampling plan for the PA/SI will only take place on public lands, which will be easy to identify, because the private landowner has clearly marked the boundaries of their property. BLM's

records show there is no current activity, in regards to mining in public lands, so there will be no conflicts with anyone who is trying to stake a claim for mining in these areas.

1.3 Stakeholders

The client for the Vulture Mine Tailing project is the BLM. The team will be working alongside BLM engineers Matt Plis and Bill Harris, as a part of the BLM led CERCLA action. This project also affects the users of BLM land and others who may be at risk from use of this cite. The stakeholders for this project include the BLM along with both the Unites States and Arizona citizens. Many citizens have taken an interest in the safety of their public lands.

1.4 Existing Conditions

The site's known primary contaminants of concerns (COC's) are lead and arsenic. Other COC's may become known upon further investigation. The mine tailing from the site migrated into a wash south of the mine through rain and flooding events. The tailings have been identified from one mile to a mile and a quarter from the cyanide leaching plant. The mine is located on private land and is currently vacant. The wash south of the mine where there appears to be thousands of tons of mine tailings is on public land. The landowner of the mine has clearly staked the boundaries of the private property so no confusion will occur. The Vulture mine is located in an arid climate and has a Sonoran Desert landscape. There is little vegetation and may be home to threatened species such as the desert tortoise, mountain plover, and the WSC California leaf-nosed bat [3]. The various types of vegetation found in the Sonoran Desert includes, Palo Verdes, Mesquite, Desert Ironwood trees, Catclaw, Chollas, and Saguaro cacti. A Google Earth image of the current site can be seen in Figure 2. The red boundary lines shown Figure 2 picture represent the location of the Vulture mine with respect to the surrounding land.

Figure 2: Google Earth image of the Vulture mine [3]

1.5 Technical Consideration

The site must undergo testing in order to determine if the contaminants are above the Arizona soil remediation levels. This project will entail identifying the main COC's, performing a ground screening using X-ray Fluorescent technology, composite grab sampling to characterize the spread of contamination, and evaluation of the ecological and human health risks. The soil samples collected from the site will be analyzed and the results will be used to develop a correlation between the field screenings and the laboratory results, which will then be compared to the Arizona soil remediation levels. The project will require a work plan document, which will include a Health and Safety Plan (HSP) and the Sampling and Analysis Plan (SAP). The PA/SI report will include these documents along with the results and recommendations for the site. Arial photography of the site will also be used in order to help pre-determined boundaries of the contaminants and assist in formulating the sample and analysis plan. Another consideration is investigating the ecological and health risk under various exposure scenarios at the site. Exposure concerns at the site include human, wild life, and vegetation.

1.6 Challenges

Throughout the project, there will be potential challenges that can influence the outcome. Some of these challenges include a 40-hour online HAZWOPER training, along with field and X-ray fluorescence device training. These trainings pose as potential challenges, because they must be completed before any site examination and testing commence. The weather is another challenge this project may encounter. Heavy rains and extreme heat could slow down the sampling process and may potentially ruin any sample that is collected. As this project progresses, more challenges may arise.

2.0 Scopes of Services

This section contains the tasks that will be completed for this project. These tasks are: Project Management, Background Research, Field Activities, PA/SI, and Broader Impacts.

2.1 Task 1: Project Management

The project management task consists of organizing and managing the project by maintaining the schedule. The project management task is divided into four subtasks.

2.1.1 Interaction with client

One team member will be the primary contact between the client and the team. The clients will have the opportunity to review and comment on the team's work. The team will then make the necessary changes to the deliverables based upon the client's comments and recommendations.

2.1.2 Team and technical advisors meetings

Team and technical advisor meetings will be held regularly throughout the project.

2.1.3 Time management

Time management is an essential task for the project to be completed within the given time frame. Time management includes creating a schedule and tracking hours. A schedule for the project will be created in the form of a Gantt chart. The Gantt chart will include the start and end dates of the milestones and tasks. The Gantt chart will be used to keep the project on schedule. In order for the project to be completed within the given time frame each team member will be required to spend a designated amount of time each week working on the project. Each team member will be responsible for logging these hours.

2.1.4 Deliverables

The following is a list of deliverables for the project.

- Final Reports, 50% design report, and a 90% completion design report
  There will be a design report prepared at approximately 50% of the project completion due in the middle of March. The 90% completion design report will be due the first part of April. The final report will include the results of the project and will include the changes based on the recommendations made by the clients and technical advisor. The Final report will be due May 1st.

- Final Presentation
  This is a formal presentation of the results of the project to be given on Friday, April 24.

- Project Website
  A home, document, and project information page must be created for the website. The final proposal document will be displayed on the site. The due date for this deliverable is May 1st.

2.2 Task 2: Background Research

Background research is a crucial component in understanding a project and the expectations that need to be met. The background research for the Vulture Mine Tailing project has been divided into six subtasks, which are listed below.

2.2.1 CERCLA Process

The CERCLA processes provides guidance for performing preliminary assessments and site inspections to help conduct high quality evaluations that will ultimately identify if a site needs further site recommendations or no further action [4]. Research on the CERCLA process will provide the team with essential background information on how the CERCLA process works, what it entails, and why the preliminary assessment and site inspection is necessary.

2.2.2 Elements of Work, Health & Safety, and Sampling & Analysis Plans

Background research will help in providing what the work, health and safety, and sampling and analysis plans contain. These plans will include sampling statistics (number of samples/reproducibility and replicates), which will ultimately serve as Quality Assurance (QA) and Quality Control (QC).

2.2.3 Available Lab Facilities and Standard Test Methods

This project anticipates finding metal contamination within the soil samples; therefore, standard test methods need to be determined before samples are sent to the lab. Research on available lab facilities will provide the team with information on what types of equipment the lab carries, what tests can be done, and the cost of testing.

2.2.4 X-Ray Fluorescence Technology

This project will entail the use of an X-Ray Fluorescence (XRF) device for on-site screening. Background research on XRF devices will inform the team of the science behind this technology and how the use of x-rays can detect elemental properties. Due to the device's ability to use x-rays to conduct screenings, it is crucial for the team to know how to properly use this technology to prevent misuse and serious injury.

2.2.5 Ecological Risk Assessment
Background research will be conducted to determine ecological (environmental) toxicology and risk assessment protocols. Maximum toxicity levels of the contaminants for indicator species, such as the desert tortoise, will also be researched so that contaminant levels found on-site can be compared and evaluated.

2.2.6 Human Health Risk Assessment
Human health risk assessment background research will include the risk assessment process including the contaminant toxicology lethal dose, and identifying exposure scenarios in which humans may come in contact with contamination. Alternative processes such as biokinetic modeling for lead will be investigated along with calculated risk.

2.3 Task 3: Work Plan
The Work Plan details the protocols that will be followed when collecting samples. A Health and Safety Plan, and a Sampling and Analysis Plan will be attached to this document as appendices.

2.3.1 Health Safety Plan (HSP)
The health plan will detail the possible hazards that may be encountered during fieldwork as well as a safety plan to mitigate any risk posed by such hazards. The team will be aware of the potential hazardous concerns. This will include Safety Data Sheets, locations of the nearest hospitals, proper clothing, and any other standards to meet CERCLA. In addition, there are two online field safety courses. These are to be completed before sampling begins.

2.3.2 Sampling and Analysis Plan (SAP)
This plan will detail the sampling and analysis protocols that must be followed when out in the field or in the lab.

I) Sampling Rationale
Approximately 100 soil samples will be collected from the Vulture Mine site. Samples will be taken from all locations of the site using a grid pattern. Soil samples will also be taken from non-contaminated soil from close proximity areas in order to determine the concentration of metals that are found naturally in the soil. Laboratory analysis on the soil samples will determine the target metals.

II) Request for Analysis
The soil samples will be sent to the Northern Arizona University Environmental Analysis Laboratory. The metals will be extracted from the soil samples using water with a pH of 6. Once the metals have been extracted a Flame Atomic Absorption Spectrometer will be used to determine the concentration of different metals in the soil samples.

III) Field Method and Procedures
Field equipment and methods for sampling collection are detailed in this section. The field equipment needed are quart-size re-salable bags, shovels, small garden shovels, XRF technology, masking tape, and writing utensils. The XRF will need to be calibrated before sampling begins and throughout the sampling process. Surface samples will be collected using the garden shovel and placed in the re-salable

bags after being sieved to remove larger particles. The bags will be labeled and the XRF technology will take a reading from the soil sample within the bags. After the soil samples have been collected all equipment used must be decontaminated [6].

IV) Sampling Containers, Preservation, and Storage
Soil samples and mine tailings will be stored and labeled in re-sealable plastic bags. The size of these plastic bags will be quart-size and will be used throughout the duration of the XRF sampling [6].

V) Sample Documentation and Shipment
All of the data that will be collected on site will be documented in logbooks, field notebooks, and on chain-of-custody records [6]. These methods of documentation will be bound, waterproof, and written in black ink. Each sample will be labeled with the following information: sample identifier, date and time of collection, site name, project number, parameters to be measured, preservatives (if any), and sampler's initials [6]. Before shipment can occur, the chain-of-custody must be signed and dated by a team member to verify that the samples indicated on the chain-of-custody record are correct. Once this is done, packing may begin. Once the samples arrive at the laboratory for analysis, the lab technician must sign and date the chain-of-custody to complete the transfer [6]. All of this documentation will be kept in logbooks and field notebooks.

VI) Quality Control
The overall objective of quality control is to develop and utilize procedures that will monitor and assure every aspect of the work, sampling, and analysis that is done for this project is of quality [5]. Quality control will also be used in the following aspects of this project to ensure these aspects reach their full potential of value: assessment of field preservation, assessment of field variability, correlation between XRF and grab samples, and data validation [6].

2.4 Task 4: Preliminary Assessment/Site Inspection (PA/SI)

The PA/SI is the final task of the Vulture Mine Tailing project. This task will follow the CERCLA process. The PA/SI is comprised of the work plan, which includes the health and safety plan along with the sampling and analysis plan. The PA/SI will also include the results of the field data and laboratory analysis, and recommendations, which may or may not propose further CERCLA action.

2.5 Task 5: Broader Impacts

Broader impacts are an important aspect to consider for any project in order to acquire a better understanding of the impacts engineering has in an ecological, environmental, global, and social context [7]. Because the outside world can heavily influence engineering practices, engineers need to have an understanding of these influences and know how to deal with them in order to be successful. Some of the broader impacts this project may encounter are environment/health, social/cultural, global, and political. These broader impacts encompass the health and safety of hikers, bikers, and any other outdoor sports people may partake in, on this site. The health of wildlife, like the desert tortious, will also be considered. As for political and global impacts, the Vulture mine may need campaigning to promote and push the private land owner towards the clean up for this state superfund site, and the wash that the mine tailings have migrated in to, may present a potential impact to nearby communities through the wash's drainage path.

3.0 Project Schedule

A schedule for the project will be created in the form of a Gantt chart. The Gantt chart will include the start and end dates of the milestones and tasks. There are six main tasks and multiple subtasks that are shown in the Gantt chart. The Gantt chart is attached to this document as appendix 1. Each task has a different start and end dates depending on its significance and role it plays in the project. The critical paths for this project (written in red on the Gantt chart) include the completion of the work plan, which encompasses the health and safety plan, sampling and analysis plan, sample testing and analysis, and the PA/SI. The critical path is a crucial element in the progression of this project. It is a means for the team to stay on schedule and to complete tasks before other tasks can begin. Table 1 displays the expected start and end dates for these tasks.

Table 1: Expected Start and End Dates

Task	Start Date	End Date
1.0 Project Management	10/1/14	4/23/15
2.0 Background Research	10/20/14	1/29/15
2.1 CERCLA Process	10/20/14	10/24/14
2.2 Elements of WP, HSP, SAP	10/20/14	11/24/14
2.3 Sampling Test Methods	10/20/14	10/24/14
2.4 Available Lab Facilities	10/25/14	10/31/14
2.5 XRF Technology	10/25/14	10/31/14
2.6 Ecological R.A.	10/25/14	1/29/15
2.7 Human Health R.A.	10/25/14	1/29/15
3.0 Work Plan	11/17/14	1/29/15
3.1 Health and Safety Plan	11/17/14	1/29/15
3.3 Sampling and Analysis Plan	11/17/14	1/29/15
4.0 Field Activities	1/30/15	2/6/15
4.1 Sample Collection	1/30/15	2/1/15
4.2 Sample Testing and Analysis	2/2/15	2/6/15
5.0 Final Deliverable	2/7/15	4/23/15
5.1 50% Completion	3/9/15	3/13/15
5.2 90% Completion	3/16/15	4/3/15
5.3 Final Project Report	4/6/15	5/1/15
5.4 Final Presentation	4/24/15	4/24/15
5.5 PA/SI	1/19/15	5/1/15
6.0 Website	12/2/14	4/22/14

4.0 Cost of Engineering Services

This section discusses the personnel working on this project along with a detailed cost breakdown of the engineering services.

4.1 Staff Title & Positions

At Gold Member Inc., the expected personnel working on the project are the senior engineer, an environmental engineer, and a lab technician. Shown in Table 2 are the different classifications and codes that will represent the position.

Table 2: Staff Title & Positions

Classification	Code
Senior Engineer	SENG
Engineer	ENG
Lab Technician	LAB

4.2 Task Matrix

There are numerous tasks that will make up this projects timeline. The estimated days each task will take to complete are shown below in Table 2. The senior engineer will be going out to the site for sample collection and assist on the final report. The environmental engineer will be the one responsible for the majority of this project, as they will partake in all the tasks listed below. The lab technician is responsible for the analysis of the samples collected.

Table 3: Staff Position Task Duration

Task	SENG days	ENG days	LAB days	
2.1 Project Management				
2.2 Background Research		9		
2.3 Work Plan		5		
2.3.1 Health and Safety Plan		5		
2.3.2 Sampling Plan		5		
I. Sampling Collection	2	2		
II. Lab Analysis		5	5	
2.4 PA/SI	10	44		**Total # of Days**
Subtotal	12	75	5	92

4.3 Cost of Engineering Services

The project costs are broken down into multiple categories. Table 4 provides an overview of expected project cost.

- Personnel hours are based on the expected hours each team member will devote to working on this project.
- Travel includes the cost of travel, hotel accommodations, and per diem. There will be a 2-day visit to the site to collect samples. The distance between Flagstaff and the Vulture Mine is approximately 175 miles and the company charges $0.50 per mile. A Northern Arizona University vehicle will be used for the transportation to the site. There will be three team members who require hotel accommodations and per diem. The site visit will require 2 hotel rooms for the team members to stay during their visit.

- The supplies required for sample collection for this project include 150 Ziploc bags, 3 garden shovels, masking tape, writing utensils, and safety equipment. The safety equipment used when in the field collecting samples include latex gloves, dusk masks, and safety glasses.
- The subcontract for this project includes the lab analysis. The cost for sampling will vary with the type of testing method used. For this project, it will cost $12.75 per sample, which includes testing for four different metals. Before these soil samples can be tested, metal extractions must be done. These extractions will cost $4.00 per sample. The NAU lab facility provides a 75% discount to students who actively participate with the metal extractions and metal concentration testing. The team plans to take approximately 100 samples and participate in the lab work. The bulk of this cost comes from the lab technician's man-hours. The cost for the subcontract found in Table 4 does not reflect the 75% discount.
- The overhead includes supplies, office rent, admiration, and utilities for the Gold Member Incorporated.

Table 4:Cost of Engineering Services

COST ESTIMATE					
	Classification	**Hours**	**Rate $/hr**	**Personnel Cost**	**Cost**
1.0 Personnel	SENG	11*8=88	$114.40	$10,067.20	-
	ENG	66*8/3=178	$52.80	$9,398.40	-
	LAB	5*8=40	$29.92	$1,196.80	-
	Total Personnel				$20,662.40
2.0 Travel	Transportation			$318.75	-
	Hotel			$160.00	-
	Per Diem			$420.00	-
	Total Travel				$898.75
3.0 Subcontract	Analytical				$1,675.00
4.0 Supplies					$155.00
5.0 Overhead					$17,250.00
6.0 Total					**$40,641.15**

The total cost for this project is approximately $41,000. The total cost includes the personnel, travel, lab analysis, supplies, and overhead required in order for Gold Member Incorporated to produce the PA/SI document.

5.0 References

[1] Google Maps: The Vulture Mine – Wickenburg, AZ. Available: [https://maps.google.com/maps?output=classic&dg=brw]

[2] Metzger, O. H. (1938, February). *Gold Mining and Milling in the Wickenburg Area, Maricopa and Yavapai Counties, Ariz.* United States Department of the Interior- Bureau of Mines. Print.

[3] Google Earth: The Vulture Mine- Wickenburg, AZ. Available: [https://www.google.com/earth/] Date Accessed: December 2, 2014

[4] (2011, December). *Environmental Protection Agency* [Online]. Available: [http://www.epa.gov/superfund/policy/cercla.htm] Date Accessed: November 2, 2014.

[5] P. Yamnik. (2011). Biological Review Technical Report Forepaugh industrial Rail Park [online PDF]. Date Acessed: November 25, 2014.

[6] ERM. (2010, March). Final Preliminary Assessment and Focused Site Inspection Work Plan [Online PDF] Date Accessed: November 21, 2014

[7] Bero, Bridget. (2014, November). *Broader Impacts*. [PowerPoint] Date Accessed: December 6, 2014

Appendix 1

	Task Name	Start	Finish
1	**1 Project Management**	**Wed 10/1/14**	**Thu 4/23/15**
2	**2 Background Research**	**Mon 10/20/14**	**Thu 1/29/15**
3	2.1 CERCLA Process	Mon 10/20/14	Fri 10/24/14
4	2.2 Elements of Health and Safety Plan, Work Plan, SAP	Mon 10/20/14	Fri 10/24/14
5	2.3 Sampling Test Methods	Mon 10/20/14	Fri 10/24/14
6	2.4 Available Lab Facilities	Sat 10/25/14	Fri 10/31/14
7	2.5 XRF Technology	Sat 10/25/14	Fri 10/31/14
8	2.6 Ecological Risk Assessment	Sat 10/25/14	Thu 1/29/15
9	2.7 Human Health Risk Assessment	Sat 10/25/14	Thu 1/29/15
10	**3 Work Plan**	**Mon 11/17/14**	**Thu 1/29/15**
11	3.1 Sampling Plan	Mon 11/17/14	Thu 1/29/15
12	3.2 Health and Safety Plan	Mon 11/17/14	Thu 1/29/15
13	**4 Field Activities**	**Fri 1/30/15**	**Fri 2/6/15**
14	4.1 Sample Collection	Fri 1/30/15	Sun 2/1/15
15	4.2 Sample Testing and Analysis	Mon 2/2/15	Fri 2/6/15
16	**5 Final Deliverable**	**Sat 2/7/15**	**Fri 5/1/15**
17	5.1 50% Completion Project Report	Mon 3/9/15	Fri 3/13/15
18	5.2 90% Completion Project Report	Mon 3/16/15	Fri 4/3/15
19	5.3 Final Project Report	Mon 4/6/15	Fri 5/1/15
20	5.4 Final Presentation	Fri 4/24/15	Fri 4/24/15
21	5.5 PA/SI	Mon 1/19/15	Fri 5/1/15
22	**6 Website**	Tue 12/2/14	Wed 4/22/15