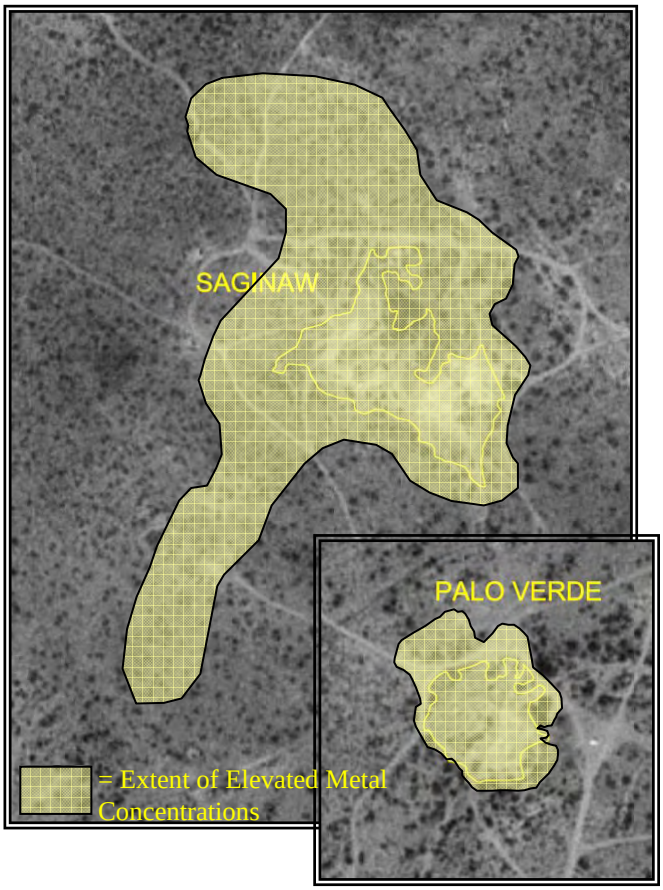
Revised Draft Engineering Evaluation / Cost Analysis (EE/CA)
Saginaw Hill, Pima County, AZ *November 2005*

Purpose of the Report

The Draft EE/CA was submitted in March of 2005. Upon review of the draft report the BLM concluded that further investigation was necessary for a more thorough characterization of the Site, and therefore, additional sampling and research was performed. The results of the extended investigation are presented in the Revised Draft EE/CA.

Source, Nature, and Extent of Contamination

The fieldwork associated with the EE/CA was intended to collect representative waste rock, tailings, and groundwater analytical samples for support in the evaluation of removal action alternatives at the Saginaw and Palo Verde mines. ***Background*** levels were established at the Site and a surrounding soil assessment was performed to determine the extent of elevated metal levels in soils and sediment at a distance from the Site (see figures, right). The results from the ***surrounding soils*** investigation confirmed the expectation that elevated metal levels in surface soils are present. The analyses obtained from the ***arroyo*** running through the Site also indicated elevated levels of arsenic and lead. Onsite ***monitoring wells*** and ***domestic wells*** were sampled in June-August 2005. From this data it can be concluded that groundwater in the vicinity of the Site flows in a west / northwest direction. The results of the groundwater study indicate that groundwater is contaminated within the direct vicinity of the Palo Verde mine (see figure, back); however, at this time, it does not appear that the contaminated water is traveling offsite and impacting any drinking water users (see table, back).



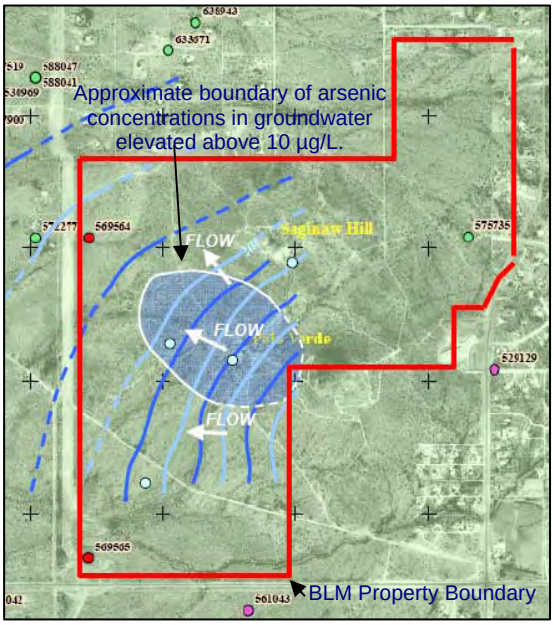
Maximum Concentrations of COCs Observed in XRF and Laboratory Samples						
Soil Criteria	Primary COCs		Secondary COCs			
	Arsenic	Lead	Antimony	Copper	Mercury	Thallium
Site Specific RMC	389	2,000	185	20,863	152	33
Background Levels	30.6	81	2.43	375.3	39.65	ND
BLM Deer Mouse RMC	230	142	NL	640	2	NL
XRF Sampling Results (milligrams per kilogram [mg/kg])						
Waste Source Material Maximum Concentrations						
Palo Verde (PV) Mine	*5,348.27*	*21,373.19*	-	*715.64*	0	-
Saginaw (SH) Mine	*30,426.17*	*49,538.71*	-	*2,3040.48*	0	-
Surrounding Areas Maximum Concentrations						
Arroyo	*1,175.19*	*2,012.72*	-	506.19	*24.54*	-
PV Surrounding Soils	*907.77*	*2,302.52*	-	*798.54*	*18.27*	-
SH Surrounding soils	*2,142.29*	*15,339.24*	-	*8,728.73*	*35.27*	-
Auxiliary Waste Piles	*47,301.04*	*22,295.06*	-	*5,224.85*	*118.72*	-
Laboratory Analysis Results (mg/kg)						
Waste Source Material Maximum Concentrations						
Palo Verde Mine	*3,140*	*111,000*	331	*4,270*	1.8	85.9
Saginaw Mine	*37,400*	*76,100*	238	*24,700*	*15.8*	11.4
Surrounding Areas Maximum Concentrations						
Arroyo	*2,300*	*3,700*	60	510	*1,300*	0.89
PV Surrounding Soils	*1,100*	*2,400*	28	440	*2,600*	0.91
SH Surrounding soils	*2,100*	*4,600*	81	570	*1,300*	1.4
Auxiliary Waste Piles	*45,000*	*25,000*	93	*3,000*	*2,300*	1.6
Overall Maximum	**47,301**	**111,000**	**331**	**24,700**	**2,600**	**85.9**

RMC = Risk Management Criteria
Site Specific RMC = Human Health Risk Criteria for Cleanup
Background Levels = Level of metal naturally occurring in the soil
BLM Deer Mouse RMC = Ecological Risk Criteria

Streamlined Risk Assessment

The purpose of the streamlined risk assessment is to determine whether or not mining activities from the Saginaw Hill Mining District could pose potentially significant human health or ecological risks to current and future receptors. While several chemicals of concern (COCs) are present at the Site, ***arsenic*** and ***lead*** have been identified as primary COCs for waste material at the Palo Verde and Saginaw Mines and surrounding media. Concentrations of these metals in waste material significantly exceed all risk-based guidelines and therefore pose a potential threat to human health and the environment. Secondary COCs include ***antimony***, ***copper***, ***mercury*** and ***thallium***. By developing remediation alternatives for the primary COCs, the secondary COCs will most likely also be removed to acceptable concentrations. The removal criteria for the primary COCs have been selected to meet the human health site-specific cleanup standards. Maximum concentrations of the primary and secondary COCs, in waste material and surrounding media are presented in the table. The

italicized values indicate an exceedance of the ecological risk management criteria (RMC). Green, yellow, and orange cells indicate an exceedance of the human site specific RMC by one, ten, and 100 times, respectively.



Removal Action Objectives

The Removal Action Objectives (RAOs) have been developed based on an analysis of the sources of contamination; the nature and extent of contamination; the results of the human health and ecological risk evaluations; and the applicable or relevant and appropriate requirements (ARARs) that have been identified. The RAOs have been developed to control the contamination sources, and to eliminate the potential for exposure of human and ecological receptors to contamination.

Maximum Concentrations of Arsenic in Groundwater Samples	
Water Criteria Benchmarks	Arsenic
Environmental Protection Agency Primary Drinking Water Maximum Contaminant Level	10
Environmental Protection Agency Secondary Drinking Water Maximum Contaminant Level	NL
Arizona Department of Environmental Quality Maximum Contaminant Level	50*
Monitoring Wells Maximum (µg/L)	**900** T
Domestic Wells Maximum (µg/L)	8.6 B

B = Analyte found in method blank
N L = Not Listed
µg/L = micrograms per liter
bold = exceeds at least one human health criteria
* = This value is likely to change to 10 µg/L
T = Total Metals Sample

Alternatives

Six alternatives have been developed based on the known nature and extent of contamination and the results of the human and ecological risk evaluations. The three general criteria that are used to analyze Removal Action Alternatives in an EE/CA are effectiveness, implementability, and cost.

	Alternative 1: No Action	**Alternative 2**: Removal of Contaminated Surface Materials and Consolidation in On-Site Repository	**Alternative 3**: Removal/Consolidation of Majority of Material and Capping of Remaining Surface Materials	**Alternative 4**: Removal of Contaminated Surface Materials to Off-Site Facility	**Alternative 5**: Groundwater Administrative Action and Long-Term Monitoring	**Alternative 6**: Groundwater Treatment through Precipitation and Optional Immobilized Ligand System
Description	No further action to assess or correct the contamination of any media identified at the Site.	Excavation of all contaminated materials from the surface of the Site and relocation into an engineered repository at the Saginaw Mine.	Excavation of all material from Palo Verde Mine, Auxiliary Waste Piles, and Arroyo; partial removal of material at Saginaw Mine; consolidation in on-site repository; and capping of remaining surface materials	All contaminated surface materials would be excavated and removed to an off-site facility.	An administrative action would be enacted to prohibit the use of groundwater from the Site for human consumption or contact, and groundwater would be monitored.	Construction of a groundwater treatment system at the Site.
Effectiveness	Will not be effective in protecting human health or the environment, will not attain ARARs and will not meet the RAOs.	Will potentially reduce contaminant mobility and receptor exposure by placing waste materials in a secure on-site repository; however, excavated areas will remain exposed before vegetation takes hold and could pose a risk.	Will effectively reduce contaminant mobility and receptor exposure by consolidating or capping the highest risk materials; surrounding areas will also be capped providing a further measure of safety.	Will potentially reduce contaminant mobility and receptor exposure by hauling waste materials offsite; however, excavated areas will remain exposed before vegetation takes hold and could pose a risk.	Provides a method to passively control the groundwater pathway, and reduce the threat of exposure to contaminated groundwater	May be effective in remediating the water directly under Palo Verde; however, underground mineralization is unknown, and high metal concentrations may return.
Implementability	Technically implementable; however, this alternative will not be acceptable as the waste material poses an unacceptable risk to human health and the environment.	Technically feasible based on available literature and using standard methods and procedures.	Technically feasible based on available literature and using standard methods and procedures.	Technically feasible based on available literature and using standard methods and procedures.	Technically feasible; however, monitoring will continue for a long period of time, and future land owners must accept restrictions.	Precipitation / co-precipitation processes for arsenic in water are commercially available and could be implemented at the Site.
	Cost: **$0**	*Cost:* **$1,614,000**	*Cost:* **$1,810,900**	*Cost:* **$13,525,400**	*Cost:* **$475,900**	*Cost:* **$4,650,300**

The recommended removal alternatives for this Site are Alternative 3, as it applies to the surface material, and Alternative 5, as it applies to groundwater. Both recommended alternatives must be implemented to adequately address all contaminated media at the Site. These alternatives are the most appropriate when evaluating them against all other alternatives presented in the table above.

For further information on the abandoned mines site investigations at Saginaw Hill, please contact:
Bureau of Land Management
Tucson Field Office
12661 E. Broadway
Tucson, AZ 85748
Telephone: 520-258-7200

Revised Draft Engineering Evaluation / Cost Analysis (EE/CA) Questions and Answers *November 2005*

#1 **Q:** Where can I access the Revised Draft EE/CA in its entirety?

A: The Revised Draft EE/CA will be made available to the public on November 14, 2005. Copies of the EE/CA can be found at the BLM field office and Tucson-Pima Public Library Southwest Branch located at 6855 W. Mark Road. The phone number for the library is (520) 791-4009 and the hours of operation are as follows: Mondays 10 am to 6 pm, Tuesdays and Wednesdays 12 pm to 8 pm, Thursdays 9 am to 6 pm, Fridays 10 am to 5 pm, and Saturdays 9 am to 5 pm. The library is closed on Sundays.

#2 **Q:** Were the additional surrounding soil characterization activities successful?

A: Yes - The surrounding materials investigation provided a more accurate boundary of the extent of concentrations of high metals in soils and sediment. The metals may have been transported from the mine sites or are naturally occurring as a result of leaching from surrounding bedrock.

#3 **Q:** Where has groundwater contamination spread, and to what extent?

A: The results of the groundwater study indicate that groundwater is contaminated within the direct vicinity of the Site. It was determined that groundwater in the vicinity of the Site flows in a west / northwest direction; however, at this time, it does not appear that the contaminated water is traveling offsite and impacting any drinking water users.

#4 **Q:** Are there any immediate threats to human health or the environment?
What steps have been taken to eliminate exposure?

A: During the site investigations, two additional waste piles were discovered. The BLM immediately fenced and signed the areas to prevent access, and in turn, exposure to the waste in these auxiliary piles. All other areas where it is believed that contaminated materials exist have also been fenced.

#5 **Q:** What are the health effects of lead and/or arsenic exposure?
For persons who have reason to believe that they have been exposed to contaminated materials what steps should be taken?

A: Arsenic exposure can cause irritation of the stomach and intestines, decreased production of red and white blood cells, skin changes, and lung irritation. Arsenic is also a known human carcinogen, meaning that it may cause cancer.
Lead exposure may cause a variety of health effects, even at lose dose levels. The organs targeted by lead are the gastrointestinal tract, central nervous system, kidneys, blood, and gingival tissue. Children six years old and younger are at the greatest risk to the effects of lead exposure.

For a full explanation of the human health effects of both the primary and secondary chemicals of concern please refer to the EE/CA document or contact the Pima County health department.

If you, or someone you know, is concerned that a significant exposure to contaminated materials has taken place, please contact the Pima County Health Department for more information.

#6 Q: What will be the criteria for removal of contaminated materials?

A: Arsenic and lead have been identified as primary chemicals of concern (COCs) for waste material at the Site. The removal action criteria for arsenic has been set at 389 mg/kg, and the criteria for lead has been set at 2,000 mg/kg. Secondary COCs include antimony, copper, mercury, and thallium. While specific risk management criteria have also been set for these contaminants, it is expected that the secondary constituents will most likely be removed to an acceptable concentration as a consequence of cleanup of the waste to the criteria set forth for the primary COCs.

#7 Q: If the residential standard for arsenic in soil is 10 mg/kg, why is 389 mg/kg used?

A: The residential standard assumes that exposure to the contaminated material occurs on a daily basis over many years, as would be expected in a residential area. The site-specific clean up level has been determined assuming that the potential receptors, or site visitors, are using the site for recreational purposes only. Therefore, the exposure frequency used in calculating the site-specific level is 52 days per year. This frequency assumes recreational use of the site at a rate of one visit per week for an entire year. Additional exposure assumptions were used in calculating this value; please refer to the EE/CA document for a full discussion of how this number was reached.

#8 Q: What are ARARs? How are they applied to the selection of a clean up solution?

A: ARARs are Applicable or Relevant and Appropriate Requirements of all environmental laws that pertain to CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act) removal actions. Applicable requirements are requirements, criteria, or limitations governed under Federal or State environmental laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, etc. Relevant and appropriate requirements are requirements, criteria, or limitations that, while not "applicable," address problems or situations sufficiently similar to those encountered at the Site. A list of ARARs can be found in the EE/CA document and are organized into three categories: action-specific, chemical-specific, and location-specific.

#9 Q: Why is Alternative 3 preferred to Alternatives 2 and 4 for addressing surface materials?

A: In Alternative 3, not only is all of the waste consolidated in a repository, but the surface from which material is excavated and the surrounding soil with high concentrations of metals is covered with a crushed rock cap. The cap will provide a barrier between any residual contamination and human or ecological contact. Alternatives 2 and 4 do not include a crushed rock barrier after removal. There is a possibility that surface soil containing high concentrations of metals may still remain after a top layer is removed. Additionally, both Alternatives 2 and 4 would leave a large scar on the natural landscape of the area and revegetation efforts could be a lengthy process.

#10 Q: Why was an alternative that does not actively treat groundwater contamination chosen?

A: A great deal is still unknown about the groundwater contamination plume; however, long term monitoring will assist in further characterization. In the preferred alternative addressing groundwater, long term monitoring will keep track of the severity and migration of groundwater contamination. Currently, no receptors are exposed to the elevated levels of arsenic observed in the groundwater under the Site. If it is determined through monitoring results that treatment is necessary, remediation technologies can be implemented at that time. Even if treatment was applied at this time, the levels of arsenic could simply return as soon as treatment concluded.

#11 Q: What is the timeline for cleanup of the Site?

A: The BLM has determined that a non-time-critical removal action is appropriate. Removal would commence within six to twelve months following approval of the removal design. It is estimated that any removal action undertaken can be completed within one year, provided that funding is available.

#12 Q: What will the Site look like after these removal actions have taken place?

A: As crushed rock will be used to cap much of the areas surrounding the mines, one can expect a surface made up of gravel-sized rock in a layer approximately 6 inches thick. The portions of the Site that will not experience excavation or construction will be left in their natural state.

#13 Q: Can the Site be used during and after construction?

A: Portions of the Site will be closed during construction to prevent exposure to contaminated materials and to provide a safe and efficient working environment for the construction crews. After the removal action is completed, access to the remediated portions of the property will remain limited.

#14 Q: What is the planned future use of the Site?

A: At this time, BLM plans to turn the land over to Pima County for use as a park.

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