U.S. Army Corps of Engineers®
Los Angeles District

June 2016

Draft

Lone Star Ore Body Development Project Environmental Impact Statement

Cooperating Agencies:

United States Environmental Protection Agency

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, U.S. ARMY CORPS OF ENGINEERS
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PHOENIX, ARIZONA 85012-1939

June 9, 2016

Draft Environmental Impact Statement

Lone Star Ore Body Development Project, Graham County, Arizona
File No. SPL-2011-01005-MWL

REGULATORY DIVISION

Dear Reader:

Enclosed for your review is the draft environmental impact statement (EIS) for the Lone Star Ore Body Development project. This document describes the environmental effects associated with issuance of a permit by the U.S. Army Corps of Engineers (Corps) under Section 404 of the Clean Water Act (CWA) to allow development of the mineral resources associated with the Lone Star ore body (the Project), located on lands owned and managed by Freeport McMoRan Safford, Inc. (FMSI), and adjacent to their existing copper mining operations in Safford, Arizona. Development of these mineral resources would require several common components of an open-pit copper mine including development rock stockpiles, a heap leach stockpile, additional conveyance route infrastructure, additional power distribution infrastructure, an expanded compactible soil borrow source, and additional stormwater management facilities, in addition to the open pit itself. FMSI applied for a permit from the U.S. Army Corps of Engineers, Los Angeles District (Corps) to allow the discharge of dredged or fill materials into Waters of the U.S. during the mining process, pursuant to Section 404 of the CWA.

The U.S. Army Corps of Engineers (Corps) is the lead agency in the preparation of this draft EIS and now invites Federal agencies, State and local governments, Native American Tribes, interested organizations, and the public to comment on this draft EIS. Comments stating concerns, issues, suggestions, or any other information that are presented relating to this document will be used to guide the preparation of the final EIS and Record of Decision (ROD). Comments received in response to this solicitation, including names and addresses of those who comment, will become part of the public record for this project.

The comment period will extend for 45 days from the publication of the Notice of Availability of the draft EIS in the *Federal Register*, and comments must be received by the Corps no later than July 25, 2016. It is important that you clearly articulate your concerns and contentions, and include your name, address, telephone number, your organization, and "Lone Star Ore Body Draft EIS" and the file number (SPL-2014-00065-MWL) in the subject line of your comments.

Please address written comments to Michael Langley, Senior Project Manager, at the U.S. Army Corps of Engineers, Arizona-Nevada Office, 3636 N. Central Avenue, Suite 900, Phoenix, Arizona 85012-1939; telephone (602) 230-6953 or email comments to: Michael.W.Langley@usace.army.mil.

During the 45-day public review period, the Corps will host a public meeting to solicit comments on this draft EIS. This meeting will be conducted on the evening of **June 28, 2016**, at the Manor House Convention Center, 415 E. U.S. Highway 70, Safford, Arizona, 85546. The meeting will be scheduled for 6:00 p.m. to 9:00 p.m.; a presentation will be provided by the Corps starting at 6:30 pm, followed by an opportunity to provide oral comments for the record.

Thank you for your interest in this project.

Sincerely,

Michael W. Langley
Senior Project Manager

DRAFT ENVIRONMENTAL IMPACT STATEMENT
LONE STAR ORE BODY DEVELOPMENT PROJECT

Lead Agency:	Department of the Army U.S. Army Corps of Engineers, Los Angeles District Regulatory Division, Arizona Branch
Project Location:	Safford, Arizona
Comments on this EIS Should be Directed to:	Mr. Michael W. Langley, Senior Project Manager U.S. Army Corps of Engineers, Los Angeles District Regulatory Division, Arizona Branch 3636 North Central Avenue, Suite 900 Phoenix, Arizona 85012-1939 (602) 230-6953
Date Draft EIS Filed with USEPA:	June 2, 2016
Date by Which Comments Must Be Received by the Corps:	July 25, 2016

ABSTRACT

The U.S. Army Corps of Engineers (Corps), Los Angeles District, as lead federal agency, is preparing this Environmental Impact Statement (EIS) to analyze the potential impacts related to the discharge of fill to jurisdictional waters of the United States (U.S.). The impacts to waters of the U.S. would occur as part of the development of the copper mine associated with the Lone Star Ore Body Development Project, located on lands owned and managed by Freeport-McMoRan Safford Inc. adjacent to existing copper mining operations in Safford, Arizona. The Corps has determined that issuance of a Section 404 permit under the Clean Water Act is required and would constitute a major federal action that could significantly affect the quality of the human and natural environment. The EIS is being prepared in compliance with the National Environmental Policy Act of 1969 (NEPA), the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] 1500-1508), and the Corps Procedures for Implementing NEPA (33 CFR 230).

The EIS considers the potential environmental impacts of constructing several components of an open-pit copper mine including development rock stockpiles, a heap leach stockpile, additional conveyance route infrastructure, additional power distribution infrastructure, an expanded compactible soil borrow source, and additional stormwater management facilities, in addition to the open pit. A related non-mining component of this project under consideration is the establishment of a compensatory mitigation site along the Gila River.

Executive Summary

ES1.1 Introduction and Background

Freeport-McMoRan Safford Inc. (FMSI) has proposed the development of the mineral resources associated with the Lone Star Ore Body Development Project (Project), located on lands owned and managed by FMSI, and adjacent to their existing copper mining operations in Safford, Arizona (see **Figure ES-1**). Development of these mineral resources would require several common components of an open-pit copper mine including development rock stockpiles, a heap leach stockpile, additional conveyance route infrastructure, additional power distribution infrastructure, an expanded compactible soil borrow source, and additional stormwater management facilities, in addition to the open pit itself. The Project would require the discharge of fill to jurisdictional waters of the United States (U.S.). FMSI applied for a permit from the U.S. Army Corps of Engineers, Los Angeles District (Corps) to allow the discharge of dredged or fill materials into waters of the U.S. during the mining process, pursuant to Section 404 of the Clean Water Act (CWA).

The Corps has determined that the proposed Project could significantly affect the quality of the human and natural environment, and that the Corps' permitting decision would constitute a major federal action. Based on these determinations, this Environmental Impact Statement (EIS) has been prepared pursuant to: (1) Section 102(2)(c) of the National Environmental Policy Act (NEPA) of 1969 (42 United States Code [USC] 4321 et seq.); (2) the Council on Environmental Quality (CEQ) regulations for implementing the procedural provisions of NEPA (40 Code of Federal Regulations [CFR] 1500 – 1508); (3) Section 404 of the CWA on permitting disposal sites for dredged or fill material (33 USC 1344), as amended; (4) Corps regulations found at 33 CFR 320 – 332, including Appendix B, NEPA Implementation Procedures for the Regulatory Program; and (5) South Pacific Division's Regulatory Program Standard Operating Procedures for Preparing and Coordinating EISs.

Located in eastern Arizona, the Safford Mine Facility has been in operation since 2007 under the ownership of FMSI, formerly Phelps Dodge Safford Inc. FMSI owns and manages approximately 36,050 acres of privately held lands within and surrounding the existing Safford Mine Facility, north of the City of Safford, Graham County, Arizona. This privately held 36,050 acres encompasses the area referred to in this EIS as the Project Area.

The Safford Mine Facility is located on lands that have been used for mining activities by various entities for more than a century. The predecessors to FMSI first began development of an underground copper mine block caving demonstration project in the region in the 1960s, and later purchased other copper mining properties in the vicinity. Between 1994 and 1996, FMSI initiated discussions to obtain authorization from the Bureau of Land Management (BLM) and the Corps to expand their copper mining operations and convert public lands within the Safford Mine Facility to private land through a land exchange process. In May 1996, FMSI formally initiated NEPA review of these proposals through submission of a Mine Plan of Operations to the BLM. The impacts of this project, termed the Dos Pobres/San Juan Project after the ore bodies proposed for development, were disclosed in the Final EIS in December 2003 (BLM 2003). The BLM Record of Decision (ROD) was published in June 2004, which approved the Mine Plan of Operations and the land exchange. Because the land exchange was approved, the Mine Plan of Operations approved by the BLM is no longer required or in effect.

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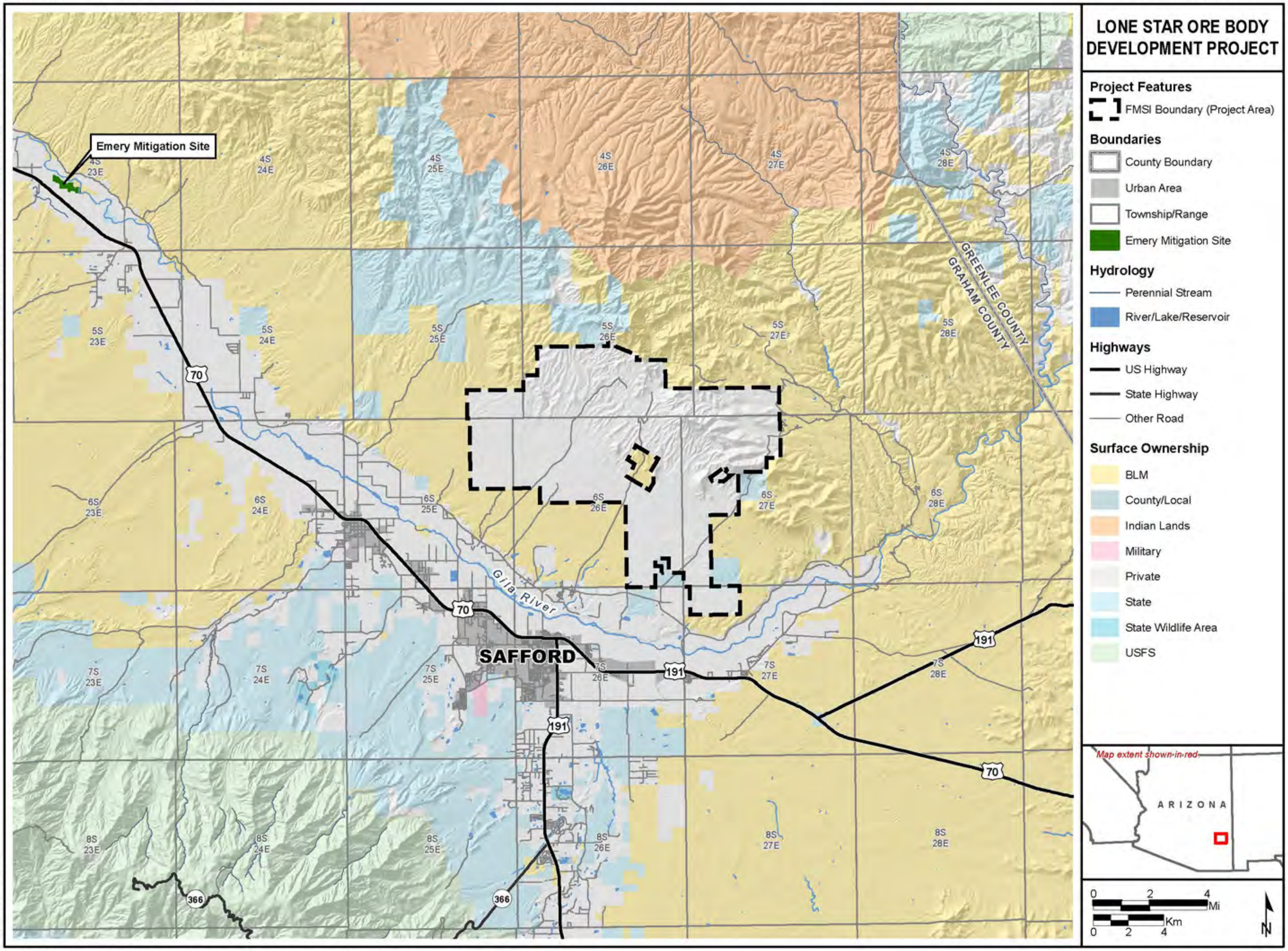

Date: 3/18/2016

Figure ES-1 General Location Map of Project

ES1.2 Corps Purpose and Need for the Action

In accordance with NEPA (40 CFR 1502.13), the Corps must specify the underlying purpose and need for the proposed Project. The purpose and need establish the framework for identifying the range of alternatives to be evaluated in the EIS. In addition to defining the purpose of the proposed project pursuant to NEPA, the statement of purpose also is used by the Corps to evaluate the proposed discharge of dredged or fill material into waters of the U.S. for compliance with the CWA Section 404(b)(1) guidelines (40 CFR 230).

FMSI is currently operating a copper mining and extraction operation at the Safford Mine Facility that is focused on the Dos Pobres and San Juan ore deposits. Because the Dos Pobres and San Juan pits are nearing the end of their anticipated life-of-mine timeframe, and because FMSI has identified and evaluated the additional ore resources of the Lone Star ore body in close proximity to current operations, FMSI has a need for new mine facilities that would allow operations to shift seamlessly from the diminishing ore resources to the new ore resource.

To meet this need, the purpose of this proposed project is the construction of mining facilities that will allow continued mining at the Safford Mine through the development of the mineral resources associated with the Lone Star ore body using conventional open-pit mining and heap leaching techniques, utilizing as much of the existing Safford Mine facilities as practicable to produce copper.

ES1.3 Coordination and Consultation

ES1.3.1 Public Participation and Scoping

Public participation for the EIS began with the scoping process. The Corps initiated the scoping process by publishing the Notice of Intent to prepare the EIS in the Federal Register on January 5, 2015. The Corps published four newspaper display advertisements providing information on the public scoping meeting. Ads were published in the Apache Messenger and Eastern Arizona Courier on January 21, and 28, 2015.

The Corps hosted one scoping meeting on February 4, 2015, in Safford, Arizona. The meeting provided an opportunity for the Corps to inform those in attendance about the Proposed Action and alternatives and the EIS process and to solicit input on the scope of the analysis and potential issues. Informational display stations positioned around the meeting room described the project and environmental resources in the Project Area, and outlined the CWA Permitting and NEPA processes scoping process, described the type of comments most useful to the Corps, and provided methods and deadlines for comment submittal. Technical experts from the Corps and FMSI were present to answer questions about the project.

At the end of the comment period, the scoping comments were compiled and analyzed to identify key issues and concerns. Some of the scoping comments were eliminated from consideration in the EIS because they addressed issues outside of the scope of the NEPA analyses, or the comment stated an opinion rather than a substantive comment that could be addressed in the EIS. A Scoping Summary Report was prepared and posted to the Corps' public website for the EIS.

ES1.3.2 Consultation and Coordination with Federal and State Agencies

Specific regulations require the Corps to coordinate and consult with federal and state agencies about the potential for a proposed project and alternatives to affect sensitive environmental and human resources. For the EIS, the Corps initiated these coordination and consultation activities through the scoping process. In addition, the Corps invited interested agencies to serve as cooperating agencies for preparation of the EIS. The U.S. Environmental Protection Agency (USEPA) is serving as a cooperating agency.

ES1.3.3 Tribal Government-to-Government Consultation

In compliance with the National Historic Preservation Act and Corps Policy Guidance Letter No. 57 (Indian Sovereignty and Government-to-Government Relations with Indian Tribes), the Corps is required to establish regular and meaningful consultation and collaboration with Native American tribal governments on development of regulatory policies that could significantly or uniquely affect their communities. As such, the Corps has initiated consultation with Native American tribes via a letter, sent May 22, 2015, informing them of the proposed project and inviting comments.

ES1.4 Alternatives Analyzed in Detail

Alternatives that meet the purpose and need for the action are analyzed in the EIS. There are other alternatives that were considered but eliminated from detailed analysis described in detail in Chapter 2.0. Following is a brief summary of the alternatives that were analyzed.

ES1.4.1 Alternative 1, Proposed Action

The Proposed Action (Alternative 1) is composed of the heap leach pad, development rock stockpiles, and conveyance route, plus additional infrastructure. Direct impacts to waters of the U.S. from implementation of the Proposed Action would total approximately 90 acres.

The Proposed Action would include developing an open pit to allow FMSI to recover approximately 785 million tons of leachable copper ore over a period of approximately 27 years. The location of the Lone Star Pit is limited to the physical location of the mineral resource. The design of the pit includes a 1,000-foot setback to accommodate the potential future mining of sulfide ore located beneath the leachable ore body. The surface footprint of the pit would be approximately 645 acres and has an estimated maximum depth of 2,000 feet. Through time, a pit lake is expected to develop in the Lone Star Pit after mining is completed.

A 1-billion-ton lined heap leach pad would be constructed southwest of the existing heap leach pad access. The heap leach pad would be constructed to achieve a final overall slope of no greater than 2.5 feet horizontal to 1 foot vertical. The final design height of the heap leach pad would be 400 feet, with an overall design footprint of approximately 2,466 acres. The heap leach pad would be constructed with a liner system to contain fluids such as the pregnant leach solution (PLS) from the leach process and precipitation falling on the pad, while keeping precipitation and stormwater away from the pad using berms and diversion channels.

Three development rock stockpiles would be constructed around the Lone Star Pit to the northeast, southeast, and southwest. The overall footprint of the three stockpiles would be approximately 2,518 acres. The combined capacity of the three stockpiles is approximately 1.7 billion tons: 969 million tons in the northeast stockpile, 535 million tons in the southeast stockpile, and 162 million tons in the southwest stockpile.

A haul road surfaced with run-of-mine materials would be constructed from the main haul road east and south of the existing heap leach pad to transport construction materials from the Lone Star Pit. Two 62-acre-foot (af) lined Process Solution Impoundments (PSIs)and one 930-af lined Non-Stormwater Impoundments (NSIs) would be constructed at the southeast corner of the new heap leach pad. The containment pond would be designed to impound stormwater runoff from the heap leach pad during a 100-year/24-hour storm event.

A lined raffinate delivery pipe corridor would be constructed to recycle barren solution from the existing raffinate storage tanks after processing to the new heap leach pad, a lined PLS collection pipe corridor would be constructed to transport solution from the new PSIs to the existing processing facilities. A laydown yard for the storage of construction equipment, materials, and operating supplies would be located immediately adjacent to the PSIs and NSIs, southwest of the new heap leach pad.

The existing overland conveyor on the west edge of the existing heap leach pad would be extended to the southwest, along the southeastern edge of the new heap leach pad. The lined overland conveyor would bring leach materials from the existing crushing facility and drum agglomerators to the new heap leach pad, where the material would be stacked using portable conveyors and a radial stacking system.

Roads for the movement of large equipment would be located on either side of the overland conveyor and along the northeastern and southeastern edges of the new heap leach pad. Light equipment roads would be located on the southwestern and northwestern edges of the heap leach pad. Although new crossings of the existing access road would be required for the haul road and overland conveyor corridor, the existing security gate and access road to the mine administration buildings would be utilized under this alternative.

Development of this alternative would necessitate the construction of three diversions to manage stormwater near the heap leach pad. Stormwater would be diverted northwest into a tributary of Butler Wash and east to a tributary of Talley Wash. The Proposed Action would continue the use of many existing ore processing facilities, the majority of the infrastructure for the current heap leach pad, and the mine access road. New power distribution infrastructure required for the Proposed Action would consist of a transmission line from the existing 69-kilovolt (kV) powerline to the Lone Star Pit.

The project proposes the expansion of the existing clay borrow pit within the Project Area by approximately 48 acres, for a total footprint of approximately 144 acres. A soil and growth medium stockpile area of approximately 86 acres would be located immediately south of the clay borrow pit. Access to the clay borrow pit would be from the existing Clay Haul road.

Additional stormwater management facilities required by the proposed project elements include stormwater containment dams downgradient of the development rock stockpiles. Other structures to be constructed include a truck service complex and a communications tower with an access road.

To compensate for the loss of aquatic resources that would occur under this alternative, a Conceptual Mitigation Plan has been developed consistent with the Corps' 2008 Mitigation Rule and the South Pacific Division Regulatory Program Standard Operating Procedure for Determination of Mitigation Ratios (12501-SPD). The plan describes the activities that would occur at the Emery Mitigation Site, which is located on the Gila River approximately 25 miles downstream from the Project Area. The Emery Mitigation Site, totaling approximately 109 acres, is divided into three areas identified as A, B, and C based on function and purpose. Area A is the riparian restoration area, approximately 69 acres; Area B is the tamarisk control and riparian enhancement area, approximately 10 acres; Area C is the buffer preservation area, approximately 30 acres. All of the areas would be protected through a conservation easement or restrictive covenant to ensure long-term maintenance of the mitigation objectives.

ES1.4.2 Alternative 2

Alternative 2 would utilize all of the same project components as the Proposed Action, with the exception of the heap leach stockpile. The design of the heap leach stockpile would be similar; however, the location would be rotated compared to the Proposed Action to maximize avoidance of potential waters of the U.S. With the different layout of the heap leach pad, there would be differences in the layout and design of the diversions that would intercept stormwater upgradient of the pad. The overall design footprint of the heap leach pad would be approximately 6,216 acres; 76 acres larger than under the Proposed Action. Impacts to potential waters of the U.S. would total approximately 76 acres.

Compensatory mitigation would be required if this alternative is implemented and would likely be very similar to the mitigation described above for Alternative 1. The amount of mitigation required would likely be less because impacts are less under this alternative.

ES1.4.3 No Action Alternative

Under the No Action Alternative, the Corps would not issue a Section 404 permit for Lone Star operations and none of the proposed mine construction, operations, reclamation, or committed compensatory mitigation activities would occur. Under this scenario, FMSI would not be issued a permit to fill waters of the U.S. associated with mining the Lone Star ore body. Following completion of mining the Dos Pobres and San Juan pits, some existing structures would remain in place following reclamation. Remaining structures would include the closed and revegetated leach pad, development rock stockpiles, selected roads, the mine pits, fencing, and the stormwater diversions.

ES1.4.4 Environmental Protection Measures

A variety of environmental protection measures and control practices have been incorporated into the project design of the action alternatives to meet applicable standards, including those of regulatory agencies such as the ADEQ, U.S. Environmental Protection Agency (USEPA), the Arizona State Mine Inspectors Office, and the Corps. Additionally, there are environmental measures and practices implemented by Safford Operations in the Project Area that would expand to include the Lone Star project.

ES1.5 Summary of Impacts

Table ES-1 summarizes the potential impacts for each resource that would be affected by the implementation of the Proposed Action and Alternative 2.

Table ES-1 Summary of Acres Disturbed and Waters of the U.S. Affected

Alternative	Surface Disturbance (acres)	Waters of the U.S. Affected (acres)
Alternative 1, Proposed Action		
Lone Star Pit	645	0
Heap Leach Pad	2,466	60.4
Development Rock Stockpiles	2,605	27.04
Conveyance Route	285	2.99
Clay Borrow Pit Expansion	48	0
Soil and Growth Medium Stockpile	86	0
Communications Tower and Road	0.29	0
Power Distribution Infrastructure	5	0
Total	**6,140**	**90.43**
Alternative 2		
Lone Star Pit	645	0
Heap Leach Pad	2,542	46.17
Development Rock Stockpile	2,605	27.04
Conveyance Route	285	2.99
Clay Borrow Pit Expansion	48	0
Soil and Growth Medium Stockpile	86	0

Table ES-1 Summary of Acres Disturbed and Waters of the U.S. Affected

Alternative	Surface Disturbance (acres)	Waters of the U.S. Affected (acres)
Communications Tower and Road	0.29	0
Power Distribution Infrastructure	5	0
Total	**6,216**	**76.2**

Source: WestLand 2016a.

Table ES-2 summarizes the potential impacts for each resource that would be affected by the implementation of the action alternatives and the No Action Alternative. The construction, operation, closure, and final reclamation activities and mine components of the proposed project were evaluated for each of the resources that would be affected. This table summarizes the analysis of impacts discussed in Chapter 3.0. Analysis of impacts assumes compliance with federal and state laws and permit requirements.

Table ES-2 Summary of Direct and Indirect Environmental Impacts

Resources Affected	No Action	Alternative 1, Proposed Action	Alternative 2
Geology	No impacts to geologic resources from mining operations would occur.	Geological impacts from mining operations would remove the overburden (e.g., Gila Volcanics), and copper ore from the Lone Star Pit.	Same as Alternative 1
Minerals	No impacts to mineral resources from mining operations would occur.	Mineral resource impacts from permanent extraction of copper ore, relocation of development rock at the Lone Star Pit, and permanent extraction of clay from the borrow pit. By the end, the mine would permanently extract approximately 785 million tons of leachable copper oxide and sulfide ores, and relocation of approximately 1.7 billion tons of development rock.	Same as Alternative 1
Topography	No impacts to topography from mining operations would occur.	Topography impacts from mining the Lone Star Pit would result in a 645-acre pit that would be stabilized and remain after site reclamation.	Same as Alternative 1

Table ES-2 Summary of Direct and Indirect Environmental Impacts

Resources Affected	No Action	Alternative 1, Proposed Action	Alternative 2
Groundwater Quantity	Based on modelling, groundwater contributions to the Gila River would be reduced by approximately 54 acre-feet per year (af/yr) through groundwater pumping and pit lake evaporation, which is less than 0.08 percent of the estimated base flow of the Gila River. The maximum reduction to groundwater quantity is predicted to occur at 105 years after pumping began.	Based on modelling, groundwater contributions to the Gila River would be predicted to decrease by a maximum of approximately 58 af/yr at 82 years after pumping began in 2006 due to groundwater extraction for mine use and the pit lake effects. This flow reduction would be offset by the fallowing program implemented by FMSI. There would be a decline of 500 feet in the Graben Aquifer and the water table under the Lone Star Pit would decline approximately 250 feet. Modelled groundwater contributions to Bonita Creek would decrease by less than 1.3 af/yr at the peak impact 300 years after mining began in 2006, with no drawdown of the water table. There would be no measureable decline in the Holocene Aquifer.	Same as Alternative 1
Groundwater Quality	Contamination of groundwater would be avoided through operation of the proposed zero-discharge system of water management, and through adherence to the SPCC Plan and APP Program. The potential for contamination would exist until the current mining operations are reclaimed and closure plans are implemented.	Contamination of groundwater would be avoided through operation of the proposed zero-discharge system of water management, and through adherence to the SPCC Plan and APP Program. The potential for contamination would be limited but would continue until the Lone Star mining operations are reclaimed and closure plans are implemented.	Same as Alternative 1.

Table ES-2 Summary of Direct and Indirect Environmental Impacts

Resources Affected	No Action	Alternative 1, Proposed Action	Alternative 2
Surface Water Quantity	The existing hydrologic patterns would remain in place even after mine reclamation and closure.	There would be increased flows (compared to current conditions) in Talley Wash because of the diversion above the heap leach pad directing flow away from portions of Watson and Butler/Coyote washes. All other affected drainages' stormflows would decrease in stormflows compared to the existing condition. The runoff patterns would be permanently affected.	Similar to Alternative 1 except Watson Wash would have increased stormflows compared to current conditions. All other affected drainages' stormflows would decrease.
Surface Water Quality	Surface water quality would continue to be affected by the past changes to the runoff patterns, existing upland disturbance outside the "zero-discharge" areas, and continue to have the risk of accidental releases of hazardous materials from mining operations. The runoff patterns would be permanently affected, while the upland disturbance and accidental release risk would remain until final closure of the existing mining and processing facilities occurred.	Water quality would be affected by the new changes to the runoff patterns, existing upland disturbance outside the "zero-discharge" areas, and continue to have the risk of accidental releases of hazardous materials from mining operations over a longer period of time, compared to the No Action Alternative. Other potential impacts to surface water quality would include increased sediment loads and increased risk of accidental releases of hazardous materials reaching surface water resources. These risks would be minimized by implementation of the SWPPP and the SPCC Plan.	Same as Alternative 1
Waters of the U.S., Wetlands, Riparian Areas	No new mine-related impacts to waters of the U.S. or riparian habitat in the Project Area would occur.	90 acres of waters of the U.S. would be adversely affected under Alternative 1. Loss of waters of the U.S. would be compensated by the mitigation to be implemented at the Emery Mitigation Site.	76 acres of waters of the U.S. would be impacted under Alternative 2. Loss of waters of the U.S. would be compensated by the mitigation to be implemented at the Emery Mitigation Site.

Table ES-2 Summary of Direct and Indirect Environmental Impacts

Resources Affected	No Action	Alternative 1, Proposed Action	Alternative 2
Soils	No new mine-related impacts to soil resources.	Approximately 6,140 acres of new disturbance to soils resulting in long-term impacts to soil productivity. Temporary surface disturbance would occur at the Emery Mitigation Site.	Approximately 6,216 acres of new disturbance to soils. Fewer impacts to hydric soils would occur (compared to Alternative 1) due to the different orientation of the heap leach pad. Temporary surface disturbance would occur at the Emery Mitigation Site.
Vegetation	No new mine-related impacts to vegetation resources.	There would be 6,140 acres of direct impacts to 7 of the 8 vegetation communities within the Project Area. Non-native riparian vegetation would be modified and replaced with native plants at the Emery Mitigation Site. There would be no adverse impacts to special status plant species.	Alternative 2 is expected to result in direct impacts to 6,216 acres of the same vegetation communities as the Proposed Action. Non-native riparian vegetation would be modified and replaced with native plants at the Emery Mitigation Site. There would be no adverse impacts to special status plant species.

Table ES-2 Summary of Direct and Indirect Environmental Impacts

Resources Affected	No Action	Alternative 1, Proposed Action	Alternative 2
General Wildlife	No impacts	Temporary and permanent losses or alteration of suitable habitat. Habitat fragmentation caused by the installation of the new conveyance route and associated haul and access roads. Mortality of some less mobile or burrowing nongame species (e.g., small mammals, nesting birds, and reptiles) as a result of crushing from vehicles and construction equipment. The short-term displacement of the more mobile species (e.g., medium-sized mammals, adult birds) as a result of surface disturbance activities. Raptors that nest close to construction locations would be likely to abandon their breeding territory or nest site, or may experience the loss of eggs or young, as a result of surface disturbance activities during construction. Riparian habitat would be enhanced through mitigation at the Emery Mitigation Site.	Similar to Alternative 1

Table ES-2 Summary of Direct and Indirect Environmental Impacts

Resources Affected	No Action	Alternative 1, Proposed Action	Alternative 2
Special Status Wildlife Species	No impacts	No adverse effects to special status wildlife species are anticipated due to the small amount of direct impacts to vegetation communities within the Project Area (less than 10 percent of the analysis area). There would be temporary impacts to habitat for the southwestern willow flycatcher and yellow-billed cuckoo at the Emery Mitigation Site, but the habitat would benefit over the long term due to proposed enhancements.	Similar to Alternative 1
Aquatic Resources	No impacts	Construction and proposed facilities in the Project Area would remove or modify riparian habitat along several ephemeral drainages but adverse impacts to aquatic biota (when present) would be considered minor. Earthmoving at the Emery Mitigation Site would remove riparian vegetation serving as aquatic habitat and may increase sedimentation, but the impacts would be temporary, lasting until disturbed areas are stabilized.	Impacts to aquatic habitat and species would be less than but similar to Alternative 1.
Special Status Aquatic Species	No impacts	No adverse impacts to federally listed aquatic species or critical habitat in the Gila River or Bonita Creek, such as the razorback sucker and Chiricahua leopard frog would result from the Proposed Action.	Same as Alternative 1

Table ES-2 Summary of Direct and Indirect Environmental Impacts

Resources Affected	No Action	Alternative 1, Proposed Action	Alternative 2
Cultural Resources	No impacts	Of the 25 cultural sites within the Area of Potential Effect (APE), 20 have been determined or are recommended eligible for the National Register of Historic Places (NRHP); 16 of these have already been mitigated. Compliance with federal and state regulations for the protection of cultural resources would minimize or eliminate adverse effects to eligible or unevaluated sites.	Of the 25 cultural sites within the APE, 16 have been determined or are recommended eligible for the NRHP; 17 of these have already been mitigated. Compliance with federal and state regulations for the protection of cultural resources would minimize or eliminate adverse effects to eligible or unevaluated sites.
Native American Concerns	No impacts	No impacts	No impacts
Air Quality	No new mine related impacts. Emissions from current operations would still occur.	The estimated maximum predicted total ambient concentrations resulting from implementation of the Proposed Action are all below the applicable Ambient Air Quality Standard (AAQS) for all pollutants and averaging periods.	Same as Alternative 1
Climate Change	No new mine related impacts. There would be 484,191 tons per year (tpy) (439,251 metric tpy) carbon dioxide equivalent (CO_2e) from facility-wide emissions under current operations.	The Project's estimated contribution to greenhouse gas (GHG) emissions, which can contribute to global climate change, is 592,032 tpy (537,082 metric tpy) under future operations. Emissions from construction at the Emery Mitigation Site would temporarily contribute to GHG emissions.	Same as Alternative 1
Transportation	Initially no change from existing levels and then a decrease in traffic levels on the regional road network as mining related traffic would decrease and ultimately end within 5 years.	Construction activity would require 200 additional contractors, resulting in an additional 308 daily vehicle trips per day and 24 additional daily truck trips for an estimated total construction traffic increase of 332 daily round-trips, an increase of 24 percent greater than existing levels.	Similar to Alternative 1 except there would be increases in storm water flow to Watson Wash due to diversions. This could affect the integrity of Safford Bryce Road where it is intersected by Watson Wash.

Table ES-2 Summary of Direct and Indirect Environmental Impacts

Resources Affected	No Action	Alternative 1, Proposed Action	Alternative 2
Land Use	No impacts to land use.	23,600 acres leased for grazing by FMSI would be reduced to 5,200 acres	Same as Alternative 1
Aesthetics and Visual Resources	Initially no change from existing levels and then a decrease in lighting as mining related traffic would decrease and ultimately end within 5 years.	Key Observation Point (KOP) A: The heap leach pad, development rock stockpiles, haul roads and alternations to ridgelines would be visible. Of these the heap leach pad would be the most prominent. KOP B: Impacts would be similar to those of KOP A, except the heap leach pad would appear less prominent. KOP C: Unobstructed middleground views of the development rock stockpiles and altered ridgelines. Site lighting may be faintly visible at night. KOP D: KOP C would have unobstructed middleground views of the development rock stockpiles and altered ridgelines. Site lighting may be faintly visible at night.	Similar to Alternative 1

Table ES-2 Summary of Direct and Indirect Environmental Impacts

Resources Affected	No Action	Alternative 1, Proposed Action	Alternative 2
Noise and Vibration	Initially no change from existing levels and then a decrease in noise as mining related traffic would decrease and ultimately end within 5 years.	Estimated noise and vibration levels at the nearest sensitive receptor, approximately 10 miles southeast of the San Juan Pit and 6 miles southeast of the area of potential future Lone Star operations, are estimated to be 86 linear decibels (dBL) and 0.016 peak particle velocity (PPV). These levels are well below Office of Surface Mining Reclamation and Enforcement (OSMRE) limits for annoyance, assuming the larger maximum charge of 2,000 pounds	Same as Alternative 1
Hazardous Materials	Initially no change from existing levels and then a decrease in traffic levels on the regional road network as mining related traffic would decrease and ultimately end within 5 years.	The small quantities of hazardous waste that would be generated and transported combined with the low probability of accidental release and likelihood of rapid cleanup in compliance with the SPCC Plan would result in a low risk to the human and natural environment.	Similar to Alternative 1.
Public Health and Safety	Under the No Action Alternative, typical mining-related effects identified for water quality, air quality, noise, and lighting would cease within 5 years. This would result in a decrease in public health and safety impacts, as mining activities would decrease and ultimately end within 5 years.	Stormwater diversions would result in increased flows during runoff events in Talley Wash, which could create increased erosion and channel instability effects in these drainages, resulting in increased sediment transport downstream. No adverse public health effects from air quality, noise, or light effects are anticipated.	Similar to Alternative 1, except stormflow diversions would result in increased flows in Watson Wash, compared to current conditions, which may cause elevated levels of erosion and channel instability and migration. Water quality impacts would include sedimentation effects would be expected downstream from the diversions that increase flows.

Table ES-2 Summary of Direct and Indirect Environmental Impacts

Resources Affected	No Action	Alternative 1, Proposed Action	Alternative 2
Socioeconomics	A decrease in population, employment, income, and demand for housing, and public schools and utilities would be expected.	An increase in population, employment, personal income, public finances would be expected. Also the demand for housing, utilities, schools, and emergency response and medical would increase.	Same as Alternative 1
Environmental Justice	As closure activities commence there would be a reduction in employment opportunities, income, as well as local and state tax receipts.	The project would continue to generate income within the affected counties and communities, potentially benefiting minority communities and low-income populations.	Same as Alternative 1

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Acronyms and Abbreviations

°F	degrees Fahrenheit
$\mu g/m^3$	micrograms per cubic meter
3M Program	Model, Monitor, and Mitigate Program
AAC	Arizona Administrative Code
AAQS	Ambient Air Quality Standards
ac-ft	acre-feet
ADEQ	Arizona Department of Environmental Quality
ADOC	Arizona Department of Commerce
ADOT	Arizona Department of Transportation
ADWR	Arizona Department of Water Resources
af	acre-foot
af-yr	acre-feet per year
AGFD	Arizona Game and Fish Department
amsl	above mean sea level
APE	Area of Potential Effect
APLIC	Avian Power Line Interaction Committee
APP	Aquifer Protection Permit
AQRV	air quality related value
ARNI	Aquatic resource of national importance
ARS	Arizona Revised Statutes
AZPDES	Arizona Pollutant Discharge Elimination System
BADCT	Best Available Demonstrated Control Technology
BCC	Birds of Conservation Concern
BLM	Bureau of Land Management
BMP	Best Management Practice
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CESA	Cumulative effects study area
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CH_4	methane
cm/sec	centimeters per second

CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
Corps	U.S. Army Corps of Engineers
CWA	Clean Water Act
dBL	linear decibels
DP/SJ Project	Dos Pobres/San Juan Project
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
EW	Electrowinning
FLM	Federal Land Manager
FMSI	Freeport-McMoRan Safford Inc.
GHG	greenhouse gas
gpm	gallons per minute
H_2SO_4	sulfuric acid
H:V	Horizontal:vertical
HAP	hazardous air pollutant
HDPE	High density polyethylene
HNO_3	nitric acid
HUC	Hydrologic Unit Code
I-10	Interstate 10
IDA	International Dark-sky Association
IPCC	Intergovernmental Panel on Climate Change
km	kilometer
KOP	key observation point
kV	kilovolt
LBF	Lower Basin Fill
LEDPA	least environmentally damaging practicable alternative
LOM	life-of-mine
LOS	level of service
MACT	Maximum Achievable Control Technology
MBTA	Migratory Bird Treaty Act
mg/L	milligrams per liter
MLRA	Major Land Resource Area
MSGP	Multi Sector General Permit

MSHA	Mine Safety and Health Administration
NAAQS	National Ambient Air Quality Standards
NCA	National Conservation Area
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NH_4	ammonium
NHPA	National Historic Preservation Act of 1966, as amended
NO_2	nitrogen dioxide
NO_3	nitrate
NO_X	nitrogen oxides
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSI	Non-Stormwater Impoundment
NSPS	New Source Performance Standards
NWP	Nationwide Permit
O_3	ozone
OSMRE	Office of Surface Mining Reclamation and Enforcement
Pb	lead
PILT	payments in lieu of taxes
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less
ppb	parts per billion
ppm	parts per million
PPV	peak particle velocity
Project	Lone Star Ore Body Development Project
PSD	Prevention of Significant Deterioration
PSI	Process Solution Impoundment
RCRA	Resource Conservation and Recovery Act
RFFA	Reasonably foreseeable future action
RNCA	Riparian National Conservation Area
ROD	Record of Decision
SGCN	Species of greatest conservation need
SO_2	sulfur dioxide
SO_4	sulfate

SPCC Plan	Spill Prevention, Control, and Countermeasure Plan
SPD	South Pacific Division of the Corps of Engineers
SWPPP	Stormwater Pollution Prevention Plan
SWReGAP	Southwest Regional Gap Analysis Program
SX	Solution extraction
SX/EW	solution extraction/electrowinning
TCP	traditional cultural property
TDS	Total dissolved solids
TMDL	Total maximum daily load
tpy	tons per year
TSDF	treatment, storage, or disposal facility
U.S.	United States
UBF	Upper Basin Fill
USC	United States Code
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VAU	visual assessment units
VOC	volatile organic compound
WestLand	WestLand Resources, Inc.
WRCC	Western Regional Climate Center

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1.0 Introduction

Freeport-McMoRan Safford Inc. (FMSI) has proposed the development of the mineral resources associated with the Lone Star Ore Body Development Project (the project), located on lands owned and managed by FMSI, and adjacent to their existing copper mining operations in Safford, Arizona (see **Figure 1-1**). Development of these mineral resources would require several common components of an open-pit copper mine including development rock stockpiles, a heap leach stockpile, additional conveyance route infrastructure, additional power distribution infrastructure, an expanded compactible soil borrow source, and additional stormwater management facilities, in addition to the open pit itself. A related non-mining component of this project is the establishment of a compensatory mitigation site, which will be evaluated as part of this project. The proposed project would require the discharge of fill to jurisdictional waters of the United States (U.S.). FMSI applied for a permit from the U.S. Army Corps of Engineers, Los Angeles District (Corps) to allow the discharge of dredged or fill materials into waters of the U.S. during the mining process, pursuant to Section 404 of the Clean Water Act (CWA).

The Corps has determined that issuance of a permit for the proposed project would constitute a major federal action that could significantly affect the quality of the human and natural environment. Based on these determinations, this Environmental Impact Statement (EIS) has been prepared pursuant to: 1) Section 102(2)(c) of the National Environmental Policy Act (NEPA) of 1969 (42 United States Code [USC] 4321 et seq.); 2) the Council on Environmental Quality (CEQ) regulations for implementing the procedural provisions of NEPA (40 Code of Federal Regulations [CFR] 1500-1508); 3) Section 404 of the CWA on permitting disposal sites for dredged or fill material (33 USC 1344), as amended; 4) Corps regulations found at 33 CFR 320–332, including Appendix B, NEPA Implementation Procedures for the Regulatory Program; and 5) South Pacific Division's Regulatory Program Standard Operating Procedures for Preparing and Coordinating EISs.

A primary purpose of a Corps' regulatory program EIS is to provide full and fair disclosure to inform agency decision makers and the public of the potential environmental effects of the proposed federal action, or reasonable alternatives. An EIS is not a regulatory decision document. It is used by agency officials, in conjunction with other relevant information in a permit application file, to inform the final decision on a permit issuance.

1.1 Project Area Setting and Background

1.1.1 Project Area Location and General Description

Located in eastern Arizona, the Safford Mine Facility has been in operation since 2007 under the ownership of FMSI, formerly Phelps Dodge Safford Inc. FMSI owns and manages approximately 36,050 acres of privately held lands within and surrounding the existing Safford Mine Facility, north of the City of Safford, Graham County, Arizona. This privately held 36,050 acres encompasses the area referred to in this EIS as the Project Area.

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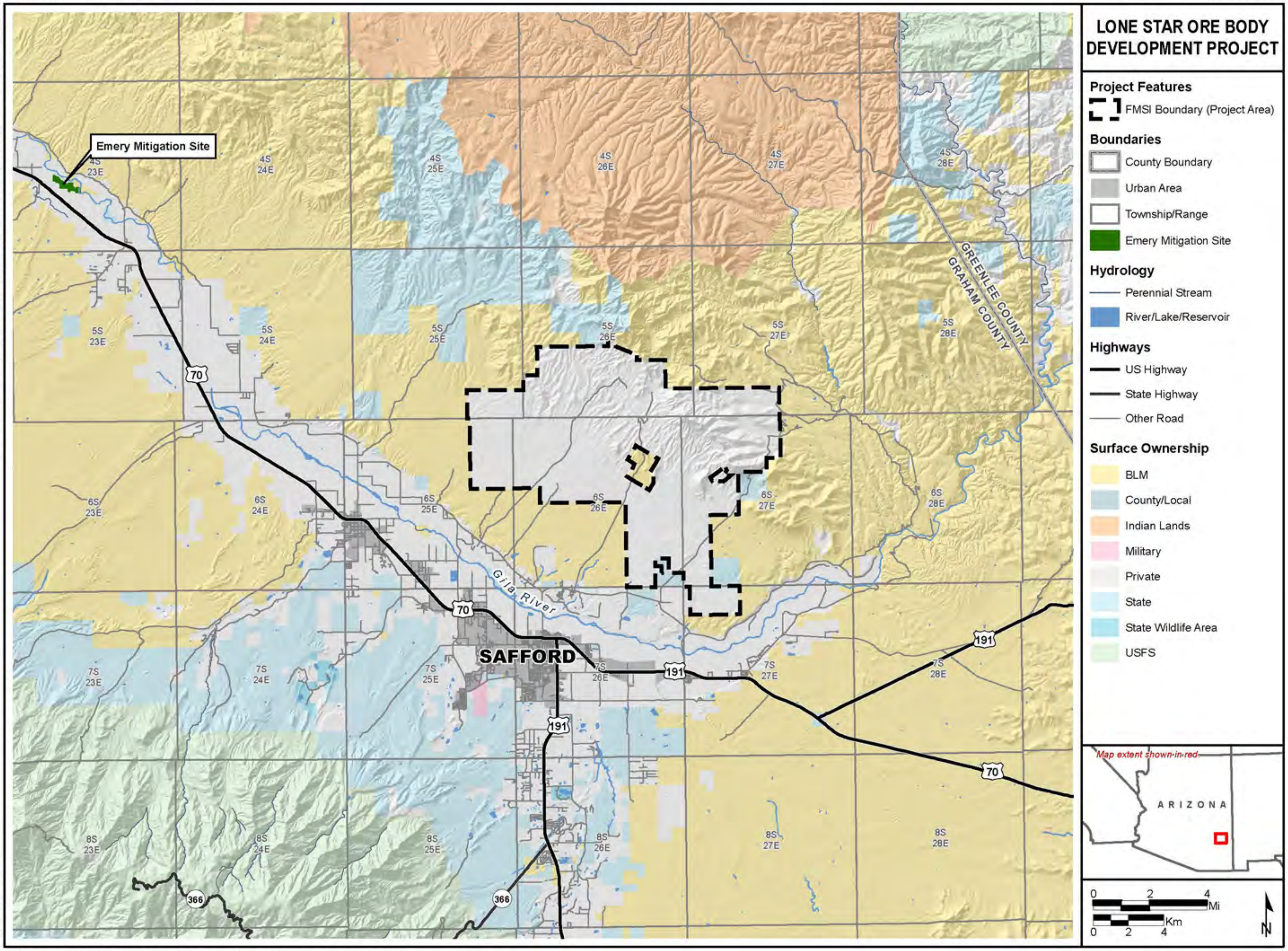

Figure 1-1 General Location Map of Project

The Safford Mine Facility is located on lands that have been used for mining activities by various entities for more than a century. The predecessors to FMSI first began development of an underground copper mine block caving demonstration project in the region in the 1960s, and later purchased other copper mining properties in the vicinity. Between 1994 and 1996, FMSI initiated discussions to obtain authorization from the Bureau of Land Management (BLM) and the Corps to expand their copper mining operations and convert public lands within the Safford Mine Facility to private land through a land exchange process. In May 1996, FMSI formally initiated NEPA review of these proposals through submission of a Mine Plan of Operations to the BLM. The impacts of this project, termed the Dos Pobres/San Juan Project after the ore bodies proposed for development, were disclosed in the Final EIS in December 2003 (BLM 2003). The BLM Record of Decision (ROD) was published in June 2004, which approved the Mine Plan of Operations and the land exchange. Because the land exchange was approved, the Mine Plan of Operations approved by the BLM is no longer required or in effect.

As a cooperating agency for the project, the Corps issued a Section 404 Individual Permit on September 27, 2004 (No. SPL-1996-4020200-MB) to authorize fill on and indirect impacts to 114.6 acres of waters of the U.S. resulting from development of the Dos Pobres/San Juan Project.

1.1.2 Existing Operations

The Safford Mine Facility is currently an open-pit copper mining operation consisting of two pits: the Dos Pobres Pit and the San Juan Pit. Each of the pits has an associated development rock stockpile: immediately west of the Dos Pobres Pit, and immediately south of the San Juan Pit. A clay borrow pit is located in the southeastern portion of the Mine Facility.

Mineral resources from both the Dos Pobres and San Juan pits are hauled by truck to the crushing plant within the Safford Mine Facility. Crushed materials are transported by conveyor to drum agglomerators, where they are mixed with sulfuric acid and water to a moisture content of 6 to 8 percent. Agglomerated ore is transported to the heap leach pad on a series of belt conveyors and placed using a radial stacker. Each lift placed on the heap leach pad is typically between 15 feet and 22 feet in height and is placed at a setback to the previous lift. An acidic solution called raffinate is applied to the stockpile. The solution percolates through the stockpile, dissolving copper minerals in the rock. After percolating through the stockpile, the pregnant leach solution (PLS) from the heap leach pad drains to collection ponds and is transported to the solution extraction/electrowinning (SX/EW) processing facilities southwest of the heap leach pad for recovery of the copper in solution. The existing Safford Mine annual production is approximately 140 million pounds of saleable copper through the mining of leachable oxide and sulfide ores. The life-of-mine (LOM) for the recovery of leachable oxide and sulfide ores from the Dos Pobres and San Juan pits was originally estimated to be approximately 16 years (BLM 2003).

1.2 Purpose of and Need for Action

In accordance with NEPA (40 CFR 1502.13), the Corps must “specify the underlying purpose and need to which the agency is responding.” The purpose and need establish the framework for identifying the range of alternatives to be evaluated in the EIS. In evaluating a 404 permit application, the Corps must evaluate the proposed discharge of dredged or fill material into waters of the U.S. for compliance with the 404(b)(1) guidelines (40 CFR 230). This 404(b)(1) report is provided as **Appendix A** of this EIS. A critical part of this compliance with Corps NEPA guidance (12509-SPD [South Pacific Division]) is identifying the basic purpose for the applicant’s project as well as the purpose and need from the Corps’ perspective.

The basic purpose for the action must be identified first to determine whether the proposed discharge is water-dependent as defined by Corps guidelines. In this case, the basic purpose is copper mining, which is not water-dependent because it does not require siting in or near special aquatic sites (such as wetlands). When a project is not water-dependent, practicable alternatives that do not involve special aquatic sites are presumed to be available, unless clearly demonstrated otherwise. Analysis of alternatives to the proposed action must be assessed within the 404(b)(1) context according to Corps guidelines, as documented in **Appendix A**. Alternatives that meet the project purpose and have been determined to be practicable are brought forward for detailed analysis as part of the required NEPA document, this EIS in the case of this proposed project.

FMSI is currently operating a copper mining and extraction operation at their Safford Mine Facility that is focused on the Dos Pobres and San Juan ore deposits. Because the Dos Pobres and San Juan pits are nearing the end of their anticipated LOM timeframe, FMSI has identified and evaluated additional ore resources (the Lone Star ore body) in close proximity to current operations. FMSI has a need for new mine elements at the Safford Mine Facility that would allow operations to readily move to the Lone Star ore body.

To meet this need, FMSI's purpose for this proposed project is to construct mining facilities, including development rock stockpiles and a heap leach pad, to allow for continued mining at the Safford Mine Facility through the development of the mineral resources associated with the Lone Star ore body using as much of the existing Safford Mine elements as practicable to produce copper.

1.3 Decision to Be Made

The Corps' decision is whether to issue or deny the permit to discharge fill into waters of the U.S. under Section 404 of the CWA, and if issued, to identify the terms and conditions of the permit. The decision will be based in part on an evaluation of the potential impacts, including cumulative impacts, of the proposed project on the natural and human environment.

1.4 Environmental Permits, Approvals, and Authorizations

FMSI submitted a preliminary application to the Corps on June 3, 2014, for a permit under Section 404 of the CWA and to the ADEQ for water quality certification under Section 401 of the CWA. The permit and certification would authorize FMSI to discharge fill material into waters of the U.S. in association with the construction and operation of the proposed Lone Star Mine. The application provides information on the facilities to be constructed for the proposed project and the types of materials to be discharged. Other permits and approvals required for FMSI to conduct mining operations at the proposed Lone Star Pit are described in this section following a description of the authorizations related to and incorporated into the NEPA analysis and subsequent Corps decision.

No federal, state, or local land use policies, plans, or programs regulating development of the proposed permit area have been identified.

The Corps must determine whether to issue a permit for the proposed project activities. In order to do so, the Corps will undertake the following actions.

Prepare Draft EIS and Final EIS—Based on information provided by FMSI, the Corps determined that the issuance of a permit under Section 404 of the CWA for the proposed project has the potential to significantly affect the quality of the human environment and warrants the preparation of an EIS. Under NEPA, a Draft EIS and Final EIS are required. These documents disclose potential impacts associated with the issuance of a Section 404 permit and a range of alternatives. The Corps will obtain public and agency input on the Draft EIS to create a final document. The Corps will consider the potential impacts and recommended mitigation measures disclosed in the Final EIS to inform its permit decision.

Prepare a ROD—The Corps will prepare a ROD documenting the agency's findings and stating whether the permit is denied or granted, based on the following findings.

- <u>Determine Compliance with 404(b)(1) Guidelines</u>: The Corps' Section 404(b)(1) alternatives evaluation (WestLand 2015d) is provided in **Appendix A**. The Corps' evaluation of the proposed project will result in four determinations that conclude whether the proposed project complies with the 404(b)(1) guidelines. The Corps can only issue a permit for a project that is the least environmentally damaging practicable alternative. The remaining determinations establish whether other applicable laws would be violated, whether the discharge would cause or contribute to the degradation of waters of the U.S., and whether steps have been taken to minimize potential impacts.

- Conduct a Public Interest Review: The Corps will evaluate FMSI's proposal against the public interest factors (33 CFR 320.4[a]). The importance of each factor and how much weight given are unique to each proposal. The Corps establishes the weight of each factor by its relevance to the proposal. Weighing these factors allows the Corps to determine whether the proposed project is in the public interest. In addition to evaluation of the public interest factors, the Corps must consider the extent of the public/private need for the proposal, the practicability of using reasonable alternative locations and methods if there are unresolved conflicts as to resource use, and the extent and permanence of the beneficial or detrimental effects of the proposal.

If the decision is to deny the permit, discharge of fill material into waters of the U.S. would not be allowed. If the decision is to issue a permit, the permit would describe the project and any terms and special conditions for implementation. If the decision is to issue a permit, FMSI would be given the opportunity to review the permit and conditions and decide whether to accept all terms and conditions, or to appeal the decision.

As part of the CWA Section 404 permit, a mitigation plan is prepared in accordance with the Corps' and USEPA 2008 Mitigation Rule (33 CFR 332 and 40 CFR 230). A Conceptual Mitigation Plan has been prepared to describe FMSI's proposed mitigation (**Appendix B**). FMSI has coordinated with the Corps to identify potential mitigation opportunities for the proposed project. Following review and approval by the Corps of the concepts contained in this conceptual plan, a Final Mitigation Plan will be completed.

The Safford Mine Facility currently operates under a number of state and federal permits. In addition to a Corps permit, many of the existing permits would require modification and/or reissuance to authorize the proposed project. **Table 1-1** lists permits and authorizations currently anticipated for the Lone Star Ore Body Development Project.

Table 1-1 Federal and State Permits and Authorizations Required for the Lone Star Project

Agency	Permit/Authorization	Status
Corps	CWA Section 404 Permit	New
Arizona Department of Environmental Quality (ADEQ)	CWA Section 401 State Water quality Certification	New
ADEQ	Arizona Pollutant Discharge Elimination System (AZPDES)	Modified
Arizona State Mine Inspector (ASMI)	Arizona Mined Lands Reclamation Act – Reclamation Plan	Modified
Arizona Department of Water Resources (ADWR)	Well Drilling Permits	New
ADEQ	Underground Storage Tank Exemption Certificate	Modified
ADEQ	Aquifer Protection Permit (APP)	Modified
ADEQ	Clean Air Act – Class II Air Quality Permit	Modified
United States Department of Transportation (USDOT)	Hazardous Materials Certificate of Registration	No Change
ADEQ	Resource Conservation and Recovery Act (RCRA) Identification Number	No Change

Table 1-1 Federal and State Permits and Authorizations Required for the Lone Star Project

Agency	Permit/Authorization	Status
ADEQ	Open Burning Permit	No Change
ADEQ	Construction Authorization for Construction of an On-site Wastewater Treatment Facility	New
ADEQ	Domestic Water System Permit	No Change
ADEQ	Outdoor Used Tire Site Registration	No Change

Source: FMSI 2015.

1.5 Scope and Focus of the Environmental Impact Statement

The scope of analysis for the Corps' Regulatory Program has two distinct elements: determining 1) the areas directly or indirectly affected by the federal action; and 2) how to evaluate direct, indirect, and cumulative environmental effects. For the purposes of NEPA, the scope of the analysis is limited to the specific activity requiring a Corps permit and any additional portions of the entire project over which there is sufficient federal control and responsibility to warrant review. In establishing the scope of analysis, the Corps must consider four basic factors to determine the extent of federal control and responsibility over a project (33 CFR 325, Appendix B). The following is a discussion of these four factors with respect to the proposed project.

- *Whether the regulated activity comprises 'merely a link' in a corridor-type project*. The regulated activity in this case is a mining operation that requires placement of fill within waters of the U.S. This is not a corridor type project and this is not part of a series of projects being evaluated; thus, the Corps would not extend the scope of its EIS analysis beyond waters of the U.S impact footprints based on this factor.
- *Whether there are aspects of the upland facility in the immediate vicinity of the regulated activity that affect the location and configuration of the regulated activity.* To develop the Lone Star ore body for copper mining and production, FMSI has identified a number of new elements that are required. In addition, existing facilities (ore processing facilities, clay borrow pit, roads, etc.) currently in place in support of operations at the Dos Pobres/San Juan pits would continue to be used for the new Lone Star Pit. Because some of the new required elements would impact waters of the U.S, and because the project elements are all required to accomplish the project purpose, the scope of analysis has been expanded to include the proposed project as a whole, except for existing facilities that support ongoing mining activities. These facilities were evaluated under the previous 404 permit and associated EIS. It would not be appropriate to evaluate only the impact footprints to waters of the U.S because those footprints are part of a larger component footprint and cannot be independently evaluated. The proposed heap leach pad, for example, is a large project feature and impact footprints to waters of the U.S. cannot be separated from the larger heap leach pad footprint. In addition, each of the project elements is dependent on the other elements; thus the scope of analysis has been established as the total project footprint for the new facilities as a whole.
- *The extent to which the entire project will be within Corps jurisdiction.* The project elements would impact a considerable amount of waters of the U.S. As indicated above, because of the interdependent nature of the water of the U.S. impact footprints with the project elements individually and collectively, the scope of analysis must be extended to include the physical extent of all new project elements.
- *The extent of cumulative federal control and responsibility*. In addition to the Corps' jurisdiction under the CWA, the Corps and the Advisory Council for Historic Preservation have responsibilities under the National Historic Preservation Act. The U.S. Fish and Wildlife Service

has responsibilities under the Endangered Species Act and Migratory Bird Treaty Act. These three federal agencies have cumulative control and responsibility over the project footprint as a whole for direct, indirect, and cumulative impacts under these federal laws.

The scope of analysis for the Section 404 permit application under consideration is established as the physical extent of new project elements associated with proposed project, including those that do not directly impact waters of the U.S. Existing mine facilities that would continue to operate as part of the proposed project are not included within the scope of analysis, but would be evaluated as part of the baseline conditions and be included in the cumulative analysis. One non-mining related component that is included in the scope of analysis is the establishment of an offsite compensatory mitigation site.

The Corps must consider the direct, indirect, and cumulative effects of the proposed project (40 CFR 1508.8). Direct effects are those impacts that are caused by the action and occur at the same time and place. Indirect effects are those impacts caused by the action that take place later in time or farther removed in distance. Cumulative effects are those that would be caused by implementation of the proposed project in combination with other past, present, and future actions. The analysis areas for each resource are described in the resource subsections of Chapter 3.0, Affected Environment. For some resources, such as geology and mineral resources, the geographic scope is limited to mined areas within the Project Area. For other resource areas, such as socioeconomic conditions, the analysis area encompasses a broader area such as the local communities.

1.6 Public Involvement

There are a number of potential issues that were identified through public scoping comments during the 45-day period following publication of the Notice of Intent to prepare an EIS on January 5, 2015, in the Federal Register (Vol. 80, No. 2, pages 212 to 213). A total of 172 comments from 14 submittals were identified. Most of the comments related to water resources, wildlife, vegetation, cultural resources, and the NEPA process. These issues identified during public scoping have been taken into account where appropriate in Chapters 2.0 and 3.0 of this EIS. More detail on the public scoping process and public comments can be found in the External Scoping Summary Report, dated March 2015, prepared for the Corps. It can be downloaded from the Corps of Engineers, Los Angeles District website (http://www.spl.usace.army.mil/Missions/Regulatory/ProjectsPrograms.aspx).

1.7 Organization of the EIS

This EIS follows the basic format guidelines provided by the CEQ at Section 1502 of Title 40 of the Code of Federal Regulations (40 CFR 1502). The EIS is presented in two volumes to facilitate simultaneous review of text and figures. Volume 1 includes five chapters and front and back matter; Volume 2 includes figures and appendices. The Table of Contents identifies the key sections and subsections within each of the five chapters. A brief summary of the content of each chapter is provided below.

Chapter 1.0, Introduction, summarizes the Project's history, identifies the Project's purpose and need, describes the decisions to be made by the Corps, and the regulatory framework that guides those decisions.

Chapter 2.0, Alternatives Including the Proposed Action, describes the alternatives that are analyzed in detail (i.e., Proposed Action, Alternative 1, and No Action); provides a comparative summary of the environmental impacts of the alternatives; and identifies alternatives considered but not analyzed in detail.

Chapter 3.0, Affected Environment and Environmental Consequences, describes the existing environment of the resources that would potentially be affected by the alternatives analyzed in detail, This section describes the baseline conditions for determining the potential effects of the alternatives. The Environmental Consequences sections under each resource heading analyze the direct, indirect, and cumulative impacts of the Proposed Action and its alternatives on the existing environment. This chapter provides the analyses for the summary table of impacts provided in Chapter 2.0.

Chapter 4.0, Consultation and Coordination, summarizes the efforts of the agencies to inform the public, including federal, state, and local agencies, and to involve them in the analysis of the Project's impacts.

Chapter 5.0, List of Preparers, identifies those persons primarily responsible for contributing to the preparation of this EIS and lists their qualifications.

Other sections include References, Glossary, Index, and Appendices.

2.0 Alternatives Including the Proposed Action

2.1 Introduction

This chapter discusses the alternatives, including the No Action Alternative, for development of the proposed project. This chapter also describes a variety of alternatives that have been considered by the Corps and were rejected as infeasible for one or more reasons including environmental, technological, and economic considerations. These rejected alternatives, including the rationale for their consideration or elimination from consideration in this EIS, as applicable, are discussed in detail in Section 2.4 of this chapter.

2.2 Identification and Evaluation of Project Alternatives

To comply with NEPA, a detailed analysis of reasonable alternatives to the proposed project is required so that their comparative merits may be considered by agency decision makers (40 CFR 1502.14[b]). The NEPA alternatives evaluation must meet the purpose and need statement and must include the applicant's proposed project as described in their Section 404 permit application, the No Action Alternative, and other potential reasonable alternatives. In general, the range of reasonable alternatives that should be considered may include alternative sites, alternative project configurations, alternative technologies, and alternative project sizes.

To determine the alternatives that would be evaluated in detail in this EIS, an alternatives analysis was conducted as required under CWA, Section 404(b)(1) guidelines (40 CFR 230) (**Appendix A**). To evaluate a range of alternatives to the proposed project described in FMSI's 404 permit application, alternatives were evaluated for practicability. An alternative was considered practicable if it is available and capable of being implemented after taking into consideration cost, existing technology, and logistics in light of the overall project purpose (40 CFR 230.10[a][2]). Alternatives that were assessed as practicable were brought forward for detailed analysis in this EIS. Those alternatives not meeting this standard were eliminated from further consideration. Because the Corps can only issue a permit for a project that is the least environmentally damaging practicable alternative (LEDPA), this EIS will be used to compare the practicable alternatives identified in the 404(b)(1) alternatives analysis and support a final determination with respect to identifying a LEDPA.

In summary, the following analysis criteria were used to determine which alternatives would be subject to detailed analysis in this EIS:

- The alternative meets the purpose and need for the project (see Section 1.2).
- The alternative is technically feasible within the project timeframe.
- The alternative is determined to be practicable in the Section 404(b)(1) alternatives analysis.

Table 2-1 summarizes the project elements evaluated in the 404(b)(1) Alternatives Analysis (WestLand 2016a) (see **Appendix A**) and whether they meet the criteria listed above. Those elements that meet the criteria were combined into two action alternatives (Alternative 1 [Proposed Action] and Alternative 2) for analysis, described in detail in Section 2.2. Those project elements that do not meet the criteria are discussed further in Section 2.4, Alternatives Considered but Eliminated from Further Evaluation. Because there are no options for the Lone Star Pit location or mining methods, they are assumed to be the same under every combination of options comprising an EIS alternative. All project elements are located within the Project Area, which is defined as the boundaries of FMSI's property.

Table 2-1 Comparison of Project Elements

Option Name	Screening-level Analysis Criteria			Carried Forward for Full Analysis?
	Meets Purpose and Need?	Technically Feasible?	Practicable?	
Heap Leach Pad Options				
Base Case	Yes	Yes	Yes	Yes
Long Pad N-S	No	No	No	No
Tall Pad	No	No	No	No
L Pad West	No	No	No	No
L Pad East	No	No	No	No
Base Case Airport	Yes	Yes	No	No
Long Pad Airport	Yes	Yes	No	No
Long Pad E-W	Yes	Yes	No	No
Base Case Pivot	Yes	Yes	Yes	Yes
Development Rock Stockpile Options				
Base Case	Yes	Yes	Yes	Yes
All South	No	No	No	No
South Split	No	No	No	No
Backfill and North SP	No	No	No	No
Backfill and South SP	No	No	No	No
North Side of Ridge	No	No	No	No
Conveyance Route Options				
Haul Road Base Case	Yes	Yes	Yes	No*
Haul Road Half-Existing	Yes	Yes	Yes	No*
Haul Road All-Existing	Yes	Yes	Yes	Yes

* While this alternative met the required evaluation criteria, the Haul Road All-Existing option was found to have the least impact on waters of the U.S. in the Section 404(b)(1) evaluation, and therefore is the only haul road option carried forward for detailed analysis in both action alternatives.

Except for the Heap Leach Pad, only one option for the each of the proposed project elements met the required evaluation criteria for detailed analysis. The Base Case Development Rock Stockpile option and Haul Road All-Existing Conveyance Route option are carried forward for analysis in both action alternatives. The Proposed Action (Alternative 1) includes the Base Case Heap Leach Pad Option and Alternative 2 includes the Base Case Pivot Heap Leach Pad Option.

One project component that was not included in the 404(b)(1) alternatives analysis (see **Appendix A**), but is applicable to Alternative 1, is compensatory mitigation activities. FMSI provided a draft Conceptual Mitigation Plan (see **Appendix B**) that describes how FMSI would mitigate for the loss of aquatic resources from directly impacting waters of the U.S. These mitigation activities are directly applicable to Alternative 1; in the event Alternative 2 is selected, a similar plan would be implemented.

2.3 Alternatives Analyzed in Detail

The Proposed Action (Alternative 1) is composed of the Heap Leach Pad (Base Case), Development Rock Stockpiles (Base Case), and Conveyance Route (Haul Road All-Existing), listed in **Table 2-1**. Alternative 2 would utilize all of the same project components as the Proposed Action, with the exception of a different configuration for the heap leach stockpile.

2.3.1 Alternative 1, Proposed Action

A description of the proposed project elements, including the open pit, is provided in this section. Direct impacts to waters of the U.S. from implementation of the Proposed Action total approximately 90 acres. **Figure 2-1** displays the locations of the proposed project elements.

2.3.1.1 Lone Star Pit

The design of the Lone Star Pit is based on three factors: 1) the currently understood nature and extent of the economic ore body of the Lone Star copper mineral deposit, 2) pit stability considerations, and 3) the removal of development rock to the extent necessary to access and mine the ore body. The open pit location is limited to the physical location of the mineral resource. FMSI estimates that there is a body of approximately 785 million tons of leachable copper oxide and sulfide ores that are economically recoverable under current market prices over a period of approximately 27 years. The design of the Lone Star Pit includes a 1,100-foot setback to accommodate the potential future mining of sulfide ore located beneath the leachable ore body.

The estimated dimensions of the Lone Star Pit at the end-of-mine life are approximately 6,100 feet on the north-south axis and 5,800 on the east west access (see **Figure 2-1**). At these dimensions, the surface footprint of the pit is approximately 645 acres and the pit has an estimated maximum depth of approximately 2,000 feet. Through time, a pit lake is expected to develop in the Lone Star Pit after mining is completed. Waters of the U.S. would not be affected by the pit.

2.3.1.2 Heap Leach Pad

The Proposed Action would construct a 1-billion-ton lined heap leach pad southwest of the existing heap leach pad (**Figure 2-1**). The heap leach pad would be constructed with setback benches to achieve a final overall external slope of no greater than 2.5 feet horizontal to 1 foot vertical (2.5H:1V). The final design height of the heap leach pad would be 400 feet, with an overall design footprint of approximately 2,466 acres. The heap leach pad would be constructed with a liner system to contain fluids such as the process solution from the leaching process and precipitation falling directly on the pad, while keeping offsite precipitation and stormwater away from the pad using berms and diversion channels.

Construction of the liner system would require the cut or fill of the natural topography, and compaction of the resulting subgrade prior to liner installation. The liner system, from the ground up, would consist of: 1) a minimum of 12 inches of low-permeability compacted soil from the existing clay borrow pit, 2) a geomembrane layer of a minimum of 60 mil of linear low density polyethylene, 3) a approximately 2 feet of crushed and screened gravel on top of the liner, and 4) a minimum of 2 feet of run-of-mine material. The design of this heap leach pad provides for the ability to accommodate the effective leaching of an additional volume of 200 million tons of ore over the currently identified mineral resource associated with the Lone Star ore body. This additional volume provides the flexibility necessary to accommodate changes in the identified mineral resources of the Lone Star ore body, as well as changes in the leach-cycle time or lift thickness that may be required by the physical and chemical properties of the processed ore.

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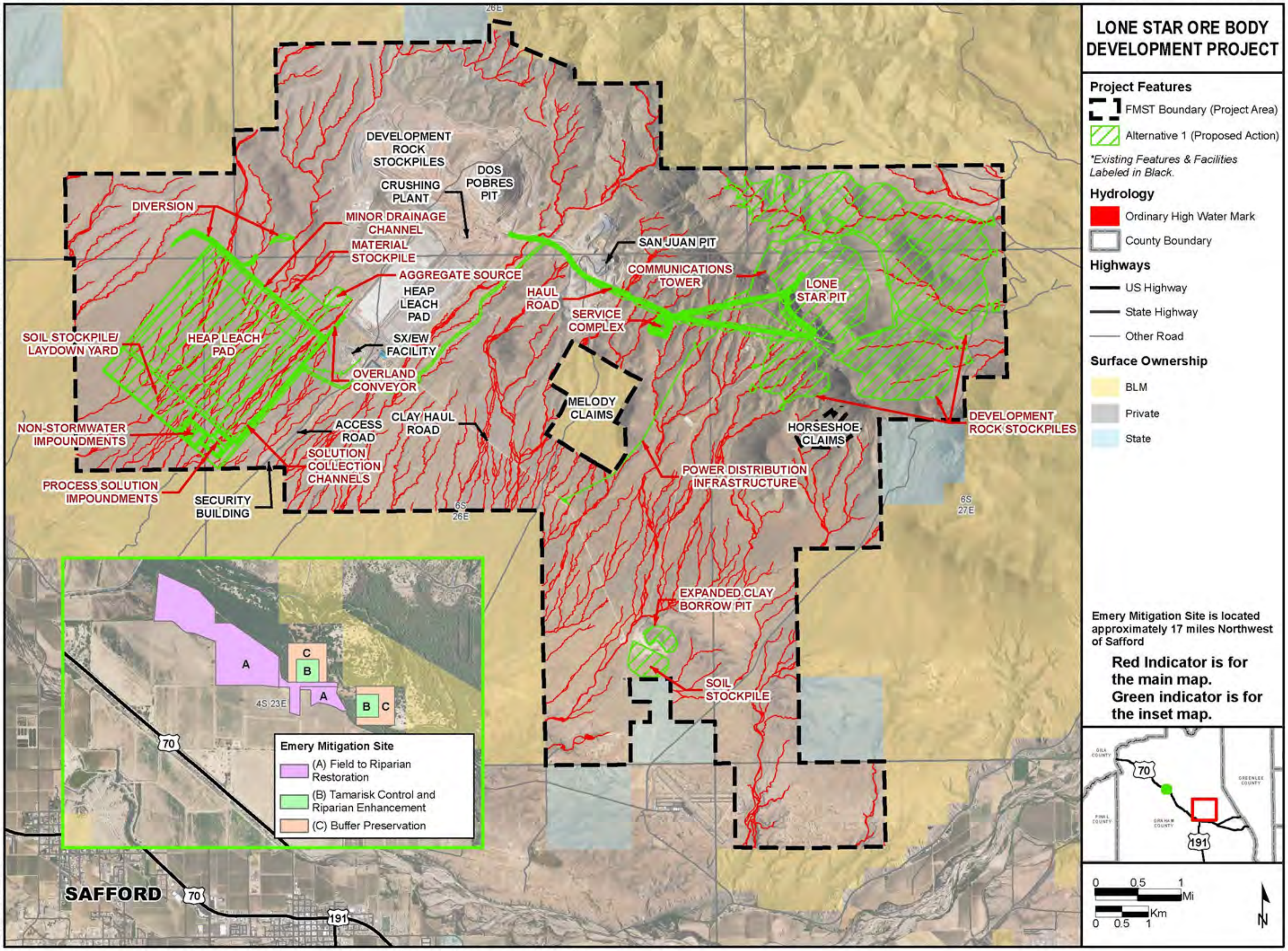

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Figure 2-1 Project Elements under Alternative 1, Proposed Action

The heap leach pad location and design facilitates the continued use of the existing crushing facilities, the existing SX/EW processing facilities, and the majority of the existing support infrastructure used for the current open pit mines and existing heap leach pad.

A haul road surfaced with non-mineralized run-of-mine materials would be constructed from the main haul road east and south of the existing heap leach pad to transport construction materials from the Lone Star Pit. A system of lined collection channels, process solution impoundments (PSIs), and non-stormwater impoundments (NSIs), would be constructed at the southeast corner of the new heap leach pad. The NSIs would be designed to have a minimum storage capacity sufficient to contain both drawdown of the pregnant leach solution (PLS) and stormwater runoff from the heap leach pad that could occur if there were a 24-hour power outage at the mine during a concurrent 100-year/24-hour storm event.

A lined raffinate delivery pipe corridor would be constructed to recycle barren solution from the existing raffinate storage tanks after processing to the new heap leach pad, a lined PLS collection pipe corridor would be constructed to transport solution from the new PSIs to the existing SX plant. A laydown yard for the storage of construction equipment, materials, and operating supplies would be located immediately adjacent to the PSIs and NSIs, southwest of the new heap leach pad.

The current overland conveyor on the west edge of the existing heap leach pad would be extended to the southwest, along the southeastern edge of the new heap leach pad. The lined overland conveyor would bring leach materials from the existing crushing facility and drum agglomerators to the new heap leach pad, where the material would be stacked using portable conveyors and a radial stacking system. The heap leach stockpile on top of the pad would be constructed in multiple phases beginning at the southwest edge, and typically stacked in 15- to 22-foot lifts using a radial stacking system during mining operations.

Roads for the movement of large equipment would be located on either side of the overland conveyor and along the northeastern and southeastern edges of the new heap leach pad. Light equipment roads would be located on the southwestern and northwestern edges of the heap leach pad. Although new crossings of the existing access road would be required for the haul road and overland conveyor corridor, the existing security gate and access road to the mine administration buildings would be utilized under this alternative.

Development of this alternative would necessitate the construction of three diversions to manage stormwater near the heap leach pad. Stormwater would be diverted northwest into a tributary of Butler Wash and east to a tributary of Talley Wash. Impacts to waters of the U.S. from installation of the heap leach pad and associated structures would be approximately 60 acres.

2.3.1.3 Development Rock Stockpiles

The Proposed Action would involve constructing three development rock stockpiles around the Lone Star Pit (**Figure 2-1**) to the northeast, southeast, and southwest. The stockpiles would be constructed in approximately 50-foot lifts at an overall 2.5H:1V slope to facilitate reclamation. The overall footprint of the three stockpiles would be approximately 2,518 acres. The combined capacity of the three stockpiles is approximately 1.7 billion tons: 969 million tons in the northeast stockpile, 535 million tons in the southeast stockpile, and 162 million tons in the southwest stockpile.

Development rock materials would be transported from the pit by truck and added to the stockpiles. Access to the stockpiles from the pit would change during the mine life, with the northeast and southeast stockpiles being accessed mainly from a northern pit exit and the southwest stockpile accessed from a southern pit exit. A small laydown yard and access point, affecting approximately 63 acres, would be constructed immediately south of the northeast stockpile.

All development rock stockpiles would be located in the upper reaches of affected watersheds and no diversion channel would be required. All stormwater controls required by the design would be located within FMSI-managed lands and would disturb approximately 27 acres.

2.3.1.4 Conveyance Route

The Proposed Action would involve construction of a haul road between the Lone Star Pit and the existing crushing facilities (**Figure 2-1**). This road would be unpaved with a drivable road surface of approximately 210 feet in width. The full width of the road footprint would vary along the length of the road, reaching a maximum of approximately 750 feet near the Lone Star Pit. The overall footprint of the haul road would be approximately 250 acres.

Under the Proposed Action, the haul road would have two endpoints at the Lone Star Pit during the life of the mine. The northernmost end is higher in elevation and would be constructed first; the second, southern end would be constructed as the Lone Star Pit increases in depth. The haul road would extend west-northwest from the Lone Star Pit, past the San Juan Pit, to the existing crushing facilities. The haul road would utilize the entire existing haul road between the San Juan Pit and the existing crushing facilities, and the new and existing haul roads would intersect east of the Cottonwood Wash crossing where the new haul road would utilize this crossing. Drainage crossings for the haul road would be constructed using culverts with sizes adequate to allow stormwater flows to pass. A truck service complex with a heavy-duty truck lube shop and a fuel station would be built south of the haul road, near the split between the northern and southern arms of the proposed haul road.

Impacts to waters of the U.S. from construction of the haul road would be approximately 3 acres.

2.3.1.5 Additional Project Elements

The Proposed Action would continue the use of the existing crushing facilities, SX/EW facilities, the majority of the infrastructure for the current heap leach pad, and the mine access road. These existing facilities are not considered part of the scope of analysis for this project, but are described as part of the baseline conditions for the NEPA analysis, including the cumulative effects analysis.

New power distribution infrastructure required for the Proposed Action would consist of a transmission line from the existing 69-kilovolt (kV) powerline to the Lone Star Pit (**Figure 2-1**). All other power distribution infrastructure would be located within the footprint or setback of the Lone Star Pit.

The project proposes the continued use and expansion of the existing clay borrow pit within the Project Area. The existing clay borrow pit would be expanded by approximately 48 acres, for a total footprint of approximately 144 acres. The clay borrow pit would be the source for the compactible soil materials used as part of the heap leach pad lining system. A soil and growth medium stockpile area of approximately 86 acres would be located immediately south of the clay borrow pit. Access to the clay borrow pit would be from the existing Clay Haul road.

Additional stormwater management facilities required by the proposed project elements include stormwater containment dams downgradient of the development rock stockpiles. Other structures to be constructed include a truck service complex and a communications tower with an access road.

There would be no effect on waters of the U.S. from the clay borrow pit expansion, or construction of the soil and growth medium stockpile, power distribution infrastructure, and communications tower and road.

2.3.1.6 Compensatory Mitigation

To compensate for the loss of aquatic resources that would occur under this alternative due to filling the ephemeral drainages identified as waters of the U.S., a Conceptual Mitigation Plan (see **Appendix B**) has been developed consistent with the Corps' 2008 Mitigation Rule and the South Pacific Division Regulatory Program Standard Operating Procedure for Determination of Mitigation Ratios (12501-SPD). The plan describes the activities that would occur at the Emery Mitigation Site, which is located on the Gila River approximately 25 miles downstream from the Project Area. The Emery Mitigation Site, totaling approximately 109 acres, is divided into three areas identified as A, B, and C based on function and purpose (see **Figure 2-1**). Area A is the riparian restoration area, approximately 69 acres; Area B is the tamarisk control and riparian enhancement area, approximately 10 acres; Area C is the buffer preservation area, approximately 30 acres. The Emery Mitigation Site is protected through the established restrictive covenant in perpetuity to ensure long-term maintenance of the mitigation objectives.

- Area A: Approximately 69 acres of land would be converted from agricultural fields with small patches of woody vegetation to riparian habitat. Activities would include removing an existing berm (which separates Area A from the active floodplain of the Gila River) and grading to restore natural contours, control of invasive species, and establishing native plants. The modifications would restore riparian values and return the area to an overbank flooding area in the floodplain of the Gila River.
- Area B: Approximately 10 acres of a riparian corridor between Area A and the Gila River would be enhanced through the removal of tamarisk, an invasive non-native species, and the establishment of native woody vegetation (cottonwood, willow, mesquite) in order to create habitat for riparian wildlife including the endangered southwestern willow flycatcher and threatened yellow-billed cuckoo.
- Area C: Approximately 30 acres surrounding Area B would be managed to preserve the existing riparian and aquatic functions and to act as a buffer to protect the important riparian corridor. Firebreaks would be cleared in some portions of Area C to lessen the chance for wildfires to damage important riparian habitat and to facilitate access to Areas A and B for restoration activities.

2.3.2 Alternative 2

Alternative 2 would utilize all of the same project components as the Proposed Action, with the exception of the heap leach pad. The design and construction of the heap leach pad would be similar to the Proposed Action, but the location would be rotated to maximize avoidance of waters of the U.S. (see **Figure 2-2**). The overall design footprint of this alternative would be approximately 6,216 acres, 76 acres larger than under the Proposed Action.

Compensatory mitigation would be required if this alternative is implemented and would be similar to the mitigation described above for Alternative 1. The amount of mitigation required would likely be less because impacts to waters of the U.S. are less under this alternative.

Impacts to potential waters of the U.S. for this design alternative would total approximately 46 acres, approximately 14 acres less than Alternative 1.

2.3.3 No Action Alternative

Under the No Action Alternative, the Corps would not issue a Section 404 permit for Lone Star operations and none of the proposed mine construction, operations, reclamation, or committed compensatory mitigation activities would occur. Under this scenario, FMSI would not be issued a permit to fill waters of the U.S. associated with mining the Lone Star ore body. Following completion of mining the Dos Pobres and San Juan pits, some existing structures would remain in place following reclamation. Remaining structures would include the closed and revegetated leach pad, development rock stockpiles, selected roads, the mine pits, fencing, and the stormwater diversions.

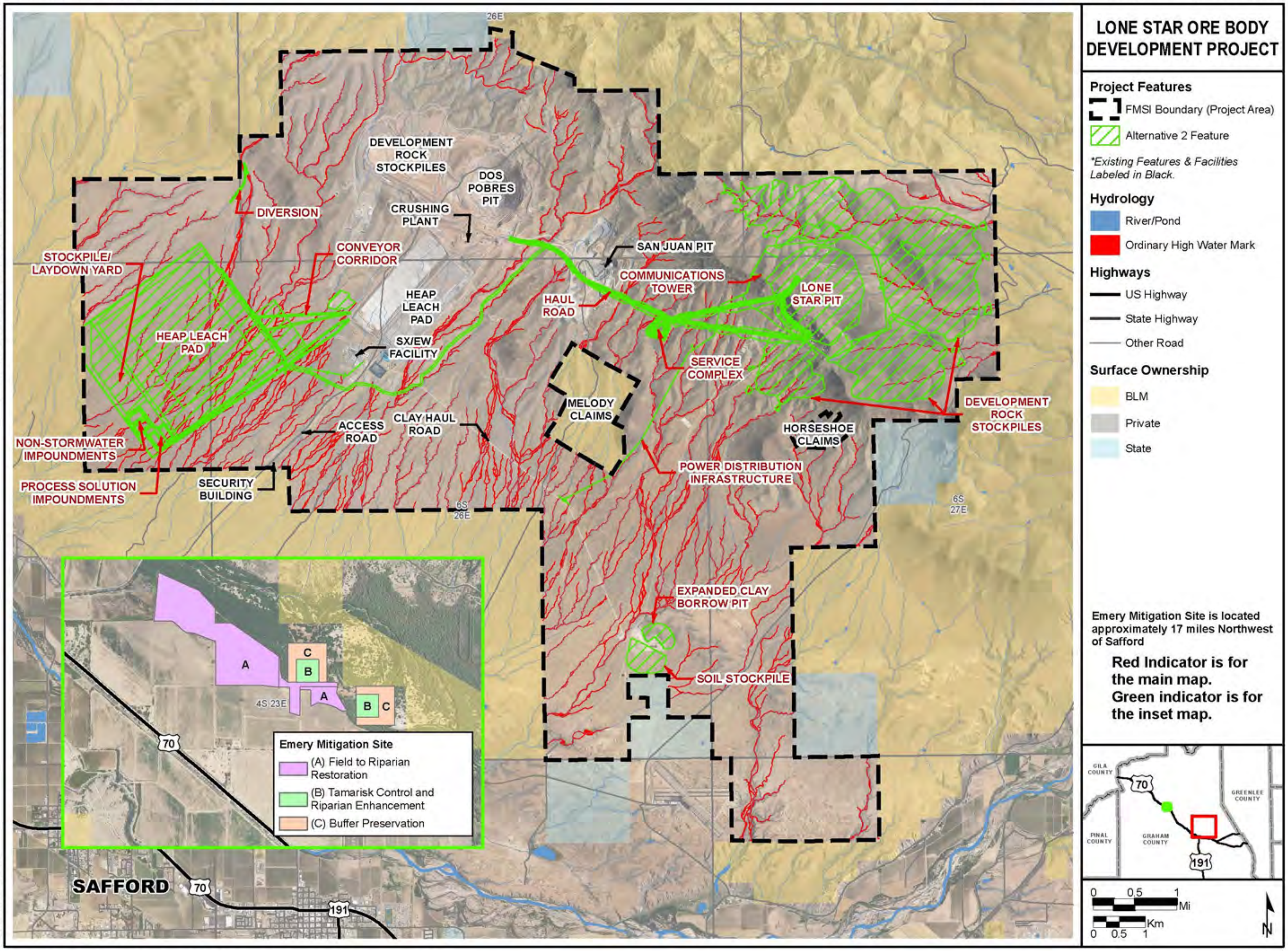

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Figure 2-2 Project Elements under Alternative 2

2.3.4 Activities and Design Features Applicable to Action Alternatives

Initial construction would involve developing the heap leach pad, primary haul roads, utility corridors, and surface water control facilities. During the first 3 years, the layer of soil and rock that overlies the ore, or overburden, would be removed and transported to the development rock stockpiles. Construction activities would continue incrementally throughout the life of the mine as the pit and haul roads advance, additional surface water control facilities would be installed, and existing roads and utilities within the mine area would be relocated.

A variety of environmental protection measures and control practices have been incorporated into the project design to meet applicable standards, including those of regulatory agencies such as the ADEQ, U.S. Environmental Protection Agency (USEPA), the Arizona State Mine Inspectors Office, and the Corps. Additionally, there are environmental measures and practices implemented by Safford Operations in the Project Area that would expand to include the Lone Star project. These are summarized in the following sections.

2.3.4.1 Surface Water Management

Most elements of the project (e.g., open pit, heap leach pad, development rock stockpiles) would be designed and operated as a “zero-discharge” facility, meaning that all process solutions and stormwater that come into contact with the mine facilities would be contained onsite rather than discharged offsite in response to the 100-year/24-hour storm event. This would necessitate installation of diversion structures to transport stormwater around the facilities in the Project Area. The general locations of proposed surface water control structures are depicted in **Figures 2-1** and **2-2**.

<u>Surface Water Diversions</u>

Surface water diversions would be designed to ensure that clean water is routed around the proposed heap leach pad and other facilities as necessary. These channels would be placed upgradient of and adjacent to the facilities to divert clean stormwater runoff around the site, preventing offsite water bodies from being affected by mining or processing activities. The diversion channels located in erodible materials would utilize riprap and energy dissipation structures to minimize channel erosion. Designs would conform to Hydraulic Design of Energy Dissipaters for Culverts and Channels, Hydraulic Engineering Circular 14, published by the Federal Highway Administration. All surface water diversions would be designed to control stormwater runoff from the 100-year/24-hour storm event (Bowman 2014, 2015). See **Appendix A** for more information on the design of culverts and diversions.

<u>Heap Leach Pad Stormwater Management System</u>

An integrated stormwater management system would be used to control stormwater runoff from the proposed heap leach pad. The system would use lined collection channels, double-lined process solution impoundments, and a lined emergency overflow impoundment (non-stormwater impoundment) below the heap leach pad. High density polyethylene (HDPE) would be used for the lining systems. Stormwater collected by the heap leach pad perimeter channels and the solution collection channel would be conveyed to the process solution impoundments at the southeastern toe of the heap leach pad. Overflow from the process solution impoundments would be conveyed by a lined overflow channel to the non-stormwater impoundment.

<u>Heap Leach Pad Non-stormwater Impoundment</u>

The NSI is designed to have a minimum storage capacity volume sufficient to contain both draindown of PLS and stormwater from the Lone Star heap leach pad that would occur if there were a 24-hour power outage at the mine during a concurrent 100-year/24-hour or greater storm event, as calculated for the period of pad development that corresponds to the potential maximum stormwater runoff. The impoundment would be lined with a single HDPE liner placed over 6 inches of compacted soil. A small depression in the bottom of the impoundment would serve as a pump sump with a pumping system to convey stormwater and solutions to the SX/EW plant for use as raffinate make-up water.

Development Rock Stockpile Stormwater Retention Management System

Stormwater runoff from the development rock stockpiles would be controlled using a series of retention dams that would be installed below the footprints of the stockpiles as they advance during mining. The general locations of the final surface water control structures are depicted in **Figures 2-1** and **2-2** and discussed in detail in the 2014 Hydrology Study (Bowman 2014) prepared for FMSI. Both the interim and final facilities would be designed to handle the 100-year/10-day storm event without discharge, during the period of stockpile development that corresponds to the potential maximum stormwater runoff (Bowman 2014). The dams would be constructed at a reasonable distance from the ultimate toe of the stockpile to avoid damage from the deposition of development rock. Stormwater runoff retained behind the dams would either evaporate or seep into the ground.

Surface Water Management Systems for Other Facilities

The SX/EW plant is designed as a zero-discharge facility, incorporating drainage design features and containment tanks. Sulfuric acid would be stored in tanks located within containment structures that can be drained to other containment facilities, such as the lined heap leach pad or the SX/EW runoff tank. The overland conveyor would incorporate a lined containment system designed to drain surface water runoff to the heap leach pad. Diluent, reagents, fuel, and other petroleum products would be stored in aboveground tanks within impervious secondary containment systems to prevent possible discharge. All tanks would have leak detection systems. Secondary containment systems would have a capacity of at least 110 percent of the volume of the largest tank contained within the secondary containment facility.

2.3.4.2 Stormwater Pollution Prevention Plan

Stormwater runoff from the small portion of the Project Area not designed as a zero-discharge facility would be regulated under the AZPDES Stormwater Multi Sector General Permit (MSGP-2010) for Sector G – Metal Mining (Ore Mining and Dressing) as stormwater associated with industrial activity. The MSGP-2010 Permit requires implementation of a Stormwater Pollution Prevention Plan (SWPPP) to ensure that stormwater discharges do not cause or contribute to exceedance of water quality standards in downgradient surface water bodies. The current SWPPP for Safford Operations would be extended to incorporate Lone Star. Structural and non-structural control measures typically employed to ensure that stormwater discharges from the site meet requirements are listed below:

Non-structural Control Measures

- Minimize Exposure—use of covered maintenance work and storage areas to minimize exposure of potential pollutants to stormwater.
- Good Housekeeping—keeping materials orderly and labeled; storing materials in appropriate containers, cleaning up spills and leaks promptly using dry methods, regular waste removal, use of drip pans and absorbents under or around leaky vehicles and equipment.
- Maintenance—vehicle and equipment maintenance to reduce potential for leaks or spills.
- Spill Prevention and Response Procedures—overflow sensing devices; spill kit availability, employee training, routine inspections and maintenance.
- Employee Training—training for employees who work in areas where industrial materials or activities are exposed to stormwater with the potential to discharge, or who are responsible for implementing activities necessary to meet the conditions of the MSGP-2010.
- Litter, garbage, and floatable debris—keeping exposed areas free of trash or intercepting them before they leave the site.

- Dust generation and vehicle tracking of industrial materials—application of dust suppressants or water to unpaved access and haul roads, regular vehicle washing.

Structural Control Measures

- Spill Prevention and Response Procedures—secondary containment.
- Erosion and sediment controls—flow velocity dissipation devices to reduce erosion and/or settle out pollutants.
- Management of runoff/stormwater diversions—stormwater diversions, impoundments and settling basins.

2.3.4.3 Spill Prevention, Control, and Countermeasure Plan

A Spill Prevention, Control, and Countermeasure (SPCC) Plan would be implemented for the Lone Star Project. Oil storage would be regulated under requirements of 40 CFR 112, Oil Pollution Prevention. The SPCC Plan would describe the procedures to prevent, control, and mitigate releases of oil and petroleum products to waters of the U. S. Control measures typically employed to ensure Safford Operations meet SPCC Plan requirements are listed below:

- Installation of secondary containment systems
- Installation of overflow sensing devices
- Placement and maintenance of spill kits
- Employee training
- Routine inspections and maintenance

2.3.4.4 Groundwater Quality Management

Septic System

A septic system would be constructed to handle sewage treatment at the proposed truck maintenance facility. This septic system would be developed in compliance with ADEQ and Graham County's septic permit requirements.

Potentially Discharging Facilities

Proposed facilities with the potential to discharge pollutants to groundwater are subject to the requirements of the State of Arizona's APP Program (ARS §§ 49-241 through 49-252; AAC Title 18, Chapter 9, Articles 1 through 3). Safford Operations will submit an application for a modification to the existing Safford Mine individual area-wide APP to include the Lone Star Project. Proposed groundwater protection measures include use of composite liner systems beneath the heap leach pad and collection ponds, stormwater controls, pumping systems, tank containment systems, and other features and operations designed to meet APP requirements. Key APP laws and rules require that there be the following:

- A demonstration that the discharging facility(s) would not cause or contribute to a violation of Aquifer Water Quality Standards at applicable points of compliance;
- A demonstration that the discharging facility(s) would be designed, constructed, and operated so as to ensure the greatest degree of discharge reduction achievable through application of Best Available Demonstrated Control Technology (BADCT), processes, operating methods, or other alternatives;
- Regular monitoring and reporting of groundwater quality; and

- Conceptual closure and post-closure plans that describe measures to be taken to ensure continued compliance with applicable numeric Aquifer Water Quality Standards at applicable points of compliance after closure of the facility.

FMSI incorporates Best Available Demonstrated Control Technology (BADCT) into facility designs to protect groundwater. For the Lone Star Project, incorporation of BADCT design criteria would be developed in a manner that achieves the greatest degree of demonstrable discharge reduction. The current groundwater monitoring program for existing facilities would be expanded to include the new heap leach pad and ponds. The monitoring would be used to verify that Aquifer Water Quality Standards are not exceeded at the point of compliance. Groundwater monitoring requirements include collection and analysis of groundwater samples from monitoring wells to be installed at approved points of compliance for the mining operations. ADEQ will specify groundwater quality constituents to be monitored in the APP based on results of groundwater quality and material characterization studies. A conceptual closure and post-closure strategy for the Lone Star Project would be included in the Project's APP amendment application.

2.3.4.5 Waste Management

Safford Operations complies with the federal Resource Conservation and Recovery Act (RCRA) and state laws and regulations regulating to solid and hazardous waste. Safford Operations is a small quantity generator of hazardous waste and a small quantity handler of universal waste. The generator status of the facility is not expected to change with the addition of the proposed project. Wastes determined to be hazardous under federal and state laws are properly packaged and transported offsite by a permitted transporter to an USEPA-approved hazardous waste treatment, storage, and disposal facility (TSDF). Solid waste is classified and transported off-site to either permitted industrial waste disposal facilities or to the local municipal landfill owned and operated by the City of Safford. Used petroleum products are transported offsite to permitted recycling companies in accordance with state and federal regulations. Nearly all scrap metal, most used HDPE pipe, and some construction debris are recycled. Waste generation information based on data from 2013 is provided in **Table 2-2**.

Table 2-2 Hazardous/Non-hazardous Waste

Type of Waste	Waste Classification	Disposal Method
Aerosol Cans	Hazardous	TSDF[1]
Waste Paint & Debris	Hazardous	TSDF
Carbon Filters	Hazardous	TSDF
Broken Lead Acid Batteries	Hazardous	TSDF
Broken Fluorescent Lamps	Hazardous	TSDF
Flammable Liquid (from Aerosol Puncturing Unit)	Hazardous	TSDF
Rags Contaminated with flammable liquid	Hazardous	TSDF
Waste Belt Splicing Kits	Hazardous	TSDF
Office Trash	Non-Hazardous	Municipal Landfill
Petroleum Contaminated Soil	Non-Hazardous	Industrial Landfill
Contaminated Plastic	Non-Hazardous	Industrial Landfill
Treated Wood	Non-Hazardous	Industrial Landfill
Used Oil and Oily Filters'	Non-Hazardous	Approved Recycler
Non-treated Wood	Non-Hazardous	Burned on site for fire training

Table 2-2 Hazardous/Non-hazardous Waste

Type of Waste	Waste Classification	Disposal Method
Electronic Waste (including circuit boards/laptops/ computers/laboratory instruments etc.)	E-waste	Approved Recycler
Batteries	Universal Waste	TSDF

[1] TSDF = Treatment, Storage, and Disposal Facility (approved).

Source: WestLand 2015b.

2.3.4.6 Hazardous Materials Storage, Handling, and Transport

Sulfuric acid, diluent, reagents, fuel, and other petroleum products used in the operations are stored in above-ground tanks situated within impervious secondary containment systems having a containment capacity of at least 110 percent of the volume of the largest tank therein. **Table 2-3** provides a list of regulated materials, the approximate onsite storage capacity, and their locations of use at the Lone Star Project. Safford Operations personnel handling hazardous materials receive appropriate training that meets the applicable requirements prescribed by ADEQ, USEPA, and the U.S. Department of Transportation (USDOT). Additionally, employees receive safety training required by the Mine Safety and Health Administration (MSHA) and other training prescribed by Safford Operations policies. Safford Operations requires that contractors transporting sulfuric acid or other hazardous materials to or from the Safford Operations certify that their drivers meet all the applicable training requirements prescribed by law and perform in accordance with Safford Operations environmental policies and safety standards.

Table 2-3 Hazardous Material Storage

Material	Tank Location, Name	Existing Storage Capacity	Additional Future Lone Star Storage Capacity
Sulfuric Acid	Agglomeration, Tank 1	2,500 tons	N/A
	Agglomeration, Tank 2	2,500 tons	N/A
	SX/EW, Day Tank	225 tons	N/A
	SX/EW, 10K1 Tank	10,000 tons	N/A
	SX/EW, 10K2 Tank	10,000 tons	N/A
Sulfuric Acid	SX/EW, AP1 Tank	2,200 tons	N/A
	SX/EW, AP2 Tank	2,200 tons	N/A
	SX/EW, 5K Tank	5,000 tons	N/A
Diluent	SX/EW Tank farm, Diluent Storage Tank	15,300 gallons	N/A
Extraction Reagent	SX/EW Tank farm, Extractant Storage Tank	12,000 gallons	N/A
Cobalt Sulfate	SX/EW Tank farm, Cobalt Sulfate Storage Tank	10,000 gallons	N/A
Red Dye Diesel	Site 1, Storage Area, TNK-55	8,000 gallons	N/A
	40K Fuel Dock, Tank100	20,000 gallons	N/A
	40K Fuel Dock, Tank101	20,000 gallons	N/A
	Site 2, Tank 200	4,000 gallons	N/A
	Southwest Energy, MF18	3599 gallons	N/A
	Southwest Energy, MF41	10178 gallons	N/A

Table 2-3 Hazardous Material Storage

Material	Tank Location, Name	Existing Storage Capacity	Additional Future Lone Star Storage Capacity
Red Dye Diesel	Lone Star Fuel Dock	N/A	20,000 gallons
Clear Diesel	Site 2, Tank 202	12,000 gallons	N/A
Gasoline	Site 2, Tank 201	12,000 gallons	N/A
Propane	Acid Plant, Propane Tank'	30,000 gallons	N/A
Ammonium Nitrate	Southwest Energy, BIN 01, BIN 02, BIN03	166,440 pounds	N/A
Liquid Nitrogen	Heavy Duty Truck Shop	565.5 cubic feet	N/A

Source: WestLand 2015b.

Tanker truck deliveries arrive from the south via U.S. Highway 191 (US-191), the east via U.S. Highway 70 (US-70), and from the west via US-70 from Globe, Arizona. Trucks coming from the south on US-191 or from the east on US-70 typically cross the river at the 8th Avenue Bridge and then access the Safford Operations via Freeport-McMoRan Road. Trucks arriving to the Safford Operations from the west cross the Gila River at the Reay Lane Bridge and enter the mine site via Freeport-McMoRan Road.

Sulfuric acid plays an important role in producing copper. Sulfuric acid is used to maintain favorable pH conditions, which allow copper to leach from the existing mineral structure in the ore and to maintain copper in a dissolved state. Sulfuric acid from offsite sources is shipped to the Safford Operations in 3,500-gallon capacity tanker trucks. Acid is also produced on site from a sulfur burner and acid plant. Approximately half of the required acid is produced onsite and the remainder is trucked from mining operations at Miami or Morenci, Arizona, or other sources. Sulfuric acid usage is not anticipated to change with the Lone Star Project. The sulfuric acid and other product delivery frequencies to the Safford Operations facility are shown in **Table 2-4**.

Table 2-4 Truck Delivery Frequency

Material	Current Arrivals	Lone Star Arrivals
Sulfuric Acid	40-70/day	40-70/day
Red Dye Diesel	2-5/day	6-10/day
Clear Diesel	5-7/week	8-12/week
Gasoline	2-3/week	3-4/week

Source: WestLand 2015b.

Acid is stored onsite in carbon steel tanks: two 2,500-ton sulfuric acid storage tanks (Agglomeration Tanks 1 & 2) near the north end of the existing heap leach pad for acid addition in the agglomeration system, one 225-ton (day tank) storage tank to provide make-up acid to the solution extraction plant and a 5,000-ton tank (5K tank) to provide acid unloading at the existing SX/EW Facility. In addition to this, there are two 2,200-ton tanks (AP1 & AP2) at the acid plant that receive product acid produced onsite and two 10,000-ton tanks (Tanks 10K1 & 10K2) for general acid storage. A new acid tank (2,000-ton) would be installed at the Lone Star heap leach pad in the area of the process solution impoundment. All sulfuric acid tanks are situated in acid-resistant, concrete secondary containment systems designed at a minimum to contain the storage capacity of at least 110 percent of the volume of the largest tank contained within the secondary containment facility. **Table 2-3** lists sulfuric acid storage locations on site.

In addition to sulfuric acid, there are several other reagents that are used and stored at the SX/EW processing area. The primary reagents include diluent, extractant, and cobalt sulfate. The diluent is a light petroleum distillate product that functions as a carrier for the extractant allowing for solution extraction to take place. The extraction reagent is an aldoxime mixture which interacts with copper and acid to move copper from various phases within the SX process. Cobalt sulfate interacts with constituents in electrolytes (manganese) to reduce oxidizing and flaking of lead anodes in the EW process. It is added directly to the electrolyte and is present in the SX facility and the tankhouse.

All reagents are stored in tanks located in the SX/EW tank farm. The tank farm and solution extraction area are designed with a containment system. Process solution bypasses, spillage from process upsets, and stormwater runoff from the tank farm are collected in the tank farm drainage system, and stored in a 1.9-million-gallon runoff tank located within the tank farm. **Table 2-3** lists reagent storage locations on site.

SX/EW reagents are delivered to the site on an as-needed and irregular basis. Reagent usage and frequency of arrival is not anticipated to change with the Lone Star Project.

Red dye diesel, clear diesel fuel, and gasoline are supplied to the Safford Operations by tanker trucks. Fuel is used at site primarily in the mobile equipment fleet. A new fueling station would be constructed for the Lone Star Project and would be located in the vicinity of the Lone Star Pit. **Table 2-3** lists fuel storage locations onsite.

Fuel usage would increase with the implementation of the Lone Star Project. Red dye diesel fuel is transported from Road Forks, New Mexico, along Interstate 10 (I-10). Clear diesel and gasoline are transported to the site from Tucson, Arizona. The transport trucks travel directly to one of the three fueling stations and offload into aboveground, double-walled storage tanks. The current and proposed fuel delivery rates to Safford Operations are shown in **Table 2-4**.

2.3.4.7 Air Quality Controls

The Lone Star Project would continue to utilize proven control equipment, process designs, and operating practices to minimize air emissions, as is currently done at the Safford Operations. These operating practices and compliance with the terms and conditions of the existing Air Quality Control Permit would ensure that operations are in compliance with applicable air quality standards.

The primary air pollutant associated with the Lone Star Project would be fugitive dust from mining, vehicle travel, and construction sources. Safford Operations developed dust control measures to be implemented for the proposed Lone Star Project based upon requirements contained in the current Safford Operations Class II Synthetic Minor Air Quality Control Permit, which comply with AAC R18-2-604-607. The regulations require that an operator must take “reasonable precautions to prevent excessive amounts of particulate matter from becoming airborne.” Fugitive airborne particulates are limited to no greater than 40 percent opacity, measured in accordance with the Arizona Testing Manual, Reference Method 9 (AAC R18-2-614).

The following are examples of reasonable precautions that would be implemented to minimize emissions from project activities and processes:

- Under wet weather conditions or inherent moisture of material, allow natural conditions to maintain dust control until necessary to use conventional dust control methods.
- Use conventional water trucks, water additives, and/or other reasonable methods.
- Apply low dust emitting material to the surface (i.e., decomposed granite, gravel, paving, etc.)
- Where practicable, apply surfactants or other dust palliatives.

- Utilize dust suppression system, water additives, agglomeration, or other reasonable methods if necessary to maintain adequate dust control measures.
- Minimize material drop height.
- Reduce vehicle speed.
- Reduce amount of traffic flow.
- Temporarily shut down activities when necessary to minimize blowing dust.

2.3.4.8 Exterior Lighting and Control Measures

Exterior lighting control measures would include approaches to illumination for a safe operational work environment that is also sensitive to meet regional astronomical and ecological needs. These objectives are derived from industry standards for safe lighting and consultation with the University of Arizona Mt. Graham International Observatory.

These lighting control measures would apply to installation and maintenance during the construction of proposed facilities, as well as the replacement of existing lighting systems at the Safford Operations, as they warrant modernization.

A lighting control and management document would be prepared prior to the start of development and mining operations at the Lone Star Pit. It would include a general discussion of the preferred features for fixed, mobile, and vehicular outdoor luminaires, and equipment specifications from which new and replacement luminaires can be derived. The best management practices (BMPs) also would include task-specific prototypical luminaire specifications and guidance for operations and maintenance considerations.

As noted above through consultation with the Mt. Graham International Observatory, the measures would be designed to meet the following minimum objectives:

- Promote operational safety and security at the project site while minimizing light pollution, glare, and offsite spill lighting, to the extent practicable.
- Conform to the standards of the National Electrical Code, MSHA, and Illuminating Engineering Society of North America recommended practices, where applicable.
- Reduce the utilization of fixed up-lighting. Fixed up-lighting would be the least preferable lighting method, except in cases where the fixture is shielded from the sky and light does not extend beyond the structural shield, or where tasks require up-lighting for operational safety.
- Temporary, vehicular, or portable lighting would be aimed so as to minimize glare and light trespass and turned off after completion of the work.
- To the extent possible, all fixed, portable, vehicular, and temporary lighting fixtures would utilize high color rendering light-emitting diode or halogen sources to minimize glare and localized skyglow.
- To the extent possible, lighting would be maintained to have a consistent color appearance throughout the site to minimize visual stress and color contrast adaptation because color rendition is a key safety feature for many lighting tasks.

2.3.4.9 Biological Resource Protection Measures

<u>Wildlife Protection Measures</u>

FMSI has established wildlife protection practices that prohibit unauthorized feeding or harassment of wildlife. Safford Operations would continue to evaluate potential risks to birds and wildlife associated with all aspects of operations, and would implement appropriate measures as needed to minimize wildlife risks associated with the Lone Star Project. Many of the already established practices and policies would continue to address wildlife protection through wildlife inventory and monitoring, risk assessment, appropriate facility and infrastructure design, nesting bird protection, minimizing habitat loss and wildlife encounters, and wildlife education.

To address the Migratory Bird Treaty Act, FMSI would schedule clearing and surface disturbance activities to the extent feasible to occur outside the avian breeding season (approximately March 1 through August 15). If this is not possible, FMSI would engage a qualified biologist to conduct nest surveys in areas proposed for disturbance to determine the presence of active nests immediately prior to the disturbance. If active nests are located, or if other evidence of nesting is observed (mating pairs, territorial defense, carrying nesting material, transporting of food), the area would be avoided, when practicable, to prevent destruction or disturbance of nests until the birds are no longer present. If avoidance is not practicable, other appropriate mitigation measures would be employed to prevent bird mortality.

Safford Operations is currently using bird-deterring propane cannons on the PSI and non-process solution impoundment at the facility, a practice that would be continued for the Lone Star Project at the new process and non-process solution impoundments associated with the new heap leach pad. There would also be chain link fencing around the solution ponds to minimize the risk to terrestrial wildlife.

Power transmission lines would be designed and constructed in accordance with best engineering practices to minimize electrocution and collision potential. Based on Avian Power Line Interaction Committee (APLIC) recommendations, transmission and distribution lines would be constructed to include avian-protection designs to minimize the potential for electrocution of perching birds. Adequate spacing between conductors (8 feet or greater based on the wingspan of a female bald eagle) would be implemented. In instances where adequate spacing could not be provided, exposed parts would be covered to reduce electrocution risk.

Operators would be trained to monitor the mining and process areas for the presence of larger wildlife such as bighorn sheep and deer. Speed limits would be established as necessary to minimize wildlife/vehicle collisions. Populations of bighorn sheep are expected to exist in close proximity to the Lone Star open pit. Safford Operations mine and processing personnel have experience dealing with populations of bighorn sheep on or near mine operations. Safford Operations staff would work closely with the AGFD to minimize risk to the local bighorn sheep herd.

Noxious Weed Control Measures

The geographic region comprising Cochise, Graham, and Greenlee counties in Arizona has relatively small infestations of noxious weeds compared to other areas in the West.

There are currently no known infestations of noxious weeds in the study area (McReynolds 2014). Noxious weeds are most likely to be carried to the site via light vehicles and mobile construction equipment coming to the site from locations where infestations of weeds are present. Safford Operations monitors for noxious weeds during regular housekeeping and other site audit and inspection activities. Additionally, FMSI can stay current on Graham County weed concerns at Natural Resources Conservation Service (NRCS) weed management area meetings held twice a year. Upon discovery of any noxious weeds at Safford Operations, FMSI would consult with the local NRCS or the University of Arizona Cooperative Extension to create a plan for control.

Safford Operations practices cultural measures to reduce the potential for weed establishment. Examples of good cultural practices include seeding areas devoid of vegetation, proper land and grazing management, use of weed-free seed and mulches, use of machinery and equipment that are not contaminated with weed seeds, and cleaning equipment before transport from an area of infestation.

Seeding disturbed areas with perennial species suited to the site would reduce the potential for noxious weed establishment.

2.3.5 Reclamation and Closure

Safford Operations has developed reclamation and closure concepts and strategies for the Lone Star open pit mine and processing operations. These concepts would be incorporated into the Reclamation Plan and Closure Strategy for the Lone Star Project. Safford Operations currently has an approved Reclamation Plan and an approved Closure Plan for the existing Safford Operations. The final plans developed in conjunction with the design of the Lone Star Project would meet state reclamation and closure requirements.

2.3.5.1 Reclamation

Safford Operations would prepare and submit a revised reclamation plan that includes the proposed Lone Star facilities to the Division of Mined Land Reclamation, Arizona State Mine Inspector in accordance with the requirements of the Arizona Mined Land Reclamation Act (ARS § 27-901) and the Arizona Mined Land Reclamation Rules (AAC R11-2-101) authorized by ARS § 27-904 of the Act, pending amendment for Safford Operations 2015. This plan would be developed to meet state reclamation requirements.

Post-mining Land Uses

Reclamation measures are intended to achieve productive post-mining land uses required by state regulation. Post-mining land uses envisioned for the Project Area include: 1) wildlife habitat and limited grazing; 2) industrial development; 3) future mineral exploration and mine development; and 4) management of environmental resources including visual, air, water, and soil. The long-term objectives of the Safford Operations Reclamation Plan modification are listed below:

- Establish wildlife habitat at selected facilities.
- Protect public health and safety by controlling access to certain mining facilities, such as the open pits, through proper management of access roads, fencing, and gates.
- Provide the basis of an expanded commercial and industrial complex (e.g., a small industrial park) during mining and post-mining by utilization of existing infrastructure.
- Anticipate future mineral exploration and development as technologies advance which may support the reprocessing of the development rock stockpile material, and mining of material below the current ore cutoff grade.
- Maintain access to recreation resources near and adjacent to the Lone Star Project area to the extent practicable while protecting the safety of recreational users.
- Implement interim reclamation and drainage control programs to facilitate long-term reclamation goals and closure requirements.
- Coordinate reclamation activities with requirements of the ADEQ APP Program to efficiently meet the collective reclamation and closure requirements including management of process materials.
- Stabilize disturbed areas and minimize erosion using appropriate vegetative ground cover using native plant materials and other control measures to protect air and water quality.

Revegetation

Revegetation of surface disturbance within the Project Area would be an ongoing component of Lone Star Project operations. Interim programs would focus on the reduction and prevention of erosion through implementation of stormwater management and erosion control programs, and a program involving selective native vegetation establishment of surface disturbances associated with Lone Star Project construction, such as peripheral areas around buildings, areas adjacent to roads, and soil stockpiles. FMSI would continue to evaluate native seed varieties and application rates that may be suitable to meet future revegetation requirements and goals.

Success of revegetation efforts would be demonstrated by establishment of a diverse native vegetative cover that retains soils and meets with the chosen post-mining land uses for each reclaimed area. Criteria for evaluating revegetation success would be self-sustaining without irrigation for not less than 3 years with not less than 70 percent of the average cover density of native species on adjacent undisturbed areas. If vegetation density measurements demonstrate that initial revegetation has been unsuccessful, additional seeding would be performed until it is demonstrated that revegetated areas are self-sustaining and with suitable cover. To lessen the potential spread of noxious and invasive plants, FMSI utilizes certified weed-free seed mixes and mulch, and would ensure that all soil, seed, and vegetative material is removed from earthmoving equipment prior to the equipment being transported to the mine site.

Public Safety

One of the primary objectives of the Arizona State Mined Land Reclamation Act is to ensure public safety. The following measures would be implemented prior to and during reclamation to reduce or eliminate potential hazards within disturbed areas after mine closure:

- Construction of physical barriers such as fences, berms, and rocks;
- Placement of warning signs;
- Stabilization of stockpile slopes;
- Demolition of unneeded buildings; and
- Proper disposal of debris.

Facility-specific Measures

Heap Leach Pad

At closure, the heap leach pad would be allowed to drain to remove residual process solutions, consistent with APP closure requirements. To achieve the post-mining land uses of wildlife habitat and limited grazing, the following measures would be implemented:

- The top surfaces of each of the last lifts of the heap leach pad would be graded to direct the flow of stormwater to the center of the heap leach pad after operations cease, where it would be collected to control infiltration.
- The top surfaces and side slopes of the heap leach pad would be covered with an evapotranspirative (ET) cover (to minimize water losses from evapotranspiration) and soil, then revegetated. The side slopes may include a layer of rock armoring for stability.

Development Rock Stockpiles

The top surfaces of the development rock stockpiles would be graded during final placement of material to direct stormwater flows off of the stockpiles and to arrive at the final configuration. The entire top surfaces and side slopes of the stockpiles would be revegetated.

Lone Star Pit

Revegetation of pit areas would interfere with potential future mining opportunities and is therefore not proposed. The open pit areas would be maintained for possible future access to mineral resources.

Through time, a pit lake is expected to develop in the Lone Star Pit after mining is completed. Based on the results of the Lone Star Pit lake evaluation, no water quality treatment or reclamation activities are anticipated to be necessary (MWH Americas, Inc. 2014).

Roads

The post-reclamation configuration of roads would be designed to meet the access requirements for future industrial uses, maintenance and security functions, and environmental monitoring. Roads that are retained as part of post-mining land uses would have controlled public access for safety purposes, would be reduced in width as appropriate, and would be maintained in accordance with designated post-mining land uses. Paved roads would be retained and maintained for long-term site access.

The following reclamation measures would be employed for access roads to be removed:

- For roads that are reclaimed, slopes on both sides would be graded to blend in with the surrounding terrain. Where possible, drainages would be established to provide stable drainage conditions. Typical sediment barriers would be placed in accordance with reclamation standards.
- After contouring and grading are completed, roads would be ripped and scarified to a depth of 1 to 2 feet to reduce compaction and to prepare a seed bed. The prepared roadbeds would then be revegetated.
- Public access would be discouraged by the placement of earth berms, boulders, or gates at roadways around the site. Appropriate signage would be placed at all retained roads to provide warning of potential hazards associated with unauthorized access.

Haul roads kept available for post-mining land uses would be reduced in width to allow two-way traffic of standard vehicles. Safety berms would be retained along the outside edges of retained haul roads as necessary to ensure safety.

2.3.5.2 Closure

Site-specific Closure and Post-closure Plans would be prepared by FMSI and submitted to ADEQ in advance of the individual facilities being closed in compliance with APP regulations at AAC R18-9-A209(B) and (C). Where possible, the activities required to close certain facilities would be incorporated into normal operations so that the overall efforts and costs required at closure can be minimized.

<u>General Closure Strategy</u>

The following is a description of Safford Operations' primary Closure Strategy methods, which include closure in place or clean closure.

Proposed Methods for Closure in Place

The closure in place method consists of leaving a facility in its place and taking actions to minimize the potential for discharge to affect groundwater, such as installing an ET cover. Controls may be implemented to limit public access or future uses of some areas.

Proposed Methods for Clean Closure

The clean closure method requires that any soils beneath a regulated facility meet certain cleanup levels to comply with aquifer water quality standards at the applicable point of compliance. Remaining liquid waste, solid waste, unused or recyclable chemicals, and contaminated materials would be removed from the site as appropriate. The soil beneath discharging facilities that are covered under the APP permit would be sampled and tested to ensure that concentrations of constituents are below applicable cleanup level standards.

Facility-specific Conceptual Closure Strategy

The following are the possible closure methods and the general closure strategy for each of the facilities at the mine that may affect water quality. Preferred closure methods may change prior to cessation of operations, and a detailed plan would be submitted prior to closure pursuant to ARS § 49-252 and AAC R18-9-A209(B).

Heap Leach Pad

Based on the characterization of ore, the heap leach pad material is acid-consuming Accordingly, the closure method would consist of grading to direct the flow of stormwater on the pad to the center of the top lifts of the heap leach pad, where it would be collected to control infiltration; installation of a system to transport excess stormwater off the pad; and installation of an ET cover. Designated ponding areas would be compacted and lined to minimize infiltration, enhance evaporative loss, and attenuate and release clean stormwater. The top surfaces and side slopes of the heap leach pad would have an ET cover installed and be revegetated. The ET cover is intended to minimize infiltration into the closed heap leach pad. Where determined necessary for additional erosion protection, side slopes reclamation may include a layer of rock armoring.

Given that the stockpile material is acid-consuming and the setting is in the arid southern Arizona climate, the following process would be implemented for closure of the heap leach pad:

- Recirculate the existing water and solution within the SX/EW circuit to recover copper and promote evaporation.
- Use the process solution impoundment and non-stormwater impoundment facility for evaporation and to manage water from significant storm events while the pad is draining.

Process Solution Impoundment and Non-stormwater Impoundment

The clean closure method would consist of removing the impoundment liners and revegetating the impoundment area. Once the liner system is removed and disposed in an approved location, the soils would be sampled to ensure that concentrations of contaminants are below applicable limits. The area would then be graded and revegetated.

2.3.5.3 Post-closure Plan

The Post-closure Plan would consist of monitoring the performance of the closure measures, including cover performance, evaporation ponds and closure structures, and monitoring and reporting the water quality at points of compliance. The duration of post-closure actions cannot be known at this time. Post-closure monitoring and maintenance activities would stop when discharge from the heap leach pad is reduced to a point that it can be treated by a small passive treatment system and stable vegetative cover has been established on all reclaimed areas.

2.3.6 Summary of Acres Disturbed and Waters of the U.S. Affected

Table 2-5 summarizes the acreage of surface disturbance and waters of the U.S. that would be affected under the action alternatives.

Table 2-5 accounts for direct impacts to waters of the U.S. from construction of the proposed facilities. This table does not reflect potential indirect impacts from diverting flows to or from drainages following construction of stormwater management structures that may result in a potential changes to the vegetation or morphology along the downstream reaches of these jurisdictional waters. The potential downstream impacts to jurisdictional waters of the U.S. from the Lone Star project are presented in the environmental consequences sections in Chapter 3.0, Sections 3.3.2.4 and 3.3.2.5.

Table 2-5 Summary of Acres Disturbed and Waters of the U.S. Affected by Action Alternatives

Alternative	Surface Disturbance (acres)	Waters of the U.S. Affected (acres)
Alternative 1, Proposed Action		
Lone Star Pit	645	0
Heap Leach Pad	2,466	60.4
Development Rock Stockpiles	2,605	27.04
Conveyance Route	285	2.99
Clay Borrow Pit Expansion	48	0
Soil and Growth Medium Stockpile	86	0
Communications Tower and Road	0.29	0
Power Distribution Infrastructure	5	0
Total	**6,140**	**90.43**
Alternative 2		
Lone Star Pit	645	0
Heap Leach Pad	2,542	46.17
Development Rock Stockpiles	2,605	27.04
Conveyance Route	285	2.99
Clay Borrow Pit Expansion	48	0
Soil and Growth Medium Stockpile	86	0
Communications Tower and Road	0.29	0
Power Distribution Infrastructure	5	0
Total	**6,216**	**76.2**

Source: WestLand 2016a.

2.4 Alternatives Considered but Eliminated from Further Evaluation

A variety of project elements were identified by FMSI and evaluated by the Corps before proposing the two action alternatives to be analyzed in detail. Lands not owned by FMSI within the boundary of the Project Area were not considered developable (i.e., Melody and Horseshoe Claims [see **Figure 2-1**]). Lands overlying additional mineral reserves or resources were excluded from development for surface facilities. A 1,300-foot-wide setback currently exists around the Dos Pobres Pit to accommodate the potential future mining of sulfide-ore milling resources located beneath the oxide ore body. As such, neither this setback, nor the Dos Pobres Pit itself was considered to be available for project development. The San Juan Pit is the site of active mining of oxide-ore leaching resources and was similarly considered to be unavailable for Lone Star Project facilities. **Tables 2-6**, **2-7**, and **2-8** list project design options that were eliminated from detailed analysis. The heap leach pad and development rock stockpile options were determined not to be practicable for the reasons stated in the tables. The haul road options listed in **Table 2-8** were eliminated because they would affect more acres of waters of the U.S. than the option included under the Proposed Action and Alternative 2. See the CWA Section 404(b)(1) Alternatives Analysis (WestLand 2016a) in **Appendix A** for maps displaying the options listed in **Tables 2-6**, **2-7**, and **2-8**.

Table 2-6 Summary of Heap Leach Pad Design Options Considered but Eliminated

Heap Leach Pad Design Option	Reason
Long Pad N-S Immediately west of the existing heap leach pad	This location of the heap leach pad creates a health and safety hazard by creating a confined topographical valley between portions of the new and existing heap leach pads. Leaching of the Lone Star oxide ores could create carbon dioxide that would settle into the valley created between the heap leach pads and force oxygen out of this area creating unsafe working conditions.
Tall Pad South and west of the existing heap leach pad	The heap leach pad exceeds the maximum design stability height for the known physical properties of leachable materials from the Lone Star Pit.
L Pad West South of the existing heap leach pad	The location of the heap leach pad creates a health and safety hazard by creating a confined topographical valley between portions of the new and existing heap leach pads at the existing SX/EW Facility. Leaching of the Lone Star oxide ores could create carbon dioxide that would settle into the valley created between the heap leach pads and force oxygen out of this area creating unsafe working conditions. The stacking sequence required for the heap leach pad design requires double the portable conveyor units needed compared to those of the Alternative 2 design, and ingress and egress for these units from the pad is impracticable. The heap leach pad design also necessitates raffinate delivery and PLS collection piping that runs the perimeter of the northeastern, southeastern, and southwestern faces of the heap leach pad.
L Pad East Immediately east and south of the existing heap leach pad	The location of the heap leach pad creates a health and safety hazard by creating a confined topographically valley between portions of the new and existing heap leach pads and at the existing SX/EW Facility. Leaching of the Lone Star oxide ores could create carbon dioxide that would settle into the valley created between the heap leach pads and force oxygen out of this area creating unsafe working conditions. The heap leach pad design under this alternative necessitates raffinate delivery and PLS collection pipe corridor that collectively runs the entire perimeter of the heap leach stockpile.
Base Case Airport Eastern portion of the Analysis Area, immediately south of the Melody Claims	Does not allow utilization of any of the existing support infrastructure for the current heap leach pad. This stockpile would also force the relocation of an existing 69-kV powerline that provides power to the existing mine facilities.
Long Pad Airport Eastern portion of the Analysis Area, between the Melody Claims and the Horseshoe Claims	The heap leach pad design under this alternative does not allow utilization of the existing support infrastructure for the current heap leach pad. The design of this heap leach pad would force the relocation of portions of the Clay Haul road and the existing 69-kV powerline that provides power to the existing mine facilities.
Long Pad E-W West and south of the existing heap leach pad	The location of the heap leach pad requires the design of a diversion structure for the three drainages that that would extend out of the Analysis Area onto lands managed by BLM. Construction and maintenance activities required for the diversion channel would necessarily take place at least partially outside of lands managed by FMSI.

Table 2-7 Summary of Development Rock Stockpile Options Considered but Eliminated

Development Rock Stockpile Options	Reason
All South One stockpile south of the Lone Star Pit	Does not provide the approximately 1.6 billion tons of necessary development rock storage capacity. The mine plan requires several pit exit locations that change during the stages of pit development. This stockpile can only be accessed from a southern pit exit during the mine life.
South Split Two stockpiles south of the Lone Star Pit	Does not provide the approximately 1.6 billion tons of necessary development rock storage capacity.
Backfill and North Stockpile One stockpile north of the Lone Star Pit and backfill of Dos Pobres Pit	Does not provide the approximately 1.6 billion tons of necessary development rock storage capacity. The mine plan requires several pit exit locations that change during the stages of pit development. The northeast stockpile can only be practicably accessed from a northern pit exit during the mine life, and does not allow flexibility in pit exits over the life of the Lone Star Pit. Haul traffic during the mine life requires a southern exit from the pit, an exit not feasible under this design. Further, the backfill of development rock to the Dos Pobres Pit covers known sulfide-ore milling resources, and this area would not be available for receiving development rock materials.
Backfill and South Stockpile One stockpile south of the Lone Star Pit and backfill of Dos Pobres Pit	Does not provide the approximately 1.6 billion tons of necessary development rock storage capacity. The mine plan requires several pit exit locations that change during the stages of pit development. The northeast stockpile can only be practicably accessed from a southern pit exit during the mine life, and does not allow flexibility in pit exits over the life of the Lone Star Pit. Additionally, the backfill of development rock to the Dos Pobres Pit covers known sulfide-ore milling resources, and would not be available for receiving development rock materials.
North Side of Ridge Two stockpiles north and east of the Lone Star Pit	This alternative does not provide the approximately 1.6 billion tons of necessary development rock storage capacity. The mine plan requires several pit exit locations that change during the stages of pit development. The two stockpiles can only be accessed from a northern pit exit during the mine life, and do not allow flexibility in pit exits over the life of the Lone Star Pit. Haul traffic during the mine life requires a southern exit from the pit, an exit not feasible under this design.

Table 2-8 Summary of Conveyance Route Options Considered but Eliminated

Conveyance Route Options	Reason
Haul Road Base Case	This haul road alignment would not reuse any of the existing haul road alignment between the San Juan Pit and the crushing facilities. While this option met all evaluation criteria, the Haul Road All-Existing alternative was determined to have less impact on waters of the U.S.
Haul Road Half-Existing	The haul road would utilize approximately half of the existing haul road alignment between the San Juan Pit and the existing crushing facilities. While this option met all evaluation criteria, the Haul Road All-Existing alternative was determined to have less impact on waters of the U.S.

2.5 Past and Present Actions and Reasonably Foreseeable Future Actions

Cumulative impacts are the combination of the individual effects of multiple actions over time in a defined area or region. The individual effects may be minor when considered separately, but may be major or significant when considered in combination. Resource-specific cumulative effects analyses are required under NEPA to disclose a proposed project's contribution to cumulative impacts resulting from other past and present actions and reasonably foreseeable future actions (RFFAs). To support the cumulative effects analyses, any past and present actions and RFFAs that may affect the same resources and overlap temporally and spatially with the anticipated impacts of a proposed project need to be identified and a brief description of each action should be incorporated into the NEPA document, where possible. Descriptions may include the type of project, location, and extent of surface disturbance where available. This information is used in conjunction with the results of the environmental consequences analyses to evaluate the potential cumulative impacts within defined resource-specific cumulative effects study areas (CESAs). The specific boundaries of the CESAs for each resource are described in Chapter 3.0.

The actions that are relevant to the cumulative effects analyses for this EIS are those that resulted or would result in surface disturbance or water usage in the CESAs, because those actions affected or would affect resources in a manner similar to the activities analyzed under the EIS action alternatives. In addition to mining, these actions may include residential, commercial, and industrial structures and facilities associated with cities and towns, roads, water supply projects, irrigation of cropland, and land management activities.

A summary of the identified past and present actions and RFFAs is presented below.

2.5.1 Past and Present Actions

Past and present actions contribute to the current resource conditions within the resource analysis area and CESAs. The major past and present actions in the vicinity of the Lone Star Project that have contributed to the total amount of impacts to waters of the U.S., water usage, surface disturbance, and socioeconomics include mining, CWA 404 permit activities, agriculture, land management activities on adjacent public lands, and recreation. More specific information on existing land uses is included in the Affected Environment sections of Chapter 3.0.

2.5.1.1 Mining

- Morenci Mine is an open pit copper mining complex owned and operated by Freeport-McMoRan. It is located approximately 30 miles northeast of Safford and recently completed expansion of mining and milling capacity. This mine draws from the same construction and operations workforce as the Safford Mine.
- The Dos Pobres and San Juan pits at the Safford Mine facility have been in operation since 2007 and use the same processing facilities proposed to be used for the Lone Star ore. The employees working on these existing operations will continue to work on the Lone Star Pit should it be approved.
- Surrounded by the Project Area are two mining claims, shown in **Figure 2-1**, that were not transferred during the land exchange. Horseshoe Claims is privately owned and patented, Melody Claims consists of federal land that is encumbered by mining claims. Both of these inholdings will continue into the future but it is unknown whether they will be mined.

2.5.1.2 Section 404 Permits

There are five subwatersheds within the Upper Gila-San Carlos Reservoir watershed (Hydrologic Unit Code [HUC] 15040005) that encompass the Safford Mine area. Between 1993 and 2015, the Corps issued 39 Section 404 permits and documented 8 unauthorized actions within these 5 subwatersheds.

The permit categories are summarized below. **Figure 2-3** displays the Section 404 permit locations in the vicinity of the proposed project.

- Standard Permit, 11
- Unknown Nationwide Permit (NWP), 10
- NWP 3 (Maintenance), 4
- NWP 6 (Survey Activities), 1
- NWP 12 (utility line activities), 3
- NWP 25 (structural discharges), 1
- NWP 27 (Aquatic Habitat Restoration, Establishment, and Enhancement Activities), 5
- NWP 37 (Emergency Watershed Protection and Rehabilitation), 4

2.5.1.3 Residential Development

Safford and Thatcher are the nearest residential areas to the Project Area, with a combined total population of less than 15,000 (Arizona Department of Commerce 2008). The towns comprise the primary residential development in the area.

2.5.1.4 Agriculture

Approximately 23,600 acres within the Project Area are leased by FMSI for livestock grazing (FMSI 2015). Some portion of this land would continue to be leased for grazing into the future. The BLM manages grazing allotments on the federal lands adjacent to the Project Area.

Farming is a major contributor to the local economy, with approximately 37,000 acres of irrigated cropland in the Gila Valley and Franklin Irrigation Districts. FMSI owns approximately 600 acres of cropland outside of the Project Area, which are used in a rotational fallowing program that provides mitigation for modeled mine effects to the Gila River surface water flows. At least 200 acres or one-third of FMSI’s cropland are fallowed each year to provide an annual benefit of 480 acre-feet of water to the Gila River through reduced consumptive use by agricultural crops.

In 2005, the Gila River Indian Community, United States of America, San Carlos Irrigation District, Franklin Irrigation District, Gila Valley Irrigation District and other parties located in the Upper Valley of the Gila River entered into a Forbearance Agreement in order to provide for the orderly settlement of various claims regarding Water Rights to the Gila River. At that time there were approximately 40,000 total acres with decreed Gila River water rights in the Gila Valley and Franklin Irrigation Districts. The Agreement required that a total of 3,000 acres of decreed land within the Gila Valley and Franklin Irrigation Districts be permanently retired from irrigation in order to increase the amount of Gila River water available to downstream users. Additionally, the Agreement required that the retired decreed acres be kept free from phreatophytes, or plants whose roots extended into capillary zone above the groundwater level, in perpetuity. The retirement program was initiated by the irrigation districts in 2008, and all 3,000 acres were retired by the end of 2011.

2.5.1.5 Public Land Management and Access

The BLM manages over 700,000 acres of public lands in Graham County, some of which is adjacent to the Project Area. In 2004, the BLM authorized the land exchange that transferred 16,297 acres from BLM-managed public lands to private ownership by the mine owner, Phelps Dodge (BLM 2004). FMSI subsequently purchased Phelps Dodge.

Solomon Pass Road provides public access to Bonita Creek and the Gila Box Riparian National Conservation Area (RNCA). This road crosses the east side of the Project Area. Access would continue into the future.

2.5.2 Reasonably Foreseeable Future Actions

No specific new projects have been identified as reasonably foreseeable other than development of the proposed Lone Star Ore Body. However, the types of activities described in Section 2.5.1 as past and present actions are likely to continue into the future in the region.

It is possible that future mining within the Project Area would include the development of the sulfide resources underlying the leachable ore at the Dos Pobres and Lone Star deposits. However, this mining is conceptual and does not have any specific proposals for development of these deposits at this time. Because this mining is speculative at this time, it will not be considered in the cumulative impacts analyses.

2.6 Comparison of Impacts Under Alternatives

Table 2-9 provides a summary of the key direct and indirect environmental impacts for each resource analyzed. Detailed descriptions of impacts are presented for each alternative under each resource in the Environmental Consequences sections of Chapter 3.0. The summarized impacts assume the implementation of applicable activities and design features and the environmental protection measures required by state and federal agencies. However, it is not assumed that the recommended mitigation measures would be implemented. Implementation of the recommended mitigation measures identified in Chapter 3.0 potentially would reduce impacts beyond that described in this table.

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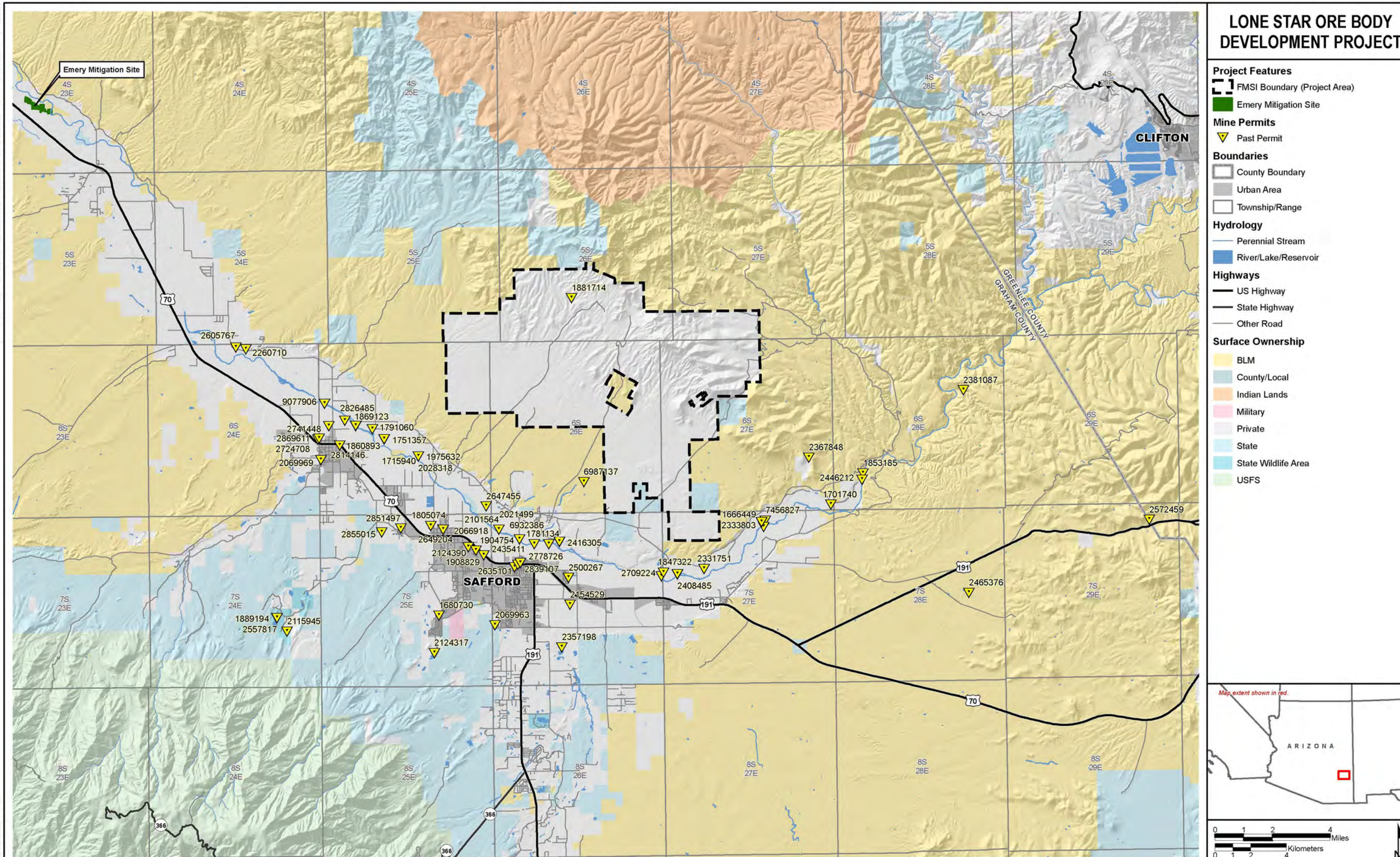

Figure 2-3 Locations of Past Section 404 Permits in the Vicinity of the Project Area

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Table 2-9 Summary of Direct and Indirect Environmental Impacts

Resources Affected	No Action	Alternative 1, Proposed Action	Alternative 2
Geology	No impacts to geologic resources from mining operations would occur.	Geological impacts from mining operations would remove the overburden (e.g., Gila Volcanics), and copper ore from the Lone Star Pit.	Same as Alternative 1
Minerals	No impacts to mineral resources from mining operations would occur.	Mineral resource impacts from permanent extraction of copper ore, relocation of development rock at the Lone Star Pit, and permanent extraction of clay from the borrow pit. By the end, the mine would permanently extract approximately 785 million tons of leachable copper oxide and sulfide ores, and relocation of approximately 1.7 billion tons of development rock.	Same as Alternative 1
Topography	No impacts to topography from mining operations would occur.	Topography impacts from mining the Lone Star Pit would result in a 645-acre pit that would be stabilized and remain after site reclamation.	Same as Alternative 1

Table 2-9 Summary of Direct and Indirect Environmental Impacts

Resources Affected	No Action	Alternative 1, Proposed Action	Alternative 2
Groundwater Quantity	Based on modelling, groundwater contributions to the Gila River would be reduced by approximately 54 acre-feet per year (af/yr) through groundwater pumping and pit lake evaporation, which is less than 0.08 percent of the estimated base flow of the Gila River. The maximum reduction to groundwater quantity is predicted to occur at 105 years after pumping began.	Based on modelling, groundwater contributions to the Gila River would be predicted to decrease by a maximum of approximately 58 af/yr at 82 years after pumping began in 2006 due to groundwater extraction for mine use and the pit lake effects. This flow reduction would be offset by the fallowing program implemented by FMSI. There would be a decline of 500 feet in the Graben Aquifer and the water table under the Lone Star Pit would decline approximately 250 feet. Modelled groundwater contributions to Bonita Creek would decrease by less than 1.3 af/yr at the peak impact 300 years after mining began in 2006, with no drawdown of the water table. There would be no measureable decline in the Holocene Aquifer.	Same as Alternative 1
Groundwater Quality	Contamination of groundwater would be avoided through operation of the proposed zero-discharge system of water management, and through adherence to the SPCC Plan and APP Program. The potential for contamination would exist until the current mining operations are reclaimed and closure plans are implemented.	Contamination of groundwater would be avoided through operation of the proposed zero-discharge system of water management, and through adherence to the SPCC Plan and APP Program. The potential for contamination would be limited but would continue until the Lone Star mining operations are reclaimed and closure plans are implemented.	Same as Alternative 1.

Table 2-9 Summary of Direct and Indirect Environmental Impacts

Resources Affected	No Action	Alternative 1, Proposed Action	Alternative 2
Surface Water Quantity	The existing hydrologic patterns would remain in place even after mine reclamation and closure.	There would be increased flows (compared to current conditions) in Talley Wash because of the diversion above the heap leach pad directing flow away from portions of Watson and Butler/Coyote washes. All other affected drainages' stormflows would decrease in stormflows compared to the existing condition. The runoff patterns would be permanently affected.	Similar to Alternative 1 except Watson Wash would have increased stormflows compared to current conditions. All other affected drainages' stormflows would decrease.
Surface Water Quality	Surface water quality would continue to be affected by the past changes to the runoff patterns, existing upland disturbance outside the "zero-discharge" areas, and continue to have the risk of accidental releases of hazardous materials from mining operations. The runoff patterns would be permanently affected, while the upland disturbance and accidental release risk would remain until final closure of the existing mining and processing facilities occurred.	Water quality would be affected by the new changes to the runoff patterns, existing upland disturbance outside the "zero-discharge" areas, and continue to have the risk of accidental releases of hazardous materials from mining operations over a longer period of time, compared to the No Action Alternative. Other potential impacts to surface water quality would include increased sediment loads and increased risk of accidental releases of hazardous materials reaching surface water resources. These risks would be minimized by implementation of the SWPPP and the SPCC Plan.	Same as Alternative 1
Waters of the U.S., Wetlands, Riparian Areas	No new mine-related impacts to waters of the U.S. or riparian habitat in the Project Area would occur.	90 acres of waters of the U.S. would be adversely affected under Alternative 1. Loss of waters of the U.S. would be compensated by the mitigation to be implemented at the Emery Mitigation Site.	76 acres of waters of the U.S. would be impacted under Alternative 2. Loss of waters of the U.S. would be compensated by the mitigation to be implemented at the Emery Mitigation Site.

Table 2-9 Summary of Direct and Indirect Environmental Impacts

Resources Affected	No Action	Alternative 1, Proposed Action	Alternative 2
Soils	No new mine-related impacts to soil resources.	Approximately 6,140 acres of new disturbance to soils resulting in long-term impacts to soil productivity. Temporary surface disturbance would occur at the Emery Mitigation Site.	Approximately 6,216 acres of new disturbance to soils. Fewer impacts to hydric soils would occur (compared to Alternative 1) due to the different orientation of the heap leach pad. Temporary surface disturbance would occur at the Emery Mitigation Site.
Vegetation	No new mine-related impacts to vegetation resources.	There would be 6,140 acres of direct impacts to 7 of the 8 vegetation communities within the Project Area. Non-native riparian vegetation would be modified and replaced with native plants at the Emery Mitigation Site. There would be no adverse impacts to special status plant species.	Alternative 2 is expected to result in direct impacts to 6,216 acres of the same vegetation communities as the Proposed Action. Non-native riparian vegetation would be modified and replaced with native plants at the Emery Mitigation Site. There would be no adverse impacts to special status plant species.

Table 2-9 Summary of Direct and Indirect Environmental Impacts

Resources Affected	No Action	Alternative 1, Proposed Action	Alternative 2
General Wildlife	No impacts	Temporary and permanent losses or alteration of suitable habitat. Habitat fragmentation caused by the installation of the new conveyance route and associated haul and access roads. Mortality of some less mobile or burrowing nongame species (e.g., small mammals, nesting birds, and reptiles) as a result of crushing from vehicles and construction equipment. The short-term displacement of the more mobile species (e.g., medium-sized mammals, adult birds) as a result of surface disturbance activities. Raptors that nest close to construction locations would be likely to abandon their breeding territory or nest site, or may experience the loss of eggs or young, as a result of surface disturbance activities during construction. Riparian habitat would be enhanced through mitigation at the Emery Mitigation Site.	Similar to Alternative 1

Table 2-9 Summary of Direct and Indirect Environmental Impacts

Resources Affected	No Action	Alternative 1, Proposed Action	Alternative 2
Special Status Wildlife Species	No impacts	No adverse effects to special status wildlife species are anticipated due to the small amount of direct impacts to vegetation communities within the Project Area (less than 10 percent of the analysis area). There would be temporary impacts to habitat for the southwestern willow flycatcher and yellow-billed cuckoo at the Emery Mitigation Site, but the habitat would benefit over the long term due to proposed enhancements.	Similar to Alternative 1
Aquatic Resources	No impacts	Construction and proposed facilities in the Project Area would remove or modify riparian habitat along several ephemeral drainages but adverse impacts to aquatic biota (when present) would be considered minor. Earthmoving at the Emery Mitigation Site would remove riparian vegetation serving as aquatic habitat and may increase sedimentation, but the impacts would be temporary, lasting until disturbed areas are stabilized.	Impacts to aquatic habitat and species would be less than but similar to Alternative 1.
Special Status Aquatic Species	No impacts	No adverse impacts to federally listed aquatic species or critical habitat in the Gila River or Bonita Creek, such as the razorback sucker and Chiricahua leopard frog would result from the Proposed Action.	Same as Alternative 1

Table 2-9 Summary of Direct and Indirect Environmental Impacts

Resources Affected	No Action	Alternative 1, Proposed Action	Alternative 2
Cultural Resources	No impacts	Of the 25 cultural sites within the Area of Potential Effect (APE), 20 have been determined or are recommended eligible for the National Register of Historic Places (NRHP); 16 of these have already been mitigated. Compliance with federal and state regulations for the protection of cultural resources would minimize or eliminate adverse effects to eligible or unevaluated sites.	Of the 25 cultural sites within the APE, 16 have been determined or are recommended eligible for the NRHP; 17 of these have already been mitigated. Compliance with federal and state regulations for the protection of cultural resources would minimize or eliminate adverse effects to eligible or unevaluated sites.
Native American Concerns	No impacts	No impacts	No impacts
Air Quality	No new mine related impacts. Emissions from current operations would still occur.	The estimated maximum predicted total ambient concentrations resulting from implementation of the Proposed Action are all below the applicable Ambient Air Quality Standard (AAQS) for all pollutants and averaging periods.	Same as Alternative 1
Climate Change	No new mine related impacts. There would be 484,191 tons per year (tpy) (439,251 metric tpy) carbon dioxide equivalent (CO_2e) from facility-wide emissions under current operations.	The Project's estimated contribution to greenhouse gas (GHG) emissions, which can contribute to global climate change, is 592,032 tpy (537,082 metric tpy) under future operations. Emissions from construction at the Emery Mitigation Site would temporarily contribute to GHG emissions.	Same as Alternative 1
Transportation	Initially no change from existing levels and then a decrease in traffic levels on the regional road network as mining related traffic would decrease and ultimately end within 5 years.	Construction activity would require 200 additional contractors, resulting in an additional 308 daily vehicle trips per day and 24 additional daily truck trips for an estimated total construction traffic increase of 332 daily round-trips, an increase of 24 percent greater than existing levels.	Similar to Alternative 1 except there would be increases in storm water flow to Watson Wash due to diversions. This could affect the integrity of Safford Bryce Road where it is intersected by Watson Wash.

Table 2-9 Summary of Direct and Indirect Environmental Impacts

Resources Affected	No Action	Alternative 1, Proposed Action	Alternative 2
Land Use	No impacts to land use.	23,600 acres leased for grazing by FMSI would be reduced to 5,200 acres	Same as Alternative 1
Aesthetics and Visual Resources	Initially no change from existing levels and then a decrease in lighting as mining related traffic would decrease and ultimately end within 5 years.	Key Observation Point (KOP) A: The heap leach pad, development rock stockpiles, haul roads and alternations to ridgelines would be visible. Of these the heap leach pad would be the most prominent. KOP B: Impacts would be similar to those of KOP A, except the heap leach pad would appear less prominent. KOP C: Unobstructed middleground views of the development rock stockpiles and altered ridgelines. Site lighting may be faintly visible at night. KOP D: KOP C would have unobstructed middleground views of the development rock stockpiles and altered ridgelines. Site lighting may be faintly visible at night.	Similar to Alternative 1

Table 2-9 Summary of Direct and Indirect Environmental Impacts

Resources Affected	No Action	Alternative 1, Proposed Action	Alternative 2
Noise and Vibration	Initially no change from existing levels and then a decrease in noise as mining related traffic would decrease and ultimately end within 5 years.	Estimated noise and vibration levels at the nearest sensitive receptor, approximately 10 miles southeast of the San Juan Pit and 6 miles southeast of the area of potential future Lone Star operations, are estimated to be 86 linear decibels (dBL) and 0.016 peak particle velocity (PPV). These levels are well below Office of Surface Mining Reclamation and Enforcement (OSMRE) limits for annoyance, assuming the larger maximum charge of 2,000 pounds	Same as Alternative 1
Hazardous Materials	Initially no change from existing levels and then a decrease in traffic levels on the regional road network as mining related traffic would decrease and ultimately end within 5 years.	The small quantities of hazardous waste that would be generated and transported combined with the low probability of accidental release and likelihood of rapid cleanup in compliance with the SPCC Plan would result in a low risk to the human and natural environment.	Similar to Alternative 1.
Public Health and Safety	Under the No Action Alternative, typical mining-related effects identified for water quality, air quality, noise, and lighting would cease within 5 years. This would result in a decrease in public health and safety impacts, as mining activities would decrease and ultimately end within 5 years.	Stormwater diversions would result in increased flows during runoff events in Talley Wash, which could create increased erosion and channel instability effects in these drainages, resulting in increased sediment transport downstream. No adverse public health effects from air quality, noise, or light effects are anticipated.	Similar to Alternative 1, except stormflow diversions would result in increased flows in Watson Wash, compared to current conditions, which may cause elevated levels of erosion and channel instability and migration. Water quality impacts would include sedimentation effects would be expected downstream from the diversions that increase flows.

Table 2-9 Summary of Direct and Indirect Environmental Impacts

Resources Affected	No Action	Alternative 1, Proposed Action	Alternative 2
Socioeconomics	A decrease in population, employment, income, and demand for housing, and public schools and utilities would be expected.	An increase in population, employment, personal income, public finances would be expected. Also the demand for housing, utilities, schools, and emergency response and medical would increase.	Same as Alternative 1
Environmental Justice	As closure activities commence there would be a reduction in employment opportunities, income, as well as local and state tax receipts.	The project would continue to generate income within the affected counties and communities, potentially benefiting minority communities and low-income populations.	Same as Alternative 1

3.0 Affected Environment and Environmental Consequences

This chapter describes the environment that would be affected by implementation of the action alternatives and the No Action Alternative analyzed in this EIS. The baseline information summarized in the Affected Environment sections was obtained from published and unpublished materials from private and government sources in the region. The affected environment for individual resources was delineated based on the area of potential direct and indirect environmental impacts that are likely to result from the future development of the Lone Star Pit and associated infrastructure, ore processing, and reclamation.

In general, the descriptions of the affected environment focus on the land within Project Area (FMSI boundary and the Emery Mitigation Site) shown in **Figure 1-1**. For some resources such as water, air quality, aquatic resources, socioeconomics, and environmental justice, the affected environment area presented is more extensive (e.g., watersheds, Gila River, county, etc.). The analysis area for some resources includes the Emery Mitigation Site where resources would be affected by the changes proposed in the Compensatory Mitigation Plan.

The specific aspects of each resource that are described in each section were selected because they have the potential to be affected by Alternatives 1 and 2 or the resource conditions may affect the proposed construction, operations, and reclamation activities.

The Environmental Consequences sections for each resource follow the description of the affected environment and present the analysis of potential impacts for each resource that would be affected by the implementation of the alternatives. The analysis compares the predicted impacts from the action alternatives to current conditions described in the affected environment sections that are used for comparison with future conditions under each alternative. No Action is baseline.

Each resource section describes the analysis of projected impacts for each alternative in as much detail as possible. Because resources were evaluated according to the available data, some discussions are based on qualitative information and some on more detailed quantitative data that was acquired from a variety of sources. It is important to understand the terminology used in the impact analyses.

- Direct effects are caused by the action and occur at the same time and place. For example, this may include vegetation removal and soil mixing resulting from clearing and grubbing for mine site preparation and excavation during mining.
- Indirect effects are caused by the action and are later in time or farther removed in distance, but still reasonably foreseeable. Indirect effects may include effects related to induce changes in the pattern of land use, population density or growth rate, and related effects on air, water, and other natural systems.

Impact analysis assumes that the design features, environmental protection measures, and plans to be developed listed in Section 2.3.4 would be successfully implemented by FMSI. It also is assumed that FMSI would comply with applicable state and federal regulations and permit conditions. If impacts identified in the resource sections can be further reduced, the section identifies potential mitigation measures that could be required by the Corps, where appropriate. Residual impacts are those that would remain after environmental protection measures, mitigation measures, and compliance with laws and regulations are implemented.

Toward the end of each resource section is a discussion of cumulative impacts. In its "Regulations for Implementing NEPA" (40 CFR 1500-1508), the CEQ defines a cumulative impact as follows (Part 1508.7):

> *"Cumulative impact" is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.*

Cumulative impacts are the combination of the individual effects of multiple actions over time in the context of other development in a project or action area or the region. The individual effects may be minor when considered separately, but may be major or significant when considered in combination with all others in the region. A CEQ memorandum issued in 2005 (CEQ 2005) provides additional guidance on the consideration of past actions in cumulative effects analysis. This memorandum stresses the "forward-looking" nature of NEPA analysis. It states that the effects of past actions are only required to be analyzed if they are relevant and useful to determine whether a proposed project or action "may have a continuing, additive and significant relationship" to projected future impacts in the region.

Past and present actions and RFFAs within the CESAs were identified in Chapter 2.0, Section 2.5. In addition to past and present copper mining operations, past and present actions for this EIS include other Section 404 permits, development in nearby urban areas, agricultural operations, and public land management. No specific RFFAs were identified within the CESAs within the timeframe of this EIS because none have actual plans or permit applications in the works.

3.1 Geology, Topography, and Mineral Resources

3.1.1 Affected Environment

3.1.1.1 Analysis Area

The analysis area for assessing impacts on topography, geology, and mineral resources consists of the Project Area with a focus on the location of the proposed Lone Star Pit, the heap leach pad, three new development rock stockpiles, the conveyance route, and the expanded clay borrow pit (**Figures 2-1** and **2-2**). There would be no impacts to geology or minerals from the proposed construction at the Emery Mitigation Site so it has not been included in the analysis area.

Physiography and Topography

The Project Area is located in the Mexican Highland section of the Basin and Range physiographic province (Fenneman 1928), which includes southeast and central Arizona and is characterized by eroded mountain ranges dispersed among desert basins. The southwestern portion of the Project Area is in the Safford Basin, a desert valley that is approximately 50 miles long from northwest to southeast and is 20 miles wide (Trapp and Reynolds 1995). The Gila River is located the central part of the Safford Valley. The Safford Basin is bounded by northwest- to southeast-trending mountain ranges. The northeast portion of the Project Area is in the Gila Mountains, an elongate northwest trending mountain range north of the Safford Basin. The range is about 50 miles long and is about 10 miles wide. Elevations in the Project Area range from about 3,100 feet above sea level in the southwest portions of the Project Area to near 6,000 feet in the Gila Mountains. Valley deposits slope gently up from the Gila River to the northeast. The terrain becomes steeper where alluvial fan terraces abut the mountain range. Abrupt steep elevations occur where igneous bedrock becomes exposed along the mountain flank.

3.1.1.2 Stratigraphy

The major surficial geologic units, displayed on **Figure 3.1-1**, are composed of igneous rocks and unconsolidated valley-fill deposits as described below from oldest to youngest:

- Safford Volcanic and Plutonic rocks (Houser et al. 1985)—The Safford Volcanics (map symbol TKv) consist of lava flows, breccias, and volcanic clastic rocks composed of andesite and dacite. The rocks were emplaced from upper Cretaceous to middle Paleocene. The sequence may be more than 5,500 feet thick. The Safford Plutonic rocks (map symbol TKg) consist of small plutons, dikes, and plugs composed of quartz monzonite and granodiorite porphyries that were intruded into the Safford Volcanics and are of Paleocene in age. The plutonic rocks are associated with the mineralization in the area.
- Gila Volcanics—The Gila Volcanics is an informal name for andesitic lava flows that unconformably overlie the Safford Volcanics and Plutonic rocks. This unit is the “upper andesite flows” of the Guthrie-Turtle mountain andesite flows of Houser et al. (1985) (map symbol Tv). These rocks belong to a series of regional andesitic flows that have been dated to Miocene to Pliocene in age. The flows in the Project Area are late Oligocene in age. The Gila Volcanics form the mountain peaks adjacent to the Lone Star deposit and are barren of mineralization. In the Project Area the Gila Volcanics range from 1,300 to 1,500 feet thick (Clear Creek Associates 2015).
- Basin Fill—The Basin Fill are Pliocene- and early Pleistocene-age alluvial fan, playa, and lacustrine deposits. The Basin Fill ranges from 200 to 1,000 feet in the Project Area, but is over 9,000 feet thick south of Safford, Arizona (AquaGeo Ltd. 2015; Corkhill 2015; Gootee 2012). The Basin Fill is divided into two distinct units. In the Project Area, the Lower Basin Fill (LBF) consists of alluvial fan deposits that were derived from erosion of the Gila Mountains and close to the mountain front, these deposits consist of unconsolidated to semi-consolidated

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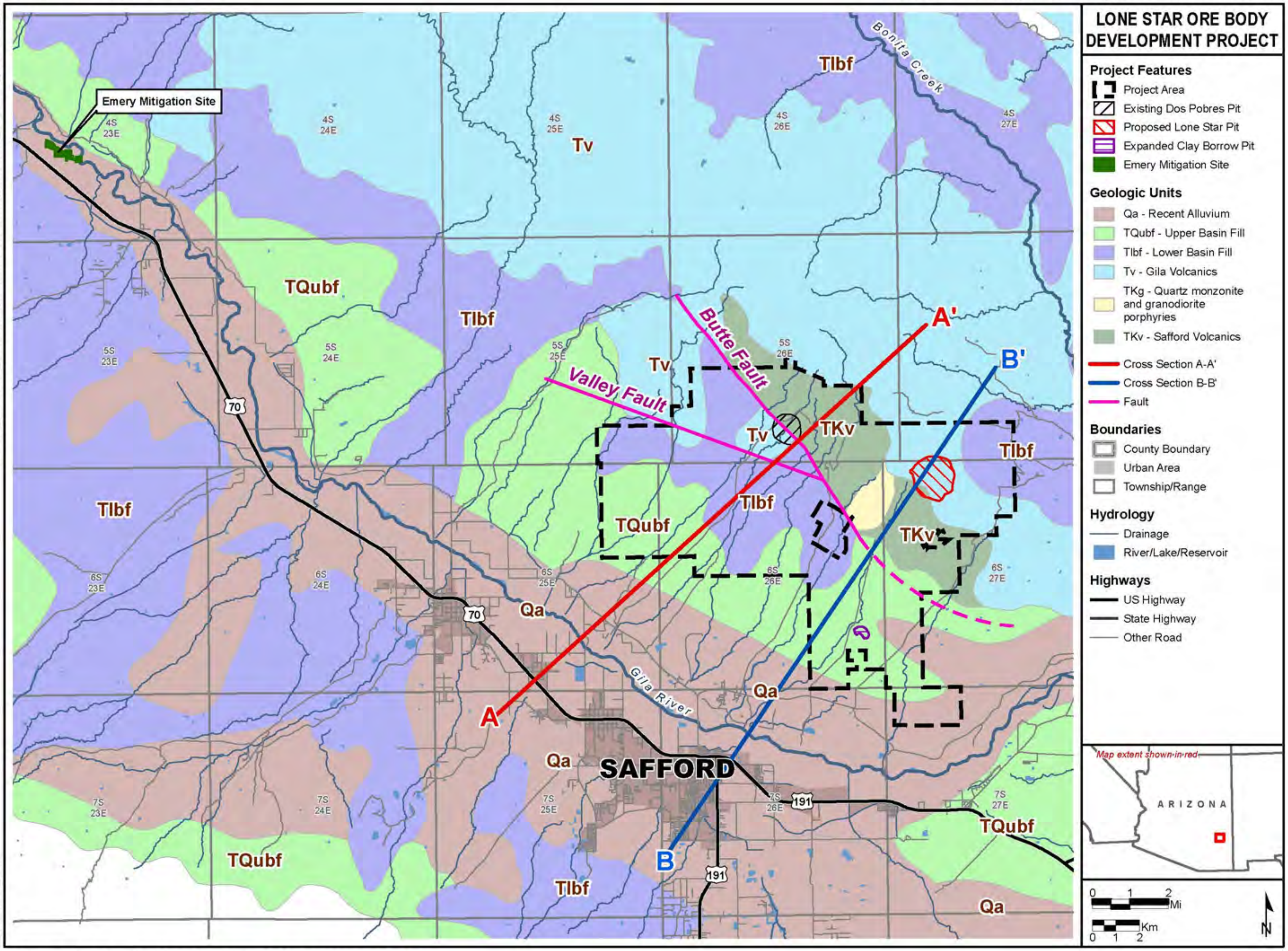

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Figure 3.1-1 Geologic Map of the Project Area conglomerate with boulder- to pebble-sized rock clasts composed of igneous rocks (map symbol Tlbf). Towards the basin, the LBF thickens and contains fine-grained lake and playa sediments composed of clay and evaporates (Gootee 2012) (**Figures 3.1-2** and **3.1-3**). The LBF is Miocene to Pliocene in age. The Upper Basin Fill (UBF) (map symbol TQubf) consists of clay-dominated fluvial deposits and were deposited from Pliocene to early Pleistocene.

- Holocene Alluvial Deposits—Holocene alluvium is associated with the Gila River and tributary washes and is composed of poorly sorted unconsolidated deposits with materials ranging in size from boulders to clay.

3.1.1.3 Geologic Structure

The Safford Basin was formed during the extensional Basin and Range block faulting during the Neogene 17 million years ago (Ma) (Hauser et al. 2004). In the Project Area, the Butte Fault is the major bounding fault between the Gila Mountains block and the Safford Valley (**Figure 3.1-1**). The Butte Fault is a normal fault which strikes northwest to southeast with the down-thrown side towards the basin. It is exposed in the Dos Pobres Pit and displacement in this area may be as much as 3,000 feet (BLM 2003). Other major faults in the Project Area are the Valley Fault and the Southwest fault. The Valley fault splays off the Butte Fault just south of the San Juan Pit and strikes to the northwest. The Valley Fault is a normal fault with the down-thrown side to the north. The area between the Butte and Valley faults is a down-dropped block of rock referred to as a graben (**Figure 3.1-2**). The graben is composed of Lower Valley Fill sediments and fragmented Gila Mountain Volcanics. The Southwest Fault is an inferred normal, down-to-the-basin fault located 3 miles southwest of the Butte and Valley Faults, but the fault is not exposed on the surface (BLM 2003). Changes in overall water quality have been offered for the existence of the fault, but the evidence is not conclusive.

In addition to the northwest striking faults, the other major structural features in the Project Area are northeast-to-southwest striking faults described by Cook and Robinson (1962). They referred to these features as “shearing” and are most prominent in the older volcanic rocks. They theorized that the shear zones may have influenced mineralization.

3.1.1.4 Geological Hazards

<u>Seismicity</u>

While Graham County has been the epicenter of a few relatively small earthquakes between 1830 and 2011 (Young and Brumbaugh 2012), the likelihood of a substantial earthquake (5 or greater) is very low. The largest was a 3- to 4-magnitude event on the south side of the Pinaleño Mountain Range approximately 20 miles southwest of the Project Area. Numerous earthquakes have been recorded between the Project Area and Lordsburg, New Mexico, along the Arizona-New Mexico state line (Arizona Geological Survey 2015; U.S. Geological Survey [USGS] 2015a). In the general vicinity there is an active fault zone that may be capable of generating strong earthquakes. The Safford fault zone is located along the eastern base of the Pinaleño Mountains 7 miles south of Safford, Arizona (USGS and Arizona Geological Survey 2006). Combined, the northern and southern segments of the fault zone are about 17 miles long. The southern segment turns southeastward and crosses US 191 east of Gillespie Mountain. The Safford Fault Zone is considered active because it cuts late Pleistocene valley fill deposits and the movement occurred less than 15,000 years ago (Pearthree 1996a,b). There are two other faults in the Safford Area, the Cactus Flat and Buena Vista faults. The Cactus Flat Fault is located about 3 miles south of Safford and crosses US 191. The Buena Vista Fault crosses US 191-70 about 7 miles east of Safford.

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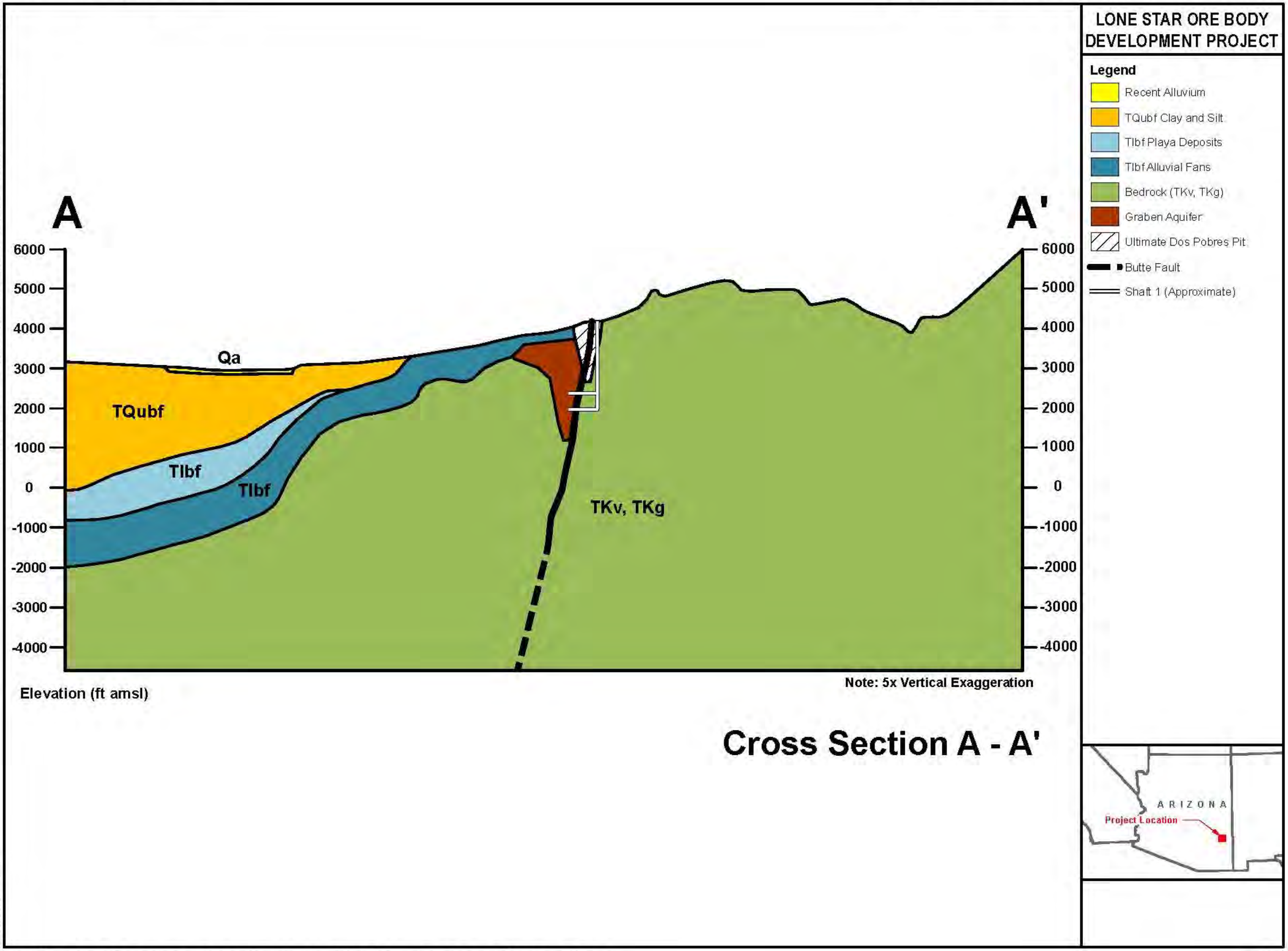


Figure 3.1-2 Generalized Cross-section (A – A') of the Project Area

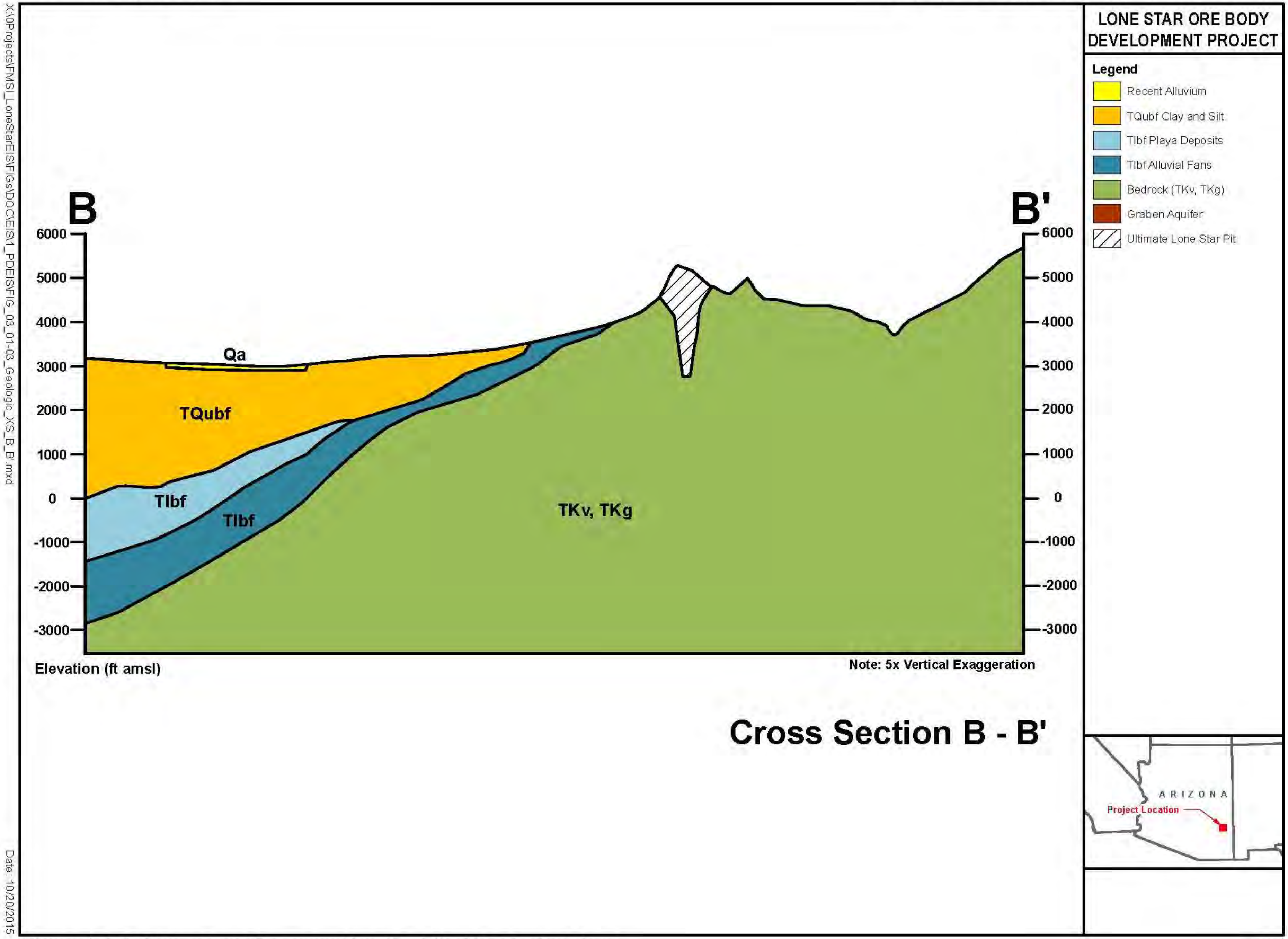


Figure 3.1-3 Generalized Cross-section (B – B') of the Project Area

The last movement of these faults appears to be less than 700,000 years ago, but are not considered to be active (Pearthree 1995a,b; USGS and Arizona Geological Survey 2006). Historical earthquake activity in southeastern Arizona has been low although the region is considered seismically active.

Other Hazards

Mass Wasting

Mass wasting is the downslope movement of large volumes of rock or earth materials and includes landslides and debris flows. Geologic mapping in the area has not identified landslide or other deposits indicative of unstable slopes (Cook and Youberg 2013; Houser et al. 1985). Debris flows are fast moving mass movements and carry large amounts of mud and rock materials. Heavy precipitation can generate flash floods and in turn create debris flows that come down through drainages. Flooding and debris flows can occur in major drainages along mountain fronts (Allison 2011).

Earth Fissures

Earth fissures occur in valleys of the Basin and Range area and are due primarily to the withdrawal of groundwater. As the water table declines, the unconsolidated valley fill materials can undergo compaction and subsidence (Allison and Shipman 2007). No earth fissures have been identified in the Project Area (Arizona Geological Survey 2015).

3.1.1.5 Mineral Resources

Copper

Historical Copper Mining

The copper deposits northeast of Safford, Arizona, comprise the Safford Mining District and include five oxide and sulfide copper deposits: San Juan, Dos Pobres, Lone Star, Sanchez, and Sol (Harris and Richard 1998). The Safford Mining District also has been referred to as the Lone Star District. Historic metal ore production has occurred in the district since 1886 (Robinson and Cook 1966). These deposits occur in a northwesterly trend along the Gila Mountain front.

The San Juan deposit was originally mined in the early 20th Century and production was sporadic into the 1970s (BLM 2003). Underground and surface mining were historically conducted at the San Juan deposit.

Exploration began at the Dos Pobres deposit in 1957 and a development shaft was begun in 1968 (BLM 2003; Langton and Williams 1982). Work was halted in 1982 due to unfavorable copper prices. Exploration at Dos Pobres in the early 1990s identified a leachable copper resource, primarily oxide, in the deposit.

At the Lone Star deposit, exploration was conducted from 1949 to 1952 by Consolidated Copper Mines and American Metal Company, Ltd. (Cook and Robinson 1962). Five boreholes were drilled in mineralized areas, but the copper that was encountered was low-grade. In 1956, the Bear Creek Mining Company (a subsidiary of Kennecott Copper), began exploration activities and when drilling indicated a large low-grade deposit at the Lone Star deposit, the company purchased the properties and sunk a development shaft in1961. The shaft was 804 feet deep with a 1,500-foot cross cut and 1,500-foot drift developed from 750 feet below the surface (Cook and Robinson 1962). Exploration activities at the Lone Star were conducted to the mid-1980s (BLM 2003).

The Sanchez deposit was discovered in 1899 and production was recorded from 1899 to the late 1930s (USGS 2009).From the 1960s to the 1990s, several mining companies looked at the deposit for possible production. A favorable record of decision for an environmental impact statement was issued in 1993 that covered a proposed plan of operations by AZCO Mining Inc. (BLM 1993). However, mining never occurred under the approved plan of operations and the property was acquired in 1995 by Phelps Dodge Corporation in (BLM 2003).The Sol deposit is the furthest south of the deposits that comprise the Safford Mining District. Exploratory drilling of the deposit was conducted by several mining companies including AMAX Exploration, Inc., Phelps Dodge Corporation, and Quintana Minerals (Yarter 1981). The deposit was deemed as uneconomic.

Current Copper Mining

In spite of the development and production that occurred into the 1970s, no mining appears to have been conducted from 1978 until 2007. In 1996, Phelps-Dodge, now Freeport-McMoRan, submitted an MPO to the BLM to develop the Dos Pobres and San Juan mines. A BLM EIS was completed in 2003 (BLM 2003) and the associated ROD in 2004 (BLM 2004), which authorized a land exchange to ensure that all of the surface and minerals were under private ownership. FMSI began production at the Dos Pobres Pit in 2007 and in the San Juan Pit in 2011 (FMSI 2015c). Known as the Safford Mine, the Dos Pobres and the San Juan pits are currently being mined. Copper production from the Safford Mine was reported to be 139 million pounds of copper in 2014, 146 million pounds in 2013, and 175 million pounds in 2012. Recoverable proven and probable reserves are reported to be 1.1 billion pounds of copper within the Project Area (FMSI 2015c).

Mineralization in the Safford Mining District

The Safford Volcanics were intruded by the quartz monzonite-granodiorite porphyry which resulted in the mineralization that created the copper deposits in the Project Area. Most of the production has come from veins in shear zones in the igneous rocks. The deposits consist of copper oxides and copper sulfides which are processed differently for mineral recovery (Clear Creek Associates 2015). Most of the copper ore (about 75 percent) in the Safford Mining District occurs in fractures in the Safford Volcanics and about 25 percent occurs porphyritic intrusions. The Lone Star deposit is the largest of the copper deposits in the Safford Mining District. The mineralization in the Lone Star ore body is about 1.5 miles in diameter and "several thousand feet deep" (Clear Creek Associates 2015). The Lone Star ore body is overlain by 400 to 800 feet of Gila Volcanics.

Geochemistry of the Lone Star Ore Body

FMSI completed a geochemical material characterization for the proposed Lone Star Project by testing the rock and ore to identify potential impacts to water quality from storage of the development rock and ore stockpiles, provide information to support closure planning, and to evaluate the analysis of the pit lake. The findings are detailed in the Lone Star Pit Lake Report, Lone Star Project, prepared for FMSI by MWH Americas, Inc., dated December 2014 (MWH 2014a), and the Material Characterization Report, Lone Star Project, dated December 2014 (MWH 2014b), summarized below.

The geochemical testing program is intended to identify and quantify the effects of sulfide mineralization when the rock is exposed to the atmosphere by the mining process. To evaluate the potential for acid generation of the rock in the Lone Star ore body, static geochemical tests implemented for the Lone Star Project include acid base accounting (ABA) and Net Acid Generation (NAG. As would be expected for mineralized rock that contains some sulfide minerals, some of the rocks are classified as non-acid-generating, some as uncertain, and some as potentially acid-generating. There were some conflicting results for ABA and NAG where one test indicates the rock is potentially acid-generating and the other test indicates the same rock is non-acid-generating.

Mineralogical and petrographic evaluations support the observation that some of the sulfide minerals present are not iron sulfide, which influences the interpretation of the ABA results. Also, the petrographic examination showed that up to 75 percent of the sulfide minerals present are encapsulated by aluminosilicate minerals, which limits the availability of sulfide surface for oxidation. This may cause the traditional static testing methods to indicate the rock is potentially acid-generating when in reality, there is not enough sulfide surface exposure to yield acid rock drainage. In this situation, sulfide oxidation is taking place, but the encapsulation lowers the effective sulfide content to values too low to produce acid rock drainage.

Water chemistry obtained from humidity cell testing (HCT) provides an independent test of the hypothesis that sulfide encapsulation effectively inhibits sulfide oxidation. As described in the Pit Lake report (MWH 2014a), there was essentially no production of acidity or a decline in pH and no measureable sulfate production. The HCT produced only limited mineral weathering as indicated by buffering of pH in HCT effluent and by low but steady production of calcium and magnesium. Results from the geochemical testing program indicate that the amount of sulfide available to react in the geologic deposits associated with the Lone Star Pit is insufficient to produce acid rock drainage.

After mining of the Lone Star Pit ends, dewatering will cease and the pit will begin to fill with water. A time-dependent dynamic systems model was developed to track the pit lake water balance, allowing evaluation of the probable steady-state water surface elevation. After conducting a sensitivity analysis, the probable long-term steady-state water surface elevation for the Lone Star pit lake would be approximately 3,200 feet amsl, or about 1,000 feet lower than the pre-mining groundwater level. This means that the Lone Star Pit would be a hydrologic sink with no outflow except evaporation from the pit water surface.

The chemical evolution of the Lone Star Pit also was tracked in order to predict the long-term water chemistry of the pit lake. Each source of water inflow had its water chemistry characterized based on available data. Most important to the pit water chemistry is the observation from the geochemical characterization program that the rocks exposed in the pit wall are unlikely to produce acid rock drainage. Based on the major constituent chemistry, the long-term pit water chemistry would result in saline water with a neutral pH and low concentrations of metals.

Aggregate

There are no large sand and gravel deposits in the vicinity of the proposed project, but large deposits are likely found in association with the alluvium of the Gila River (Allison 2011).

3.1.2 Environmental Consequences

3.1.2.1 Scoping Issues

During public scoping, the only concern raised related to geology and minerals was related to geochemistry and whether chemical contamination would leach from the development rock or mine pit.

3.1.2.2 Method of Analysis and Impact Indicators

Changes to topography and geology in the analysis area are described for each alternative and the potential changes in water quality from rock geochemistry are evaluated. Impact indicators are based on the amount of ore extracted and the amount of development rock stockpiled as well as impacts from ground-disturbing activities that would result in permanent or temporary impacts on topography, geology, and minerals.

3.1.2.3 Assumptions for Analysis

The following assumptions were made during analysis of impacts to geology and minerals.

- Development rock would remain in stockpiles and not be used to backfill the pit.
- Leachable copper ore would be fully extracted from the Lone Star Pit but mill-grade sulfides would not be targeted for extraction or processing at this time.

- Drainage from development rock and from exposed rock on edges of the open pit would not contribute to adverse effects to surface water or groundwater based on the geochemical analysis described in Section 3.1.1.5.

3.1.2.4 Alternative 1, Proposed Action

Within the analysis area, Alternative 1 would result in permanent and long-term temporary impacts on topography, geology, and minerals. The topography would be altered primarily due to mining the Lone Star Pit, which would have a surface area of 645 acres, and the establishment of the heap leach pad. The pit would be stabilized and remain after site reclamation. Development rock stockpiles near the pit would remain in place, occupying over 2,500 acres to the north, east, and south of the Lone Star Pit. Due to the low potential for generation of acid rock drainage and metals leaching, no adverse effects on surface water runoff flowing from the development rock stockpiles are anticipated.

Geological impacts would result from mining operations that would remove overburden (primarily Gila Volcanics) and copper ore from the Lone Star Pit. Therefore, the original characteristics of the strata in the mine areas would be permanently altered.

Permanent impacts to mineral resources would result from extraction of copper ore, relocation of development rock at the Lone Star Pit, and extraction of clay from the borrow pit. The clay borrow pit would be expanded by 48 acres from its current footprint, to have a surface area of 144 acres by the end of construction.

By the end of operations, the mine would permanently extract approximately 785 million tons of leachable copper oxide ore and relocate approximately 1.7 billion tons of development rock.

In compliance with the closure plan, some areas would be regraded and reclaimed, restoring the natural topography, but some areas such as the pit, development rock stockpiles, and clay borrow area would permanently alter the topography.

3.1.2.5 Alternative 2

The impacts from this alternative would be similar to the Proposed Action (Alternative 1) for geology, topography, and minerals. The primary difference between this alternative and the Proposed Action would be the location and size of the heap leach pad, which would not affect geology or minerals. Impacts on topography would be slightly greater due to the larger footprint for the heap leach pad that would ultimately be regraded and reclaimed.

3.1.2.6 No Action Alternative

While the existing heap leach pad and some of the roads and other facilities would be regraded and stabilized, most of the existing conditions would remain. Therefore, this alternative would have only a minor impact on topography, geology, or mineral resources upon completion of mining.

3.1.2.7 Potential Mitigation Measures

No additional mitigation measures would be needed.

3.1.2.8 Cumulative Impacts

The CESA would be the same as the analysis area for direct and indirect effects. The cumulative impacts of mineral extraction, development rock stockpiles, and construction of facilities for past mining and operations at the Dos Pobres and San Juan pits would combine with the proposed future mining of the Lone Star Pit and associated facilities to contribute to the long-term cumulative alterations of the topography, geology, and the minerals. The permanent extraction of copper ore and clay resources would contribute to an overall reduction in available mineral resources in the future. Copper sulfide would be more readily available for future extraction because the pits would not be backfilled.

3.1.2.9 Residual Adverse Effects

Residual adverse effects would occur gradually over the long term from the development of the permanent 645-acre Lone Star Pit, the development rock stockpiles, and the clay borrow pit that would remain unreclaimed. The other proposed facilities would be reclaimed according to the final approved closure and reclamation plan.

3.2 Water Resources

3.2.1 Groundwater

3.2.1.1 Affected Environment

Analysis Area

The analysis area considered in the EIS analysis for direct and indirect effects to groundwater resources includes the area within the 2014 groundwater model domain (AquaGeo, Ltd. 2015) depicted in **Figure 3.2-1**, which extends just beyond Bonita Creek to the northeast, and just beyond the Gila River to the south, covering an area of 23 by 25 miles. The analysis area also includes the Emery Mitigation Site.

Hydrogeologic Units

In the analysis area, there are four hydrogeologic units that include three aquifers and one confining unit (AquaGeo, Ltd. 2015):

1) Permeable zones in otherwise low-permeability igneous rocks, one of which is historically referred to as the Graben Aquifer;
2) A deep aquifer composed of lower basin fill (LBF) deposits, referred to as the LBF Aquifer;
3) The shallow aquifer associated with Holocene Fill deposits along the Gila River, referred to as the Holocene Fill Aquifer; and
4) A confining unit referred to as the Upper Basin Fill (UBF).

An aquifer is defined as “a formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs” (Lohman 1972). In this case, a confining unit consists of a body of impermeable or low-permeability material stratigraphically above one or more aquifers.

Graben Aquifer

The Graben Aquifer is an example of an aquifer that occurs in normally low-permeability igneous rocks where reasonable permeability has been created by fracturing. The Graben Aquifer is an important aquifer that occurs between the Butte Fault and the Valley Fault (AquaGeo, Ltd. 2015). It is composed of highly fractured volcanic rock and the fracturing has enhanced the permeability. This aquifer is an important source of water for the mine and wells drawing water have good productivity. Wells in the Graben Aquifer yield several hundred gallons per minute while wells in bedrock outside the Graben Aquifer generally have much less productivity. The Graben Aquifer resource area is shown on **Figure 3.3-2**. Water in the Graben Aquifer and bedrock areas outside of the graben flows to the southwest, with steep gradients coincident with the Butte Fault

Total dissolved solids (TDS) can be used as a general indicator of water quality. The Graben Aquifer water has generally low concentrations of TDS. The typical TDS range for water in the Graben Aquifer is 220 to 320 milligrams per liter (mg/L) (Clear Creek Associates 2015).

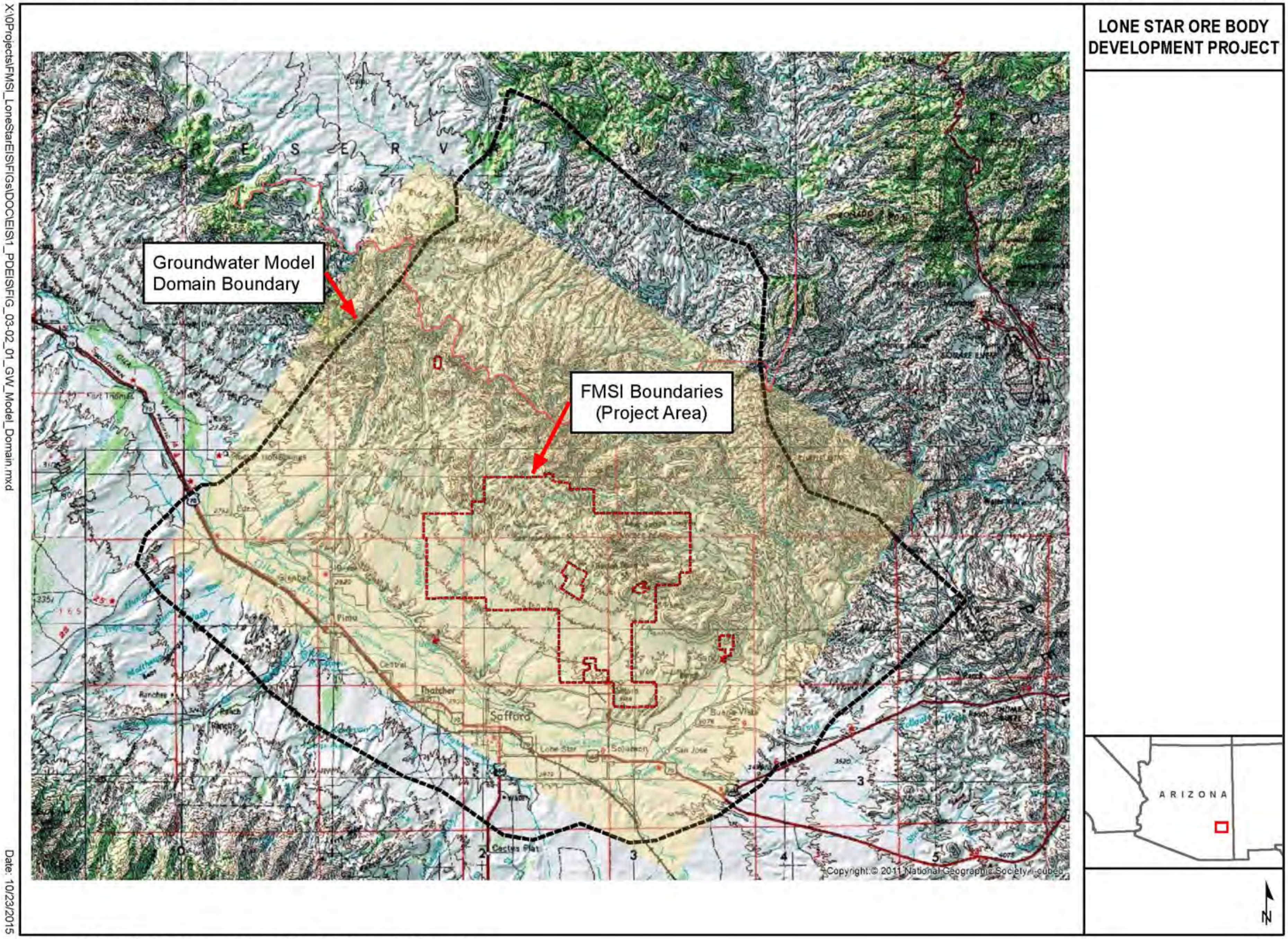


Figure 3.2-1 2014 Groundwater Model Domain Boundary

Lower Basin Fill Aquifer

The LBF Aquifer is composed of coarse-grained alluvial fan material (AquaGeo, Ltd. 2015). In the analysis area, the LBF Aquifer is 200 to 300 feet thick and groundwater flows to the southwest. Wells that monitor the LBF Aquifer are located in the LBF resource area southwest of the mine area (see **Figure 3.2-2**). Wells in the LBF Aquifer have open intervals that vary from 250 to 1,015 feet below land surface. One well (WW-02 on **Figure 3.2-2**) in the aquifer was tested at a yield of 1,100 gallons per minute (gpm). As reported by AquaGeo, Ltd. (2015), "the average permeability of the LBF Aquifer is 117,000 gallons per day per foot (gpd/ft) with a storage coefficient of 0.0044 and a specific yield of 0.028. At a thickness of 200 to 300 feet, the bulk hydraulic conductivity ranges from 52 to 78 feet per day (ft/day)."

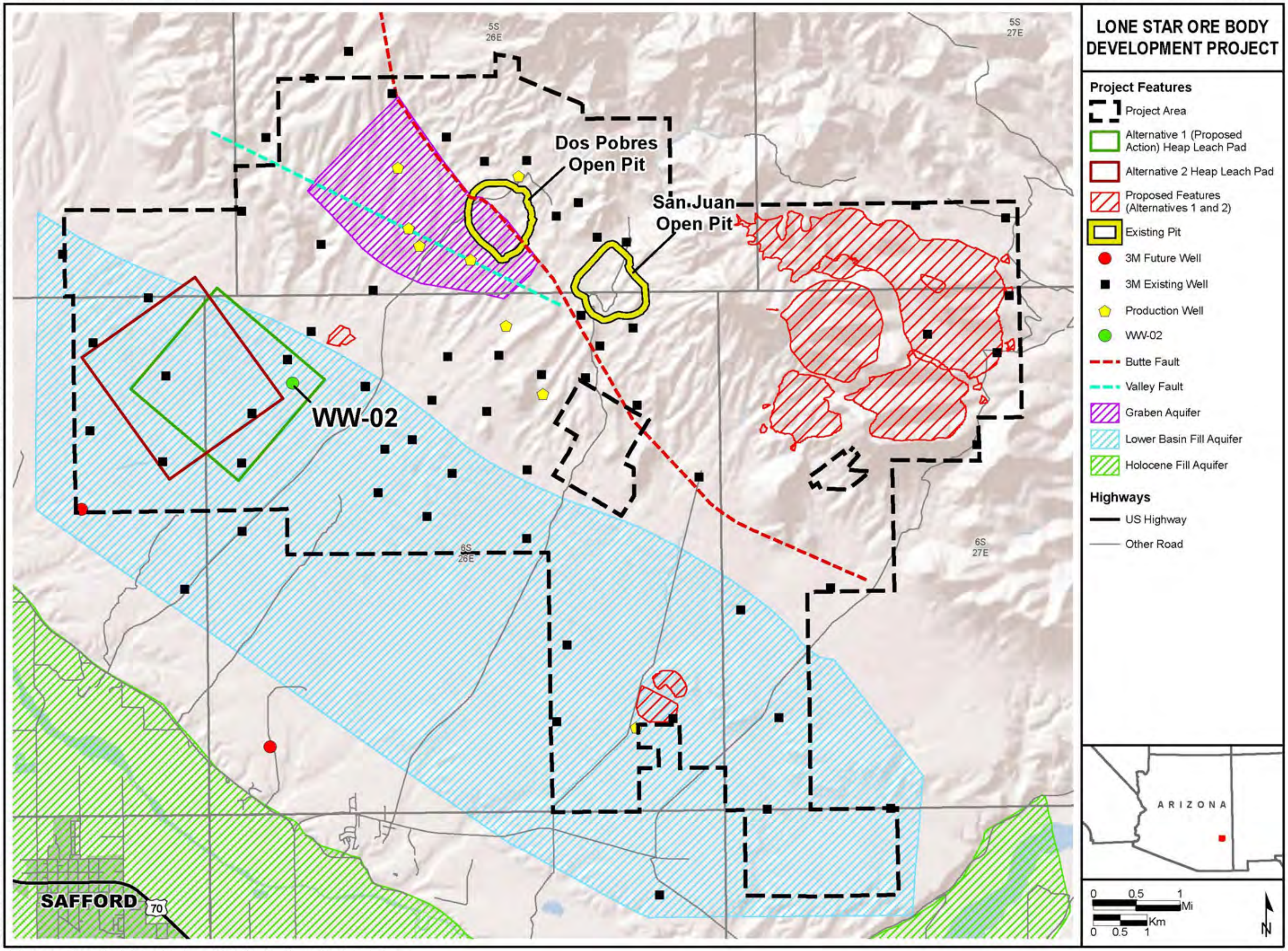
Groundwater in the LBF Aquifer in the vicinity of the proposed Lone Star heap leach pad has higher concentrations of TDS compared to the Graben Aquifer with concentrations typically ranging from 1,100 to 2,100 mg/L (Clear Creek Associates 2015). Water chemistry indicates a gradation from sulfate to calcium plus magnesium and from sodium plus potassium to calcium plus magnesium, which indicates that it contains water from various sources. Salinity appears to increase with depth, but with few data points it is not possible to demonstrate a positive correlation of depth and salinity (Gootee 2012). A deep well encountered salinity in the LBF Aquifer that exceeds 10,000 mg/L at a depth greater than 2,600 feet.

Upper Basin Fill

Overlying the LBF is the UBF, which is composed of fine-grained material that was deposited in a lacustrine (lake) environment and is largely composed of dense clay. Because of its composition, the UBF forms a confining unit over the LBF Aquifer causing artesian head pressure in this aquifer. The clay may be substantially more than 1,000 feet thick further west and south of Safford in the center of the basin (Gootee 2012). Permeability measurements were conducted in a laboratory on minimally-disturbed core samples of UBF clay collected from borings on the mine site and areas throughout the Safford Valley. Results indicated hydraulic conductivity values ranging from 4×10^{-6} to 5×10^{-10} centimeters per second (cm/sec) with an average of 1.8×10^{-9} cm/sec" (FMSI 2014a). The UBF water is not used within the analysis area. However, even if the UBF exhibits generally low permeability, it is possible to extract water from the unit, but not in usable quantities or of good quality. There are several springs (or seeps) and wells in the Gila Valley within or close to the analysis area (Gootee 2012). Salinity ranges from 3,351 to 120,000 mg/L and averages 31,700 mg/L. The water sampled from wells is from the UBF while the aquifer(s) of origin for the spring and seep samples were not determined (Gootee 2012).

Holocene Fill

Holocene Fill deposits are composed of irregular and discontinuous beds of gravel, sand, and fine-grained materials (Turner 1946). The location of the Holocene fill is shown on Figure 3.3-2. Where saturated, these deposits comprise the Holocene Fill Aquifer. The Holocene Fill Aquifer is isolated from the LBF due to the generally low permeability of the UBF (Clear Creek Associates 2015). In the analysis area but outside the Project Area, groundwater is found at shallow depths (less than 100 feet and commonly 20 feet below ground surface in the Safford-Pima area) in the Holocene Fill Aquifer, which is the primary source of water for agriculture in the area near the Gila River (Arizona Department of Water Resources [ADWR] 2009; AquaGeo, Ltd. 2015). Although TDS in some places has been measured at less than 500 mg/L, TDS concentrations commonly range from 1,000 to 3,000 TDS (slightly saline) (Turner 1946). Holocene Fill Aquifer measurements indicate that TDS values fluctuate over long periods. In 1995, sampled wells indicated TDS values ranged from approximately 500 to 1,500 mg/L (ADEQ 2009). The same wells in 2004 showed a range of concentrations from 1,000 to 3,000 mg/L TDS. Concentrations of TDS can vary over time due to upward leakage and irrigation recharge. In the Safford area, well yields from the Holocene Fill Aquifer are commonly in the 1,000 to 2,000 gpm and several wells have yields in excess of 2,000 gpm (ADWR 2009).



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Date: 5/16/2016

Figure 3.2-2 Monitoring Wells in the Project Area

The source of groundwater at the Emery Mitigation Site is the Holocene Fill Aquifer. Water levels in nearby wells range from approximately 20 to 40 feet below the ground surface (ADWR 2009).

Groundwater Model and Monitoring

The Model, Monitor, and Mitigate (3M) Program for groundwater in the mine area and vicinity is being implemented in accordance with the Dos Pobres/San Juan Project CWA Section 404 Mitigation and Monitoring Plan, described in the Dos Pobres/San Juan Project Final EIS (BLM 2003; AquaGeo, Ltd. 2014). The USGS provides support in the form of technical review of annual reports, conducts biennial sampling of wells for water chemistry analyses, and is the host for the 3M Program website. Under the 3M Program, monitoring wells were placed to monitor the LBF Aquifer, the Graben Aquifer, the groundwater level in the vicinity of the future Lone Star Pit, and the groundwater level at Pima Gap next to the boundary of the San Carlos Apache Reservation. The 3M program monitoring wells are shown on Figure 3.2-2. The monitoring is used to fine-tune a groundwater model that was originally developed in 2002 (AquaGeo, Ltd. 2014). Monitoring has been conducted since 2002 and annual reports are available at http://az.water.usgs.gov/projects/9671-BGJ/index.html. Monitoring and model results are briefly summarized below.

Groundwater Pumping

Pumping from mainly the Graben Aquifer prior to mining occurred at rates that ranged from 40 to 680 gpm (AquaGeo, Ltd. 2014). In 2012-2013, pumping averaged 1,800 gpm, which is a rate that is slightly less than half of the rate that was simulated for the Final EIS model (BLM 2003). No substantial pumping was reported from the LBF Aquifer.

Water Levels

Water levels declined for most of the monitoring wells consistent with pumping, with a few exceptions. Water level rises have occurred periodically in a few wells over time and are thought to have been in response to a combination of alteration of surface terrain by mine construction and recharge from anomalous precipitation events (AquaGeo, Ltd. 2014). Water levels in several monitoring wells completed in the LBF Aquifer were documented to be rising between 2005 and 2011. This rise was most likely due to recovery after pumping related to underground mining during the 1970s and 1980s and to pumping in 1996 related to groundwater exploration work. Large declines have occurred in wells near the Butte Fault and the greatest declines have occurred in the Graben Aquifer where pumping has been more intense. Lesser declines have occurred in wells outside of the Graben Aquifer. Over the observation period (2007 – 2013), declines have ranged from 0 to almost 103 feet and are probably due to mine pumping.

There are nearly 1,000 wells in the analysis area. Of these, 170 are exempt from state permitting for water use (e.g., less than 35 gpm) or designated for domestic uses and 310 are designated non-exempt (e.g., greater than 35 gpm or for irrigation use). Nearly 500 wells are monitoring or exploratory wells.

Groundwater Model

According to the most recent monitoring report (AquaGeo, Ltd. 2014): “The intent of the 3M Program is to provide a representative groundwater model that can reliably predict future effects of mine pumping on the groundwater system. The available data indicate that stresses from mine pumping remain relatively localized within and near the Graben Aquifer and have not had wider impacts on other regional aquifers.”

In order to obtain more reliable predictive results, the model has been updated to accommodate the considerable information gathered under the 3M Program and other investigations (AquaGeo, Ltd. 2015). The updated model is referred to as the 2014 Model (AquaGeo, Ltd. 2015). An increase in future pumping is anticipated to meet increased mine and ore processing demands. Additional groundwater would be pumped from the LBF Aquifer to meet the increased demand (AquaGeo, Ltd. 2015).

Groundwater may also be pumped from the Lone Star Pit, if necessary to keep the pit dewatered during mining.

3.2.1.2 Environmental Consequences

Scoping Issues

During external scoping the Corps identified impacts to water quality and water quantity as issues to be analyzed in depth in the EIS, including the following concerns: 1) the potential for and effects of movement of any contaminated surface water to the subsurface, including through the pit bottom; and pollution from storm water runoff; 2) impacts to the Gila River or other aquatic resource of national importance (ARNI); and 3) impacts to water resources that would affect the Gila Box RNCA, the Bonita Creek watershed, and other wetland and riparian habitats (Corps 2015).

Method of Analysis and Impact Indicators

Alternative scenarios are compared based on the results of the numerical finite-element 2014 Model (AquaGeo, Ltd. 2015). The model calculated the potential changes in water volume contributed from the potentially affected aquifer systems to surface water bodies which provide impact indicators to the Gila River and Bonita Creek.

Assumptions for Analysis

Assumptions used for analysis are based on a “three-pit scenario” for Alternatives 1 and 2 and a “two-pit scenario” for the No Action Alternative. The “three-pit scenario” involves the following assumptions (AquaGeo, Ltd. 2015):

- Most of the water in the three-pit scenario would be pumped from the LBF Aquifer, but water would continue to be produced from the Graben Aquifer and other permeable zones in the igneous bedrock to supply demand for potable water.
- Water demand of up to 4,600 gpm from the aquifers listed above would continue until the estimated cessation of mining and heap leach operations in approximately 2048.

The assumptions for the analysis of the two-pit scenario are listed below (AquaGeo, Ltd. 2015):

- Pit lake effects predicted by the original groundwater model (URS 2002) would be valid for the two-pit scenario.
- Pumping would continue until approximately 2024, when residual leaching is expected to end several years after mining at the San Juan and Dos Pobres pits ceases.

The analysis for groundwater resources relies heavily upon the assumption that the Lone Star Project would be developed in compliance with existing pertinent regulations. Foremost is the APP Permit and the application of BADCT (ADEQ 2005) for the mining facilities, as discussed in Section 2.3.4.6.

Impacts Common to All Action Alternatives

The potential groundwater impacts are the same for Alternatives 1 and 2 and are described in the following subsections.

Groundwater resources may be directly and indirectly impacted by the Project through changes in the water quantity and quality. Either of these impacts may in turn affect other users of the groundwater or other resources that depend upon the groundwater. Other resources potentially include riparian vegetation and aquatic wildlife species that depend upon contributions to surface water flows from groundwater. Impacts specific to riparian areas are discussed in Section 3.3, and to aquatic resources are discussed in Section 3.7.

Groundwater Quantity

Alternatives 1 and 2 would require an additional water supply proposed to come largely from the LBF Aquifer for heap leach pad operations and dust control. There are no known users of the LBF Aquifer in the analysis area. Utilizing this higher TDS water would minimize adverse impacts to the quantity of current good quality water sources used for domestic, livestock, or irrigation water. Groundwater would be extracted at an average annual rate of up to 4,600 gpm, a 100 percent increase over current average mine-related use. Reliance on the Graben Aquifer would continue for particular uses where potable or other good quality water is required; however, the LBF Aquifer pumping would provide most of the needed water for the Lone Star Project. The water demand would continue until the proposed mine and heap leach pad operations cease around 2048.

Based on the 2014 Model, the total groundwater reduction of flow to the Gila River from the 3-pit scenario is conservatively estimated to be 133 af/yr. Modeled pumping and pit lake effects would peak at different times in the future and are projected to be less than 133 af/yr combined at any one point in time. For example, peak pumping-related effects are projected to be 58 af/yr approximately 82 years after pumping began in 2006. The predicted maximum local effects on the Gila River from mine-related groundwater pumping and pit lake evaporation would not exceed 0.003 percent of the available surface water in the river.

The projected maximum of 133 af/yr reduction of groundwater to the Gila River from pumping and pit lake evaporation, plus the estimated reduction in stormwater runoff due to mine capture (189 af/yr) (AquaGeo, Ltd. 2015), would total 322 af/yr. The current fallowing program would compensate for this flow reduction in the Gila River by providing approximately 1.5-times the water that would be reduced by the proposed mining operations (AquaGeo, Ltd. 2016). The 2014 Model predicts that groundwater flow would not be affected across the boundary of the San Carlos Apache Tribe (AquaGeo, Ltd. 2015).

Groundwater modelling predicts that the groundwater contribution to Bonita Creek would decrease by less than 1.3 af/yr at the peak impact 300 years after mining began in 2006. This reduction in flow would occur along an approximately 3-mile stretch of Bonita Creek, but its effect on the Gila River would be so small (0.007 percent of available water) as to be impossible to measure (AquaGeo, Ltd. 2016). The modelling also shows there would be no drawdown to the water table at Bonita Creek.

The following changes to groundwater are expected to occur at the peak of impact to the Gila River (82 years after pumping began in 2006), due to mine-related pumping and dewatering, according to the 2014 Model (AquaGeo, Ltd. 2015):

- A water table decline of 500 feet would occur in the vicinity of the Graben Aquifer.
- A predicted water table decline of 250 feet in the vicinity of the Lone Star Pit.
- The potentiometric heads in the LBF Aquifer would decline about 85 to 90 feet.
- No measureable decline in the water table of the Holocene Fill Aquifer would occur.

Additionally, creation of a new mine pit would affect groundwater elevations if the pit were to extend below the existing groundwater elevation. Pit dewatering or evaporation from the surface of a pit lake also would lower groundwater elevations, acting as an additional demand on the groundwater system.

The current irrigated crop fallowing program that is being operated by FMSI has been designed to offset both the groundwater contribution and surface water stormflow decreases from the mine to the Gila River. This program fallows a minimum 200 acres of active cropland annually, on a rotational basis, which leaves approximately 480 acre-feet per year of water in the Gila River that would have otherwise been diverted for irrigation and consumed by crops (AquaGeo, Ltd. 2015). The fallowing program compensates for other water uses in the present time by reducing total peak impacts from groundwater usage long before the peak is modelled to occur decades later.

Groundwater Quality

Hem (1950) describes how water of poor quality from deep groundwater sources may degrade the quality of shallow groundwater and surface water. As a result, any potential reduction in water contribution from the LBF Aquifer to other aquifers or surface water streams would reduce a source of poor quality water influx, thereby potentially improving the water quality of those other water sources over time.

Groundwater quality could be impacted through contamination of recharge water that is infiltrating to aquifers or through migration of accidentally released hazardous materials. Surface waters that infiltrate, or soak, into the ground percolate through the soil and geologic materials to recharge groundwater. If this recharge water contains contaminants on the surface, those contaminants are likely to leach through the soil and find their way to the groundwater eventually. Potential sources of contaminants from the proposed Project include the fluids used in the heap leach and SX/EW processes, metals and other materials present in the mine pit and development rock stockpiles that could be leached into water during rain events, and hazardous materials associated with operating mining equipment and motor vehicles.

Contamination of groundwater would be avoided through operation of the proposed zero-discharge system of water management, and through adherence to the SPCC Plan and APP Program. The APP program was established by the Arizona Environmental Quality Act of 1986 (Arizona Water Resources 1987). APP rules were implemented in 1989 and require that any facility that discharges directly or indirectly to an aquifer must obtain a state permit. The program requires the application of Best Available Demonstrated Control Technology (BADCT) which calls for “evaluation of site-specific engineering, environmental, and economic criteria” to achieve the greatest possible reduction in discharge (ADWR 2014). The program also requires compliance with aquifer water quality standards measured at a designated point of compliance. The proposed mitigation at the Emery Mitigation Site would have no impacts on groundwater under Alternatives 1 and 2. Mine pumping would have no impact on the Holocene Fill Aquifer that underlies the Emery Mitigation Site.

<u>No Action Alternative</u>

Under the No Action Alternative, the current mining processes would continue and the existing rate of withdrawal of groundwater would continue to supply make-up water for the current leaching operation. From 2008 to 2014, an average of 2,300 gpm was extracted from the Graben Aquifer for the heap leach pad operation (AquaGeo, Ltd. 2015) The following paragraphs describe the major impacts under the No Action Alternative.

Current mine operations do not reduce groundwater contributions to Bonita Creek when compared to the pre-mine conditions, but the groundwater model predicts that they do reduce groundwater contributions to the Gila River by a maximum of 54 af/yr through groundwater pumping and pit lake evaporation, which is less than 0.08 percent of the estimated base flow of the Gila River (AquaGeo, Ltd. 2015, Table 1). Peak groundwater impacts to the Gila River under the No Action alternative are not predicted to occur for about 105 years. The existing fallowing program provides nearly 4 times the amount of water that is reduced by groundwater and surface water impacts (total of 125 af/yr) to the Gila River from the current mining operation (AquaGeo, Ltd. 2015) so potential adverse impacts to Gila River flows are offset.

Under the No Action Alternative, at the peak of groundwater impact to Gila River (estimated to be 105 years after mine pumping began in 2006), the 2014 Model predicts the following groundwater level effects would occur due to mine-related pumping:

- Water table declines from 250 to 500 feet would occur in the vicinity of the Graben Aquifer.
- The potentiometric heads LBF Aquifer would decline about 20 to 25 feet.
- No measureable decline in the water table of the Holocene Fill Aquifer would occur.

Groundwater flow across the boundary of the San Carlos Apache Tribe would be unaffected by groundwater pumping for mining.

The 3M program would continue to monitor groundwater quantity to assess the need for adaptive management measures.

3.2.1.3 Potential Mitigation Measures

No additional mitigation measures are recommended for groundwater resources.

3.2.1.4 Cumulative Impacts

The groundwater CESA is the same area used as the analysis area for direct and indirect impacts. Because the alternatives propose to obtain additional water needs from the LBF Aquifer, this would increase demand on that aquifer but would avoid increased demand on the highly utilized Holocene Fill Aquifer, the Graben Aquifer, and other permeable zones in the igneous rocks. The cumulative impact to the Gila River from reduced flows due to declining contributions from groundwater would be expected to remain relatively constant as the mining in the area progresses, as the Dos Pobres and San Juan pits are completed and mining of the Lone Star Pit is underway. These impacts would continue to be offset by the irrigated crop fallowing program implemented under the 3M Program.

3.2.1.5 Residual Adverse Effects

Localized reductions in groundwater elevations would occur around supply wells in the aquifers in which the wells are completed. These reductions would persist until mining and heap leach pad operations cease and the wells are no longer operated at which time groundwater elevations would begin to rebound as water recharges the affected aquifers. Additionally, localized reductions in groundwater elevations would occur around the mine pits if the pits extend below the groundwater level and pit lakes form. Reduced water elevations in the area of the pits would occur long-term due to groundwater discharge to and evaporation from the pit lakes.

3.2.2 Surface Water

3.2.2.1 Affected Environment

<u>Analysis Area</u>

The proposed project is located within the portions of Cottonwood Wash and Yuma Wash watersheds that are north of the Gila River. FMSI identified nine washes or drainages to be modified by the proposed project that fall within the Butler Wash, Watson Wash, Peterson Wash, Lone Star Wash, and Dry Canyon Wash subwatersheds (**Table 3.2-1**). The portions of these subwatersheds north of the Gila River and south of Bonita Creek is the geographic extent of the surface water analysis area, which is depicted in **Figure 3.2-3**. For purposes of the analysis, both the Gila River and Bonita Creek are considered within the analysis area where they occur along the analysis area boundary. Also included in the analysis area is the Emery Mitigation Site, which is located approximately 25 miles downstream of the Project Area, within and directly adjacent to the Gila River floodplain. This site is located within the Upper Gila Basin in the Day Mine Wash-Gila River Subwatershed, which is separate from the mine site.

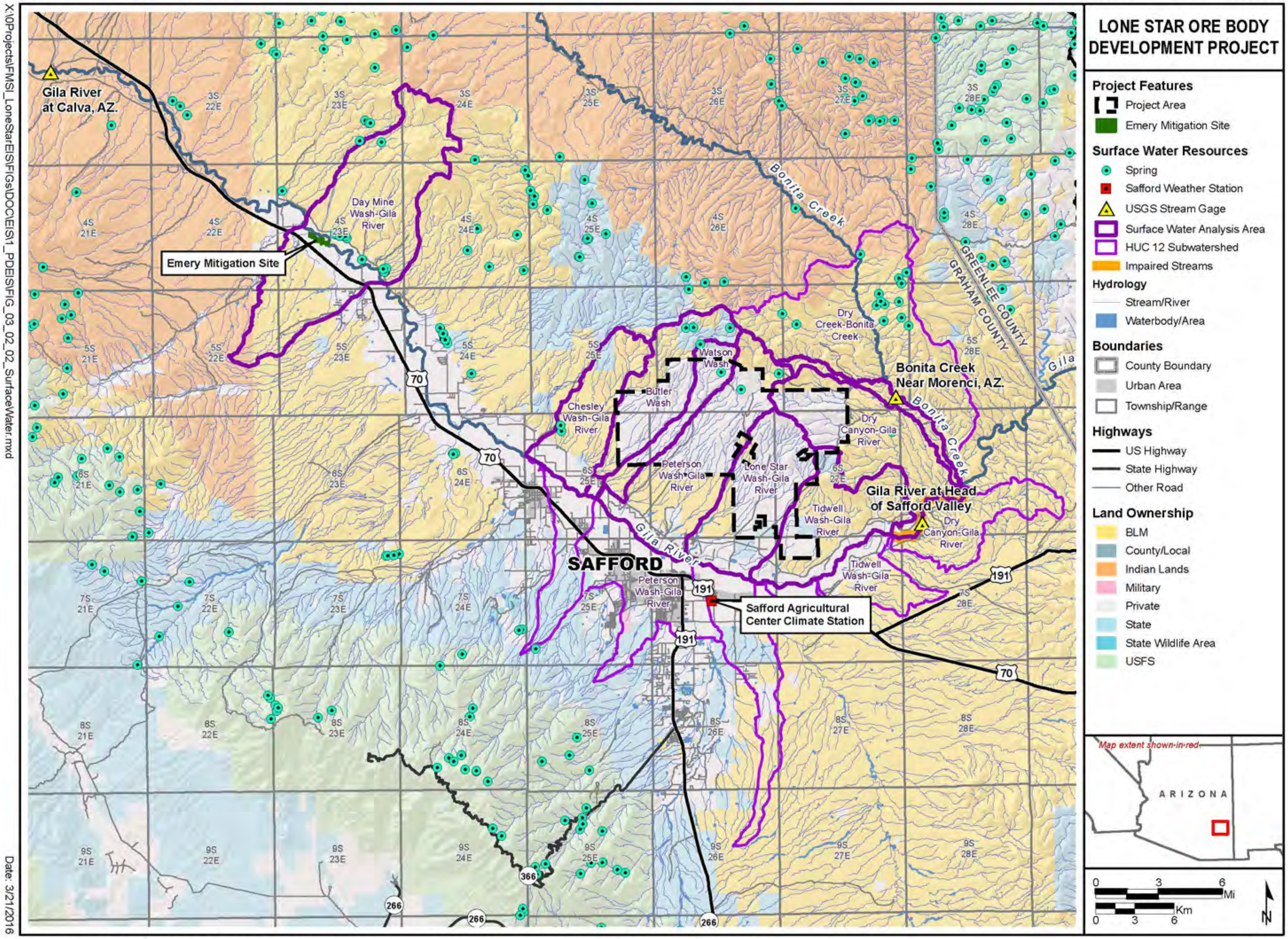

Figure 3.2-3 Surface Water Analysis Area, Subwatersheds, and Water Resource Features

Table 3.2-1 Hydrologic Unit Codes Containing the Analysis Area

Region Name	Basin Name	Watershed Name	Subwatershed Name	Modelled Wash/Drainage Name(s)	HUC12	HUC12 Total Acres	Analysis Area Acres
Lower Colorado	Upper Gila	Bonita Creek	Dry Creek-Bonita Creek	na	150400050408	35,995	3,048
		Yuma Wash-Gila River	Dry Canyon-Gila River	Dry Canyon; Bear Springs	150400050503	18,519[1]	4,698
		Cottonwood Wash-Gila River	Lone Star Wash-Gila River	Wilson; Lone Star	150400050701	16,755[1]	9,976
			Watson Wash	Watson	150400050704	5,816	3,723
			Peterson Wash-Gila River	Talley; Cottonwood; Peterson	150400050705	21,699[1]	9,355
			Butler Wash	Butler/Coyote	150400050706	12,889	6,177
		Goodwin Wash-Gila River	Day Mine Wash-Gila River	na	150400050906	35,439	na

[1] Total acres of HUC12 excludes area south of Gila River.

Source: Bowman Consulting 2014; U.S. Department of Agriculture (USDA)-NRCS et al. 2010.

Hydrology

The Safford Agricultural Center climate station is located approximately 8 miles south of the proposed Project, where it reports an average of approximately nine inches of precipitation per year (Western Regional Climate Center [WRCC] 2015). Nearly half of that average annual precipitation (4.3 inches) occurs during the late summer months of July, August, and September due to the heavy rains coming from convective, monsoonal storms that occur in the region.

Drainages within the Project Area are ephemeral in nature, only flowing through the Project Area and into the larger analysis area in response to precipitation events.

The Gila River is found along the southern edge of the analysis area, and one stream gage is located along this reach (Gila River at Head of Safford Valley). Several other gages outside the analysis area are reported including two additional gages on the Gila River, one upstream (Gila River near Clifton) and one downstream (Gila River at Calva) from the analysis area, and a gage to the north of the analysis area on Bonita Creek. Average monthly streamflows from these four gages are graphed in **Figure 3.2-4**.

Streamflow in the Gila River shows spatial trends where it increases in flow between the Clifton and Safford gages, then decreases at the Calva gage (USGS 2015b). This indicates that the river begins to lose flow to one or more sources, including water use diversions for irrigation (ADEQ 2015) and likely groundwater recharge. There also is an annual temporal trend exhibited in the flow of the Gila River; low-flows occur in mid-summer, with average daily flows dropping below 100 cubic feet per second (cfs) at the Safford gage and below 20 cfs at the Calva gage (USGS 2015b). Higher flows are exhibited during the monsoonal rain season of late summer, and peak flows occur on average in February or March. Average daily high-flow is near 500 cfs for the Clifton gage, and over 1,000 cfs for the Safford and Calva gages. Storm-flows exceed these averages by nearly two orders of magnitude: the peak average daily flow recorded during the periods of record at these gaging stations is nearly 30,000 cfs at Clifton (December 1979) and 90,000 cfs at Safford and Calva (October 1984) (USGS 2015b). These flows also demonstrate the spatial variability of the storms occurring, because in the case of the 1984 high-flow event, the flows at Clifton only rose to 8,200 cfs indicating much less intense precipitation at or upstream of that area. Over 80,000 cfs entered the Gila River from tributary streams or direct runoff between Clifton and Safford (28 river miles) during that storm event. Tributaries in that reach include the San Francisco River, Eagle Creek, and Bonita Creek. Bonita Creek is a small, gaged, perennial stream along the northern edge of the analysis area that exhibits similar temporal trends and variability as the Gila River, but with much lower flows. Average monthly flows at the Bonita Creek gage range from 34 cfs in January to 2.7 cfs in June (USGS 2015b).

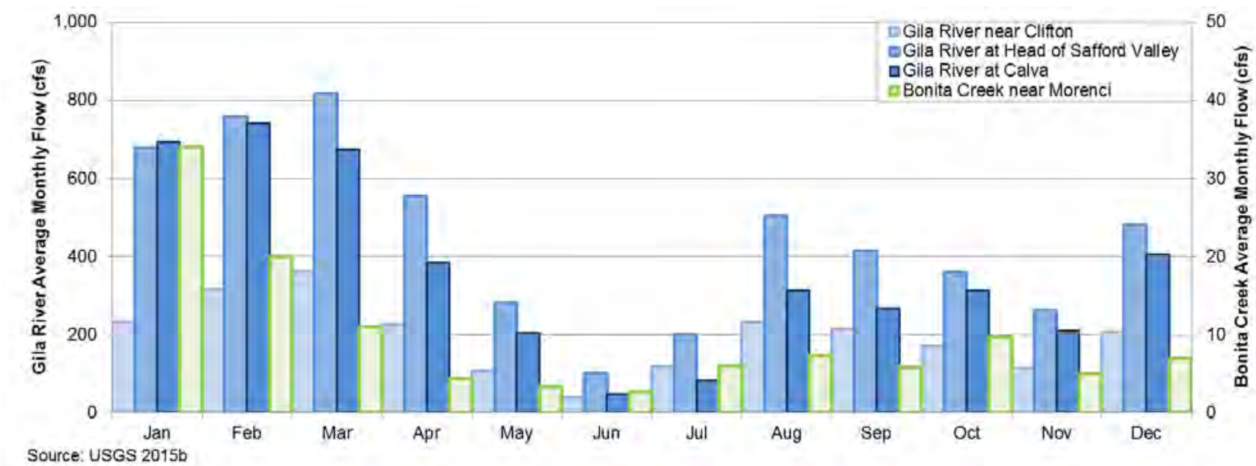

Figure 3.2-4 Average Monthly Streamflows in Gila River and Bonita Creek near the Analysis Area

Water Quality

Along the southern eastern edge of the analysis area, the Gila River from Bonita Creek to Yuma Wash (upgradient from the Project Area) has been identified to have elevated levels of lead, *Escherichia coli* (E. coli) bacteria, and suspended sediment concentrations. The elevated lead concentrations have been given a low priority for development of a total maximum daily load (TMDL) by ADEQ (2015). TMDLs have been developed for both E. coli and suspended sediment concentrations for this reach of the Gila River, established in 2012 and 2013, respectively (ADEQ 2013, 2012). No other streams within the analysis area are identified as having water quality impairments.

Water Use

The right to use surface water in Arizona is based upon a version of the prior-appropriation doctrine (first in time, first in right), and there is an ongoing adjudication for the Gila River system that includes the analysis area, that is based on the Globe Equity Consent Decree No. 59 and the Arizona Water Settlements Act (Public Law 108-451). The settlement was enacted in 2004 and incorporated into the decree per the Gila River Adjudication Court in 2007 (ADWR 2010).

ADWR data was consulted regarding surface water use in the analysis area (ADWR 2015, 2014). There are approximately 200 surface water rights filed in the analysis area as points of use or diversion. Of these, there is 1 municipal use (City of Safford), 42 domestic uses, 185 stock uses, and 47 irrigation uses.

3.2.2.2 Environmental Consequences

Scoping Issues

During public scoping, the following concerns related to potential impacts to water quality and water quantity to be analyzed in the EIS were identified.

- Impacts to waters of the U.S.
- Impacts to the Gila River or other ARNI.
- Impacts to water resources that would affect the Gila Box RNCA, Bonita Creek watershed, and other wetland and riparian habitats.
- Potential for contamination of meteoric water (water that comes from precipitation) via existing and proposed development rock stockpiles, heap leach pad, roads, and other mine facilities.
- Potential for and effects of movement of any contaminated surface water to the subsurface, including through the pit bottom; and pollution from stormwater runoff (Corps 2015).

Impacts to waters of the U.S. are discussed in Section 3.5, Wetlands, Riparian Habitat, and Waters of the U.S. Only a small portion of the Gila Box RNCA and none of the Bonita Creek watershed are within the surface water resources analysis area because it would not be impacted by the action alternatives due to their location upstream from the Project Area, where no runoff would affect them. Movement of water, including contamination, to groundwater systems is addressed in Section 3.2.1, Groundwater.

Method of Analysis and Impact Indicators

The method of analysis for surface water resources includes the following items.

- Assessment of impacts to surface water quantity and quality from changes to stormflows. A peak flow analysis produced modelled stormflows for multiple duration storm events using the WIN TR-55 program (Bowman Consulting 2014a). This allows for the comparison of modelled stormflows based on the pre-mining condition, current condition, as well as the effects of surface water diversions under Alternatives 1 and 2.
- The amount of disturbed land that has the potential for accelerated erosion providing a sediment source to downstream waters has been identified for each alternative.
- Qualitative discussion of accidental releases of hazardous materials, water chemistry, and water use also are included.

Assumptions for Analysis

The analysis for surface water resources relies heavily upon the assumption that the project would be developed in compliance with existing pertinent regulations. It also is assumed that the project's "zero-discharge" system would capture all runoff from the areas within the boundaries of the proposed development rock stockpiles, heap leach pad, and associated facilities.

Impacts Common to All Action Alternatives

Impacts common to all action alternatives would include physical changes to runoff patterns including alteration of waters of the U.S., increased water use, accelerated erosion and sedimentation from bare ground, potential changes in water chemistry within the "zero-discharge" area from contact with development rock and ore processing facilities, and the risk of accidental releases of hazardous materials reaching downstream waterbodies. The changes to runoff patterns and potential water chemistry changes would be long-term effects. Impacts from surface disturbance, increased water use, and risk of accidental releases would end after the mining and leaching operations concluded and final reclamation is established according to the final closure plan.

As described in Section 2.3.4.1, the mine process facilities would be constructed as “zero-discharge” facilities. Fluids coming into contact with proposed development rock stockpiles, heap leach pad, and associated facilities would be contained onsite, avoiding impacts to water resources. Design of the “zero-discharge” facilities accounted for handling up to the 100-year/10-day storm event. Mine process solutions and stormwater runoff from the heap leach pad would be captured in the solution impoundments, and routed through the SX/EW process and eventually reused as makeup water in the leaching process. Stormwater runoff from the development rock stockpiles would be captured by retention ponds located a short distance downgradient of each stockpile, and would either be evaporated or seep into the ground.

The stormwater diversion facilities upgradient of the heap leach pad would modify the existing runoff patterns and avoid or minimize impacts to water resources from discharges of pollutants by diverting stormwater before it comes into contact with process water and decreasing flows in the “zero-discharge” areas. Clean stormwater runoff from watersheds upgradient of the heap leach pad would be diverted through structures, emptying into nearby drainages. The receiving drainages would experience increased flows during runoff events, which could create increased erosion and channel instability effects in these drainages. The increased flows and channel instability could create concerns for downstream infrastructure, such as roads and structures located in or near drainage channels. The SWPPP (see Section 2.3.4.2) would address the structural and non-structural control measures to be employed to meet stormwater discharge requirements. Locations of stream channels upgradient of the proposed facilities would not be impacted; however, stream channels downgradient would experience indirect impacts due to the changes in runoff patterns.

Water quality impacts to water resources from stormwater runoff flowing over or through the heap leach pad would be avoided by the proposed “zero-discharge” system. Similarly, runoff from the development rock stockpiles would be captured and not allowed to continue downstream to unaffected surface waters. Stormwater runoff from other surface disturbance in upland areas, such as construction of the haul roads, the vehicle service complex, clay borrow pit, and power distribution infrastructure would have accelerated erosion rates that would result in locally increased suspended sediment concentrations compared to the undisturbed uplands. The SWPPP would contain measures to control and minimize this erosion so that it would not transport sediment offsite. Accidental releases of hazardous materials from mining equipment and facilities would be a potential risk to water quality if a spill were to occur in a location or of a volume that reaches a waterbody or drainage. This risk would be minimized through implementation of the requirements of the APP, SWPPP, and SPCC Plan, as outlined in Sections 2.3.4.2 and 2.3.4.3.

<u>Alternative 1, Proposed Action</u>

Hydrology

Table 3.2-2 lists the change to the area within the zero discharge system and subsequent remaining acreage where downstream stormwater drainage could occur within the Project Area. Alternative 1 would increase the “zero-discharge” area by nearly 6,300 acres compared to the existing condition. This would constitute an approximately 18 percent decrease in the portion of the analysis area available to contribute runoff to drainages during precipitation events.

Table 3.2-3 contains the results of hydrologic modelling of the action alternatives. Changes in drainage areas as well as modelled stormflows from design storms with recurrence intervals of 10, 25, 50, and 100 years are presented in this table. While the percent change reflects the departure of the alternative scenarios from the current condition, it is important to note the pre-mine condition values as they represent the hydrologic regime of the modelled areas prior to the 2004 authorization of the existing mine operation. Hydrologic modelling indicates that stormflows to the drainages from the 10-year to 100-year precipitation events would decrease by approximately 14 percent across the analysis area. Flows to Bonita Creek would not be affected by the stormflow diversions.

Individual drainages within the analysis area would exhibit a range of impacts due to changing surface water runoff patterns through diversions. Talley Wash flows would more than double the current condition with the 100-year storm, and increase up to 167 percent with the 10-year storm because the diversion above the heap leach pad would direct flow from portions of Watson and Butler/Coyote washes into Talley Wash. It should be noted that although the stormflows in Tally Wash would increase compared to current conditions, the increase would not reach the levels of stormflows modelled in the pre-mine conditions. Downstream road crossings and structures near Talley Wash located below the Project Area but above the confluence with the Gila River could be affected by the increased flows; however, infrastructure designed and built prior to authorization to develop the Dos Pobres and San Juan pits would not experience impacts because the modelled flows would not be greater than the modelled pre-mine conditions. All other affected drainages' stormflows would range from an approximately 17 percent increase (Butler/Coyote Wash) to an 89 percent decrease in stormflows from the current condition caused by a 100-year storm event due to proposed diversions and water routed to the "zero-discharge" areas.

The increased flows in Talley Wash would be expected to cause elevated levels of channel erosion and instability compared to the current condition. Because the flows modelled under Alternative 1 would remain less than or similar to the modelled pre-mine flows, these effects would be expected to be similar to historic conditions. Increased sedimentation effects compared to current conditions would be expected downstream from the diversions that increase flows to near the pre-mining conditions. However, because there is low-gradient terrain (causing sediment to be deposited) between the Project Area and the confluence with the Gila River, and because the Gila River would have elevated flows and sediment loads from stormflows, adverse impacts to the Gila River would not be expected from changes in stormwater runoff patterns.

Table 3.2-2 Zero Discharge and Stormwater Drainage Areas for the Current Condition and the Action Alternatives in the Project Area

	Zero-Discharge Area (acres)	Mapped and Modelled Drainage Area (acres)	Percent Change to Drainage Area
Pre-mine	0	39,537	Not Applicable
Current	4,062	35,475	Not Applicable
Alternative 1	10,361	29,176	-18%
Alternative 2	9,872	29,665	-16%

[1] Percent change is compared to the current condition.

Source: Bowman Consulting 2015, 2014.

Table 3.2-3 Drainage-specific Modelled Stormflows for the Current Condition and the Action Alternatives in the Project Area

		Butler/ Coyote[1]	% Change[2]	Watson[1]	% Change[2]	Talley	% Change[2]	Lone Star	% Change[2]	Dry Canyon	% Change[2]	Bear Springs	% Change[2]	Cottonwood	Peterson	Wilson
Drainage Area (acres)	Pre-mine	11,449	na	6,001	na	5,860	na	7,812	na	4,568	na	3,847	na	7,732	2,339	4,760
	Current	12,897	na	2,555	na	3,796	na	7,812	na	4,568	na	3,847	na	7,732	2,339	4,760
	Alt 1	11,801	-8%	959	-62%	4,912	29%	7,227	-7%	2,368	-48%	1,909	-50%	7,732	2,339	4,760
	Alt 2	8,931	-31%	5,434	113%	3,796	0%	7,227	-7%	2,368	-48%	1,909	-50%	7,732	2,339	4,760
10-Year Flow (cfs)	Pre-mine	3,593	na	1,743	na	1,111	na	862	na	1,281	na	1,649	na	No Modelled Changes[3]		
	Current	4,051	na	211	na	247	na	862	na	1,281	na	1,649	na			
	Alt 1	4,008	-1%	62	-71%	660	167%	665	-23%	859	-33%	892	-46%			
	Alt 2	2,799	-31%	1,702	707%	247	0%	665	-23%	859	-33%	892	-46%			
25-Year Flow (cfs)	Pre-mine	5,006	na	2,386	na	1,520	na	1,337	na	1,818	na	2,237	na			
	Current	5,606	na	334	na	399	na	1,337	na	1,818	na	2,237	na			
	Alt 1	5,579	<-1%	106	-68%	926	132%	1,045	-22%	1,216	-33%	1,209	-46%			
	Alt 2	3,862	-31%	2,409	621%	399	0%	1,045	-22%	1,216	-33%	1,209	-46%			
50-Year Flow (cfs)	Pre-mine	5,556	na	3,547	na	1,851	na	1,736	na	2,270	na	2,724	na			
	Current	6,220	na	1,131	na	533	na	1,736	na	2,270	na	2,724	na			
	Alt 1	6,877	11%	147	-87%	1,153	116%	1,370	-21%	1,517	-33%	1,476	-46%			
	Alt 2	4,743	-24%	2,998	165%	533	0%	1,370	-21%	1,517	-33%	1,476	-46%			
100-Year Flow (cfs)	Pre-mine	6,265	na	4,603	na	2,181	na	2,196	na	2,751	na	3,229	na			
	Current	7,013	na	1,799	na	679	na	2,196	na	2,751	na	3,229	na			
	Alt 1	8,208	17%	194	-89%	1,388	104%	1,745	-21%	1,838	-33%	1,751	-46%			
	Alt 2	5,640	-20%	3,620	101%	679	0%	1,745	-21%	1,838	-33%	1,751	-46%			

[1] It is estimated that 10% of the flows for the 50-year storm or 15% of the flows for the 100-year storm would cross from the Coyote Wash into the Watson Wash.

[2] Percent change is from the current existing condition.

[3] No "zero-discharge" areas or diversions would be included in these drainages; therefore, no changes to stormflows would be anticipated.

Source: Bowman Consulting 2015, 2014.

The changes at the mouth of Talley Wash and subsequent increases in sediment loads may temporarily affect downstream channels and road crossings during storm events similar to pre-mine conditions, but would be minimal relative to the flows and suspended sediment levels in the river during high runoff events. There is an electrical substation located along Talley Wash on the south side of Safford Bryce Road that was constructed after development of the existing mine, and this facility could experience adverse impacts from the increased stormflows under Alternative 1.

The reach of Butler/Coyote Wash between the location used to model stormflows and the Gila River has a home located less than 200 feet from the drainage in the relatively flat inactive floodplain of the Gila River. The drainage has been channelized through this area, but there is a risk of flooding due to the magnitude of the stormflows that might occur through this area. Although modelling for Butler/Coyote Wash under Alternative 1 shows a slight decrease in the stormflows associated with the 10-year and 25-year storm events when compared to the current condition, the modelled stormflows are all greater than the pre-mining conditions. The modeled stormflows for the 50-year and 100-year storm events would be 24 and 31 percent higher, respectively, than pre-mining conditions.

Other drainages would not be expected to have elevated erosion and sediment levels because the modelled flows are predicted to decrease from the current condition due to the reduced size of the contributing areas. Although stormflows to Bonita Creek would not be affected under Alternative 1, groundwater modelling indicates that groundwater contributions to Bonita Creek would be reduced by approximately 1 af/yr from the effects of the Lone Star Pit, which is 0.01 percent of the average annual flow of Bonita Creek.

The mitigation proposed for the Emery Mitigation Site would increase temporary surface disturbance while the flood control berm and the tamarisk are removed. If flood flows occurred during the time of disturbance or prior to reclamation of the lands, increases in erosion and associated sediment delivery to the Gila River would be expected. However, upon completion of the mitigation and successful site stabilization, the mitigation would enhance the functioning of the riparian areas to compensate for the losses to waters of the U.S. under Alternative 1.

Water Quality

Effects to water quality would include increased sediment loads and increased risk of accidental releases of hazardous materials reaching surface water resources. These effects would be minimized through implementation of the requirements of the APP, SWPPP, and the SPCC Plan. The “zero-discharge” areas would avoid potential impacts to surface water from ore processing.

Water Use

No surface water would be used under Alternative 1; all water needed for mining processes would be procured from groundwater sources. Therefore, no impacts to existing uses of surface water sources would be anticipated.

Alternative 2

Hydrology

Table 3.2-2 lists the change to the area within the zero discharge system and subsequent remaining acreage where downstream stormwater drainage could occur within the Project Area.

Alternative 2 would increase the “zero-discharge” area by approximately 5,800 acres compared to the existing condition, and decrease the portion of the analysis area available to contribute increased runoff to drainages flowing to the Gila River during storm events by approximately 16 percent.

Table 3.2-3 contains the results of hydrologic modelling of the action alternatives. Changes in drainage areas as well as modelled stormflows from design storms with recurrence intervals of 10, 25, 50, and 100 years are presented in these tables. While the percent change reflects the departure of the alternative scenarios from the current condition, it is important to note the pre-mine condition values as they represent the hydrologic regime of the modelled areas prior to the 2004 authorization of the existing mine operation. Hydrologic modelling indicates that peak flows from the 10-year to 100-year precipitation events would decrease by approximately 9 percent across the analysis area compared to current conditions. The impact to individual drainages within the analysis area would exhibit a wider range of impacts relative to Alternative 1 due to the configuration of stormflow diversions. Watson Wash would have increased stormflows of up to approximately 7 times the current stormflows due to a large increase in the drainage area intercepted by diversions around the heap leach pad, redirecting large portions of Butler/Coyote Wash into Watson Wash. It should be noted that although the stormflows in Watson would increase compared to current conditions, the increase would return the stormflows to similar levels as those modelled for pre-mine conditions. All other affected drainages' stormflows would decrease from approximately 20 percent to 46 percent compared to the existing condition due to proposed diversions and water routed to the "zero-discharge" areas. Flows to Bonita Creek would not be affected by the stormflow diversions.

The increased flows in Watson Wash are likely to cause accelerated levels of erosion and channel instability compared to the current condition, as discussed for Alternative 1. Sedimentation would be expected downstream from the diversions that increase flows, and erosion and sedimentation would likely continue down Watson Wash to the confluence with the Gila River. Road crossings and structures near Watson Wash located below the mine but above the confluence with the Gila River would be impacted by the increased flows; however, because the flows modelled under Alternative 2 would remain less than or similar to the modelled pre-mine flows, these effects would be expected to be similar to historic conditions. Similar to Alternative 1, because the Gila River would have elevated flows and sediment loads during storm events, the impacts to the Gila River from these changes in stormwater runoff patterns would be minimal.

Modelled flows and associated potential impacts to the specific infrastructures along Talley Wash and Butler/Coyote Wash noted in Alternative 1 would be minimized under Alternative 2. In both these washes, modelled stormflows are decreased below the level of or equal to pre-mining and current conditions.

Other drainages would not be expected to have increased erosion and sediment levels because the modelled flows decrease due to decreased contributing area. Impacts to Bonita Creek from groundwater drawdown would be the same as those described under Alternative 1.

Impacts from the proposed changes at the Emery Mitigation Site would be similar to those described under Alternative 1.

Water Quality

Impacts to surface water quality would be the same as those described under Alternative 1.

Water Use

Surface water use impacts for Alternative 2 would be the same as those described under Alternative 1.

<u>No Action Alternative</u>

Under the No Action Alternative, the existing hydrologic patterns would remain in place, which capture all stormwater from mine facilities in the existing "zero-discharge" system, and divert clean stormwater runoff away from the existing mine facilities.

Water quality would continue to be affected by the past changes to the runoff patterns, existing upland disturbance outside the "zero-discharge" areas, and continue to have the risk of accidental releases of hazardous materials from mining operations until the mine closure plan is implemented. The runoff patterns would be long-term impacts, while the upland disturbance and accidental contaminant release risks would remain until final closure of the existing mining and processing facilities occurs in accordance with the approved mine reclamation and closure plan.

3.2.2.3 Potential Mitigation Measures

3.2.2.4 No additional mitigation measures are suggested for surface water resources. Cumulative Impacts

The surface water resources CESA is the same area considered for direct and indirect impacts. The action alternatives would combine with the past and present actions to alter the natural drainage patterns.

No RFFAs are known at this time within the CESA. Any future mining may further alter the drainage patterns, and should be considered on a case-by-case basis.

3.2.2.5 Residual Adverse Effects

The stormflows of the drainages with diversions or "zero-discharge" facilities would be impacted. Some drainages would experience increased flows, thus increased erosion and channel instability affects. Other drainages would exhibit decreased flows. The risk of potential spills would be elevated during the time that additional mining operations were occurring.

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3.3 Wetlands, Riparian Habitat, and Waters of the U.S.

3.3.1 Affected Environment

3.3.1.1 Analysis Area

The geographical extent of the analysis area for these resources includes the land within the Project Area (mine site), as well as the Emery Mitigation Site located along the Gila River approximately 25 miles downstream. The analysis area is located within an arid desert landscape where wetlands and other waterbodies are small and uncommon.

3.3.1.2 General Setting and Definitions

Waters of the U.S. currently are defined in 33 CFR 328.3 as all non-tidal waters that are currently, or were used in the past, or may be susceptible to use in interstate commerce; all interstate waters including wetlands; all other waters such as interstate lakes, rivers, streams (including intermittent streams), mud flats, sand flats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, of which the use, degradation or destruction could affect interstate commerce; and all impoundments of waters of the U.S. In addition, tributaries of the above listed waters, including arroyos and other intermittent drainages, and wetlands adjacent to the above listed waters also are considered to be waters of the U.S. This regulation is currently under review and may be revised but the definitions provided are those used at this time.

The Corps has regulatory authority over jurisdictional wetlands. According to the Corps' 1987 Wetland Delineation Manual, a "three-parameter" approach is required for delineating wetlands (Corps 1987), where areas are identified as wetlands if they exhibit hydrophytic vegetation, hydric soils, and wetland hydrology. No jurisdictional wetlands were identified within the analysis area in the Preliminary Jurisdictional Delineation (SPL-2014-00065-MWL) (WestLand 2013).

Riparian areas are generally defined as the vegetated transitional zones that lie between aquatic and terrestrial (upland) environments. Riparian areas usually occur as belts along streams, rivers, lakes, marshes, bogs, and other water bodies. As a transitional zone between aquatic and upland environments, riparian systems often exhibit characteristics of both. Generally, only perennial and intermittent streams can support riparian areas that serve the entire suite of riparian ecological functions. Ephemeral streams rarely possess the hydrologic conditions that allow true riparian vegetation to grow. As noted in the Vegetation section of this EIS (Section 3.5.1.2), there is a small amount of riparian vegetation within the Project Area.

The 2003 Final EIS (BLM 2003) identified two riparian plant communities within the 2003 Study Area, which is larger than the analysis area for this EIS: 1) Xeroriparian Mixed Scrub, and 2) riparian vegetation, associated with perennial springs. Xeroriparian habitats were found along many of the ephemeral drainage features within the 2003 Study Area, but as the vegetation in this community was similar to that found in adjacent uplands, these habitats were not depicted separately in the 2003 Final EIS (BLM 2003). Xeroriparian habitat refers to the vegetation in washes (arroyos) that comprise dry riparian habitats. The washes may carry water only a few hours a year but share most of their defining characteristics with traditional wet riparian habitats. They are often disturbed, unstable sites where water and nutrients are harvested and provided from upstream areas (watersheds). These washes are corridors for dispersal of plants and animals that need more water than the surrounding habitat (Arizona-Sonora Desert Museum 2015).

Riparian vegetation types were found to occur in association with four perennial springs and one seep in the 2003 Study Area, but these communities were so small that specific classification of plant communities was not warranted (WestLand 2014b). The springs and seeps do not occur within the analysis area under consideration in this EIS. Riparian and wetland vegetation is found along the Gila River within the Emery Mitigation Site.

3.3.1.3 Waters of the U.S. in Analysis Area

Waters of the U.S. within the Project Area are comprised of ephemeral drainages that mainly occur within the Cottonwood Wash subwatershed (WestLand 2016a). The primary drainages within this subwatershed include Wilson, Peterson, Cottonwood, Talley, Watson, Dry Canyon, Bear Springs, and Coyote washes; all of which drain into the Gila River (see **Figure 3.2-2**). Some of these drainage systems have been altered and surface water was diverted for previously permitted mining activities (WestLand 2013). Field delineations to identify the characteristics of ordinary high water marks in drainages within the Project Area were conducted in July, 2012, and March, 2013. Observed ordinary high water mark characteristics consisted mainly of evidence of sediment sorting and a change in substrate in the drainages compared to the surrounding upland area. The delineation and the 404(b)(1) analysis documented 474 acres of potential waters of the U.S. within the Project Area, all of which are ephemeral drainages (WestLand 2016a, 2013).

Vegetation along the drainages within the Project Area is xeroriparian, with a variety of plant species common to upland habitats. Most of the xeroriparian habitats in the analysis area are dominated by mesquite (*Prosopis juliflora*), catclaw acacia (*Senegalia greggii*), whitethorn acacia (*Vachellia constricta*), blue paloverde (*Parkinsonia florida*), and desertbroom (*Baccharis sarothroides*). One drainage in Bear Springs Canyon, in the northeastern portion of the analysis area, is dominated by scrub oak (*Quercus turbinella*). These drainages are typical for the general geographic area providing ephemeral flow with denser vegetation and ordinary high water mark indicators. See Section 3.5.1.2 and **Table 3.5-1** for more detail on vegetation types within the analysis area.

Aquatic resources within the analysis area were identified and qualitatively classified based on physical parameters that may affect hydrologic, chemical, and biotic function, in compliance with the Corps South Pacific Division Regulatory Program Standard Operating Procedure for Determination of Mitigation Ratios (12501-SPD) (Corps 2013). This functional assessment is the first step of setting the mitigation ratios to compensate for the waters of the U.S. that would be altered should the proposed project be approved. The details of the process for evaluating the Emery Mitigation Site are provided in **Appendix B** as part of the Mitigation Ratio-Setting Checklist (WestLand 2016c) and are summarized below.

Two classes of aquatic resources (waters of the U.S.) were characterized in the Project Area in order to evaluate the quality and function to be mitigated at the Emery Site: Ephemeral Classes A and B.

- Ephemeral Class A consists of approximately 60 acres of low-gradient, braided, ephemeral drainages that occur mainly in the southern and western portions of the Project Area on the bajada below the foothills of the Gila Mountains. The dominant vegetation is the Chihuahuan Piedmont Semi-Desert Grassland and Shrub Steppe and the Chihuahuan Mixed Salt Desert Scrub.
- Ephemeral Class B consists of approximately 30 acres of moderate- to high-gradient, relatively straight, ephemeral drainages that occur mainly in the northern and eastern portions of the Project Area in the foothills of the Gila Mountains. The dominant vegetation types are Chihuahuan Mixed Desert Scrub Shrub and a mix of Madrean Pinyon-Juniper Woodland and Savanna and the Chihuahuan Piedmont Semi-Desert Grassland and Shrub Steppe.

As noted in **Appendix B**, Conceptual Mitigation Plan, and summarized briefly in Chapter 2.0, Section 2.3.1.6, there are three areas within the Emery Mitigation Site that would be utilized for mitigating the adverse effects of filling waters of the U.S. within the Project Area.

- Area A (50 acres) is currently composed of former agricultural fields with patches of tamarisk and cottonwoods in the northwestern portion and forbs and shrubs in patches throughout.
- Area B (59 acres) consists primarily of non-native (tamarisk) riparian vegetation.
- Area C (42 acres) consists primarily of riparian vegetation.

The three areas at the Emery Mitigation Site were determined to have suitable acreage and good potential for aquatic resource enhancement to compensate for the waters of the U.S. that would be altered should the proposed project be approved.

3.3.2 Environmental Consequences

3.3.2.1 Scoping Issues

The following issues and concerns were identified by the public and agencies related to potential impacts to waters of the U.S., wetlands, and riparian areas.

- Potential impacts to wetlands, streams, springs, and riparian habitats
- The importance of several specific riparian areas in and adjacent to the Gila River, including Coyote and Watson Washes and Bear Springs Canyon.
- Potential impacts to the xeroriparian areas in the Project Area. These comments identified several large washes that traverse the proposed sites of the heap leach pad (Coyote and Watson Washes and side drainages) and development rock stockpiles (Bear Springs Canyon) as xeroriparian areas of significant environmental importance.
- Potential impacts to the Gila Box Riparian National Conservation Area and Bonita Creek watershed in particular, identifying them as riparian ecosystems with plant and animal diversity.
- The need for compensatory mitigation such as riparian habitat enhancement or creation.

3.3.2.2 Method of Analysis and Impact Indicators

Methods of analysis for waters of the U.S. and riparian areas include the following.

- Identify surface disturbance areas within the analysis area and compare to acreage and location of waters of the U.S.
- Calculate percentage of waters of the U.S. and riparian areas that would be disturbed under each alternative.

The following indicators have been identified to analyze the effects of the alternatives on waters of the U.S. and riparian/wetland habitats.

- Amount of waters of the U.S. disturbed under each alternative
- Riparian/wetland habitats that may be degraded or lost, by alternative

3.3.2.3 Assumptions for Analysis

Assumptions for waters of the U.S. and riparian/wetland habitats include the following:

- There are no wetlands in the Project Area.
- Adverse impacts to waters of the U.S. and riparian habitats could occur during or after initial disturbance. Impacts also could occur as a result of the continued use, maintenance, or reclamation of any resulting infrastructure.

- FMSI will comply with the design features described in Chapter 2.0, Section 2.3.4, as well as federal and state laws, regulations, and permit requirements such as the CWA, Endangered Species Act (ESA), and compensatory mitigation measures. The analysis assumes implementation of the proposed design features and compliance with the federal and state laws, regulations, and permit requirements.
- Mining activities would alter some of the ephemeral drainages within the analysis area. Direct impacts to waters of the U.S. would result from excavation and fill activity in washes during development of the infrastructure for the Lone Star Pit.

3.3.2.4 Alternative 1, Proposed Action

In order to construct the facilities needed to support mining of the Lone Star Pit, implementation of Alternative 1 would result in direct alteration of 90 acres of waters of the U.S. (see **Figure 2-1** and **Table 2-5**). The impacts would result from construction of the mining structures and facilities necessary to mine the Lone Star ore body and the infrastructure needed to transport and process the ore.

The 90 acres of waters of the U.S. that would be affected by Alternative 1 encompasses about 69 miles of drainages and represents approximately 20 percent of the total amount of waters of the U.S. within the Project Area, based on the Jurisdictional Delineation (SPL-2014-00065-MWL) approved by the Corps (WestLand 2013). The proposed project would not adversely affect any special aquatic sites including wetlands. No adverse indirect impacts on downstream waters of the U.S. have been identified with the possible exception of increased stormwater flows and associated increased sedimentation, and bank and channel erosion in Talley Wash and Butler/Coyote Wash described in Surface Water, Section 3.2.2.2.

There are 10 steps in the standard process for determining the appropriate mitigation ratios to offset proposed modifications in the Project Area, ending in the calculation of acreage of converted lands that would be commensurate with the quality and function of the aquatic resources to be removed. The identification and classification of affected waters of the U.S., described briefly in Section 3.3.1.3, is the first step (WestLand 2016c). The subsequent steps involve an assessment of the functions of the affected areas and the proposed mitigation site, an adjustment to the ratio based on the location of the mitigation site in relation to the Project Area, followed by assessments of the net loss of aquatic resources, the type of proposed conversion to or enhancement of aquatic resources, risk and uncertainty, the length of time required for establishment of mitigation measures, the final mitigation ratios, and a summary of proposed mitigation measures based on affected acreage and mitigated acreage. There would be 60 acres of Ephemeral Class A affected under Alternative 1 and 30 acres of Ephemeral Class B.

The resulting final assessment (see **Appendix B**) calls for a mitigation ratio for the Project Area waters of the U.S. to the Emery Mitigation Site listed in **Table 3.3-1**. The ratio is reported in terms of acres mitigated at the Emery Mitigation Site for each acre of waters of the U.S. altered in the Project Area.

Table 3.3-1 Final Mitigation Ratios by Drainage Class and Area at Emery Mitigation Site

Emery Mitigation Site Area	Ephemeral Class A Mitigation Ratio	Ephemeral Class B Mitigation Ratio
A	1.59:1	1.43:1
B	1.16:1	1.10:1
C	6:1	6:1

Source: WestLand 2016c (also see **Appendix B**).

3.3.2.5 Alternative 2

Alternative 2 would utilize all of the same project components as the Proposed Action, with the exception of the heap leach stockpile. The design would be similar; however, the location would be rotated compared to the Proposed Action to minimize impacts to waters of the U.S. Alternative 2 is expected to result in direct alteration of approximately 76 acres of waters of the U.S. (see **Figure 2-2** and **Table 2-5**).

The 76 acres of waters of the U.S. that would be affected by Alternative 2 encompasses about 55 miles of drainages and represents approximately 16 percent of the total amount of waters of the U.S. within the Project Area, based on the Preliminary Jurisdictional Delineation (SPL-2014-00065-MWL) approved by the Corps. The proposed project would not adversely affect any special aquatic sites, including wetlands. No adverse indirect impacts on downstream waters of the U.S. have been identified with the possible exception of increased stormwater flows and associated increased bank and channel erosion in Talley Wash and Butler/Coyote Wash described in Surface Water, Section 3.2.2.2. Should Alternative 2 be selected, a process for evaluating the acreage needed for mitigation similar to that presented for Alternative 1 would be performed. Because the acreage of waters of the U.S. affected under this alternative would be less than that described for Alternative 1, the acreage to be used for mitigation at the Emery Mitigation Site also would be less.

3.3.2.6 No Action Alternative

Under the No Action Alternative, the Corps would not issue a Section 404 permit and the existing mine would continue to operate as currently authorized. No new mine-related impacts to waters of the U.S. or riparian habitat in the Project Area would occur. Development of the Emery Mitigation Site would not occur.

3.3.2.7 Potential Mitigation Measures

No additional mitigation measures would be needed to minimize adverse impacts to waters of the U.S. beyond the compensatory mitigation measures and other conditions of the Section 404 permit issued by the Corps. Mitigation activities to be completed at the Emery Mitigation Site to compensate for adverse impacts to waters of the U.S. are described in Section 3.3.2.4 above, in Section 2.3.4, and in **Appendix B**.

3.3.2.8 Cumulative Impacts

The CESA is the same as the analysis area defined for direct and indirect effects. Development of the mine within the Project Area would contribute to cumulative impacts including mining-related disturbances (fill and excavation) under Alternatives 1 and 2. Over the past 25 years, the Corps has authorized the fill of 212.7 acres of waters of the U.S. in the Yuma Wash-Upper Gila River and Cottonwood Wash-Upper Gila River Watersheds (HUC 1504000505 and HUC 1504000507) that encompass the Project Area. No other pending Section 404 permit applications within these watersheds are known at this time (see **Appendix A**).

Selection of the No Action Alternative would maintain the existing conditions of the mine sites and would not result in additional adverse cumulative effects to waters of the U.S., wetlands, and riparian areas.

3.3.2.9 Residual Adverse Effects

Residual effects under Alternatives 1 and 2 include loss of waters of the U.S. that would be mitigated under Section 404 of the CWA. Selection of the No Action Alternative would not result in residual adverse effects.

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3.4 Soils

3.4.1 Affected Environment

3.4.1.1 Analysis Area

The analysis area for direct, indirect, and cumulative impacts for soils encompasses the Project Area (FMSI boundary) as well as the Emery Mitigation Site.

3.4.1.2 General Setting

The Project Area is located within two Major Land Resource Areas (MLRAs) of soil resources. Generally, from north to south, these include the following (NRCS-USDA 2006):

- MLRA 38—Mogollon Transition
- MLRA 41—Southeastern Arizona Basin and Range

The Mogollon Transition MLRA consists of canyons and structural troughs and valleys. Elevations generally range from 3,000 to 7,500 feet above mean sea level (amsl) in the mountains. Most of this area is covered by deep alluvium washed in from the adjacent mountains. These deposits of silt, sand, and gravel are very young in the present-day drainages and much older on the valley floors and terraces. This MLRA is an area of intensive volcanism. There are isolated outcrops of granite and andesite and basalt flows are common. The soils in the MLRA are very shallow to very deep and are well drained and somewhat excessively drained. Most of the soils formed in alluvium or residuum derived from igneous or metamorphic rock.

The Southeastern Arizona Basin and Range MLRA has mountain ranges that trend southeast to northwest and has relatively smooth valleys between the mountains. Elevations generally range from 2,620 to 5,900 feet amsl in the mountains. Most of this MLRA is covered by deep alluvium washed in from the adjacent mountains. These deposits of silt, sand, and gravel are very young in the present-day drainages and much older on the valley floors and terraces. This MLRA is an area of intensive volcanism. There are isolated outcrops of granite and andesite and basalt flows are common. The soils in the MLRA are very shallow to very deep and are well drained and somewhat excessively drained. Most of the soils formed in alluvium or residuum derived from igneous or metamorphic rock.

3.4.1.3 Soils in Analysis Area

The soils in the analysis area are highly varied and range in depth from shallow (i.e., less than 20 inches) to very deep (i.e., greater than 60 inches). The shallow soils lie in the northern and eastern portions of the analysis area and the deeper soils fan out to the south and west. Soils along ridge tops, mountain slopes, and hillsides tend to be shallow with coarser textures and are high in rock fragments. The alluvial fans and fan terraces include deep, coarse textured soils that are high in rock fragments. Floodplains include deep soils that formed in alluvium from mixed bedrock types and are occasionally flooded. While the Project Area does not extend to the Gila River, there are some alluvial or floodplain soils mapped within the boundaries that were formed from soil material deposited primarily along washes.

Table 3.4-1 summarizes the geomorphic location, physical and chemical characteristics, and reclamation suitability of soil map units that occur within the Project Area. **Table 3.4-2** summarizes the characteristics of soil map units that occur within the Emery Mitigation Site (see inset on **Figure 3.4-1**). Soil resources within the analysis area were rated by soil horizon on their suitability for use as growth media. Soil map unit suitability ratings in addition to their recommended salvage depths are provided in **Table 3.4-1**. These ratings are based on the listed limiting factors of the dominant soil type within the map unit. **Figure 3.4-1** displays the soil map units in relation to the proposed and existing facilities in the analysis area.

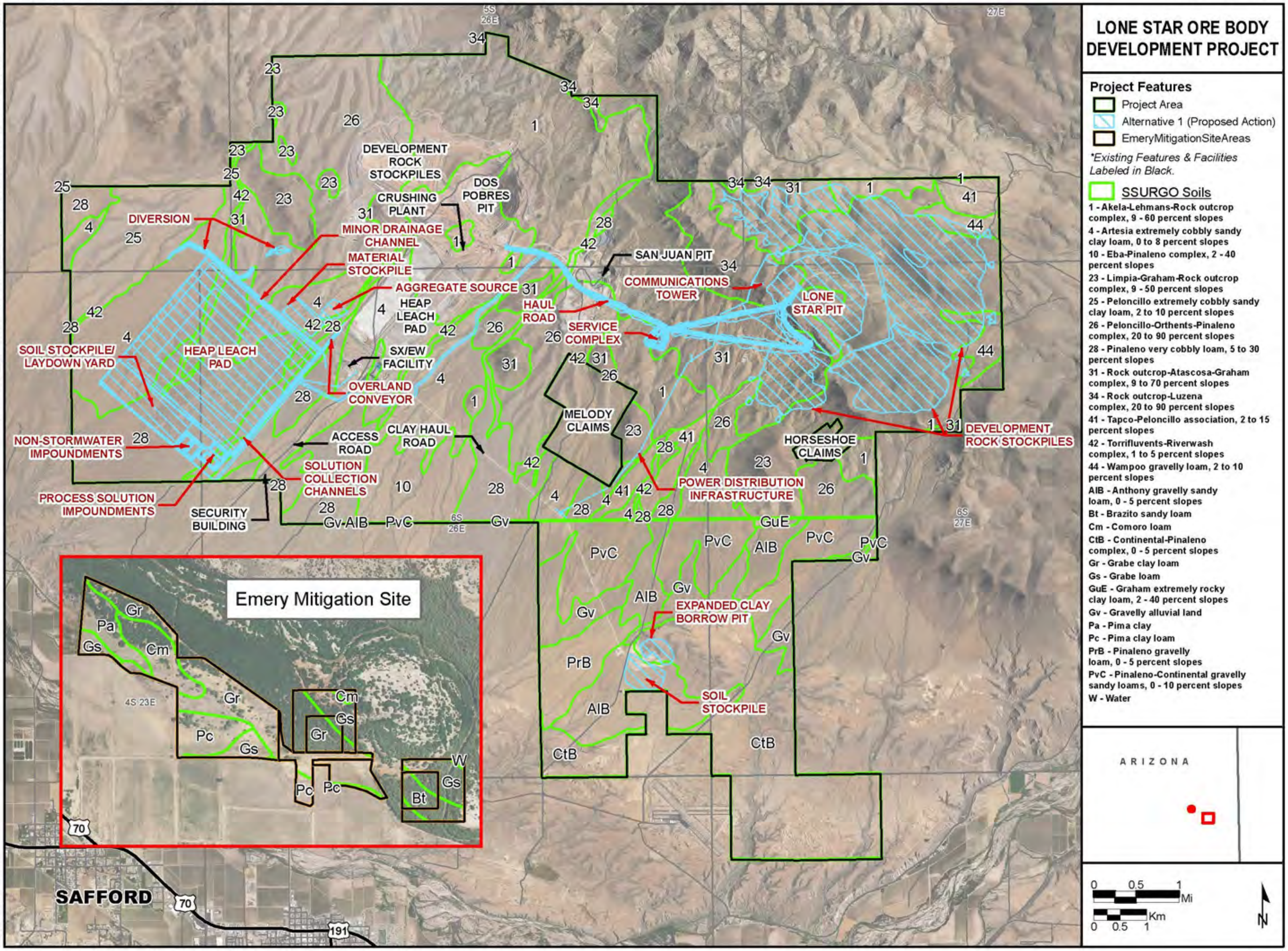

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Figure 3.4-1 Soil Map Units in the Analysis Area

Table 3.4-1 Physical and Chemical Characteristics and Reclamation Suitability of Soil Map Units within the Project Area

Map Unit Symbol[1]	Map Unit Name	Acres	Geomorphic Description	Erosion Hazard of Bare Surface		Hydric	Topsoil Suitability	Limiting Factors[4]	Salvage Depth (in.)
				Water[2]	Wind[3]				
1	Akela-Lehmans-Rock outcrop complex, 9 to 60 percent slopes	3,810	Hills	Moderate	Low	No	Poor	D, BR, OM, R	0
4	Artesia extremely cobbly sandy clay loam, 0 to 8 percent slopes	4,407	Fan terraces	Low	Low	No	Poor	D, C, CP, CA, OM, R	0
10	Eba-Pinaleno complex, 2 to 40 percent slopes	724	Hillsides	Low	Low	No	Poor	C, D, OM, CA, CB, R	0
23	Limpia-Graham-Rock outcrop complex, 9 to 50 percent slopes	4,453	Mountains	Moderate	Low	No	Poor	C, CP, D	0
25	Peloncillo extremely cobbly sandy clay loam, 2 to 10 percent slopes	972	Fan terraces	Low	Low	No	Poor	D, CP, OM, C, R	0
26	Peloncillo-Orthents-Pinaleño complex, 20 to 90 percent slopes	5,167	Fan terraces	Moderate	Low	No	Poor	D, CP, OM, C, CA, R	0
28	Pinaleño very cobbly loam, 5 to 30 percent slopes	3,873	Hills	Low	Low	No	Fair	OM, D, R	17
31	Rock outcrop-Atascosa-Graham complex, 9 to 70 percent slopes	3,375	Mountains	Moderate	Low	No	Poor	D, BR, R	9
34	Rock outcrop-Luzena complex, 20 to 90 percent slopes	978	Mountains	Moderate	Low	No	Poor	BR	0
41	Tapco-Peloncillo association, 2 to 15 percent slopes	494	Fan terraces	Moderate	Low	No	Poor	C, D, CP, OM, R	10
42	Torrifluvents-Riverwash complex, 1 to 5 percent slopes*	722	Flood plains	Moderate	Low	Yes	Poor	NR	0
44	Wampoo gravelly loam, 2 to 10 percent slopes	328	Fan terraces	Severe	Low	No	Fair	C, CP, R, D, OM	60
AlB	Anthony gravelly sandy loam, 0 to 5 percent slopes	1,155	Alluvial fans, flood plains, terraces	Moderate	Moderate	No	Fair	OM, R	60
CtB	Continental-Pinaleño complex, 0 to 5 percent slopes	2,840	Terraces	Moderate	Moderate	No	Poor	C, D, OM, CA, R	29

Table 3.4-1 Physical and Chemical Characteristics and Reclamation Suitability of Soil Map Units within the Project Area

Map Unit Symbol[1]	Map Unit Name	Acres	Geomorphic Description	Erosion Hazard of Bare Surface		Hydric	Topsoil Suitability	Limiting Factors[4]	Salvage Depth (in.)
				Water[2]	Wind[3]				
GuE	Graham extremely rocky clay loam, 2 to 40 percent slopes	33	Mountains	Moderate	Low	No	Poor	D, BR, C, R	14
Gv	Gravelly alluvial land	751	Fans, terraces	Low	Low	No	Poor	R	0
PrB	Pinaleño gravelly loam, 0 to 5 percent slopes	463	Terraces	Moderate	Low	No	Fair	D, OM, CA, R	30
PvC	Pinaleño-Continental gravelly sandy loams, 0 to 10 percent slopes	1,507	Alluvial fans, terraces	Low	Moderate	No	Poor	D, OM, CA, R	30

[1] Map Unit Symbol is the label used in the soil survey maps.

[2] Water erosion hazard class determined from combination of Soil Erodibility Factor (Kw) and slope.

[3] Wind erosion hazard class based on Wind Erodibility Group Rating.

[4] Limiting Factors:
BR = Depth to Bedrock
C = Too Clayey
CA = High Carbonates
CP = Cemented Pan
D = Droughty
OM = Low Organic Matter
R = Rock Fragments

[5] Recommended Soil Salvage Depth.

Source: NRCS 2015.

Table 3.4-2 Soil Characteristics at the Emery Mitigation Site

Map Unit Symbol[1]	Map Unit Name	Acres	Geomorphic Description	Hydric	Hydrologic Soil Group	LCC[2]
Bt	Brazito sandy loam	8.9	Alluvial fans, floodplains	No	A	7s
Cm	Comoro loam	16.2	Floodplains	No	B	6s
Gr	Grabe clay loam	59.1	Floodplains, alluvial fans	No	C	6c
Gs	Grabe loam	26.8	Alluvial fans, floodplains	No	B	6c
Pa	Pima clay	12.2	Alluvial fans, floodplains	No	C	6s
Pc	Pima clay loam	17.3	Alluvial fans, floodplains	No	C	7c

[1] Map Unit Symbol is the label used in the soil survey maps.

[2] Land Capability Class.

Source: NRCS 2015

The analysis area has been previously disturbed by historic and recent mining activities and by past agricultural practices. Where previous mining disturbance has occurred, it is assumed that growth media are no longer available and the previously mapped soil has been altered or removed. **Figure 3.4-2** displays the distribution of topsoil suitability for reclamation purposes within the Project Area by map unit.

Susceptibility to erosion is a function of characteristics such as soil texture and structure, topography, surface roughness, soil cover (made up of vegetation, duff/litter, rock, and woody debris), and climate. Erosion may be influenced by the length of time the soils are bare and by disruption of drainage and erosion control structures. Erosion caused by surface water flows occurs primarily on loose, non-cohesive soils with little or no vegetative cover on moderate to steep slopes, particularly during high intensity storm events. Wind-induced erosion often occurs on dry, fine, sandy soils where vegetation cover is sparse and strong winds are prevalent. Erosion hazard of the native soils across the Project Area are shown in **Table 3.4-1**.

The mixing of soil horizons during excavation, piling, and reapplication for reclamation would lower soil productivity by diluting the physical, biological, and chemical properties of the topsoil with less productive subsoil. Segregation of topsoil from subsoil helps to mitigate these effects. If topsoil is mixed, it may take many years for a productive topsoil horizon to form naturally.

Physical and chemical properties such as high sodium content, high alkalinity, low organic matter, high salinity, rock fragments, high carbonates, and high sand or clay content have a negative effect on soil productivity and can reduce the potential for successful revegetation during reclamation. The limiting factors are listed in **Table 3.4-1**.

Hydric soils are soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. These soils are commonly associated with floodplains, lake plains, basin plains, and with riparian areas, wetlands, springs, and seeps. The Torrifluvents-Riverwash complex is the only map unit containing hydric soils within the Project Area.

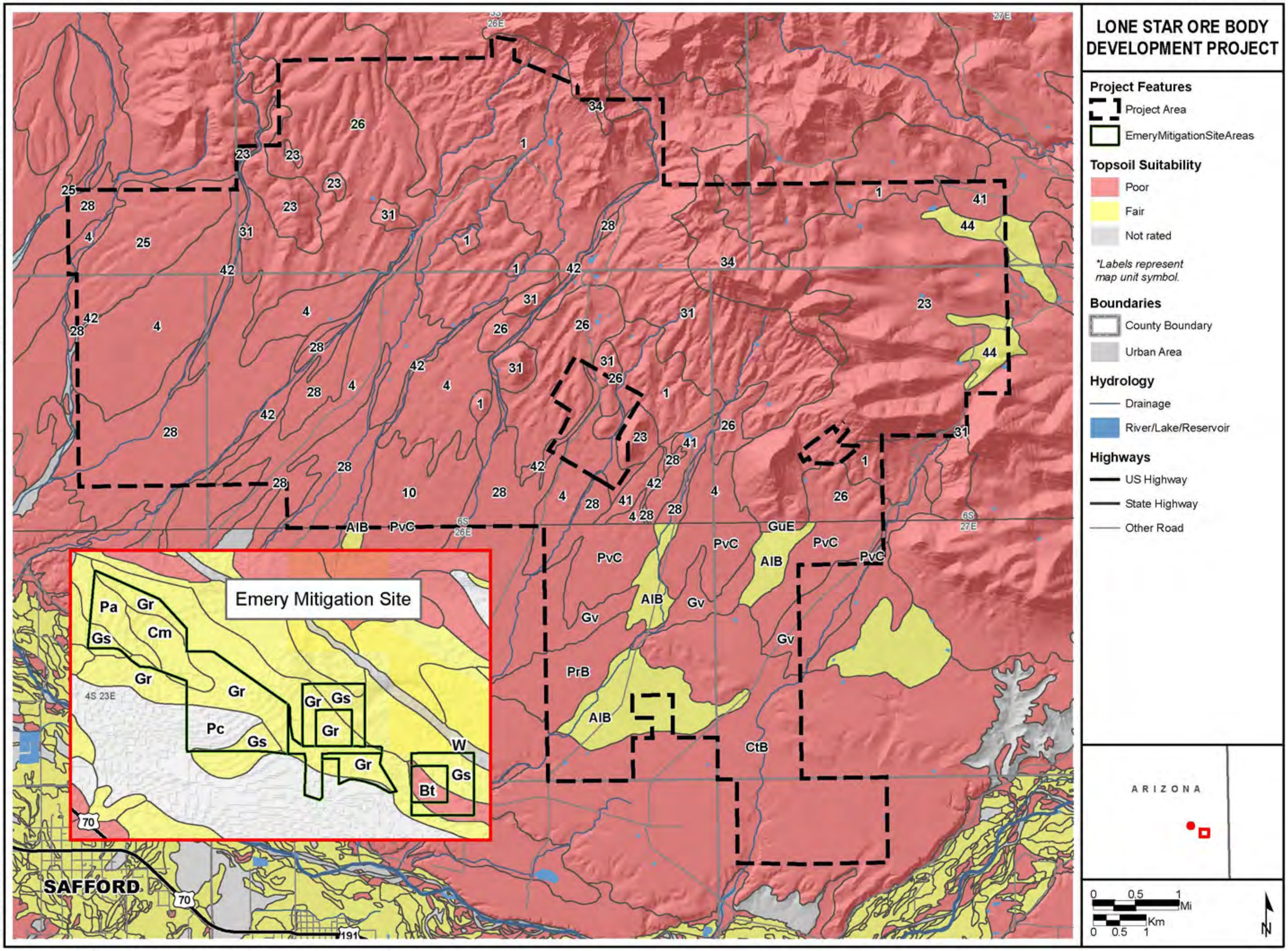

Figure 3.4-2 Topsoil Suitability in the Analysis Area

Growth media suitability (**Table 3.4-1**) is a rating used for areas that have been disturbed by surface mining or similar activities. Soil properties that affect the erodibility and stability of the surface and the productive potential of the reconstructed soil are considered in the rating. These properties include the content of sodium, salts, and calcium carbonate; available water capacity; erodibility; texture; content of rock fragments; thickness of suitable material; available water capacity; and content of organic matter and other features that affect fertility (NRCS 2015). The recommended growth media salvage depths, provided in **Table 3.4-1**, is based on this rating.

Capability classes shown in **Table 3.4-2** describe the suitability of soils for field crops within the Emery Mitigation Site. Class 6 soils have severe limitations that make them generally unsuitable for cultivation and restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat. Class 7 soils have very severe limitations that make them unsuitable for cultivation and restrict their use mainly to grazing, forestland, or wildlife habitat. The “s” rating is because the soil limitations are primarily because it is shallow, droughty, or stony (NRCS 2015).

Hydrologic soil groups shown in **Table 3.4-2** for the Emery site are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long duration storms (NRCS 2015). Groups range from A (low runoff potential, high infiltration rate) through D (high runoff potential, very slow infiltration rate). This soil property can be used as an indication of how soils will hold precipitation or allow it to run off rapidly into the river.

3.4.2 Environmental Consequences

3.4.2.1 Scoping Issues

Scoping issues identified by the public related to soil and reclamation include the following concerns.

- Potential for spills that would create petroleum-contaminated soils
- Availability of suitable soils and growth media for revegetation
- Potential for successfully reclaiming mine-related disturbance

3.4.2.2 Method of Analysis and Impact Indicators

Potential impacts to soil resources were investigated by identifying the soil types (based on available soil survey data), their extent, and their physical and chemical characteristics in relation to the locations of disturbance within the Project Area.

3.4.2.3 Assumptions for Analysis

The analysis of the impacts to soil resources is based on the following assumptions.

- Soil disturbed during project activities would be susceptible to erosional forces, such as wind and water.
- Bare soil (without vegetation or other surface cover) with a surface layer that has been altered from its natural condition is more susceptible to accelerated wind and water erosion than undisturbed soil.
- Any surface disturbance has the potential to degrade soil quality and productivity because it damages the biological soil crust and exposes the bare soil to the erosive forces of wind and water until revegetation or other ground cover is established.

- Erosion from disturbed areas would be minimal once vegetation is reestablished. Successful establishment of vegetation generally takes a minimum of 3 years, depending on soil productivity and precipitation or irrigation, and requires monitoring during this time.
- Surface disturbance from construction would modify soils by disrupting soil stability, changing vegetative cover that can reduce nutrient recycling, damaging biological crusts, decreasing productivity, and increasing compaction.
- When surface disturbance occurs on highly erodible soils, the potential for accelerated erosion is greater than on less erodible soils. Sensitive soils would incur greater adverse impacts from surface-disturbing activities than non-sensitive soils. Sensitive soils include those that are highly erodible, have a high pH, high salinity or sodicity, have a high clay content, or have a low reclamation potential.
- The risk of BMP failure is greater on highly erodible soils. To be effective on highly erodible soils, more extensive BMPs and more aggressive maintenance techniques than those commonly used are often required.
- Erosion on the landscape may contribute to sedimentation in the surface water drainage system of washes that may transport the sediment downstream. Only a fraction of the total amount of soil erosion on the landscape actually reaches surface water channels such as those identified as waters of the U.S.
- Operating motorized vehicles on moist soils, especially heavy equipment, is likely to cause compaction of the surface layer, which may increase runoff, decrease infiltration and aeration, and reduce soil productivity by making it more difficult for plant roots to establish or obtain soil moisture and nutrients.
- The analysis of the impacts to soil resources is based on the assumption that FMSI will comply with the design features described in Chapter 2.0, Section 2.3.4, as well as federal and state laws, regulations, and permit requirements that minimize erosion and sedimentation.

3.4.2.4 Alternative 1, Proposed Action

The Proposed Action (Alternative 1) would disturb soils mainly during construction of the Lone Star Pit and associated infrastructure. The Proposed Action would result in 6,142 acres of new disturbance to soils. Soil mapping units in proposed disturbance areas are illustrated in **Figure 3.4-1**. Impacts also may occur during operations, especially where soil is compacted by equipment during wet conditions or where bare soils remain unprotected by a surface cover, and during post-mining reclamation when the final growth medium is redistributed.

As described in Section 2.3.6.1, reclamation is managed under the Arizona Mined Land Reclamation Act, which provides a mechanism for requiring the reclamation of mined lands to a safe, stable condition. FMSI would prepare and submit a reclamation plan for the proposed new disturbance that includes the Lone Star facilities described in Section 2.3.1, to the Division of Mined Land Reclamation, Arizona State Mine Inspector. The State Mine Inspector is responsible for reclamation on private property. The reclamation plan would be developed to meet state reclamation requirements.

Two criteria contained in the statute specifically involve soils and soil productivity: Section 27-971(B)(9) requires that the plan include information on proposed reclamation measures that would be taken to address erosion control and stability; and Section 27-974 specifies that prior to disturbance, soil shall be conserved unless otherwise it is unable to be conserved or it is unnecessary to do so. The recommended salvage depths for growth media associated with the native soils in the Project Area is provided in **Table 3.4-1**.

Soil productivity varies with vegetation community and land management practices. In contrast, soil quality is an inherent soil resource characteristic involving aeration, permeability, texture, microbial populations, fertility, and other physical and chemical characteristics that are beneficial to plant growth and establishment. Due to the removal of vegetation and alteration of the natural soil horizons during construction, there would be adverse impacts to the existing quality and productivity of native soils from project-related disturbance. Following successful reclamation, soil productivity may be restored over a long period.

Soil excavated during the heap leach pad site preparation and suitable rock material excavated during construction would be stockpiled for use as growth media and capping material during reclamation. Two soil and growth media stockpiles would be created during construction of the heap leach pad and in preparation for the development rock stockpiles. The soil stockpiles would be marked with signs identifying the material as soil and stabilized, as necessary, to prevent excessive losses due to erosion. Other soil stockpiles may be developed if it is determined that sufficient soils exist in the footprints of the development rock stockpiles to economically justify excavation prior to the lateral build-out of the development rock stockpiles. Stabilization of soil stockpiles would be accomplished by grading slopes to minimize erosion and placing silt fence, as necessary, around the downgradient slope of the stockpiles to minimize offsite sedimentation. Side slopes and the tops of the soil stockpiles would be seeded for erosion and weed control (FMSI 2015).

Excavation, transport, storage, and redistribution would modify existing soil structure, which would affect future productivity and quality. It is likely that some mixing of textural zones would occur. This would result in changes to the chemical, biological, and physical properties. Due to these probable effects, the initial soil quality of reconstructed seedbeds and root zones would be less than that of the existing soil resources.

Biological soil crusts are an important component in arid ecosystems because they are essential for soil stability due to low vegetative growth and soil cover. They provide soil stability, minimize erosion, fix nitrogen, increase infiltration rates, and may reduce the establishment of noxious weeds. Crusts are very sensitive to ground disturbance, and can take decades or longer to fully recover.

Soil compaction and rutting could result from the movement of heavy equipment and other vehicles. The degree of compaction would depend on the soil texture, number of passes, and moisture content at the time of impact. Compaction would be most severe where heavy equipment operates on moist to wet soils with high clay content. Compaction also can occur on soils of various textures and moisture contents if many passes are made by equipment, especially rubber-tired heavy equipment. Compaction would reduce infiltration of rainfall into the soil and accelerate runoff leading to an increase in water erosion.

Most of the soils within the Project Area have moderate to severe susceptibility to water erosion**.** Sandy and silty textured, sparsely vegetated soils are subject to wind erosion. Although accelerated erosion due to mining-related soil disturbance could occur at any stage of the proposed project, the maximum potential for erosion would be expected while soils are loose, with little or no established cover. Erosion also would be of concern after reclamation work has been completed but before a vegetative cover has been reestablished. If the ground surface is left smooth and barren during this period, winds could dislodge soil particles and rainfall intercepting barren surfaces could result in increased erosion. Implementation of stormwater management and erosion control practices would help to reduce the potential for erosion.

Hydric soils, associated with map unit 42, would be impacted by construction of the heap leach pad, haul road, and construction of the diversions. Hydric soils are typically associated with wetlands and riparian areas and can be relatively sparse in the arid west. Additionally, these soils are prone to rutting, compaction, and an increase in bulk density when disturbed.

Soil contamination would result if petroleum products are spilled. Precipitation events or a high water table would have the potential to diffuse contaminates to larger areas. As described in Section 2.3.4.3, a SPCC Plan would be developed that provides procedures to prevent, control, and mitigate releases of oil and petroleum products. Preventative measures including employee training, installation of secondary containment systems and overflow sensing devices, and routine inspection and maintenance would help to prevent large spills of petroleum products. Any petroleum-contaminated soils would be disposed in a designated and approved industrial landfill (FMSI 2015).

The Emery Mitigation Site would likely result in a beneficial impact to soil resources over time although initial grading to remove the berm and recontour the land would alter surface soils. Most of the soils are not the best for growing agricultural crops based on the land capability classes listed in **Table 3.4-2**, but would be suitable for being converted from farmland back to riparian areas with native vegetation. Additionally, the removal of non-native species (tamarisk) and seeding with native floodplain species would help to minimize soil erosion and promote nutrient cycling from the leafy litter associated with the cottonwood, willow, and mesquite.

3.4.2.5 Alternative 2

Alternative 2 would have similar impacts to soil resources as described for Alternative 1, except the location and size of the heap leach pad. Alternative 2 would result in approximately 6,202 acres of new disturbance to soils. While 60 more acres of soils would be impacted by this alternative (compared to Alternative 1), the primary difference with Alternative 2 would be that fewer impacts to hydric soils would occur due to the different orientation of the heap leach pad. This would be a beneficial impact to soil resources, considering that hydric soils are uncommon in the arid west, as described in the Alternative 1 discussion.

The impacts to soils at the Emery Mitigation Site would be similar to that described for Alternative 1.

3.4.2.6 No Action

Under the No Action Alternative, the project would not be permitted and no impacts to soils would occur associated with new mine construction, operation, or reclamation. Under this alternative, the existing mine would continue to operate as currently authorized.

3.4.2.7 Potential Mitigation Measures

- No additional mitigation measures would be needed beyond those described in Section 2.3.6.1, Revegetation.

3.4.2.8 Cumulative Impacts

The CESA for soils is the same as the analysis area. Past, present and reasonably foreseeable future actions that may affect soil resources include mining-related surface disturbance, equipment traffic, and livestock grazing.

Mining occurs throughout the CESA. Mining-related cumulative impacts would be similar to the impacts to soils discussed under Alternative 1. Mining would be expected to result in a reduction in soil productivity and quality at least until reclamation is successfully completed.

Where lands are grazed, depending on the management, soils often experience an increase in compaction, a decrease in soil cover, and an increase in invasive weeds, resulting in accelerated runoff and erosion and a reduction in soil quality. With good grazing management however (such as controlled grazing), impacts to soils can be minimal.

3.4.2.9 Residual Adverse Effects

Residual adverse effects to soils would include a permanent irreversible loss of soil productivity on approximately 645 acres in association with the pit that would remain after mining is completed. As long as the development rock stockpiles are left in place, the soil underneath them would be unavailable for productive vegetation growth.

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3.5 Vegetation

3.5.1 Affected Environment

This section presents the current conditions and environmental impacts anticipated for general vegetation resources, including noxious weeds and invasive plants, and special status plant species.

3.5.1.1 Analysis Area

The analysis area for vegetation resources includes two components: the Project Area and the Emery Mitigation Site (see **Figure 1-1**). The Project Area is composed of the land within the FMSI boundary and is approximately 36,050 acres. The Emery Mitigation Site is located about 24 miles downstream of the Project Area along the Gila River and is divided into three areas (A, B, and C). Detailed information on the Emery Mitigation Site is found in Appendix B with a summary in Section 2.3.1.6.

3.5.1.2 Plant Communities

The analysis area is located within portions of three ecoregions: the Chihuahuan Desert ecoregion, the Madrean Archipelago ecoregion, and the Sonoran Basin and Range ecoregion.

The Chihuahuan Desert is found between 2,600 and 3,500 feet elevation in Arizona in the Safford Basin along the Gila River. This area is dominated by desert shrubs and grasses including creosotebush (*Larrea tridentata*), tarbush (*Flourensia cernua*), fourwing saltbush (*Atriplex canescens*), *Acacia* spp., and low cacti including prickly pear (*Opuntia* spp.). The Madrean Archipelago ecoregion occurs generally above 4,500 or 5,000 feet elevation. It is a mild winter/wet summer woodland that can be shrubby in places. The Madrean encinal, or evergreen oak woodlands, have a mosaic of savannas, denser woodlands, and grassy openings. Emory (*Quercus emoryi*), silverleaf (*Quercus hypoleucoides*), and Arizona white oak (*Quercus arizonica*) occur, along with some scattered pinyon (*Pinus* spp.), juniper (*Juniperus* spp.), mesquite (*Prosopis* spp.), and chaparral species. Understory grasses can include grama species (*Bouteloua* spp.). Pinyon-juniper woodland, with a few scattered oaks, occupies some parts of the region. Riparian areas include cottonwood (*Populus* spp.), sycamore (*Platanus* spp.), and willow (*Salix* spp.). The Sonoran Basin and Range ecoregion is found at elevations ranging from about 1,500 to over 4,500 feet. Vegetation includes saguaro (*Carnegiea gigantean*), foothill paloverde (*Parkinsonia micrphylla*), creosotebush, prickly pear, cholla (*Cylindropuntia* spp.), ocotillo (*Fouquieria splendens*), and ironwood (*Olneya tesota*) (Griffith et al. 2014).

Vegetation community identifications from the 2003 Final EIS followed the classification system of Brown, Lowe, and Pase (BLM 2003). Four upland plant communities and two riparian plant communities were identified in the 2003 Study Area. The upland plant communities identified in the 2003 Study Area were: 1) Sonoran Desertscrub, 2) Semidesert Grassland, 3) Sonoran Desertscrub/ Semidesert Grassland ecotone, and 4) Disturbed Land. Each of the upland biotic communities were found to grade gradually into the next in a progression from the southwest to the northeast, following general changes in elevation, topography, and soil. The Disturbed Land designation dealt solely with four sites formerly used for mining purposes located within the 2003 Study Area, which are now part of or within the active operations of the existing Safford Mine Facility (WestLand 2014b).

In an effort to provide more comprehensive vegetative cover information, the four previously classified plant communities in the 2003 Final EIS were reanalyzed and reclassified using the USGS Southwest Regional Gap Analysis Program (SWReGAP) (USGS 2004). Eight vegetation communities were mapped in the Project Area including 1) Chihuahuan mixed desert scrub-shrub, 2) Chihuahuan mixed salt desert scrub, 3) Chihuahuan piedmont semi-desert grassland and steppe, 4) developed/disturbed/ sparsely vegetated, 5) Madrean pine-oak forest and woodland, 6) Madrean pinyon-juniper woodland and savanna, 7) Sonoran mixed desert scrub-shrub, and 8) warm desert lower montane riparian woodland and shrubland. The SWReGAP identifies four vegetation communities mapped in the mitigation area including 1) agriculture, 2) Chihuahuan mixed desert scrub-shrub, 3) Chihuahuan mixed salt desert scrub, and 4) warm desert lower montane riparian woodland and shrubland. Acreages for vegetation cover type in the various components of the Project Area are summarized in **Table 3.5-1**. Of the nine total vegetation communities identified in the analysis area, two communities predominate for a combined 78 percent: Chihuahuan mixed desert scrub-shrub and Chihuahuan mixed salt desert scrub. The vegetation communities are described below. **Figure 3.5-1** illustrates the vegetation cover types based on SWReGAP data of the analysis area.

Table 3.5-1 Vegetation Community Types within the Analysis Area

Vegetation Cover Type	Acres	Percent of Analysis Area
Agriculture	91	<1
Chihuahuan Mixed Desert Scrub-Shrub	17,536	48
Chihuahuan Mixed Salt Desert Scrub	10,742	30
Chihuahuan Piedmont Semi-Desert Grassland and Steppe	4,670	13
Developed/Disturbed/Sparsely Vegetated	295	1
Madrean Pine-Oak Forest and Woodland	200	1
Madrean Pinyon-Juniper Woodland and Savanna	2,095	6
Sonoran Mixed Desert Scrub-Shrub	524	1
Warm Desert Lower Montane Riparian Woodland and Shrubland	6	<1
Total	**36,159**	**100**

Source: USGS 2004.

Agriculture

The agriculture vegetation community covers less than 1 percent of the analysis area, located only within the Emery Mitigation Site. This is categorized as an aggregated land cover type that includes both pasture/hay: areas of grasses, legume, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, and cultivated crops: areas used for the production of annual crops such as corn, soybeans, vegetables, tobacco, and cotton.

Chihuahuan Mixed Desert Scrub-Shrub

The Chihuahuan mixed desert scrub-shrub vegetation community covers the majority of the analysis area (49 percent) and includes vegetation from four ecological systems identified in SWReGAP. It is broadly defined as xeric creosotebush basins and plains, mixed desert scrub, open shrublands of vegetated coppice dunes and sandsheets. Tall-shrub/short-tree species of mesquite (*Prosopis* spp.) and various oaks (*Quercus* spp.) are common. Shrubs include fourwing saltbush, ephedra species (*Ephedra* spp.), creosotebush mixed with thornscrub and other desert scrub and thorntree species (*Acacai* spp.). Succulents include ocotillo, green sotol (*Dasylirion leiophyllum*), agave species (*Agave* spp.), yucca (*Yucca elata*), prickly pear species, candelilla (*Euphorbia antisyphilitica*), and barrel cactus (*Ferocactus* spp.).

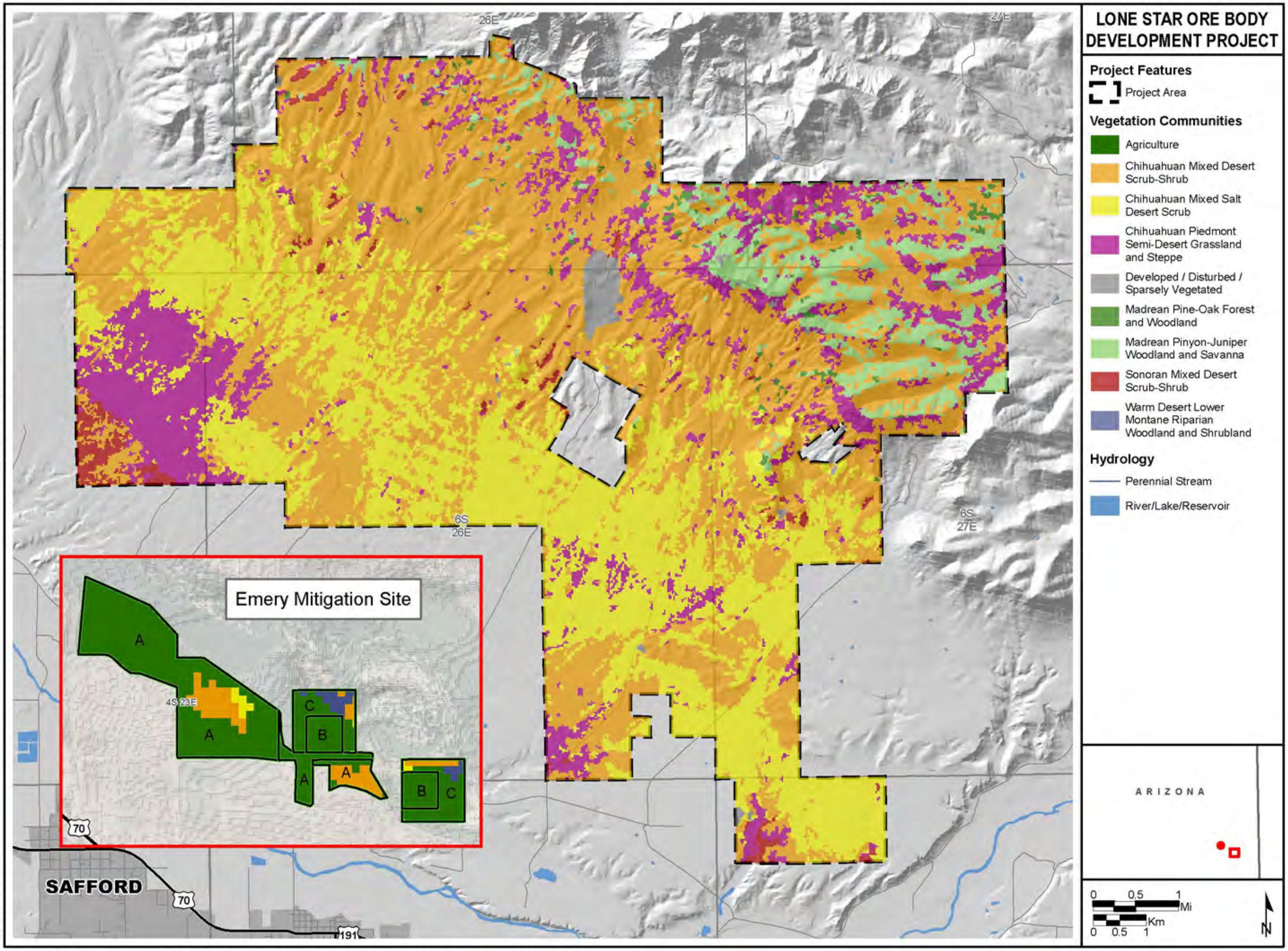

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Figure 3.5-1 Vegetation Communities within the Analysis Area

Chihuahuan Mixed Salt Desert Scrub

This community covers approximately 30 percent of the analysis area and includes extensive open-canopied shrublands of typically saline basins in the Chihuahuan Desert. Stands often occur on alluvial flats and around playas. Vegetation is typically composed of one or more saltbush species (*Atriplex* spp.) along with iodinebush (*Allenrolfea occidentalis*), tarworts (*Flourensia* spp.), pickleweeds (*Salicornia* spp.), seepweeds (*Suaeda* spp.), or other halophytic plants. Graminoid species may include alkali sacaton (*Sporobolus airoides*) and saltbrass (*Distichlis spicata*) at varying densities.

Chihuahuan Piedmont Semi-desert Grassland and Steppe

This community is a broadly defined desert grassland, mixed shrub-succulent or xeromorphic tree savanna and covers approximately 13 percent of the analysis area. It is found on gently sloping bajadas that supported frequent fire throughout the Sky Islands and on mesas and steeper piedmont and foothill slopes in the Chihuahuan Desert. It is found on gently sloping bajadas that historically supported frequent fire and on mesas and steeper piedmont and foothill slopes in the Chihuahuan Desert. It is characterized by typically diverse perennial grasses. Common grass species include grama species (*Bouteloua* spp.), Muhly species (*Muhlenbergia* spp.), and dropseeds in more sandy areas (*Sporobolus* spp.). Many of the historical desert grassland and savanna areas have been converted to shrub landscapes through intensive grazing and other land uses.

Developed/Disturbed/Sparsely Vegetated

This land cover type covers approximately 1 percent of the analysis area. Sparsely vegetated desert areas are typically found in flat basins where extreme temperature and wind develop ground surfaces where little to no vegetation grows. Other sparsely vegetated areas include desert bedrock cliff and outcrop areas, canyon and tablelands, badlands, and desert volcanic rocklands. Scattered vegetation may include cactus species (*Opuntia* spp., *Ferocactus* spp.), some trees/shrubs (*Pinus* spp., *Atriplex* spp.), and lichen. Developed areas are characterized by surface disturbance associated with mining and two-track and wider road rights-of-way. These areas are usually unvegetated or sparsely vegetated. Disturbed areas include places dominated with weedy or invasive vegetation and are often found within or adjacent to disturbed areas.

Madrean Pine-Oak Forest and Woodland

This community includes Mogollon chaparral, Madrean pine-oak forest and woodland, and Madrean encinal ecological systems and covers approximately 1 percent of the analysis area. It occurs on foothills, mountain slopes, bajadas and plateaus. The moderate to dense shrub canopy includes species such as oak species, mountain mahogany (*Cercocarpus montanus*), juniper species (*Juniperus* spp.), sumac species (*Rhus* spp.), and manzanita (*Arctostaphylos* spp.) at higher elevations. Most chaparral species are fire-adapted, resprouting vigorously after burning or producing fire-adapted seeds. Stands occurring within montane woodlands are seral and a result of recent fires. Madrean pine forests include pine species (*Pinus* spp.) and evergreen oaks intermingled with patchy shrublands on most mid-elevation slopes. Subcanopy and shrub layers may include typical encinal and chaparral species such as *Agave* spp. and *Nolina* spp. Some stands have moderate cover of perennial grasses such as muhly and grama species. Lower elevation stands are typically open woodlands or savannas where they transition into desert grasslands, chaparral, or in some cases desertscrub.

Madrean Pinyon-Juniper Woodland

This community is found on foothills, mountains, plateaus, and savannas and covers approximately 6 percent of the analysis area. Substrates are variable, but soils are generally dry and rocky. The presence of pine species or other Madrean trees and shrubs is diagnostic of this woodland system. Juniper species and/or pinyon pine (*Pinus edulis*) may be present to dominant. Madrean oaks may be codominant. Ponderosa pine (*Pinus ponderosa*) is absent or sparse. If present, understory layers are variable and may be dominated by shrubs or grasses. Savanna areas have widely spaced mature juniper trees and moderate to high cover of grasses (more than 25 percent cover).

Sonoran Mixed Desert Scrub-Shrub

This community covers approximately 1 percent of the analysis area and occurs on hillsides, mesas and upper bajadas. Climate is too dry for chaparral species to be abundant. Vegetation is characterized by a diagnostic sparse, emergent tree layer of saguaro and/or a sparse to moderately dense canopy dominated by xeromorphic deciduous and evergreen tall shrubs foothill paloverde and creosote bush with mesquite species, ironwood, and ocotillo less prominent. Other common shrubs and dwarf-shrubs include catclaw acacia (*Acacia greggii*), *Lycium* spp., jojoba (*Simmondsia chinensis*), and many cacti including barrel cactus, hedgehog cactus (*Echinocereus* spp.), and *Opuntia* spp. (both cholla and prickly pear). The sparse herbaceous layer is composed of perennial grasses and forbs with annuals seasonally present and occasionally abundant. On slopes, plants are often distributed in patches around rock outcrops where suitable habitat is present.

Warm Desert Lower Montane Riparian Woodland and Shrubland

This community occurs in mountain canyons and valleys and consists of riparian corridors along perennial and seasonally intermittent streams. It is uncommon within the analysis area and covers less than 1 percent. The vegetation is a mix of riparian woodlands and shrublands. Dominant trees include poplar/cottonwood/aspen species (*Populus* spp.), Arizona sycamore (*Platanus wrightii*), Arizona walnut (*Juglans major*), and velvet ash (*Fraxinus velutina*). Shrub dominants include *Salix* spp., *Prunus* spp., and *Alnus* spp. Vegetation is dependent upon annual or periodic flooding and associated sediment scour and/or annual rise in the water table for growth and reproduction.

3.5.1.3 Special Status Plant Species

Special status plant species are species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. Included in this category are federally listed and federally proposed species protected under the ESA, species that are candidates for listing by the USFWS and species that are listed by the Arizona Game and Fish Department (AGFD) as species of greatest conservation need (SGCN).

In accordance with the ESA, the lead agency, in coordination with the USFWS, must ensure that any federal action that is authorized, funded, or implemented would not adversely affect a federally listed threatened or endangered species or its critical habitat. Designation as an AGFD SGCN species is intended to guide management decisions that involve wildlife and habitat.

The U.S. Fish and Wildlife Service (USFWS) lists the Arizona cliff-rose (*Purshia subintegra*) as endangered in Graham County, Arizona (USFWS 2015). This species is not known to occur in the analysis area (WestLand 2014b), which is approximately 43 miles from the only known population of this species in Graham County, on the San Carlos Indian Reservation below the Mogollon Rim, approximately 12 miles northwest of the town of Bylas, (Rutman 1995).

The AGFD Heritage Data Management System identifies 21 special status plant species in Graham County (AGFD 2015). Of these, only one is known to occur within or near the Project Area, Pima Indian mallow (*Abutilon parishii*) (AGFD 2014, 2000). No species of concern were observed in the analysis area during field surveys conducted as part of the 2014 Baseline Vegetation Study (WestLand 2014b).

3.5.1.4 Noxious and Invasive Species

The spread of noxious weeds on public, state trust, and private lands in southeastern Arizona poses risks to native and rangeland animals, threatens biodiversity and native plant species, damages park land and natural resources, and causes economic hardship for farmers, ranchers, and municipalities.

The geographic region comprising Cochise, Graham, and Greenlee counties in Arizona has relatively small infestations of noxious weeds compared to other areas in the West (University of Arizona Cooperative Extension 2015).

The federal Noxious Weed Act of 1974, as amended (7 USC 2801 et seq.), requires cooperation with state, local, and federal agencies in the application and enforcement of all laws and regulations relating to the management and control of noxious weeds. AACs R3-4-244 and R3-4-235 (Arizona Department of Agriculture 2014a,b) regulate certain invasive species in the state. A noxious weed is defined as any species of plant that is detrimental or destructive and difficult to control or eradicate and includes plant organisms found injurious to any domesticated, cultivated, native, or wild plant.

Prohibited species are not currently present in Arizona or have limited distribution. Management of these species focuses on prevention of new infestations, and eradication of existing infestations. Watch species are species of concern in the state that have the potential to become problematic. When these species are encountered, their location should be documented and provided to the appropriate authorities.

Table 3.5-2 lists noxious weeds of concern Graham County (NRCS 2015).

Table 3.5-2 Noxious Weeds of Concern in Graham County

Scientific Name	Common Name	Classification	Notes
Pennisetum ciliare	Buffelgrass	Prohibited Regulated	Arizona Department of Transportation (ADOT) found one plant in the Artesia area several years ago and removed it.
Brassica tournefortii	Saharan mustard	N/A[1]	This has been known in the Safford Valley for about 10 years. It occurs on ditch banks and in some fields, also along roadways. There has also been an infestation along Highway 191 that ADOT has been controlling. A closely related species, black mustard, was reported in the Safford Valley by an Arizona Department of Agriculture employee.
Cardaria draba	Whitetop (Hoary cress)	Prohibited Restricted	This species does not currently occur in Graham County, but is aggressively taking hold along the Gila River in Greenlee County.
Acroptilon repens	Russian knapweed	Prohibited Restricted	This species does not currently occur in Graham County, but there are extensive infestations along the Gila River in Greenlee County.
Centaurea melitensis	Malta starthistle	N/A[1]	This plant is found throughout the county, mainly along roadsides, disturbed areas, and irrigated pastures.
Alhagi pseudalhagi	Camelthorn	Restricted	There was one plant found near Fort Thomas about 20 years ago. ADOT treated it and no reoccurrence has been reported.
Pentzia incana	Karoo bush	N/A[1]	Small infestations found in the Marijilda and Stockton Pass areas.

Table 3.5-2 Noxious Weeds of Concern in Graham County

Scientific Name	Common Name	Classification	Notes
Euryops subcarnosus	Sweet resinbush	Restricted	Extensive infestation on Frye Mesa. Smaller infestation in the Marijilda area.
Arundo donax	Giant reed grass	N/A[1]	BLM has been treating this plant along the Gila River on their lands along with salt cedar.
Tamarix spp.	Saltcedar	N/A[2]	Prevalent along the Gila River (near the Emery mitigation site).

[1] These plants are identified by NRCS as being noxious weeds; however, they are not formally classified as such by the state.

[2] Not classified as a noxious weed by NRCS or the state; however, it is an invasive and non-native species of concern for the southwestern U.S.

Source: NRCS 2015; Orr et al. 2014.

No noxious or invasive weed species were mentioned in the 2003 Final EIS (BLM 2003) and no noxious or invasive weeds species were noted as being observed during the 2014 vegetation surveys conducted as part of the 2014 Baseline Vegetation Report (WestLand 2014b).

3.5.2 Environmental Consequences

3.5.2.1 Scoping Issues

The following issues submitted during public scoping were analyzed for vegetation resources:

- Impacts to special status or native plant species and habitat.
- Impacts to riparian areas and other vegetation communities.
- Control of noxious and invasive species.

3.5.2.2 Impact Indicators and Method of Analysis

The following indicators have been identified to analyze the effects of the alternatives on vegetation resources.

- Vegetation communities: acres (percent) of surface disturbance by vegetation type and alternative.
- Noxious weeds: qualitative analysis based on known occurrences.
- Special status plants: qualitative analysis (potential habitat for federally listed and state special status plant species, presence of known individuals, and populations within the analysis area.

The methods of analysis for vegetation resources include the following for each alternative.

<u>Vegetation Communities</u>

- Identify vegetation community types within the analysis area.
- Identify acres of potential impact from the footprint of proposed facilities.
- Estimate acres of impact to calculate percentage of each vegetation community's approximate disturbance under each alternative.

Noxious Weeds

- Evaluate qualitatively based on the assumption that where more acreage of disturbance and vehicle access is projected, there is a greater likelihood of noxious weeds spreading and establishing.
- Identify weed prevention, treatment, and management practices that would be applied to all ground-disturbing activities within the analysis area.
- Identify reclamation/restoration requirements that would be applied to all ground-disturbing activities within the analysis area.

Special Status Plant Species

- Identify rare plant potential habitat within the analysis area
- Identify acres of potential surface disturbance using surface disturbance information contained in Chapter 2.0.
- Estimate acres of impact to calculate the percentage of each special status plant species suitable habitat's approximate disturbance from reasonably foreseeable development.

3.5.2.3 Assumptions for Analysis

Assumptions were made concerning the surface-disturbing impacts as they relate to vegetation as a whole. The following assumptions were made for the analysis of impacts to general vegetation communities and noxious weeds:

- SWReGAP data were used to represent the vegetation communities in the analysis area and as the basis for potential habitat for special status plant species.
- Adverse impacts to vegetation resources could occur during or after initial disturbance. Impacts also could occur as a result of the continued use, maintenance, or reclamation of any resulting infrastructure.
- There is a likelihood of noxious weeds spreading or proliferating as disturbance expands.
- FMSI will comply with laws and regulations (e.g. CWA, ESA, etc.) and the analysis assumes implementation.

Surface disturbance from mining-related activities would affect vegetation community composition, species diversity, and the relative occurrence of structural stages through vegetation removal and mechanical damage to plants during construction of infrastructure. Additional impacts of surface disturbance on vegetation could include soil compaction, erosion, changes in hydrology, and encroachment by noxious weeds and invasive plant species. These impacts could affect recovery or reclamation of vegetation communities and riparian/wetland habitats following disturbance. Surface disturbance and removal of existing vegetation could increase opportunities for the establishment and subsequent spread of noxious or invasive weeds.

Development of mining facilities could have an impact on vegetation beyond the acreage of disturbance due to the fugitive dust generated from vehicle travel depositing on vegetation, most likely within and adjacent to road rights-of-way. Plant health and vigor may be reduced due to disrupted photosynthesis caused by dust accumulation on leaf surfaces. Where concentrated development occurs over large areas, surface-disturbing activities could affect the overall health of the plant communities and riparian/wetland habitats.

3.5.2.4 Alternative 1, Proposed Action

The Proposed Action is expected to result in direct impacts to seven of the eight vegetation communities in the Project Area: Chihuahuan mixed desert scrub-shrub, Chihuahuan mixed salt desert scrub, Chihuahuan piedmont semi-desert grassland and steppe, developed/disturbed/sparsely vegetated, Madrean pine-oak forest and woodland, Madrean pinyon-juniper woodland and savanna, and Sonoran mixed desert scrub-shrub. Vegetation would be cleared to construct pits, development rock stockpiles, heap leach pad, roads, shops, and other facilities. Riparian vegetation (warm desert lower montane riparian woodland and shrubland vegetation community) is not anticipated to be directly or indirectly impacted by the proposed project within the Project Area.

Of the 36,050 acres within the Project Area, approximately 6,140 acres of vegetation would be impacted by earthmoving and construction under the Proposed Action. **Table 3.5-3** summarizes the direct impacts of the Proposed Action on the individual vegetation communities occurring within the Project Area.

Because no federally listed or state listed special status plant species were identified in the analysis area, no threatened, endangered, or other listed species would be affected by Alternative 1.

Table 3.5-3 Vegetation Community Types Expected to be Impacted by the Proposed Action within the Project Area

Vegetation Cover Type	Acres	Percent of Project Area
Chihuahuan Mixed Desert Scrub-Shrub	2,476	7
Chihuahuan Mixed Salt Desert Scrub	890	2
Chihuahuan Piedmont Semi-Desert Grassland and Steppe	1,735	5
Developed/Disturbed/Sparsely Vegetated	20	<1
Madrean Pine-Oak Forest and Woodland	52	<1
Madrean Pinyon-Juniper Woodland and Savanna	953	3
Sonoran Mixed Desert Scrub-Shrub	4	<1
Total	**6,140**	**17**

Although the mitigation site is not included in the acreage affected by mine-related earthmoving shown in **Table 3.5-3**, construction activities at the Emery Mitigation Site would result in surface disturbance near the Gila River from the removal of a berm (Area A), noxious weed control, tamarisk removal (Area B), vegetation planting, regrading to restore natural contours, and creation of firebreaks (Area C only). Because this area would count as mitigation for the disturbance at the mine site, no additional mitigation is required for the short-term disturbance at this location. These activities may affect long-term productivity of vegetation. The spread of noxious weeds would be minimized by the control measures described in Section 2.3.4.9. The productivity of vegetation would be temporarily reduced due to surface-disturbing activities but would be restored once planned native vegetation is established. Tamarisk removal would remove existing riparian vegetation in Area B until native vegetation becomes established.

3.5.2.5 Alternative 2

Alternative 2 would utilize all of the same project components as the Proposed Action, with the exception of the heap leach stockpile. The design of the heap leach pad would be similar, but the location would be rotated compared to the Proposed Action to maximize avoidance of potential waters of the U.S.

Alternative 2 is expected to result in direct impacts to the same vegetation communities as the Proposed Action, with slightly more acreage affected. Of the approximately 36,050 acres within the Project Area, approximately 6,125 acres would be impacted under Alternative 2. **Table 3.5-4** summarizes the direct impacts of Alternative 2 on the vegetation communities occurring within the Project Area.

Table 3.5-4 Vegetation Community Types Expected to be Impacted by Alternative 2 within the Project Area

Vegetation Cover Type	Acres	Percent of Project Area
Chihuahuan Mixed Desert Scrub-Shrub	2,311	6
Chihuahuan Mixed Salt Desert Scrub	723	2
Chihuahuan Piedmont Semi-Desert Grassland and Steppe	2,131	6
Developed/Disturbed/Sparsely Vegetated	20	<1
Madrean Pine-Oak Forest and Woodland	52	<1
Madrean Pinyon-Juniper Woodland and Savanna	953	3
Sonoran Mixed Desert Scrub-Shrub	27	<1
Total	**6,216**	**17**

Because no federally listed or state listed special status plant species were identified in the analysis area, no threatened, endangered, or other listed species would be affected by the proposed project.

Impacts from Alternative 2 on vegetation at the Emery Mitigation Site most likely would be similar to that described for Alternative 1.

3.5.2.6 No Action Alternative

Under the No Action Alternative, the Corps would not issue a Section 404 permit and the existing mines would continue to operate as currently authorized but the Lone Star Pit and associated facilities would not be constructed. No new mine-related impacts to vegetation resources on the Project Area would occur.

3.5.2.7 Potential Mitigation Measures

There are no additional mitigation measures would be needed beyond what is proposed by FMSI as design features described in Chapter 2, Section 2.3.4, and the compensatory mitigation that may be required as part of the Section 404 permit under Corps' regulations.

3.5.2.8 Cumulative Impacts

The CESA for vegetation is the same as the analysis area. Development of the Lone Star Pit and associated infrastructure would contribute to cumulative impacts to vegetation including past or present disturbance from mining activities and livestock grazing.. However, on a regional or statewide scale, these impacts are not considered cumulatively significant. This is supported by the widespread distribution and relatively low value of vegetation community habitats located within the analysis area that would be affected by the proposed project.

Selection of the No Action Alternative would maintain the existing conditions of the mine sites and would not result in adverse cumulative effects to vegetation and wildlife resources.

3.5.2.9 Residual Adverse Effects

Residual effects under Alternatives 1 and 2 include loss of vegetation and the potential spread of noxious weeds on the Project Area. Selection of the No Action Alternative would not result in residual adverse effects.

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3.6 Terrestrial Wildlife (Including Special Status Species)

3.6.1 Affected Environment

3.6.1.1 Analysis Area

The analysis area for terrestrial biological resources is comprised of two components, the Project Area as defined as the FMSI boundary and the Emery Mitigation Site, approximately 25 miles downstream of the Project Area on the Gila River (see **Figure 3.6-1**).

3.6.1.2 General Setting

The region supports a diverse terrestrial wildlife community of large and small mammals, migratory birds, and reptiles. Occurrence and density of wildlife species within this analysis area are dependent upon a variety of factors including the size and mobility of the animal, food habits, water, existing and ongoing development, and overall habitat carrying capacities (Prior Magee 2007). All wildlife species present in the region are important members of a functioning ecosystem and wildlife community, but most are common and have wide distributions in the region. Consequently, the relationships of most of these species to this analysis area are not discussed in the same depth as species that are threatened, endangered, sensitive, of special concern, of special economic interest, or otherwise of high public interest or unique value.

Information regarding terrestrial wildlife habitat and species occurrence was obtained from baseline reports and biological surveys of the analysis area (WestLand 2015c, 2014c), USFWS Information for Planning and Conservation System (USFWS 2015a, d), and species occurrence information from the AGFD (AGFD 2015a,b,c,f,g; AGFD 2014a,b).

<u>Project Area</u>

The wildlife habitat within the analysis area is composed of nine vegetation communities that are summarized in **Table 3.5-1**. Two communities predominantly cover the Project Area (combined 78 percent): Chihuahuan mixed desert scrub-shrub and Chihuahuan mixed salt desert scrub. Detailed descriptions of these vegetation community types are discussed in Section 3.4, Vegetation. **Figure 3.4-1** illustrates the vegetation cover types in the Project Area. Wildlife species may utilize several different habitat types or vegetation communities in different seasons or throughout their life cycles.

<u>Emery Mitigation Site</u>

The Emery Mitigation Site has been identified for project mitigation activities to compensate for impacts to waters of the U.S. Four vegetation communities were mapped at the Emery Mitigation Site including agriculture, Chihuahuan mixed desert scrub-shrub, Chihuahuan mixed salt desert scrub, and warm desert lower montane riparian woodland and shrubland (Section 3.4, Vegetation). Detailed information on the Emery Mitigation Site is found in **Appendix B**.

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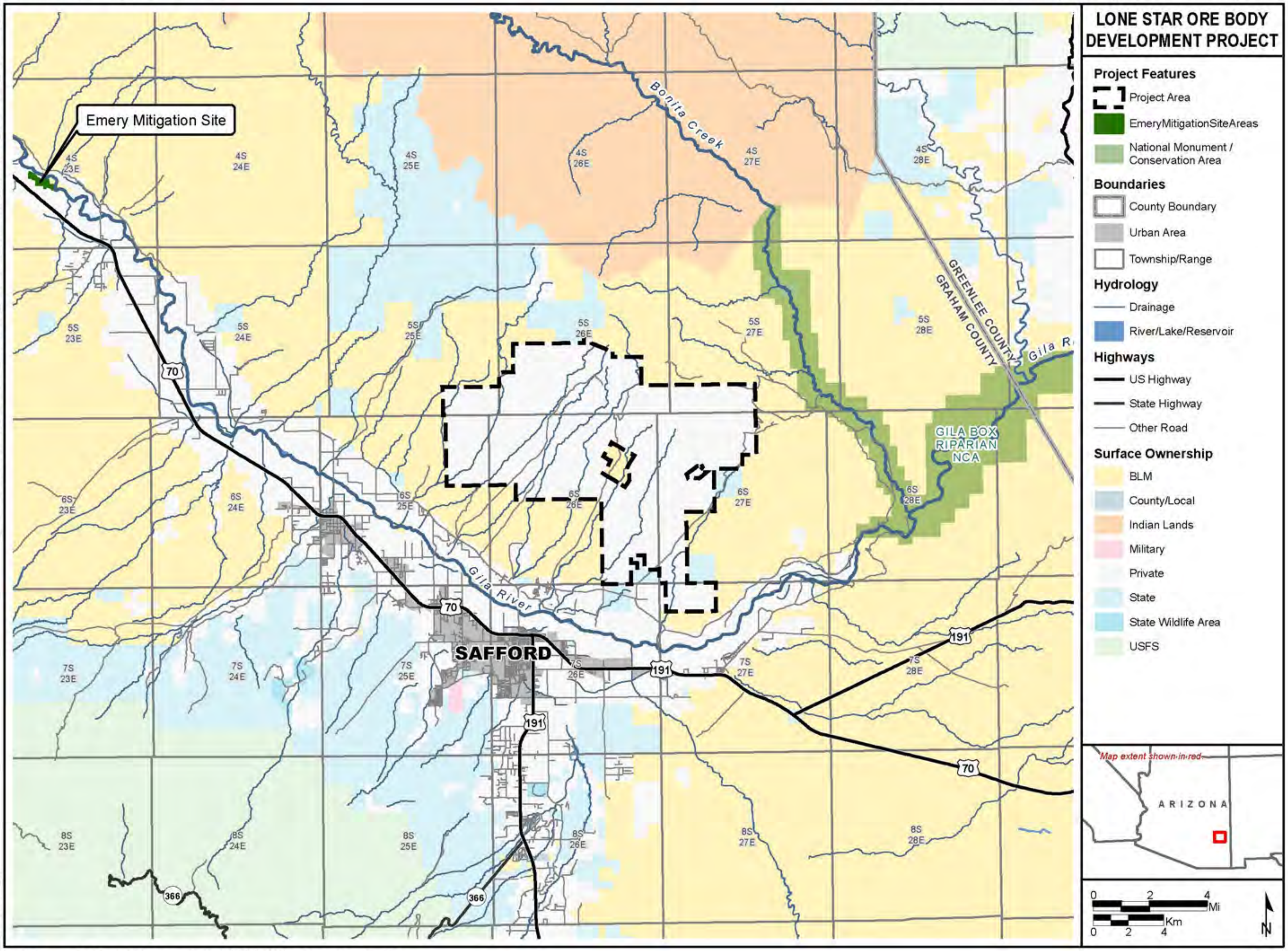

Figure 3.6-1 Terrestrial Wildlife Analysis Area

3.6.1.3 Game Species

The analysis area is located within Game Management Unit 28 of AGFD Region V – Tucson. Big game species reported to occur within or near the analysis area include bighorn sheep (*Ovis canadensis canadensis*), American black bear (*Ursus americanus*), javelina (*Pecari tajacu*), mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*), and mountain lion (*Puma concolor*) (AGFD 2015a,b). The AGFD identified the proposed open pit and development rock stockpiles as being located in an area that is important for bighorn sheep connectivity between the Gila Mountains and Bonita Creek Canyon. Over 30 bighorn sheep were observed in the area during a 2014 survey (AGFD 2015c). Based on known ranges and habitat preferences, a variety of small game species, mammalian predators, and furbearers are likely to be present in the analysis area. Species include desert cottontail (*Sylvilagus audubonii*), white-winged dove (*Zenaida asiatica*), band-tailed pigeon (*Patagioenas fasciata*), bobcat (*Lynx rufus),* badger (*Taxidea taxus*), beaver (*Castor Canadensis*), raccoon (*Procyon lotor*), Mexican fox squirrel (*Sciurus nayaritensis*), Gambel's quail (*Callipepla gambelii*), and scaled quail (*Callipepla squamata*).

Big and small game species identified as Species of Economic and Recreation Importance by AGFD within the analysis area include Gambel's quail, scaled quail, mule deer, Rocky Mountain bighorn sheep, band-tailed pigeon, javelina, mountain lion, Mexican fox squirrel, American black bear, and white-winged dove (AGFD 2015a). However, there is no public access to hunting within the Project Area. Within the Emery Mitigation Site, low-intensity public use, including minor forms of hunting or fishing may be allowed (WestLand 2016b).

3.6.1.4 Non-game species

The analysis area supports many types of non-game species (e.g., small mammals, reptiles, raptors, and passerines) occupying the habitat types. Non-game species serve as predators, prey, and scavengers in ecosystems. Common non-game small mammals species observed in the analysis area include rock squirrel (*Spermophilus variegatus),* Merriam's kangaroo rat (*Dipodomys merriami*), cactus mouse (*Peromyscus eremicus*), and white-throated woodrat (*Neotoma albigula*). Bat species observed in the analysis area include pale Townsend's big-eared bat (*Corynorhinus townsendii pallescens*), California leaf-nosed bat (*Macrotus californicus*), and cave myotis (*Myotis velifer*). Reptile species observed in the analysis area include Greater earless lizard (*Cophosaurus texanus*), round-tailed horned lizard (*Phrynosoma modestum*), common collared lizard (*Crotaphytus collaris*), side-blotched lizard (*Uta stansburiana*), desert spiny lizard (*Sceloporus magister*), tiger whiptail (*Cnemidophorus tigris*), and western diamondback rattlesnake (*Crotalus atrox*) (WestLand 2015c). Many of these species provide a substantial prey base for predators including larger mammals including coyotes (*Canis latrans*), badger (*Taxidea taxus*), and bobcat; and raptors (e.g., eagles, hawks, falcons, owls).

A wide variety of non-game birds occur in the analysis area, including passerine (also known as songbirds) and non-passerine (including raptor) species. Many of these species are considered resident species that breed and over-winter in the same area. Common passerine species in the analysis area include western kingbird (*Tyrannus verticalis*), barn swallow (*Hirundo rustica*), greater roadrunner (*Geococcyx californianus*), lesser nighthawk (*Chordeiles acutipennis*), verdin (*Auriparus flaviceps*), cactus wren (*Campylorhynchus brunneicapillus*), black-tailed gnatcatcher (*Polioptila melanura*), and black-throated sparrow (*Amphispiza bilineata*). Common raptor species include Swainson's hawk (*Buteo swainsoni*), prairie falcon (*Falco mexicanus*), American kestrel (*Falco sparverius*), and burrowing owl (*Athene cunicularia*) (WestLand 2015c).

3.6.1.5 Migratory Bird Treaty Act

Most of the non-game birds within the analysis area are migratory bird species that are protected under the Migratory Bird Treaty Act of 1918 (MBTA) (16 USC 703-711). The MBTA applies only to migratory bird species that are native to the U.S. or its territories. A native migratory bird is one that is present as a result of natural biological or ecological processes, not species whose presence in the U.S. is solely the result of human-assisted introductions. Non-game species that are excluded from protection under the MBTA include the rock pigeon, Eurasian collared-dove, European starling, and Old World sparrows such as the house sparrow.

To protect native migratory bird species, the MBTA includes, but is not limited to, the following points:

- Protection of 1,007 species of migratory birds and their parts, including eggs, feathers, and nests.
- Eagle nests are protected year-round; other migratory bird nests are protected only during the active nesting season.
- The MBTA is a strict liability statute. Proof of intent to violate the MBTA is not required for prosecution.
- The MBTA has no consultation process such as Section 7 consultation under the ESA.
- The MBTA does not permit incidental or unintentional take, such as that provided by Sections 7 and 10 of the ESA.

Further, Executive Order (EO) 13186, Responsibilities of Federal Agencies to Protect Migratory Birds, was signed in January 2001. In order to avoid or minimize the taking of migratory birds, EO 13186 requires the development and implementation of Memorandums of Understanding with all pertinent federal agencies when the actions or decisions of those agencies "…have had or are likely to have negative effects on migratory birds protected under MBTA." While the MBTA has no provision for protecting bird habitats, EO 13186 provides opportunities for protecting, improving, or replacing affected habitats.

3.6.1.6 Bald and Golden Eagle Protection Act

In addition to the MBTA, bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (BGEPA) (16 USC 668 et seq.). This statute prohibits anyone without a permit from committing a "take" of bald and golden eagles, including their parts, nests, and eggs. "Take" is defined as the actions to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb. In 2009, the USFWS implemented two rules authorizing new permits under BGEPA.

- 50 CFR 22.26 authorizes limited "take" of bald and golden eagles where the "take" is associated with, but is not the purpose of, an activity and cannot practicably be avoided.
- 50 CFR 22.27 authorizes the intentional take of eagle nests where necessary to alleviate safety hazards to people or eagles; to ensure public health and safety; where a nest prevents the use of a human-engineered structure; and when an activity, or mitigation for the activity, will provide a net benefit to eagles. Only inactive nests are allowed to be taken, except in the case of safety emergencies.

BGEPA provides the Secretary of the Interior with the authority to issue eagle-take permits only if he/she is able to determine that the take is compatible with the preservation of the eagle. This take must be "…consistent with the goal of increasing or stabilizing breeding populations." For golden eagles, current data indicate a negative population trend in the lower latitudes, such as the southwestern U.S., while data indicate a positive population trend in the northern Bird Conservation Regions. These trends may simply indicate movement patterns; however, evidence may demonstrate a lack of resiliency in golden eagle populations.

3.6.1.7 USFWS Birds of Conservation Concern

A list of Birds of Conservation Concern (BCC) was developed by the USFWS as a result of a 1988 amendment to the Fish and Wildlife Conservation Act. This act mandates that the USFWS "identify species, subspecies, and populations of all migratory non-game birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973." The goal of the BCC list is to prevent or remove the need for ESA bird listings by implementing proactive management and conservation actions and requiring consultation in accordance with EO 13186 (USFWS 2008). The list of BCC birds potentially occurring in this analysis area are presented in **Table 3.6-1**.

Table 3.6-1 Birds of Conservation Concern Potentially Occurring within the Analysis Area

Common Name	Scientific Name	Seasonal Occurrence
Bald Eagle	*Haliaeetus leucocephalus*	Wintering
Bell's Vireo	*Vireo bellii*	Breeding
Bendire's Thrasher	*Toxostoma bendirei*	Year-round
Black-chinned Sparrow	*Spizella atrogularis*	Breeding
Black-throated Gray Warbler	*Dendroica nigrescens*	Breeding
Brewer's Sparrow	Spizella breweri	Wintering
Burrowing Owl	*Athene cunicularia*	Breeding
Canyon Towhee	*Pipilo fuscus*	Year-round
Chestnut-collared Longspur	*Calcarius ornatus*	Wintering
Common Black-hawk	*Buteogallus anthracinus*	Breeding
Elegant Trogon	*Trogon elegans*	Year-round
Elf Owl	*Micrathene whitneyi*	Breeding
Flammulated Owl	*Otus flammeolus*	Breeding
Fox Sparrow	*Passerella iliaca*	Wintering
Gilded Flicker	*Colaptes chrysoides*	Year-round
Golden Eagle	*Aquila chrysaetos*	Year-round
Grace's Warbler	*Dendroica graciae*	Breeding
Gray Vireo	*Vireo vicinior*	Breeding
Lark Bunting	*Calamospiza melanocorys*	Wintering
Lewis's Woodpecker	*Melanerpes lewis*	Wintering
Loggerhead Shrike	*Lanius ludovicianus*	Year-round
Lucy's Warbler	*Vermivora luciae*	Breeding
Northern Beardless-tyrannulet	*Camptostoma imberbe*	Breeding
Olive Warbler	*Peucedramus taeniatus*	Breeding
Peregrine Falcon	*Falco peregrinus*	Year-round
Pinyon Jay	*Gymnorhinus cyanocephalus*	Year-round
Red-faced Warbler	*Cardellina rubrifrons*	Breeding
Sonoran Yellow Warbler	*Dendroica petechia ssp. sonorana*	Breeding
Swainson's Hawk	*Buteo swainsoni*	Breeding
Williamson's Sapsucker	*Sphyrapicus thyroideus*	Wintering
Phainopepla	*Phainopepla nitens*	Breeding

Source: USFWS 2008.

3.6.1.8 Special Status Species

Special status species are those species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. Included in this category are federally listed species that are protected under the ESA (federal endangered, threatened, proposed, or candidate species) and SGCN in Arizona by the AGFD. In accordance with the ESA, the lead agency (the Corps) in coordination with the USFWS must ensure that any action that they authorize, fund, or carry out would not adversely affect a species that is identified as endangered, threatened, proposed, or candidate by federal regulation administered by the USFWS (collectively called federally listed).

Information regarding special status wildlife species and their habitats within the analysis area was obtained from a review of existing published and online sources including file information from the USFWS and AGFD. Special status terrestrial wildlife species initially identified as having the potential to occur within the analysis area are identified in **Table 3.6-2**. Occurrence potential within the analysis area was further evaluated for each species based on its habitat requirements and known geographic distribution. These species, their associated habitats, and their potential for occurrence are summarized in **Table 3.6-2**.

Table 3.6-2 Terrestrial Special Status Species Potentially Occurring within the Analysis Area

Scientific Name	Common Name	Status	Habitat	Potential to Occur within the Analysis Area
Accipiter gentilis atricapillus	Northern Goshawk	SGCN	Coniferous forests	No, suitable habitat is limited and the analysis area is not within AGFD's predicted distribution for this species.
Aix sponsa	Wood Duck	SGCN	Riparian woodlands	Yes, suitable habitat is found within the Emery Mitigation site.
Ammodramus savannarum perpallidus	Western Grasshopper Sparrow	SGCN	Grasslands	Yes
Ammospermophilus harrisii	Harris' Antelope Squirrel	SGCN	Desert scrub-shrub,	Yes
Aquila chrysaetos	Golden Eagle	SGCN	Cliff and canyon; desert scrub-shrub, grassland	Yes
Aspidoscelis flagellicauda	Gila Spotted Whiptail	SGCN	Riparian areas, woodlands, and grasslands along waterbodies.	Yes, suitable habitat is found within the Emery Mitigation site.
Aspidoscelis stictogramma	Giant Spotted Whiptail	SGCN	Riparian areas	Yes, suitable habitat is found within the Emery Mitigation site.
Athene cunicularia hypugaea	Western Burrowing Owl	SGCN	Desert scrub-shrub, grassland associated with existing mammal burrows	Yes, this species has been predicted to occur within or adjacent to the Project Area based on the AGFD range models, but not within or adjacent to the Emery Mitigation Site.
Botaurus lentiginosus	American Bittern	SGCN	Wetlands, marshes	Yes, suitable habitat is found within the Emery Mitigation site.
Buteo regalis	Ferruginous Hawk	SGCN;	Cliff and canyon; desert scrub-shrub, grasslands	Yes

Table 3.6-2 Terrestrial Special Status Species Potentially Occurring within the Analysis Area

Scientific Name	Common Name	Status	Habitat	Potential to Occur within the Analysis Area
Buteogallus anthracinus	Common Black Hawk	SGCN	Riparian woodlands	No, this species has been predicted to occur within or adjacent to the Project Area component of the analysis area only based on AGFD environmental review tool. However, the Project Area does not contain suitable habitat for this species within its known range.
Canis lupus baileyi	Mexican Gray Wolf	PE,XN; SGCN	All habitats	No, the analysis area is outside the known range for this species.
Castor canadensis	American Beaver	SGCN	Riparian, waterbodies	Yes, suitable habitat is found within the Emery Mitigation site.
Chordeiles minor	Common Nighthawk	SGCN	Woodlands, riparian areas, grasslands	Yes
Coccothraustes vespertinus	Evening Grosbeak	SGCN	Conifer woodlands, aspen forests, and pinyon-juniper woodlands.	Yes
Coccyzus americanus	Western Yellow-billed Cuckoo	FT; SGCN	Riparian woodlands	Yes, suitable habitat occurs within the Emery Mitigation Site.
Colaptes chrysoides	Gilded Flicker	SGCN	Desert scrub-shrub with saguaro associations	Yes
Coluber bilineatus	Sonoran Whipsnake	SGCN	All habitats	Yes
Corynorhinus townsendii pallescens	Pale Townsend's Big-eared Bat	SGCN	Cave, mines, desert scrub-shrub, woodlands, and coniferous forests	Yes
Crotalus cerberus	Arizona Black Rattlesnake	SGCN	All habitats	Yes
Crotalus tigris	Tiger Rattlesnake	SGCN	Rocky slopes within desert scrub-shrub and woodlands.	Yes.
Cynanthus latirostris	Broad-billed Hummingbird	SGCN	Desert scrub-shrub, grassland, woodlands	Yes
Cynomys ludovicianus	Black-tailed Prairie Dog	SGCN	Desert scrub-shrub, grassland	Yes
Dipodomys spectabilis	Banner-tailed Kangaroo Rat	SGCN	Desert scrub-shrub, grassland	No, the analysis area is outside the known range for this species.
Empidonax traillii extimus	Southwestern Willow Flycatcher	FE; SGCN	Riparian areas	Yes, suitable habitat and nesting observations have been documented within the Emery Mitigation Site.
Euderma maculatum	Spotted Bat	SGCN	Cliffs, ponderosa pine, desert scrub-shrub, and riparian areas	Yes
Eugenes fulgens	Magnificent Hummingbird	SGCN	Pine-oak woodlands, desert scrub-shrub, grasslands	Yes

Table 3.6-2 Terrestrial Special Status Species Potentially Occurring within the Analysis Area

Scientific Name	Common Name	Status	Habitat	Potential to Occur within the Analysis Area
Eumops perotis californicus	Greater Western Bonneted Bat	SGCN	Cliffs, desert scrub-shrub	Yes
Falco peregrinus anatum	American Peregrine Falcon		Cliffs	Yes
Haliaeetus leucocephalus	Bald Eagle	SGCN	Riparian woodlands	Yes, this species may be observed as a migrant or foraging individual through the analysis area. Suitable nesting and winter roost habitat is found within the Emery Mitigation site.
Heloderma suspectum	Gila Monster	SGCN	Rocky areas, canyons, grasslands	Yes
Idionycteris phyllotis	Allen's Lappet-browed Bat	SGCN	Ponderosa pine, pinyon-juniper, woodland and riparian areas	Yes
Junco phaeonotus	Yellow-eyed Junco	SGCN	Conifer forests, pine-oak woodlands	Yes
Lampornis clemenciae	Blue-throated Hummingbird	SGCN	Pine-oak and deciduous woodlands	Yes
Lasiurus blossevillii	Western Red Bat	SGCN	Riparian and woodlands	Yes
Leopardus pardalis	Ocelot	FE; SGCN	All habitats	No, the analysis area is outside the known range for this species.
Leptonycteris curasoae yerbabuenae	Lesser Long-nosed Bat	FE; SGCN	Cave, mines, desert scrub-shrub, semi-desert grassland and oak woodlands areas with saguaro associations	No, the analysis area is outside the known range for this species.
Macrotus californicus	California Leaf-nosed Bat	SGCN	Cave, mines, desert scrub-shrub	Yes
Melanerpes uropygialis	Gila Woodpecker	SGCN	Desert scrub-shrub with saguaro associations, forests, riparian woodlands	Yes
Melospiza lincolnii	Lincoln's Sparrow	SGCN	Desert scrub-shrub, forests, riparian woodlands	Yes
Melozone aberti	Abert's Towhee	SGCN	Riparian woodlands	Yes, suitable habitat occurs within the Emery Mitigation Site.
Micruroides euryxanthus	Sonoran Coralsnake	SGCN	Rocky upland deserts.	Yes
Myotis occultus	Arizona Myotis	SGCN	Riparian, woodlands	Yes
Myotis velifer	Cave Myotis	SGCN	Cave, mines, desert scrub-shrub	Yes
Myotis yumanensis	Yuma Myotis	SGCN	Caves, mines, cliffs, buildings, riparian, desert scrub, moist woodlands and forests. Prefer cliffs and rocky walls near water.	Yes

Table 3.6-2 Terrestrial Special Status Species Potentially Occurring within the Analysis Area

Scientific Name	Common Name	Status	Habitat	Potential to Occur within the Analysis Area
Nyctinomops femorosaccus	Pocketed Free-tailed Bat	SGCN	Rocks, caves, buildings, desert scrub.	Yes
Oreohelix grahamensis	Pinaleno Mountainsnail	SGCN	Talus deposits	No, the analysis area is outside the known range for this species.
Ovis canadensis canadensis	Rocky Mountain Bighorn Sheep	SGCN	Desert mountains, grasslands	Yes
Panthera onca	Jaguar	FE; SGCN	Riparian areas, pine-oak woodlands	No, the USFWS Information for Planning and Conservation system does not identify this species as potentially occurring within the vicinity of the analysis area.
Passerculus sandwochensis	Savannah Sparrow	SGCN	Open areas, grasslands, wetlands, and marshes	Yes
Picoides arizonae	Arizona Woodpecker	SGCN	Pine-oak mountain woodlands	Yes
Progne subis Hesperia	Desert Purple Martin	SGCN	Desert scrub-shrub with saguaro associations	No, the analysis area is outside the known range for this species.
Sciurus arizonensis	Arizona Gray Squirrel	SGCN	Deciduous woodland/montane forest	No, this species has been predicted to occur within or adjacent to the Project Area component of the analysis area only based on AGFD environmental review tool. Suitable habitat is extremely limited based on the vegetation analysis of the Project Area.
Setophaga petechia	Yellow Warbler	SGCN	Riparian woodlands	Yes, suitable habitat occurs within the Emery Mitigation Site
Sonorella christenseni	Clark Peak Talussnail	SGCN	Talus	No, the analysis area is outside the known range for this species.
Sonorella grahamensis	Pinaleno Talussnail	SGCN	Talus	No, the analysis area is outside the known range for this species.
Sonorella imitator	Mimic Talussnail	SGCN	Talus	No, the analysis area is outside the known range for this species.
Strix occidentalis lucida	Mexican Spotted Owl	FT; SGCN	Cliff, canyon, conifer forests	No, the USFWS IPaC system does not identify this species as potentially occurring within the vicinity of the analysis area. Additionally, suitable habitat is extremely limited based on the vegetation analysis.
Tadarida brasiliensis	Brazilian Free-tailed Bat	SGCN	Desert scrub, coniferous forests	Yes
Thamnophis eques megalops	Northern Mexican gartersnake	FT	Wetland, riparian	No, the analysis area is outside the known range for this species.

Table 3.6-2 Terrestrial Special Status Species Potentially Occurring within the Analysis Area

Scientific Name	Common Name	Status	Habitat	Potential to Occur within the Analysis Area
Troglodytes pacificus	Pacific Wren	SGCN	Coniferous and mixed forests, often near water	Yes
Vireo bellii arizonae	Arizona Bell's Vireo	SGCN	Riparian areas	Yes, suitable habitat occurs within the Emery Mitigation Site
Vulpes macrotis	Kit Fox	SGCN	Desert scrub-shrub, grassland	Yes

Status: FT = Federally listed as threatened; FE = Federally listed as endangered; PE,XN = Experimental Population, Non-essential; SGCN = AGFD Species of Greatest Conservation Need.

Source: AGFD 2015a,b,f, g; 2014a,b; Cornell University 2015; USFWS 2015 a,d.

As detailed in **Table 3.6-2**, eight federally listed terrestrial wildlife species were determined to have the potential to occur within the analysis area (AGFD 2015 a, b; 2014a,b; USFWS 2015a,d). After further evaluating the potential for occurrence within the analysis area for each species based on habitat requirements and known distribution, all but the southwestern willow flycatcher and yellow-billed cuckoo have been eliminated from further analysis. A brief description of these species' associated habitat and occurrence is provided below.

Southwestern Willow Flycatcher

The southwestern willow flycatcher was listed as endangered under the ESA in 1995. Critical habitat for this species was designated in 1997, 2005, and 2013. The 2013 revision of the critical habitat designation includes the reach of the Gila River from Earven Flat (just downgradient of the confluence with Bonita Creek) to the San Carlos Reservation boundary (USFWS 2013). Critical habitat is designated within the analysis area at the Emery Mitigation Site and is depicted on **Figure 3.6-2**.

Four specific types of breeding habitat have been described for the southwestern willow flycatcher. The first is comprised of dense stands of willows 10 to 23 feet in height with no distinct overstory. This community is often associated with sedges, rushes, or other herbaceous wetland plants. A second habitat type includes dense stands of salt cedar or Russian olive up to 33 feet in height. These species form a dense, closed canopy with no distinct understory layer. Native broadleaf–dominated communities form a third habitat type. The final habitat type is a mixture of native and exotic riparian species (Sogge et al. 1997).

Occurrence of this species would be restricted to the Emery Mitigation Site along the Gila River due to the lack of quality riparian habitat within the Project Area (see Section 3.3.1.3 for more information). Surveys have been conducted documenting the presence of southwestern willow flycatcher along the Gila River (WestLand 2015b). At the Emery Mitigation Site, surveys have documented nesting activity within or adjacent to the area between 2006 and 2014 (Stillwater Sciences 2014).

Yellow-billed Cuckoo

The western distinct population segment of the yellow-billed cuckoo was listed as threatened under the ESA in 2014. Designated critical habitat for this distinct population segment of the species has been proposed along the Gila River from 12 miles upgradient of Safford, including portions of the Emery Mitigation Site (see **Figure 3.6-2**), to the San Carlos Reservoir, and along a 6-mile-long reach of Bonita Creek upgradient of its confluence with the Gila River (USFWS 2014b).

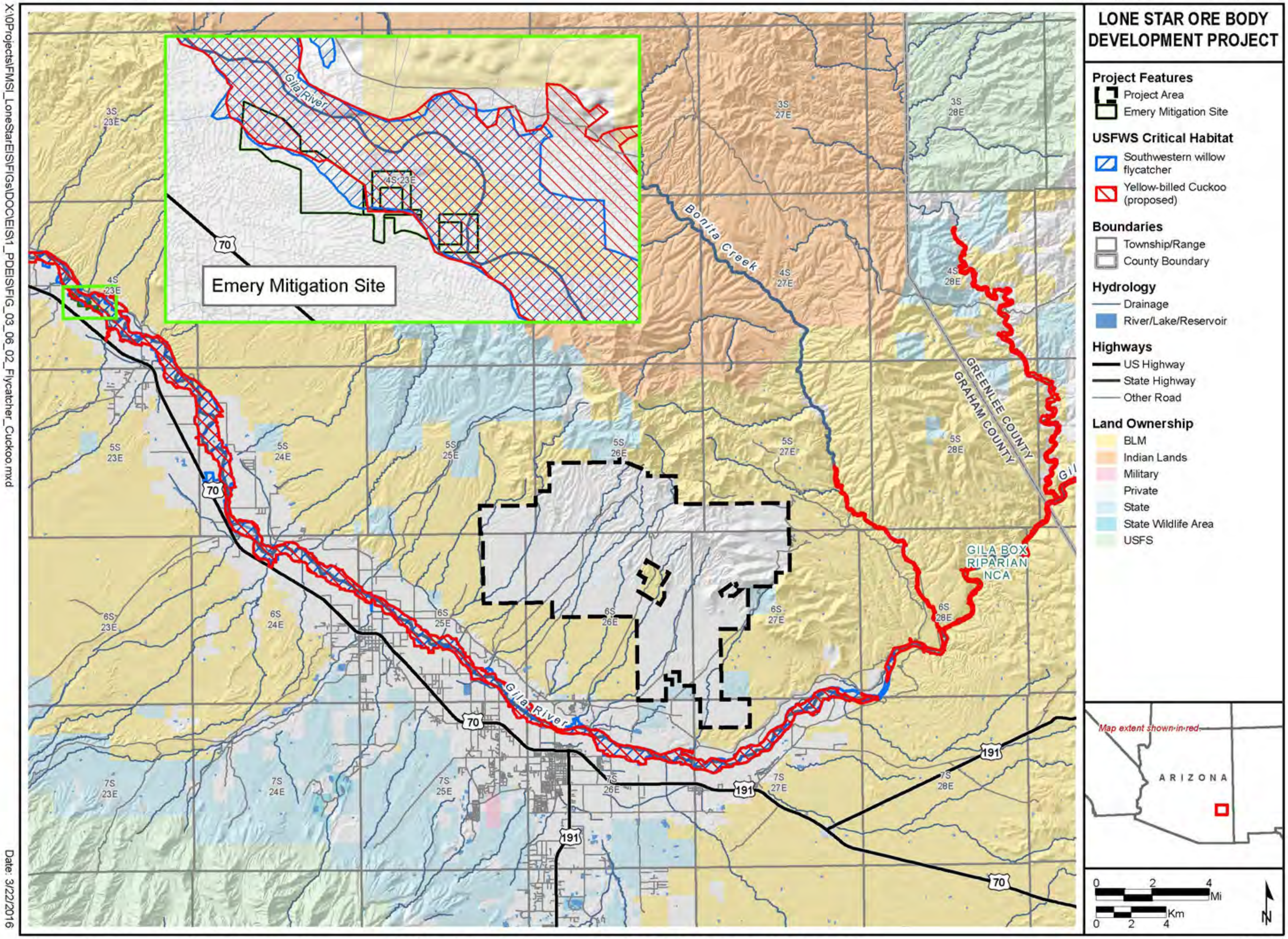

Figure 3.6-2 Designated and Proposed Critical Habitat for Federally Listed Terrestrial Species

Similar to the southwestern willow flycatcher, suitable habitat for this species is dependent on riparian habitat associated with perennial streams. More specifically, this species requires riparian woodlands along riparian corridors, limiting the potential for occurrence to the Emery Mitigation Site along the Gila River (**Figure 3.6-2**). No observations of the species have occurred within the past nine years within the portion of the Emery Mitigation Site included as part of the Upper Gila River Restoration Project (Stillwater Sciences 2014).

Numerous surveys have been conducted, documenting the presence of yellow-billed cuckoos adjacent to the Emery Mitigation and Project Area along the Gila River (WestLand 2015b). Individuals were detected during surveys of the Gila River and Bonita Creek in 1998 and 1999 (Corman and Magill 2000) and more recent surveys of the Gila River in 2005, 2006, and 2007 at the Fort Thomas Preserve along the Gila River between the Emery Mitigation and Project Area (Stillwater Sciences 2014).

More detailed information regarding the life histories and occurrences within the Project Area for the southwestern willow flycatcher and yellow-billed cuckoo can be found in the Biological Opinion for the Dos Pobres/San Juan Project (USFWS 2002).

3.6.2 Environmental Consequences

3.6.2.1 Scoping Issues

The primary issues related to terrestrial wildlife resources include the direct loss or alteration of terrestrial habitats in the analysis area, potential impacts to threatened and endangered species, and noise and lighting effects on wildlife. More specifically, during the public scoping process, areas of concern for terrestrial wildlife include:

- Impacts to wildlife habitat, such as the physical loss of habitat and a reduction in diversity and habitat effectiveness;
- Impacts on any threatened, endangered, and candidate wildlife species as identified by the USFWS;
- Impacts to wildlife species found in the area, including those species listed in the AGFD's Species of Greatest Conservation Need and Species of Economic and Recreational Importance; and
- Impacts to wildlife from noise and light.

3.6.2.2 Method of Analysis and Impact Indicators

Impacts to terrestrial wildlife, including special status species, were analyzed based on the associated impacts to suitable habitat identified by the extent of surface disturbance in the vegetation analysis. The identification of habitat types using plant communities from the affected environment section establishes the relationship between vegetation types and wildlife habitat.

3.6.2.3 Assumptions for Analysis

The following assumptions were used in the analysis of impacts to terrestrial wildlife resources:

- Species will be considered as having the potential to occur within the analysis area if: 1) recent occurrence has been documented for the species; and 2) the current species range exists within the analysis area and suitable habitat is present.

- Construction of the project components would lead to the loss of terrestrial wildlife habitat.
- Installation of roads would increase disturbance of wildlife species and fragmentation of native habitat.
- Increased vehicle traffic would contribute to disruption of wildlife populations and movement corridors.
- Installation of new powerlines associated with the project elements would increase the potential for migratory bird collisions with powerlines. New powerlines would increase the potential for roosting locations for raptors and other predatory birds.
- Increased human activities from construction, maintenance, and operations of mining, roads, and powerlines are likely to alter wildlife movement patterns and the use of native habitat, and increase the potential for wildlife mortality.
- The impacts to species and wildlife habitat types would be in similar proportion to the distribution of species and habitat types or vegetation types described for the analysis area in the Affected Environment section, Section 3.6.1.
- It could take up to 15 years for shrub species to fully re-establish and 20 plus years for tree species to reestablish following reclamation. Establishment of grasses and forbs would take at least 3 years.

3.6.2.4 Alternative 1, Proposed Action

Potential impacts to terrestrial wildlife as a result of development of the Proposed Action can be classified as short-term and long-term, direct and indirect. Short-term impacts are associated with habitat removal and disturbance as well as mining-related activities. Short-term impacts would cease following mine closure and completion of successful reclamation according to the reclamation plan. Direct impacts include wildlife mortality, habitat loss and alteration, habitat fragmentation, and displacement. Indirect impacts include increased noise, light, and human presence. Long-term impacts include changes to, or loss of, habitats and the wildlife populations that depend on those habitats that continue well beyond completion of successful reclamation (and may become permanent). Even with successful reclamation, the plant communities would be altered from native conditions for a long time.

Construction and operation of the Lone Star Pit, heap leach pad, development rock stockpiles, and conveyance route and associated project elements (i.e., roads and powerlines), as well as vegetation treatments at the Emery Mitigation Site would result in long-term and short-term habitat loss and alteration, and also would result in direct losses of smaller, less mobile wildlife species, such as small mammals and reptile species. It is anticipated that the larger species displaced from the disturbance areas to surrounding habitats during construction and operation would return following reclamation as long as the habitat is successfully restored. However, if surrounding habitats are already at carrying capacity, species may be forced to use marginal habitat, migrate, or they may experience indirect mortality impacts. The disturbed areas in the Project Area would be reclaimed to achieve the post-mining land uses discussed in Section 2.3.6.1. The areas selected for vegetation treatments at the Emery Mitigation site would be restored to native conditions, resulting in improved riparian habitat for listed species once vegetation is established. Section 3.5, **Table 3.5-3** summarizes direct impacts to vegetation communities and associated habitat types under Alternative 1.

<u>Project Area</u>

Construction

Direct impacts to all terrestrial wildlife, including special status species, as a result of surface disturbance during construction activities within the Project Area include the temporary and permanent loss or alteration of associated suitable habitat. The loss of some native vegetation would be long-term, most likely more than 20 years after final reclamation of disturbed areas. Herbaceous species and grasses may become established within 3 to 5 years, depending on reclamation success. In most locations, suitable habitat adjacent to construction disturbance areas would be available until grasses, shrubs, and woody vegetation is reestablished. The predominant vegetation communities that would be affected by construction disturbance are Chihuahuan mixed desert scrub-shrub and Chihuahuan mixed salt desert scrub (**Table 3.5-3**). They would be replaced by native grasses and herbaceous plants during initial reclamation, which would attract both game and nongame species that utilize grasslands and herbaceous feed and cover.

Terrestrial wildlife habitat would be affected by increased habitat fragmentation caused by the installation of the new haul and access roads, pit, development rock stockpiles, and the heap leach pad. The construction of roads would dissect the landscape and may alter wildlife movements within the Project Area, such as travel routes for game species. The locations of the proposed open pit and development rock stockpiles are in an area important for sheep habitat connectivity and may segregate the bighorn population or affect movement between the Gila Mountains and Bonita Creek Canyon.

Direct impacts to some less mobile or burrowing species (e.g., small mammals, nesting birds, and reptiles) include habitat disruption caused by human disturbance that may result in nest or burrow abandonment or loss of eggs or young and direct mortality of as a result of crushing from vehicles and construction equipment. If surface-disturbing activities occur near nesting sites during the breeding season for passerines (approximately March 1 through September 30), impacts would result in nest or territory abandonment and possibly the loss of eggs or young resulting in the loss of productivity for that breeding season. For species protected under the MBTA, the loss of an active nest site, incubating adults, eggs, or young would be a violation of the MBTA. However, the extent of impacts to nesting birds would depend on the nest location relative to the actual locations of construction, the phase of the breeding period, and the level and duration of the disturbance.

Raptors that nest close to construction locations would be likely to abandon their breeding territory or nest site, or may experience the loss of eggs or young, as a result of surface disturbance activities during construction. These losses, if they were to occur, would reduce productivity for that breeding season. The degree of these impacts would depend on a number of variables including the location of the nest site, the species' relative sensitivity to disturbance, and the breeding cycle. New and rerouted overhead powerlines could pose an electrocution hazard for raptor species attempting to perch on the structures and would slightly increase collision potential for migrating and foraging birds. Collision potential typically is dependent on variables such as the location of the powerlines in relation to high-use habitat areas (e.g., nesting, foraging, and roosting), line orientation to flight patterns, and movement corridors, visibility, and line design (Avian Power Line Interaction Committee 1994). The proposed new powerlines would be located in or near areas with high levels of human activity. Therefore, raptors may be deterred from the powerlines due to human activity, which may minimize nesting and roosting.

Direct impacts to more mobile species (e.g., medium-sized mammals, big game, adult birds) include the short-term displacement as a result of surface disturbance activities. The habitats adjacent to the proposed disturbance areas may support some displaced animals, depending on current carrying capacity.

Indirect impacts to terrestrial wildlife species would result from increased noise levels and human presence during construction. Big game species would likely decrease their use of areas surrounding surface disturbance activities. However, this displacement would be short-term and animals would return to the adjacent areas following completion of construction activities. Indirect impacts would include the temporary displacement of small game from the construction areas as a result of increased noise and human activities. Displacement of small game from construction areas would be short-term and wildlife would return following construction activities where habitat remains available.

Artificial light at night introduced to areas currently without lighting could adversely impact wildlife behaviors including mating, foraging, sleeping, and migratory behaviors (International Dark-sky Association [IDA] 2008). These behaviors are determined by the length of nighttime lighting. For example, birds can become disoriented by artificial light, disrupting migration routes and causing additional energy expenditure by staying near light sources. Crepuscular and nocturnal mammals such as raccoons, bats, deer, coyotes, and mice may lose the nighttime ecosystem they depend on for food and protection against predators (IDA 2008). As detailed in Section 2.3.4.8, BMPs for exterior lighting control measures would include approaches to illumination for a safe operational work environment that is also sensitive to meet regional astronomical and ecological needs. A lighting control and management plan would be prepared and implemented for mine construction and operations. It is anticipated that these practices would serve to minimize adverse effects on wildlife in the vicinity of the Project Area..

Operations

Direct impacts to many wildlife species from the operation and maintenance activities associated with the Proposed Action would include the incremental long-term habitat loss or alteration of potential breeding or foraging habitats until native vegetation has become reestablished after closure of facilities and reclamation.

The projected groundwater drawdown under the Proposed Action would not cause changes to the vegetation communities, surface water sources, or the associated wildlife habitat in the locations identified in Section 3.4, Vegetation. Therefore, there would be no impacts to wildlife from groundwater drawdown. The reduction in stormwater flows due to diversion construction in Watson Wash may result in some reduction of riparian vegetation downgradient from the diversion structures.

Due to the lack of surface water sources for wildlife in the Project Area, the PSIs and NSIs proposed for the project may entice wildlife to use them as new watering sources, which would be detrimental. The ponds would be likely to attract a variety of migratory bird and bat species, causing disease or mortality unless deterrents are employed. The potential exposure of wildlife to these process water sources may result in acute or chronic toxicity. Indirect impacts to wildlife species would result from the increase in habitat disruption from human presence, including increased vehicle traffic, noise, and artificial lighting during operations and maintenance activities. The most common wildlife responses to noise and human presence are avoidance or accommodation. Avoidance would result in displacement of animals from an area larger than the actual disturbance area. It is not possible to predict the total extent of habitat lost as a result of wildlife avoidance response, because the degree of this response varies from species to species and can vary between individuals of the same species. After initial avoidance of human activity and noise, certain wildlife species would acclimate to the activity and reoccupy areas formerly avoided. For example, during the initial development phases, it is likely that big game would be displaced from a larger area than the actual disturbance sites due to the avoidance response. Avoidance distances of 100 to 200 meters are common for some big game species (Lyon 1983). However, these big game species have demonstrated the ability to acclimate to infrequent vehicle traffic and a variety of mining activities as long as human harassment levels do not increase substantially. The extent of displacement would be located adjacent to actively used areas along the haul roads, pit, and heap leach and development rock stockpile areas; and in areas where construction activities would continue incrementally throughout the life of the mine, such as the pit and haul roads advancement, additional surface water control facilities installation, and existing road and utility relocation within the Project Area. The impacts of artificial lighting are the same as those discussed above under construction. Implementation of the lighting and control measures described in Chapter 2, Section 2.3.4.8, would minimize adverse impacts to terrestrial wildlife species.

Potential impacts to terrestrial wildlife, including special status species, from construction and operation activities would be minimized through implementation of the environmental protection measures and control practices described in Chapter 2, Section 2.3.4.9.

Emery Mitigation Site

Direct impacts to all terrestrial species as a result of treatment activities (i.e., recontouring, tamarisk removal, planting, etc.) at the Emery Mitigation Site include the temporary loss or alteration of suitable habitat for terrestrial wildlife species. Of concern is the impact to designated critical habitat for the southwestern willow flycatcher and proposed critical habitat for the western yellow-billed cuckoo. The predominant vegetation that would be affected by vegetation treatments is tamarisk and the vegetation covering the former agricultural fields. They would be replaced by native riparian vegetation, which, once established, would attract a diverse group of big game species as well as many small game and non-game species, including the federally listed southwestern willow flycatcher and the western yellow-billed cuckoo.

Impacts to game and nongame species during treatment activities (i.e., access road construction and vegetation removal) would be similar to those identified as surface disturbance activities during construction of the Project Area. However, over time, the vegetation treatments are expected and designed to improve riparian habitat within the site.

Impacts to associated special status species habitats [i.e., vegetation communities identified within the Project Area (**Tables 3.5-3** and **3.5-4**) and at the Emery Mitigation Site; as well as agricultural lands, wetlands, and aquatic habitat found only at the Emery Mitigation Site] as a result of Alternative 1 implementation are detailed in **Table 3.6-3**. No adverse effects to special status wildlife species are anticipated due to the small amount of direct impacts to their habitat (less than 10 percent of the analysis area) and the beneficial outcome of the vegetation treatments at the Emery Mitigation Site. As described in Appendix B, no special aquatic sites, including wetlands, would be adversely affected by the project. Vegetation restoration activities at the Emery Mitigation Site involving the removal of tamarisk would lead to the temporary loss and disturbance of terrestrial wildlife habitat until native woody vegetation is established. Although considered an exotic species, tamarisk provides suitable nesting and migrating habitat for the special status species southwestern willow flycatcher and yellow-billed cuckoo and other migratory bird species.

3.6.2.5 Alternative 2

Impacts to suitable habitats associated with terrestrial wildlife from the construction and operation of Alternative 2 would be similar to the impacts outlined for the Proposed Action within the Project Area. The amount of surface disturbance associated wildlife habitat would be increased by 76 acres at the Project Area compared to Alternative 1. Similar to Alternative 1, impacts to special status species as a result of Alternative 2 are detailed in **Table 3.6-3**.

Table 3.6-3 Effects from Surface Disturbance to Terrestrial Special Status Species Suitable Habitat

	Habitat									
	Chihuahuan Mixed Desert Scrub-Shrub[1]	**Chihuahuan Mixed Salt Desert Scrub[2]**	**Chihuahuan Piedmont Semi-Desert Grassland and Steppe**	**Developed/ Disturbed/ Sparsely Vegetated**	**Madrean Pine-Oak Forest and Woodland**	**Madrean Pinyon-Juniper Woodland and Savanna**	**Sonoran Mixed Desert Scrub-Shrub**	**Warm Desert Lower Montane Riparian Woodland and Shrubland[3]**	**Open Water/ Wetlands/ Marsh[3]**	**Agriculture[3]**
Alternative 1 – Proposed Action (acres of associated habitat)	**2,476**	**890**	**1,735**	**20**	**52**	**953**	**4**	**6**	**64**	**86**
Alternative 2 (acres of associated habitat)	**2,311**	**723**	**2,131**	**20**	**52**	**953**	**27**	**6**	**64**	**86**
Species										
Wood Duck								X	X	X
Western Grasshopper Sparrow			X							
Harris' Antelope Squirrel	X	X					X			
Golden Eagle	X	X	X	X			X			
Gila Spotted Whiptail								X	X	
Giant Spotted Whiptail								X	X	
Western Burrowing Owl	X	X	X	X			X			
American Bittern									X	
Ferruginous Hawk	X	X	X	X			X			
American Beaver									X	
Common Nighthawk			X		X	X		X		
Evening Grosbeak					X	X		X		
Western Yellow-billed Cuckoo								X		
Gilded Flicker							X			

Table 3.6-3 Effects from Surface Disturbance to Terrestrial Special Status Species Suitable Habitat

	Habitat									
	Chihuahuan Mixed Desert Scrub-Shrub[1]	**Chihuahuan Mixed Salt Desert Scrub[2]**	**Chihuahuan Piedmont Semi-Desert Grassland and Steppe**	**Developed/ Disturbed/ Sparsely Vegetated**	**Madrean Pine-Oak Forest and Woodland**	**Madrean Pinyon-Juniper Woodland and Savanna**	**Sonoran Mixed Desert Scrub-Shrub**	**Warm Desert Lower Montane Riparian Woodland and Shrubland[3]**	**Open Water/ Wetlands/ Marsh[3]**	**Agriculture[3]**
Alternative 1 – Proposed Action (acres of associated habitat)	**2,476**	**890**	**1,735**	**20**	**52**	**953**	**4**	**6**	**64**	**86**
Alternative 2 (acres of associated habitat)	**2,311**	**723**	**2,131**	**20**	**52**	**953**	**27**	**6**	**64**	**86**
Species										
Sonoran Whipsnake	X	X	X	X	X	X	X	X	X	X
Pale Townsend's Big-eared Bat	X	X			X	X	X	X		
Arizona Black Rattlesnake	X	X	X	X	X	X	X	X	X	X
Tiger Rattlesnake	X	X			X	X	X	X		
Broad-billed Hummingbird	X	X	X		X	X	X	X		
Black-tailed Prairie Dog	X	X	X	X			X			
Southwestern Willow Flycatcher								X		
Spotted Bat	X	X		X	X	X	X	X		
Magnificent Hummingbird	X	X	X		X		X	X		
Greater Western Bonneted Bat	X	X		X			X			
American Peregrine Falcon				X						
Bald Eagle								X	X	
Gila Monster				X						
Allen's Lappet-browed Bat					X	X		X		
Species										

Table 3.6-3 Effects from Surface Disturbance to Terrestrial Special Status Species Suitable Habitat

	Habitat									
	Chihuahuan Mixed Desert Scrub-Shrub[1]	**Chihuahuan Mixed Salt Desert Scrub**[2]	**Chihuahuan Piedmont Semi-Desert Grassland and Steppe**	**Developed/ Disturbed/ Sparsely Vegetated**	**Madrean Pine-Oak Forest and Woodland**	**Madrean Pinyon-Juniper Woodland and Savanna**	**Sonoran Mixed Desert Scrub-Shrub**	**Warm Desert Lower Montane Riparian Woodland and Shrubland**[3]	**Open Water/ Wetlands/ Marsh**[3]	**Agriculture**[3]
Alternative 1 – Proposed Action (acres of associated habitat)	**2,476**	**890**	**1,735**	**20**	**52**	**953**	**4**	**6**	**64**	**86**
Alternative 2 (acres of associated habitat)	**2,311**	**723**	**2,131**	**20**	**52**	**953**	**27**	**6**	**64**	**86**
Yellow-eyed Junco					X			X		
Blue-throated Hummingbird					X			X		
Western Red Bat					X	X		X		
California Leaf-nosed Bat	X	X					X			
Gila Woodpecker	X	X			X	X	X	X		
Lincoln's Sparrow	X	X			X	X	X	X		
Abert's Towhee								X		
Sonoran Coralsnake				X						
Arizona Myotis					X	X		X		
Cave Myotis	X	X					X			
Yuma Myotis	X	X		X	X	X	X	X		
Pocketed Free-tailed Bat	X	X		X	X		X			
Rocky Mountain Bighorn Sheep				X	X					
Savannah Sparrow			X			X		X		

Table 3.6-3 Effects from Surface Disturbance to Terrestrial Special Status Species Suitable Habitat

	Habitat									
	Chihuahuan Mixed Desert Scrub-Shrub[1]	Chihuahuan Mixed Salt Desert Scrub[2]	Chihuahuan Piedmont Semi-Desert Grassland and Steppe	Developed/ Disturbed/ Sparsely Vegetated	Madrean Pine-Oak Forest and Woodland	Madrean Pinyon-Juniper Woodland and Savanna	Sonoran Mixed Desert Scrub-Shrub	Warm Desert Lower Montane Riparian Woodland and Shrubland[3]	Open Water/ Wetlands/ Marsh[3]	Agriculture[3]
Alternative 1 – Proposed Action (acres of associated habitat)	**2,476**	**890**	**1,735**	**20**	**52**	**953**	**4**	**6**	**64**	**86**
Alternative 2 (acres of associated habitat)	**2,311**	**723**	**2,131**	**20**	**52**	**953**	**27**	**6**	**64**	**86**
Species										
Arizona Woodpecker					X	X		X		
Yellow Warbler								X		
Brazilian Free-tailed Bat	X	X			X	X		X		
Pacific Wren					X	X		X		
Arizona Bell's Vireo								X		
Kit Fox	X	X	X				X			X

[1] The 2,306 acres identified for the Proposed Action includes the 2,294 acres of this community type found within the Project Area identified in **Table 3.5-3**, as well as an additional 12 acres of this vegetation community found within Areas A and B of the Emery Mitigation Site. The 2,473 acres includes the 2,461 acres of this community type found within the Project Area identified in **Table 3.5-4**, as well as an additional 12 acres of this vegetation community found within Areas A and B of the Emery Mitigation Site.

[2] The 725 acres identified for the Proposed Action includes the 723 acres of this community type found within the Project Area identified in **Table 3.5-3**, as well as an additional 2 acres of this vegetation community found within Areas A and B of the Emery Mitigation Site. The 892 acres includes the 890 acres of this community type found within the Project Area identified in **Table 3.5-4**, as well as an additional 2 acres of this vegetation community found within Areas A and B of the Emery Mitigation Site.

[3] Located within the Emery Mitigation Site only. Acreage of surface disturbance within this area is not known at this time. For purposes of analysis, it was assumed that all habitat would be disturbed but this is likely to be overestimated.

Source: AGFD 2015d; USGS 2004; NWI 2014.

Should Alternative 2 be selected, compensatory mitigation would be implemented at the Emery Mitigation Site, with similar impacts to that described for Alternative 1. The acreage of compensatory mitigation would most likely be less because fewer acres of waters of the U.S. would be affected by the proposed project at the mine site.

3.6.2.6 No Action Alternative

Under the No Action Alternative, the Corps would not issue a Section 404 permit and the proposed new mine, including the construction, operations, reclamation activities, would not occur. No impacts to wildlife or special status species would result.

3.6.2.7 Potential Mitigation Measures

In addition to the environmental protection measures and control practices that have been incorporated into the project design as described in Chapter 2.0, the following additional mitigation measures are recommended to minimize potential adverse impacts to terrestrial wildlife and special status species. Conservation measures may be implemented to protect federally listed species if required during consultation with the USFWS as part of the Section 7 (ESA) process.

- During activities at the Emery Mitigation site, avoid clearing access routes within suitable southwestern willow flycatcher and the western yellow-billed cuckoo habitat and during the nesting season for these species (approximately April 15 to September 30).
- To minimize adverse impacts to the southwestern willow flycatcher and the western yellow-billed cuckoo vegetation treatments, implement the conservation measures listed by the USFWS in the Biological Opinion (BO) for the Upper Gila River Vegetation Management Project (USFWS 2015) such as conducting nesting surveys, and implementing appropriate protection buffer distances for herbicide application and in-stream work.

3.6.2.8 Cumulative Impacts

The CESA for terrestrial wildlife is the same as the analysis area for direct and indirect impacts. Actions that have resulted in past or present disturbance include mining activities and livestock grazing. No specific new projects have been identified as reasonably foreseeable future actions. Overall, cumulative impacts to terrestrial wildlife and special status species would be the same as the impacts described for the Proposed Action. The proximity of future mine sites within the CESA to past, present, and future mine operations and other development may affect nearby wildlife habitat value and availability. However, on a regional or statewide scale, these impacts are not considered cumulatively significant. This is supported by the widespread distribution and relatively low value of vegetation community habitats located within the Project Area that would be impacted by the proposed project.

Although wildlife populations that occur in the CESA are likely to continue to occupy their respective habitats and breed successfully, species composition and population numbers may change relative to the amount of cumulative habitat loss and disturbance from incremental area development. Implementation of the final reclamation plan for mine projects would restore habitats to post-mining land uses in areas other than the open pit. It is expected that reclaimed areas would be capable of supporting wildlife; however, species composition and densities would be expected to be impacted, at least until native vegetation is fully restored. Revegetated areas would be planted with species appropriate to the proposed post-mining land uses, but natural processes of species competition and survival will modify these communities over time. Thus, it is expected that wildlife habitats on reclaimed areas gradually would resemble the surrounding undisturbed habitats, leading to similar gradual changes in the wildlife populations using these areas. The unreclaimed area of the open pit would leave permanent changes in the landscape through the establishment of roads and structures, permanent changes to wildlife habitat would persist.

Selection of the No Action Alternative would maintain the existing conditions of the Project Area and Emery Mitigation Site and would not result in adverse cumulative effects to vegetation and wildlife resources.

3.6.2.9 Residual Impacts

Residual adverse effects to terrestrial species, including special status species, would include the long-term net loss of terrestrial upland habitat resulting from the construction and operation of the proposed project. Residual adverse effects to species using shrub and forested habitats would include long-term loss of habitat, as it could take up to 15 years for shrub species to fully reestablish and 20 plus years for tree species to reestablish. Assuming successful reclamation is achieved, these shrub and forested habitat residual adverse effects would be minimized over time in the reclaimed areas. The proposed open pit area would not be reclaimed and would have ongoing residual adverse effect during operations and into the future. Implementation of a reclamation plan and compensatory mitigation measures required by the Corps would eventually restore riparian habitat in the analysis area.

3.7 Aquatic Resources (Including Special Status Species)

3.7.1 Affected Environment

Aquatic biological resources addressed in this section include aquatic habitat and species that are considered to be important from a recreational or game fish perspective and those that have special status. Special status aquatic species include fish and amphibian species that are federally listed species protected under the ESA (federal endangered, threatened, proposed, or candidate species) and those identified as SGCN in Arizona by the AGFD.

3.7.1.1 Analysis Area

The geographical extent of the analysis area for aquatic biological resources includes the FMSI boundary (Project Area), Bonita Creek, as well as the Gila River because it receives drainage from streams within the mine site (**Figure 3.7-1**). The analysis area also includes the Gila River near the Emery Mitigation Site downstream. The Gila River reach extends from the Bonita Creek confluence downstream to the Emery Mitigation Site, which is approximately 25 miles downstream from Safford.

Information regarding aquatic habitat and species was obtained from a review of existing published reports related to the hydrology of the Project Area (WestLand 2014c), fish surveys (Westland 2015a), a Biological Opinion for the mine site (USFWS 2002a) and several other USFWS documents cited in this section, and species occurrence information in reports from the AGFD (2015b) and WestLand (2015a).

<u>Aquatic Habitats</u>

Project Area

Aquatic habitat within the Project Area is comprised of ephemeral drainages that mainly occur within the Cottonwood Wash subwatershed (WestLand 2014c). The primary drainages include Wilson, Peterson, Cottonwood, Talley, Watson, and Coyote washes. Some of these drainage systems have been altered and diverted under previously permitted activities, which then altered their respective watershed sizes due to the construction of diversions and other structures (WestLand 2013). All of these drainages ultimately flow into the Gila River, with the approximate lengths ranging from 1 to 5 miles.

Gila River

Water input to the Gila River in Safford Valley is primarily from groundwater inflow from the Holocene Aquifer (Arizona Department of Water Resources 2015). Even with this groundwater inflow, the river is intermittent throughout the valley due to heavy agricultural pumping of groundwater and water use by encroaching phreatophytes (plants that rely on a constant source of surface water or shallow groundwater). River flow in this segment is sporadic depending on seasonal runoff and irrigation demand from nearby agriculture (Environmental Defense Fund 2012). As a result of the intermittent flow, aquatic habitat is limited to periods when there is flow or in scattered locations where water can persist as pools. The closest perennial segments to Safford include the areas near the USGS gaging station at Solomon (10 miles upstream) and the USGS gaging station at Calva (35 miles downstream) (see **Figure 3.2-3** in Section 3.2.2.1, Water Resources.

Aquatic habitat in the Gila River adjacent to the Emery Mitigation Site is characterized as a meandering, braided channel with tamarisk-dominated riparian vegetation. The river configuration consists of an active channel with numerous side channels. This section of the Gila River is considered perennial, although there is considerable fluctuation in river discharge in response to seasonal storms and dry periods. The flashy flow dynamics are characteristic of large, dryland riverine systems (USFWS 2015f). River flow also is affected by irrigation diversions.

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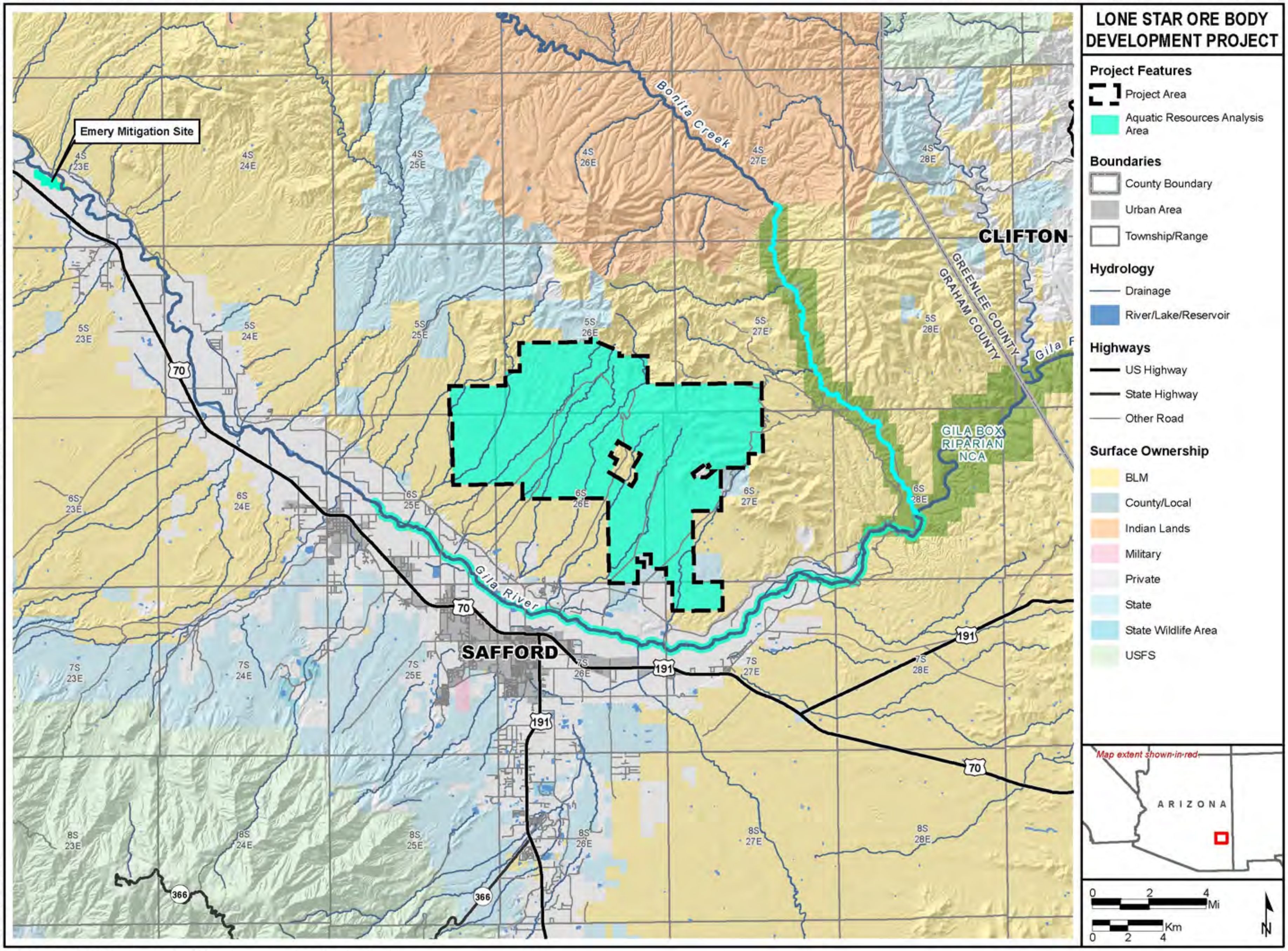

Figure 3.7-1 Aquatic Resources Analysis Area

Bonita Creek

Bonita Creek is a south-flowing tributary to the Gila River that originates in the highlands on the San Carlos Apache Reservation. The total perennial length of Bonita Creek is approximately 18.8 miles (Turner and List 2007). The majority of the 14-mile stretch from the reservation boundary to the Gila River confluence is within federal land managed by the BLM. The topography of the upper portion of the drainage is characterized as a broad alluvial valley, while much of the stream channel on BLM land is dominated by steep canyon walls with widths narrowed to approximately 50 feet in some locations (BLM 2007). The City of Stafford has an infiltration gallery dike across the streambed at approximately 6.3 miles upstream from the Gila River confluence (BLM and AGFD 2009). A U.S. Bureau of Reclamation fish barrier was built approximately 1.25 miles upstream of the Gila River confluence during the summer of 2008, and stream renovation has been completed between the infiltration gallery dike and the constructed fish barrier. Large beaver complexes existed in the stream prior to the stream renovation work, but they were removed. However, a considerable amount of large pool habitat is still present in this portion of the stream. Bonita Creek upstream of the fish barrier currently is managed as a native-only fishery (U.S. Bureau of Reclamation 2010).

The Gila Box RNCA was established in 1990 by the BLM, which administers the RNCA based on a comprehensive management plan (BLM1998). A principal objective of the RNCA Management Plan is to maintain or enhance populations of threatened, endangered, and other special status species. The Gila Box RNCA includes a reach of Bonita Creek. Native species with special status are discussed in more detail in the Special Status Species section below.

<u>Fish and Amphibians</u>

Project Area

No fish are present in the ephemeral drainages located within the Project Area due to a lack of water on a consistent basis. There could be potential habitat for amphibians, if water is present during their breeding period. Species that could use the ephemeral drainages include red spotted frog (*Bufo punctatus*) and canyon tree frog (*Hyla arenicolor*).

Gila River

Fish and amphibian occurrence in the Safford Valley portion of Gila River is limited due to intermittent flow. Fish could be present during periods of flow or in areas where water persists for an extended period of time. Based on fish monitoring in Bonita Creek, game fish species such as smallmouth bass (*Micropterus dolomieu*), green sunfish (*Lepomis macrochirus*), black bullhead (*Ameiurus melas)* yellow bullhead (*Ameiurus natalis*), and channel catfish (*Ictalurus punctatus*) could be present at times in the Gila River because they may migrate from the lower portion of Bonita Creek (BLM 2007). Nongame native fish species that potentially occur in this segment of the Gila River include the speckled dace (*Rhinichthys osculus*), longfin dace (*Agosia chrysogaster*), Sonora sucker (*Catostomus insignis*), and desert sucker (*Pantosteus clarki*). Potential habitat exists for the following nongame non-native fish species: fathead minnow (*Pimephales notropis*), red shiner (*Cyprinella lutrensis*), and mosquitofish (*Gambusia affinis*). The occurrence of these species is more likely near the confluence with Bonita Creek. Amphibian species in the Safford Valley section of the Gila River are the same as the species listed for the Project Area (red spotted frog and canyon tree frog).

Although site-specific data are lacking for the section of the Gila River adjacent to the Emery Mitigation Site, a review of fish occurrence in the Gila River by Rinne et al. (2005) included a segment designated as area 2 that encompasses the site. Game fish species listed for area 2 included channel catfish, yellow bullhead, black bullhead, flathead catfish (*Pylodictis olivaris*), largemouth bass (*Micropterus salmoides*), smallmouth bass, green sunfish, bluegill (Lepomis macrochirus), and black crappie (*Pomoxis nigromaculatus*). Non-native non-game species are similar to the species listed for the Safford Valley with the addition of carp (*Cyprinus carpio*), golden shiner (*Notemigonus crysoleucas*), and Mozambique tilapia (*Oreochromis mossambicus*). The non-game native species are the same as those listed above for the Safford Valley area. Native fish species that could be present include the razorback sucker, which is discussed in Section 3.7.1.2, Federally Listed Species.

Because aquatic invertebrates (macroinverebrates) were used as a biotic function parameter for the Mitigation Ratio-Setting Checklist (WestLand 2016c) for the Emery Mitigation Site, macroinvertebrate information is provided for this portion of the Gila River. The closest site with macroinvertebrate data is the Calva stream gage, which is located approximately 6 miles downstream of the Emery site. A total of eight aquatic invertebrates were collected in one sampling effort in May 2013, including Nematoda (nematodes), Oligochaeta (worms), Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies), Odonata (dragonflies), Coleoptera (beetles), and Diptera (true flies) (ADEQ 2015b). Macroinvertebrate groups with the largest number of taxa in the collections were mayflies and true flies (chironomid midges).

Bonita Creek

A portion of Bonita Creek also was designated as part of the RNCA, with one of the purposes being maintaining and enhancing habitat for native fish species (BLM and AGFD 2009). Fish species in Bonita Creek are comprised of native and introduced non-native species. Native fish species consist of Gila chub (*Gila intermedia*), speckled dace (*Rhinichthys osculus*), longfin dace (*Agosia chrysogaster*), Sonora sucker (*Catostomus insignis*), and desert sucker (*Pantosteus clarki*). Non-native fish species include green sunfish (*Lepomis macrochirus*), smallmouth bass, channel catfish, black bullhead, yellow bullhead, fathead minnow (*Pimephales notropis*), red shiner (*Cyprinella lutrenis*), common carp (*Cyprinis carpio*), and mosquitofish (*Gambusia affinis*) (BLM 2007). Smallmouth bass, green sunfish, and black bullhead have been introduced in the past 30 years. These three introduced species are restricted to the lower 3.75 miles of Bonita Creek below the infiltration gallery. Game fish consist of the bullhead species, channel catfish, green sunfish, and smallmouth bass, which likely resulted from AGFD stocking, local private introductions, and live baitfish escapes. Some of these species likely moved upstream from the Gila River.

Amphibian species known to occur in Bonita Creek include the red spotted frog and canyon treefrog. One turtle, Sonoran mud turtle (*Kinosternon sonoriense*) also has been documented in or near the creek (BLM 2007).

Several actions were completed in Bonita Creek to maintain and enhance of native fish populations. Following completion of the Bureau of Reclamation fish barrier was eradication of non-native fish and salvage of native fish above the fish barrier in 2009 and ongoing restocking of native fish species (BLM and AGFD 2009). Species considered for native stocking include razorback sucker, spikedace, loach minnow, desert pupfish, and Gila topminnow.

3.7.1.2 Federally Listed Species

All of the federally listed species discussed in this section also are included in the list of Arizona SGCN. The tier level of the SGCN species is 1A, which is the highest vulnerability ranking.

<u>Desert Pupfish</u>

Desert pupfish (*Cyprinodon macularius*) was federally listed as endangered in 1986 and a recovery plan was prepared in 2006. Desert pupfish occurs in Bonita Creek as a result of reintroduction in 2008 when 147 fish were stocked in October (BLM and AGFD 2009). Surveys conducted in Bonita Creek in 2008 and 2010 determined that the species is present. Desert pupfish does not occur in the Gila River. No critical habitat occurs in the Gila River or Bonita Creek. Pupfish are adaptable and can survive in aquatic habitats with high temperatures and salinity, although they likely prefer more amenable conditions. Given the opportunity, they will move into areas of lower salinity and temperatures (USFWS 2015a). The spawning period is the spring and early summer months (USFWS 2015a).

Gila Chub

Gila chub (*Gila intermedia*) was listed as federally endangered in 2005. No recovery plan was prepared for this species. Gila chub is endemic to the Gila River Basin, with the remaining populations isolated due to the use of surface water and groundwater, which has eliminated the connectivity between habitats (USFWS 2015b). This species occurs in Bonita Creek as a result of reintroduction in 2008 when 230 fish were stocked in October (BLM and AGFD 2009). Surveys conducted in Bonita Creek in 2008 and 2010 determined that the species is present. Gila chub does not occur in the Gila River. No critical habitat occurs in the Gila River or Bonita Creek. Adult Gila chub prefer quiet-water areas in pools in smaller streams, ciénegas, and artificial ponds (USFWS 20015b). Older juveniles may use higher velocity areas in riffles and runs. The breeding period is in late spring and summer (USFWS 2015b).

Gila Topminnow

Gila topminnow (*Poeciliopsis occidentalis*) was listed as federally endangered in 1967. No critical habitat has been designated for this species. A draft recovery plan was prepared in 1999, but it has not been updated or finalized. Although this species once was abundant in the Gila River, occurrence is now limited to a maximum of nine locations (USFWS 2002a). The closest historical occurrence to the Project Area is an introduced population in Watson Wash, downstream of the Project Area where it is associated with an artesian well near the Gila River. However, the species no longer exists at this site. Gila topminnow were stocked in Bonita Creek in 2008, with individuals being observed in 2008 and 2010 surveys (WestLand 2015d; BLM and AGFD 2009). Potential habitat also exists in the Gila River adjacent to the Emery Mitigation Site. The Gila topminnow occurs in shallow water with minimal to no flow in a variety of habitats including ponds, ciénegas, tanks, pools, springs, small streams, and the margins of larger streams (USFWS 2015b). They are associated with dense algal mats and debris along the margins of these habitats, which serves as a source of cover and forage. The breeding season usually is from January through August, although it can be year-round if temperatures and food availability are suitable (USFWS 2015b).

Loach Minnow

The loach minnow (*Rhinichthys cobitis*) was federally listed in 1986, with critical habitat being designated in 2000. A recovery plan was prepared for the loach minnow in 1991 (Marsh 1991). A portion of the critical habitat designation includes the Gila River from the upstream end of Safford Valley near Owl Canyon and along Bonita Creek from the confluence with the Gila River. In 2012, the original critical habitat designation was revised to include only the reach of Bonita Creek; the Gila River was excluded (USFWS 2012) so no critical habitat occurs within the analysis area. Loach minnow were stocked in Bonita Creek in 2008, with individuals being observed in 2008 and 2010 surveys (WestLand 2015d; BLM and AGFD 2009).Habitat for loach minnow consists of shallow, turbulent riffles in small to large streams with cobble-dominated substrates (USFWS 2012). The loach minnow uses the spaces between the substrates for resting and spawning. It is absent or rare in streams with sediment-filled interstitial spaces between the cobble substrates. Spawning can occur between late winter through early to late spring (USFWS 2015c).

Razorback Sucker

Razorback sucker (*Xyrauchen texanus*) was federally listed as endangered in 1991. The initial recovery plan for the razorback sucker was published in 1998 and amended in 2002 (USFWS 2002b). Critical habitat was designated in the Gila River and its 100-year floodplain from the Arizona-New Mexico border to Coolidge Dam in 1994 (USFWS 2002b). Critical habitat for razorback sucker exists within the Emery Mitigation Site. Razorback suckers were reintroduced into the Gila River and its tributaries between 1981 and 1989 (USFWS 2002a). However, there is no evidence that the introductions have established a self-sustaining population. Razorback sucker was stocked in Bonita Creek in 1987, but they were not detected during native fish management studies in Bonita Creek in 2008 and 2010 (WestLand 2015a). The types of habitat used by razorback sucker vary depending on the life stage and time of year. Adults use eddies, pools, and backwaters during the nonbreeding period from July through March (Maddux et al. 1993). Seasonal habitat use includes pools and eddies from November through April, runs and pools from July through October, runs and backwaters in May, and backwaters and backwaters and flooded gravel pits during June. Juveniles prefer shallow water with minimal flow in backwaters, tributary mouths, off-channel impoundments, and lateral canals (Maddux et al. 1993). Spawning usually occurs in April through mid-June when river flows are relatively high and adult razorback sucker congregate in flooded bottomlands and gravel pits, backwaters, and impounded tributary mouths near spawning sites (USFWS 2002b).

Spikedace

Spikedace (*Meda fulgida*) was originally listed as federally threatened in 1986 and then changed to endangered in 2012 (USFWS 2012). A recovery plan was prepared for the species in 1990 (USFWS 1990). The critical habitat designation for the spikedace is the same as described for the loach minnow. Spikedace was stocked (448 individuals) in Bonita Creek in 2008, with individuals being observed in 2008 and 2010 surveys (WestLand Resources 2015c; BLM and AGFD 2009). Adult spikedace occur in flowing water along or above gravel/sand bars and quiet eddies on the downstream edge of riffles (USFWS 1990). Younger fish are associated with quiet water areas along pool margins over soft, fine-grained substrates. Spikedace breed in the spring (April through June) (USFWS 1990).

Chiricahua Leopard Frog

Chiricahua leopard frog (*Lithobates [Rana] chirichuaensis*) was federally listed in 2002. No critical habitat has been designated in the Safford Valley portion of the Gila River. Historical records exist for the Chiricahua leopard frog in Bonita Creek within the San Carlos Reservation, but the collection sites are located upstream of the Bonita Creek analysis area. This species was not observed during native fish management studies along Bonita Creek in 2008 and 2010 (WestLand 2015a). Historically, it occurred in a variety of wetland habitats, but it is now restricted primarily to stock tanks and other man-made waters, as well as headwater streams, ciénegas, and springs that lack introduced predators. This species breeds primarily from April through October (USFWS 2014a).

3.7.1.3 Arizona Listed Species

In addition to the federally listed fish and amphibian species, which are also on the Arizona SGCN list, four other SGCN occur in the Gila River or Bonita Creek portions of the Gila Box RNCA, which is managed by the BLM. The species include the desert sucker, longfin dace, Sonora sucker, and speckled dace. All of these species were collected in the native fish surveys conducted in 2008 through 2010. In addition, the SGCN, Bylas springsnail (*Pyrgulopsis arizonae*) occurs in a spring adjacent to the Gila River near Bylas, Arizona (WestLand 2015d). Because these species are outside the analysis area, they are not discussed further.

3.7.2 Environmental Consequences

3.7.2.1 Scoping Issues

The following issues and concerns were identified by the public for fish and amphibian resources. Scoping issues include the need to identify:

- Potential impacts to the Gila River as an aquatic resource of national importance (ARNI), especially due to changes in water quality, quantity, chemistry, temperature, and alteration to flow regimes.
- Effects from project construction and operations on waters of the U.S that support aquatic species.
- Effects from project construction and operation on special status species and their habitat in the Gila River.

- Potential for the project to pollute waters that support aquatic species and amphibians and potential mitigation measures to prevent such pollution.

3.7.2.2 Method of Analysis and Impact Indicators

Impacts were evaluated for each alternative using the following methodology:

- Aquatic habitat for fish and amphibians was identified in the analysis area based on previous studies or publications.
- Evaluation of potential effects on special status species and habitat
- Project design features were considered in the impact evaluations in terms of reducing or avoiding impacts to aquatic habitat.

Impact indicators used for analysis:

- Acres of waters of the U.S. disturbed under each alternative compared to total acreage of waters of the U.S.
- Level of risk of water quality impacts from spills or discharges from processing facilities
- Qualitative evaluation of water quantity in the Gila River that may be affected

3.7.2.3 Assumptions for Analysis

The following assumptions were applied during the analysis of impacts.

- FMSI will comply with the design features described in Chapter 2.0, Section 2.3.4, Activities and Design Features Applicable to Action Alternatives, as well as federal and state laws, regulations, and permit requirements such as the Clean Water Act, Endangered Species Act, and the ADEQ APP. The analysis assumes implementation.
- FMSI will continue to implement the requirements of the 3M Program (see Section 3.2.1.1) and the fallowing program (described in Chapter 2.0, Section 2.5.1.4) to offset the effects of groundwater pumping for mining operations on the Gila River and Bonita Creek.

3.7.2.4 Alternative 1, Proposed Action

Construction activities associated with developing the Lone Star Pit, heap leach pad, development rock stockpiles, conveyance route, clay borrow pit expansion, soil and growth medium stockpile, roads, and power distribution infrastructure would overlap with the ephemeral drainages within the Project Area. Construction activities would result in soil disturbance and pose a risk of potential sediment input to the drainages. However, when considering the ephemeral nature of these drainages, potential sediment input to the drainages would be localized and minimized through implementation of the stormwater management and erosion and sediment control design features proposed by FMSI. Sedimentation could be deposited and moved offsite in drainages after storm events when flow is at its peak levels. However, these periods present a small portion of typical flow conditions during the year.

Biological communities would likely consist of macroinvertebrates and amphibians that can tolerate ephemeral flows and low water levels. No fish are present in the ephemeral drainages within the Project Area. The design features described in Chapter 2.0, Section 2.3.4 involving implementation of erosion and sediment control measures would be used to reduce sedimentation from proposed project facilities and disturbed areas into ephemeral drainages, as defined in the SWPPP (see Section 2.3.4.2). By implementing the erosion control measures, project-related effects of sediment on ephemeral drainages and aquatic biota (when present) would be considered minor.

Construction of the heap leach pad, development rock stockpiles, and conveyance route would disturb and remove 90 acres of waters of the U.S. These areas provide habitat for aquatic invertebrates and vegetation including algae and macrophytes (i.e., aquatic vegetation). Amphibian species such as red spotted frog and canyon treefrog also may be present at times when water is present during their breeding period. The habitat is considered to value to aquatic species such as fish because there is no perennial flow in the drainages. For context, construction would remove approximately 19 percent (90 out of 476 acres) of aquatic habitat defined as waters of the U.S. within the Project Area. A considerable amount of aquatic habitat (386 acres) within the Project Area would not be disturbed.

The proposed project would be operated as “zero-discharge” facility, which means that no process solutions would be discharged to adjacent drainages. Vehicle and equipment use and chemical storage in areas near the ephemeral drainages or wetlands pose a risk to aquatic species from fuel spills or leaks reaching these waterbodies. If a spill occurred, the magnitude of the impact would depend upon the volume spilled and the extent of dispersal within the waterbody. If fuel entered a drainage or wetland with flowing water, adverse effects on aquatic species (mainly invertebrates or amphibians) could occur depending on the spill volume and hydrologic conditions. Spilled fuel products could result in mortalities to aquatic species, sublethal effects on physiological functions or habitat degradation due to effects on water quality. Implementation of the SPCC Plan would reduce the adverse effects of spills to a low level. As a result, potential spill effects on aquatic species and their habitat would be low. Because chemicals and metals from the heap leach pad and SX/EW plant would be collected using the liner, collection, and liquids recycling systems, the potential for toxic materials from processing to contaminate aquatic resources would be eliminated.

Construction activities at the Emery Mitigation Site would result in surface disturbance near the Gila River from the removal of a berm (Area A only), noxious weed control, tamarisk removal (Area B only), vegetation planting, and regrading to restore natural contours. Suspended sediment could increase in adjacent sections of the river temporarily, especially in areas where equipment or vehicles enter the river and where earthmoving is adjacent to the river. Erosion control measures would be implemented to minimize sediment input to the river. Tamarisk removal would eliminate riparian vegetation in Area B until native vegetation becomes established. Overhanging cover for fish would be reduced in the Area B portion of the Gila River. Noxious weed control in Area A would involve the selective application of appropriate herbicides that are rated for low toxicity to warmwater fish. Once the riparian area enhancements are complete and vegetation is established at the Emery Mitigation Site, riparian vegetation would be improved, providing cover for invertebrates along the streambanks and for fish in the river.

The effects of groundwater pumping on surface flows in the Gila River and Bonita Creek were estimated by the model prepared for FMSI’s 3M Program, which includes a commitment by FMSI to update and improve the model so that mitigation measures are adequate for current mining operations. In addition, the Alternate Year Fallowing Program would be applied as mitigation for groundwater pumping effects on Gila River flows. The groundwater model predicted a very small flow reduction in Bonita Creek (AquaGeo 2015). This volume reduction would not measurably reduce aquatic habitat for aquatic species in Bonita Creek.

The model analysis for impacts to Gila River flows would be offset by the fallow field mitigation. After applying the benefit of the agricultural land fallowing measure, there would be little or no net flow reduction in the Gila River. As a result, there would be no adverse effect from groundwater pumping on aquatic habitat and species in the Gila River.

3.7.2.5 Alternative 2

Impacts from Alternative 2 on aquatic biological resources would be the same as Alternative 1 with one difference. Construction of the heap leach pad, development rock stockpiles, and conveyance route would disturb and remove 76 acres of waters of the U.S. under Alternative 2. This disturbance to waters of the U.S. would be 14 acres less than Alternative 1. As a result, impacts to aquatic habitat and species (macroinvertebrates and amphibians) would be lower under Alternative 2.

It is likely that impacts to the Emery Mitigation Site would occur under Alternative 2, similar to those described for Alternative 1.

3.7.2.6 No Action Alternative

Under the No Action Alternative, new surface disturbance from the Lone Star Project would not occur in the ephemeral drainages. Therefore, potential sedimentation effects on aquatic species and their habitat would not occur under the No Action Alternative. In addition, disturbance to waters of the U.S. containing aquatic habitat would not occur, because the heap leach pad, development rock stockpiles, and conveyance route would not be constructed. Risk of fuel spills on aquatic habitat would exist under the No Action Alternative until operations at Dos Pobres and San Juan are completed. Processing of ore from the Dos Pobres and San Juan pits would continue until those sources are depleted and reclamation and closure activities are completed.

3.7.2.7 Potential Mitigation Measures

Given that the impoundments must meet ADEQ's Best Available Demonstrated Control Technology requirements, and FMSI must implement the SWPPP, SPCC Plan, and comply with compensatory mitigation required by the Corps, no additional mitigation measures would be needed.

3.7.2.8 Cumulative Impacts

The CESA for aquatic biological resources is the same as the analysis area, including the Project Area, Bonita Creek, the Emery Mitigation Site, and the Gila River downstream. Alternatives 1 and 2 would result in minor adverse impacts on aquatic biological resources in ephemeral drainages as a result of proposed surface disturbance activities and there would be a low risk from potential fuel spills. There would be a loss of aquatic habitat in waters of the U.S. of 90 or 76 acres, respectively for Alternatives 1 and 2. These impacts would combine with other past and present actions in the CESA.

No RFFAs were identified within the CESA. Actions that have resulted in past or present disturbance within the CESA include the Dos Pobres and San Juan pits and associated processing facilities, and livestock grazing. Erosion control measures have been required on these mining projects to reduce sedimentation to the numerous ephemeral drainages. However, collectively these projects most likely have resulted in some low level of sedimentation to the drainages.

Downstream on the Gila River, no adverse impacts to fish and special status aquatic species would result from implementation of either action alternative in combination with past and present activities within the CESA. The fallowing of agricultural land by FMSI would continue to offset an Gila River flow reductions by reducing irrigation water use.

3.7.2.9 Residual Impacts

Implementation of design features involving sediment control and the SPCC would avoid residual adverse effects on water quality in the Project Area ephemeral drainages and the Gila River. The disturbance to waters of the U.S. under Alternatives 1 or 2 would remove aquatic habitat on a long-term basis, which would represent a residual effect on aquatic habitat and species such as macroinvertebrates and possibly amphibians that occur in waterbodies when water is present. Implementation of a reclamation plan and compensatory mitigation measures required by the Corps would eventually restore aquatic habitat in the analysis area.

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3.8 Cultural Resources

3.8.1 Affected Environment

Cultural resources are prehistoric and historic sites, structures, districts, or other places with evidence of human activity that are considered significant to a community, culture, or ethnic group. Significant cultural resources are those that meet one or more criteria for inclusion in the NRHP. The responsibilities of federal agencies with respect to these resources are identified in several regulations, including the National Historic Preservation Act (NHPA), the Archaeological Resources Protection Act, and the Native American Graves Protection and Repatriation Act (25 USC §§ 3001-3013). The Corps' procedures for cultural resources within a CWA permitting context are contained in 33 CFR 325 Appendix C – Procedures for the Protection of Historic Properties.

3.8.1.1 Analysis Area

The analysis area for the assessment of impacts to cultural resources corresponds to the Area of Potential Effect (APE) developed by the Corps for consultation under Section 106 of the NHPA. This area includes the combined footprints of the Alternatives 1 and 2, as well as a 100-foot buffer around the combined footprints. It also includes the Emery Mitigation Site plus a 100-foot buffer.

3.8.1.2 General Setting

Archaeologists working in southeastern Arizona recognize several phases of the region's prehistory. The earliest is the Paleoindian period (ca. 10800 – 8000 B.C.), representing an adaptation to the generally cooler and wetter conditions of the terminal Pleistocene. Known primarily from kill sites, Paleoindian groups are thought to have focused primarily on the hunting of megafauna such as mammoth and bison, although generalized gathering is likely to have been important as well. The subsequent Archaic (8000 – 2100 B.C.) period also is marked by evidence for a mobile land use, but with a general trend toward becoming sedentary over time, as well as some evidence for limited cultivation late in the period (Brotinsky and Merritt 1986; Irwin-Williams 1979). Evidence for agriculture appears in the region by around 2100 B.C., with the more complex and sedentary Hohokam culture appearing by around A.D. 450. The Hohokam culture declined and eventually collapsed during the 15th Century A.D (Whittlesley et al. 1994). Spanish explorers and missionaries arriving in the region during the 16th and 17th centuries encountered groups now known as the O'odham, of whom many consider themselves descendants of the Hohokam. Apache groups are believed to have arrived during the early 17th Century (Basso 1983; Whittlesley et al. 1994).

The Town of Safford was founded in 1878 on land owned by the Chiricahua Cattle Company. Incorporated in 1901, the community soon attracted attention from mining interests for the bodies of copper ore just north of the town. Initially the production was low, with the Lone Star Mining District producing only 110,000 pounds of copper prior to 1907 (Cook and Robinson 1962). In 1955, Kennecott Copper Corporation optioned areas in the Gila Mountains, and on the basis of exploratory drilling purchased the land in 1959. In 1960, Phelps Dodge also purchased a series of claims, drilling a 1,875-foot shaft (Azcarza 2015). In 1986, Phelps Dodge acquired the Lone Star deposit from Kennecott, and in 2007 was acquired by Freeport-McMoRan Copper & Gold, Inc.

3.8.1.3 Project Area

Previous cultural resources investigations and all known archaeological resources within the APE are described in a recent synthesis prepared by WestLand (Purcell 2014). The following discussion is summarized from that document.

Archaeological Resources

A total of 50 separate archaeological investigations have been conducted within the Project Area, including intensive field surveys, Historic Properties Treatment Plans, and data recovery projects. The Emery Mitigation Site also has been surveyed for cultural resources, with negative findings (WestLand 2016d). A total of 150 archaeological sites have been recorded within the Project Area, of which 61 date to the prehistoric period, 69 are historic, and 14 contain both historic and prehistoric materials. Six sites consist of simple rock features of unknown origin. Prehistoric components consist generally of lithic debitage, flaked and ground stone tools, and ceramic sherds. Also common is rock art, with petroglyphs recorded at 16 sites and a pictograph at 1 site. One rock art site also is reported to contain a rock shelter. Prehistoric rock features, consisting generally of small rock piles, alignments, cairns, and circular arrangements, are recorded at 27 sites. Historic materials are related primarily to mining activity, consisting principally of shafts, adits, prospects, and related features, as well as associated artifacts. Most of the historic rock features, recorded at 21 sites, also are likely related to mining or agricultural activity. Ranching and agriculture is represented by at least one ranch complex as well as by two corrals. Finally, water control features are found at 19 locations, consisting primarily of Civilian Conservation Corps erosion control structures (Purcell 2014).

A total of 25 archaeological resources have been recorded within the APE. Of these, 8 are prehistoric, 16 are historic, and 1 contains both historic and prehistoric materials. The prehistoric sites consist of three artifact scatters and five sites containing petroglyphs. The historic deposits appear to consist principally of materials and features related to mining as well as water control features such as check dams and spreader dikes (**Table 3-8.1**).

Table 3.8-1 Archaeological Resources within the APE

Site	Description	NRHP Eligibility	Treatment Status
AZ CC:1:149	Rock ring, artifact scatter	Unknown	Testing Recommended
AZ CC:1:150	Road	Recommended Ineligible	N/A
AZ CC:1:151	Road	Recommended Ineligible	N/A
AZ CC:2:183	Water control feature	Determined Eligible	Mitigated
AZ CC:2:184	Water control feature	Determined Eligible	Mitigated
AZ CC:2:192	Water control feature; artifact scatter	Determined Eligible	Mitigated
AZ CC:2:219	Lithic scatter	Determined Eligible	Mitigated
AZ CC:2:221	Lithic scatter	Determined Eligible	Mitigated
AZ CC:2:231	Rock features, petroglyphs	Determined Eligible	Treatment Recommended
AZ CC:2:245	Rock feature	Determined Eligible	Mitigated
AZ CC:2:347	Petroglyph	Determined Eligible	Treatment Recommended
AZ CC:2:349	Water control feature	Determined Eligible	Mitigated
AZ CC:2:428	Mining activity, rock features, artifact scatter	Recommended Eligible	Mitigated
AZ CC:2:431	Mining activity, road segment	Recommended Eligible	Mitigated
AZ CC:2:432	Mining activity, road segment, artifact scatter	Recommended Eligible	Mitigated
AZ CC:2:433	Rock features, artifact scatter	Recommended Eligible	Mitigated
AZ CC:2:434	Mining activity	Recommended Eligible	Mitigated
AZ CC:2:436	Mining activity	Recommended Eligible	Mitigated

Table 3.8-1 Archaeological Resources within the APE

Site	Description	NRHP Eligibility	Treatment Status
AZ CC:2:437	Mining activity, artifact scatter	Recommended Eligible	Mitigated
AZ CC:2:438	Mining activity	Recommended Eligible	Mitigated
AZ CC:2:439	Mining activity, artifact scatter	Recommended Eligible	Mitigated
AZ CC:2:440	Mining activity, camp, artifact scatter	Recommended Eligible	Mitigated
AZ CC:2:443	Petroglyph	Recommended Eligible	Treatment Recommended
AZ CC:2:445	Petroglyph	Recommended Eligible	Treatment Recommended
AZ CC:2:446	Petroglyph	Recommended Eligible	Treatment Recommended
AZ CC:2:453	Mining activity	Recommended Eligible	Treatment Recommended

Source: WestLand 2016d.

Of the 25 sites within the APE, 9 have been determined eligible for the NRHP, 13 have been recommended as eligible, 2 have been recommended as ineligible, and 1 has not been evaluated. Of the sites that have been determined or recommended as eligible, 17 are considered to have been sufficiently documented to mitigate adverse effects under Section 106 of the NRHP. Data recovery investigations have not been conducted at five of the eligible properties (Purcell 2014; WestLand 2015c).

Traditional Cultural Properties and Sacred Sites

Efforts to identify traditional cultural properties (TCPs) conducted in support of the EIS for the Dos Pobres/San Juan Project (BLM 2003) included consultation with 11 tribes. During this process the tribes were requested to identify both TCPs and sacred places that may warrant consideration under the American Religious Freedom Act, the NHPA, and EO 13007, which requires federal land managing agencies to accommodate access to and ceremonies at sacred sites by Native American religious practitioners.

During this consultation, the Four Southern Tribes (the Tohono O'odham Nation, Ak-chin Indian Community, Gila River Indian Community, and Salt River Pima-Maricopa Indian Community) identified 14 sites as TCPs, including all sites that until that time were known to contain petroglyphs as well as several containing rock rings. The additional 3 rock art sites that have been discovered since that consultation likely also would be considered to be TCPs by the Four Southern Tribes. The San Carlos Apache Tribe, the Hopi Tribe, and the Pueblo of Zuni all stated that all prehistoric sites within the Project Area are considered to be TCPs, a designation that now would include 75 sites. The White Mountain Apache Tribe identified three sites as TCPs.

As a result of the consultation, 3 sites (AZ CC:2:200, 211, and 234) were identified by tribes as sacred sites warranting consideration under EO 13007. All three were identified as sacred by the White Mountain Apache, while two (AZ CC:2:200 and 211) are considered sacred by the Tohono O'odham Nation, Hopi Tribe, Ak-chin, Gila River, and Salt River Pima-Maricopa Indian Communities. In 2005, a conservation easement for access to these sites was granted by Phelps Dodge to 8 tribes, including the Gila River Indian Community, Ak-Chin Indian Community, the Salt River Pima-Maricopa Indian Community, the Tohono O'odham Nation, the White Mountain Apache Tribe, the Hopi Tribe, and the Pueblo of Zuni. FMSI maintains this easement. The 3 sites are protected in perpetuity by restrictive covenants.

The sacred sites addressed by the conservation easement are summarized in **Table 3.8-2**. All three contain archaeological remains, including four rock rings, a rock pile, a rockshelter, and prehistoric artifacts. Purcell (2014) notes that the original site description for AZ CC:2:234 stated that possible human dental remains are present, but provided no additional information. All three of these sites have been determined eligible for the NRHP. None are within the APE or footprint of either of the proposed alternatives.

Table 3.8-2 Identified Native American Sacred Sites

Site	Description	NRHP Status
AZ CC:2:200	3 rock rings	Eligible
AZ CC:2:211	Rock ring and lithic scatter	Eligible
AZ CC:2:234	Rockshelter with small rock pile; possible human dental remains	Eligible

3.8.2 Environmental Consequences

3.8.2.1 Scoping Issues

Cultural resources issues identified during the public scoping process include concerns related to the following items.

- Impacts to cultural resources that are eligible or listed on the NRHP.
- The potential to affect TCPs or other sites significant to Native American tribes.

3.8.2.2 Method of Analysis and Impact Indicators

The identification of NRHP-listed or eligible properties is based on documents prepared by WestLand summarizing the results of previous Class II and III archaeological investigations conducted within the Project Area (Purcell 2014; WestLand 2015c). The identification of TCPs or other sites of concern to Native American tribes is based on previous tribal consultations regarding lands included in the APE (BLM 2003) as well as ongoing consultation between the Corps and the Ak-Chin Indian Community, Gila River Indian Community, Salt River Pima-Maricopa Indian Community, San Carlos Apache Tribe, Tohono O'odham Nation, and the White Mountain Apache Tribe. Analysis was performed by identifying which recorded sites that are eligible or listed on the NRHP fall within the area proposed for disturbance under each alternative.

For this analysis, significant impacts to cultural resources are defined as project activities that meet the criteria of adverse effect specified in federal regulations (36 CFR 800.5). Under these criteria, adverse effects are found when an undertaking directly or indirectly alters any of the characteristics of a property that qualify it for the NRHP.

3.8.2.3 Assumptions for Analysis

- It is assumed that FMSI will comply with all federal and state regulations to protect cultural resources.
- Should new archaeological sites be uncovered during construction, earthmoving would stop until the findings can be evaluated by a professional archaeologist to determine whether mitigation is necessary.

3.8.2.4 Alternative 1, Proposed Action

The analysis area contains 25 cultural sites, of which 20 are within the construction footprints of the proposed alternatives and 5 are within the surrounding buffer area. Potential impacts to these resources, their NRHP eligibility status, and recommended treatments are summarized in documentation prepared by WestLand in support of the required consultation under Section 106 of the NHPA (WestLand 2015c).

Of the 20 sites within the alternative footprints, 18 are within the footprint of Alternative 1 (**Table 3.8-3**).

Table 3.8-3 Summary of Archaeological Resources within the Analysis Area

NRHP Eligibility	Treatment	Total Sites Within APE	Alternative 1 Footprint	Alternative 2 Footprint	Buffer Area
Eligible	Treatment Recommended	5	4	2	
	Mitigated	17	13	14	3
Ineligible	No Further Treatment	2	1	1	1
Unevaluated	Testing Recommended	1	-	-	1
Total		**25**	**18**	**17**	**5**

Source: WestLand 2015c.

Of the 18 cultural sites within the Proposed Action footprint, 17 have been determined or are recommended eligible for the NRHP. Of these, 13 are historic mining sites that are considered to have been sufficiently documented to resolve any adverse effects from the undertaking. Four of the eligible properties, however, are prehistoric petroglyph sites (AZ CC:2:231, 443, 445, and 446) and impacts to these sites would be significant if activities related to the Proposed Action meet the legal criteria of adverse effect to cultural resources (36 CFR 800.5). One site within the Proposed Action footprint (AZ CC:1:151, a series of unimproved dirt roads) is recommended ineligible for the NRHP so impacts to this site resulting from the Proposed Action would not be significant.

Prior to implementation of Alternative 1, treatment of four sites eligible for the NRHP is recommended because they are located within the footprint of proposed surface disturbance.

Five sites are within the buffer area around the disturbance footprint of both action alternatives. Three of these sites (AZ CC:2:245, AZ CC:2:437, and AZ CC:2:438) have been determined or are recommended eligible for the NRHP, while one (AZ CC:1:150) is ineligible and one (AZ CC:1:149) has not been evaluated. All 3 of the eligible properties are considered to have been sufficiently documented to mitigate any adverse effects from the undertaking, and any impacts to the ineligible site would not be significant. Any impacts to the unevaluated site (AZ CC:1:149) would be significant if the site is determined to be eligible for the NRHP and if project activities would result in adverse effects (36 CFR 800.5). Should the location of the unevaluated site be used for equipment storage or be planned for disturbance during construction, further evaluation of the site would be required in advance to determine eligibility and the need for treatment or mitigation.

3.8.2.5 Alternative 2

Of the 17 cultural sites within the Alternative 2 footprint (see **Table 3.8-2**), 16 have been determined or are recommended eligible for the NRHP. Of these, 14 are considered to have been sufficiently documented to mitigate any adverse effects from the proposed Project (WestLand 2015c). These include seven historic mining sites, four water control features, one rock feature, and two prehistoric artifact scatters. Two of the eligible properties, however, are prehistoric petroglyph sites (AZ CC:2:347 and AZ CC:2:445) and impacts to these sites would be significant if activities related to Alternative 2 meet the legal criteria of adverse effect to cultural resources (36 CFR 800.5). One site within the Alternative 2 footprint (AZ CC:1:151, a series of unimproved dirt roads) is recommended ineligible for the NRHP so impacts to this site resulting from the Project construction would not be significant.

Prior to implementation of Alternative 2, treatment of two sites eligible for the NRHP is recommended because they are located within the footprint of proposed surface disturbance.

Impacts to sites within the buffer area in the APE would be the same as described for Alternative 1.

3.8.2.6 Native American Resources

As noted in Section 3.7.1, none of the 3 sites that were identified by tribes as sacred sites warranting consideration under EO 13007 (AZ CC:2:200, 211, and 234) are within the APE. Ongoing consultation between the Corps and tribes regarding the present undertaking, however, may reveal additional TCPs or sacred sites that would require protection or mitigation should one of the action alternatives be selected.

3.8.2.7 No Action Alternative

No adverse effects to cultural resources would occur because no surface disturbance related to construction of the Lone Star Pit and associated infrastructure would occur under the No Action Alternative.

3.8.2.8 Potential Mitigation Measures

The Corps has made a determination of adverse effect to historic properties based on the presence of NRHP-eligible cultural resources within the APE. To resolve these effects, a Historic Properties Treatment Plan should be developed that specifies measures to avoid, minimize, or mitigate adverse effects at each historic property. Additionally, a Memorandum of Agreement should be executed among the consulting parties to ensure that the Historic Properties Treatment Plan is fully implemented.

3.8.2.9 Cumulative Impacts

The CESA is the same as the APE. Previous surveys in advance of earthmoving for constructing processing and mining infrastructure have contributed to the knowledge of cultural resources in the APE. The sites within the CESA were identified and recorded as a result of previous surveys in advance of mining. Several of the eligible sites have been treated or mitigated as a result of previous surveys to preserve the knowledge contained within these sites before they were disturbed.

3.8.2.10 Residual Adverse Effects

By documenting, avoiding, or treating eligible sites in compliance with laws and permits, no residual adverse effects are anticipated.

3.9 Air Quality and Greenhouse Gases

Air quality in a given location can be evaluated using available measurements of pollutant concentrations in the atmosphere, generally expressed in units of parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). Regional air quality can be affected by natural events such as windstorms and wildfires, as well as larger emissions generating facilities such as power plants, industrial facilities, and vehicle use in urban corridors. Natural events generally are short-lived, lasting from several hours to several days. The effects on air quality during these events may adversely affect human health and the environment, but generally are considered part of the natural physical environment.

Both long-term climatic factors and short-term weather fluctuations are considered part of the air quality of a region because they control dispersion and affect ambient air concentrations. The physical effects of air quality depend on the characteristics of the receptors (human or environmental) and the type, amount, and duration of exposure. This section describes the existing air quality of the region and the applicable air regulations that would apply to the Proposed Action and alternatives.

3.9.1 Affected Environment

3.9.1.1 Analysis Area

The analysis area for air quality is Graham County, Arizona. Air quality within the analysis area has the potential to be affected by emissions from construction and operation of mine-related facilities and equipment, the use of access roads, and other construction and management activities.

3.9.1.2 Air Quality Regulatory Framework

The CAA of 1970 (42 USC § 7401 et seq.) as amended in 1977 and 1990 is the basic federal statute governing air pollution. Provisions of the CAA of 1970 that potentially are relevant to the Project are listed below.

- National Ambient Air Quality Standards (NAAQS)
- Prevention of Significant Deterioration (PSD)
- New Source Performance Standards (NSPS)
- National Emission Standards for Hazardous Air Pollutants (NESHAP)
- Maximum Achievable Control Technology (MACT) Standards
- Conformity Requirements
- Federal Operating Permits Program
- Greenhouse Gas (GHG) Tailoring Rule
- GHG Reporting Rule

The CAA also provides states with the authority to regulate air quality within state boundaries.

National and State Ambient Air Quality Standards

The CAA amendments of the 1990s require all states to control air pollution emission sources so that the NAAQS are met and maintained. The CAA directs the USEPA to delegate primary responsibility for air pollution control to state governments. The State of Arizona adopted the NAAQS as state air quality standards and added a few ambient air quality standards applicable only to Arizona. The ADEQ serves as the state's environmental regulatory body. In addition to these requirements, the National Park Service (NPS) Organic Act requires the NPS to protect the natural resources of the lands it manages from the adverse effects of air pollution.

The NAAQS establishes maximum acceptable concentrations for nitrogen dioxide (NO_2), carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter (PM), ozone (O_3), and lead (Pb). Given the extremely low levels of lead emissions from project sources, the lead standards are not addressed in this analysis. These pollutants are known as criteria pollutants. The NAAQS are established by the USEPA and are outlined in 40 CFR 50.

These standards represent the maximum allowable atmospheric concentrations to protect public health and welfare, and include a reasonable margin of safety to protect the more sensitive individuals in the population. The air quality analysis for the proposed Project must show that the Project-related impacts do not contribute to an exceedance of the NAAQS and the Arizona AAQS in the air quality analysis area. Together these standards will be referred to as the AAQS (Ambient Air Quality Standards). An area that does not meet the AAQS is designated as a nonattainment area on a pollutant-by-pollutant basis. Applicable federal and state criteria are presented in **Table 3.9-1**.

According to the ADEQ Air Quality Division's PSD Minor Source Map (ADEQ 2015a), there are six Air Quality Control Regions designated in Arizona. The proposed Project is located in Graham County, which is part of the Southeast Arizona Intrastate Air Quality Control Regions.

Prevention of Significant Deterioration

New emissions sources in an attainment area are required to follow PSD regulations. PSD regulations restrict the degree of ambient air quality deterioration allowed. They apply to proposed new or modified major stationary sources located in an attainment area that have the potential to emit pollutants in excess of predetermined *de minimis* values (40 CFR 51) and Title V Greenhouse Gas Tailoring Rule (Tailoring Rule). As defined in 40 CFR 51 and the Tailoring Rule, a new source would be considered a major stationary source if it:

1. Can be classified in one of the 28 named source categories listed in Section 169 of the CAA, and it emits or has the potential to emit 100 tpy or more of any criteria pollutant regulated by the CAA (USEPA 1990);
2. Is any other stationary source that emits or has the potential to emit 250 tpy or more of any criteria pollutants regulated by the CAA (USEPA 1990); or
3. Is any other stationary source constructed that emits or has the potential to emit 100,000 tpy or more of CO_2e.

Allowable deterioration to air quality can be expressed as the incremental increase to ambient concentrations of criteria pollutants, or PSD increment. The PSD increments for criteria pollutants are based on the PSD classification of the area. Class I area status is assigned to federally protected wilderness areas and allows the lowest amount of permissible deterioration. Class II designations allow a higher level of increment consumption relative to Class I areas. There are no designated Class III or heavy industrial use areas in the U.S. **Figure 3.9-1** displays the locations of the Class I and sensitive Class II areas closest to the proposed Project.

Table 3.9-1 National and Arizona Ambient Air Quality Standards

Pollutant	Primary/Secondary	Averaging Period	Level (NAAQS)	Level (Arizona AAQS[A])
CO	Primary	8-hour	9 ppm[1]	—
		1-hour	35 ppm[1]	—
Pb	Primary and secondary	Rolling 3-month	0.15 μg/m[3]	—
NO_2	Primary	Annual	53 ppb	—
	Primary and secondary	1-hour	100 ppb[2]	—
O_3	Primary and secondary	1-hour	Revoked[3]	—
		8-hour	0.075 ppm[4]	—
$PM_{2.5}$ *	Primary	Annual	12 μg/m[3, 5]	
	Secondary	Annual	15 μg/m[3, 6]	—
	Primary and secondary	24-hour	35 μg/m[3, 7]	—
PM_{10} **	Primary and secondary	Annual	Revoked[8]	—
		24-hour	150 μg/m[3, 1]	—
SO_2		Annual	Revoked[9]	0.03 ppm
		24-hour	Revoked[9]	0.14 ppm
	Primary	1-hour	75 ppb[10]	—
	Secondary	3-hour	0.50 ppm	—

For the State of Arizona

1 Not to be exceeded more than once per year.

2 The 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area is not to exceed this standard.

3 The 1-hour NAAQS will no longer apply to an area 1 year after the effective date of the designation of that area for the 8-hour ozone NAAQS. The standard would be attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is <= 1. The effective designation date for most areas is June 15, 2004 (40 CFR 50.9; see *Federal Register* of April 30, 2004 [69 Federal Register 23996]).

4 To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average O_3 concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm.

5 To attain this standard, the 3-year average of the annual arithmetic mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 12.0 $\mu g/m^3$.

6 To attain this standard, the 3-year average of the annual arithmetic mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 $\mu g/m^3$.

7 To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 $\mu g/m^3$.

8 The annual PM_{10} NAAQS of 50 $\mu g/m^3$ was revoked by USEPA on September 21, 2006; Federal Register Volume 71, Number 200, 10/17/06.

9 The 24-hour and annual SO_2 NAAQS were revoked by USEPA on June 22, 2010; 75 Federal Register 35520.

10 The 3-year average of the annual 99th percentile of the 1-hour daily maximum must not exceed this standard.

* $PM_{2.5}$ = particulate matter with an aerodynamic diameter of 2.5 microns or less.

** PM_{10} = particulate matter with an aerodynamic diameter of 10 microns or less.

Source: ADEQ 2015a; USEPA 2014 a.

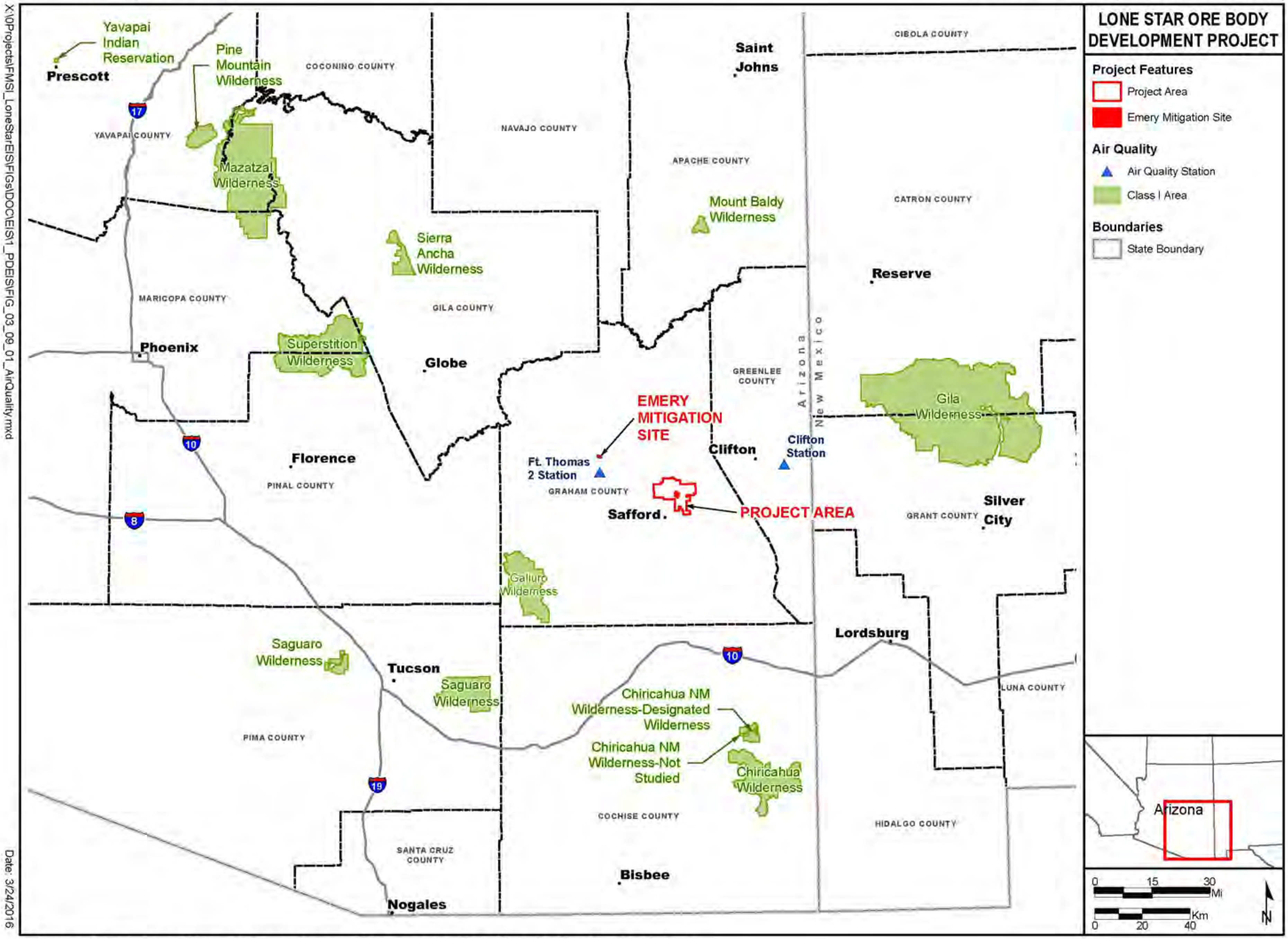


Figure 3.9-1 Location of Class I Sensitive Areas Relative to the Project Area

A project's PSD increment consumption is typically determined through the use of an air quality model. Atmospheric concentrations of NO_2, SO_2, $PM_{2.5}$, and PM_{10} predicted by the air quality model are compared with allowable PSD increments. The allowable PSD increments for Class I and Class II areas are given in **Table 3.9-2**. A comparison of project impacts to PSD Class II increments may be required as part of the permitting phase of the Project but is not typically evaluated under NEPA.

Table 3.9-2 Increments for Class I and Class II Areas

PSD Class	Pollutant	Allowable Increment (µg/m^3)		
		Annual Arithmetic Mean	24-hour Maximum	3-hour Maximum
Class I	NO_2	2.5	—	—
	SO_2	2	5	25
	$PM_{2.5}$	1	2	—
	PM_{10}	4	8	—
Class II	NO_2	25	—	—
	SO_2	20	91	512
	$PM_{2.5}$	4	9	—
	PM_{10}	17	30	—

PSD Class I areas are not located within the analysis area. The nearest Class I area is U.S. Forest Service (USFS) Galiuro Wilderness is located approximately 40 miles (65 kilometers [km]) to the southwest from the Project Area. In addition, the Gila Wilderness Area, which also is managed by the USFS, is approximately 50 miles (80 km) northeast from the Project Area.

In addition to having more stringent PSD increment requirements, Class I areas are protected by Federal Land Managers (FLMs) who manage air quality related values (AQRVs) such as visibility and atmospheric deposition. Though not a regulatory program under PSD, FLMs review the issuance of a PSD permit for any impacts that exceed guideline thresholds for these parameters. In addition to analysis of the visibility and atmospheric deposition, the change in the acid neutralizing capacity of sensitive lakes is assessed by FLMs.

The FLMs consider a source location greater than 50 km from a Class I area to have negligible impacts with respect to Class I AQRVs if its total SO_2, nitrogen oxide (NO_X), PM_{10}, and sulfuric acid annual emissions (in tpy based on 24-hour maximum allowable emissions) divided by the distance (in km) from the Class I area (referred to as a "Q/D" analysis) is equal to or less than 10. If the Q/D analysis is equal to or less than 10, the FLMs would not request further Class I AQRV impact analyses. In general, the Federal Land Managers' Air Quality Related Values Work Group recommends that an applicant apply the Q/D test (Federal Land Managers' Air Quality Related Values Work Group 2010) for proposed sources greater than 50 km from a Class I area to determine whether any further visibility analysis is necessary.

New Source Performance Standards

The regulation of new sources through the development of standards applicable to a specific category of sources was an important step taken by the CAA. The NSPS apply to all new, modified, or reconstructed sources within a given category, regardless of geographic location or the existing ambient air quality. The standards define emission limitations that would be applicable to a particular source group. The NSPS potentially applicable to the proposed Project include the following subparts of 40 CFR 60:

- Subpart A – General Provisions
- Subpart LL – Standards of Performance for Metallic Mineral Processing Plants

Subpart A—General Provisions

Certain provisions of Subpart A apply to the owner or operator of any stationary source subject to a NSPS. Provisions of Subpart A potentially would apply depending on the applicability of emission generating units to be installed as part of the proposed new facilities and whenever another Subpart applies.

Subpart LL—Metallic Mineral Processing Plants

Project operations will be subject to NSPS Subpart LL. Subpart LL applies to some of the current and proposed processing equipment and operations, including crushers and screens, bucket elevators, conveyor belt transfer points, thermal dryers, product packaging stations, storage bins and enclosed storage areas, and truck loading and unloading points.

The requirements of Subpart LL include an emission limit of 0.05 grams per dry standard cubic meter for PM, and 7 percent opacity on stack emissions (unless stack emissions are discharged from facilities with wet scrubbing emission control devices). In addition, process fugitive emissions that exhibit greater than 10 percent opacity may not be discharged on and after the sixtieth day after achieving maximum production rates at a facility (no later than 180 days after startup).

Compliance is determined using USEPA Reference Method 5 or Method 17 for PM concentrations, and Reference Method 9 for opacity determinations for stack emissions and process fugitive emissions. Recordkeeping and reporting must follow the requirements contained in 40 CFR 60.385.

National Emission Standards for Hazardous Air Pollutants

The CAA requires the USEPA to regulate toxic air pollutants from large industrial facilities and to develop standards for controlling the emissions of air toxics from sources in an industry group (source categories). Under the NESHAP, the USEPA promulgated standards pursuant to Section 112 of the 1990 CAA Amendments. The rules are provided in 40 CFR 63. The standards for these sources are known as MACT standards, and are based on emissions levels that are already being achieved by the better-controlled and lower-emitting sources in an industry. Additionally, USEPA air toxics regulation for asbestos is intended to minimize the release of asbestos fibers during activities involving the handling of asbestos. USEPA regulates the Asbestos NESHAP in 40 CFR 61, Subpart M.

USEPA is required to identify categories of industrial sources that emit one or more of the listed 187 toxic air pollutants. These industrial categories include:

- Major sources. Sources of air toxics that emit 10 tpy of a single air toxic or 25 tpy of a combination of air toxics.
- Area sources. Sources that release smaller amounts of toxic pollutants into the air—less than 10 tpy of a single air toxic, or less than 25 tpy of a combination of air toxics. Although emissions from individual area sources are often relatively small, cumulatively their emissions can be of concern (USEPA 2013).
- In the Air Toxics Strategy, the USEPA identifies the toxic air pollutants that pose a health threat in the largest number of urban areas and regulates sufficient area source categories to ensure that the emissions of these urban air toxics are reduced.

The proposed Project is anticipated to be a minor source of hazardous air pollutants (HAPs), and there are currently no applicable area source MACT standards that apply to the proposed Project.

Conformity for General Federal Actions

According to Section 176(c)(4), of the CAA (40 CFR 51.853), a federal agency must make a conformity determination when considering approval of a project with air emissions that exceed specified thresholds in nonattainment or maintenance areas. The proposed Project is not located in a nonattainment or maintenance area; therefore, a general conformity analysis is not required.

Federal Operating Permits Program

All major stationary sources (primarily industrial facilities and large commercial operations) emitting certain air pollutants are required to obtain Title V operating permits under the Federal Operating Permits Program outlined in 40 CFR 70 of the CAA. Whether a source meets the definition of "major" depends on the type and amount of air pollutants it emits and, to some degree, on the overall air quality in its vicinity. Generally, major sources include stationary facilities that emit 100 tons or more per year of a regulated air pollutant including compounds such as CO, PM_{10}, $PM_{2.5}$, volatile organics, SO_2, and NO_X. Major sources of toxic air pollutants (i.e., any source that emits more than 10 tpy of an individual toxic air pollutant or more than 25 tpy of any combination of toxic air pollutants) also are covered under the Federal Operating Permits Program. The proposed Project is anticipated to be a minor source under the Federal Operating Permits Program.

Hazardous Air Pollutants

HAPs are those pollutants known or suspected to cause cancer or other serious health effects, such as damage to reproduction, birth defects, or adverse environmental impacts. The USEPA has classified 187 air pollutants as HAPs. Neither the State of Arizona nor the USEPA have established ambient air quality standards for HAPs; however, the 1990 CAA amendments established the NESHAP program, to regulate emissions of certain HAPs from particular industrial sources. The levels of HAPs defined as Title V major source thresholds by section 112 of the CAA are 10 tpy for any HAP and 25 tpy for total HAPs. The proposed Project is anticipated to be a minor source of hazardous air pollutants (HAPs).

Carbon Dioxide and Other Greenhouse Gases

CO_2 and other GHGs are naturally occurring gases in the atmosphere whose status as pollutants are not related to their toxicity, but to the added long-term impacts they may have on the climate due to their increased levels in the earth's atmosphere. Because they are non-toxic and non-hazardous at normal ambient concentrations, carbon dioxide (CO_2) and other naturally occurring GHGs do not have applicable ambient standards or emission limits under the major environmental regulatory programs.

On October 30, 2009, the USEPA issued the final mandatory reporting rule for major sources of GHG emissions (40 CFR 98). The rule requires a wide range of sources and source groups to record and report selected GHG emissions, including CO_2, methane (CH_4), nitrous oxide, and some halogenated compounds. The USEPA delayed a comparable rule for GHG emissions for various petroleum and natural gas industry groups.

On June 3, 2010, the USEPA issued the PSD and Title V GHG Tailoring Rule. The rule tailors the applicability criteria that determine which stationary sources become subject to permitting requirements for GHG emissions under the PSD and Title V programs of the CAA. Under this rule, new facilities with GHG emissions of at least 100,000 tpy CO_2e and existing facilities with at least 100,000 tpy CO_2e making changes that would increase GHG emissions by at least 75,000 tpy CO_2e would be required to obtain PSD permits. Facilities that must obtain a PSD permit anyway, to cover other regulated pollutants, also must address GHG emissions increases of 75,000 tpy CO_2e or more. However, on June 23, 2014, the U.S. Supreme Court issued its decision in Utility Air Regulatory Group v. EPA, 134 S.Ct. 2427 (2014) ("UARG"). The Court held that EPA may not treat GHGs as an air pollutant for purposes of determining whether a source is a major source required to obtain a PSD or title V permit. The Court also held that PSD permits that are otherwise required (based on emissions of other pollutants) may continue to require limitations on GHG emissions based on the application of Best Available Control Technology (BACT). EPA intends to continue applying the PSD BACT requirements to GHG if both of the following circumstances are present: (I) the modification is otherwise subject to PSD for a pollutant other than GHG; (2) the modification results in a GHG emissions increase and a net GHG emissions increase equal to or greater than 75,000 tpy CO_2e and greater than zero on a mass basis.

The USEPA rules do not require any controls or establish any standards related to GHG emissions or impacts. Therefore, there is no evident requirement at this time that would affect development of the proposed Project under the USEPA rules, other than the possibility of monitoring, recordkeeping, and reporting of GHG emissions.

3.9.1.3 Climate

Table 3.9-3 shows the maximum, average, and minimum temperatures at the Ft. Thomas 2 and Clifton, Arizona, stations during the period of record (1981 to 2010). Average temperatures at Clifton and Ft. Thomas 2 stations range from about 44°F in January to the 80s (°F) in July and August. Summers are typically hot and dry except in the higher mountain ranges. The average annual precipitation is approximately 10.5 inches at the Ft. Thomas 2 site and 16 inches at the Clifton site.

Table 3.9-3 Monthly Climate Summary

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Monthly Climate Summary – Ft. Thomas 2, Arizona[1]													
Average Max. Temperature (°F)	60.9	65.7	72.7	81.2	89.7	98.1	98.6	96.0	92.5	82.5	69.8	59.6	80.7
Average Min. Temperature (°F)	28.5	32.4	36.2	43.0	52.6	61.7	69.4	68.1	60.5	47.7	35.0	28.1	47.0
Average Temperature (°F)	44.7	49.0	54.4	62.1	71.1	79.9	84.0	82.1	76.5	65.1	52.4	43.9	63.8
Average Total Precipitation (in.)	0.98	1.11	0.83	0.35	0.39	0.15	1.55	1.53	1.04	0.92	0.62	1.00	10.47
Monthly Climate Summary – Clifton, Arizona[1]													
Average Max. Temperature (°F)	59.6	64.2	70.9	79.1	88.9	98.2	99.1	96.2	91.4	80.7	68.3	58.5	79.7
Average Min. Temperature (°F)	34.4	38.9	44.6	51.2	60.5	69.3	73.9	72.3	66.5	55.1	42.4	34.4	53.7
Average Temperature (°F)	47.0	51.5	57.8	65.1	74.7	83.7	86.5	84.3	78.9	67.9	55.4	46.5	66.7
Average Total Precipitation (in.)	1.26	1.35	1.06	0.49	0.52	0.47	2.30	3.04	1.60	1.35	1.14	1.37	15.95

[1] Meteorological data recorded from January 1, 1981 to December 31, 2010.

Source: WRCC 2015b.

Three important meteorological factors influence the dispersion of pollutants in the atmosphere: mixing height, wind (speed and direction), and stability. Mixing height is the height above ground within which rising warm air from the surface would mix by convection and turbulence. Local atmospheric conditions, terrain configuration, and source location determine dilution of pollutants in this mixed layer. Mixing heights vary diurnally, with the passage of weather systems, and with season. For the analysis area, the mean annual morning mixing height is estimated to be approximately 1,000 feet above ground level; however, during the winter months the mean morning mixing height is approximately 80 feet above ground level (Holzworth 1972).

Because of the typically dry atmosphere, bright sunny days and clear nights frequently occur in the analysis area. This allows rapid heating of the ground surface during daylight hours and rapid cooling at night. Because heated air rises, and cooled air sinks, winds tend to blow uphill during the daytime and downslope at night. This upslope and downslope cycle generally occurs in all the geographical features, including mountain range slopes and river courses. The volume of air affected is dependent on the area of the feature; the larger the horizontal extent of the feature, the greater the volume of air that moves in the cycle. The complexity of terrain features cause complex movements in the cyclic air patterns, with thin layers of moving air embedded within the larger scale motions. The lower level, thermally driven winds also are embedded within larger scale upper wind systems (i.e., synoptic winds). Synoptic winds in the region are predominantly west to east, characterized by daily weather variations that enhance or diminish the boundary layer winds, and significantly channeled by regional and local topography.

Wind speed has an important effect on area ventilation and the dilution of pollutant concentrations from individual sources. Light winds, in conjunction with large source emissions, may lead to an accumulation of pollutants that can stagnate or move slowly to downwind areas. During stable conditions, downwind usually means down valley or toward lower elevations.

Morning atmospheric stability conditions tend to be stable because of the rapid cooling of the layers of air nearest the ground. Afternoon conditions, especially during the warmer months, tend to be neutral to unstable because of the rapid heating of the surface under clear skies. During the winter, periods of stable afternoon conditions may persist for several days in the absence of synoptic (i.e., continental scale) storm systems to generate higher winds with more turbulence and mixing. A high frequency of inversions at lower elevations during the winter can be attributed to the nighttime cooling and sinking air flowing from higher elevations to the low lying areas in the basins. Although winter inversions are generally quite shallow, they tend to be more stable because of reduced surface heating.

Precipitation throughout Arizona is governed to a great extent by elevation and the season of the year. From November through March, storm systems from the Pacific Ocean cross the state. These winter storms occur frequently in the higher mountains of the central and northern parts of the state and sometimes bring heavy snows. Snow accumulation may reach depths of 100 inches or more during the winter in northern parts of the state.

Summer rainfall begins early in July and usually lasts until mid-September. Moisture-bearing winds sweep into Arizona from the southeast, with their source region in the Gulf of Mexico. Another important source of moisture for southern Arizona is the Gulf of California. Summer rains occur in the form of thunderstorms which result largely from excessive heating of the ground and the lifting of moisture-laden air along main mountain ranges. The heaviest thunderstorms are usually found in mountainous regions of the central and southeastern portions of Arizona. These thunderstorms are often accompanied by strong winds and brief periods of blowing dust prior to the onset of rain.

The air is generally dry and clear, with low relative humidity and a high percentage of sunshine. April, May, and June are the months with the greatest number of clear days, while July and August, as well as December, January, and February have the cloudiest weather and lowest amount of sunshine (WRCC 2015a).

Climate Trends

As with any field of scientific study, there are uncertainties associated with the science of climate change; however, this does not imply that scientists do not have confidence in many aspects of climate change science. Some aspects of the science are known with virtual certainty because they are based on well-known physical laws and documented trends (USEPA 2011). The effects of anthropogenic (man-made) GHG emissions and changes in biological carbon sequestration due to land management activities on global climate have been identified as the likely causes of the increased rate of average surface temperature of the planet. Through complex interactions on a regional and global scale, these GHG emissions and net losses of biological carbon sinks cause a net warming effect on the atmosphere, primarily by impeding the rate of heat energy radiated by the earth back into space.

Although GHG levels naturally exhibit cyclical patterns over the millennia, recent industrialization and burning of fossil carbon sources have caused CO_2 concentrations to increase dramatically and are likely to contribute to overall global climatic changes. Several activities contribute to the phenomena of climate change, including emissions of GHGs (especially CO_2 and CH_4) from fossil fuel development, large wildfires, activities using combustion engines, changes to the natural carbon cycle, and changes to radiative forces and reflectivity (albedo) of the earth-atmosphere system by resulting in the surface absorbing more or less radiation. It is important to note that many GHGs have a sustained climatic impact because of their long atmospheric lifetimes. For example, recent emissions of CO_2 may influence climate for 100 years (Intergovernmental Panel on Climate Change [IPCC] 2013).

The IPCC reports that since 1750, the largest contribution to total radiative forcing is caused by the increase in atmospheric concentration of CO_2 (IPCC 2013). In addition, "the atmospheric concentrations of CO_2, CH_4, and nitrous oxide have increased to levels unprecedented in at least the last 800,000 years. CO_2 concentrations have increased by 40 percent since pre-industrial times, primarily from fossil fuel emissions and secondarily from net land use change emissions" (IPCC 2013).

According to the National Climate Assessment (Melillo et al. 2014), U.S. average temperatures have increased by 1.3°F to 1.9°F since record keeping began in 1895, and most of this increase has occurred since 1970.

While the earth has had many episodes of warming/cooling in the past, the IPCC recently concluded that the recent warming of the climate system is very unique when compared to those past episodes. Additionally, most of the observed increase in globally average temperatures since the mid-20th Century is due to the observed increase in anthropogenic GHG concentrations (IPCC 2013). Since the early 20th Century, portions of Arizona have seen annual average temperatures increases of 2°F to 4°F above historical averages (USEPA 2014b).

In 2001, the IPCC projected that by the year 2100, global average surface temperatures could increase by 2.5°F to 10.4°F above 1990 levels. The National Academy of Sciences (2008) has confirmed these projections, but also has indicated that there are uncertainties regarding how climate change may affect different regions. Computer model predictions indicate that increases in temperature would not be equally distributed, but are likely to be accentuated at higher latitudes. Models indicate that average temperature changes are likely to be greater in the Northern Hemisphere. Warming during the winter months is expected to be greater than during the summer. Although large-scale spatial shifts in precipitation distribution may occur, these changes are more uncertain and difficult to predict. During this century, projections indicate that areas of the Southwestern U.S. are projected to experience 150 or more days a year above 90°F by the end of the century. In addition to occurring more frequently, these very hot days are projected to be about 10°F hotter at the end of this century than they are today (USEPA 2014b).

Table 3.9-4 provides a summary of the Arizona's GHG emissions from large facilities in million metric tons of CO_2 equivalents ($MMTCO_2e$) as estimated with the USEPA's Facility Level Information on Greenhouse gases Tool (FLIGHT) (USEPA 2015d). The table provides a comparison of emissions by sector and shows that 90 percent of the GHG emissions in Arizona are related to power plants while minerals come in second at almost 4 percent of all reported GHG emissions.

Table 3.9-4 Arizona GHG Emissions by Sector (2014)

Sector	GHG Emissions ($MMTCO_2e$)
Power Plants	55.4
Minerals	2.4
Waste Management	1.6
Natural Gas and Oil Systems	0.8
Chemicals	0.5
Metals	0.2
Other	0.8
Total	**61.7**

Source: USEPA 2015d.

Table 3.9-5 provides a summary of the energy-related CO_2 emissions as reported by the U.S. Energy Information Administration (USEIA) in their 2014 Annual Energy Outlook. The table provides a comparison of CO_2 emissions by fuel type for both the entire United States and the Mountain Region. The USEIA defines the Mountain Region as the states of Arizona, Colorado, Idaho, Montana, New Mexico, Nevada, Utah, and Wyoming. The table shows that in the entire U.S., petroleum sources are the largest contributor to CO_2 followed by coal, while in the Mountain Region, the largest contributor to CO_2 emissions is coal followed by petroleum.

Table 3.9-5 Energy Related CO_2 Emissions by Fuel Type (2011)

Fuel Type	United States ($MMTCO_2$)	Mountain Region ($MMTCO_2$)
Petroleum[1]	2,304.0	156.8
Natural Gas	1,306.0	96.6
Coal	1,876.0	206.5
Other[2]	12.0	0.0
Total	**5,498.0**	**459.9**

1 This includes carbon dioxide from international bunker fuels, both civilian and military, which are excluded from the accounting of carbon dioxide emissions under the United Nations convention. From 1990 through 2012, international bunker fuels accounted for 90 to 126 million metric tons annually.

2 Includes emissions from geothermal power and nonbiogenic emissions from municipal waste.

Source: USEIA 2014.

3.9.1.4 Air Quality in the Analysis Area

The existing air quality of the analysis area is typical of the largely undeveloped regions of the western U.S. For the purposes of statewide regulatory planning, this area has been designated as in attainment for all pollutants that have an AAQS. In other words, ambient concentrations of criteria pollutant are below the AAQS in the analysis area. Current sources of air pollutants in the region, primarily PM_{10} and $PM_{2.5}$, include copper mines, agricultural activities and windblown dust from surrounding deserts.

Current Conditions Criteria Pollutants

Current air quality conditions are shown in **Table 3.9-6**. Although there is no onsite monitoring within the Project Area, air quality concentrations are available from monitoring stations in the vicinity. The background concentrations data were obtained from USEPA's Air Quality System, the location of each monitor station is indicated in the table.

Table 3.9-6 Ambient Air Quality Conditions

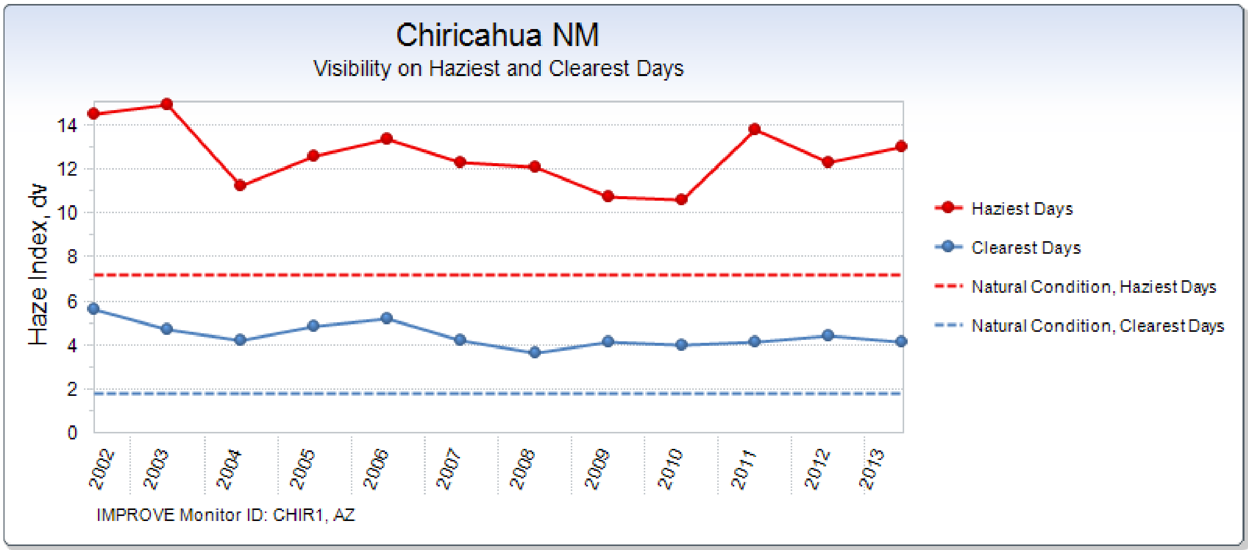
Pollutant	Units	Averaging Period	2014*	Monitoring Site
O_3	ppm	8-Hour[1]	0.068	Chiricahua National Monument, Arizona
CO	ppm	1-Hour[2] 8-Hour[2]	1.8 1.1	2745 N Cherry, Tucson, Arizona
NO_2	ppb **	1-Hour[3]	43	1237 S. Beverly, Tucson, Arizona
$PM_{2.5}$	μg/m^3	24-Hour[4] Annual[5]	16 7	1445-1449 15th Street, Douglas, Arizona
PM_{10}	μg/m^3	24-Hour[2]	61	523 10th Ave, Safford, Arizona
SO_2	ppb	1-Hour[6] 24-Hour[2]	6 1	400 W River Road, Tucson, Arizona

1 Annual fourth-highest daily maximum.
2 Annual maximum.
3 98th percentile of 1-hour daily maximum.
4 98th percentile of 24-hour value.
5 Arithmetic mean of 24-hour values.
6 99th percentile of the daily maximum 1-hour values in the year.
* All values from year 2014 except for PM_{10} which reflects data from 2007.
** ppb = parts per billion.
Source: USEPA 2015a.

Air Quality Related Values

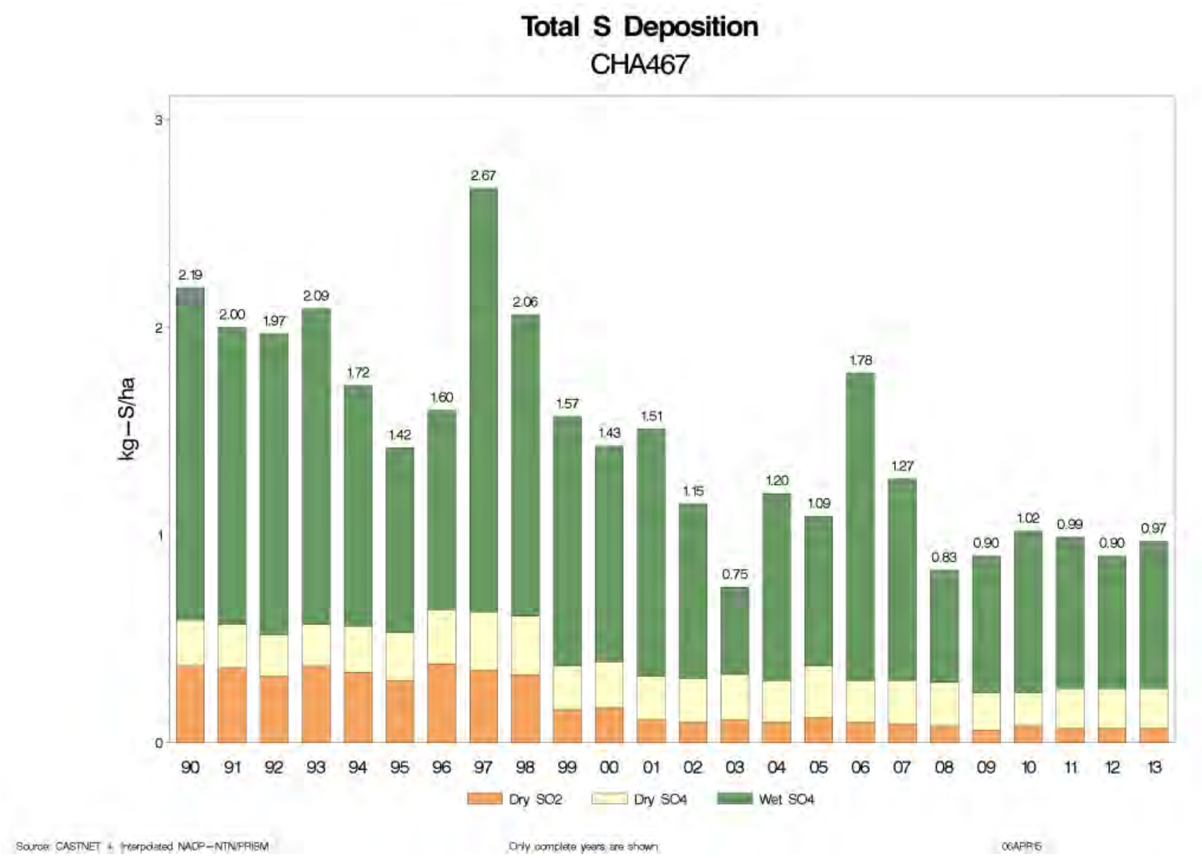
AQRVs are metrics for atmospheric-related phenomena like visibility and pollutant deposition impacts that may adversely affect specific scenic, cultural, biological, physical, ecological, or recreational resources. Visibility changes can occur when an excessive amount of pollutants (mostly fine particles) scatter light such that the background scenery becomes hazy. Atmospheric deposition can cause excess nutrient loading in native soils and acidification of the landscape, which can lead to declining buffering capacity changes in sensitive stream and lake water chemistry (commonly referred to as acid neutralization change). Air pollutants can be deposited by wet deposition (precipitation) and dry deposition (gravitational settling). The chemical components of wet deposition include sulfate (SO_4), nitrate (NO_3), and ammonium (NH_4) ions; the chemical components of dry deposition can include SO_4, SO_2, NO_X, NO_3, NH_4, and nitric acid (HNO_3). The NPS Technical Guidance on Assessing Impacts on Air Quality in NEPA and Planning Documents (NPS 2011) suggests that critical sulfur load values above 3 kg/ha-yr may result in moderate impacts. AQRVs are important to FLMs because they have a mandate to ensure their Class I areas meet scientific (landscape nutrient loading) and congressionally mandated goals (i.e., regional haze). Class I areas are generally pristine landscapes such as national parks, national forests, and wilderness areas that are specifically provided the highest levels of air quality protection under the CAA.

Although Galiuro Wilderness is the closest Class I area to the Project Area, the nearest Class I area that also monitors AQRVs is the Chiricahua National Monument located approximately 68 miles to the southeast of the Project Area. **Figure 3.9-2** below shows the last ten years of visibility conditions (in terms of the haze index) at Chiricahua National Monument. **Figure 3.9-3** and **Figure 3.9-4** provide sulfur and nitrogen deposition information at Chiricahua National Monument. In general, trends with a negative slope indicate better atmospheric conditions for each potentially affected area.



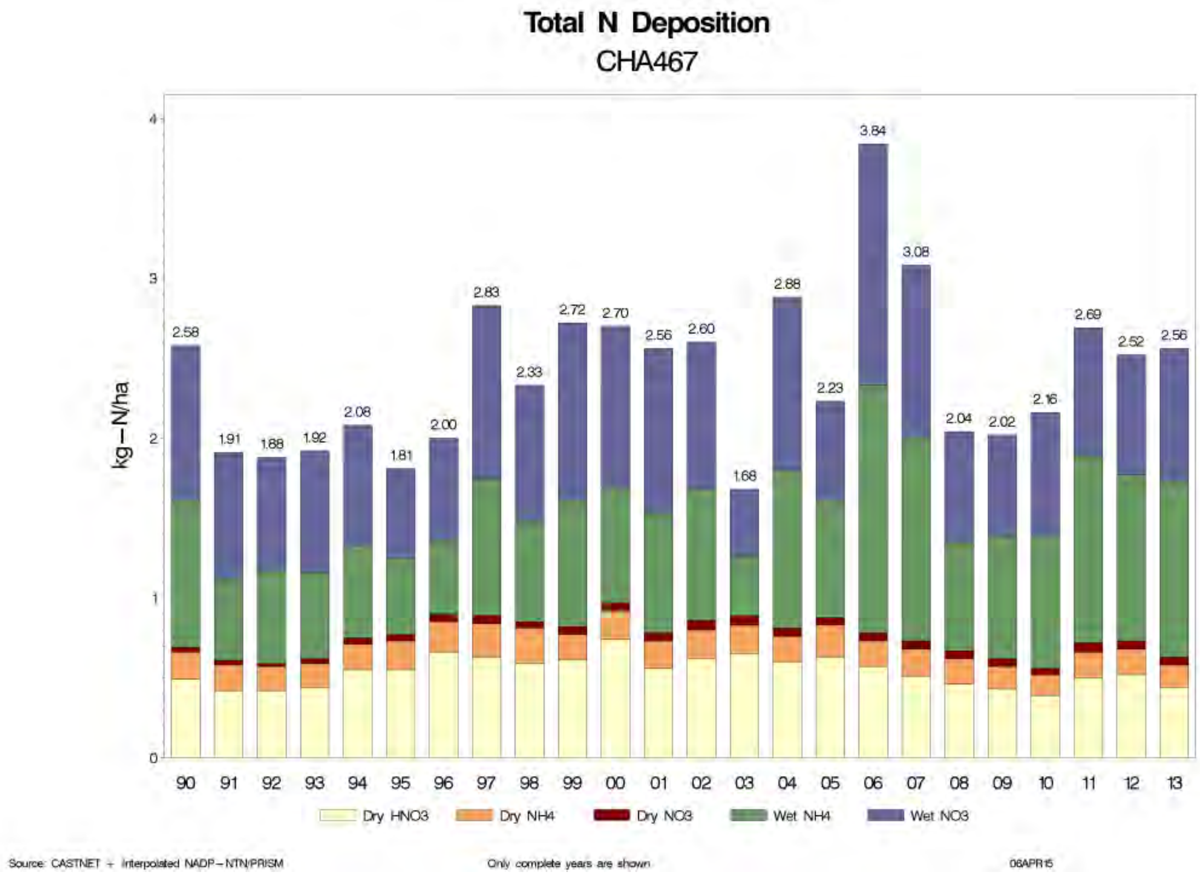
Source: Federal Land Manager Environmental Database (FED) 2015.

Figure 3.9-2 Visibility at Chiricahua National Monument



Source: USEPA 2015b.

Figure 3.9-3 Sulfur Deposition at Chiricahua National Monument



Source: USEPA 2015b.

Figure 3.9-4 Nitrogen Deposition at Chiricahua National Monument

3.9.2 Environmental Consequences

3.9.2.1 Scoping Issues

Scoping issues and concerns identified by the public related to air quality and greenhouse gas emissions are listed below. Many of these comments call for discussions to be included in the EIS. These items were included in the Affected Environment or Environmental Consequences sections to the degree possible with the existing information. Some of the comments called for a level of detail that is not known at this point, such as site-specific modeling and an emissions inventory, that would be included in an air quality permit application, should one be required by ADEQ.

- Descriptions of existing air quality in the Project vicinity.
- Discussions of the NAAQS and PSD increments applicable to air quality in the Project Area. Comments noted that PSD increments exist for SO_2, NO_2, PM_{10}, and $PM_{2.5}$.
- Identification of all Class I PSD areas located within 100 km of the proposed Project site. Discussions of potential impacts to Class I PSD areas, including visibility impacts.
- Summaries of project emissions from all facilities and roads related to the mine's operations, including any offsite processing and support activities, such as vehicle traffic and delivery trucks for fuels, maintenance supplies, and other materials.
- Consideration of cumulative emissions from other sources in the Project Area, including existing facilities and ongoing operations associated with the Dos Pobres and San Juan pits.
- Modeling to determine concentrations of criteria air pollutants for an accurate comparison with the NAAQS. The air quality analysis presented in the EIS should demonstrate that new emissions emitted from the proposed Project, in conjunction with other applicable emissions increases and decreases from existing sources, will not cause or contribute to a violation of any applicable NAAQS or PSD increment.
- Potential for fugitive dust, especially dust that contains toxins, abrasives, or otherwise ecologically disruptive compounds.
- List in detail all possible sources of HAPs and the unit processes that generate this material; estimate releases of HAPs from the proposed Project to air, soil, and water resources; and describe the HAPs monitoring that would be conducted, including locations and reporting requirements.
- Discuss how all HAPs would be controlled to reduce their emissions as much as possible.
- Analysis of GHGs and climate change should be consistent with new CEQ draft guidance provided in December 2014, which indicates that impact analysis should consider both the potential effects of a Proposed Action on climate change as well as the implications of climate change.
- Identify sustainable design and operation measures that reduce GHGs.

3.9.2.2 Method of Analysis and Impact Indicators

The baseline reports prepared for FMSI provided the projected local and regional air quality, emissions inventory, and air modeling results (Trinity 2014a,b). The results from the emissions and modeling were compared to the AAQS and existing background conditions for ozone, visibility, and climate change to facilitate a comparison with the proposed alternatives. Details of the modeling performed are described below.

3.9.2.3 Assumptions for Analysis

- It is assumed that FMSI will comply with the design features described in Chapter 2.0, Section 2.3.4, as well as federal and state laws, regulations, and permit requirements that minimize adverse impacts to regional air quality.
- Any air quality permits required by ADEQ will be completed outside of the NEPA process according to state permit requirements. The modeling information presented in this section is not as detailed as modeling that may be required for a permit application.

3.9.2.4 Alternative 1, Proposed Action

This section describes the potential sources of air pollutants for the Proposed Action and presents an evaluation of the impact of these emissions to the air quality in the surrounding area.

Potential Sources of Air Pollutants

It is expected that current mining operations would continue under the Proposed Action. A detailed description of mining activities with the potential to emit air pollutants is provided below.

Open Pit Mining

The open pit mining process used at this site would use standard techniques of drilling, blasting, loading, and hauling. Rock would be loosened in the open pit by blasting with an ammonium nitrate blasting agent or a mixture of such agents. Next, rock would be loaded onto haul trucks and hauled to either the primary crusher hopper, or the heap leach pad. Development rock would be transported to development rock stockpiles. Potential fugitive particulate emissions (PM, $PM_{2.5}$, and PM_{10}) can result from these processes, and would be minimized by utilizing shrouds during drilling and applying water to haul roads as needed (Trinity Consultants 2014a).

Crushing and Conveying

The crushing, screening, and conveying processes conducted at the mine would all result in dust emissions of PM, PM_{10}, and $PM_{2.5}$. Fabric filter dust collectors are currently used to control these emissions, and emission rates vary based on fabric filter grain loading and dust collector flow rates. This practice would continue.

Heap Leaching

Due to the type and high moisture content of the material being processed, heap leaching is not anticipated to produce any emissions (Trinity Consultants 2014a).

Solution Extraction/Electrowinning

The SX/EW process currently in place would continue to be used for processing ore from the Lone Star Pit. An industry standard copper SX plant is utilized to capture dissolved copper and convert it to an electrolyte. This copper-rich electrolyte is then plated onto cathode blanks using EW cells and harvested. The organic phase solution in the SX process could potentially emit VOCs and HAPs, and the equipment involved in the SX process is covered to reduce emissions through evaporation. Sulfuric acid (H_2SO_4) also can be emitted during the EW process, and such emissions are reduced through the use of an acid mist suppressing agent and mist coalescing balls that are primarily used to control heat loss (Trinity Consultants 2014a).

Production of Sulfuric Acid

Molten sulfur is burned in a furnace at the acid plant to produce sulfuric acid. This process can result in emissions of SO_2, H_2SO_4, and NO_x, which are vented to a caustic scrubber. Particulate matter such as

PM_{10} and $PM_{2.5}$ could potentially be emitted uncontrolled from the cooling tower (Trinity Consultants 2014a).

Fuel Burning Equipment

Stationary fuel burning equipment such as propane heaters at the acid plant and SX/EW areas, diesel and propane emergency generators and firewater pumps, and other fuel combustion equipment is utilized at the site. This equipment has the potential to emit PM, PM_{10}, and $PM_{2.5}$, as well as NO_x, CO, SO_2, HAPs, and GHGs (Trinity Consultants 2014a).

Storage Tanks

Seven diesel storage tanks and one gasoline storage tank are used onsite to store fuels used in mining and processing. Breathing and working losses could result in VOC emissions from these storage tanks (Trinity Consultants 2014a).

Stockpiles

FMSI would utilize several stockpiles that have the potential to emit PM_{10} and $PM_{2.5}$ pollutants due to wind erosion. These include the coarse ore stockpile that would be used to store primary crushed ore before it is transported for secondary crushing, and the run-of-mine stockpile that would be used to supplement activities in case of temporary disruptions in the mine or crushing system. The development rock stockpiles are not anticipated to result in emissions due to the large size of the stored rock (Trinity Consultants 2014a).

Support Traffic

Traffic at the FMSI site includes many types of equipment such as light duty vehicles, bulldozers working on the development rock stockpiles, vehicles used in material delivery and shipment of various reagents and products, and haul trucks (Trinity Consultants 2014a). This support traffic could potentially result in PM_{10} and $PM_{2.5}$ emissions during travel on paved and unpaved roads. Road watering would be used to control fugitive dust emissions on unpaved roads.

Stemming and Road Base Crushing Plant

A stemming plant uses non-ore material to provide material that is used to stem holes created during drilling and increase the efficiency of blasting operations. Material that cannot be used for stemming would be stored as road base and used throughout the facility. Stemming plant operations can result in PM_{10} and $PM_{2.5}$ emissions. Water sprays would be used to control dust emissions from the feeder, screen, jaw crusher, and conveyors used at the stemming plant, but controls would not be used during loading/unloading operations or at stockpiles (Trinity Consultants 2014a).

Under the Proposed Action, specific future activities would increase for some of the sources described above, resulting in greater air pollutant emissions. FMSI's mining plans call for the Lone Star mine to be active for a period of 27 years. The estimated future annual activity rates for the Lone Star mine are summarized in **Table 3.9-7** for key emission-generating processes. The table shows that mining process rates are predicted to be highest in Year 4, which corresponds to year 2021 because the Dos Pobres and San Juan pits will be operating concurrently with the Project. Correspondingly, the highest emissions for the Proposed Action are predicted to occur during 2021 (Trinity Consultants 2014a). For this reason, 2021 was selected to perform the modeling assessment for this project.

Table 3.9-7 Projected Mining Activity Rates, 2017-2044

	2017	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028 - 2029**	**2030**	**2031**	**2032**	**2033 - 2037**	**2038 - 2042**	**2043 - 2044**
Activity	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11 - 12	Year 13	Year 14	Year 15	Year 16 - 20	Year 21 - 25	Year 26 - 27
Drilling (holes/year)	512	15,561	40,180	44,760	85,458	84,773	85,156	72,545	71,380	67,609	57,153	66,817	66,817	66,817	66,817	24,752	20,599	28,547
Blasting (klb explosive/ear)	645	19,606	50,627	56,398	107,678	106,814	107,297	91,407	89,939	85,188	72,013	84,189	84,189	84,189	84,189	31,188	25,955	35,969
Mining Process Rate - Total (kton/year)	922	28,009	72,324	81,628	153,825	152,591	153,281	130,581	129,476	125,697	122,660	120,270	121,262	120,270	120,270	49,065	41,865	59,037
Haul Truck VMT - Total (VMT/year)	0	116,018	234,528	1,450,272	1,343,033	1,076,699	1,374,300	1,142,659	2,235,036	1,185,557	709,923	1,471,819	2,575,724	1,471,819	1,471,819	874,586	840,974	1,231,390
Haul Truck Fleet Size (haul trucks/year)	0	4	9	12	38	31	38	35	34	34	32	32	32	32	32	21	20	25
Additional Mining Auxiliary Equipment Fleet Size (auxiliary equipment/year)	0	44	78	85	88	88	88	88	88	88	88	88	88	81	78	78	78	78

Source: Trinity Consultants 2014a.

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Note that some emissions activities are not included in **Table 3.9-7**. Specifically, emissions from the acid plant, wind erosion of stockpiles, and fuel burning equipment would be the same for all years. Emissions from the crushing and screening process also are not predicted to change due to the constant rate of loading. Emissions related to the portable stemming and road base plant, as well as support traffic are anticipated to vary in proportion to drilling and ore mining rates. The SX/EW process would result in a small increase in VOCs due to the addition of two new mixer/settlers.

Emissions and Source Characterization

For the pollutants included in the air quality dispersion modeling analysis, the estimated facility-wide potential annual emissions in units of tpy are presented in **Table 3.9-8**. The FMSI site includes two stationary sources of air pollutants: mining operations (the primary on-site activity), which are governed by a 250 tpy “major source” threshold, and operations at the sulfuric acid plant, which is governed by a 100 tpy “major source” threshold (Trinity Consultants 2014a). These activities are considered a single stationary source but are subject to different “major source” thresholds because only the operations at the acid plant are on the list of 28 source categories described in Title V or PSD programs (40 CFR 70 and 40 CFR 52.21). Therefore, emissions are estimated differently to determine “major source” status (i.e., while fugitive emissions are not included in the calculation for source-wide Potential to Emit for mining operations, they are included in the source-wide Potential to Emit for the sulfuric acid plant).

FMSI identified the Emery Mitigation Site for compensatory mitigation activities related to this Project. More detail on this mitigation site can be found in Chapter 2.0, Section 2.3.1.6. **Table 3.9-9** provides an emissions inventory for the compensatory mitigation activities, similar to that provided for construction and operation of the mine-related facilities. The inventory provides estimates of the types of equipment necessary to complete the compensatory mitigation activities. The total elapsed time represented by the proposed duration of equipment operation is approximately 22 weeks. **Table 3.9-9** provides the emissions inventory related only to the Emery Mitigation Site based on these anticipated equipment types and estimated operating times.

Air Quality Modeling Analysis

AAQS are maximum concentrations of pollutants in ambient air that are considered protective of the public health. These standards are established by environmental regulatory authorities for air pollutants with known human health effects or that would adversely impact the environment. Air quality impacts in the form of AAQS have been determined using the latest version of the American Meteorological Society/USEPA Regulatory Model, known as AERMOD. The estimated total ambient concentrations (modeled concentrations plus applicable background concentrations) from this analysis were compared with applicable AAQS for disclosure of potential future air quality impacts.

The dispersion model calculates ambient concentrations for each hour of the modeled time period. Accordingly, hourly emission rates were calculated for each modeled source. The Proposed Action was modeled to represent a facility configuration that simulated a realistic operational maximum scenario. The emission inventory was not developed for each of the 27 operation years. Instead, the emission inventory was developed for an operating year in which the total site-wide emissions are expected to be at the maximum level, year 2021 (Trinity Consultants 2014a).

Additional details on the meteorological data and the model configurations associated with this analysis can be found on the dispersion modeling report (Trinity Consultants 2014b).

Table 3.9-8 Facility-wide Potential Emissions from the Proposed Action by Source Category in the Project Area

Source Category	PM (tpy)	$PM_{2.5}$ (tpy)	PM_{10} (tpy)	NO_X (tpy)	CO (tpy)	SO_2 (tpy)	VOC (tpy)	HAPs (tpy)	H_2SO_4 (tpy)	CO_2e (tpy)
Fugitive[1]	7,491	2,040	255.06	309.57	1,243	0.1	8.43	--	8.76	193,102
Non-Fugitive: Stationary[1]	74.54	74.54	74.54	93.87	30.67	53.9	4.54	--	8.98	27,318
Non-Fugitive: Portable[1]	0.53	0.53	0.53	6.9	8.72	0	0.85	--	0	755
Total[1]	7,566	2,115	330.13	410.35	1,283	53.99	13.82	--	17.74	221,175
Total[2]	7,754	2,303	518.81	4,349	2,367	56.49	238.38	11.07	17.74	592,032

1 Excludes tailpipe emissions.

2 Includes tailpipe emissions.

Source: Trinity Consultants 2014a,b.

Table 3.9-9 Emery Mitigation Site Potential Emissions by Equipment type

Equipment	PM (ton/total use)[1]	$PM_{2.5}$ (ton/total use)	PM_{10} (ton/total use)	NO_X (ton/total use)	CO (ton/total use)	SO_2 (ton/total use)	VOC (ton/total use)
Diesel 336 F Excavator w Thumb	0.11	0.11	0.11	1.93	2.37	0.00	0.28
Diesel Bull Dozer D9 11' BLADE	0.20	0.20	0.20	3.43	4.23	0.00	0.50
Diesel Grader 14 G 14' Mowboard	0.04	0.04	0.04	0.76	0.94	0.00	0.11
Diesel 336 F Excavator W Cutting Att.	0.09	0.09	0.09	1.56	1.92	0.00	0.23
Tree Chipper	0.04	0.04	0.04	0.54	0.34	0.00	0.74
Water Truck/5,000 Gallon Water Pull	0.09	0.09	0.09	1.62	1.99	0.00	0.23
336f Excavator With Auger	0.05	0.05	0.05	0.81	0.99	0.00	0.12
4,000 Gal. Water Truck	0.09	0.09	0.09	1.62	1.99	0.00	0.23
4 Chainsaws	0.11	0.11	0.11	0.01	7.13	0.01	2.19
Fugitive Dust Emissions	0.43	0.02	0.13	0.00	0.00	0.00	0.00
Total	1.25	0.84	0.95	12.27	21.91	0.02	4.63

1 Emissions in units of tons per total use, where the total elapsed time represented by the proposed duration of equipment operation is approximately 22 weeks

Source: WestLand 2015f.

ADEQ's "Learning Site Policy," establishes that if a facility is within 2 miles or less of a learning site, the facility should submit a modeling analysis to demonstrate compliance with the Acute/Chronic Ambient Air Concentrations for listed air toxics. Because there are no learning sites within 2 miles of the proposed Project, an analysis of Acute/Chronic Ambient Air Concentration impacts is not required and is not presented as part of this analysis. An ozone impact analysis is not required because, pursuant to 40 CFR 52.21, only a proposed project with an increase of VOC or NO_x emissions in excess of 100 tpy triggers an ambient ozone impact analysis for the Project. The proposed Project is not subject to the requirements of the PSD program under 40 CFR 52.21 because VOC and NO_x emissions increases for stationary sources would be less than 100 tpy. Compliance with the PSD program would apply only if the proposed Project constituted a major source, which would then address the major source thresholds for the primary source activity and nested categorical source activity.

The model-predicted maximum concentrations and the estimated total ambient concentrations (modeled concentrations plus background concentrations) are presented in **Table 3.9-10** relative to applicable AAQS. Maximum impacts from primary PM, SO_2, and NO_x are expected to occur near the boundary of the Project Area.

Table 3.9-10 Highest Modeled Air Pollutant Concentrations from the Proposed Action

Pollutant	Averaging Period	Dispersion Modeling Results (µg/m^3)	Background (µg/m^3)	Dispersion Modeling Results with Background (µg/m^3)	Ambient Standard (µg/m^3)
CO	1-hour	404.93	582.00	986.93	40,000
	8-hour	118.35	582.00	700.35	10,000
NO_2	1-hour	152.59	24.50	177.09	188
	Annual	17.28	24.50	41.78	100
$PM_{2.5}$	24-hour	15.74	7.20	22.94	35
	Annual	3.58	3.10	6.68	12
PM_{10}	24-Hour	31.33	37.40	68.73	150
SO_2	1-hour	17.87	20.90	38.77	196
	3-hour	9.90	43.00	52.90	1,300
	24-hour	1.77	17.00	18.77	365
	Annual	0.23	3.00	3.23	80

Source: Trinity Consultants 2014b.

The estimated maximum predicted total ambient concentrations resulting from implementation of the Proposed Action are all below the applicable AAQS for all pollutants and averaging periods. Note that for $PM_{2.5}$, the impact analysis followed the recommendations in the USEPA Guidance, which is a screening level analysis. The results indicate that the Proposed Action is not expected to lead to any exceedances of the 24-hour and annual $PM_{2.5}$ AAQS.

Secondary $PM_{2.5}$ formation as a result of the Proposed Action's SO_2 and NO_x emissions are not anticipated to contribute to a $PM_{2.5}$ adverse impact in the area surrounding the Project Area. Low SO_2 emissions from existing sources in the vicinity of the Project Area combined with the Project's negligible SO_2 emissions minimize secondary formation of $PM_{2.5}$. NO_x emissions would be greater than those of SO_2; however, warm average temperatures in the arid climate of southern Arizona would limit nitrate formation from NO_x.

Air Quality Related Values Analysis

A visibility analysis was conducted to evaluate the potential visibility impacts at Galiuro Wilderness Area, which is a Class I area located approximately 40 miles (65 km) from the Project Area, and Gila Wilderness Area, which is located approximately 50 miles (80 km) from the Project Area. Visibility impacts were estimated using the VISCREEN tool which calculates the visual effects of a pollution plume as observed from a given vantage point. It is designed as a conservative screening tool and, for this project, the Level 2 screening assessment was conducted. The analysis considered particulate matter emissions from the mine operations but not fugitive emissions from the haul trucks and blasting activities. NO_x from non-fugitive sources also was considered and a NO_2 to NO_x conversion ratio was assumed. SO_2 emissions were not included given that formation of sulfate is assumed to be negligible over the short distances and conditions typical of the plume.

Table 3.9-11 shows the results of the visibility impacts analysis. The values in the table are compared to the color difference parameter screening criteria of 2.0 and the plume green contrast screening criteria of 0.05. The modeling results indicate no exceedances of the Sky and Terrain Visibility criteria. As a result, the proposed Project is not expected to have adverse visibility impacts at the Galiuro or Gila Wilderness Areas.

Table 3.9-11 Proposed Action Visibility Impacts Analysis

Class I Area	Background	Color Difference		Contrast	
		Criteria	Model Results	Criteria	Model Results
Galiuro Wilderness Area	Sky	2	0.300	0.05	0.006
	Terrain	2	0.696	0.05	0.005
Gila Wilderness Area	Sky	2	0.231	0.05	0.004
	Terrain	2	0.267	0.05	0.003

Source: WestLand 2015f; Trinity Consultants 2014b.

Climate Change

Scientific research has identified the potential impacts of anthropogenic GHG emissions and changes in biological carbon sequestration due to land management activities on global climate. More recent research on trends in global mean surface temperatures (IPCC 2013) provides further evidence that the earth is getting warmer and describes the potential impacts of climate change. Standardized protocols designed to measure factors that may contribute to climate change, and to quantify climatic impacts, are presently unavailable. Moreover, specific levels of significance have not yet been established by regulatory agencies. Calculating the degree of impact any single emitter of GHGs may have on global climate, or on the changes various ecosystems that accompany climate change is highly complex and predicting those impacts requires elaborate computer modeling. Currently, no feasible and reliable tools exist to predict the impacts from an individual project GHG emissions would have on the global, regional, or local climate. This analysis therefore only compares total expected GHG emissions with projected Arizona and U.S. GHG emissions. In addition, BLM discusses available information regarding expected changes to the global climatic system and the empirical evidence of climate change that has occurred to date.

The proposed Project's estimated contribution to GHG emissions, which can contribute to global climate change, is 484,191 tpy (439,251 metric tpy) CO_2e under current operations, and 592,032 tpy (537,082 metric tpy) CO_2e under future operations (Trinity Consultants 2014b). Sources of GHGs in this Project Area include blasting, leaching processes, stationary combustion, portable engines including emergency firewater pumps, emergency generators, light towers, and vehicle tailpipe emissions. Most of the future increases in CO_2e would result from vehicle tailpipe emissions attributed to the use of utility vehicles, haul trucks, and delivery vehicles. The Project's future emissions represent only a small increase (0.12 percent) in Arizona's overall GHG emissions, which were 80 million metric tons CO_2e in 2000 (Trinity Consultants 2014b).

The Arizona Climate Change Action Plan (Arizona, 2006) provides estimates of future years GHG emissions inventories for Arizona. In year 2020, estimates show that Arizona's annual GHG emissions will be approximately 163,900,000 metric tons CO_2(e). The Project's annual GHG emissions for year 2021 including tailpipe emissions would represent about 0.3 percent of the state of Arizona's year 2020 annual GHG emissions.

For additional context, USEPA has recently modeled global climate change impacts from a source emitting 20 percent more GHGs than a 1,500MW coal-fired steam electric generating plant (approximately 14,132,586 metric tons per year of CO_2, 273.6 metric tons per year of nitrous oxide, and 136.8 metric tons per year of methane). The results ranged from a 0.00022 to 0.00035 degrees Celsius change in mean global temperature occurring approximately 50 years after the facility begins operation. The modeled changes are extremely small, and any downsizing of these results from the global scale would produce greater uncertainty in the predictions. USEPA concluded that even assuming such an increase in temperature could be downscaled to a particular location when considering impacts to endangered species habitat, it "would be too small to physically measure or detect" (Meyers 2008). Because the potential emissions from this project would be only a fraction (~4%) of the USEPA's modeled source and would be shorter in duration, the projected annual related impacts on the climate would be minimal.

The following predictions were made by the USEPA for the Southwest region with respect to climate change associated with cumulative (i.e., World-wide) GHG emissions:

- Warming temperatures and reduced snowpack have been observed in recent decades in the Southwest.
- Increasing temperatures and more frequent and severe droughts are expected to heighten competition for water resources for use in cities, agriculture, and energy production.
- Native communities are expected to experience more difficulties associated with access to freshwater, agricultural practices, and declines in medicinal and cultural plants and animals.
- Drought, wildfire, invasive species, pests, and changes in species' geographic ranges will increase threats to native forests and ecosystems.

Because climate change is a result of cumulative human activities around the world, any of the predictions above cannot be attributed specifically to this project's GHG emissions.

To minimize GHG emissions, FMSI may want to implement some of the following measures if they are determined to be practical and feasible.

- Use conveyors rather than haul trucks for transporting ore to processing areas and the heap leach facility;
- Incorporate alternative energy components such as onsite solar power generation;
- Offer ride-sharing or shuttle opportunities for mine employees commuting to the site;
- Use high efficiency diesel particulate filters on diesel engines to reduce black carbon emissions.

3.9.2.5 Alternative 2

Alternative 2 would utilize all of the same project components as the Proposed Action, with the exception of the heap leach stockpile. Although the operation of the heap leach process would be identical, the footprint would be rotated compared to the Proposed Action and 76 acres larger. Under Alternative 2, it is expected that the impacts on air quality would be similar to the impacts presented above for Alternative 1, Proposed Action.

3.9.2.6 No Action

Under the No Action Alternative, FMSI would not mine copper from the Lone Star ore body. No new mine construction, operations, reclamation, or compensatory mitigation activities would be authorized under this alternative. Therefore, only the emissions corresponding to the current operations at the FMSI site would occur as part of this alternative (**Table 3.9-9**) and those emissions would cease at the end of the mine life for the Dos Pobres and San Juan pits.

Table 3.9-12 Facility-wide Potential Emissions from the No Action by Source Category

Source Category	PM (tpy)	$PM_{2.5}$ (tpy)	PM_{10} (tpy)	NO_X (tpy)	CO (tpy)	SO_2 (tpy)	VOC (tpy)	HAPs (tpy)	H_2SO_4 (tpy)	CO_2e
Fugitive[1]	3,336	966.59	115.24	178.39	716.42	0.06	6.76	--	8.76	222,100
Non-Fugitive: Stationary[1]	74.18	74.18	74.18	82.71	24.16	52.67	3.77	--	8.98	26,023
Non-Fugitive: Portable[1]	0.64	0.64	0.64	10.63	10.90	0.41	1.11	--	0	1,187
Total[1]	3,411	1,041	190.06	271.73	751.47	53.13	11.64	--	17.74	249,310
Total[2]	3,533	1,163	311.91	2,700	1,464	55.99	151.75	8.01	17.74	484,191

[1] Excludes tailpipe emissions.

[2] Includes tailpipe emissions.

Source: Trinity Consultants 2014a,b.

The air dispersion model simulated a scenario which only considered current emissions at the mining site. **Table 3.9-10** presents the modeled concentrations and their comparison with the applicable AAQS, while **Table 3.9-11** presents the visibility impacts under the No Action Alternative.

Table 3.9-13 Highest Modeled Air Pollutant Concentrations from the No Action Alternative

Pollutant	Averaging Period	Dispersion Modeling Results (μg/m³)	Background (μg/m³)	Dispersion Modeling Results with Background (μg/m³)	Ambient Standard (μg/m³)
CO	1-hour	649.14	582.00	1,231.14	40,000
	8-hour	134.93	582.00	716.93	10,000
NO_2	1-hour	160.12	24.50	184.62	188
	Annual	8.84	24.50	33.34	100
$PM_{2.5}$	24-hour	13.63	7.20	20.83	35
	Annual	2.03	3.10	5.13	12
PM_{10}	24-Hour	74.85	37.40	112.25	150

Table 3.9-13 Highest Modeled Air Pollutant Concentrations from the No Action Alternative

Pollutant	Averaging Period	Dispersion Modeling Results (μg/m³)	Background (μg/m³)	Dispersion Modeling Results with Background (μg/m³)	Ambient Standard (μg/m³)
SO_2	1-hour	17.88	20.90	38.78	196
	3-hour	9.84	43.00	52.84	1,300
	24-hour	1.73	17.00	18.73	365
	Annual	0.23	3.00	3.23	80

Source: Trinity Consultants 2014b.

Table 3.9-14 No Action Visibility Impacts Analysis

Class I Area	Background	Color Difference		Contrast	
		Criteria	Model Results	Criteria	Model Results
Galiuro Wilderness Area	Sky	2	0.275	0.05	0.005
	Terrain	2	0.660	0.05	0.005
Gila Wilderness Area	Sky	2	0.104	0.05	0.001
	Terrain	2	0.126	0.05	0.001

Source: FMSI 2015d; Trinity Consultants 2014b.

3.9.2.7 Potential Mitigation Measures

No additional mitigation measures are recommended or necessary in view of the demonstrated absence of adverse impacts to air quality. Air quality emission sources for the proposed Project would be subject to the requirements of federal and Arizona air quality regulations. ADEQ would determine whether air quality construction and operating permits and associated mitigation measures would be required should the Project be permitted. The air quality permitting process may require FMSI to submit a permit application, including a complete inventory of potential criteria air pollutant emissions from the selected alternative.

3.9.2.8 Cumulative Impacts

The CESA would be the same as the analysis area for all pollutants, except for GHG emissions that have a global impact. Cumulative impacts to air quality would include impacts from the proposed Project emission sources in combination with impacts from nearby emission sources that are accounted for in the background levels added to the modeled impacts. An increase in surface disturbance affects the emissions and impacts of particulates ($PM_{2.5}$ and PM_{10}). However, it is anticipated that the formation of secondary PM as a result of the emission from this project is limited and therefore not expected to contribute to exceedances of AAQS.

Although GHG emissions are a contributing factor to climate change, at present there is no regulatory program that requires reductions in GHG emissions, and the tools necessary to quantify climatic impacts presently are unavailable. Climate change impacts are global in nature, but expected predictions from USEPA specific for the Southwest region that includes Arizona have been presented the Climate Change section above.

3.9.2.9 Residual Impacts

Emissions of criteria pollutants would occur as a result of implementing either of the action alternatives. Furthermore, the proposed Project would not result in emissions above major-source thresholds for any criteria pollutants. Project emissions would not cause exceedances of the AAQS. Residual impacts associated with particulate matter (PM_{10} and $PM_{2.5}$) would be minimized through soil stabilization and subsequent reclamation. As vegetation becomes re-established on disturbed areas, particulate levels should return to typical conditions of a dry desert environment. Once the disturbance ceases and wind-erodible surfaces are reclaimed, air quality would return to approximately its pre-mining conditions.

3.10 Land Use

3.10.1 Affected Environment

3.10.1.1 Analysis Area

The analysis area for land use is defined as Project Area, Emery Mitigation Site and surrounding areas. The primary land uses in Graham County include mining, agriculture, ranching, and recreation. The Graham County Comprehensive Plan (2014) encourages beneficial mining efforts on public and private lands, and encourages working cooperatively with federal and state agencies regarding resource issues related to mining.

3.10.1.2 Public Land Management

In 1994, FMSI submitted a land exchange proposal to acquire the BLM-administered lands adjacent to and surrounding its privately owned properties and ore deposits. In exchange, the BLM would acquire FMSI-owned lands that had high resource value. In 1996, the BLM initiated a NEPA review of these proposals, ultimately resulting in the publication of the Dos Pobres/San Juan Final EIS in December 2003 and BLM ROD in June 2004. In the ROD, the BLM selected the land exchange as its preferred alternative. Under the land exchange, approximately 16,300 acres of BLM-managed lands were transferred to FMSI (BLM 2003). The BLM still manages most of the land surrounding the Project Area; however, there are no readily accessible public lands in the Project Area.

3.10.1.3 Land Ownership

Land ownership in the analysis area is depicted in **Figure 3.10-1**. The proposed project would be constructed entirely on private lands. The eastern, northern, and western boundaries of the Project Area are almost entirely bordered by BLM-administered lands. Parcels of state-managed land border the analysis area along portions of the southern boundary (T07S, R26E, Section 2; T06S, R26E, Section 36), eastern boundary (T06S, R27E, Sections 32 and 16), and northern boundary (T05S R26E Section 16).

Within the interior of the Project Area are two small parcels of land not owned by FMSI, the Melody Claims and the Horseshoe Claims. The 628-acre Melody Claims are managed by the BLM and were not included in the Dos Pobres/San Juan Project land exchange because the mining claims are held by a third-party. The 110 acre Horseshoe Claims are owned by several private parties other than FMSI. There is no public access or recreation associated with these two areas.

FMSI has identified a mitigation site (Emery Site) to compensate for all unavoidable project impacts to waters of the U.S. The Emery Mitigation Site is approximately 109 acres of private land located south of the Project Area downstream along the Gila River. There are three proposed mitigation areas within the site which contain riparian habitat. The majority of the Emery Site is former agricultural fields. Mitigation goals would be designed to enhance riparian functions. Under the long-term protection of the site, some low-intensity public uses such as hiking, bird watching, and/or minor forms of hunting or fishing may be allowed.

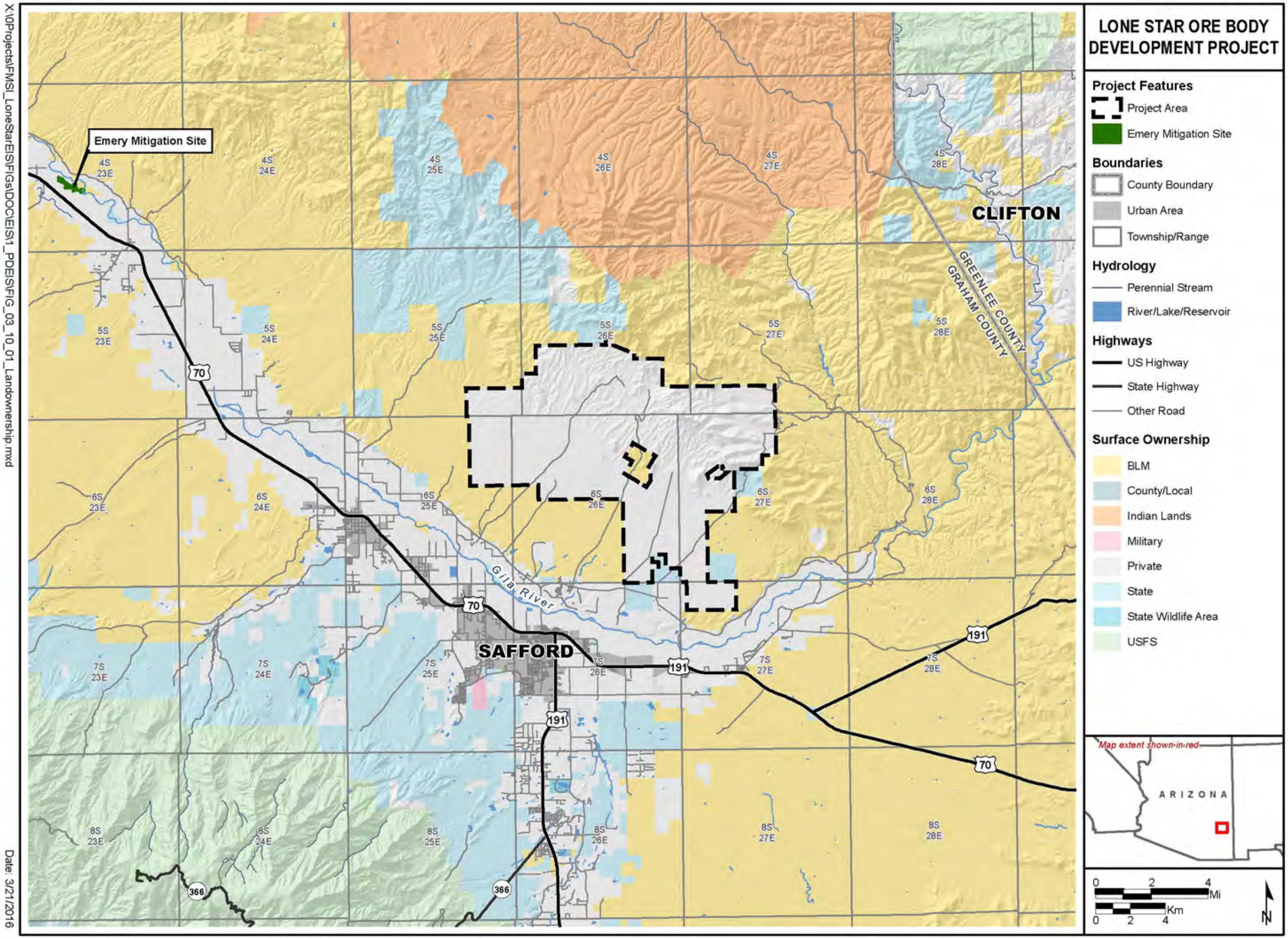

Figure 3.10-1 Land Ownership Within and Around the Analysis Area

3.10.1.4 Access and Recreation

Access

Four roads originating from Safford Bryce Road/Airport Road provide access to the Project Area: Freeport-McMoRan Road, San Juan Mine Road, Lone Star Mountain Road, and Solomon Pass Road (see **Figure 3.12-1** in the Transportation section for the roads named). Solomon Pass Road is the only road providing public access through a small portion of the Project Area on the east side. Access to the Project Area by other roads is restricted by FMSI gates. Public access to Solomon Pass Road would not be restricted or limited as a result of development of the Lone Star Project. Perimeter fencing and signs are located in areas where inadvertent access may be an issue.

FMSI currently leases portions of the Project Area for grazing. There is limited access to portions of the Project Area outside of active operations that is provided to ranchers who graze livestock under the management and control of FMSI.

Recreation

The public land in the vicinity provides a wide variety of recreation opportunities, such as back country driving, birdwatching, mountain biking and hiking. There are no developed recreational sites present within the analysis area. The only public access road in the analysis area is Solomon Pass Road, which runs through the southeastern portions of the Project Area (see **Figure 3.12-1**). Solomon Pass Road provides access to the Gila Box RNCA and Bonita Creek.

The western boundary of the Gila Box RNCA is approximately 1.8 miles away from the Project Area. This 21,767-acre conservation area provides many recreational opportunities, such as hiking, fishing, camping, boating, hunting, and wildlife viewing. While Solomon Pass Road does not provide access to the main entrance of the NCA, it does provide access to the Lee Trail Parking Area and Trailhead and the RNCA’s northwest system of trails and unpaved roads. Within the conservation area are a 23-mile segment of the Gila River (7.8 miles for recreational use) and a 15-mile segment of Bonita Creek (8.1 miles for recreational use). In 1997, both of these segments were recommended to be included in the National Wild and Scenic River System. The recreational segments provide fishing, rafting, tubing, and water-play opportunities for visitors (BLM 1998).

The west trailhead for the Safford-Morenci Trail is approximately 1 mile east of the Project Area on West Ranch Road. Solomon Pass, Salt Trap Road and West Ranch Road provide access to the trailhead, with the last 4 miles requiring a four-wheel drive, high clearance vehicle. In the late 1800s, the trail was used by pioneer ranchers and farmers to access mines in the Clifton-Morenci areas. The trail’s historical significance makes it eligible for the NRHP (BLM 2014).

The Gila Box RNCA provides hunting opportunities for visitors with necessary hunting permits. Visitors are allowed to hunt mule and white-tailed deer, javelina, Gambel’s and scaled quail, mourning and white-winged dove, and black bear.

The analysis area falls within the AGFD Management Unit 28 in Region IV. This unit represents 1 of 18 management units where hunting activity is monitored and reported. Species within Game Management Unit 28 include bighorn sheep, black bear, javelina, mule deer, white-tailed deer, Cottontail Rabbit, Dove and Quail. The average number of hunting permits issued in the past 5 years comprised 1,200 permits for mule deer, 450 for javelina, 2 for desert bighorn sheep, and 3 for Rocky Mountain bighorn sheep (AGFD 2015d). No hunting is permitted within the Project Area.

3.10.1.5 Agriculture and Livestock Grazing

Most of the agricultural land in Graham County is used for cotton production, with remaining acreage used for hay and grain production (Arizona Department of Commerce 2008). Water for irrigation is typically drawn from the Gila River. FMSI leases approximately 23,600 acres within the Project Area for grazing. FMSI intends to reduce these leased grazing areas by approximately 5,200 acres.

3.10.2 Environmental Consequences

3.10.2.1 Scoping Issues

Public scoping issues related to land use and recreation identified include the following.

- Effects on recreation areas and dispersed recreation activities.
- Conflicts with hunting or wildlife-based recreation.

3.10.2.2 Method of Analysis and Impact Indicators

The method of analysis considered how the locations of proposed surface disturbance would affect existing land uses in the analysis area by overlaying the locations of proposed facilities on the current land uses described in the Affected Environment section. Following is a list of indicators used to identify potential impacts.

- Conflicts or conversion of existing lands
- Changes to recreational opportunities or access in the area

The following assumptions were used in the analysis.

- Given the local history of mining activity, the proposed project would be consistent with county land plans and local zoning.
- Recreational activities that may be affected fall under the category of dispersed recreation.

3.10.2.3 Alternative 1, Proposed Action

Under the Proposed Action, there would be surface disturbance of 6,140 acres. The Proposed Action would continue the use of existing facilities, including the processing facilities, the majority of the infrastructure for the current heap leach pad, and the mine access road. New power distribution infrastructure would consist of two substations and a transmission line from the existing 69-kV power line to the Lone Star Pit.

The proposed action is consistent with the Graham County Comprehensive Plan as it relates to land use and reclamation (Graham Co. 2014).

<u>Land Use</u>

Under the Proposed Action, all mining activities and construction would occur on private land. All public and private land uses outside the Project Area would not be affected by the proposed surface disturbance.

With development of the Proposed Action, the 23,600 acres leased for grazing by FMSI would be reduced to 5,200 acres. To achieve post-mining land uses of wildlife habitat, grazing would continue to be limited upon closure and reclamation of the mine. This permanent reduction may cause ranchers to either reduce the number of livestock they manage under these private lease agreements, or relocate their herds to nearby federally managed grazing allotments if available.

The 109 acres of the Emery Mitigation Site would be used for off-site mitigation for project impacts to waters of the U.S. The 69 acres of agricultural land would be converted to riparian habitat. The riparian habitat would be enhanced and its functionality would be improved. Land ownership would not change.

Access

Use of Solomon Pass by the public would not be restricted under the Proposed Action.

Recreation

FMSI would maintain access to recreation areas surrounding the Project Area via Solomon Pass Road. The road provides access to Bonita Creek and the Gila Box RNCA. Adequate signs and perimeter fencing in this area would prevent inadvertent access to the mining facilities by recreational users.

The riparian habitat within the 109 acre Emery Mitigation Site would be managed to improve functionality. This could result in improved opportunities for low impact recreational activities, particularly those that involve wildlife viewing.

3.10.2.4 Alternative 2

The direct and indirect effects of Alternative 2 on land use and recreation would be the same as those described for the Proposed Action.

3.10.2.5 No Action Alternative

There would be no impacts to land use and recreation under the No Action Alternative.

3.10.2.6 Potential Mitigation Measures

No additional monitoring or mitigation measures are recommended.

3.10.2.7 Cumulative Impacts

The CESA for land use and recreation includes the analysis area and the adjacent land, including the mining claims, public lands used for recreation, livestock grazing, and the residential areas to the south.

The Melody and Horseshoe claims would continue into the future with their present owners. It is unknown if these mining claims will be developed in the future. If the mining claims were developed in the future, effects to land use and recreation would be similar to that of the Lone Star mining project. There would be minimal, if any, impacts to land use and recreation.

The Morenci Mine is an open pit copper mining complex owned and operated by Freeport McMoRan. It is located approximately 30 miles northeast of Safford and recently completed expansion of mining and milling capacity. The mine draws from the same construction and operations workforce as the Safford mine. This operation is outside of the CESA and will have no indirect effects on land use or recreation.

The Dos Pobres and San Juan pits in the Project Area have been in operation since 2007 and use the same processing facilities that would be used in the Proposed Action for the Lone Star Pit. These mining pits are within the CESA, but would have no effect on the current status of land use and recreation in the area. There would be minimal impacts, if any, to land use and recreation in the CESA if the project is developed.

3.10.2.8 Residual Adverse Effects

Assuming successful reclamation of all project components, residual impacts would only affect the private lands owned by FMSI. The acreage reductions for grazing on FMSI lands will likely remain around the reduced 5,200 acres to achieve post-mining land uses of wildlife habitat.

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3.11 Aesthetics and Visual Resources

The visual resources inventory and assessment of potential impacts include the evaluation of visual character, visual quality, and viewer sensitivity to proposed conditions. Data were collected from several sources, including aerial photography, previous environmental documents, and field reviews.

3.11.1 Analysis Area

The analysis area for visual resources is defined as 15 miles from the proposed project alternatives, as views beyond 15 miles would be seldom seen.

3.11.2 Affected Environment

Within the analysis area, the Gila River Valley is nestled between the Gila Mountains to the north and the Pinaleno Mountain to the south. Agricultural fields dominate the river's bottomlands and numerous small towns are more or less regularly spaced within the valley. East of the Project Area is the Gila Box Riparian NCA, a popular recreational area where the Gila River and Bonita Creek are confined to narrow canyons (BLM 2015).

The Project Area is situated on gradually sloping, hummocky alluvial fan terraces and low foothills along the Gila Mountains. The ridges become steeper toward the location of the proposed Lone Star Pit and development rock stockpiles. The undeveloped landscape is predominately natural desert upland, dominated by evenly spaced creosote brush. The lower and gentler slopes of these mountains appear to be covered by grasses, giving way to exposed rock where slopes are steeper, especially on the southwestern faces. Existing mining facilities found in the Project Area can be seen from Safford and other areas to the south and west. The most visible of these features are the 400-foot-tall heap leach pad and development rock stockpiles associated with the Dos Pobres and San Juan mines.

3.11.2.1 Visual Quality

Visual quality or attractiveness of a landscape is determined by evaluating the overall character and diversity of the landform's vegetation, water, color, and cultural or manmade features in a landscape, as well as the aesthetic and cultural value to the viewer. Typically, more complex or distinct landscapes have higher visual quality. A landscape is assigned a "high," "moderate," or "low" rating based on a combination of these elements:

- **Vividness**: The memorability of the visual impression received from contrasting landscape elements as they combine to form a striking and distinctive visual pattern.
- **Intactness**: The integrity of visual order in the natural and man-build landscape, and the extent to which the landscape is free from visual encroachment.
- **Unity**: The visual coherence and harmony of the landscape when considered as a whole.

There are six general landscapes or visual assessment units (VAUs) within the analysis area. These were identified based on observable changes in landscape character and the presence of special features. They include mountainous areas, developed areas, agriculture, the natural desert found in the Gila River Valley; mining areas; and the Gila River RNCA. **Table 3.11-1** provides brief descriptions of the VAUs and the visual quality rating based upon the criteria listed above.

Table 3.11-1 Visual Quality by General Land Use Type

VAU	Description	Visual Quality Rating
Mountains	The Pinaleno Mountains rise approximately 7,000 from the base to over 10,500 feet at the peak of Mount Graham, just outside of the analysis area. State Route 366 Swift Trail Parkway, a 35-mile designated scenic byway, twists and turns as it rises toward Mount Graham, giving motors panoramic views of the River Valley and the Project Area (Scenic USA 2015). The Gila Mountains line the Gila River Valley to the north, affording panoramic views of the river basin. The mountain range is comprised of irregular and undulating ridgelines and incised canyons. Surrounding communities have expressed the scenic and cultural value these mountainous landscapes bring to the region (City of Safford 2004).	High
Gila Box Riparian NCA	The Gila Box RNCA contains a riparian ecosystem with high levels of plant and animal diversity. The incised river canyons are lined with cliffs that tower more than 1,000 feet above the Gila River and Bonita Creek.	High
Developed Areas	The small communities with within the Gila River Valley, comprised of low to moderately dense development, make up the majority of this VAU. The communities each have their own unique history and aesthetics, but are largely similar in character, as they share common roots in the agricultural and mining history of the region.	Moderate
Agriculture	Agriculture fields occupy the river's bottomlands and allow for unobstructed views across the flat terrain. The landscape is intact, but offers few unique or memorable characteristics.	Moderate
Natural Desert (Gila River Valley)	The general landscape is natural desert upland. The terrain is generally flat allowing for broad, open views. The landscape is intact, but offers few unique or memorable characteristics.	Moderate
Mining	Mining elements associated with the Dos Pobres and San Juan mines mining operations have introduced large scale landforms that are not intact or unified in line, color, and texture with the surrounding landscape.	Low

3.11.2.2 Viewer Exposure and Visual Sensitivity

Terrain shielding and viewing distance both affect a user's exposure to impacted views. Foreground views are more evident and attract greater attention than those in the background. To determine where the proposed project has the potential to be seen a visibility analysis was conducted (see **Figure 3.11-1**). For the purpose of this evaluation there were four distance zones defined.

1. Foreground (0 to 0.5 mile)
2. Middleground (0.5 mile to 5 miles)
3. Background (5 to 15 miles)
4. Seldom Seen (greater than 15 miles)

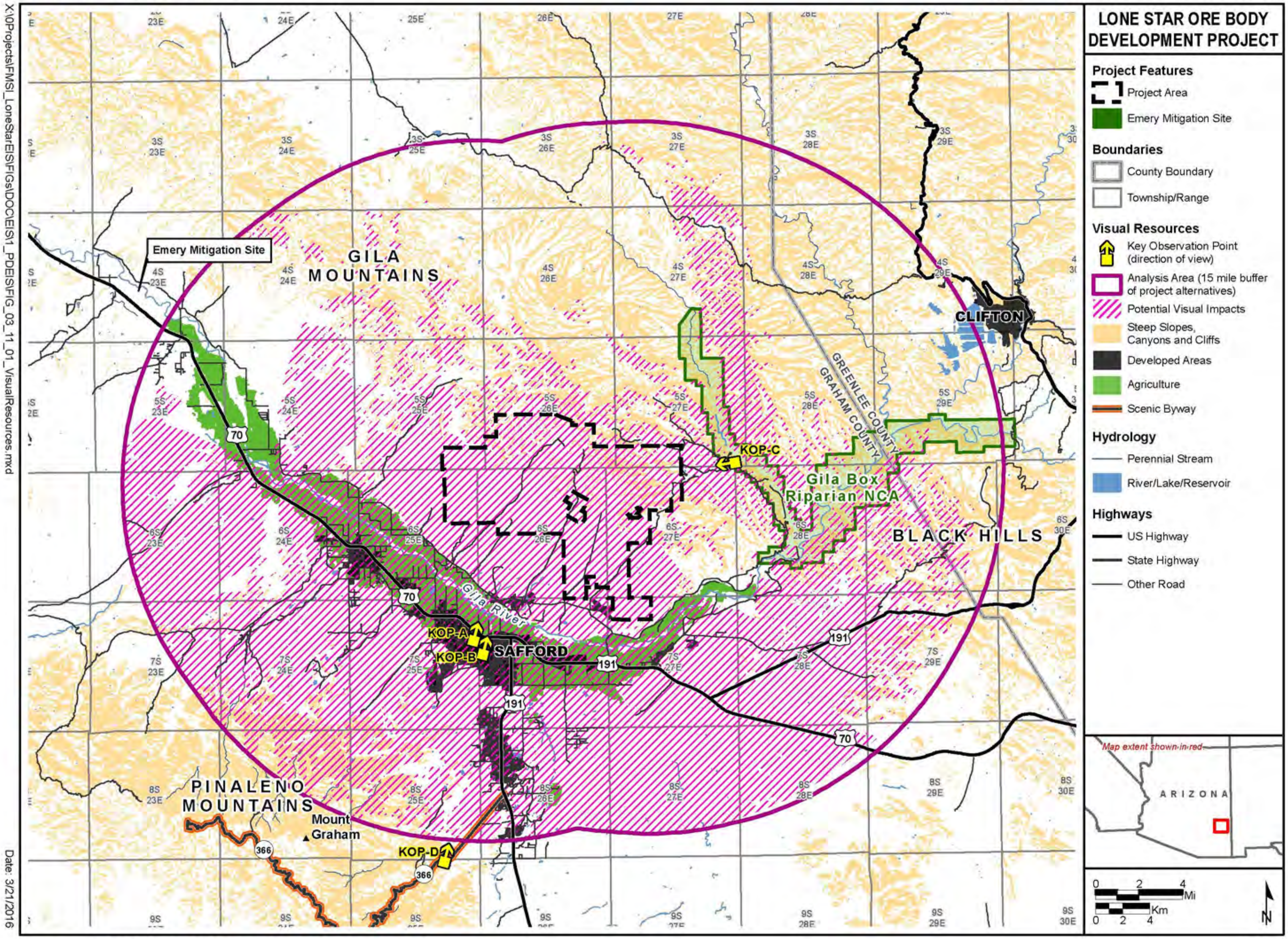


Figure 3.11-1 Visual Resources Analysis Area

Impacted viewers may have varying degrees of concern for changes in the landscape. Factors such as type and of viewer, volume, and duration can influence viewer sensitivity. For example, residential and recreational users would typically be more sensitive to landscapes changes than would commercial or industrial users. **Table 3.11-2** summarizes the viewer sensitivity within the analysis area.

Table 3.11-2 Viewer Sensitivity within the Analysis Area Based on Land Use

Viewer	Viewer Sensitivity
Residents	High
Gila Box RNCA	High
State Route 366 (Swift Trail Parkway)	High
Local parks and outdoor recreation areas	Moderate
Agriculture	Low
Commercial, industrial, and transportation land use (does not include designated scenic routes)	Low

The Gila River Valley, including the number of small communities, would have middle and background views of the proposed project. The Gila Mountains provide a visual shield to much of the northern portion of the analysis area, limiting views to the fore- and middleground. The Gila Box RNCA may have some views from the perimeter at the rim, but not from within the incised canyons along the river. The Project Area may be visible in the background from areas within the Pinaleno Mountains, including from scenic route State Route 366.

3.11.3 Environmental Consequences

3.11.3.1 Scoping Issues

The following issues related to impacts to visual resources were identified during scoping and will be addressed in the impact analysis.

- Concerns about visual impacts to the Gila Box RNCA and other nearby areas as a result of landform alterations. Comments indicated that a view of a flat plateau in between two mountains would not mitigate the impacts from mining to the maximum degree possible.
- Concern about mine lighting. Comments suggested minimizing lights to the degree needed only for human safety, using narrow spectrum bulbs as often as possible, and shielding or otherwise directing lighting so that light reaches only areas needing illumination.

In addition, comments were received that recommended the proposed project utilize the surface contouring techniques proposed at the Rosemont Mine as a way to mitigate visual impacts resulting from the development rock stockpiles.

3.11.3.2 Methods of Analysis and Impact Indicators

KOPs were identified to represent typical views of the Project Area and views of highly sensitive viewers (**Figure 3.11-1**). Photo simulations were used to visualize the anticipated proposed conditions at KOPs A, B, and C. Impacts were then determined by comparing the existing visual quality of a landscape, viewer sensitivity, and anticipated contrast between existing and proposed conditions. The following KOPs were evaluated.

- **KOP A** is a representative view from the City of Safford. Located at the back of a commercial area, it affords unbroken views of the Project Area from the city.

- **KOP B** is a representative view from the City of Safford. Located in the stands of the Safford High School football stadium, it affords a view to the west slope of the Gila Mountains and the Project Area.
- **KOP C** is located within the Gila Box RNCA. It is on the rim of the Bonita Creek drainage and at the intersection of three unpaved roads. This KOP allows an unbroken view of the east slopes of the Gila Mountains.
- **KOP D** is located at a scenic pull-out along State Route 366 Swift Trail Parkway. The pull-out is located within the Safford District of Coronado National Forest and affords an expansive view to the northeast, incorporating the City of Safford, the Project Area and the Gila Mountains. Although the location is slightly beyond the analysis area boundary, the volume and duration of views would represent impacts to the scenic byway.

The following visual contract levels were established to facilitate the evaluation of impacts.

- **Not Noticeable:** Changes in the landscape scenery or views that would not be evident unless pointed out due to such factors as previous disturbance, distance, terrain, and vegetation screening, dominance of adjacent landscape features, and background terrain. Changes are typically viewed in the background and are unobstructed. However, it may include middleground views that are partially screened or foreground views that are completely screened.
- **Noticeable:** Changes in the landscape scenery or views that would be evident but visually subordinate to the setting. These changes may attract slight attention, but do not compete with adjacent landscape scenery or views. Changes are typically viewed in the middleground or background and are obstructed.
- **Co-dominant:** Changes in the landscape scenery or views that attract attention and begin to compete with adjacent landscape or scenery or views. Changes are typically viewed in the middleground and are unobstructed or partially screened in the foreground.
- **Dominant:** Changes in the landscape scenery or views that become the focal point or most significant (dominant) feature in the setting. Changes are typically viewed in the foreground and are unobstructed. In extreme cases often cause a lasting impression when viewed in the landscape.

3.11.3.3 Assumptions for Analysis

The visibility of the proposed project was determined using a USGS Digital Elevation Model, which does not account for existing vegetation or structures. The results could indicate greater visibility than would actually occur because views could be affected by visual obstructions in the immediate foreground such as local topography and vegetation.

Surface contouring has not been considered at this time, but would be addressed during the development of the mine reclamation plan.

3.11.4 Environmental Consequences

3.11.4.1 Alternative 1, Proposed Action

Alternative 1 would introduce elements that would result in permanent modifications to the landscape, similar to those from previous mining operations in the Project Area. Impacts to visual resources would be long-term and visible beyond the Project Area. The most prominent would be the heap leach pad, which would appear like a flat topographical feature, and three development rock stockpiles with an overall footprint of approximately 2,600 acres. Mining of the Lone Star ore body would result in the alteration of a portion of the Gila Mountain ridgeline. The existing riparian habitat at the Emery Site would be enhanced, but would be consistent with the visual character and quality of the area.

KOP A

Visual impacts would be generally consistent with the forms, lines, textures, and colors of ongoing mine operations. By the end of the proposed project, a new heap leach pad, new development rock stockpiles, new haul roads and the upper western cut of the new pit would be visible on the terraces above the Gila River and across the slopes and ridgelines of the Gila Mountains (**Figures 3.11-2** and **3.11-3**). Of these, the new heap leach pad would be the most noticeable from this location due to its size and proximity to the viewer. The southeast corner of the pad would stand approximately 400 feet above current grade and the southeast face of the pad would extend approximately 8,000 linear feet to the northwest when fully constructed. Both the pad at the western end of the Project Area and the development rock stockpiles at the eastern end would appear similar to, though larger than, existing mine features. They would exhibit long horizontal tops and shorter diagonal side slopes. These side slopes would appear geometric and finely textured, with blue-to-purplish or brownish-reddish tints depending on the lighting and time of day, similar to existing mine works. On the eastern side of the Project Area, the skyline of the Gila Mountains would change over time. During the first 3 years of the proposed project, overburden would be removed to expose the ore body. As overburden is removed, a section of the ridgeline would be lowered, and portions of the upper slopes of the new development rock stockpiles would be silhouetted against the sky. As the ore body is developed, the resulting pit would remain invisible from this KOP; the upper western cut would be visible as a steep brownish-reddish slope. The cut and fill slopes associated with the new haul roads would be visible and would appear as brownish-reddish diagonal and horizontal lines across the face and lower slopes of the mountains.

KOP A is located within a well-lit urban area; therefore, no noticeable changes from current conditions are anticipated with respect to nighttime lighting. At the outset of the removal of overburden, lights associated with the excavation or drill equipment and mobile site lighting may be faintly discerned, depending on their locations in the Gila Mountains. At this distance, haul truck headlights would not be readily distinguished. New lighting associated with the new heap leach pad would be installed similar to that associated with the existing pad. No appreciable changes from current conditions are anticipated with respect to the perception of nighttime lighting on the heap leach pad.

***Viewer Sensitivity*:** Moderate – KOP A is representative of views from Safford

***Daytime Contrast Rating*:** Co-dominant

***Nighttime Contrast Rating*:** Not Noticeable

KOP B

Visual impacts resulting from the proposed project would be similar to those described in KOP A. From this more westerly location, the new heap leach pad would not appear as prominent as it would from KOP A (**Figures 3.11-4** and **3.11-5**). Changes to the view from this location would be generally consistent with the forms, lines, textures and colors that are associated with the existing Safford Mine Facility.

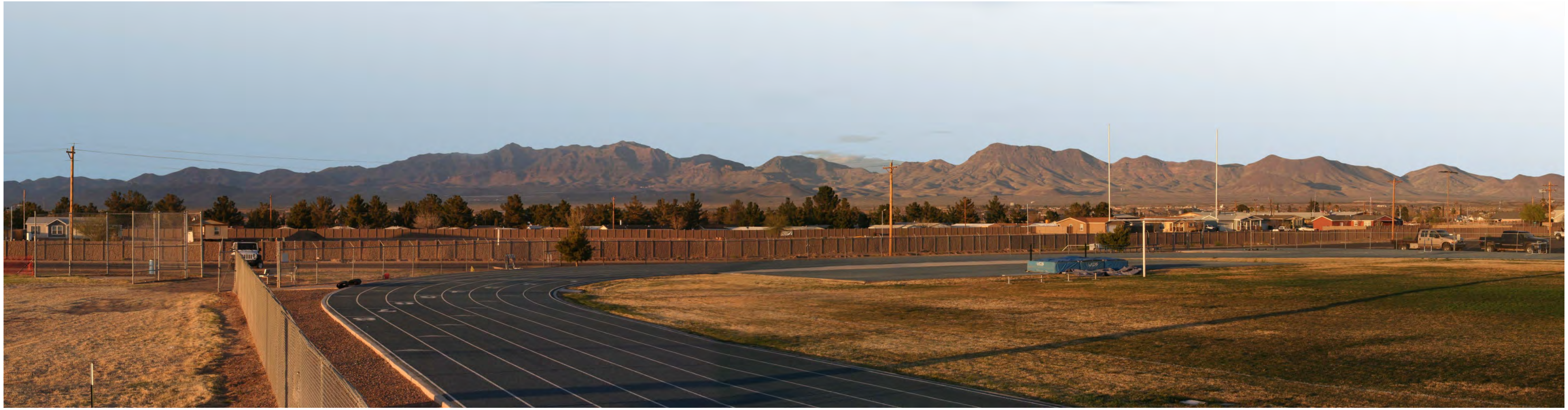
***Viewer Sensitivity*:** Moderate – KOP B is representative of views from Safford

***Daytime Contrast Rating*:** Co-dominant

***Nighttime Contrast Rating*:** Not Noticeable

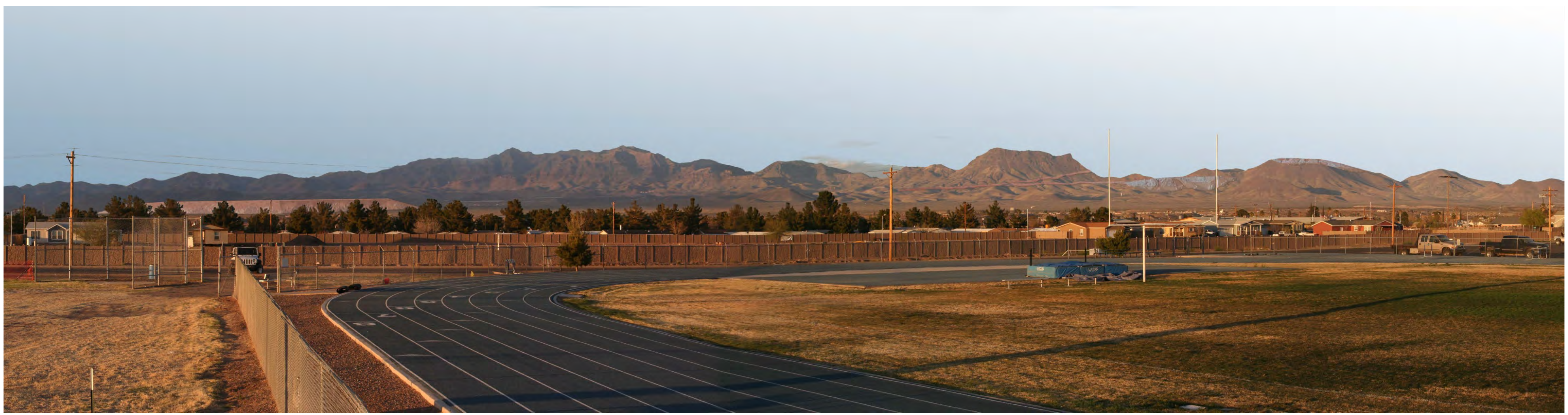
Figure 3.11-2 View of Existing Safford Mine Facility from KOP A Source: WestLand 2014a.

Figure 3.11-3 Visual Simulation of Proposed Project from KOP A Source: WestLand 2014a.



Source: WestLand 2014a.

Figure 3.11-4 View of Existing Safford Mine Facility from KOP B



Source: WestLand 2014a.

Figure 3.11-5 Visual Simulation of Proposed Project from KOP B

KOP C

Visual impacts from the new development rock stockpiles would be mostly from views on the northeastern slopes of the mountains (**Figures 3.11-6** and **3.11-7**). These stockpiles would differ in form, line, texture and color from the existing landscape. The tallest mesa-like top of these stockpiles would be approximately 1,000 feet in height relative to the existing grade. From this KOP, the stockpiles would appear to extend approximately 6,500 linear feet from south to north. They would be silhouetted against the sky. At the outset of overburden removal, nighttime equipment lights associated with excavation or drill equipment and mobile site lighting may be faintly discerned, depending on their locations within the Gila Mountains relative to this KOP. Mobile site lighting installed at active dump locations associated with the development rock stockpiles would be faintly visible from this KOP, depending on the location of the dump. Haul truck headlights also may be occasionally visible. No visual impacts are anticipated for views from the day-use area adjacent to Bonita Creek.

Viewer Sensitivity: High

Daytime Contrast Rating: Co-dominant

Nighttime Contrast Rating: Noticeable

KOP D

Visual impacts resulting from the proposed project would be consistent in form, line, texture, and color of ongoing mine operations. The proposed project would contribute a relatively small addition to this existing development (**Figure 3.11-8**). The most noticeable visual change would be caused by the heap leach pad due to its light color and overall size. This KOP also would likely afford a greater view of the new pit and surrounding development rock stockpiles compared to views from the other KOPs located at lower elevations.

At the outset of overburden removal, nighttime equipment lights associated with excavation or drill equipment and mobile site lighting may be faintly discerned, depending on their locations within the Gila Mountains relative to this KOP. Mobile site lighting installed at active dump locations associated with the development rock stockpiles would be faintly visible from this KOP, depending on the location of the dump.

Viewer Sensitivity: High

Daytime Contrast Rating: Noticeable

Nighttime Contrast Rating: Not Noticeable

Impacts to Visual resources from Alternative 1 are summarized in **Table 3.11-3**.

Table 3.11-3 Summary of Visual Impacts

KOP	VAU	Visual Quality	Viewer Sensitivity	Contrast Rating	Summary
KOP A	Developed Areas	Moderate	Moderate	Daytime: Co-dominant Nighttime: Not Noticeable	The heap leach pad, development rock stockpiles, haul roads and alternations to ridgelines would be visible. Of these the Heap leach pad would be the most prominent. Located in well-lit urban area, KOP A would not notice any changes in nighttime lighting.
KOP B	Developed Areas	Moderate	Moderate	Daytime: Co-dominant Nighttime: Not Noticeable	Impacts would be similar to those of KOP A, except the heap leach pad would appear less prominent.
KOP C	Gila Box RNCA	High	High	Daytime: Co-dominant Nighttime: Not Noticeable	KOP C would have unobstructed middleground views of the development rock stockpiles and altered ridgelines. Mobile site lighting at active dump locations associated with the stockpiles would be faintly visible depending on the location of the dump. Haul truck headlights also may be visible at times. Impacted views from the Gila Box RNCA would be limited to the rims. The proposed project would not been visible within the canyons, near Bonita Creek and Gila River.
KOP D	Mountains (State Route 366 Swift Trail Parkway)	High	High	Daytime: Noticeable Nighttime: Not Noticeable	The proposed project would be visible in the background from the Pinaleno Mountains. The most noticeable visual change would be the heap leach pad due to its overall color and size. Nighttime light may be faintly discernable.

Source: WestLand 2014a.

Figure 3.11-6 View of Existing Safford Mine Facility from KOP C

Source: WestLand 2014a.

Figure 3.11-7 Visual Simulation of Proposed Project from KOP C

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Source: WestLand 2014a.

Figure 3.11-8 View of Existing Safford Mine Facility from KOP D

3.11.4.2 Alternative 2

Alternative 2 would utilize all of the same project components as Alternative 1, except the heap leach pad would be rotated making only minor changes to its visibility. Alternative 2 would have similar impacts to visual resources as Alternative 1. KOPSs A, B, and D would have similar unobstructed views of the modified heap leach pad.

3.11.4.3 No Action Alternative

Under the No Action Alternative, the Project Area would remain in its current state, and the visual resources would not be affected or significantly altered. Active mining of the Dos Pobres Pit and the San Juan Pit would continue for several more years with both the associated heap leach pad and the development rock expected to expand in size accordingly. The western half (Phase II) of the existing heap leach pad will continue to expand vertically, until it matches the ultimate height of the eastern half (Phase I).

3.11.4.4 Potential Mitigation Measures

No mitigation measures beyond those proposed by FMSI for visual and aesthetic resources are necessary to minimize adverse impacts.

3.11.4.5 Cumulative Impacts

The CESA for aesthetics and visual resources is any location where the proposed project would be visible within the analysis area (**Figure 3.11-1**). The impacts to visual resource from the project are primarily a result of substantial changes to the topography of the landscape and project lighting. Similar impacts within the CESA have resulted from the Dos Pobres and San Juan mines. Development of the project would add additional impacts to already impacted views where the Dos Pobres and San Juan facilities are currently visible.

Existing projects in combination with the proposed project would increase changes in the visible landscape. Lighting associated with the proposed project would not necessarily be more visible, but perhaps move to a different location after the Dos Pobres and San Juan mines are closed. Increased lighting may be visible in the short term, while the Dos Pobres and San Juan mines overlap with the project, but over the longer term the visible mine lighting would move to the vicinity of the project.

3.11.4.6 Residual Adverse Effects

The proposed project would permanently alter the visual landscape. The heap leach pad and development rock stockpiles would remain in place and continue to be visible after closure and reclamation of the Lone Star Pit. During reclamation the top surfaces and side slopes of the development rock stockpiles would be revegetated, reducing the contrast in color and texture with the surrounding landscape. The topological changes resulting from the proposed project would be permanent.

3.12 Transportation

3.12.1 Affected Environment

3.12.1.1 Analysis Area

The transportation analysis area includes the Project Area as well as the primary regional access roads and transportation features such as 8th Avenue, Reay Lane, Safford Bryce Road, Airport Road, Main Street, Sanchez Road, Norton Road, US-70, and US-191. Additional transportation features are the Arizona Eastern Railway (AZER) and the Safford Regional Airport. The CESA for transportation is the same as the analysis area. **Figure 3.12-1** illustrates Project Area as well as the primary regional access roads and transportation features which make-up the analysis area and CESA for Transportation.

3.12.1.2 Regional Transportation Network Overview

The analysis area is served by a network of roadways which includes municipal and county roads as well as U.S. highways. US-191 begins well south of the Project Area near Mexico and heads north, transecting I-10 before intersecting US-70 in the City of Safford. The two-lane highway connects with US-70 in Safford. US-191 has been designated a Scenic Byway from Morenci and Eagar, northeast of the analysis area (MyScenicDrives 2015). US-70 transects the analysis area in a northwest-southeast direction. US-70 is a four-lane highway with median turn-lanes between the municipalities of Pima and Safford. Northwest of Pima and southeast of Safford the highway narrows to two lanes. Reay Lane is a paved two-lane road heading north from the town of Thatcher and over the Gila River before connecting with Safford Bryce Road. 8th Avenue is a paved four-lane road heading north from the City of Safford and over the Gila River before connecting with Safford Bryce Road. Safford Bryce Road is a two-lane road which roughly parallels the Gila River to the south. Safford Bryce Road is the main thoroughfare to Freeport-McMoRan Mine Road, the main entrance to the mine. Freeport-McMoRan Mine Road is a two-lane paved road.

The AZER 'Sunset Route' mostly parallels US-70 through the analysis area, transecting the southern half of Arizona. The top five commodities shipped on the Sunset Route in 2014 by volume were metallic minerals, intermodal wholesale, non-ferrous metals, cement and miscellaneous minerals, and wheat (Union Pacific 2015). The Safford Regional Airport, adjacent southeast to the mine site, is owned by the City of Safford and consists of two paved runways with asphalt surface condition rated by the Federal Aviation Administration (FAA) as 'good' (FAA 2015).

3.12.1.3 FMSI Mine Access and Highway Volume

Freeport-McMoRan Road is a two-lane paved road and the main access point to the mine, running northeast from Safford Bryce Road. FMSI employee and operations traffic arrive from the south via US-191, from the east and west via US-70. Trucks coming from the south on US-191 or from the east on US-70 typically cross the Gila River at the 8th Avenue Bridge on North 8th Avenue originating in Safford, and then access the Safford Operations via Freeport-McMoRan Road. The 8th Avenue Bridge is four lanes, approximately 1,250 feet in length, and was reconstructed around 2000 (Graham County 2015). Trucks arriving to the Safford Operations from the west cross the Gila River at the Reay Lane bridge on Reay Lane in the Town of Thatcher and enter the mine site via Freeport-McMoRan Road as well. The Reay Lane bridge is a two-lane bridge approximately 900 feet in length and was reconstructed around 1998 (Graham County 2015). Both 8th Avenue and Reay Lane eventually connect with Safford Bryce Road shortly after crossing the Gila River.

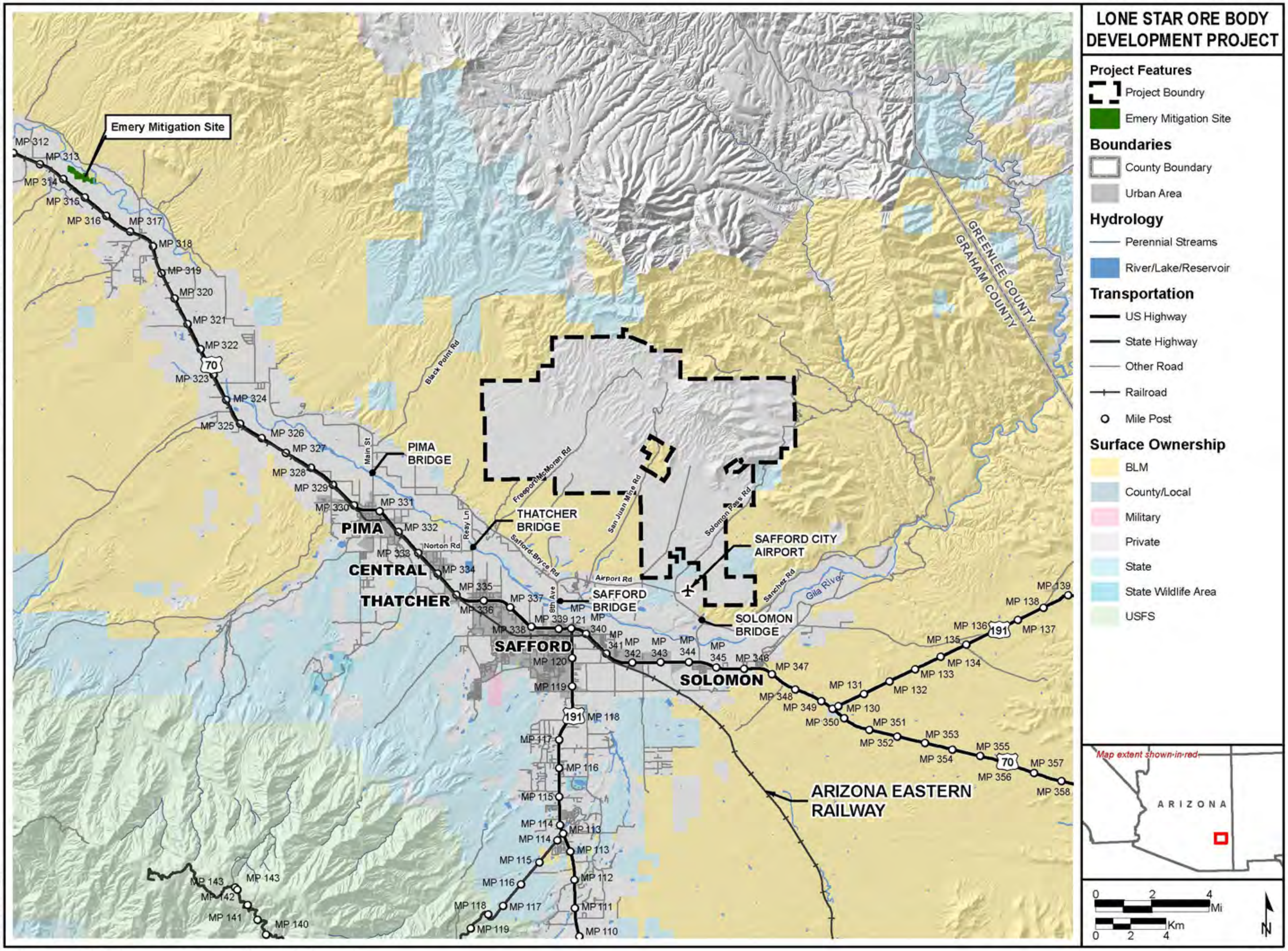

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Figure 3.12-1 Transportation Network

Solomon Pass Road provides public access through portions of the extreme southeastern and eastern portions of the Project Area to Bonita Creek and the Gila Box RNCA. Solomon Pass Road is paved for approximately 3 miles from its intersection with Airport Road, after which it becomes a dirt surface. All other roads into the analysis area are barred by gates and do not provide public access. Perimeter fencing and signage are located in areas where inadvertent access may be an issue. There is limited access to portions of the analysis area outside of active operations that is provided to ranchers who graze livestock at the discretion of FMSI (FMSI 2015a).

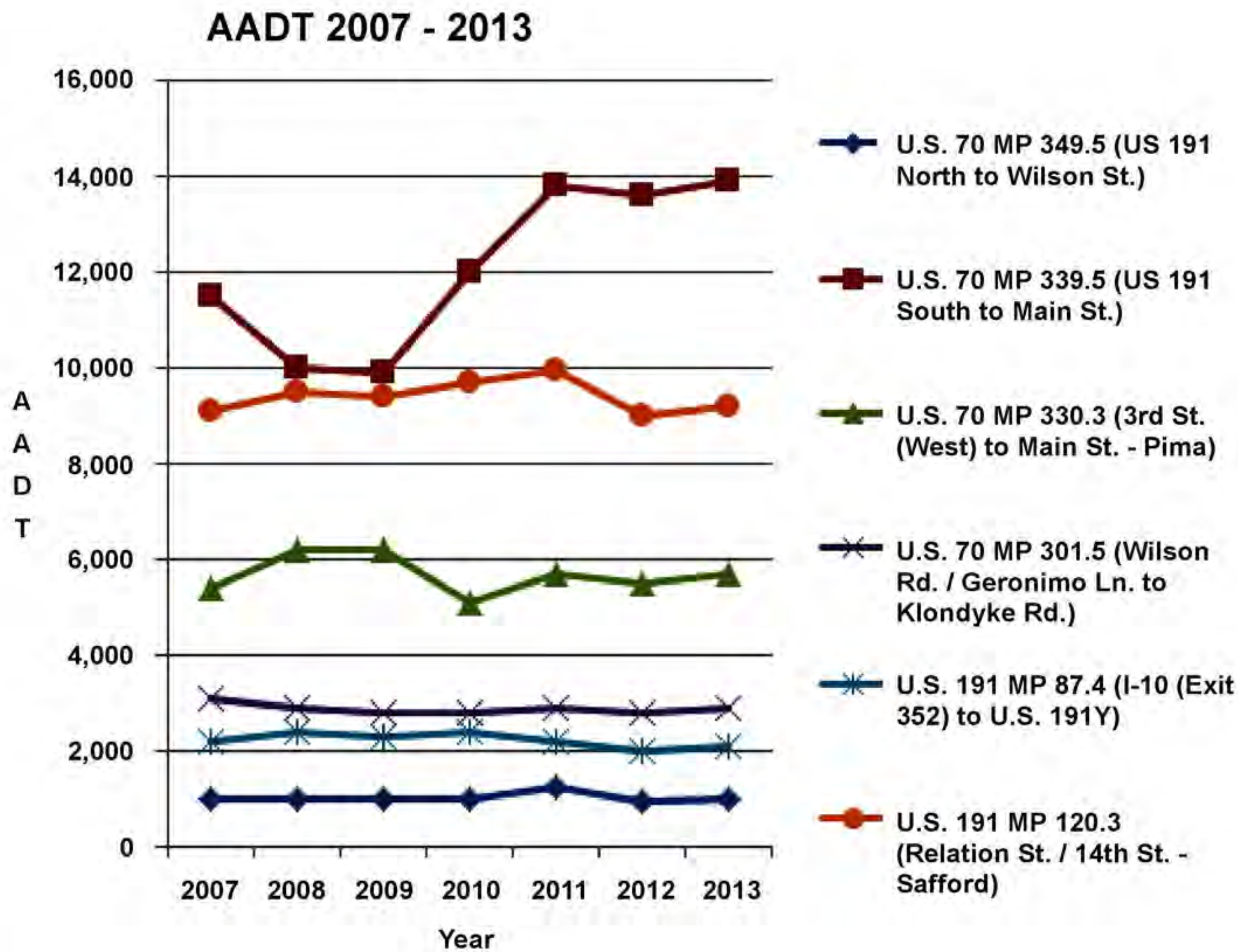
Traffic volumes on U.S. highways within the analysis area are detailed in **Table 3.12-1** and **Figure 3.12-2** for 2007 to 2013. Traffic volume on segments of US-70 and US-191 during this timeframe ranged from static to slightly increasing. The notable exceptions were US-70 within and southeast of the City of Safford. US-70 had a 21 percent increase in traffic volume between 2007 and 2013 within Safford city limits. This segment of highway also recorded the highest traffic volumes. In contrast, the segment of US-70 southeast of city limits experienced a 3 percent decline in all vehicle traffic during this same period. The remaining highway segments in **Table 3.12-1** recorded modest volume increases. As of 2013, truck traffic made up 16 percent of total vehicular traffic on US-70 southeast of Safford. On US-191 north of the I-10 exit total truck traffic made up 40 percent of all vehicular traffic.

Table 3.12-1 Highway Traffic within the Analysis Area (Average Annual Daily Traffic)

Location	Year 2007		Year 2010		Year 2013		Percent Change All Vehicles 2010-2013	Percent Change All Vehicles 2001-2010
	All Vehicles	All Trucks	All Vehicles	All Trucks	All Vehicles	All Trucks		
US-70 MP 349.5 (US-191 North to Wilson St)	1,000	NA	1,000	25	972	153	-3	-3
US-70 MP 339.5 (US-191 South to Main St)	11,500	NA	12,000	300	13,885	306	16	21
US-70 MP 330.3 (3RD St to Main St - Pima)	5,400	NA	5,100	128	5,674	365	11	5
US-70 MP 301.5 (Wilson Rd/Geronimo Ln to Klondyke Rd)	3,100	NA	2,800	73	2,878	162	3	7
US-191 MP 87.4 (I-10 (Exit 352) to U.S. 191Y)	2,200	NA	2,400	91	2,088	842	13	5
US-191 MP 120.3 (Relation St/14th St – Safford)	9,100	NA	9,700	369	9,201	194	5	1

Source: ADOT 2014.

LONE STAR ORE BODY DEVELOPMENT PROJECT



Source: ADOT 2014

Figure 3.12-2 Highway Traffic within the Analysis Area (Average Annual Daily Traffic)

Level of Service (LOS) describes how well a roadway operates under prevailing traffic conditions. The LOS rating scale uses ratings LOS A through LOS F where a rating of LOS A indicates free-flowing traffic, whereas LOS F indicates forced flow and extreme congestion. In communities with a population below 50,000, LOS C is the level used as the planning and design tool (WestLand 2015e). All of the communities within the analysis have populations under 50,000. All local roads detailed in the analysis area are operating at LOS A or B (WestLand 2015e).

FMSI currently has approximately 686 employees and 100 contractors working at the Safford Mine Facility. Based on records of vehicle traffic passing through the main gate of the Safford Mine Facility, there are approximately 605 employee vehicle daily round trips and 88 truck round trips, for a total of 693 vehicle daily round trips (WestLand 2015e).

3.12.2 Environmental Consequences

3.12.2.1 Scoping Issues

Relevant issues and concerns raised during public scoping are listed below.

- Minimizing construction-related trips of workers and equipment, including trucks and heavy equipment.

3.12.3 Method of Analysis and Impact Indicators

Impacts to transportation were determined by evaluating how the proposed project would affect current transportation conditions, including LOS, in the Project Area and the region.

3.12.3.1 Assumptions for Analysis

Assumptions for analysis area as follows:

- Project-related construction vehicle traffic would temporarily affect traffic on local roads within the analysis area.
- To determine project-induced daily trips the evaluation considers the total number of direct employees. Included in this total are a number of shift employees that may not work every day. Actual daily trips may be lower.

3.12.3.2 Alternative 1, Proposed Action

Access to the Safford Mine Facility will not change during the proposed construction and operation of Lone Star Project. As access remains the same, the potential to affect transportation components in the Safford area remains the same. The nature, timing, and magnitude of these impacts are divisible into two distinct phases: a construction, or on-peak phase, and an operations only, or off-peak, phase. Construction of the leach pad and other mine features requires more employees and contractors than the projected normal operations. Vehicles such as concrete and service trucks would be on local roads in addition to the daily commuter traffic by employees. The timing of the construction creates peaks in both the number of employees and contractors travelling to and from the Safford Mine.

During the initial construction phase, there is an anticipated peak in employment of both direct employees and contractors working to construct the Lone Star Project while the existing Safford Facility continues normal operations. The highest peak of employment would occur in 2021 with 895 employees and 289 contractors. Current distribution of daily mine traffic is 693 vehicle round trips, including 88 daily truck round trips. The proposed project would contribute 279 additional daily vehicle round trips, including 12 daily truck round trips (WestLand 2015e). Although the peak in 2021 is the highest, similar peaks would occur in 2024 and 2032. Anticipated daily round trips would be expected to be similar during these peaks. The majority of construction traffic is expected to access the Project Area via 8th

Avenue, followed by Reay Lane, Sanchez Road, and lastly, Main Street. These roads are depicted in **Figure 3.12-1**. Access roads that experience the least amount of existing traffic, such as Main Street and Sanchez Road, would notice the increase in construction related traffic to a greater degree. The percent traffic increase to those roads would be modest, around 7 percent on each road, and existing traffic levels are low, between 450 and 460 vehicles a day, resulting in an increase that would be within road capacity.

During the Lone Star operations-only phase traffic would consist of 865 daily vehicle round trips, including 88 daily truck round trips. This is 172 daily round trips higher than with current operations (WestLand 2015e). As during construction, the increase in operations traffic would be experienced the most on 8th Avenue, followed by Reay Lane, Sanchez Road, and Main Street. Each of these roads would experience a traffic increase of approximately 58 percent; however, with relatively low levels of existing traffic, the project-induced increase would be within the capacity of these roads. The expected increase would not exceed the capacity of the transportation network. The roads would continue to operate at an acceptable level of performance (LOS C or better).

3.12.3.3 Alternative 2

Impacts under this alternative would be similar to those of the Proposed Action. Although increased stormwater run-off into Watson Wash from the diversion above the leach pad would result in substantially higher stormwater flows than are experienced currently, it is not anticipated to affect the integrity of Safford Bryce Road at Watson Wash. This is because roads downstream of the Project Area were constructed based on pre-mining condition (pre-2006). While Alternative 2 increases flows from the current condition, its resulting peak flows closely return to the pre-mining, original natural condition. Additional detail regarding increased Watson Wash flows is found in Section 3.2.

3.12.3.4 No Action Alternative

Under the No Action Alternative, none of the proposed mine construction, operations, reclamation, or committed compensatory mitigation activities would occur and mining activities would cease within 5 years. This would result in a decrease in traffic levels on the regional road network as mining related traffic would decrease and ultimately end within 5 years.

3.12.3.5 Potential Mitigation Measures

No mitigation measures beyond those proposed by FMSI are necessary to minimize adverse effects to transportation resources.

3.12.3.6 Cumulative Impacts

The CESA for transportation is the same as the analysis area, described in Section 3.12.1.1. The Proposed Action would incrementally add to the regional traffic levels during construction and then again during peak construction years. This increase in project traffic levels in addition local municipal traffic and traffic associated with the Morenci Mine is expected to be within the capacity of the local road network and add slightly to existing traffic levels.

3.12.3.7 Residual Adverse Effects

No residual adverse effects are anticipated to transportation resources.

3.13 Noise and Vibration

3.13.1 Affected Environment

There are many factors which determine how well and how far noise and vibration move from a certain source, such as FMSI mining activities. Topography is a factor, especially when ground rises between a noise and vibration source and receptor. Atmospheric conditions are another contributing factor, specifically humidity, and how sound is absorbed by the air. Ground cover, which includes shrubs and trees, is another contributing factor to noise and vibration propagation as are meteorological features such as air turbulence.

3.13.1.1 Analysis Area

The analysis area for noise and vibration includes the Project Area and the nearest sensitive receptors or land uses within approximately 6 to 10 miles from the Project Area. The Project Area and nearest sensitive receptors and land uses are portrayed in **Figure 3.13-1**. The analysis area is designed to include all potential noise and vibration impacts of the project.

3.13.1.2 Regulatory Guidance

Federal regulations on the use of explosives provide the noise and vibration regulatory environment for the proposed project (30 CFR 816/817.67). The regulation provides ground-borne vibration thresholds in peak particle velocity values and airblast limits, set in linear decibels (dBL). The dBL measures the loudness of all frequencies with the same sensitivity. The dBL is used because portions of a given blast event's sound pressure levels are at or below frequencies (e.g., Hertz [Hz]) that are audible to the human ear so, unlike dBA, this measurement does not weight decibels to emphasize human sound perception (Tetra Tech 2014). Linear decibels are still a logarithmic scale, as are decibels, but dBL are only linear in terms of frequency response. **Table 3.13-1** shows allowable ground-borne vibration levels for sensitive receptors at certain distances. Sensitive locations include any dwelling, public building, school, church, community, or institution outside the permit area. Allowable airblasts are limited to 129 dBL at frequencies of 6 Hz or lower and 133 dBL at frequencies of 2 Hz or lower.

Table 3.13-1 Ground-borne Vibration Thresholds

Allowable ground-borne Vibration Levels	Distance
1.25 (in/sec) PPV	0 to 300 feet
1.00 (in/sec) PPV	301 to 5,000 feet
0.75 (in/sec) PPV	5,001 < feet

Source: 30 CFR 817.67(d)(2).

There are no statewide noise and vibration regulations that are applicable to the proposed project, and there are no local vibration or airblast regulations applicable to the proposed project (Tetra Tech 2014).

3.13.1.3 Baseline Assessment

Baseline noise at the mine site is consistent with typical mining activities, such as noise produced from blasting, heavy machinery, and haul trucks. Typical noise at sensitive receptors in the analysis area generally consists of periodic roadway traffic, insects, and noise associated with mineral processing actviities. Similar to noise, vibration was also produced from blasting, heavy machinery, and haul trucks.

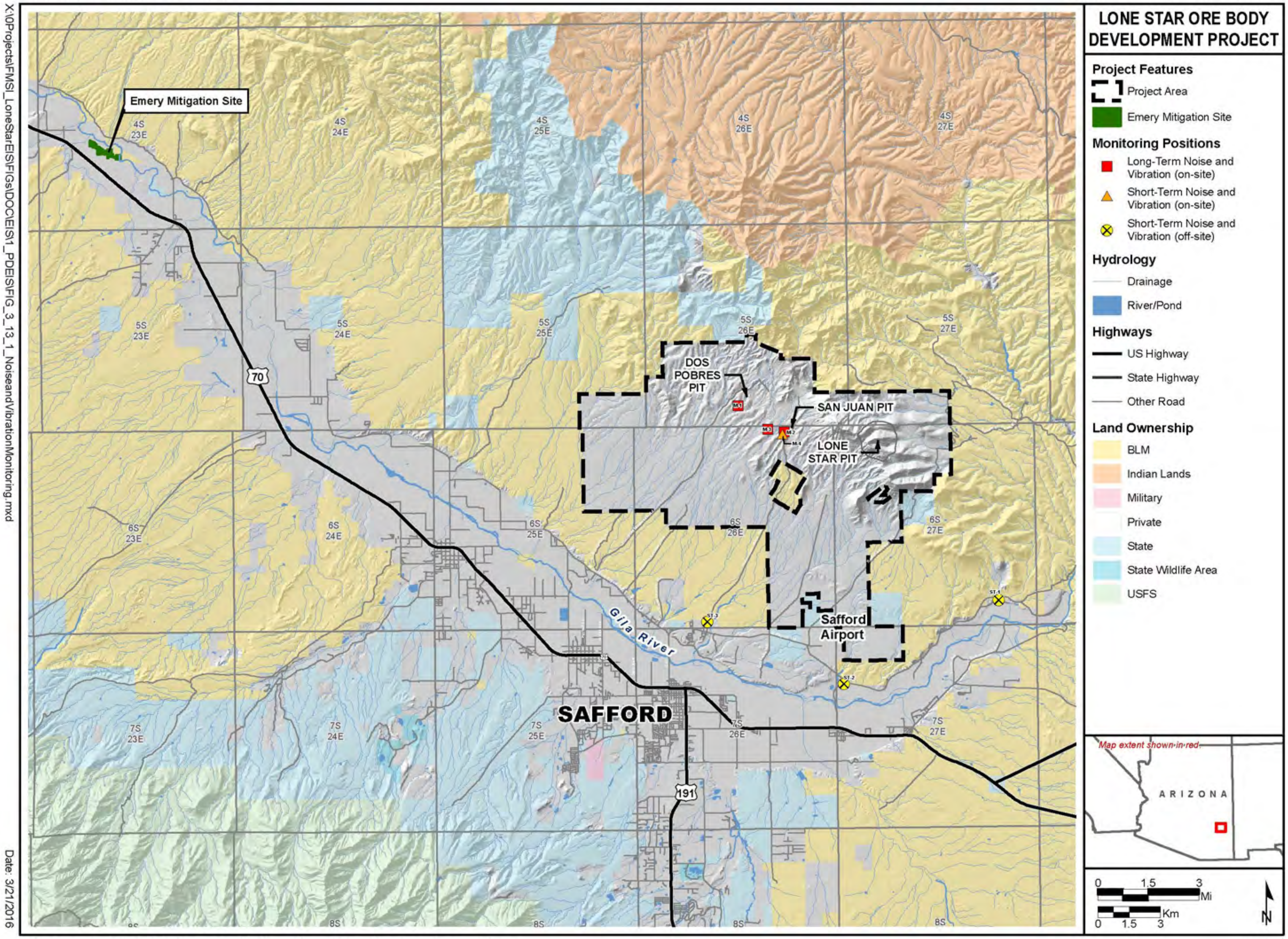


Figure 3.13-1 Noise and Vibration Monitoring Locations

To determine current conditions, monitoring of airblast, noise, and ground vibration at key receptor locations was performed from October 22, 2014 to November 6, 2014, during blasting events at the active pits (Tetra Tech 2014). Monitoring locations are shown on **Figure 3.13-1**. Sensitive receptors closest to the proposed blasting at Lone Star are represented by the short-term (ST) off-site monitoring locations.

<u>Monitor 1</u>

Monitor (M)-1 is located along the southwest edge of the Dos Pobres Pit between the haul road and along the edge of the highwall. Twenty-four-hour ambient noise monitoring, vibration, and airblast monitoring was completed at M-1. Observed sound sources included haul road traffic, heavy machinery, and ore processing (conveyor, rock crushing, etc.). Although there is a rock berm lining the road, the haul trucks are at least twice as tall as the berm and sound from the passing trucks is only partially shielded. The processing area is located approximately 1,600 feet south, with the conveyor and other equipment within line of site to M-1. M-1 is approximately 8,300 feet from the nearest highwall of the San Juan Pit. No blast event occurred during the 24-hour measurement.

<u>Monitor 2</u>

M-2 is located along a ridge overlooking the San Juan Pit from the south and approximately 700 feet from the edge of the pit's highwall to the north. The haul road accessing the pit follows a relatively steep descent between M-2 and edge of the highwall, with the lower portion of the haul road where it meets the base of the pit located approximately 800 feet away. Twenty-four-hour ambient noise monitoring, vibration, and airblast monitoring was completed at M-2. Line of sight to the haul trucks and M-2 is shielded where the haul road hugs the edge of the highwall, which provides some acoustic shielding from truck noise. Heavy equipment and haul trucks were audible from M-2 where the shovel is loading haul trucks. Additionally, blasting noise was observed near the pit. M-2 is approximately 5,800 feet from the nearest highwall of the Dos Pobres Pit.

<u>Monitor 3</u>

M-3 is located along a ridge approximately 3,400 feet southwest of the San Juan Pit and 3,800 southeast of the Dos Pobres Pit. A haul road is located approximately 1,350 feet north of M-3 and the processing center is located approximately 3,200 feet west. Long-term (10 days) ambient noise monitoring as well as vibration and airblast monitoring were completed at M-3. Acoustic shielding from haul truck noise to M-3 was provided by the surrounding terrain and ground cover. Heavy equipment and haul trucks were audible from M-3, although less than at M-1 and M-2.

<u>Monitor 4</u>

M-4 is located along the same ridge as M-2 but approximately 400 feet further southwest of the San Juan Pit. Observed sound sources were the same at M-4 as at M-2. M-4 was deployed for a short duration (2 hours) to collect blast event data on October 23, 2014, at the San Juan Pit.

<u>Short-Term 1</u>

ST-1 is located near a group of residences along Sanchez Road approximately 6 miles southeast of the Project Area, 10 miles southeast of the San Juan Pit, and across from the FMSI Technology Center. Noise and vibration measurements were conducted during daytime blasting and noise monitoring was conducted at nighttime. FMSI does not blast at night. The location is relatively quiet with observed sounds from the FMSI Technology Center and periodic roadway traffic on Sanchez Road. During the nighttime measurement, the sounds of mineral processing or other activities at the FMSI Technology Center were dominant; however, during the day the sounds from the Project Area were not as noticeable. Vibration monitoring during blasting was attempted at the site but because of the long set-back distance from the shot, the intervening topography and ground cover, and relatively small blast size, there was not sufficient ground vibration to trigger a waveform recording.

Short-Term 2

ST-2 is located near a group of residences along Sanchez Road approximately 7 miles south of the Project Area and 8 miles southeast of the San Juan Pit across from the intersection of Sanchez Road and Airport Road. Noise and vibration measurements were conducted during blasting at the mine during the daytime and ambient noise monitoring was conducted at night. The location is relatively quiet with the only observed sounds from roadway traffic at night. During the nighttime measurement, there were several loud heavy trucks (semi-tractor trailers) that influenced the measurements. These trucks appeared to be associated with activities in the area and are considered typical of the nighttime noise environment. Vibration monitoring during blasting was attempted at the site but due to the set-back distance from the shot, and intervening topography and ground cover, such as trees and shrubs, it was not of sufficient strength to record a waveform. Baseline vibration at ST-2 ranged from 0.006 PPV to 0.007 PPV when a vehicle passed by.

Short-Term 3

ST-3 is located near a group of residences along San Juan Mine Road 7 miles southwest of the Project and 6 miles south of the San Juan Pit. Noise and vibration measurements were conducted during blasting at the mine during the daytime and ambient noise monitoring was conducted at nighttime. Adjacent to the residential area is a gravel pit and loading area. During the day, the acoustic environment is dominated by the sound of rock processing, truck traffic, and heavy machinery audible at the gravel pit. At night, the gravel pit does not operate so the location is relatively quiet with the only observed sounds from roadway traffic. Vibration monitoring during blasting was attempted at the site but due to the set-back distance from the shot, and intervening topography and ground cover, such as trees and shrubs, it was not of sufficient strength to record a waveform. Existing vibration at ST-3 was recorded at 0.012 PPV and attributed to the activities at the nearby gravel pit.

Summary of Noise and Vibration Monitoring

Noise monitoring at the residences near Sanchez Road recorded periodic roadway traffic during the day and sounds associated with mineral processing during the evening hours. Noise associated with mineral processing lessened during the day. As a result of the long distances and intervening topography and ground cover, such as trees and shrubs, ground vibration was not sufficient enough to be recorded.

Noise monitoring at residences southeast of Safford Airport recorded only minimal roadway traffic and background insect activity. Nighttime noise measurements recorded several heavy trucks associated with typical nighttime activities in the area. As a result of long distances from the source and intervening topography and ground cover, such as trees and shrubs, ground vibration was not sufficient enough to be recorded.

Noise monitoring at the residences 6 miles south of the San Juan Pit recorded noise that was dominated by sounds associated with a nearby gravel pit. Nighttime noises observed were roadway traffic and background insect activity. As a result of long distances from the source and intervening topography and ground cover, such as trees and shrubs, ground vibration was not sufficient enough to be recorded. **Table 3.13-2** summarizes the results of the baseline noise survey.

Table 3.13-2 Baseline Noise Monitoring Results

Sound Levels (dBA)				
Monitoring Location	**L_{eq}(day)**	**L_{eq}(night)**	**L_{dn}**	**L_{90}**
M-1*	56	57	64	50
M-2	53	56	62	45
M-3	56	48	49	40
ST-1	56	45	56	32
ST-2	54	56	63	28
ST-3	42	53	60	30

Source: Tetra Tech 2014.

Ground Vibration and Airblast Levels during Blasting

Existing blasting vibration levels at sensitive receptors did not register on the vibration monitors above the baseline vibration levels, which were found to be approximately 0.006 PPV. Airblast levels of 121.8 dBL were recorded at a distance of approximately 3,100 feet from the San Juan Pit blast site. It is assumed that at the closest sensitive receptor, over 30,000 feet to the south, airblasts associated with current activities were negligible as a result of distance, topography, and intervening ground cover, such as trees and shrubs.

3.13.2 Environmental Consequences

3.13.2.1 Scoping Issues

Relevant issues and concerns raised during public scoping are listed below.

- Impacts to wildlife from noise
- General concern about the impacts of noise

3.13.2.2 Method of Analysis and Impact Indicators

Methods developed by the OSMRE were used to predict proposed ground vibration and airblast conditions (Rosenthal and Morlock 1987). The analysis assumes that the attenuation rates for the proposed project would be similar to what was monitored at the Dos Pobres and San Juan pits.

3.13.2.3 Assumptions for Analysis

Assumptions for analysis area as follows:

- Attenuation rates for the proposed project would be similar to what was monitored at Dos Pobres and San Juan pits.
- The blast on October 23, 2014, is being used as a “worst-case” and therefore reasonable to use for conservative predictive calculations.
- According to the OSMRE, annoyance is minimized where airblast levels are kept below 120 dBL and 0.08 PPV (Rosenthal and Morlock 1987). For the purpose of this analysis, 120 dBL and 0.08 PPV are utilized to evaluate the potential for human annoyance from the proposed project.
- Noise is primarily going to be generated from within the Project Area.

3.13.2.4 Alternative 1, Proposed Action

Noise associated with proposed project activities as well as vibration from blasting would occur within the Project Area under the Proposed Action. Noise would be generated from blasting and vehicle traffic. Blasting activities would center around the Lone Star Pit, southeast of existing operations at the Dos Pobres and San Juan pits.

Blasting at the Lone Star Pit would be similar to blasting activity associated with current operations that were monitored. Estimated noise and vibration levels at the nearest sensitive receptor, approximately 10 miles southeast of the San Juan Pit and 6 miles southeast of the location of future Lone Star operations, are estimated to be 86 dBL and 0.016 PPV. These levels are well below OSMRE limits for annoyance, assuming the larger maximum explosive charge weight of 2,000 pounds. Vibration and airblast predictions at sensitive receptors are detailed in **Table 3.13-3**.

Under Alternative 1, blasting would be similar to existing levels at Dos Pobres and San Juan pits. Vibration at the nearest receptor would be below human perceptibility and noise would be at least 30 dBL below the level of annoyance (120 dBL). Noise from traffic would be similar to existing levels.

Table 3.13-3 OSMRE Ground Vibration and Airblast Predictions

Location	Distance From Project	OSMRE PPV Annoyance Level	Estimated Ground Vibration PPV (in/sec.)	OSMRE dBL Annoyance Level	Estimated Airblast Noise dBL
One mile	1		0.109	NA	114
Two miles	2		0.051	NA	103
Three miles	3		0.032	NA	97
Four miles	4		0.023	NA	92
Administrative Building	5	0.08	0.017	NA	88
ST-1	6	0.08	0.016	120	86
ST-2	7	0.08	0.013	120	83
ST-3	7	0.08	0.013	120	83

Source: Tetra Tech 2014.

3.13.2.5 Alternative 2

Impacts under this alternative would be identical to those of the Proposed Action.

3.13.2.6 No Action Alternative

Under the No Action Alternative, none of the proposed mine construction, operations, reclamation, or committed compensatory mitigation activities would occur and mining activities would cease within 5 years. This would result in a decrease in noise and blasting levels as mining activities would decrease and ultimately end within 5 years.

3.13.2.7 Potential Mitigation Measures

No potential mitigation measures have been identified.

3.13.2.8 Cumulative Impacts

Mining operations associated with the Dos Pobres and San Juan mines would continue during the initial, pre-stripping period of the proposed project. Once the overburden is removed, and the Lone Star ore is mined, operations associated with Dos Pobres and San Juan mines would cease, eliminating the initial cumulative effect. At such time, cumulative impacts from noise and vibration would be the same as described for the Proposed Action.

3.13.2.9 Residual Adverse Effects

No residual adverse effects are anticipated.

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3.14 Hazardous Materials and Solid Waste

3.14.1 Affected Environment

The affected environment for hazardous materials and solid waste includes air, water, soil, and biological resources within the analysis area that could be affected by an accidental release of hazardous materials or solid wastes during transportation to or from the proposed Lone Star mine or during on site storage and use.

3.14.1.1 Hazardous Materials

Hazardous materials, which are defined in various ways under a number of regulatory programs, can represent potential risks to both human health and to the environment when not managed properly. The term hazardous materials include the following materials that may be utilized or disposed of in conjunction with a proposed project.

- Substances covered under the Occupational Safety and Health Administration Hazard Communication Standard (29 CFR 1910.1200) and MSHA Communication Standards (30 CFR 47) – the types of materials that may be used in mining activities and that would be subject to these regulations would include almost all of the materials covered by the regulations identified below.
- "Hazardous materials" as defined under the U.S. Department of Transportation (USDOT) regulations in 29 CFR 170-177 – the types of materials that may be used in mining activities and that would be subject to these regulations would include fuels, some paints and coatings, and other chemical products.
- "Hazardous substances" as defined by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and listed in 40 CFR Table 302.4 – the types of materials that may contain hazardous substances that are used in mining activities and that would be subject to these requirements include solvents, solvent-containing materials (e.g., paints, coatings, degreasers), acids, and other chemical products.
- "Hazardous wastes" as defined in the RCRA – procedures in 40 CFR 262 are used to determine whether a waste is hazardous – the types of materials used in mining activities and that would be subject to these requirements could include liquid waste materials with a flash point less than 140°F, spent solvent-containing wastes, and corrosive liquids.
- Any "hazardous substances" and "extremely hazardous substances" as well as petroleum products such as gasoline, diesel, or propane, that are subject to reporting requirements if volumes on-hand exceed threshold planning quantities under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act – the types of materials that may be used in mining activities and that would be subject to these requirements include fuels, coolants, acids, and solvent-containing products such as paints and coatings.
- Petroleum products defined as "oil" in the Oil Pollution Act of 1990 – the types of materials used in mining activities and that would be subject to these requirements include fuels, lubricants, hydraulic oil, and transmission fluids.

In conjunction with the definitions noted above, the following lists provide information regarding management requirements during transportation, storage, and use of particular hazardous chemicals, substances, or materials:

- Superfund Amendment and Reauthorization Act Title III List of Lists or the Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-to-Know Act and Section 112(r) of the CAA.
- Certain types of materials, while they may contain potentially hazardous constituents, are specifically exempt from regulation as hazardous wastes. Used oil, for example, may contain toxic metals, but would not be considered a hazardous waste unless it meets certain criteria. Other wastes that might otherwise be classified as hazardous are managed as “universal wastes” and are exempted from hazardous waste regulation as long as those materials are handled in ways specifically defined by regulation. An example of a material that could be managed as a universal waste is lead-acid batteries. As long as lead-acid batteries are recycled appropriately, requirements for hazardous waste do not apply.
- Pursuant to regulations promulgated under CERCLA, as amended by Superfund Amendment and Reauthorization Act, release of a reportable quantity of a hazardous substance to the environment must be reported immediately to the National Response Center (40 CFR 302).

Table 3.14-1 summarizes the permits or regulatory actions and the laws and statues related to the production, transportation, storage, and disposal of toxic and hazardous materials in Arizona that may apply to the proposed project.

Table 3.14-1 Permits, Laws, and Regulatory Codes Related to Facilities That Produce, Transport, Store, or Dispose of Toxic or Hazardous Materials in Arizona

Permit or Regulatory Action	Regulatory Mechanism
Hazardous Waste Permit	ARS 49-921 AAC R18-8-260
EPA Identification Number	ARS 49-922
Pollution Prevention Plan	ARS 49-961 through 49-973
Hazardous Waste Management Facility – Annual Registration	ARS 49-929 ARS 49-930
Emergency and Community Right to Know	42 U.S.C. 11001 et seq. 40 CFR 372
Toxic Data Report	ARS 49-963 ARS 49-964 ARS 49-971 ARS 49-973
Solid Waste Plan Approval	ARS 49-761 et seq. for solid waste ARS 49-857.01 ARS 49-241 et seq. governs the aquifer protection permit program 40 CFR 257
Emergency Planning and Community Right-to-Know Act	40 CFR 300 to 313

3.14.1.2 Project-related Hazardous Materials

3.14.1.3 Solid Waste

Solid waste consists of a broad range of materials that include garbage, refuse, wastewater treatment plant sludge, non-hazardous industrial waste, and other materials (solid, liquid, or contained gaseous substances) resulting from industrial, commercial, mining, agricultural, and community activities (USEPA 2015d). Solid wastes are regulated under different subtitles of RCRA and include hazardous waste (discussed in the previous section) and non-hazardous waste. Non-hazardous wastes are regulated under RCRA Subtitle D.

The solid wastes at the proposed mine and processing facilities would include hazardous waste, solid non-hazardous waste, and sanitary waste. Hazardous waste would consist of “universal wastes,” which include florescent bulbs, mercury containing equipment, and batteries. Hazardous waste also includes flammable liquids, solvent rags, and paint debris. Solid non-hazardous materials (for example, construction debris and trash) would be disposed at an off-site licensed facility. Appropriate materials (used oil, intact lead acid batteries, and antifreeze) would be recycled. A septic system will be constructed to handle sewage treatment at the Lone Star truck maintenance facility. This septic system will be developed in compliance with ADEQ and Graham County’s septic permit requirements.

Waste generation and disposal methods, based on data from 2013, are shown in Chapter 2.0, **Table 2-2**. The quantities of hazardous materials currently stored onsite and the materials proposed for the Lone Star project are listed in Chapter 2.0, **Table 2-3**.

3.14.2 Environmental Consequences

3.14.2.1 Analysis Area

The analysis area for hazardous materials and solid waste is defined as the Project Area and primary access roads.

3.14.2.2 Scoping Issues

Scoping issues identified for the Lone Star Project related to hazardous materials and solid waste include the following:

- Potential impacts to wildlife from hazardous materials;
- Accidental releases of hazardous materials;
- Concerns about failure of the solution containment systems, methods for discovering such failures, and the degree to which impacts would be reversible; and
- Petroleum-contaminated soils management.

3.14.2.3 Method of Analysis and Impact Indicators

The methods of analysis for hazardous materials include the following:

- Review the proposed mining activities and identify the hazardous materials that would be utilized or produced and solid waste (including hazardous waste) that would be generated
- Describe how, where, and generalized quantities of hazardous materials that would be utilized during mining and reclamation.
- Review and summarize applicable rules concerning the transport, storage, handling and disposal of hazardous materials and solid waste. Describe how oil and gas operations would comply with all applicable regulations.
- Analysis will be based on generic lists of hazardous materials

The criterion for evaluating hazardous materials impacts is the risk of a potential spill and the associated impacts to sensitive receptors along transportation routes or exposure pathways.

3.14.2.4 Assumptions for Analysis

- Management of hazardous materials and solid wastes will be conducted in accordance with all applicable laws/rules/regulations.
- The magnitude of potential impacts will be generally proportional to the scale of mining operations.
- Releases below levels for which there is a regulatory reporting requirement do not constitute a significant impact, because reporting requirements are set to require reporting at levels which could result in significant adverse impacts to human health or the environment.
- Not all releases above reporting levels actually result in significant adverse impacts. It depends on the material, the quantity, setting, and receptors.

3.14.2.5 Alternative 1, Proposed Action

The Proposed Action would utilize the transportation routes shown in **Figure 3.12-1** requiring the transport, handling, storage, use, and disposal of materials classified as hazardous under various regulatory frameworks. All hazardous materials would be shipped to and from the mine site in accordance with applicable USDOT hazardous materials regulations. All shipping containers and vehicles would be USDOT-approved for the specific materials. A brief description of the storage, use, and spill response for hazardous materials during operations under the Proposed Action is presented in Section 2.3.4.2, Spill Prevention, Control, and Countermeasure Plan and 2.3.4.6, Spill Prevention and Emergency Response. The proposed storage volumes of these substances are listed in **Table 2-3**.

As described in Section 2.3.4.5, solid waste would be transported offsite to permitted industrial waste disposal facilities or to the local municipal landfill owned and operated by the City of Safford, based on the type of waste to be disposed. Used petroleum products would be transported offsite to permitted recycling companies in accordance with state and federal regulations. Nearly all scrap metal, most used HDPE pipe, and some construction debris would be recycled.

Hazardous materials such as sulfuric acid, diluent, reagents, fuel, and other petroleum products would be stored in above-ground tanks situated within impervious secondary containment systems with secondary containment structures capable of containing 110 percent of the volume of the largest tank.

<u>Effects of a Release</u>

Process chemicals, fuel, and waste materials could be accidentally released during transport to and from the analysis area. The Proposed Action would require the continuation of transport and disposal of the materials and quantities shown in **Tables 2-3** and **2-4**.

The environmental effects of an accidental release would depend on the substance, quantity, timing, and location of the release. This analysis considers the potential for off-site release incidents during transportation, but does not indicate a volume or location. The event could range from a minor oil spill on the project site where cleanup equipment would be readily available to a large fuel or chemical spill during transportation. Some of the chemicals could have immediate adverse effects on water quality and aquatic resources if a spill were to enter a flowing stream or a spring or wetland area. However, considering the transportation routes, the probability of a spill entering a wetland or other waterway would be low. Therefore, it is unlikely that spills of these materials would impact waterways. Rapid response to any spills and subsequent cleanup actions would lessen adverse effects to the impacted media.

The primary emphasis in this analysis is placed upon the release of liquid material that could pose an immediate human health hazard or an off-site contaminant hazard (sulfuric acid, diluent, reagents, diesel fuel, and gasoline).

Sulfuric acid spills that occur on the ground or in water would have the potential to impact local populations of aquatic and terrestrial life through the oxidizing action that destroys plant and animal cells. An acid spill into a waterway would have the potential to migrate from the initial spill site.

A release of diesel fuel would have the potential to impact soil, water, wildlife, and vegetation resources. A spill into a waterway would cause contamination of water and soil, likely affecting local aquatic populations. A spill on the ground may adversely impact soils and potentially any vegetation in the spill area.

However, the small quantities of hazardous material that would be generated and transported under the Proposed Action, combined with the low probability of accidental release, and likelihood of rapid cleanup in compliance with the SPCC Plan (see Section 2.3.4.3) would result in a low risk to the human and natural environment.

3.14.2.6 Alternative 2

The impacts from implementation of this alternative would be similar to the Proposed Action (Alternative 1) for hazardous materials and solid waste. Impacts may be slightly reduced due to the heap leach pad being moved further from wetlands and waterbodies. However, due to the design features of the heap leach pad, zero discharge of contaminants is anticipated under both action alternatives.

3.14.2.7 No Action Alternative

Under the No Action Alternative, the proposed project would not be developed. There would be no project-related risk of impacts to sensitive receptors along transportation routes or exposure pathways from a potential spill of hazardous materials.

The current mining and mineral processing operations would continue until the ore in the Dos Pobres and San Juan pits is depleted.

3.14.2.8 Potential Mitigation Measures

The transportation and use of hazardous materials and the generation and disposal of solid wastes are regulated by federal and state regulations and would be sufficient to provide protection to the environment and public health. Therefore, no additional monitoring and mitigation measures are recommended.

3.14.2.9 Cumulative Impacts

The CESA for hazardous materials and solid waste is the same as the analysis area defined above. Past and present actions and RFFAs are presented in Section 2.5, Past, Present, and Reasonably Foreseeable Future Actions.

Past and present projects that receive chemical shipments on the routes analyzed in this assessment include the Morenci Mine and the Safford Mine. These properties are responsible for operating in accordance with applicable regulations, and there are no known current environmental impacts from the delivery of chemicals along the analyzed transportation routes from these operations. The existing Safford Mine currently receives chemical shipments and stores hazardous materials and waste onsite in accordance with applicable local, state, and federal requirements. Maintenance activities along utility corridors bring increased vehicle traffic and may involve the transport of small amounts of chemicals to the various sites within the CESA. Increased traffic on the access roads also increases the potential for vehicle collision spills associated with a supply vehicle.

As stated in Section 2.5.2, no projects have been identified as reasonably foreseeable other than development of the proposed Lone Star Ore Body within the CESA. The types of activities described in

Section 2.5.1 as past and present actions are likely to continue into the future in the region and chemical transport associated with these projects would also continue. With the continued compliance with applicable regulations and proper implementation of the SPCC Plan (Section 2.3.4.2) and Spill Prevention and Emergency Response Plan (Section 2.3.4.6), cumulative impacts associated with storage, use, and transportation of hazardous materials are expected to be small. Proper disposal of solid waste, as planned, also would limit the risk of potential impacts to the environment.

3.14.2.10 Residual Impacts

Residual adverse effects from the use of hazardous materials under the Proposed Action and Alternative 2 would depend on the substance, quantity, timing, location, and response involved in the event of an accidental spill or release. Regulations governing the transportation, storage, use, and disposal of hazardous materials have greatly reduced the potential for residual effects due spills of hazardous materials. Proper disposal of non-hazardous solid waste in the permitted landfills would minimize residual effects with regard to such materials.

3.15 Public Health and Safety

3.15.1 Affected Environment

The resources that comprise the affected environment for public health and safety include groundwater and surface water quality, air quality, visual (as it relates to lighting), noise, and hazardous materials. The affected environment descriptions for these resources are presented in Sections 3.2, 3.8, 3.10, and 3.12.

3.15.2 Environmental Consequences

3.15.2.1 Alternative 1, Proposed Action

Public health issues associated with a typical open pit copper mine would include potential water quality effects from the mining operation, including use of chemicals during reclamation; potential air quality effects from mine related air emissions; potential noise and lighting effects on sensitive receptors, and potential effects from and the accidental spill of hazardous materials. The potential direct and indirect impacts to these resources are discussed in Sections 3.2.1.2, 3.2.2.2, 3.8.1.2, 3.10.1.2, 3.12.1.2, and 3.14.2. A summary of the potential related public health and safety effects is presented below. There would be little or no adverse effects from proposed activities at the Emery Mitigation Site.

<u>Surface Water Quality and Quantity Effects</u>

During construction and operations at the mine, effects to water quality would include increased sediment loads and increased risk of accidental releases of hazardous materials reaching surface water resources as previously discussed. Stormwater runoff from stream channels upgradient of the mine would be diverted around the mine facilities through diversion channels, emptying into nearby drainages. Talley Wash would experience increased flows during runoff events, compared to current conditions, which could create increased erosion and channel instability effects in these drainages, resulting in increased sediment transport downstream (see Section 3.2.2.2, Water Resources).

<u>Air Quality Effects</u>

As discussed in Section 3.8.1.2, the criteria for impacts to air quality are the lowest concentrations at which adverse human health effects from exposure to air pollution are known or suspected to occur. The NAAQS and Arizona AAQS set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly.

The NAAQS establishes maximum acceptable concentrations for NO_2, CO, SO_2, PM, and O_3. The estimated maximum predicted total ambient concentrations resulting from implementation of the Proposed Action are all below the applicable AAQS for all pollutants and averaging periods. Please note that for $PM_{2.5}$, the impact analysis followed the recommendations in the USEPA Guidance which is a screening level analysis. The results indicate that the Proposed Action is not expected to cause or contribute to a violation of the 24-hour and annual $PM_{2.5}$ AAQS.

Furthermore, secondary $PM_{2.5}$ formation as a result of the Proposed Action's SO_2 and NO_x emissions are not anticipated to contribute to a $PM_{2.5}$ impact in the area surrounding the project. Low SO_2 emissions from existing sources in the vicinity of the project combined with the project's negligible SO_2 emissions minimize secondary formation of $PM_{2.5}$. NO_x emissions from the project are greater than those of SO_2; however, warm average temperatures in the arid climate of southern Arizona would limit nitrate formation from NO_x.

<u>Noise Effects</u>

Federal and local laws, regulations, and guidelines provide the noise and vibration regulatory environment for the proposed project. The OSMRE provides threshold limits for ground-borne vibrations and peak airblast from blasting at mines (Rosenthal and Morlock 1987). There are no state noise regulations that pertain to noise and vibration applicable to the proposed project.

The nearest sensitive receptor is approximately 10 miles southeast of the San Juan Pit and 6 miles southeast of the proposed Lone Star Pit. Assuming the maximum charge weight of 2,000 points, the noise and vibration levels here are estimated to be 86 dBL and 0.016 PPV. These levels are well below OSMRE limits for annoyance of 120 dBL and 0.08 PPV. Vibration would be below human perceptibility and noise would be at least 30 dBL below the level of annoyance. Noise from traffic would be similar to existing levels (see Section 3.13.2.4). The temporary/transitory noise levels associated with the mine would not be expected to cause adverse health effects or contributed to noise-related cumulative public health effects.

Light Effects

During mining, nighttime equipment lights associated with excavation or drill equipment and mobile site lighting may be faintly discerned, depending on their locations within the Gila Mountains This lighting would not be expected to have a noticeable effect on overall night light levels. As such, mining-related night lighting is not expected to result in adverse health effects. No light effects to public health are anticipated.

Hazardous Materials Effects

The proposed project would require the transport, handling, storage, use, and disposal of materials classified as hazardous under various regulatory frameworks. All hazardous materials would be shipped to and from the mine site on transportation routes in accordance with applicable USDOT hazardous materials regulations. All shipping containers and vehicles would be USDOT-approved for the specific materials. A brief description of the storage, use, and spill response for hazardous materials during operations is presented in Section 2.3.4.2, Spill Prevention, Control, and Countermeasure Plan and in Section 2.3.4.6, Spill Prevention and Emergency Response.

The environmental effects of an accidental release would depend on the substance, quantity, timing, and location of the release. This analysis considers the potential for off-site release incidents during transportation, but does not indicate a volume or location. The event could range from a minor oil spill on the project site where cleanup equipment would be readily available to a large fuel or chemical spill during transportation. Some of the chemicals could have immediate adverse effects on water quality and aquatic resources if a spill were to enter a flowing stream or a spring or wetland area. However, considering the transportation routes, the probability of a spill entering a wetland or other waterway would be low. Therefore, it is unlikely that spills of these materials would adversely affect waterways. Rapid response to minimize spills and subsequent cleanup actions according to the SPCC Plan would lessen potential adverse effects to waterways and public health (see Section 3.14, Hazardous Materials)

Safety

During construction and operations, public access to the Project Area would be restricted. The FMSI boundary is fenced and the main security gate with the guard shack would continue to control all access to the mine and processing areas. Additional fencing and signage would be installed around the Lone Star mine facility for security and safety and to keep cattle out of the active pit. No adverse effects to public safety are anticipated.

3.15.2.2 Alternative 2

Alternative 2 would have similar impacts to the Proposed Action. Alternative 2 would utilize all of the same project components as Alternative 1; however, the heap leach pad would be rotated, resulting in only minor changes to its visibility, noise, and air quality. Activities at the Emery Mitigation Site would be similar to those described for the Proposed Action, with little or no impact to public health and safety.

Stormflow diversions would result in smaller increases in flows in Talley Wash, which would cause elevated levels of erosion and channel instability and migration. Water quality impacts would include sedimentation effects would be expected downstream from the diversions that increase flows (see Section 3.2.2.2, Water Resources). Increased surface water flows in drainages downstream of the Project Area would be less under this alternative, resulting in fewer potential impacts to downstream properties.

3.15.2.3 No Action Alternative

Under the No Action Alternative, the mining-related effects identified for water quality, air quality, noise, and lighting that may result from the current operations would cease within 5 years. This would result in a decrease in the potential for adverse public health and safety impacts, as mining activities would decrease and ultimately end at the end of the current mine life.

3.15.2.4 Potential Mitigation Measures

No monitoring or mitigation measures have been identified for public health and safety.

3.15.2.5 Cumulative Impacts

Mining operations associated with the Dos Pobres and San Juan mines would continue during pre-stripping of development from the Lone Star open pit. Once the development rock is removed, and the Lone Star ore is mined, operations associated with Dos Pobres and San Juan mines would cease, eliminating the initial noise, visual, and air quality cumulative effect. At such time cumulative impacts would be the same as described for the action alternatives.

3.15.2.6 Residual Adverse Effects

No residual adverse effects to public health and safety would be anticipated.

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3.16 Socioeconomics

This analysis characterizes socioeconomic conditions in areas and communities that could be affected by the proposed project. The analysis describes economic, population and housing conditions, local government infrastructure, school district information, key public services, fiscal conditions, and the social setting in counties and communities within the socioeconomic and analysis area.

3.16.1 Affected Environment

The Project Area lies within the Safford Valley near the City of Safford, Arizona. The analysis area includes Graham and Greenlee counties with an emphasis on the Safford Valley communities (includes the City of Safford, Town of Thatcher, and Town of Pima). Both Graham and Greenlee counties are included as FMSI employs residents of both counties, and the economies of both counties would have the potential to be influenced by the proposed project. The CESA is the same as the analysis area.

3.16.1.1 Population and Demographics

Graham and Greenlee counties recorded population growth during the 2010 to 2013, with Greenlee outpacing the growth of the state, while Graham County underperformed state growth. Greenlee County recorded the lowest population of all the Arizona counties. Graham County also had a relatively low population when compared against other Arizona counties, ranking 13 out of 15. City of Safford is the largest city near the Project Area and accounts for approximately 25 percent of the population of Graham County. The towns of Thatcher and Pima also are near the Project Area, but have much smaller populations. **Table 3.16-1** details the population of Arizona, as well as counties and municipalities near the Project Area.

Table 3.16-1 Analysis Area Population

Town/County	Population (2000)	Population (2010)	Population (2013 Estimate)	2000-2013 Percent Change	Population Density (2013 Estimate)
Arizona State	5,130,632	6,392,017	6,626,624	29.2	58.3
Graham County	33,489	37,220	37,482	11.2	8.1
Pima Town	1,989	2,387	2,466	24.0	419.4
Thatcher Town	4,022	4,865	4,957	23.2	738.7
Safford City	9,232	9,566	9,602	4.0	1,121.7
Greenlee County	8,547	8,437	9,049	5.9	4.9

Source: Telesto 2015; U.S. Census Bureau 2014.

The majority of residents within Graham and Greenlee counties identify themselves as white. American Indian and Alaska Native also were large populations within the counties, with the nearby presence of San Carlos Reservation augmenting the population total. Further racial demographic information is detailed in Section 3.17.1, **Table 3.17-2**.

3.16.1.2 Population Trends

The population of Graham County has increased steadily over the past 50 years. Since 2000 the county has experienced a growth rate slightly less than 1 percent annually. The 1970 to 1980 timeframe recorded the most substantial growth at 38 percent, while the 2000 to 2010 timeframe recorded the lowest growth in the past 50 years at 11 percent. The county continued to expand between 2010 and the most recent estimated data available in 2013. Greenlee County recorded population declines between

1960 and 1990, dropping 30 percent. Since 1990, the county has slowly expanded recording total growth of 13 percent from 1990 to 2013. These population trends are shown in **Table 3.16-2** and **Figure 3.16-1**.

Table 3.16-2 Graham and Greenlee County Population Trends

Year	Population in Graham County	Population in Greenlee County
1960	14,045	11,509
1970	16,578	10,330
1980	22,862	11,406
1990	26,554	8,008
2000	33,489	8,547
2010	37,220	8,437
2013 (estimate)	37,482	9,049

Source: Telesto 2015; U.S. Census Bureau 2014.

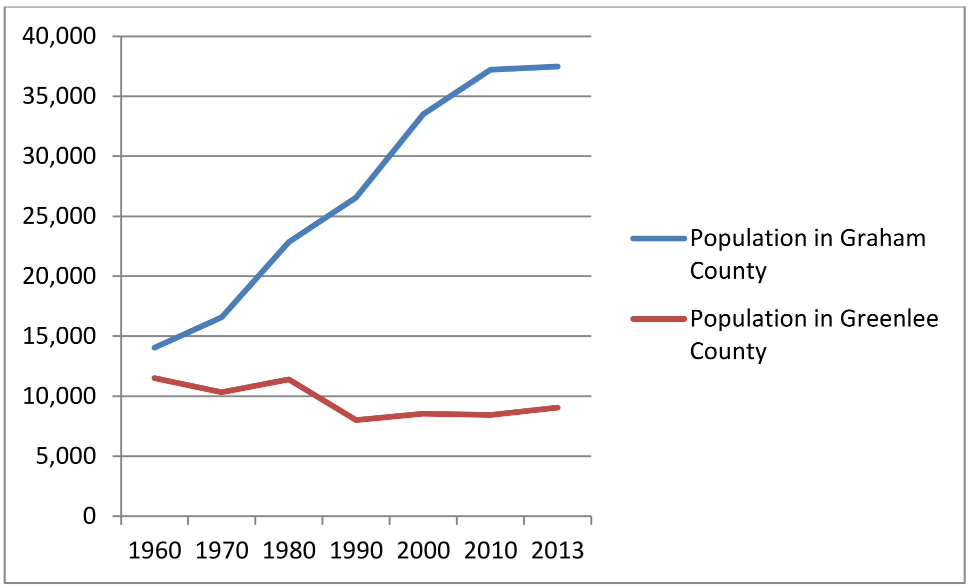

Figure 3.16-1 Graham and Greenlee County Population Trends

3.16.1.3 Employment, Income, and Finances

Employment

As detailed in **Table 3.16-3**, the top employment industries within Graham County are educational services, healthcare, and social assistance, agriculture, forestry, fishing and hunting, and mining, followed by retail trade. These multiple employment sectors depict a diverse economy within the county. Within Greenlee County the agriculture, forestry, fishing and hunting industry employment sector and the mining employment sector accounts for almost half of employment within the county. Although copper mining and mining of precious metals are main facets of the county economy, farming and ranching also has played a vital, with ranching on the Blue River, Eagle Creek, and the “Frisco” River having added to the economy since the 1870s (Greenlee County 2015).

Table 3.16-3 Employment Distribution by Industry Sector in Graham and Greenlee Counties (2009-2013)

Employment Industry	Graham County		Greenlee County	
	Number of Persons	% of Total	Number of Persons	% of Total
Agriculture, forestry, fishing and hunting, and mining	1,703	14.0	1,536	47.6
Construction	877	7.2	281	8.7
Manufacturing	352	2.9	38	1.2
Wholesale trade	134	1.1	28	0.9
Retail trade	1,473	12.1	204	6.3
Transportation and warehousing, and utilities	446	3.7	86	2.7
Information	152	1.3	23	0.7
Finance and insurance, and real estate and rental and leasing	425	3.5	28	0.9
Professional, scientific, and management, and administrative and waste management services	597	4.9	123	3.8
Educational services, and health care and social assistance	3,303	27.2	493	15.3
Arts, entertainment, and recreation, and accommodation and food services	1,144	9.4	200	6.2
Other services, except public administration	482	4.0	45	1.4
Public Administration	1,055	8.7	144	4.5

Source: U.S. Census Bureau 2009-2013.

Local area unemployment statistics from the 2009-2013 American Community Survey 5-year estimates are detailed in **Table 3.16-4**. Both Greenlee and Graham counties recorded unemployment rates that were higher than the Arizona state average, as did the local communities of Pima and Safford. The community of Thatcher was the only local municipality with an unemployment rate lower than the state average. In 2013, FMSI employed approximately 700 people at the Safford Mine Facility in Graham County. Of these employees, 87 percent resided in Graham County, 3 percent in Greenlee, and the balance in other Arizona counties or outside the state (Telesto 2015).

Table 3.16-4 Local Area Unemployment Statistics (2009-2013)

	Arizona	Graham	Pima	Thatcher	Safford	Greenlee County
Civilian Labor Force	3,038,226	13,973	1,054	2,013	4,055	3,661
Employed	2,721,866	12,143	909	1,820	3,476	3,229
Unemployed	316,360	1,830	145	193	579	432
Unemployment Rate*	10.4	13.1	13.8	9.6	14.3	11.8

Source: U.S. Census Bureau 2009-2013.

Personal Income

Total personal income in the analysis area was estimated at $1.4 billion in 2013 (the last year for which data are available), a modest increase of 9 percent from 2008 to 2013 and roughly in line with the state trend. (**Table 3.16-5**). Personal per capita income in the analysis area grew at a cumulative 4 percent during the 2008 to 2013 timeframe. This net increase occurred despite the single-year decreases for both counties in 2009 from 2008 levels during the national recession. This is reflected both in **Table 3.16-5** and **Figure 3.16-2**.

Table 3.16-5 Per Capita Personal Income, Analysis Area: 2008-2013

Geographic Location	Year						% Change 2008-2013
	2008	2009	2010	2011	2012	2013	
Arizona	$35,722	$33,995	$33,993	$35,512	$36,624	$36,983	3.5
Graham County	$25,769	$24,219	$25,167	$25,780	$26,296	$27,548	6.9
Greenlee County	$37,110	$29,548	$30,008	$31,535	$32,730	$37,355	0.7

Source: U.S. Bureau of Economic Analysis 2014.

Residents of the analysis area generally realized lower income, on a per capita basis, than the state average from 2008 to 2013. In 2013, per capita income for Greenlee County was slightly above the state average; however, Graham County recorded per capita income that was substantially below the state average. In 2013, per capita income in the analysis area ranged from $27,548 in Graham County to $37,355 in Greenlee County. Statewide per capita income for the same period was $36,983 and the national average was $44,475. As previously noted, per capita income in both counties and the state experienced declines between 2008 and 2009 (**Figure 3.16-2**). In 2013, Graham and Greenlee counties ranked eleventh and second highest, respectively, among Arizona's 15 counties in terms of per capita income.

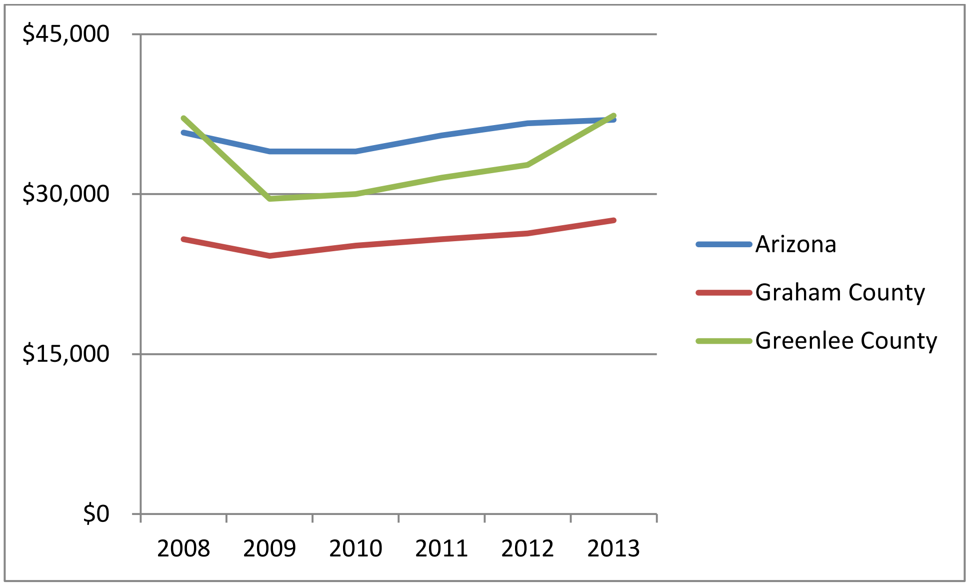

Figure 3.16-2 Personal Per Capita Income: 2008-2013

Public Finances

Private property taxes collected directly by county and municipal governments are an important source of locally based revenues. These taxes are collected on assessed property values. In Graham County, total net assessed property values for the 2014 tax year were $213,508,436 (Telesto 2015). **Table 3.16-6** shows a summary of Graham County's net assessed property values per property class for tax year 2014. Commercial and owner occupied residential property by a wide margin made up the most substantial portion of Graham County's 2014 net assessed value. Agricultural or vacant property class was the third largest contributor to the county's net assessed value. **Table 3.16-7** details the distribution of property tax levies for Graham County in 2014. Education was by far the largest beneficiary of the property tax levy distribution going to Safford School District and Eastern Arizona College. The county was the third largest beneficiary.

Table 3.16-6 Net Assessed Property Value Percentages by Property Class in Graham County

Property Class Description	Graham County 2014 Net Assessed Values	Percent Net Assessed Value
Commercial	$79,219,019	37
Agricultural or Vacant	$33,964,514	16
Owner Occupied Residential	$69,017,976	32
Residential Non-Primary Residence	$5,856,416	3
Rental Residential	$4,665,452	2
Non-Profit Residential	$6,570	<1
Licensed Nursing/Care	$32,665	<1
Bed & Breakfast	$2,080,621	<1
Ag Housing	$39,698	<1
CVP Railroads	$507,852	1

Table 3.16-6 Net Assessed Property Value Percentages by Property Class in Graham County

Property Class Description	Graham County 2014 Net Assessed Values	Percent Net Assessed Value
Historic Non-commercial	$18,100,000	<1
Enterprise Zone	$4,785	<1
Environmental Tech	$18,100,000	8
Improvements on Government Property	$4,785	<1
Total	**$213,508,436**	**-**

Source: Telesto 2015.

Table 3.16-7 Graham County Property Tax Levy Distribution

Recipient	Distribution (Percent of Total)
County of Graham	17.4
Rural Fire District	0.5
School Equalization	4.4
Graham County Flood Control District	0.6
Eastern Arizona College	22.9
City of Safford	0.9
Town of Pima	1.3
Safford Fire Department	1.3
Pima Fire Department	0.2
Ft. Thomas Fire Department	0.1
C/JH Fire Department	0.5
Safford School District	28.2
Thatcher School District	8.4
Solomon School District	2.5
Pima School District	3.7
Klondyke School District	0.1
Bonita School District	5.1
Gila Inst for Technology	0.4
Gila Valley Irrigation	1.4

Source: Telesto 2015.

The State of Arizona collects revenue from businesses within the state via a Transaction Privilege, Use and Severance Tax. Portions of this revenue are returned to each county by a formula based on both the total amount of collections in that county and the proportion of the state population. Disbursements also are made to municipalities, but these payments are based solely on population (Telesto 2015).

Table 3.16-8 lists the taxable activities and businesses, taxable income, and tax collections for Graham and Greenlee counties for the fiscal year beginning July 1, 2012, and ending June 30, 2013. The State of Arizona also collects income taxes and distributes portions of this revenue to incorporated cities and towns as “revenue sharing” (Telesto 2015).

The values presented in **Table 3.16-8** highlight some of the fundamental differences between the economies of Graham and Greenlee counties. In Graham County, retail services dominate, representing 50 percent of tax collections. This reflects the City of Safford’s role as the retail shopping center for the region. In Greenlee County, the “Other Taxable Activities” classification which includes mining, dominates with 46 percent tax collections. This percentage reflects the preeminent position of the Morenci Mine in the economic structure of the county. Between Fiscal Year (FY) 1995 and 2013, the percentage of “Other Taxable Activities” for Graham County increased from 14 percent to 28 percent; this shift reflects the increased mining efforts at the Safford Mine Facility in Graham County over this time. **Table 3.16-8** also illustrates the more diverse economic base in Graham County compared to Greenlee County (Telesto 2015).

Table 3.16-8 Transaction Privilege, Use, and Severance Tax Collections (FY 2012-2013)

County	Taxable Activity	Calculated Net Taxable Income ($)	Collections ($)	Percent of County Total (%)
Graham	Communications	11,557,700	577,885	2.6
	Restaurants and Bars	30,547,414	1,527,371	6.8
	Rentals of Personal Property	15,820,295	791,015	3.5
	Contracting	41,608,469	2,080,423	9.2
	Retail	223,924,184	11,196,209	49.7
	Other Taxable Activities	172,290,948	6,346,613	28.2
	Total	495,749,010	22,519,516	-
Greenlee	Communications	3,811,119	190,556	0.6
	Restaurants and Bars	6,491,267	324,563	1.0
	Rentals of Personal Property	6,342,498	317,125	1.0
	Contracting	107,138,266	5,356,913	16.9
	Retail	221,058,512	11,052,926	34.9
	Other Taxable Activities	506,169,142	14,419,010	45.5
	Total	851,010,803	31,661,094	-

Source: Telesto 2015.

Table 3.16-9 details the distribution of Transaction Privilege, Use, and Severance tax by the state to county governments in FY 2013. The values further serve to illustrate the economic differences between Graham and Greenlee counties. Compared to Graham County, Greenlee County’s distribution amount was greater, even though Greenlee County has a small population. This disproportion means that the benefit from the Transaction Privilege, Use, and Severance Tax distributions are greater to each resident of Greenlee County than to residents of Graham County (Telesto 2015).

Table 3.16-9 Distribution of Transaction Privilege, Use, and Severance Tax Contributions

County	Distribution Amount FY 2012-2013	% of All Counties
Graham	3,606,256	0.5
Greenlee	4,983,640	0.8
All Counties	666,175,440	-

Source: Telesto 2015.

Another source of revenue for Graham and Greenlee counties are payments in lieu of taxes (PILT). Congress authorized PILT to local governments that have certain federal lands within their boundaries (31 USC 6901-6907–1976). These payments supplement other federal land receipt-sharing payments that the government may receive to help offset the costs of providing public services such as law enforcement, fire protection, and road construction/maintenance affected by the presence and use of those federal lands.

PILTs are authorized to local governments, generally counties, based on the acres of entitlement lands within their boundaries. Such entitlement lands consist of lands in the National Forest and National Park systems, some lands involved in Bureau of Reclamation projects, National Wildlife Refuges, and lands administered by the BLM. The entitlement acreage is updated annually to reflect additions or disposal of federal lands. The amount of PILT disbursed to each eligible county is based on a formula factoring in the number of entitlement acres, a per-acre payment rate, deductions for certain other federal land payments, and a ceiling or cap on payments based on the population of the area. PILT payments and entitlement acreage is depicted in **Table 3.16-10**.

Table 3.16-10 Payments in Lieu of Taxes Received by Graham and Greenlee Counties FY 2010 - 2014)

Fiscal Year	Graham County		Greenlee County		All Counties	
	Payment	Total Acres	Payment	Total Acres	Payment	Total Acres
FY 2010	$2,672,505	1,114,629	$755,663	907,852	$27,823,593	27,934,227
FY 2011	$2,644,642	1,114,629	$816,028	907,852	$31,546,890	28,207,623
FY 2012	$2,700,447	1,114,629	$891,483	907,852	$32,886,575	28,207,029
FY 2013	$2,636,873	1,114,629	$783,176	907,852	$32,203,852	28,192,513
FY 2014	$2,784,560	1,099,637	$844,890	905,970	$34,497,956	28,127,031

Source: Telesto 2015.

A total of 2,005,607 acres of entitlement land are located in the two-county analysis area (**Table 3.16-10**). Of that total, approximately 56 percent is public land managed by the USFS, 44 percent is public land managed by the BLM, and the remainder is other eligible federal lands. Among the two counties, Graham County has the largest base of PILT entitlement acres with 1.1 million.

3.16.1.4 Infrastructure and Services

Housing

This section describes existing conventional housing resources and conditions in the analysis area. Conventional housing includes single and multifamily homes and mobile homes. **Table 3.16-11** details housing structures constructed by year. Based on 2009 to 2013 American Community Survey estimates, 65 percent of homes in Greenlee County and 47 percent of homes in Graham County were constructed prior to 1980. The Safford Valley communities of Safford and Pima both reported the majority of their housing structures built before 1980. The Town of Thatcher reported slightly less than 50 percent of housing structures built before 1980. There is notable increase in housing construction between 1970 and 1979 in Graham and Greenlee counties as well as the communities of Safford, Thatcher, and Pima. This increase in housing construction correlates with peaks in copper prices that occurred in the 1970s and associated increased mining efforts that took place in the region (Telesto 2015). In 2008 the City of Safford experienced another boom in housing construction at the commencement of copper production at the Safford Mine Facility (Telesto 2015).

Table 3.16-11 Housing Structures and Year Constructed

Year Built	Greenlee County	Graham County	Safford City	Thatcher Town	Pima Town	State of Arizona
Built 2010 or later	15	160	50	28	4	15,579
Built 2000 to 2009	638	2,396	455	502	151	732,809
Built 1990 to 1999	388	2,430	690	223	140	588,742
Built 1980 to 1989	482	1,921	418	205	101	538,061
Built 1970 to 1979	1,125	2,595	697	415	202	508,132
Built 1960 to 1969	670	1,140	349	227	126	210,265
Built 1950 to 1959	421	867	369	98	102	166,475
Built 1940 to 1949	91	740	402	56	6	50,953
Built 1939 or earlier	551	877	481	51	131	48,752
Total Housing Units	4,381	13,126	3,911	1,805	963	2,859,768
Structures Built before 1980	65%	47%	59%	47%	59%	34%

Source: U.S. Census Bureau 2009-2013.

The homeowner vacancy rate for the state of Arizona was 3.4 percent and the rental vacancy rate was 10 percent based on 2009-2013 American Community Survey estimates. Greenlee County recorded homeowner and rental vacancy rates slightly greater than the state of Arizona during this same timeframe; however, the homeowner and rental vacancy rates for Graham County were during this timeframe were lower than that of the state average. The municipalities of Thatcher and Safford City recorded homeowner vacancy rates below the state average. As detailed in **Table 3.16-12**, the median values for owner-occupied homes in Greenlee County and median gross rents were the lowest in the state among the areas evaluated. Thatcher Town recorded the highest median value of owner occupied homes, while Pima Town recorded the highest median gross rent.

Table 3.16-12 Housing Profiles

Geographic Area	Total Housing Units	Owner-Occupied Units	Renter-Occupied Units	Homeowner Vacancy Rate (Percent)	Rental Vacancy Rate (Percent)	Median Value, Owner-Occupied ($)	Median Gross Rent, Rental-Occupied ($)
Greenlee County	4,381	1,561	1,825	4.2	10.3	81,000	381
Graham County	13,126	8,193	2,838	1.8	8.9	122,200	711
Safford City	3,911	2,287	1,143	1.0	3.2	134,900	668
Thatcher Town	1,805	1,112	351	0.0	30.8	159,700	742
Pima Town	963	553	260	7.3	1.9	117,800	816
State of Arizona	2,859,768	1,527,475	842,814	3.4	10.0	165,100	896

Source: U.S. Census Bureau 2009-2013.

3.16.1.5 Utilities

Based on location relative to the Project Area and population statistics, the affected environment for utilities is concentrated mostly on the City of Safford. Data for the towns of Thatcher and Pima, as well as Graham and Greenlee counties are noted where applicable.

Water/Wastewater/Sewer

The Safford Water Department is responsible for the City of Safford's water and wastewater programs. The City of Safford provides potable water services for all residents within its water service area, including Thatcher, Son Jose, Solomon, Thunderbird Valley, Cactus, Hillcrest, and to the airport north of the Gila River (Telesto 2015). The Town of Pima receives municipal water from Graham County Electrical Cooperative Inc. (Telesto 2015). The Safford Water Department water system infrastructure delivers potable water through the Bonita Creek Water System to provide adequate water pressure and fire protection. This system includes 255 miles of water main, nearly 1,000 fire hydrants, 8 booster pumps, 11 wells, 7 chlorine treatments plans, and 7 water storage tanks with the capacity to store a total of 19.5 million gallons of water (Telesto 2015).

The Safford Water Department relies on groundwater resources for their municipal water supplies. As a result of below average precipitation in recent years, the regional water table has lowered. Correspondingly, the City of Safford has implemented water use restrictions for roughly the past three years. Currently "Stage 3" water use restrictions are being enforced (Telesto 2015).

Wastewater collection and treatment services for the City of Safford are provided under contract with Seven Trent Services, operating and maintaining a 2 million gallon per day water reclamation plant. The wastewater collection system contains 75 miles of sewer main and over 1,000 manholes (Telesto 2015).

Electric/Gas

The City of Safford provides electrical power to nearly 4,000 residential and commercial customers through the City of Safford's Electric Department. The city's electrical system consists of roughly 400 miles of overhead lines and 12 miles of underground, primary service. The city has an electrical crew consisting of six employees that are responsible for the maintenance, repair and construction of the system. In addition, the city contracted with Atkinson Power to upgrade an existing 1.8 miles of 69-kV powerline in order to increase the reliability of electrical provisions to Safford customers. Natural gas supplies are transported to city customers via pipelines originating in Texas and Oklahoma. The City of Safford serves natural gas to nearly 4,000 customers and maintains over 71 miles of distribution pipelines (Telesto 2015).

An additional supplier of electric and gas services is the Graham County Electrical Cooperative, Inc. which is a non-profit, distribution cooperative that provides electricity to more than 6,600 members covering most of Graham County. The Graham County Electrical Cooperative maintains over 1,200 miles of electrical line and approximately 9,300 active electrical meters (Telesto 2015). The cooperative employs 44 people, and power is supplied from the Arizona Electric Power Cooperative. Graham Counties Utilities, Inc. is the primary natural gas supplier for Graham County, servicing approximately 5,166 active gas meters and maintaining approximately 239 miles of gas pipeline (Telesto 2015).

Solid Waste

Vista Recycling provides waste management and recycling services for Graham and Greenlee counties, serving the City of Safford as well as the Towns of Pima and Thatcher (Telesto 2015). Furthermore, the City of Safford Landfill Division operates the regional landfill, serving all of Graham County. The city also provides solid waste services to Safford residents (Telesto 2015).

Telephone

Local telephone services for the Safford Valley communities are available from Valley Telecom, CenturyLink, and Cable One.

3.16.1.6 Schools

There are nine school districts in Graham County along with two private schools and two charter schools (Telesto 2015). Within the Safford School District there are two high schools, one middle school, and three elementary schools. Additionally, the Safford Christian Academy and Triumphant Learning Center are within the City of Safford (Telesto 2015). As depicted in **Table 3.16-7** the Safford Valley communities' school districts received roughly 40 percent of Graham County's property tax levy dollars in 2014.

Emergency Response and Medical

The City of Safford Police Department provides services through the following programs: administration, detective division, patrol division, animal control, grants and outside funding. The police department currently employees 26 positions, with a need to increase the workforce (Telesto 2015). The Safford Fire Department has 30 members, 29 of which are volunteers that serve a fire district covering approximately 110 square miles, serving 27,000 people. The Safford Fire Department responds to roughly 200 fire calls annually and is equipping with 6 fire engines and 1 tanker truck (Telesto 2015).

The Mount Graham Regional Medical Center is located in the City of Safford and is the main source of healthcare for residents in both Graham and Greenlee counties. The Mount Graham Regional Medical Center includes a 49-bed hospital with a full emergency department, laboratory, imaging, general orthopedic surgery, obstetrics, and intensive care unit services. The Mount Graham Regional Medical Center also offers a rural health clinic and oncology, cardiology and gastroenterology services (Telesto 2015).

3.16.2 Environmental Consequences

3.16.2.1 Scoping Issues

Relevant issues and concerns raised during public scoping are listed below.

- Boom and bust effect on the community after non-local workers leave the area.
- Construction and operation socioeconomic impacts to local communities and counties near the Project Area.
- Impacts to wildlife species of economic value (see Section 3.6 for analysis).

3.16.2.2 Method of Analysis and Impact Indicators

The assessment of project-induced effects on social and economic values included review and analysis of existing conditions and trends in population and demographics, economic activity, employment, income, poverty, housing, and local government services and fiscal revenue.

For the assessment, the potential social and economic effects of construction and operations of the mine were identified, and considering the location and timing of work force and construction activities in the context of the existing social and economic conditions, infrastructure, and housing capacities. Potential revenues associated with construction and operations were considered for their potential to offset public costs of providing services to the construction and operations work force.

3.16.2.3 Assumptions for Analysis

Assumptions for analysis area as follows:

- Impacts are expected to be concentrated in the Safford/Thatcher/Pima corridor of Graham County, primarily in the City of Safford itself;
- The nature, timing, and magnitude of these impacts would reflect the two major phases: the initial 3-year construction phase and the long-term 25-year production phase;
- 80 percent of new operation jobs would be filled by locals, 15 percent of which would require new housing;
- 20 percent of new operations jobs would be filled by non-locals, 100 percent of which would require new housing;
- 85 percent of contract jobs would be filled by locals, 15 percent of which would require new housing; and
- 15 percent of contract jobs would be filled with newcomers, 100 percent of which would require new housing.

3.16.2.4 Alternative 1, Proposed Action

<u>Population and Demographics</u>

The Proposed Action would result in an increase of both construction contract workers and full-time workers associated with operations. Population would increase during the construction phase by approximately 175 people. The increase in population, 0.5 percent greater than the current Graham County population, is expected to be short-term, lasting as long as initial construction activities, approximately 3 years. Contract employees are generally less likely to bring dependents than long-term operational employees. The long-term full-time new employment of operations employees is anticipated to increase by 225 new workers. Most of these new jobs are assumed to be filled mostly from Graham County and regional residents; however, it is anticipated 45 operational jobs filled would be filled by new non-local workers. It also is assumed that 178 indirect jobs would be created by the Proposed Action. Of these 178 new indirect jobs, it assumed approximately 36 indirect jobs would be non-local. Ultimately, it is anticipated that 129 new households would result from both new direct and indirect job opportunities. Given an average household size of 3.15 people, this would result in an anticipated total population increase of 406 people above existing levels. These totals do not take into account new households from contract workers, which would be much less than from direct FMSI employed workers and would be short-term, lasting until construction activities are complete. **Table 3.16-13** shows households produced from local and non-local direct and indirect employment, as well as relevant assumptions.

Table 3.16-13 Direct and Indirect Worker Households*

	Direct FMSI Workers	Indirect Workers	Totals
Long-Term	225	178	403
Local**	180	142	322
New Local Households**	27	21	48
Non-Local***	45	36	81
New Non-Local Households***	45	36	81

* New household growth from contract workers would be substantially lower than from long-term direct and indirect workers, and so are not included.

** Assumes 80 percent hired locally, 15 percent of local hires would form new households.

*** Assumes 20 percent hired non-locally and 100 percent would form new households.

Population Trends

The temporary increases in the construction workforce will be short-term, winding down in 2021 and 2022; however, the increase of direct 225 operations workers and indirect 178 workers is expected to last until 2032 before beginning to decline until closure activities begin in 2044. As previously noted, this increase in direct and indirect workers would add approximately 406 new people to the local region. The growth rate for Graham County between 2000 and 2013 was approximately 13 percent, averaging around 1 percent a year. The operational increase in new employees and their families would equal approximately 1 year of historical growth to Graham County, generally regarded as within normal growth capacity.

Employment, Income, and Finances

Employment

The Proposed Action would slightly increase current region wide employment levels. It is assumed that the majority, 85 percent, of the 175 construction contractors would come from out of town and their residency in the region would be temporary; however, approximately 225 new direct full-time employees and 178 new indirect jobs would be added during the first half of the operations phase, through approximately the year 2032. The estimation of the increase in indirect jobs was based on a Labor Multiplier Effect of 1.74 to 1.84, from the San Juan/Dos Pobres Final EIS (BLM 2003). Indirect jobs, servicing Proposed Action activities would likely be generated within retail and service sectors. As of June 2015, the preliminary unemployment rate in Graham and Greenlee counties was 7.4 percent and 7.5 percent, respectively, both well above state and national levels (U.S. Bureau of Labor Statistics 2015). The addition of 225 new direct full-time employees and 178 new indirect jobs would assist in contributing to downward pressure in the county and local unemployment rates. Higher local unemployment rates indicate there is 'slack' in the labor market, which would assist in locally filling long-term employment positions.

Personal Income

Implementation of the Proposed Action would result in beneficial short-term and long-term increases in personal income in the region. Jobs in the construction and mining industries contribute to enhanced economic welfare for the directly affected households. The short-term direct increases, consisting of wages, salaries, and the value of benefits to be paid to contract construction workers are estimated in excess of $30 million, the majority of which, approximately 85 percent, would accrue to non-residents, although a substantial amount also would accrue to local residents (Telesto 2015). Much of the income accruing to non-residents would leave the region, but the local economy would benefit from local purchases of goods and services made by non-local workers during their time of local tenancy. Personal income associated with indirect and induced jobs supported by the construction phase of the project would generate further increases in personal income.

Long-term gains in labor income associated with operations are based on an estimated average income $62,000 a year per direct full-time employee, resulting in an approximate total of $14.0 million per year for the 225 new direct employees, through 2032, totaling $181.4 million for the initial 13 years of production. After 2032, new direct employment would fall to 50 jobs extending to year 2044, and resulting in $3.1 million in income each year extending over the last 12 operational years of the project, totaling $37.2 million for the 12 year period. This would generate total new direct full-time employee income of $176.7 million over the 25-year production life of the project. When added to the $62 million paid to contract workers over the life of the project, this represents an average of total paid income over both construction and production phases of $238.7 million. These estimates do not include the value of benefits, bonuses, overtime payments, or any other fringe benefits which may be provided to employees. Although substantial, and with higher than average earnings per job, the annual average full-time direct employee wage of $62,000 would represent approximately a 100 percent increase over the average annual per capita total income of Graham and Greenlee counties in 2013 year. Reclamation would generate additional short-term income in the future.

Public Finances

A substantial state and local revenue source directly associated with the Proposed Action would include local ad valorem (property) taxes on the value of production and mining equipment and facilities. Local governments would benefit from increases in sales tax revenue. The state also would realize an incremental gain in severance taxes. Construction and operations of the Proposed Action also would generate substantial incremental corporate income taxes; however, such taxes have not been estimated.

The Proposed Action would result in additional payments of FMSI property taxes of $175,000,000 and employee, direct and indirect, property taxes of $2,100,000 for another 25 years. Additional taxes accruing to local governments would include sales taxes (both state and local), totaling an estimated $5,000,000 over the course of the project. Additionally, approximately $22.7 million would be paid in state severance tax from FMSI to the state of Arizona. These taxes total an additional estimated $211.8 million over the life of the project when compared to baseline levels. Continuation of local property taxes would accrue, in part, to local school-districts, providing continued fiscal support. **Table 3.16-14** details state and local taxes that would be generated by the Proposed Action.

Property taxes provide the greatest project generated revenue, followed by severance taxes, state and local sales tax, and state income tax. Graham County levies a 0.5 sales tax, and the communities of Safford, Thatcher and Pima employ an additional 2.5 percent, 2.4 percent, and 2.0 percent sales tax, respectively. This results in total sales tax rates in Safford, Thatcher, and the Town of Pima of 8.6 percent, 8.6 percent, and 8.1 percent, respectively. **Table 3.16-15** details sales and income tax generated by construction and operations workers. State income tax also is generated from indirect employment, and sales tax is generated by new households.

Table 3.16-14 State and Local Taxes Generated by the Proposed Action

Tax Payer	Property (local)	Sales (state & local)	Income (state)	Severance (state)	Total
FMSI	$175,000,000	$3,500,000	$1,022,000	$22,666,000	$202,188,000
Employees (Direct and Indirect)	$2,100,000	$1,499,000	$6,053,000	NA	$9,652,000
Total	**$177,100,000**	**$4,999,000**	**$7,075,000**	**$22,666,000**	**$211,840,000**
Average Annual	$7,084,000	$199,960	$283,000	$906,640	$8,473,600

Source: Telesto 2015.

Table 3.16-15 Estimate of State and Local Sales and Income Taxes

Sales tax generated by construction worker expenditures	$191,000 over 7-year build-out
State income tax generated by construction worker wages	$805,000 over 7year buildout*
State income tax generated by direct employee salaries	209,911 annually, totaling $5,248,000 over the life of the project*

* Assumes payment of the Arizona 2014 statewide average of $871 per file per year.

Source: Telesto 2015.

Offsite Mitigation

FMSI has identified a mitigation site (Emery Site) to compensate for unavoidable project impacts to water of the U.S. The Emery Site is approximately 109 acres of private land owned by FMSI located south of the Project Area downstream along the Gila River. The majority of the Emery Site is former agricultural fields. Mitigation goals would be designed to enhance riparian functions and would be funded by FMSI. Funding of this mitigation would potentially result in low-intensity public uses such as hiking, bird watching, and/or minor forms of hunting or fishing. Funding of the mitigation may also result in potential employment opportunities to execute the mitigation over the five-year mitigation period. More information on the potential compensatory mitigation site is detailed in **Appendix B**.

Infrastructure and Services

Housing

The construction phase would add 175 new temporary contract workers to the Project Area, which would result in a short-term increase in demand for rentals and other short-term housing. A larger number of contract and construction workers were required for the start-up of the San Juan/Dos Pobres project, therefore, it is anticipated that the smaller increase in contract construction workers required for Proposed Action construction would be adequately accommodated by existing housing resources.

Long-term it is anticipated that both direct and indirect employment would create the demand for 129 new households and subsequent housing units. There are no current planning efforts within the City of Safford to meet housing demand, as there is a housing surplus from the intense level of housing construction that took place during the boom years between 2004 and 2008 (Telesto 2015). It is anticipated that the majority of short-term workers would reside in Safford; however, a number of workers also would take short-term accommodations in nearby towns, such as Thatcher and Pima as well as other outlying communities.

Utilities

Water/Wastewater/Sewer, Electric/Gas, Solid Waste, Telephone

Construction related impacts to public utilities would be minor, resulting from the relatively small increase in construction employment when compared to the regional population. Although impacts would be concentrated in the City of Safford, potential impacts also would be spread among other regional municipalities such as Thatcher and Pima. It is anticipated there would be a short-term net increase of approximately 4 percent on public utilities within the water service area. This increase in could require an increase in the capacity of the existing water system and water supplies. The relatively small increase in short-term population is not expected to result in a notable demand on sewer facilities, electrical power, solid waste collection and disposal systems, public communications services, or public utility infrastructure in the Safford Valley communities.

Schools

The introduction of 129 new households in the community is expected to increase enrollment in local school districts. Based on the statistics utilized in the San Juan/Dos Pobres Final EIS (BLM 2003), Approximately 110 new students are expected to enroll, including 74 students in the Safford School District and 36 students in the Thatcher school district, an increase of approximately 4 percent in both the Safford and Thatcher School Districts.

Emergency Response and Medical

There would be no noticeable increase in demands on law enforcement and medical and emergency response services in the Project Area, resulting from the relatively small increase in employment when compared to existing levels already serviced by law enforcement and emergency response services.

3.16.2.5 Alternative 2

Socioeconomic impacts under this alternative would be identical to those of the Proposed Action.

3.16.2.6 No Action Alternative

Population and Demographics

The regional population would potentially decrease, as production activities would end and reclamation activities begin, resulting from the net reduction in employment at the FMSI mine site. Households would potentially decrease as well, as operations employees may leave the region after long-term employment ends at the mine site.

Population Trends

The closing of the FMSI mine site under the No Action Alternative, would contribute to downward pressure on long-term population trends, as workers may leave the area after long-term FMSI employment opportunities end.

Employment, Income, and Finances

Employment opportunities would decrease as long-term employment at the FMSI site ends. This would additionally reduce employment levels and opportunities at local economic sectors that currently support FMSI operations. Income also would subsequently decrease with the closure of the mine and the reduction in direct employment. Income also would decrease within economic sectors that currently support FMSI operations.

State and local tax revenues generated by FMSI operations would decrease after closure. Direct and indirect tax revenues, such as property tax, sales tax, income tax, and severance tax would be reduced as mining activities cease in 2021.

Infrastructure and Services, Utilities, Schools, and Emergency Response and Medical

Under the No Action Alternative, as the numbers of direct and indirect employees are reduced, there would be a subsequent reduction in the demand for housing, enrollment in public schools, local utilities use, and emergency and medical response.

3.16.2.7 Potential Mitigation Measures

No potential mitigation measures have been identified.

3.16.2.8 Cumulative Impacts

The CESA is the same as the analysis area, described in Section 3.16.1. The proposed project would add to the ongoing growth of households within the region, especially during peak operational years. This increase in household levels would be coupled with existing household growth from current economic conditions and other local economic contributors such as the Morenci Mine. New demands on infrastructure resulting from the proposed project are small relative to the socioeconomic benefits from additional tax revenues that would be generated directly and indirectly by the project. Cumulative impacts to socioeconomic resources are expected to be positive.

3.16.2.9 Residual Adverse Effects

No residual adverse effects are anticipated to socioeconomics.

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3.17 Environmental Justice

Environmental justice is defined as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (USEPA1998). EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, tasks “each Federal agency [to] make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high adverse human health and environmental effects of its programs, policies, and activities on minority populations and low-income populations.”

Implementation of EO 12898 for NEPA requires the following steps:

1. Identification of the presence of minority and low-income populations and Indian Tribes in areas that may be affected by the action under consideration.
2. Determination of whether the action under consideration would have human health, environmental, or other effects on any population.
3. Determine of whether such environmental, human health or other effects would be disproportionately high and adverse on minority or low-income populations or Indian Tribes.
4. Provision of opportunities for effective community participation in the NEPA process, including identifying potential effects and mitigation measures in consultation with affected communities and improving the accessibility of public meetings, crucial documents, and notices (USEPA 1998).

3.17.1 Affected Environment

The analysis area for environmental justice includes Graham and Greenlee counties with an emphasis on the Safford Valley communities (includes the City of Safford, Town of Thatcher, and Town of Pima). Both Graham and Greenlee counties are included as FMSI employs residents of both counties, and the economies of both counties would have the potential to be influenced by the proposed project.

The USEPA (1998) suggests using census poverty thresholds for identifying low-income populations, therefore low-income populations are defined as “…people below poverty level in the past 12 months (for whom poverty status is determined)”. In the State of Arizona, approximately 17.9 percent of the population fell into this category based on 2009-2013 5-year estimates. Both Graham and Greenlee counties reported the percent of people below the poverty level that were less than the Arizona state average. Of the municipalities near the Project Area, Safford and Pima recorded poverty levels that were higher than the state. Poverty levels are shown in **Table 3.17-1**.

Table 3.17-1 Poverty Levels (2009-2013)

County/Town	Percent of People Below the Poverty Level	Margin of Error (+/-)
Arizona State	17.9	0.2
Greenlee County	16.0	3.6
Graham County	16.8	2.6
Pima Town (analysis area)	18.9	6.2
Thatcher Town (analysis area)	16.5	7.4
Safford City (analysis area)	19.9	5.8

Source: U.S. Census Bureau 2009-2013.

The majority of residents within Graham and Greenlee counties identify themselves as white. American Indian and Alaska Native also were large populations within Graham County, with 15.3 percent of the population identifying themselves as American Indian and Alaska Native. The presence of the San Carlos Reservation is reflective of the larger American Indian population within Graham County. The majority of San Carlos Reservation population centers are well to the north and west of the Project Area, the closest being the unincorporated community of Bylas, approximately 20 miles northwest of Safford along US-70. **Table 3.17-2** shows racial and ethnic composition by state and county. Environmental justice populations are determined to be present if they are greater than 50 percent of the population or meaningfully greater than a larger representative population, in this case the State of Arizona (USEPA 1998). Although there are no minority populations greater than 50 percent, by this definition, Graham County contains an environmental justice population, as the American Indian and Alaska Native population of the county is notably greater than the Arizona state percentage. Additionally, Greenlee County contains an environmental justice population as the Hispanic or Latino population is notably greater than the state percentage. Graham County also contains a large Hispanic or Latino population; however, it is comparable in size, as a percentage, to the Arizona state Hispanic population.

Table 3.17-2 Racial/Ethnic Composition, 2000 and 2010

	White (%) (2010)	**Black (%) (2010)**	**American Indian and Alaska Native (%) (2010)**	**Native Hawaiian and Other Pacific Islander (%) (2010)**	**Asian (%) (2010)**	**Hispanic or Latino (of any race) (2010)***
Arizona	75.9	5.0	5.5	0.4	3.6	29.6
Graham County	74.6	2.4	15.3	0.3	0.8	30.4
Greenlee County	80.7	1.3	3.4	0.1	0.8	47.9
	White (%) (2000)	**Black (%) (2000)**	**American Indian and Alaska Native (%) (2000)**	**Native Hawaiian and Other Pacific Islander (%) (2000)**	**Asian (%) (2000)**	**Hispanic or Latino (of any race) (2000)**
Arizona	77.9	3.6	5.7	0.3	2.3	25.3
Graham County	68.9	2.1	15.6	0.1	0.8	27.0
Greenlee County	77.4	0.6	2.7	0.1	0.3	43.1
	White (2000-2010 % Change)	**Black (2000-2010 % Change)**	**American Indian and Alaska Native (2000-2010 % Change)**	**Native Hawaiian and Other Pacific Islander (2000-2010 % Change)**	**Asian (2000-2010 % Change)**	**Hispanic or Latino (of any race) (2000-2010 % Change)**
Arizona	+21.4	+71.7	+20.8	+87.1	+94.6	+14.5
Graham County	+20.3	+24.5	+9.2	+134.7	20.7	+12.6
Greenlee County	+2.9	+109.3	+26.8	+60	+183.3	+11.1

* People who identify their origin as Hispanic or Latino may be of any race. Thus, the percent Hispanic or Latino should not be added to the race as percentage of population categories.

Source: U.S. Census Bureau 2014, 2000.

3.17.2 Environmental Consequences

3.17.2.1 Scoping Issues

Relevant issues and concerns raised during public scoping are listed below.

- Analysis of disproportionate adverse impacts of federal actions on minority and low-income populations.

3.17.2.2 Method of Analysis and Impact Indicators

The environmental justice analysis evaluates whether minority or low-income populations in the analysis area would realize disproportionate and adverse effects from project-related activities, relative to the general population. Information from the U.S. Census Bureau was used to assess the presence of minority or low-income populations. The analysis was conducted at the city, county, and state level.

3.17.2.3 Assumptions for Analysis

Assumptions for environmental justice follow EPA guidance in determining whether minority populations should be identified, and are as follows:

- The minority population of the affected area exceeds 50 percent; or
- The minority population of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographical analysis. (USEPA 1998).

3.17.2.4 Alternative 1, Proposed Action

As required by EO 12898 "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," the proposed project was evaluated for any disproportionately high and adverse human health or environmental effects on minority communities and low-income communities within the context of NEPA. The environmental justice conclusions reached in the Final EIS (BLM 2003) were reviewed for adequacy and relevance. The Dos Pobres/San Juan Final EIS concluded that the potential effects on minority and low-income populations closest to the project site were positive from a socioeconomic perspective, by creating a large number of direct and indirect employment opportunities. Even with the existence of American Indian and Alaska Native populations in Graham County and Hispanic or Latino populations in Greenlee County adverse economic impacts would not be disproportionately high.

Ultimately the proposed project would continue to generate income within the affected counties and communities, potentially benefiting minority communities and low-income populations. Moreover, because the proposed project is not located within urban areas, but has been dictated by the location of copper ore deposits, there is no evidence that the proposed project would have a disproportionately high adverse human health or environmental effect on minority and low-income populations.

3.17.2.5 Alternative 2

Environmental justice impacts under this alternative would be identical to those of the Alternative 1, Proposed Action.

3.17.2.6 No Action Alternative

Under the No Action Alternative, current operations would cease between 2021 and 2026, and closure and post-closure activities would begin. As closure activities commence there would be a reduction in employment opportunities, income, as well as local and state tax receipts. These reductions would not disproportionately affect minority or low income populations.

3.17.2.7 Potential Mitigation Measures

No potential mitigation measures have been identified.

3.17.2.8 Cumulative Impacts

The CESA is the same as the analysis area, described in Section 3.17.1. The proposed project would add to the ongoing growth of households within the region, especially during peak operational years. This increase in household levels would be coupled with existing household growth from current economic conditions and other local economic contributors such as the Morenci Mine. This growth would continue to generate income within the affected counties and communities, potentially benefiting minority communities and low-income populations.

3.17.2.9 Residual Adverse Effects

There are no project-related residual adverse effects anticipated to environmental justice populations.

3.18 Relationship Between Short-term Uses of the Human Environment and the Maintenance and Enhancement of Long-term Productivity

For impact analysis purposes, short-term is defined as the operational life of a mine plus the closure and reclamation period; long-term is defined as the future following final reclamation. This section identifies the tradeoffs between the short-term impacts to environmental resources during mine construction, operation, and reclamation versus long-term impacts to resource productivity that extend beyond the end of reclamation. Note that this discussion is not applicable to hazardous materials, noise and vibration, and public health and safety.

3.18.1 Geology and Mineral Resources

Copper mining would affect the long-term potential for development of mineral resources because extraction of leachable ore would be completed. By not backfilling the mine pits, there may be potential for extraction and processing of copper sulfide in the future.

3.18.2 Water Resources

The short-term use of the proposed mine would not alter the long-term productivity of the groundwater resource. Although local effects to the groundwater elevations around the mine pit would occur, the overall groundwater system would return to near the condition of the pre-mining environment once groundwater withdrawals concluded. The drainage patterns of the surface water would remain altered even after the mine closure. The mine facilities, including the mine pit, the development rock stockpiles, and the heap leach pad, would all remain in the “zero-discharge” system because once they become exposed to runoff they continue to be a potential source of contaminants to surface water resources. The “zero-discharge” system would need to ensure that the controls are maintained in perpetuity to continue protection of long-term productivity of the surface water resources downstream from the Project Area.

3.18.3 Waters of the U.S., Including Wetlands and Riparian Areas

Mining activities would affect long-term productivity of waters of the U.S. and riparian areas due to the alteration of the ephemeral drainages in order to construct infrastructure and stockpiles associated with the Lone Star Pit. Impacts to long-term productivity of waters of the U.S. would be mitigated through implementation of compensatory mitigation and site reclamation. There are no wetlands within the Project Area so no short-term or long-term impacts would occur. Long-term improvements to the riparian areas at the Emery Mitigation Site would compensate for the loss of ephemeral drainages in the Project Area and result in no net loss of waters of the U.S.

3.18.4 Soils

Soil productivity varies with vegetation community, but more importantly, with land management objectives as they relate to the establishment of desirable or productive vegetation types. Soil quality determines productivity and is an inherent soil resource characteristic affected by aeration, permeability, texture, salinity and alkalinity, microbial populations, fertility, and other physical and chemical characteristics. There would be impacts to short-term uses and long-term soil productivity because the native soils would be disturbed and, in some cases, greatly modified. With the exception of the open pit, clay borrow pit, and development rock stockpiles, long-term soil productivity can be restored once successful revegetation is completed.

3.18.5 Vegetation

Mining activities would affect the long-term productivity of vegetation and could increase the presence of noxious weeds. The productivity of vegetation would be reduced or lost due to surface-disturbing activities. Reclamation measures (revegetation and removal of structures and roads) would mitigate this loss of vegetation so that productivity would be restored following completion of mining except at the location of the Lone Star Pit, clay borrow pit, and development rock stockpiles.

3.18.6 Terrestrial Wildlife

Specific short-term and long-term impacts to associated habitat and species would include alteration or loss, modification, and fragmentation of habitat, direct mortality of individuals, and increased disturbance from human activity. Wildlife habitat would be reduced due to local short-term and long-term uses until reclaimed areas return to mature vegetation communities. These temporal losses can vary in the time required to return to pre-construction conditions. This range of temporal loss is expected to be between 5 and 50 years, depending on the vegetation community. These impacts would be mitigated in the long-term with successful implementation of the reclamation plan. There would be a temporary, short-term loss of riparian habitat at the Emery Mitigation Site, but this would be replaced by enhanced riparian habitat once native vegetation is established.

3.18.7 Aquatic Resources

Construction would result in some short-term and long-term impacts to aquatic habitat and macroinvertebrates and amphibians in the Project Area, especially if disturbance occurs when water is present. There would be no short- or long-term effects on fish species. Specific short-term and long-term impacts to aquatic habitat and macroinvertebrate and amphibian species would include alteration or loss of habitat and water quality effects from sedimentation and contaminant spills. The disturbance to waters of the U.S. under both alternatives would remove aquatic habitat on a permanent basis. Implementation of applicant-committed environmental protection measures involving sediment control and the SPCC would avoid residual adverse effects on water quality in the Project Area ephemeral drainages and Gila River. Although short-term and long-term impacts would occur under all alternatives, none of the alternatives is expected to adversely affect the overall productivity of aquatic resources in the Project Area.

3.18.8 Cultural Resources

Short-term and long-term impacts to cultural resources would include the permanent direct loss of any archaeological sites and historic resources identified within the mine-related disturbance area. Treatment for any NRHP-eligible sites would be completed prior to ground disturbance; the scientific information associated with these resources would be preserved for the long term. Although NRHP-eligible sites would be mitigated through implementation of data recovery or other forms of mitigation, some of the cultural value associated with these sites would not be fully mitigated; therefore, long-term impacts to these resources would be anticipated.

Mining and associated construction would result in the loss of cultural resources within the disturbance area that are not eligible for the NRHP. Although these sites would be recorded to Corps and State Historic Preservation Officer standards and the information integrated into local and statewide databases, the sites ultimately would be destroyed by mine construction and operation, resulting in long-term impacts.

3.18.9 Air Quality and Greenhouse Gases

During the operation of the facility, emissions of criteria pollutants would occur. Project emissions emitted over the short term are not predicted to cause exceedances of the AAQS. Once the disturbance ceases and wind-erodible surfaces are reclaimed, the resource would return to a stable condition and would not impair the air quality conditions over the long term. However during the life of the project emissions of GHGs would occur and would contribute slightly to climate change that has both short- and long-term impacts.

3.18.10 Land Use

Specific short-term and long-term impacts associated with land use include a reduction in the amount of privately owned FMSI land leased for grazing. With development of the Proposed Action, the 23,600 acres currently leased for grazing by FMSI would be reduced to 5,200 acres and forage yield would be reduced at least over the short term. This forage productivity may return following successful site reclamation. There would be a long-term conversion of 69 acres of agricultural land to riparian habitat at the Emery Mitigation Site.

3.18.11 Aesthetics and Visual Resources

Impact to visual resources would be both short and long term. While impacts associated with processing facilities and mining operations would cease when they are removed at closure, the mine pit, heap leach pad, development rock stockpiles and altered ridgelines would permanently change the landscape and affect visual quality of the area in perpetuity.

3.18.12 Transportation

There would be an incremental short-term increase in traffic on affected roadways. However, there would be no long-term impact to area roads.

3.18.13 Socioeconomics

Development and production of the proposed project would provide economic support for local households. Communities would benefit from continued and additional investments, and public entities, including state and local governments, would derive revenues from economic activities. Development of these resources also would continue to benefit residential, commercial, and industrial consumers outside the region. Some of the infrastructure put in place to serve the proposed project also may support future production of resources from other deposits in the region or nearby.

3.18.14 Environmental Justice

Short-term impacts from construction activities would potentially supports jobs and income for local environmental justice populations. Long-term operations would continue to potentially contribute job opportunities and income to environmental justice populations.

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3.19 Irreversible and Irretrievable Commitment of Resources

Developing the Lone Star mine and associated infrastructure would result in the irreversible commitment or the irretrievable commitment of resources. Irreversible impacts are those that result in the loss of production or use of natural resources during the life of mining and processing operations. Irretrievable impacts would include the loss of future options for resource development or management, especially of nonrenewable resources, such as minerals and cultural resources, as a result of implementing the proposed project. There would be no irreversible or irretrievable commitment of resources resulting from the proposed activities at the Emery Mitigation Site.

3.19.1 Geology, Paleontology, and Mineral Resources

Copper mining would cause an irreversible change in the topography in the area of the pit, development rock stockpiles, and clay borrow pit. There would be an irreversible and irretrievable commitment of the leachable copper ore that would be mined and would not be available for future use.

3.19.2 Water Resources

The changes to the surface water drainage patterns to accommodate the “zero-discharge” system would be irreversible. The groundwater that would be consumed by the Project would be irretrievable.

3.19.3 Waters of the U.S., Including Wetlands and Riparian Areas

There would be an irretrievable loss of waters of the U.S. and riparian areas during construction and mining operations. These impacts may be reversible with successful implementation of the compensatory mitigation plan and the reclamation plan.

3.19.4 Soils

An irretrievable commitment of a resource is one in which the resource or its use is lost for a period of time. An irreversible commitment of a resource is one in which the resource use is lost permanently or indefinitely. An irretrievable and irreversible loss of soil productivity and quality would be associated with the Lone Star Pit, development rock stockpiles, heap leach pad, and clay borrow pit because the soils would not be restored.

3.19.5 Vegetation

There would be an irretrievable commitment of vegetation resources in disturbance areas until reclamation is completed. There may be an irreversible commitment of upland vegetation to riparian vegetation associated with implementation of the compensatory mitigation plan.

3.19.6 Terrestrial Wildlife

There would be an irretrievable loss of upland habitat and ephemeral drainages associated with the Lone Star Project construction and operation. These impacts would be reversible with successful implementation of the reclamation plan, returning affected areas to native habitats. In sensitive habitats with woody vegetation, it may require 50 years or longer to return to native conditions. Regardless of timeframes, it is possible that wildlife habitat affected during construction and operations could return to pre-development conditions, avoiding irreversible commitments of wildlife habitat over the long term. It is likely, however, that there would be an irreversible impact to species that are not very mobile, like amphibians utilizing the riparian areas.

3.19.7 Aquatic Resources

Irreversible impacts to aquatic habitat and macroinvertebrate and amphibians would occur in the waters of the U.S that are removed permanently. Habitat loss would be irreversible although other sites may be improved to make up for the loss.

3.19.8 Cultural Resources

Cultural resources would be irreversibly and irretrievably lost through disturbance; however, significant (NRHP-eligible) cultural resources would be mitigated through avoidance or data recovery.

3.19.9 Air Quality and Greenhouse Gases

Operation of mining and processing equipment would not exceed federal or state air quality standards. Local air quality would return to existing conditions after completion of project and reclamation. Therefore, the project would not result in irreversible or irretrievable effects on local air quality. However, emissions of GHGs for the life of the Project would have contributed to climate change and potentially result in irreversible effects on climate.

3.19.10 Land Use

There would be an irretrievable loss of private grazing land leased by FMSI. To achieve post-mining land uses of wildlife habitat, grazing would continue to be limited upon closure of the mine. This permanent reduction may cause ranchers to either reduce the number of livestock they manage under these private lease agreements, or relocate their herds to nearby federally-managed grazing allotments, if possible.

3.19.11 Aesthetics and Visual Resources

There would be an irretrievable loss of nighttime viewing conditions in the direction of the mine during the period of construction and operation. At the completion of mining, when lighting is removed, it would no longer affect the night sky. An irretrievable commitment of visual quality would occur in association with long-term uses of roads and facilities until these areas are reclaimed and revegetated.

There would be an irreversible loss of visual quality within the Project Area resulting from the introduction of project elements that would permanently alter the terrain. The leach pad and development rock stockpiles would remain in place and continue to be visible after closure and reclamation of the Lone Star pit. Existing views of the Gila Mountains would be irreversibly altered along the ridgelines at the Lone Star pit.

3.19.12 Transportation

Mine-related traffic impacts would continue for the life of mining operations, but would be reversible and would cease following mine closure and reclamation.

3.19.13 Noise and Vibration

The continuation of elevated noise levels and blasting that would occur within the Project Area during construction and operation would be an irretrievable impact. However, noise and blasting would be reversible and would cease following mine closure and reclamation.

3.19.14 Hazardous Materials and Solid Waste

No irreversible impacts or irretrievable commitment of resources are anticipated in relation to hazardous materials or solid wastes. However, if a spill were to affect a sensitive resource, an irretrievable impact could occur pending the cleanup of that spill and subsequent recovery of the resource.

3.19.15 Socioeconomics

The economic investment and human effort by employable labor associated with the construction and continued operation of the proposed project could be considered an irreversible commitment of resources. However, this commitment could be viewed as a positive impact due to the jobs created or maintained in this area that, in part, relies on mineral development as a major employer.

3.19.16 Environmental Justice

No irreversible and irretrievable impacts to Environmental Justice populations are anticipated.

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4.0 Consultation and Coordination

4.1 Public Participation and Scoping

Public participation began with the scoping process. Scoping is the process of actively soliciting input from the public and interested federal, state, and local agencies about a proposed action. The process provides a mechanism for determining the EIS scope and significant issues (40 CFR Parts 1501.7 and 1508.25) so the EIS can focus the analyses on areas of interest and concern. Therefore, the public's participation during the scoping period is a vital component to preparing a comprehensive and sound NEPA document. The Corps overall scoping goal for the EIS was to engage a diverse group of public, tribal, and agency participants in the NEPA process, solicit relevant input, and provide timely information during the EIS process.

The Corps initiated the scoping process by publishing the Notice of Intent to prepare the EIS in the Federal Register on January 5, 2015. Four newspaper display advertisements were published to provide information on the public scoping meeting. Ads were published (2 in each newspaper 1 week apart) in the Apache Messenger and Eastern Arizona Courier on January 21 and 28, 2015.

The Corps hosted one scoping meeting on February 4, 2015, in Safford, Arizona. The meeting provided an opportunity for the Corps to inform those in attendance about the Proposed Action and alternatives and the EIS process and to solicit input on the scope of the analysis and potential issues. Informational display stations positioned around the meeting room described the project and environmental resources in the Project Area, outlined the CWA permitting and NEPA processes, described the types of comments most useful to the Corps, and provided methods and deadlines for comment submittal. Technical experts from the Corps and FMSI were present to answer questions about the project.

At the end of the comment period, the scoping comments were compiled and analyzed to identify key issues and concerns. Some of the scoping comments were eliminated from consideration in the EIS because they addressed issues outside of the scope of the NEPA analyses, or the comment stated an opinion rather than a substantive comment that could be addressed in the EIS. A Scoping Summary Report was prepared and posted to the Corps' public website for the EIS.

4.1.1 Comments on NEPA Process

The scope of the EIS reflects input received from the public and from government agencies. Key issues identified during the scoping process include the following:

Scoping comments identified a need for multiple consultation and coordination processes, including:

- Biological consultations and coordination (USFWS, AGFD);
- Cultural resources consultation with the State Historic Preservation Office;
- Consultation with tribes (including Ak-Chin Indian Community, Gila River Indian Community, Salt River Pima-Maricopa Indian Community, San Carlos Apache Tribe, Tohono O'Odham Nation, and the White Mountain Apache Tribe); and
- Coordination with other agencies from which permits are required, such as ADEQ.

The Corps has been in contact with these federal and state agencies and tribes for comments and concerns. The issues summarized below reflect their concerns and interests. The Corps will continue to be in contact with applicable federal and state agencies and tribes throughout the NEPA process.

4.1.2 Comments on Purpose and Need

Comments stated that the EIS needs to adequately identify and describe the underlying need(s) for the project and the associated objectives or outcomes for purposes of both the NEPA analysis and the CWA Section 404(b)(1) alternatives analysis.

4.1.3 Comments on Alternatives

Comments stated that the Proposed Action description needs to adequately identify all resource requirements and include clear description of the processes and best available demonstrated control technology that would be used during the life of the project. Respondents also requested that the EIS include a petroleum-contaminated soil management plan, hazardous material storage plans and comprehensive reclamation plan for review and incorporation into the analysis.

As part of the EIS process and in accordance with the USEPA's 404(b)(1) guidelines, the Corps will conduct a comprehensive alternative assessment. Social and environmental issues, concerns, and opportunities will be considered in this assessment.

The Corps will develop a range of reasonable alternatives to be considered in detail in the Draft EIS. In reviewing possible project alternatives for consideration in the EIS, the Corps will examine numerous locations, operational methods, and mitigation measures. The type and range of alternatives will be determined from public comments and key issues that have been identified during the scoping process, as well as reviewing the purpose of and need for the proposed tailings storage facility. Some alternatives may be eliminated from detailed evaluation because they do not meet the purpose and need of the project, because they are outside the bounds of this project, or they have technical complications that would prohibit implementation. In addition, alternatives may be eliminated because they do not meet practicability requirements as described in the USEPA's 404(b)(1) guidelines (40 CFR Part 230).

NEPA requires that a "no action" alternative be considered in EIS documents. Under the No Action Alternative, the 404 permit for the proposed tailings storage facility would be denied. This alternative serves as the baseline for estimating the effects of action alternatives. The baseline for analysis would be the existing condition of the environment.

4.1.4 Comments on Resource Issues

Scoping issues related to specific resources are summarized near the beginning of each resource section in Chapter 3.0.

4.1.5 Comments on Mitigation and Monitoring

Comments recommended development of a comprehensive mitigation and monitoring plan. Areas of concern include: 1) effectiveness and enforceability of mitigation; 2) responsibility for implementation and enforcement 3) contingency measures if mitigation is not successful; 4) timeframe for management and monitoring; and 5) funding mechanisms.

4.2 Government-to-Government and Section 106 Consultation

In compliance with NHPA and Corps Policy Guidance Letter No. 57 (Indian Sovereignty and Government-to-Government Relations with Indian Tribes), the Corps is required to establish regular and meaningful consultation and collaboration with Native American tribal governments on undertakings within Corps jurisdiction. As such, the Corps-Los Angeles District initiated consultation with Native American tribes.

On May 22, 2015, the Corps mailed registered letters to seven tribes to formally invite each tribe to participate in consultation initiated under Section 106 of the NHPA. The tribes receiving letters are the

Ak Chin Indian Community, the Gila River Indian Community, the Hopi Tribe, the Salt River Pima-Maricopa Indian Community, the White Mountain Apache Tribe, the San Carlos Apache Tribe, and the Tohono O'odham Nation. The letter described the proposed project under consideration and informed the recipient that the Corps has made a determination of "adverse effect" related to the proposed project's effect on historic properties. Accompanying each letter was a document summarizing the cultural resources in the Project Area (Purcell 2014), two survey reports, and maps of the APE and the proposed footprint of the new facilities under Alternatives 1 and 2. The letter requested comments and input on the proposed project and potential effects on cultural resources. To date, no responses have been received.

A similar letter was sent to the Arizona State Historic Preservation Officer and communication is ongoing with that agency.

4.3 Public and Agency Outreach

In preparing the EIS, the Corps communicated with or received input from various federal, state, and local agencies. The following sections identify these contacts.

4.3.1 Federal and State Agencies

U.S. Environmental Protection Agency

Bureau of Land Management

Arizona Game and Fish Department

Arizona Department of Environmental Quality

4.3.2 Notification of Availability

The Notice of Availability of the Draft EIS was published in the Federal Register. Notification to the public of the availability of the Draft EIS and public hearings was made using advertisements in the Apache Messenger and Eastern Arizona Courier newspapers, as well as through email notifications or postcards to those who submitted scoping comments and a public notice on the Corps of Engineers website. Hard copies of the Draft EIS were made available in the Safford and Morenci, Arizona, libraries.

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5.0 EIS Preparers and Reviewers

The following table lists the Corps reviewers and the staff who prepared this EIS under direction of the Corps.

Table 5-1 List of Preparers and Reviewers

Responsibility	Affiliation / Name	Degree and Experience
U.S. Army Corps of Engineers EIS Team		
Chief, Arizona Regulatory Branch	Sallie Diebolt Arizona Regulatory Branch	BS Biology 18 years experience
Regulatory Project Manager	Michael Langley Arizona Regulatory Branch	BS Meteorology 26 years experience
AECOM EIS Team (Third-party Contractor to U.S. Army Corps of Engineers)		
Project Manager	Ellen Dietrich New Mexico	BA Anthropology 40 years experience
Assistant Project Manager, Visual Resources, Public Health and Safety	Anita Richardson Frijia Phoenix, Arizona	BS Applied Geography 17 years experience
Geology, Paleontology, Minerals; Groundwater Resources; Hazardous Materials and Solid Waste	Bill Berg Fort Collins, Colorado	MS Geology BS Geology 33 years experience
Surface Water Resources	David Fetter Fort Collins, Colorado	MS Civil Engineering BS Forest Management 31 years experience
Vegetation; Waters of the U.S., Wetlands, Riparian Areas	Rachel Puttmann Denver, Colorado	BS Biology MS Environmental Sciences 8 years experience
Waters of the U.S.	Meagan Jones	BS Environmental Biology 4 years experience
Soils	Terra Mascarenas Fort Collins, Colorado	BS Soil and Crop Science 18 years experience
Vegetation	Mandy Leming	BS, Natural Resource Management, Minor in Conservation Biology 12 years experience
Terrestrial Wildlife	Patricia Lorenz Fort Collins, Colorado	BS Wildlife Biology 12 years experience
Aquatic Resources	Rollin Daggett Fort Collins, Colorado	MS Freshwater and Marine Biology BS Zoology 40 years experience
Cultural Resources	Andy York San Diego, California	BA Cultural Anthropology MA Cultural Resource Management 30 years experience

Table 5-1 List of Preparers and Reviewers

Responsibility	Affiliation / Name	Degree and Experience
Air Quality, Climate Change	Marco Rodriguez Fort Collins, Colorado	Ph.D. Mechanical and Aerospace Engineering 11 years experience
Land Use	Chris Dunne Fort Collins, Colorado	BS Natural Resources Management 16 years experience
Transportation, Socioeconomics, Environmental Justice	Steve Graber AECOM Fort Collins, Colorado	BS Natural Resource Management BA Economics 10 years experience
Geographic Information Systems	Steve Ensley Denver, Colorado	BS Environmental Conservation 11 years experience
	Ben Tracy Fort Collins, Colorado	BA Humanities BS Natural Resources 5 years experience
Document Production	Susan Coughenour AECOM Fort Collins, Colorado	General Education Studies 29 years experience

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Glossary

Air quality related values (AQRVs)	Resources sensitive to air quality and include vegetation, soils, water, fish and wildlife, and visibility.
Alluvium	Material deposited by rivers that consist of silt, sand, clay, gravel and organic matter.
Ambient Noise	Background noise. The total volume of noise produced from nearby and distant sources.
Anthropogenic	Relating to, or resulting from the influence of human beings on nature.
Aquatic Resource of National Importance (ARNI)	A resource-based threshold used to determine whether a dispute between EPA and the Corps regarding individual permit cases are eligible for elevation under the 1992 MOA. Factors used in identifying ARNIs include: economic importance of the aquatic resource, rarity or uniqueness, and/or importance of the aquatic resource to the protection, maintenance, or enhancement of the quality of the nation's waters.
Aquifer	Any geological formation containing or conducting ground water, especially one that supplies the water for wells, springs, etc.
Archaic	The time period between 6000 B.C. to around A.D. 0.
Arroyo	A small steep-sided watercourse or gulch with a nearly flat floor: usually dry except after heavy rains.
Atmospheric Deposition	The process by which chemical substances, such as pollutants, are transferred from the atmosphere to the earth's surface.
Attainment Area	Any area (other than an area identified in clause (i)) that meets the national primary or secondary ambient air quality standard for the pollutant.
Carrying Capacity	The maximum population or level of activity that can be supported without degradation of the habitat or the population.
Chaparral	An ecological community composed of shrubs and dwarf trees.
Clastic	Denoting rocks composed of broken pieces of older rocks.
Confluence	The junction of two rivers, primarily rivers of approximately equal width.
Copper Deposit	Known copper mineralization continuous over a relatively large area.
Copper Resources	Rock containing copper mineralization.
Cretaceous	The geologic span of time between 144 and 66 million years ago.
Critical Habitat	Habitat that is present in minimum amounts and is the determining factor in the potential for population maintenance and growth.

Criteria Pollutants (Air)	Six commonly found air pollutants for which the USEPA sets standards. USEPA develops human health-based and/or environmentally based science-based guidelines for setting allowable levels of these pollutants. The six are: particle pollution, ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead.
Cumulative Impacts	The combined environmental impacts that accrue over time and space from a series of similar or related individual actions, contaminants, or projects. Although each action may seem to have a negligible impact, the combined effect can be significant. Included are activities of the past, present, and reasonably foreseeable future; synonymous with cumulative effects.
dBL	Air vibration is measured in linear or unweighted, decibels where the loudness of all frequencies is measured with the same sensitivity. Much of airblast noise energy is below the frequencies audible to humans so, unlike dBA, this measurement does not weight decibels to emphasize human sound perception. Linear decibels are logarithmic in scale, as are decibels, but are linear in terms of frequency response.
dBA	An "A" weighting is commonly used when sound is measured in decibels. It emphasizes vibrations at middle frequencies where the human ear is most sensitive, and puts less emphasis on the higher and lower frequencies to which the ear is not sensitive.
Decibel	Units of comparison of sound pressure on a logarithmic scale.
Direct Effects	Impacts that are caused by the action and occur at the same time and place (40 CFR 1508.7); synonymous with direct impacts.
Discharge	The volume of water flowing past a point per unit time, commonly expressed as cubic feet per second, gallons per minute, or million gallons per day.
Disturbed Area	An area where natural vegetation and soils have been removed.
Drainage	The natural channel through which water flows some time of the year; natural and artificial means for affecting discharge of water as by a system of surface and subsurface passages.
Drawdown	The lowering of the water level in a well as a result of withdrawal; the reduction in head at a point caused by the withdrawal of water from an aquifer.
Drum Agglomerators	Machines used to bring together fines in the presence of moisture via a large rotating drum.
Ecoregion	A major ecosystem defined by distinctive geography and receiving uniform solar radiation and moisture.
Electrowinning	The electrodeposition of metals from their ores that have been put in solution via a process commonly referred to as leaching.
Endangered Species	Any species in danger of extinction throughout all or a significant portion of its range. Plant or animal species identified by the Secretary of the Interior as endangered in accordance with the 1973 ESA.

Ephemeral Stream	A stream or portion of a stream that flows briefly in direct response to precipitation in the immediate vicinity and whose channel is at all times above the water table.
Fault	A fracture in rock units along which there has been displacement.
Floodplain	That portion of a river valley, adjacent to the channel, that is built of sediments deposited during the present regimen of the stream and that is covered with water when the river overflows its banks at flood stages.
Forage	Vegetation used for food by wildlife, particularly big game wildlife, and domestic livestock.
Forb	Any herbaceous plant other than a grass, especially one growing in a field or meadow.
Fugitive Dust	Dust particles suspended randomly in the air from road travel, excavation, and rock loading operations.
Fugitive emissions	Emissions of gases or vapors from pressurized equipment due to leaks and other unintended or irregular releases of gases.
Growth Media	Suitable material that may be used in place of topsoil for reclamation purposes.
Hertz (H_Z)	Unit of frequency of one cycle per second.
Historic	The time period after A.D. 1600.
Holocene	Geologic span of time from 11.7 thousand years ago to present.
Hydraulic Conductivity	The capacity of a rock to transmit water. It is expressed as the volume of water at the existing kinematic viscosity that will move in unit time under a unit hydraulic gradient through a unit area measured at right angles to the direction of flow.
Hydrologic Unit Code (HUC)	A way of identifying all of the drainage basins in the United States in a nested arrangement from largest (Regions) to smallest (Cataloging Units).
Igneous	Having solidified from lava or magma.
Impact	A modification in the status of the environment brought about by the Proposed Action or an alternative.
Impoundment	A body of water confined within an enclosure, such as a reservoir.
Indirect Effects	Impacts that are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable (40 CFR 1508.8); synonymous with indirect effects.
Infrastructure	The basic framework or underlying foundation of a community or project, including road networks, electric and gas distribution, water and sanitation services, and facilities.
Intactness	The integrity of visual order in the natural and man-build landscape, and the extent to which the landscape is free from visual encroachment.
Intermittent Stream	A stream that flows only part of the time or during part of the year.
Invertebrate	An animal without a backbone.

Irretrievable	Applies primarily to the lost production or use of natural resources during the life of the project.
Irreversible	Applies primarily to the use of nonrenewable resources, such as minerals, cultural resources, wetlands, or to those factors that are renewable only over long time spans, such as soil productivity. Irreversible also includes loss of future options.
Jurisdictional Wetland	A wetland area identified and delineated by specific technical criteria, field indicators, and other information for purposes of public agency jurisdiction. The public agencies that administer jurisdictional wetlands are the USACE, USEPA, USFWS, and NRCS (see Wetland).
Lacustrine	Permanently flooded and intermittent lakes and reservoirs that typically have extensive areas of deep water
Lithic Scatter (Archaeology)	A discrete grouping of flakes of stone created as a byproduct in the tool making process. Often includes flakes used as tools as well as formal stone tools, such as projectile points, knives, or scrapers.
Level of Service (LOS) (Transportation)	A standardized method of qualitatively measuring the operational conditions of traffic flows on roadways and the perception of those conditions by motorists and passengers.
Macroinvertebrate	Animals lacking a spinal cord that can be seen without magnification.
Meteoric Water	Water that is derived from precipitation (snow and rain). This includes water from lakes, rivers, and icemelts, which all originate from precipitation indirectly.
Mineralization	The hydrothermal deposition of economically important metals in the formation of ore bodies or lodes.
Mitigate, Mitigation	To cause to become less severe or harmful; actions to avoid, minimize, rectify, reduce or eliminate, and compensate for impacts to environmental resources.
Mixing Height	The height above ground within which rising warm air from the surface would mix by convection and turbulence
Monitor	To systematically and repeatedly watch, observe, or measure environmental conditions in order to track changes.
National Environmental Policy Act (NEPA)	The NEPA of 1969; the national charter for Protection Act protecting the environment. NEPA establishes policy, sets goals, and provides means for carrying out the policy. Regulations from 40 CFR 1500-1508 implement the act.
National Register of Historic Places (NRHP)	A list, maintained by the NPS, of areas that have been designated as being of historical significance.
Native American Consultation Database (NACD)	A tool for identifying consultation contacts for Indian tribes and Native Hawaiian organizations developed by the NPS.
Native Species	Plants that originated in the area in which they are found (i.e., they naturally occur in that area).
Neogene	Geologic period starting 23.03 million years ago and ending 2.58 million years ago.

Noise	Unwanted sound; one that interferes with one's hearing of something; a sound that lacks agreeable musical quality or is noticeably unpleasant.
Noxious Weed	Any species of plant that is detrimental or destructive and difficult to control or eradicate and includes plant organisms found injurious to any domesticated, cultivated, native, or wild plant.
Open Pit	Mine type/method currently used to recover ore from ore bodies at the Safford Mine Facility.
Ore	A naturally occurring mineral containing a valuable constituent (such as metal) for which it is mined and worked.
Ore Body	The portion of a mineral deposit that has been determined to be economically recoverable ore.
Outfalls	Discharge points from the drainage control system to downstream drainages.
Overburden	Material that must be removed to allow access to an orebody, particularly in a surface mining operation.
Paleontology	The study of fossils; what fossils tell us about the ecologies of the past, about evolution, and about out place, as humans, in the world. Information about interrelationship between the biological and geological components of ecosystems over time.
Passerine	Referring to birds in the order Passeriformes, which includes perching birds.
Peak Flow	The greatest flow attained during winter snowmelt or during a large precipitation event.
Peak Particle Velocity (PPV)	The maximum speed of a particular particle as it oscillates about a point of equilibrium that is moved by a passing wave used to describe vibration, or elastic movement, resulting from excitation by seismic energy as it passes a particular point.
Perennial Stream	A stream or reach of a stream that flows throughout the year.
pH	The measure of the acidity or basicity of a solution.
Phreatophytes	Plants that rely on a constant source of surface water or shallow groundwater.
Physiographic	Based on terrain texture, rock type, and geologic structure and history.
Pliocene	Geologic timescale that extends from 5.333 million to 2.58 million years before present.
Pleistocene	Geologic span of time occurring 1.8 million years ago and lasted until about 11,700 years ago.
Project Area	The contiguous 36,050 acres owned by FMSI within the Safford Mining District.
Raptor	A bird of prey, including eagles, hawks, falcons, osprey, and owls.
Reclamation	The process by which lands disturbed as a result of human activity are restored to the original condition.

Recovery (Groundwater)	Used to refer to an increase in water levels following drawdown. An increase in groundwater levels such that the groundwater elevations return to approximate initial baseline groundwater elevations.
Residual Impacts	Remaining results or conditions after project and mitigation completion.
Right-of-way	Strip of land or corridor through which a power line, access road, or maintenance road would pass.
Riparian Area	The vegetated transitional zones that lie between aquatic and terrestrial (upland) environments. Riparian areas usually occur as belts along streams, rivers, lakes, marshes, bogs, and other water bodies.
Runoff	That part of precipitation that appears in surface streams; precipitation that is not retained on the site where it falls and is not absorbed by the soil.
Safford Mine Facility	The overall active and planned mine operations including Dos Pobres open pit, San Juan open pit, future Lone Star open pit, and existing processing facilities.
Safford Mining District	All areas of mining potential within the geographical area (including Dos Pobres, San Juan, Lone Star, Sanchez, and others) on both private and public land.
Sediment	Material suspended in or settling to the bottom of a liquid. Sediment input comes from natural sources, such as soil erosion and rock weathering, as well as construction activities or anthropogenic sources, such as forest or agricultural practices.
Slough	An area of soft, muddy ground; swamp or swamplike.
Soil Horizon	A layer of soil material approximately parallel to the land surface differing from adjacent genetically related layers in physical, chemical, and biological properties.
Stratigraphy	Form, arrangement, geographic distribution, chronological succession, classification, and relationships of rocklayers.
Subsidence	The gradual caving in or sinking of an area of land.
Terrace	A nearly level strip of land with a more or less abrupt descent along the margin of the sea, a lake, or a river.
Terrestrial	Species living or growing on land or on or in the ground; not aquatic, arboreal, or epiphytic
Tertiary	The geologic span of time between 65 and 3 to 2 million years ago.
Arizona Pollutant Discharge Elimination System (AZPDES)	A part of the Clean Water Act that requires point source dischargers to obtain Elimination System permits. In Arizona, these permits are referred to as AZPDES permits and are administered by the state.
Threatened Species	Any species of plant or animal that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Topography	The form and structure of the surface of land.
Understory	Underlying plants (smaller trees, saplings, shrubs, grasses) that grow below the larger trees in a forest.
Unity	The visual coherence and harmony of the landscape when considered as a whole.
Viewshed	The area from which the proposed project area can be seen.
Visual Sensitivity	A relative measure of the degree of concern by the viewer for changes in the landscape.
Vividness	The memorability of the visual impression received from contrasting landscape elements as they combine to form a striking and distinctive visual pattern.
Volatile Organics	Large group of carbon-based chemicals that easily evaporate at room temperature and can affect air quality.
Water Table	Level of water in the saturated zone at which the pressure is equal to the atmospheric pressure.
Waters of the United States	A jurisdictional term from Section 404 of the CWA referring to water bodies such as lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds. The use, degradation, or destruction of these waters could affect interstate or foreign commerce.
Watershed	A region or area bounded peripherally by a water parting divide, and draining ultimately to one particular location, usually a watercourse or body of water.
Wetlands	Areas that are inundated by surface or groundwater with a frequency sufficient to support (and under normal circumstances do or would support) a prevalence of vegetation or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.
Wind Rose (Air)	Weather map showing the frequency and strength of winds from different directions.
Xeroriparian	A xeric riparian zone

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Appendix A

CWA Section 404(b)(1) Alternatives Analysis

CWA SECTION 404(b)(1) ALTERNATIVES ANALYSIS

LONE STAR ORE BODY DEVELOPMENT PROJECT

Prepared for:

United States Army Corps of Engineers

On Behalf of:

Freeport-McMoRan Safford Inc.

Prepared by:

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Project No. 0201.26 D 04.1

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(*follow text*)

1. INTRODUCTION

Freeport-McMoRan Safford Inc. (FMSI) has proposed the development of the mineral resources associated with the Lone Star ore body, located on lands owned and managed by FMSI, and proximate to their existing copper mining operations in Safford, Arizona (***Figure 1***). Development of the mineral resources associated with the Lone Star ore body (the Project) will require several common components of an open-pit copper mine including development rock stockpiles, a heap leach pad, additional conveyance route infrastructure, an expanded compactable soil borrow source, related stormwater management facilities, and other appurtenant features, in addition to the open pit itself. The proposed Project requires the discharge of fill to surface drainage features that the U.S. Army Corps of Engineers (Corps) has preliminarily determined (SPL-2014-00065-MWL) may be jurisdictional waters of the United States (waters of the U.S.), and FMSI has made application for a Department of the Army permit for development of the Project. The Corps has determined that the preparation of an Environmental Impact Statement (EIS) pursuant to the National Environmental Policy Act (NEPA) is necessary prior to their determination whether to issue a permit for the Project.

An analysis of alternatives is required to demonstrate compliance with guidelines established under the Clean Water Act (CWA) Section 404(b)(1) (40 CFR §230) for avoidance and minimization of impacts to jurisdictional waters of the U.S. The 404(b)(1) alternatives analysis is intended to ensure that no discharge be permitted "if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences" (40 CFR §230.10(a)). NEPA policy directs that federal agencies should identify and assess reasonable alternatives to the proposed action (40 CFR §1500.2(e)). The Council on Environmental Quality (CEQ) identifies *reasonable* alternatives as "those that are practical or feasible from the technical and economic standpoint and using common sense" (CEQ 1981). This 404(b)(1) document has been prepared in compliance with the guidelines provided at 40 CFR §230 to identify *practicable* alternatives that meet the Project's purpose and need. An alternative is deemed practicable if it is "available and capable of being implemented after taking into consideration existing technology, logistics, and economics in light of overall project purpose" (40 CFR §230.10(a)).

In the context of both NEPA and the CWA Section 404(b)(1) requirements, this alternatives analysis, once accepted by the Corps, identifies the range of reasonable alternatives that would be considered in the Corps' NEPA analysis of the proposed project. To complete this assessment, a set of alternatives was formulated for each of the major elements of the Project, and the anticipated impacts to potential waters of the U.S. under each alternative of the element are presented. The practicability of the element's alternatives were then analyzed to identify the least environmentally damaging practicable alternative for each component which fulfills the Project purpose. Practicable alternatives of these elements were organized into Project design alternatives that could fulfill the Project purpose.

The screening provided by the analysis herein identifies practicable alternatives, which in turn will be brought forward for detailed analysis in the EIS that is being prepared by the Corps for this project. Other alternatives evaluated herein that are not considered practicable will not be analyzed in detail in the EIS.

For the purposes of this alternatives analysis, the FMSI-owned property of the existing Safford Mine has been defined as the Analysis Area (***Figure 2***). The impacts to potential waters of the U.S. evaluated under each of the alternatives presented in this document are based on the Preliminary Jurisdictional Delineation (SPL-2014-00065-MWL) completed by the Corps for the Project.

This alternatives analysis document is presented in seven sections:

Section 1. *Introduction*. This section includes the purpose and organization of the alternatives analysis document.

Section 2. *Project History and Background*. Section 2 provides background information on the Project, identifies the basic and overall project purposes, and describes the physical and natural environment of the Analysis Area, including the extent of potential waters of the U.S. within the Analysis Area.

Section 3. *Formulation of Element and Project Alternatives*. Section 3 provides a description of the general approach taken in formulating alternatives for each of the major elements of the Project, and in combining those elements into Project design alternatives that could potentially satisfy the applicant's overall Project purpose. Information presented in this section includes the factors considered in determining the geographic scope of the Analysis Area, a description of the practicability criteria used in the evaluation of element and Project design alternatives, and a list of the element and Project design alternatives to be considered.

Section 4. *Element Alternative Description and Practicability Determination*. Section 4 provides a description and practicability analysis for alternatives to each of the three major mine elements identified for the Project: a heap leach pad, development rock stockpiles, and conveyance route infrastructure between the crushing plant and the pit. The section includes this description and analysis for nine heap leach pad alternatives, five development rock stockpile alternatives, and three conveyance route alternatives. The practicability analysis is an evaluation of the practicability of each element alternative per the CWA Section 404(b)(1) (40 CFR §230) guidelines and an assessment of the impact of each element alternative on the aquatic ecosystem and the overall environment.

Section 5. *Project Design Alternative Description and Practicability Determination*. Section 5 provides a description and practicability analysis for the two design alternatives identified for the Project. Project design alternatives are analyzed as combinations of the element alternatives identified as practicable in *Section 4*. The practicability analysis for Project design alternatives is an evaluation of the practicability of each alternative per the CWA Section 404(b)(1) (40 CFR §230) guidelines and an assessment of the impact of each alternative on the aquatic ecosystem and the overall environment.

Section 6. *Practicable Alternatives – Identification of Impacts to Waters of the U.S. and Other Adverse Environmental Consequences*. This section provides a comparative analysis of those alternatives determined to be practicable in the previous section. This comparative analysis includes a discussion of impacts to the aquatic ecosystem (waters of the U.S.) and other anticipated adverse environmental consequences under each of the practicable alternatives. Based partly on these anticipated impacts, the section further discusses these impacts in the context of other identified cumulative impacts.

Section 7. *Summary and Conclusions*. In Section 7, the findings of the analysis are summarized, and the least environmentally damaging practicable alternative for the Project that meets the overall purpose is identified.

Section 8. *References*. Section 8 lists all reference materials cited in this alternatives analysis document.

2. PROJECT HISTORY AND BACKGROUND

2.1. SAFFORD MINING DISTRICT

Located in eastern Arizona, the Safford Mine has been in operation for almost 8 years under the ownership of FMSI, formerly Phelps Dodge Safford Inc. FMSI owns and manages approximately 36,050 acres of privately held lands within and surrounding the existing Safford Mine facility, north of the City of Safford, Graham County, Arizona (see ***Figure 1***). These privately held lands comprise the Analysis Area (see ***Figure 2***) used for the formulation and evaluation of element and Project design alternatives, and include portions of Sections 35 and 36, Township 5 South, Range 25 East; portions of Sections 19-22 and 26-36, Township 5 South, Range 26 East; portions of Sections 31-33, Township 5 South, Range 27 East; portions of Sections 1, 2, and 11-14, Township 6 South, Range 25 East; portions of Sections 1-18, 23-26, 35, and 36, Township 6 South, Range 26 East; portions of Sections 3-10, 17-20, 30, and 31, Township 6 South, Range 27 East; and portions of Sections 5 and 6, Township 7 South, Range 27 East.

The Safford Mine is located within the Safford Mining District, and lands within the Analysis Area have been used for mining activities by various entities for more than a century. FMSI (or its predecessors) first began development of an underground copper mining operation in the district in the 1960s, and later purchased other properties in the vicinity. Between 1994 and 1996, FMSI initiated discussions to obtain authorization from the Bureau of Land Management (BLM) and the Corps to construct the Safford Mine, and in May 1996, formally initiated NEPA review of this proposal through submission of a Mine Plan of Operations (MPO) to the BLM. NEPA review of the project, termed the Dos Pobres/San Juan Project (DP/SJ Project) after the ore bodies proposed for development, involved the publication of a Draft Environmental Impact Statement (DEIS) in September 1998, a Final Environmental Impact Statement (FEIS) in December 2003, and a BLM Record of Decision (ROD; No. 1793 [AZ-040] AZA-31133) in June 2004. As a component of the NEPA review, the Corps (a cooperating agency for the EIS) completed a Section 404(b)(1) Alternatives Analysis in October 1997 and issued a Section 404 Individual Permit (No. 964-0202-MB) for impacts to Waters from development of the DP/SJ Project on September 27, 2004.

The existing Safford Mine is currently an open-pit copper mining operation consisting of two pits, the Dos Pobres Pit and the San Juan Pit, and the associated handling, processing, and support infrastructure for mineral resources recovered from the two pits (***Figure 3***). Existing features of this integrated system include a three-stage crushing system, two drum agglomerators, a heap leach pad, a solution extraction/electrowinning (SX/EW) processing facility, and support facilities (see ***Figure 3***). Each of the pits has an associated development rock stockpile: for Dos Pobres immediately west of the pit, and for San Juan immediately south of the pit (see ***Figure 3***). A compactible soil borrow area, or clay borrow pit, is located in the southeastern portion of the current Analysis Area, away from the main location of the other Safford Mine facilities (see ***Figure 3***).

Currently, mineral resources from the both the Dos Pobres and San Juan pits are hauled by truck to the crushing plant within the existing Safford Mine. Crushed materials are transported by conveyor to the drum agglomerators, where they are mixed with sulfuric acid and water to a moisture content of 6 to 8 percent. Agglomerated ore is transported to the heap leach pad on a series of belt conveyors and placed using a radial stacker. Each lift placed on the heap leach pad is typically between 15 feet and 22 feet in height and is placed at a setback to the previous lift. Pregnant leach solution (PLS) from the heap leach pad drains to collection ponds and is transported to the SX/EW processing facilities southwest of the leach pad for recovery of the copper in solution. The DP/SJ Project anticipated the production of approximately 2.9 billion pounds of saleable copper through the mining of 626 million tons of leachable oxide and sulfide ores. The mining of approximately 385 million tons of low-grade and non-mineralized materials, referred to as development rock, was also anticipated during mine operation. The life-of-mine (LOM) for the recovery of leachable oxide and sulfide ores from the Dos Pobres and San Juan pits was estimated at 16 years.

2.2. LONE STAR ORE BODY DEVELOPMENT PROJECT

FMSI has proposed the development of the mineral resources associated with the Lone Star ore body (***Figure 4***), located on the private, FMSI-owned lands of the Analysis Area, and proximate to the existing Safford Mine. The Dos Pobres and San Juan pits will be nearing the end of the current LOM anticipated under the DP/SJ Project. Development of the Lone Star ore body was originally considered as a Reasonably Foreseeable Future Action (RFFA) during NEPA review of the DP/SJ Project, and the lands around the ore body (as it was defined at that time) were identified as having mining operations as an anticipated future use (***Figure 5***). Development of the Lone Star ore body was also considered in the cumulative impacts analysis of the 2003 FEIS for the DP/SJ Project.

Since authorization of the DP/SJ Project, FMSI has undertaken additional evaluation of the Lone Star ore body to define the mineral resource associated with this porphyry copper deposit. The results of this evaluation indicate that the Lone Star ore body contains an estimated 785 million tons of leachable oxide and sulfide ores that are economically recoverable under current market prices. As described below, the purpose of the currently proposed Project is the economic recovery of the mineral resources associated with the Lone Star ore body. FMSI has designed the proposed Lone Star Project to make use of as much of the existing Safford Mine infrastructure as is practicable. Although the location of the open pit for the Project is tied to the physical location of the mineral resource, the locations of the remaining Project elements under the analysis have been optimized to continue using existing infrastructure wherever possible. These existing elements are identified under each of the alternatives analyzed below. New elements anticipated as necessary for the development of the Project under all Project alternatives include the open pit, a heap leach pad, development rock stockpile(s), the conveyance route between the pit and crusher, additional power distribution infrastructure, an expanded clay borrow pit, soil and growth medium stockpiles, a truck service complex, a communications tower, and additional stormwater management facilities. Where alternatives require the replacement of an existing infrastructure element, such as a new crushing facility, these replaced elements and their proposed location(s) are identified under the alternative description.

Recent world copper demand averages approximately 2.2 kilograms (5 pounds) of copper per capita per year (Snider 2010), requiring approximately 15.9 million tons of production each year worldwide. Demand for copper, and commodity resources in general, has recently been driven primarily by the growth of the middle class in developing countries such as Brazil, Russia, India, and China, as well as Mexico and South Korea. The rate of growth in developing countries has been nearly three times that in developed countries (Grantham 2011), leading to predictions that the increase in per capita consumption over the next 20 years (Snider 2010) will require the production of between 36.6 and 42.1 million tons of copper per year, an increase of 2.3 to 2.65 times current production. Despite higher production yields from new technologies, the extensive time involved in developing new mines, including exploration, environmental impact studies, and permitting, requires the full utilization of known resources in existing mines to meet the predicted global demand. Therefore, the need for this Project is driven by the anticipated increases in world copper demand forecast through the year 2050, and FMSI's desire to maximize the use of existing infrastructure developed to support mining activities at the Safford Mine to help meet this demand.

2.3. PURPOSE OF THE PROJECT

In accordance with the requirements of the Section 404(b)(1) guidelines, for the purpose of determining a project's water dependency, the basic Project purpose is copper mining, which is not water dependent. For the development of alternatives to the proposed Project, the overall Project purpose is the construction of mining facilities, including development rock stockpiles and a heap leach pad, which will allow continued mining at the Safford Mine through the development of the mineral resources associated with the Lone Star ore body using conventional open-pit mining, heap leaching techniques, and SX/EW processing, and utilizing as much of the existing Safford Mine as practicable, for the purpose of producing copper. Copper production will take place in a manner that is sensitive to the natural environment and in compliance with applicable regulations, with an economic return adequate to justify the development costs and risks associated with the construction of the Project elements and associated facilities.

2.4. PHYSICAL AND NATURAL ENVIRONMENT

The Analysis Area is located in the Safford Valley, north of the Gila River, near the City of Safford, Arizona. Elevations within the Analysis Area range from approximately 3,010 feet (ft) above mean sea level (amsl) to approximately 6,095 ft amsl. The topography of the Analysis Area consists primarily of the gently sloping bajada between the rocky slopes of the southern edge of the Gila Mountains and the alluvial floodplain of the Gila River. The sediments that form this bajada are principally derived from the basalt, andesite, and rhyolite bedrock of the Gila Mountains. The drainages in the Analysis Area are all ephemeral, dendritic in form on the higher slopes, but gradually becoming braided as the slope gradient decreases. The primary drainages within the Analysis Area, from east to west, are Wilson Wash, Peterson Wash, Cottonwood Wash, Talley Wash, Watson Wash, and Coyote Wash. All of these drainages ultimately report to the Gila River.

Climate in the Safford Valley is temperate and semi-arid, with a growing season of about 200 days per year (Sellers and Hill 1974). Measures of the average daily minimum and maximum temperatures and the mean annual precipitation near the Analysis Area were obtained from the Western Regional Climate Center (WRCC), and are based on data collected at the National Climate Data Center (NCDC). The nearest operating station in the National Weather Service (NWS) Cooperative Network is the Safford Agricultural Center station (Station ID 027390) located approximately three miles south of the Analysis Area (WRCC 2013). The other nearest stations are Safford (Station ID 021849) approximately two miles to the southwest, and Fort Thomas 2 SW, Arizona (Station ID 023510) approximately 13 miles to the northwest. The Safford station ceased operation in 1973, but the Fort Thomas 2 SW station is still in operation.

Records from the Safford Agricultural Center station indicate an average daily maximum temperature of 80.1° Fahrenheit (F) and an average daily minimum temperature of 46.5°F for the period of record between 1948 and 2012. The Fort Thomas SW 2 records indicate similar temperature values for the period of record between 1966 and 2012: an average daily maximum temperature of 80.3°F and an average daily minimum temperature of 46.7°F. Mean annual precipitation is 8.93 inches at the Safford Agricultural Center station and 9.79 inches at the Fort Thomas 2 SW station. The vast majority of this precipitation comes in the form of rain, although light snow is possible. The snowfall in the vicinity of the Analysis Area generally functions in the same capacity as rainfall, usually melting and running off in the course of a single day, rather than forming a "snow pack" in the traditional sense of that term.

The Analysis Area is mapped primarily within two biotic communities as described by Brown (1994): the Arizona Upland subdivision of the Sonoran Desertscrub biotic community and the Semidesert Grassland biotic community. Native vegetation within the majority of the Analysis Area, and between the Analysis Area and the Gila River, is generally more characteristic of the Arizona Upland subdivision of the Sonoran Desertscrub biotic community. Throughout most of the Analysis Area, this community is dominated by creosotebush (*Larrea tridentata*). Within the Analysis Area, the biotic communities generally progress from Sonoran Desertscrub to Semidesert Grassland through an ecotone of the two communities from southwest to northeast, following the general trend of rising elevation. The Semidesert Grassland biotic community is dominated by snakeweed (*Gutierrezia sarothrae*) and grasses, with generally widely scattered shrubs and trees. The ecotone between the two biotic communities supports a mixture of species found in those communities. The only species of plant more common in the transition area than in either the Sonoran Desertscrub or Semidesert Grassland is jojoba (*Simmondsia chinensis*), which occurs in dense patches on some north- and west-facing hillsides in the foothills of the Gila Mountains.

Vegetation along the larger drainages within the Analysis Area is xeroriparian, and is composed of a variety of plant species common to the upland habitats of the Analysis Area. The majority of xeroriparian habitats in the Analysis Area are dominated by mesquite (*Prosopis juliflora*), catclaw acacia (*Senegalia greggii*), whitethorn acacia (*Vachellia constricta*), blue paloverde (*Parkinsonia florida*), and desert broom

(*Baccharis sarothroides*). One drainage in the northeastern portion of the Analysis Area, Bear Spring Canyon, is dominated by scrub live oak (*Quercus turbinella*).

2.5. WATERS OF THE UNITED STATES

As noted above, the drainages in the Analysis Area are all ephemeral, dendritic in form on the higher slopes, but gradually becoming braided as the slope gradient decreases. Notwithstanding the nature of these drainages, a Preliminary Jurisdictional Delineation (SPL-2014-00065-MWL) was completed by the Corps in accordance with Regulatory Guidance Letter (RGL) 08-02. The Preliminary Jurisdictional Delineation found there 'may be' waters of the U.S. within the Analysis Area, as indicated by an observable ordinary high water mark (OHWM) present within the ephemeral drainages (***Figure 6***). In jurisdictional waters of the U.S., the OHWM, as defined at 33 CFR §328, represents the lateral boundaries of potential Corps jurisdiction.

WestLand Resources Inc. (WestLand) performed field delineations of the characteristics of an OHWM within Analysis Area drainages between July 17 and 27, 2012, and March 26 through 28, 2013. Observed OHWM characteristics consisted mainly of evidence of sediment sorting and a change in substrate in the drainage as compared to the surrounding upland area. A clear, definable bed and bank was difficult to discern for all but the largest drainages within Analysis Area. The field delineation was used to interpret the characteristics of the drainage features visible on current aerial photography. The Corps subsequently visited the Analysis Area in November 2014 to review the OHWM delineation.

The Corps signed a Preliminary Jurisdictional Delineation (SPL-2014-00065-MWL) on January 2, 2015. The delineation documents 474 acres of potential waters of the U.S. present within the Analysis Area. All of the potential waters of the U.S. identified within the Analysis Area were ephemeral drainages, and no areas meeting the criteria for wetlands were identified. The delineation did not consider ephemeral drainages previously considered as impacted or lost under the 2004 Section 404 Individual Permit (No. 964-0202-MB) for the development of the DP/SJ Project.

The impacts to potential waters of the U.S. considered in the analysis of alternatives for the proposed Project only include those impacts within the direct footprint of the alternative, and do not include indirect, downstream secondary effects. Authorization for development of the existing Safford Mine included the issuance of a CWA Section 404 permit, Permit Number 964-0202-MB, and the implementation of a CWA Section 404 Mitigation and Monitoring Plan (MMP), dated December 27, 2002. This MMP includes a monitoring provision known as the Downstream Monitoring Program, developed to monitor those drainages considered dewatered, and therefore indirectly impacted, by stormwater diversion and mine development activities for a period of 15 years. Monitoring data was also collected from a set of unimpacted, or control, drainages for comparison and analysis. Downstream monitoring has been conducted in 2006, 2011, and 2015.

As detailed in the 2015 Downstream Monitoring Program report provided to the Corps (WestLand 2015), the analysis of monitoring data does not show a significant loss of function in those drainages described as dewatered, as compared to the control drainages. Both dewatered and control drainages showed an increase in live vegetation volume, or LVV, and the percent increase in LVV did not differ between the drainage groups (WestLand 2015). Both the ground photos and geomorphological transects demonstrate there has been no functionally meaningful change in channel structure or configuration at the monitoring sites in either group of drainages. Based on these data, indirect impacts to the function of any potential waters of the U.S. are not anticipated from the development any Project alternative and are not considered further in this analysis.

3. FORMULATION OF ELEMENT AND PROJECT ALTERNATIVES

This section of the alternatives analysis outlines the approach utilized to develop alternative configurations of Project elements and infrastructure and to develop the combinations of those elements into Project design alternatives that meet the overall purpose of the Project. Information presented in this section includes the factors considered in determining the geographic scope of the Analysis Area, the factors considered in determining the geographic scope for each element alternative, a description of the practicability criteria used in the evaluation of alternatives of each element, a description of the practicability criteria used in the evaluation of Project design alternatives, and a list of the element and Project design alternatives considered. An alternative is deemed *practicable* if it is "available and capable of being implemented after taking into consideration existing technology, logistics, and economics in light of overall project purpose (40 CFR §230.10(a))." FMSI formulated a number of alternatives for each Project element and combined those elements into Project design alternatives to accomplish the overall Project purpose. The Analysis Area developed for the evaluation of both element and Project design alternatives was based on the nature of the Project purpose, the location of the Lone Star mineral resources, the distribution of potential waters of the U.S. within the Analysis Area, and the location of the existing infrastructure within the Safford Mine.

3.1. GEOGRAPHIC SCOPE OF THE ANALYSIS AREA

The geographic scope of the overall Analysis Area (see ***Figure 2***) consists of the entire 36,050 acres of FMSI-owned lands surrounding the mineral resources of the Lone Star ore body and the existing infrastructure of the Safford Mine. The ore body and existing infrastructure form fixed loci for both the geographic scope of the overall Analysis Area and the evaluation of alternatives for individual Project elements. The location of the open pit for the Project is tied to the physical location of the mineral resource, and, in actual practice, the placement of development rock stockpiles and the leach pad are not functionally independent of the pit location. Haul distance for both development rock and ore-bearing rock is a significant factor in the economic recovery of the copper ore, and is considered in the extent of the geographic scope of the current Analysis Area. FMSI has also designed the proposed Project to make use of as much of the existing infrastructure developed for the DP/SJ Project as is practicable, to minimize both cost and environmental impact.

The resulting Analysis Area is bounded by several major topographic, geopolitical, and/or geographic features of the region. The existing Safford Mine and the Lone Star ore body are located within the upper Gila River watershed. The Gila River forms a major geographic boundary to the south of the Analysis Area, with sections of BLM, State, and privately managed lands between the active channel of the river and the southern boundary of the Analysis Area (***Figure 7***). The eastern boundary of the Analysis Area is defined by the Bonita Creek watershed, which is separated from the Analysis Area by a ridge of the Gila Mountains. The northern boundary is generally defined by the higher elevations of the southern Gila Mountains, and the BLM and State-managed lands north of the Analysis Area. The southern edge of the San Carlos Apache Reservation also lies several miles to the north of the Analysis Area boundary.

No major topographic feature constrains the Analysis Area to the west; the western boundary is described completely by the interface between the BLM-managed and FMSI-owned lands in this portion of the Analysis Area. However, the distribution of ephemeral drainages on the bajada landform west of the Analysis Area are anticipated to be similar to that distribution found within the western portion of the Analysis Area. Any element alternatives or Project design alternatives placed west of the current Analysis Area boundary would be anticipated to impact similar amounts of potential waters of the U.S. as those located on the bajada landform within the Analysis Area as currently described. The distance from both the Lone Star ore body and the existing Safford Mine infrastructure also become important factors limiting extension of the Analysis Area further to the west.

There are no special aquatic sites within the areas of any of the proposed element alternative footprints, nor within any Project design alternative footprint described herein. As such, the presumption that a less damaging, practicable offsite alternative exists does not apply [Army Corps of Engineers Standard Operating Procedures for the Regulatory Program, Section 12, 2009; 40 CFR §230.10(a)(3)].

3.2. GENERAL ALTERNATIVE DEVELOPMENT CRITERIA

This section of the alternatives analysis describes the general criteria used to develop the range of alternatives for each of the Project elements, and to develop the combinations of those elements into Project design alternatives that meet the overall purpose of the Lone Star Project. An alternative is deemed practicable if it is "available and capable of being implemented after taking into consideration existing technology, logistics, and economics in light of overall project purpose" (40 CFR §230.10(a)). Mine elements anticipated as necessary for the development of the Project under all Project design alternatives, and fulfillment of the overall Project purpose include the open pit, a heap leach pad, development rock stockpile(s), the conveyance route between the pit and crusher, additional power distribution infrastructure, an expanded clay borrow pit, soil and growth medium stockpiles, a truck service complex, a communications tower, and additional stormwater management facilities. Alternatives for mine elements determined not to be practicable were not carried forward in the development of Project design alternatives.

The alternatives developed by FMSI have been designed to minimize impacts to potential waters of the U.S. to the maximum extent practicable. As described in *Section 3.3* below, not all of the proposed Project elements impact potential waters of the U.S. The development of alternative designs for the Project incorporated a substantial effort to avoid and minimize impacts to potential waters of the U.S. For most of the alternatives analyzed in this document, only the heap leach pad, development rock stockpile(s), the conveyance route between the pit and crusher, and the stormwater management facilities have impacts to potential waters of the U.S. The continued use of existing operational infrastructure wherever possible was considered a general criterion of this avoidance and minimization. However, some of the alternatives analyzed below do contemplate the construction of otherwise existing infrastructure in a new location as required by the location and operational design of mine elements. For example, some alternatives for the heap leach pad in the eastern end of the Analysis Area would require the construction of new crushing and SX/EW facilities, rather than the continued use of the existing facilities. These additional requirements are identified under each of the alternatives, as necessary.

Land position was considered in the development of alternatives. There are two areas of land not owned by FMSI, interior to the boundary of the Analysis Area. These lands include the Melody Claims in the central portion of the Analysis Area and the Horseshoe Claims Property in the eastern portion of the Analysis Area (see ***Figure 3***). The Melody Claims property consists of thirty-one unpatented mining claims managed by the United States Department of Interior, Bureau of Land Management and acquired by FMSI in 2015. The Horseshoe Property consists of a group of private patented lands held by a group of parties including FMSI, which acquired a minority interest in 2015. Regardless of ownership, neither the Melody Claims nor the Horseshoe Claims provides either the topography or land area necessary for the development of Project elements, such as the heap leach pad or development rock stockpiles.

Lands overlying areas delineated as additional mineral reserves or resources were not considered as available for the development of alternatives. A 1,300-foot-wide setback currently exists around the Dos Pobres pit to accommodate the potential future mining of sulfide-ore milling resources located beneath the oxide ore body. As such, neither this setback, nor the Dos Pobres pit itself is available as a location for elements of the Lone Star Project. The San Juan pit is also still the site of active mining of oxide-ore leaching resources and is similarly unavailable as a location for elements of the Lone Star Project.

The designs of Project elements, specifically the designs of the heap leach pad and the development rock stockpile(s), must incorporate additional volume as a storage buffer to accommodate changes in the identified mineral resources of the Lone Star ore body, as well as changes in the leach-cycle time or lift thickness, which may be necessitated by the physical and chemical properties of the processed ore. The volume of identified resources within the Lone Star ore body is based on drilling data that provides the best available, yet necessarily incomplete, data about the characteristics of the mineral body. More detailed information generated from future mining activities may increase or decrease the amount of recoverable ore, or change the predicted ore/non-ore balance of materials within the projected pit. Stockpile and leach pad facilities must be able to efficiently accommodate a reasonable volume of additional material without significantly decreasing leach facility efficiencies or affecting the scheduled removal of development rock during mining. The storage buffers included in the designs for the heap leach pad and the development rock stockpile(s) are described under each alternative, as necessary.

The sizing and operation of heap leach pads is complex and based on a variety of technical, logistical, and environmental considerations. SX/EW technologies require the specific development and placement of leachable materials to allow the solution extraction process to be effective and to provide for full extraction and utilization of the mineral resources. The leaching process, or cycle, is the period during which the ore is irrigated with leach solution. The anticipated leach-cycle time for oxide-ore materials from the Lone Star pit is 150 days, during which additional ore may not be added on top of the area being irrigated. The heap leach pad alternatives have also been designed to accommodate the presence of some leachable sulfide-ore materials within the Lone Star pit. Sulfide-ore materials will be stockpiled separately until a sufficient amount has been generated to create a complete lift on the heap leach pad. The anticipated leach-cycle time for sulfide-ore materials from the Lone Star Pit is 280 days. FMSI bases the anticipated cycle times on extensive test work and operational practices that have been shown to optimize the leaching process. Reducing leach-cycle times may result in substantial reduction of mineral recovery rates. The mining industry refers to this situation as “short-cycle.” Increasing the rate of application of the leach solution does not increase the recovery of copper, as the leach process is time-dependent rather than flow dependent. To avoid short-cycle, mine operators need sufficient surface area to place ore and allow for full leach-cycle times. Once an adequate leaching period has elapsed, the pad is prepared to accept additional material.

Based on experience with leachable materials from the Dos Pobres pit, FMSI must incorporate additional volume within the heap leach pad to accommodate changes in the leach-cycle time or lift thickness that may be necessitated by the physical and chemical properties of the processed ore. Additional information on the physical and chemical properties of the leachable materials from the Dos Pobres pit prompted a similar change in the lift thickness and ultimate design height of the existing leach pad for the DP/SJ Project. Originally designed with lifts of 30 feet and an ultimate design height of 600 feet, factors related to the acid consumption and coppery recovery of the crushed Dos Pobres materials required the shortening of constructed lifts to a thickness of 15 to 22 feet and the lowering of the ultimate design height for the existing leach pad to 350 feet. The storage buffers included in the heap leach pad designs are necessary to accommodate such possible future changes in pad design based on the data collected during future mining operations.

3.3. ALTERNATIVES CONSIDERED

A set of alternatives was formulated for each of the major elements of the Project, and the anticipated impacts to potential waters of the U.S. under each alternative of the element are presented. The practicability of the element’s alternatives were then analyzed to identify the least environmentally damaging practicable alternative for each element which fulfills the Project purpose. Practicable alternatives of these elements were subsequently organized into Project design alternatives that could fulfill the Project purpose. Mine elements anticipated as necessary for the development of the Project under all Project alternatives include the open pit, a heap leach stockpile, development rock stockpile(s), the conveyance route between the pit and crusher, additional power distribution infrastructure, an expanded clay borrow pit, soil and growth medium stockpiles, a truck service complex, a communications tower, and additional stormwater management facilities. Alternatives for mine elements determined not to be practicable were not carried forward in the development of Project design alternatives.

The following section includes description and analysis for nine heap leach pad alternatives, five development rock stockpile alternatives, and three conveyance route alternatives. These alternatives are as follows:

3.3.1. Heap Leach Pad Alternatives

Alternative 1: Base Case
Alternative 2: Long Pad N-S
Alternative 3: Tall Pad
Alternative 4: L Pad West
Alternative 5: L Pad East
Alternative 6: Base Case Airport
Alternative 7: Long Pad Airport
Alternative 8: Long Pad E-W
Alternative 9: Base Case Pivot

3.3.2. Development Rock Stockpile Alternatives

Alternative 1: Base Case
Alternative 2: All South
Alternative 3: South Split
Alternative 4: Backfill and North SP
Alternative 5: Backfill and South SP
Alternative 6: North Side of Ridge

3.3.3. Conveyance Route Alternatives

Alternative 1: Haul Road Base Case
Alternative 2: Haul Road Half-Existing
Alternative 3: Haul Road All-Existing

3.3.4. Additional Element Alternatives

The remaining seven of the mine elements, the open pit, the additional power distribution infrastructure, an expanded clay borrow pit, a soil and growth medium stockpile associated with the clay borrow pit, a truck service complex, a communications tower, and the additional stormwater management facilities are unique with respect to the formulation of alternatives under this analysis. These features are generally tied to the physical location of a resource or another mine element, and, except for the stormwater management facilities, do not have impacts to potential waters of the U.S. Each of these elements is described in detail below, and the proposed configuration of the element included in the description of the Project design alternatives in *Section 5*.

The development of the Project requires power and radio communications be provided in the area of the proposed Lone Star pit. The additional power distribution infrastructure extends to the Lone Star pit from the existing 69kV line within the Analysis Area, and due to the limited footprint of individual power poles, would not in itself impact any potential waters of the U.S. Radio communications for the Project require construction of a repeater transmitter tower and associated access road west of the Lone Star pit. Neither the proposed tower or road has impacts to potential waters of the U.S. Individual alternatives were not developed for the location of the additional power distribution infrastructure or the communications tower, but the proposed designs of these elements are included in the description of the Project design alternatives in *Section 5*.

The Project proposes the continued use and expansion of the existing compactible soil borrow source, or clay borrow pit, within the Analysis Area (see ***Figure 3***). The existing clay borrow pit is identified as the borrow source for the compactible soil materials used as part of the lining system under the proposed heap leach pad. The proposed expansion of the clay borrow pit is approximately 48 acres, for a resulting total footprint of approximately 144 acres. A soil and growth medium stockpile approximately 86 acres in size will be located immediately south of the clay borrow pit. Access to the clay borrow pit and soil stockpile will be from the existing Clay Haul road. There are no impacts to potential waters of the U.S. required for either the expansion of the borrow pit or construction of the soil stockpile. Alternatives to the continued use and expansion of the existing clay borrow pit or the development of this soil and growth medium stockpile were not carried forward in this analysis.

Alternatives for the design of additional stormwater management facilities and the truck service complex were necessarily interdependent with the design of other mine elements. Stormwater management facilities were included where the run-on of unimpacted stormwater or the runoff of impacted stormwater were design criteria. Stormwater management facilities required by the proposed Project elements include diversion facilities upgradient of the heap leach pad and stormwater containment dams downgradient of the development rock stockpile(s). Similarly, the truck service complex needs to be located in proximity to roads designed to accommodate haul trucks, in this case the proposed haul road between the Lone Star pit and the existing crusher. The designs of these facilities were included in the description of and calculation of impacts for each alternative of their associated elements. No alternatives solely for the design of additional stormwater management facilities or the truck service complex were formulated for this analysis.

The design of the Lone Star open pit is based on three factors: (1) the currently understood nature and extent of the economic ore body of the Lone Star deposit, (2) pit stability considerations, and (3) the removal of development rock to the extent necessary to access and mine the ore body. The location of the open pit for the Project is tied to the physical location of the mineral resource. The purpose of the Lone Star Project is the economic recovery of the mineral resources associated with the Lone Star ore body, and the current pit design estimates a body of approximately 785 million tons of leachable oxide and sulfide ores that is economically recoverable under current market prices. As with the Dos Pobres pit, design of the Lone Star pit contains a 1,100-foot setback to accommodate the potential future mining of sulfide-ore milling resources located beneath the leachable ore body. Given these factors, and acknowledging that the footprint of the Lone Star pit itself does not impact potential waters of the U.S., alternative locations or designs for the pit were not carried forward in this analysis.

3.3.5. Project Design Alternatives

Using the mine elements anticipated as necessary for the development of the Project, and the practicability determinations for these mine elements as described in *Section 4*, two alternatives for the design of the Project were formulated. These alternatives are described and analyzed in *Section 5* and are as follows:

Project Design Alternative 1: Base Case
Project Design Alternative 2: Pivot Option

4. ELEMENT ALTERNATIVES DESCRIPTION AND PRACTICABILITY DETERMINATION

The description of the details of each element alternative is followed by a determination of the alternative's practicability. The specific factors used in the determination of each alternative's practicability are also presented. Each alternative was analyzed for its potential practicability under the criteria defined by the CWA Section 404(b)(1) Guidelines. An alternative is to be deemed practicable if it is "available and capable of being implemented after taking into consideration existing technology, logistics, and economics in light of overall project purpose" (40 CFR §230.10(a)).

4.1. HEAP LEACH PAD ALTERNATIVES

Using the Analysis Area and technical factors described above, nine design alternatives for the heap leach pad were formulated for use in the analysis of Project alternatives. The nine alternatives formulated and analyzed here are as follows:

Alternative 1: Base Case
Alternative 2: Long Pad N-S
Alternative 3: Tall Pad
Alternative 4: L Pad West
Alternative 5: L Pad East
Alternative 6: Base Case Airport
Alternative 7: Long Pad Airport
Alternative 8: Long Pad E-W
Alternative 9: Base Case Pivot

These alternatives, along with their practicability determinations, are described in detail in the following subsections.

4.1.1. Heap Leach Pad Alternative 1: Base Case

4.1.1.1. Description of Heap Leach Pad Alternative 1: Base Case

Heap Leach Pad Alternative 1: Base Case proposes the construction of a 1-billion-ton lined heap leach pad southwest of the existing heap leach pad (***Figure 8***). The Base Case heap leach pad would be constructed in multiple phases beginning at the southwest edge, and be typically stacked in 16- to 20-foot lifts using a radial stacking system. The leach pad would be constructed with setback benches to achieve a final overall slope of no greater than two and a half horizontal to one vertical (2.5H:1V). The final design height of the heap leach pad is 400 feet, with an overall design footprint of approximately 2,466 acres. The design of this leach pad provides for the ability to accommodate the effective leaching of an additional volume of 200 million tons of ore over the currently identified mineral resource associated with the Lone Star ore body. This additional volume provides the flexibility necessary to accommodate changes in the identified mineral resources of the Lone Star ore body, as well as changes in the leach-cycle time or lift thickness that may be necessitated by the physical and chemical properties of the processed ore. The leach pad would be lined in those areas where ore will be processed.

Construction of the liner system would require the cut or fill of the natural topography, and compaction of the resulting subgrade prior to liner installation. The liner system, from the ground up, would consist of: (1) a minimum of 12 inches of low-permeability compacted soil from the existing clay borrow pit, (2) a geomembrane layer of a minimum of 60 mil of linear low density polyethylene (LLDPE), (3) a minimum of 2 feet of minus 1.5-inch crushed and screened rock as overliner fill, and (4) a minimum of 2 feet of run-of-mine material. A construction materials stockpile would be placed to the north of the leach pad for the storage of materials from the Lone Star pit to be used in construction of the leach pad liner. A soil and growth medium stockpile would be located immediately adjacent to the southwest edge of the leach pad to hold soil excavated during leach pad construction.

Heap Leach Stockpile Alternative 1: Base Case facilitates continued use of the existing crushing facilities, existing SX/EW processing facilities, and the majority of the existing support infrastructure for the current leach pad. Under this alternative, a run-of-mine (ROM) haul road would be constructed from the main haul road east and south of the existing leach pad to transport construction materials from the Lone Star pit. Two lined pregnant leach solution (PLS) ponds and two lined non-stormwater impoundment (NSI) ponds would be constructed at the southwest edge of the new leach pad. Each PLS pond would have a storage capacity of 114 acre feet (37.18 million gallons) plus two feet of freeboard (crest capacity is 134 acre feet), and each NSI pond would have a storage capacity of 395.5 acre feet (128.8 million gallons) plus two feet of freeboard (crest capacity is 427 acre feet). The NSI ponds would be designed to impound impacted runoff from the heap leach pad during events greater than the 100-year/24-hour storm event. A lined raffinate delivery pipe corridor would be constructed from the existing raffinate storage tanks to the new leach pad and a PLS collection pipe corridor constructed from the new PLS ponds to the existing SX plant. A laydown yard for the storage of construction equipment, materials, and operating supplies would be constructed atop the soil and growth medium stockpile northwest of the PLS and NSI ponds, southwest of the new leach pad.

The current overland conveyor on the west edge of the existing leach pad would be extended to the south, along the southeastern edge of the new leach pad. The lined overland conveyor would bring leach materials from the existing crushing facility and drum agglomerators to the new leach pad, where the material would be stacked using portable conveyors and a radial stacking system. Roads for the movement of large equipment would be located on either side of the overland conveyor and along the northeastern and southeastern edges of the new heap leach pad. Light equipment roads would be located on the southwestern and northwestern edges of the leach pad. Although new crossings of the existing access road would be required for the ROM haul road and overland conveyor corridor, the existing security gate and access road to the mine administration buildings would still be utilized under this alternative.

Development of this alternative would necessitate the construction of three diversion channels: the 3136 Diversion, the Minor Drainage Channel, and the Interim Diversion Channel. The 3136 Diversion and the Minor Drainage Channel would be located upgradient of the new heap leach pad (see ***Figure 8***). The 3136 Diversion would intercept potential flows from the existing Upper West and Lower West Diversions (see ***Figure 3***) and transport them north and west to a tributary of Butler Wash. The Minor Drainage Channel would be constructed east of the 3136 Diversion, along the northeast edge of the leach pad, and would collect stormwater immediately north of the leach pad not captured by the 3136 Diversion. These potential stormwater flows would be moved east to a tributary of Talley Wash. The Interim Diversion Channel would be constructed above each phase of the leach pad as it advances to divert stormwater reporting from the area downgradient of the other two diversions until the leach pad reaches its ultimate footprint. As this Interim Diversion channel is entirely within the ultimate design footprint of the leach pad, it does not have additional impacts to potential waters of the U.S., and is not shown on ***Figure 8***.

Direct impacts to potential waters of the U.S. for this leach pad alternative total approximately 60.40 acres.

Table 1. Design for the Heap Leach Pad under Heap Leach Pad Alternative 1: Base Case

Heap Leach Pad Design Components	Acres of Land Impacted	Acres of Potential Waters Impacted
New Leach Pad/Liner	1,773	46.64
New Appurtenant Components	639	13.06
Existing Crushing Plant	0	0
Existing SX/EW	0	0
New Drainage Diversion Structures	54	0.70
Existing Access Road	0	0
TOTAL	**2,466**	**60.40**

4.1.1.2. Practicability Determination

Heap Leach Pad Alternative 1: Base Case is both technically and logistically practicable, and utilizes the existing crushing facilities, existing SX/EW processing facilities, and the majority of the existing support infrastructure for the current leach pad. The leach pad design under this alternative allows proper allocation of the leachable ore to provide the necessary leach-cycle times. This design also provides the flexibility necessary to accommodate changes in the identified mineral resources of the Lone Star ore body, as well as changes in the leach-cycle time or lift thickness that may be necessitated by the physical and chemical properties of the processed ore. Impacts to potential waters of the U.S. under this alternative are the 5th highest of all the leach pad alternatives.

4.1.2. Heap Leach Pad Alternative 2: Long Pad N-S

4.1.2.1. Description of Heap Leach Pad Alternative 2: Long Pad N-S

Heap Leach Stockpile Alternative 2: Long Pad N-S proposes the construction of a 1-billion-ton lined heap leach pad immediately west of the existing heap leach pad (***Figure 9***). The Long Pad N-S heap leach pad would be constructed in two phases beginning at the southwest edge, and be typically stacked in 16- to 20-foot lifts using a radial stacking system. The leach pad would be constructed with setback benches to achieve a final overall slope of no greater than two and a half horizontal to one vertical (2.5H:1V). The final design height of the heap leach pad is 400 feet, with an overall design footprint of approximately 2,583 acres. The design of this leach pad provides for the ability to accommodate the effective leaching of an additional volume of 200 million tons of ore over the currently identified mineral resource associated with the Lone Star ore body. This additional volume provides the flexibility necessary to accommodate changes in the identified mineral resources of the Lone Star ore body, as well as changes in the leach-cycle time or lift thickness that may be necessitated by the physical and chemical properties of the processed ore. The leach pad would be lined in those areas where ore will be processed.

Construction of the liner system would require the cut or fill of the natural topography, and compaction of the resulting subgrade prior to liner installation. The liner system, from the ground up, would consist of: (1) a minimum of 12 inches of low-permeability compacted soil from the existing clay borrow pit, (2) a geomembrane layer of a minimum of 60 mil of LLDPE, (3) a minimum of 2 feet of minus 1.5-inch crushed and screened rock as overliner fill, and (4) a minimum of 2 feet of run-of-mine material. A construction materials stockpile would be placed to the north of the leach pad for the storage of materials from the Lone Star pit to be used in construction of the leach pad liner. A soil and growth medium stockpile would be located immediately adjacent to the southwest edge of the leach pad to hold soil excavated during leach pad construction.

Heap Leach Pad Alternative 2: Long Pad N-S facilitates continued use of the existing crushing facilities, existing SX/EW processing facilities, and the majority of the existing support infrastructure for the current leach pad. Under this alternative, a ROM haul road would be constructed from the main haul road east and south of the existing leach pad to transport construction materials from the Lone Star pit. Two lined PLS ponds and two lined NSI ponds would be constructed at the southeast corner of the new leach pad. Each PLS pond would have a storage capacity of 114 acre feet (37.18 million gallons) plus two feet of freeboard (crest capacity is 134 acre feet), and each NSI pond would have a storage capacity of 395.5 acre feet (128.8 million gallons) plus two feet of freeboard (crest capacity is 427 acre feet). The NSI ponds would be designed to impound impacted runoff from the heap leach during events greater than the 100-year/24-hour storm event. A lined raffinate delivery pipe corridor would be constructed from the existing raffinate storage tanks to the new leach pad and a PLS collection pipe corridor constructed from the new PLS ponds to the existing SX plant. A laydown yard for the storage of construction equipment, materials, and operating supplies would be constructed atop the soil and growth medium stockpile immediately adjacent to the PLS and NSI ponds, southwest of the new leach pad.

The current overland conveyor on the west edge of the existing leach pad would be extended to the south, along the southeastern edge of the new leach pad. The lined overland conveyor would bring leach materials from the existing crushing facility and drum agglomerators to the new leach pad, where the material would be stacked using portable conveyors and a radial stacking system. Roads for the movement of large equipment would be located on either side of the overland conveyor and along the southeastern and southwestern edges of the new heap leach pad. Light equipment roads would be located on the northwestern and northeastern edges of the leach pad. Although the existing security gate could still be utilized under this alternative, a new access road to the mine administration buildings would be required.

Development of this alternative would necessitate the construction of two diversion channels: the 3136 Diversion and the Interim Diversion Channel. The 3136 Diversion would be located west and upgradient of the new heap leach pad (see ***Figure 9***). The 3136 Diversion would intercept potential flows from the existing Upper West and Lower West Diversions (see ***Figure 3***) and transport them north and west to a tributary of Butler Wash. The Interim Diversion Channel would be constructed above each phase of the leach pad as it advances to divert stormwater reporting from the area downgradient of the other diversion until the leach pad reaches its ultimate footprint. As this Interim Diversion channel is entirely within the ultimate design footprint of the leach pad, it does not have additional impacts to potential waters of the U.S., and is not shown on ***Figure 9***.

Direct impacts to potential waters of the U.S. for this alternative total approximately 59.15 acres.

Table 2. Design for the Heap Leach Pad under Heap Leach Pad Alternative 2: Long Pad N-S

Heap Leach Pad Design Components	Acres of Land Impacted	Acres of Potential Waters Impacted
New Leach Pad/Liner	1,865	42.39
New Appurtenant Components	646	15.83
Existing Crushing Plant	0	0
Existing SX/EW	0	0
New Drainage Diversion Structures	41	0.37
New Access Road	31	0.56
TOTAL	**2,583**	**59.15**

4.1.2.2. Practicability Determination

Although Heap Leach Pad Alternative 2: Long Pad N-S is technically practicable, the design and location of the leach pad is not logistically practicable. The leach pad design does utilize the existing crushing facilities, existing SX/EW processing facilities, and the majority of the existing support infrastructure for the current leach pad. The leach pad design under this alternative also allows proper allocation of the leachable ore to provide the necessary leach cycle times and provides the flexibility necessary to accommodate changes in the identified mineral resources of the Lone Star ore body or physical and chemical properties of the processed ore.

However, the location of the leach pad creates a health and safety hazard by creating a confined topographical valley between portions of the new and existing leach pads (see ***Figure 9***). Leaching of the Lone Star oxide ores could create carbon dioxide that would settle into the valley created between the leach pads and force oxygen out of this area creating unsafe working conditions. These conditions make construction and operation of the leach pad under this alternative logistically impracticable. Impacts to potential waters of the U.S. under this alternative are the 4th lowest of all the leach pad alternatives.

4.1.3. Heap Leach Pad Alternative 3: Tall Pad

4.1.3.1. Description of Heap Leach Pad Alternative 3: Tall Pad

Heap Leach Pad Alternative 3: Tall Pad proposes the construction of a 1-billion-ton lined heap leach pad south and west of the existing heap leach pad (***Figure 10***). The Tall Pad heap leach pad would be constructed in two phases beginning at the southwest edge, and be typically stacked in 16- to 20-foot lifts using a radial stacking system. The leach pad would be constructed with setback benches to achieve a final overall slope of no greater than two and a half horizontal to one vertical (2.5H:1V).The final design height of the heap leach pad is 560 feet, with an overall design footprint of approximately 1,583 acres. The design of this leach pad provides for the ability to accommodate the effective leaching of an additional volume of 200 million tons of ore over the currently identified mineral resource associated with the Lone Star ore body. This additional volume provides the flexibility necessary to accommodate changes in the identified mineral resources of the Lone Star ore body, as well as changes in the leach-cycle time or lift thickness that may be necessitated by the physical and chemical properties of the processed ore. The leach pad would be lined in those areas where ore will be processed.

Construction of the liner system would require the cut or fill of the natural topography, and compaction of the resulting subgrade prior to liner installation. The liner system, from the ground up, would consist of: (1) a minimum of 12 inches of low-permeability compacted soil from the existing clay borrow pit, (2) a geomembrane layer of a minimum of 60 mil of LLDPE, (3) a minimum of 2 feet of minus 1.5-inch crushed and screened rock as overliner fill, and (4) a minimum of 2 feet of run-of-mine material. A construction materials stockpile would be necessary for the storage of materials from the Lone Star pit to be used in construction of the leach pad liner. A soil and growth medium stockpile would be necessary to hold soil excavated during leach pad construction.

Heap Leach Pad Alternative 3: Tall Pad could theoretically facilitate continued use of the existing crushing facilities, existing SX/EW processing facilities, and the majority of the existing support infrastructure for the current leach pad. Under this alternative, it is anticipated that the designs of the ROM haul road, construction materials stockpile, pipe corridors, and laydown yard would be similar to those for Alternative 1: Base Case and Alternative 2: Long Pad N-S above.

However, further development of the details of the leach pad under this alternative was abandoned, as the leach pad as formulated exceeds the maximum design stability height for the physical and chemical properties of leachable materials from the Lone Star pit. The direct impacts to potential waters of the U.S. for the developed components of this alternative as shown in ***Figure 10*** are approximately 44.84 acres. The total impacts to potential waters of the U.S., were this design completed, were not calculated.

Table 3. Design for the Heap Leach Pad under Heap Leach Pad Alternative 3: Tall Pad

Heap Leach Pad Design Components	Acres of Land Impacted	Acres of Potential Waters Impacted
New Leach Pad/Liner	1476	41.64
New Appurtenant Components	93	3.20
Existing Crushing Plant	0	0
Existing SX/EW	0	0
New Drainage Diversion Structures	Not Calculated	Not Calculated
Existing Access Road	0	0
TOTAL	**Not Calculated**	**Not Calculated**

4.1.3.2. Practicability Determination

Heap Leach Pad Alternative 3: Tall Pad is not technically practicable, as the leach pad as formulated exceeds the maximum design stability height for the known physical properties of leachable materials from the Lone Star pit. The existing leach pad constructed for the DP/SJ Project was originally designed with lifts of 30 feet and an ultimate design height of 600 feet. Factors related to the acid consumption and copper recovery of the crushed Dos Pobres materials required the shortening of constructed lifts to a thickness of 15 to 22 feet and the lowering of the ultimate design height for the existing leach stockpile to 350 feet. The properties of the leachable materials from the Lone Star pit are anticipated to be similar in physical and chemical properties to those from the Dos Pobres pit. The design of the heap leach pad under this alternative exceeds the maximum design height for stockpiling of these materials and is therefore not technically practicable. Impacts to potential waters of the U.S. for the designed components of this alternative are the lowest of all the leach pad alternatives. However, it should be noted this calculated impact does not include impacts for those components of this alternative for which development was abandoned, including the designs of the ROM haul road, construction materials stockpile, soil and growth medium stockpile, pipe corridors, and laydown yard, which would increase impacts to potential waters of the U.S. under this alternative.

4.1.4. Heap Leach Pad Alternative 4: L Pad West

4.1.4.1. Description of Heap Leach Pad Alternative 4: L Pad West

Heap Leach Pad Alternative 4: L Pad West proposes the construction of a 1-billion-ton lined heap leach pad south of the existing heap leach pad (***Figure 11***). The L Pad West heap leach pad would be constructed in two phases beginning with the western half of the pad, and be typically stacked in 16- to 20-foot lifts using a radial stacking system. The leach pad would be constructed with setback benches to achieve a final overall slope of no greater than two and a half horizontal to one vertical (2.5H:1V). The final design height of the heap leach stockpile is 400 feet, with an overall design footprint of approximately 2,457 acres. The design of this stockpile provides for the ability to accommodate the effective leaching of an additional volume of 200 million tons of ore over the currently identified mineral resource associated with the Lone Star ore body. This additional volume provides the flexibility necessary to accommodate changes in the identified mineral resources of the Lone Star ore body, as well as changes in the leach-cycle time or lift thickness that may be necessitated by the physical and chemical properties of the processed ore. The leach pad would be lined in those areas where ore will be processed.

Construction of the liner system would require the cut or fill of the natural topography, and compaction of the resulting subgrade prior to liner installation. The liner system, from the ground up, would consist of: (1) a minimum of 12 inches of low-permeability compacted soil from the existing clay borrow pit, (2) a geomembrane layer of a minimum of 60 mil of LLDPE, (3) a minimum of 2 feet of minus 1.5-inch crushed and screened rock as overliner fill, and (4) a minimum of 2 feet of run-of-mine material. A construction materials stockpile would be placed to the north of the leach pad for the storage of materials from the Lone Star pit to be used in construction of the leach pad liner. Two soil and growth medium stockpiles would be necessary to hold soil excavated during leach pad construction: one located immediately adjacent to the collection ponds at the southwest corner of the new leach pad, and one near the southeast corner.

Heap Leach Pad Alternative 4: L Pad West facilitates continued use of the existing crushing facilities, existing SX/EW processing facilities, and the majority of the existing support infrastructure for the current leach pad. Under this alternative, a ROM haul road would be constructed from the main haul road east and south of the existing leach pad to transport construction materials from the Lone Star pit. Two lined PLS ponds and two lined NSI ponds would be constructed almost at the midpoint of the southeastern edge of the new leach pad. Each PLS pond would have a storage capacity of 114 acre feet (37.18 million gallons) plus two feet of freeboard (crest capacity is 134 acre feet), and each NSI pond would have a storage capacity of 395.5 acre feet (128.8 million gallons) plus two feet of freeboard (crest capacity is 427 acre feet). The containment pond would be designed to impound impacted runoff from the heap leach pad during events larger than the 100-year/24-hour storm event. A lined raffinate delivery pipe corridor would be constructed from the existing raffinate storage tanks to the new leach pad and a PLS collection pipe corridor constructed from the new PLS ponds to the existing SX plant. Laydown yards for the storage of construction equipment, materials, and operating supplies would be constructed atop both of the soil and growth medium stockpiles.

The current overland conveyor on the west edge of the existing leach pad would be extended to the south, to the southwestern edge of the new leach pad. The lined overland conveyor would bring leach materials from the existing crushing facility and drum agglomerators to the new leach pad, where the material would be stacked using portable conveyors and a radial stacking system. Roads for the movement of large equipment will be located on either side of the overland conveyor and along the northeastern and northwestern edges of the new heap leach pad. Light equipment roads would be located on the southwestern and southeastern edges of the leach pad. Although the existing security gate could still be utilized under this alternative, a new access road to the mine administration buildings would be required.

Development of this alternative would necessitate the construction of at least two diversion channels: the 3136 Diversion and the Interim Diversion Channel. The 3136 Diversion would be located west and upgradient of the new heap leach pad (see ***Figure 11***). The 3136 Diversion would intercept potential flows from the existing Upper West and Lower West Diversions (see ***Figure 3***) and transport them north and west to a tributary of Butler Wash. The Interim Diversion Channel would be constructed above each phase of the leach pad as it advances to divert stormwater reporting from the area downgradient of the other diversion until the leach pad reaches its ultimate footprint. As this Interim Diversion channel is entirely within the ultimate design footprint of the leach pad, it does not have additional impacts to potential waters of the U.S., and is not shown on ***Figure 11***. A diversion of Cottonwood Wash around the east side of the leach pad would likely also be necessary under this alternative, but has not been fully designed.

Direct impacts to potential waters of the U.S. for this alternative total approximately 62.41 acres.

Table 4. Design for the Heap Leach Pad under Heap Leach Pad Alternative 4: L Pad West

Heap Leach Stockpile Design Components	Acres of Land Impacted	Acres of Potential Waters Impacted
New Leach Pad/Liner	1,803	49.06
New Appurtenant Components	586	12.56
Existing Crushing Plant	0	0
Existing SX/EW	0	0
New Drainage Diversion Structures	41	0.37
New Access Road	27	0.42
TOTAL	**2,457**	**62.41**

4.1.4.2. Practicability Determination

Although Heap Leach Pad Alternative 4: L Pad West is technically practicable, the design and location of the leach pad is not logistically practicable. The heap leach pad design does utilize the existing crushing facilities, existing SX/EW processing facilities, and the majority of the existing support infrastructure for the current leach pad. The leach pad design under this alternative also allows proper allocation of the leachable ore to provide the necessary leach cycle times and provides the flexibility necessary to accommodate changes in the identified mineral resources of the Lone Star ore body or physical and chemical properties of the processed ore.

However, operation of this leach pad is not logistically practicable. The location of the leach pad creates a health and safety hazard by creating a confined topographical valley between portions of the new and existing leach pads at the existing SX/EW facility (see ***Figure 11***). Leaching of the Lone Star oxide ores could create carbon dioxide that would settle into the valley created between the leach pads and force oxygen out of this area creating unsafe working conditions. These conditions make construction and operation of the leach pad under this alternative logistically impracticable. The stacking sequence required for the leach pad design requires double the portable conveyor units needed from those of the Alternative 1: Base Case design, and ingress and egress for these units from the pad is impracticable. The leach pad design under this alternative also necessitates raffinate delivery and PLS collection piping that runs the perimeter of the northeastern, southeastern, and southwestern faces of the leach pad. Impacts to potential waters of the U.S. for the components of this alternative are the highest of all the leach pad alternatives.

4.1.5. Heap Leach Pad Alternative 5: L Pad East

4.1.5.1. Description of Heap Leach Pad Alternative 5: L Pad East

Heap Leach Pad Alternative 5: L Pad East proposes the construction of a 1-billion-ton lined heap leach pad immediately east and south of the existing heap leach pad (***Figure 12***). The L Pad East heap leach pad would be constructed in three phases beginning with the southern arm of the stockpile, and be typically stacked in 16- to 20-foot lifts using a radial stacking system. The leach pad would be constructed with setback benches to achieve a final overall slope of no greater than two and a half horizontal to one vertical (2.5H:1V). The final design height of the heap leach stockpile is 400 feet, with an overall design footprint of approximately 2,506 acres. The design of this stockpile provides for the ability to accommodate the effective leaching of an additional volume of 200 million tons of ore over the currently identified mineral resource associated with the Lone Star ore body. This additional volume provides the flexibility necessary to accommodate changes in the identified mineral resources of the Lone Star ore body, as well as changes in the leach-cycle time or lift thickness that may be necessitated by the physical and chemical properties of the processed ore. The leach pad would be lined in those areas where ore will be processed.

Construction of the liner system would require the cut or fill of the natural topography, and compaction of the resulting subgrade prior to liner installation. The liner system, from the ground up, would consist of: (1) a minimum of 12 inches of low-permeability compacted soil from the existing clay borrow pit, (2) a geomembrane layer of a minimum of 60 mil of LLDPE, (3) a minimum of 2 feet of minus 1.5-inch crushed and screened rock as overliner fill, and (4) a minimum of 2 feet of run-of-mine material. A construction materials stockpile would be placed to the north of the leach pad for the storage of materials from the Lone Star pit to be used in construction of the leach pad liner. Two soil and growth medium stockpiles would be necessary to hold soil excavated during leach pad construction: one located immediately adjacent to the southeastern edge of the new leach pad and one near the southwest corner.

Heap Leach Pad Alternative 5: L Pad East facilitates continued use of the existing crushing facilities and existing SX/EW processing facilities, but not the majority of the existing support infrastructure for the current leach pad. Under this alternative, a ROM haul road would be constructed from the main haul road south to the new leach pad to transport construction materials from the Lone Star pit. Two lined PLS ponds and two lined NSI ponds would be constructed near the southeastern corner of the new leach pad. Each PLS pond would have a storage capacity of 114 acre feet (37.18 million gallons) plus two feet of freeboard (crest capacity is 134 acre feet), and each NSI pond would have a storage capacity of 395.5 acre feet (128.8 million gallons) plus two feet of freeboard (crest capacity is 427 acre feet). The NSI ponds would be designed to impound impacted runoff from the heap leach pad during events larger than the 100-year/24-hour storm event. A lined raffinate delivery pipe corridor would be constructed from the existing raffinate storage tanks to the new leach pad and a PLS collection pipe corridor constructed from the new PLS ponds to the existing SX plant. Laydown yards for the storage of construction equipment, materials, and operating supplies would be constructed atop both of the soil and growth medium stockpiles.

A new overland conveyor would be constructed along the northern edge of the existing leach pad and along the southeastern and southwestern edges of the new heap leach pad. The lined overland conveyor would bring leach materials from the existing crushing facility and drum agglomerators to the new leach pad, where the material would be stacked using portable conveyors and a radial stacking system. Roads for the movement of large equipment would be located on either side of the overland conveyor and along the southeastern and southwestern edges of the new heap leach pad. Light equipment roads would be located on the northwestern and northeastern edges of the leach pad. Although the existing security gate could still be utilized under this alternative, a segment of new access road to the mine administration buildings would be required.

Development of this alternative would necessitate the diversion of several drainages around the new heap leach pad. A diversion channel and a series of detention dams would be constructed upgradient of the heap leach pad to divert stormwater runoff to a portion of an unnamed wash watershed west of the new heap leach pad. Additionally, the Cottonwood and Peterson Washes would need to be diverted around both the east side of the leach pad and a small hill southwest of the existing San Juan Pit. However, further development of the details of the leach pad under this alternative was abandoned, and neither drainage diversion design was developed. The direct impacts to potential waters of the U.S. for the developed components of this alternative as shown in ***Figure 12*** are approximately 62.18 acres. The total impacts to potential waters of the U.S., were this design completed, were not calculated.

Table 5. Design for the Heap Leach Pad under Heap Leach Pad Alternative 5: L Pad East

Heap Leach Pad Design Components	Acres of Land Impacted	Acres of Potential Waters Impacted
New Leach Pad/Liner	1,959	48.38
New Appurtenant Components	Not Calculated	Not Calculated
Existing Crushing Plant	0	0
Existing SX/EW	0	0
New Drainage Diversion Structures	Not Calculated	Not Calculated
New Access Road	17	0.39
TOTAL	**Not Calculated**	**Not Calculated**

4.1.5.2. Practicability Determination

Although Heap Leach Pad Alternative 5: L Pad East is technically practicable, the design and location of the leach pad is not logistically practicable. The pad design does utilize the existing crushing facilities, existing SX/EW processing facilities, and the majority of the existing support infrastructure for the current leach pad. The leach pad design under this alternative also allows proper allocation of the leachable ore to provide the necessary leach cycle times and provides the flexibility necessary to accommodate changes in the identified mineral resources of the Lone Star ore body or physical and chemical properties of the processed ore.

However, the location of the leach pad creates a health and safety hazard by creating a confined topographically valley between portions of the new and existing leach pads and at the existing SX/EW facility (see ***Figure 12***). Leaching of the Lone Star oxide ores could create carbon dioxide that would settle into the valley created between the leach pads and force oxygen out of this area creating unsafe working conditions. These conditions make construction and operation of the leach pad under this alternative logistically impracticable. Routing the Cottonwood and Peterson Washes around the small hill to the southwest of the existing San Juan pit is also logistically impracticable. Additionally, the leach pad design under this alternative necessitates raffinate delivery and PLS collection pipe corridor that collectively runs the entire perimeter of the leach stockpile. Impacts to potential waters of the U.S. for the designed components of this alternative are the 2nd highest of all the leach pad stockpile alternatives. However, it should be noted this calculated impact does not include impacts for those components of this alternative for which development was abandoned, including the designs of the ROM haul road and drainage diversions, which would increase impacts to potential waters of the U.S. under this alternative.

4.1.6. Heap Leach Pad Alternative 6: Base Case Airport

4.1.6.1. Description of Heap Leach Pad Alternative 6: Base Case Airport

Heap Leach Pad Alternative 6: Base Case Airport proposes the construction of a 1-billion-ton lined heap leach pad in the eastern portion of the Analysis Area, immediately south of the Melody Claims (***Figure 13***).

The Alternative 6 heap leach pad would be constructed in three phases beginning with the southern edge of the pad, and be typically stacked in 16- to 20-foot lifts using a radial stacking system. The leach pad would be constructed with setback benches to achieve a final overall slope of no greater than two and a half horizontal to one vertical (2.5H:1V). The final design height of the heap leach stockpile is 400 feet, with an overall design footprint of approximately 2,884 acres. The design of this stockpile provides for the ability to accommodate the effective leaching of an additional volume of 200 million tons of ore over the currently identified mineral resource associated with the Lone Star ore body. This additional volume provides the flexibility necessary to accommodate changes in the identified mineral resources of the Lone Star ore body, as well as changes in the leach-cycle time or lift thickness that may be necessitated by the physical and chemical properties of the processed ore. The leach pad would be lined in those areas where ore will be processed.

Construction of the liner system would require the cut or fill of the natural topography, and compaction of the resulting subgrade prior to liner installation. The liner system, from the ground up, would consist of: (1) a minimum of 12 inches of low-permeability compacted soil from the existing clay borrow pit, (2) a geomembrane layer of a minimum of 60 mil of LLDPE, (3) a minimum of 2 feet of minus 1.5-inch crushed and screened rock as overliner fill, and (4) a minimum of 2 feet of run-of-mine material. However, a new source for the clay used in liner construction would need to be developed, as the existing clay borrow pit would be partially covered by the leach pad in this alternative. A construction materials stockpile would be placed to the east of the leach pad for the storage of materials from the Lone Star pit to be used in construction of the leach pad liner. Two soil and growth medium stockpiles would be necessary to hold soil excavated during leach pad construction: one located immediately adjacent to the eastern and southern edges of the new leach pad and one north of the new crushing facility.

Heap Leach Pad Alternative 6: Base Case Airport does not facilitate the continued use of the existing facilities or support infrastructure, and would require the construction of new crushing facilities, SX/EW processing facilities, and support infrastructure for the new leach pad. Under this alternative, a ROM haul road would be constructed south from the main haul road to the east of the existing leach pad to an intersection with the existing Clay Haul road. The Clay Haul road would be reconstructed as a ROM haul road east to the location of the new leach pad to transport construction materials from the Lone Star pit. A new crushing facility similar to the existing facility will be constructed at the northeast corner of the new leach pad (see ***Figure 13***). Under this alternative, the ROM haul road would be used as the main haul road from the Lone Star pit to the new crushing facility.

Two lined PLS ponds and two lined NSI ponds would be constructed near the southwestern corner of the new leach pad. Each PLS pond would have a storage capacity of 114 acre feet (37.18 million gallons) plus two feet of freeboard (crest capacity is 134 acre feet), and each NSI pond would have a storage capacity of 395.5 acre feet (128.8 million gallons) plus two feet of freeboard (crest capacity is 427 acre feet). The NSI ponds would be designed to impound impacted runoff from the heap leach pad during events greater than the 100-year/24-hour storm event. New SX/EW facilities, storage tanks, and circulation pipe corridor would need to be constructed south of the new leach pad under this alternative (see ***Figure 13***). A lined raffinate delivery pipe corridor would be constructed from the new raffinate storage tanks to the new leach pad and a lined PLS collection pipe corridor constructed from the new PLS ponds to the new SX plant. Laydown yards for the storage of construction equipment, materials, and operating supplies would be constructed atop both of the soil and growth medium stockpiles.

A new overland conveyor would be constructed from the new crushing facility along the northern edge of the new leach pad. The lined overland conveyor would bring leach materials from the new crushing facility and drum agglomerators to the new leach pad, where the material would be stacked using portable conveyors and a radial stacking system. Roads for the movement of large equipment would be located on either side of the overland conveyor and along the northern and western edges of the new heap leach pad. Light equipment roads would be located on the northwestern and northeastern edges of the leach pad. The existing security gate and access road to the mine administration buildings would still be utilized under this alternative. However, a new Clay Haul road may need to be constructed and portions of the existing 69kV power line relocated under this alternative, as portions of these existing components would be covered by the new leach pad (see ***Figure 13***).

Development of this alternative would necessitate the diversion some drainages around the new heap leach pad. However, further development of the details of the leach pad under this alternative was abandoned, and the drainage diversions, new clay borrow pit, relocated Clay Haul road, and relocated 69kV power line designs were not developed. The direct impacts to potential waters of the U.S. for the developed components of this alternative as shown in ***Figure 13*** are approximately 61.06 acres. The total impacts to potential waters of the U.S., were this design completed, were not calculated.

Table 6. Design for the Heap Leach Pad under Heap Leach Pad Alternative 6: Base Case Airport

Heap Leach Pad Design Components	Acres of Land Impacted	Acres of Potential Waters Impacted
New Leach Pad/Liner	1,776	43.99
New Appurtenant Components	974	13.31
New Crushing Plant	64	2.38
New SX/EW	70	1.38
New Drainage Diversion Structures	Not Calculated	Not Calculated
Existing Access Road	0	0
New Clay Borrow Pit	Not Calculated	Not Calculated
New Clay Haul Road	Not Calculated	Not Calculated
New 69kV Power line	Not Calculated	Not Calculated
TOTAL	**Not Calculated**	**Not Calculated**

4.1.6.2. Practicability Determination

Although Heap Leach Pad Alternative 6: Base Case Airport is technically practicable, the location of the new leach pad is not logistically practicable. The leach pad location does not facilitate continued use of any of the existing mine facilities. The alternative does not allow utilization of the existing crushing facilities, existing SX/EW processing facilities, existing clay borrow pit, or any of the existing support infrastructure for the current leach pad. This stockpile would also force the relocation of an existing 69kV power line that provides power to the existing mine facilities (see ***Figure 3***). The leach pad design under this alternative does allow proper allocation of the leachable ore to provide the necessary leach cycle times and provides the flexibility necessary to accommodate changes in the identified mineral resources of the Lone Star ore body or physical and chemical properties of the processed ore.

The leach pad design covers portions of the existing clay borrow pit, proposed for use during construction of the new leach pad. This would require the development of a new source at an alternate location, an action assumed to have additional impacts to potential waters of the U.S. Impacts to potential waters of the U.S. for the designed components of this alternative are the 3rd highest of all the leach pad alternatives. It should be noted this calculated impact does not include impacts for those components of this alternative for which development was abandoned, including the designs of the drainage diversions, new clay borrow pit, relocated Clay Haul road, and relocated 69kV power line, which would increase impacts to potential waters of the U.S. under this alternative.

4.1.7. Heap Leach Pad Alternative 7: Long Pad Airport

4.1.7.1. Description of Heap Leach Pad Alternative 7: Long Pad Airport

Heap Leach Pad Alternative 7: Long Pad Airport proposes the construction of a 1-billion-ton lined heap leach pad in the eastern portion of the Analysis Area, between the Melody Claims and the Horseshoe Claims (***Figure 14***). The Long Pad Airport heap leach pad would be constructed in three phases beginning with the southern edge of the stockpile, and be typically stacked in 16- to 20-foot lifts using a radial stacking system. The leach pad would be constructed with setback benches to achieve a final overall slope of no greater than two and a half horizontal to one vertical (2.5H:1V). The final design height of the heap leach pad is 400 feet, with an overall design footprint of approximately 2,735 acres. The design of this stockpile provides for the ability to accommodate the effective leaching of an additional volume of 200 million tons of ore over the currently identified mineral resource associated with the Lone Star ore body. This additional volume provides the flexibility necessary to accommodate changes in the identified mineral resources of the Lone Star ore body, as well as changes in the leach-cycle time or lift thickness that may be necessitated by the physical and chemical properties of the processed ore. The leach pad would be lined in those areas where ore will be processed.

Construction of the liner system would require the cut or fill of the natural topography, and compaction of the resulting subgrade prior to liner installation. The liner system, from the ground up, would consist of: (1) a minimum of 12 inches of low-permeability compacted soil from the existing clay borrow pit, (2) a geomembrane layer of a minimum of 60 mil of LLDPE, (3) a minimum of 2 feet of minus 1.5-inch crushed and screened rock as overliner fill, and (4) a minimum of 2 feet of run-of-mine material. A construction materials stockpile would be placed to the west of the leach pad for the storage of materials from the Lone Star pit to be used in construction of the leach pad liner. A soil and growth medium stockpile would be located at the southwestern corner of the heap leach pad to hold soil excavated during leach pad construction.

Heap Leach Stockpile Alternative 7: Long Pad Airport does not facilitate the continued use of the existing facilities or support infrastructure, and would require the construction of new crushing facilities, SX/EW processing facilities, and support infrastructure for the new leach pad. Under this alternative, a ROM haul road would be constructed south from the main haul road to the east of the existing leach pad to an intersection with the existing Clay Haul road. The Clay Haul road would be reconstructed as a ROM haul road east to the location of the new leach pad to transport construction materials from the Lone Star pit. A new crushing facility similar to the existing facility would be constructed on the northeast edge of the new leach pad (see ***Figure 14***). Under this alternative, the ROM haul road would be used as the main haul road from the Lone Star pit to the new crushing facility.

Two lined PLS ponds and two lined NSI ponds would be constructed near the southeastern corner of the new leach pad. Each PLS pond would have a storage capacity of 114 acre feet (37.18 million gallons) plus two feet of freeboard (crest capacity is 134 acre feet), and each NSI pond would have a storage capacity of 395.5 acre feet (128.8 million gallons) plus two feet of freeboard (crest capacity is 427 acre feet). The NSI ponds would be designed to impound impacted runoff from the heap leach pad during events greater than the 100-year/24-hour storm event. New SX/EW facilities, storage tanks, and circulation pipe corridors would need to be constructed immediately southeast of the PLS and containment ponds under this alternative (see ***Figure 14***). A lined raffinate delivery pipe corridor would be constructed from the new raffinate storage tanks to the new leach pad and a lined PLS collection pipe corridor constructed from the new PLS ponds to the new SX plant. A laydown yard for the storage of construction equipment, materials, and operating supplies would be constructed atop the soil and growth medium stockpile.

A new overland conveyor would be constructed from the new crushing facility along the southeastern edge of the new leach pad. The lined overland conveyor would bring leach materials from the new crushing facility and drum agglomerators to the new leach pad, where the material would be stacked using portable conveyors and a radial stacking system. Roads for the movement of large equipment would be located on either side of the overland conveyor and along the northeastern and southeastern edges of the new heap leach pad. Light equipment roads would be located on the southwestern edge of the leach pad.

The existing security gate and access road to the mine administration buildings would still be utilized under this alternative. However, a new Clay Haul road may need to be constructed and portions of the existing 69kV power line relocated under this alternative, as portions of these existing components would be covered by the new leach pad. Under this alternative, the existing clay borrow pit would be used in the construction of the new leach pad (see ***Figure 14***).

Further development of the details of the stockpile under this alternative was abandoned, and the designs for the relocated Clay Haul road and 69kV power line were not developed. The direct impacts to potential waters of the U.S. for the developed components of this alternative as shown in ***Figure 14*** are approximately 60.70 acres. The total impacts to potential waters of the U.S., were this design completed, were not calculated.

Table 7. Design for the Heap Leach Pad under Heap Leach Pad Alternative 7: Long Pad Airport

Heap Leach Pad Design Components	Acres of Land Impacted	Acres of Potential Waters Impacted
New Leach Pad/Liner	1,865	47.01
New Appurtenant Components	764	12.30
New Crushing Plant	64	0.85
New SX/EW	42	0.54
Existing Access Road	0	0
New Clay Haul Road	Not Calculated	Not Calculated
New 69kV Power line	Not Calculated	Not Calculated
TOTAL	**Not Calculated**	**Not Calculated**

4.1.7.2. Practicability Determination

Heap Leach Pad Alternative 7: Long Pad Airport is technically practicable, but not logistically practicable. This alternative does not facilitate continued use of any of the existing mine facilities. The leach pad design under this alternative does not allow utilization of the existing crushing facilities, existing SX/EW processing facilities, or any of the existing support infrastructure for the current leach pad. The design of this leach pad would force the relocation of portions of the Clay Haul road and the existing 69kV power line that provides power to the existing mine facilities (see ***Figure 3***). Impacts to potential waters of the U.S. for the designed components of this alternative are the 4th highest of all the leach pad alternatives. It should be noted this calculated impact does not include impacts for those components of this alternative for which development was abandoned, including the designs of the relocated Clay Haul road and relocated 69kV power line, which would increase impacts to potential waters of the U.S. under this alternative.

4.1.8. Heap Leach Pad Alternative 8: Long Pad E-W

4.1.8.1. Description of Heap Leach Pad Alternative 8: Long Pad E-W

Heap Leach Pad Alternative 8: Long Pad E-W proposes the construction of a 1-billion-ton lined heap leach pad west and south of the existing heap leach pad (***Figure 15***). The Long Pad E-W heap leach pad would be constructed in two phases beginning at the southwest edge, and be typically stacked in 16- to 20-foot lifts using a radial stacking system. The leach pad would be constructed with setback benches to achieve a final overall slope of no greater than two and a half horizontal to one vertical (2.5H:1V). The final design height of the heap leach stockpile is 400 feet, with an overall design footprint of approximately 2,437 acres. The design of this stockpile provides for the ability to accommodate the effective leaching of an additional volume of 200 million tons of ore over the currently identified mineral resource associated with the Lone Star ore body. This additional volume provides the flexibility necessary to accommodate changes in the identified mineral resources of the Lone Star ore body, as well as changes in the leach-cycle time or lift thickness that may be necessitated by the physical and chemical properties of the processed ore. The leach pad would be lined in those areas where ore will be processed.

Construction of the liner system would require the cut or fill of the natural topography, and compaction of the resulting subgrade prior to liner installation. The liner system, from the ground up, would consist of: (1) a minimum of 12 inches of low-permeability compacted soil from the existing clay borrow pit, (2) a geomembrane layer of a minimum of 60 mil of LLDPE, (3) a minimum of 2 feet of minus 1.5-inch crushed and screened rock as overliner fill, and (4) a minimum of 2 feet of run-of-mine material. A construction materials stockpile would be placed to the north of the leach pad for the storage of materials from the Lone Star pit to be used in construction of the leach pad liner. A soil and growth medium stockpile would be located along the southwestern edge of the heap leach pad to hold soil excavated during leach pad construction

Heap Leach Pad Alternative 8: Long Pad E-W facilitates continued use of the existing crushing facilities, existing SX/EW processing facilities, and the majority of the existing support infrastructure for the current leach pad. Under this alternative, a ROM haul road will be constructed from the main haul road east and south of the existing leach pad to transport construction materials from the Lone Star pit. Two lined PLS ponds and two lined NSI ponds would be constructed at the southeast corner of the new leach pad. Each PLS pond would have a storage capacity of 114 acre feet (37.18 million gallons) plus two feet of freeboard (crest capacity is 134 acre feet), and each NSI pond would have a storage capacity of 395.5 acre feet (128.8 million gallons) plus two feet of freeboard (crest capacity is 427 acre feet). The NSI ponds would be designed to impound impacted runoff from the heap leach pad during events larger than the 100-year/24-hour storm event. A lined raffinate delivery pipe corridor would be constructed from the existing raffinate storage tanks to the new leach pad and a lined PLS collection pipe corridor constructed from the new PLS ponds to the existing SX plant. A laydown yard for the storage of construction equipment, materials, and operating supplies would be constructed atop the soil and growth medium stockpile.

The current overland conveyor on the west edge of the existing leach pad would be extended to the south and then along the northeastern edge of the new leach pad. The lined overland conveyor would bring leach materials from the existing crushing facility and drum agglomerators to the new leach pad, where the material would be stacked using portable conveyors and a radial stacking system. Roads for the movement of large equipment would be located on either side of the overland conveyor and along the southeastern edge of the new heap leach pad. Light equipment roads would be located on the southwestern and northwestern edges of the leach pad. Although new crossings of the existing access road would be required for the ROM haul road and overland conveyor corridor, the existing security gate and access road to the mine administration buildings would still be utilized under this alternative.

Development of this alternative would necessitate the diversion of three drainages around the new heap leach stockpile. A diversion channel and a series of detention dams would be constructed upgradient of the heap leach pad to divert stormwater runoff to a portion of the Butler Wash watershed northwest of the new heap leach pad. Although the design of this drainage would be comparable to that for the design under Heap Leach Pad Alternative 1: Base Case, the complete drainage diversion design was not developed for this alternative. The direct impacts to potential waters of the U.S. for the developed components of this alternative as shown in ***Figure 15*** are approximately 48.87 acres. The total impacts to potential waters of the U.S., were this design completed, were not calculated.

Table 8. Design for the Heap Leach Pad under Heap Leach Pad Alternative 8 Long Pad E-W

Heap Leach Pad Design Components	Acres of Land Impacted	Acres of Potential Waters Impacted
New Leach Pad/Liner	1,865	35.25
New Appurtenant Components	572	13.62
Existing Crushing Plant	0	0
Existing SX/EW	0	0
New Drainage Diversion Structures	Not Calculated	Not Calculated
Existing Access Road	0	0
TOTAL	**Not Calculated**	**Not Calculated**

4.1.8.2. Practicability Determination

Although Heap Leach Pad Alternative 8: Long Pad E-W is technically practicable, the design and location of the leach pad is not logistically practicable. The leach pad design does utilize the existing crushing facilities, existing SX/EW processing facilities, and the majority of the existing support infrastructure for the current leach pad. The leach pad design under this alternative also allows proper allocation of the leachable ore to provide the necessary leach cycle times and provides the flexibility necessary to accommodate changes in the identified mineral resources of the Lone Star ore body or physical and chemical properties of the processed ore.

However, the location of the leach pad requires the design of a diversion structure for the three drainages that that would extend out of the Analysis Area onto lands managed by BLM. Construction and maintenance activities required for the diversion channel would necessarily take place at least partially outside of lands managed by FMSI, and would not be logistically practicable. Impacts to potential waters of the U.S. for the designed components of this alternative are the 3rd lowest of all the leach pad alternatives. However, it should be noted this calculated impact does not include impacts for those components of this alternative for which development was abandoned, including the drainage diversion designs, which would increase impacts to potential waters of the U.S. under this alternative.

4.1.9. Heap Leach Pad Alternative 9: Base Case Pivot

4.1.9.1. Description of Heap Leach Pad Alternative 9: Base Case Pivot

Heap Leach Pad Alternative 9: Base Case Pivot proposes the construction of a 1-billion-ton lined heap leach pad southwest of the existing heap leach pad (***Figure 16***). The Base Case Pivot heap leach stockpile would be constructed in multiple phases beginning at the southwest edge, and be typically stacked in 16- to 20-foot lifts using a radial stacking system. The leach pad would be constructed with setback benches to achieve a final overall slope of no greater than two and a half horizontal to one vertical (2.5H:1V). The final design height of the heap leach stockpile is 400 feet, with an overall design footprint of approximately 2,542 acres. The design of this stockpile provides for the ability to accommodate the effective leaching of an additional volume of 200 million tons of ore over the currently identified mineral resource associated with the Lone Star ore body. This additional volume provides the flexibility necessary to accommodate changes in the identified mineral resources of the Lone Star ore body, as well as changes in the leach-cycle time or lift thickness that may be necessitated by the physical and chemical properties of the processed ore. The leach pad would be lined in those areas where ore will be processed.

Construction of the liner system would require the cut or fill of the natural topography, and compaction of the resulting subgrade prior to liner installation. The liner system, from the ground up, would consist of: (1) a minimum of 12 inches of low-permeability compacted soil from the existing clay borrow pit, (2) a geomembrane layer of a minimum of 60 mil of LLDPE, (3) a minimum of 2 feet of minus 1.5-inch crushed and screened rock as overliner fill, and (4) a minimum of 2 feet of run-of-mine material. A construction materials stockpile will be placed to the north of the leach pad for the storage of materials from the Lone Star pit to be used in construction of the leach pad liner. A soil and growth medium stockpile would be located along the southwestern edge of the heap leach pad to hold soil excavated during leach pad construction

Heap Leach Pad Alternative Base 9: Base Case Pivot facilitates continued use of the existing crushing facilities, existing SX/EW processing facilities, and the majority of the existing support infrastructure for the current leach pad. Under this alternative, a ROM haul road would be constructed from the main haul road east and south of the existing leach pad to transport construction materials from the Lone Star pit. Two lined PLS ponds and two lined NSI ponds would be constructed at the southeast corner of the new leach pad. Each PLS pond would have a storage capacity of 114 acre feet (37.18 million gallons) plus two feet of freeboard (crest capacity is 134 acre feet), and each NSI pond would have a storage capacity of 395.5 acre feet (128.8 million gallons) plus two feet of freeboard (crest capacity is 427 acre feet). NSI ponds would be designed to impound impacted runoff from the heap leach pad during events greater than the 100-year/24-hour storm event. A lined raffinate delivery pipe corridor will be constructed from the existing raffinate storage tanks to the new leach pad and a lined PLS collection pipe corridor constructed from the new PLS ponds to the existing SX plant. A laydown yard for the storage of construction equipment, materials, and operating supplies would be constructed atop the soil and growth medium stockpile, southwest of the new leach pad.

The current overland conveyor on the west edge of the existing leach pad would be extended to the southwest, towards the northeastern edge of the new leach pad. Optimal design of the angle of the conveyor and location where it meets the new leach pad is still in process, so the area within which it will be located is shown as a conveyor corridor on ***Figure 16***. All potential waters of the U.S. within this corridor are considered as impacted for this analysis. The lined overland conveyor would bring leach materials from the existing crushing facility and drum agglomerators to the new leach pad, where the material would be stacked using portable conveyors and a radial stacking system. Roads for the movement of large equipment would be located on either side of the overland conveyor and along the northeastern and southeastern edges of the new heap leach pad. Light equipment roads would be located on the southwestern and northwestern edges of the leach pad. Although new crossings of the existing access road would be required for the ROM haul road and overland conveyor corridor, the existing security gate and access road to the mine administration buildings would still be utilized under this alternative.

Development of this alternative would necessitate the construction of four diversion channels: the Coyote-Butler Diversion, the Lone Star Leach Pad (LSLP) Diversion, the Watson-Talley Diversion, and the Interim Diversion Channel. The Coyote-Butler Diversion and the LSLP Diversion would be located upgradient of the new heap leach pad (see ***Figure 16***). The Coyote-Butler Diversion would intercept potential flows in Coyote Wash and transport them west into an unnamed tributary of Butler Wash. The LSLP Diversion would be constructed along most of the northeast edge of the new leach pad to route stormwater from upgradient of the leach pad to the natural channel of Watson Wash. The Watson-Talley Diversion would be located along the boundary of Watson and Talley Washes. The Watson-Talley Diversion would keep stormwater from significant storm events captured by the LSLP Diversion from overwhelming Watson Wash and affecting the neighboring Talley Wash (see ***Figure 16***).

The Interim Diversion Channel would be constructed above each phase of the leach pad as it advances to divert stormwater reporting from the area downgradient of the LSLP Diversion until the leach pad reaches its ultimate footprint. As this Interim Diversion channel is entirely within the ultimate design footprint of the leach pad, it does not have additional impacts to potential waters of the U.S., and is not shown on ***Figure 16***.

Direct impacts to potential waters of the U.S. for this alternative total approximately 46.17 acres.

Table 9. Design for the Heap Leach Pad under Heap Leach Pad Alternative 9: Base Case Pivot

Heap Leach Pad Design Components	Acres of Land Impacted	Acres of Potential Waters Impacted
New Leach Pad/Liner	1,773	30.82
New Appurtenant Components	737	14.34
Existing Crushing Plant	0	0
Existing SX/EW	0	0
New Drainage Diversion Structures	32	1.01
Existing Access Road	0	0
TOTAL	**2,542**	**46.17**

4.1.9.2. Practicability Determination

Heap Leach Pad Alternative 9: Base Case Pivot is both technically and logistically practicable, and utilizes the existing crushing facilities, existing SX/EW processing facilities, and the majority of the existing support infrastructure for the current leach pad. The leach pad design under this alternative allows proper allocation of the leachable ore to provide the necessary leach cycle times. This design also provides the flexibility necessary to accommodate changes in the identified mineral resources of the Lone Star ore body, as well as changes in the leach-cycle time or lift thickness that may be necessitated by the physical and chemical properties of the processed ore. Alternative 9 is extremely similar to the design of Heap Leach Pad Alternative 1: Base Case, but the footprint of the pad has been rotated to maximize avoidance of potential waters of the U.S. This change makes the impacts to potential waters of the U.S. under this alternative the 2nd lowest of all the leach pad alternatives.

4.2. Development Rock Stockpile Alternatives

Using the Analysis Area and technical factors described above, six design alternatives for the development rock stockpile element were formulated for use in the analysis of Project alternatives. The six alternatives formulated and analyzed here are as follows:

Alternative 1: Base Case
Alternative 2: All South
Alternative 3: South Split
Alternative 4: Backfill and North SP
Alternative 5: Backfill and South SP
Alternative 6: North Side of Ridge

These alternatives, along with their practicability determinations, are described in detail in the following subsections.

4.2.1. Development Rock Stockpile Alternative 1: Base Case

4.2.1.1. Description of Development Rock Stockpile Alternative 1: Base Case

Development Rock Stockpile Alternative 1: Base Case proposes the construction of three development rock stockpiles around the Lone Star pit (***Figure 17***). The stockpiles are identified as the northeast, southeast, and southwest stockpiles. The stockpiles would be constructed in approximately 50-foot lifts at an overall two and a half horizontal to one vertical (2.5H:1V) slope to facilitate reclamation. Construction of the stockpiles would involve initial lifts, smaller in area, which gradually increase to fill the overall proposed footprint of the stockpiles. The final overall footprint of the three stockpiles is 2,518 acres as the footprints of the northeast stockpile and the southeast stockpile will eventually merge. The combined capacity of the three stockpiles is approximately 1.6 billion tons: 969 million tons in the northeast stockpile, 535 million tons in the southeast stockpile, and 162 million tons in the southwest stockpile.

Development rock materials would be transported from the pit by haul truck and added to the stockpiles. Access to the stockpiles from the pit changes during the mine life, with the northeast and southeast stockpiles being accessed mainly from a northern pit exit and the southwest stockpile accessed from a southern pit exit. A small laydown yard and access point would be constructed immediately south of the northeast stockpile.

All stockpiles would be located in the upper reaches of impacted drainage watersheds and no drainage diversion would be required. All stormwater control features required by the design would be located within the FMSI-managed lands of the Analysis Area under this alternative (see ***Figure 17***). Direct impacts to potential waters of the U.S. for this alternative total approximately 27.04 acres.

Table 10. Design for the Development Rock Stockpile under Alternative 1: Base Case

Development Rock Stockpile Design Components	Acres of Land Impacted	Acres of Potential Waters Impacted
Northeast Stockpile	1,648	18.19
Southeast Stockpile	572	2.13
Southwest Stockpile	298	3.53
Laydown Yard/Access Point	63	1.42
Stormwater Control Features	24	1.77
TOTAL	**2,605**	**27.04**

4.2.1.2. Practicability Determination

The Development Rock Stockpile design under Alternative 1: Base Case is both technologically and logistically practicable. These three stockpiles provide the approximately 1.6 billion tons of necessary development rock/overburden storage capacity, a volume which provides the flexibility to accommodate changes in the identified mineral resources of the Lone Star ore body. The mine plan requires several pit exit locations that change during the stages of pit development. All three stockpiles can be practicably accessed from northern and southern pit exits during the mine life. Impacts to potential waters of the U.S. under this alternative are the 2nd highest of the development rock stockpile alternatives.

4.2.2. Development Rock Stockpile Alternative 2: All South

4.2.2.1. Description of Development Rock Stockpile Alternative 2: All South

Development Rock Stockpile Alternative 2: All South proposes the construction of one development rock stockpile south of the Lone Star pit (***Figure 18***). The stockpile is identified as the southwest stockpile. The stockpile would be constructed in approximately 50-foot lifts at an overall two and a half horizontal to one vertical (2.5H:1V) slope to facilitate reclamation, and has an ultimate footprint of 1,522 acres. Construction of the stockpile would involve initial lifts, smaller in area, which gradually increase to fill the overall proposed footprint of the stockpile. The capacity of this stockpile is approximately 1.46 billion tons.

Development rock/overburden materials will be transported from the pit by haul truck and added to the stockpile. Access to the stockpile from the pit would not change during the mine life, with the stockpile being accessed only from a northern pit exit.

The stockpile would be located in the upper reaches of impacted drainage watersheds and no drainage diversion would be required. All stormwater control features required by the design would be located within the FMSI-managed lands of the Analysis Area under this alternative (see ***Figure 18***). Direct impacts to potential waters of the U.S. for this alternative total approximately 27.99 acres.

Table 11. Design for the Development Rock Stockpile under Alternative 2: All South

Development Rock Stockpile Design Components	Acres of Land Impacted	Acres of Potential Waters Impacted
Southwest Stockpile	1,522	27.48
Stormwater Control Features	18	0.51
TOTAL	**1,540**	**27.99**

4.2.2.2. Practicability Determination

The Development Rock Stockpile design under Alternative 2: All South is technologically practicable, but not logistically practicable. This stockpile does not provide the approximately 1.6 billion tons of necessary development rock storage capacity, a volume which provides the flexibility to accommodate changes in the identified mineral resources of the Lone Star ore body. The mine plan requires several pit exit locations that change during the stages of pit development. This stockpile can only be accessed from a southern pit exit during the mine life. Impacts to potential waters of the U.S. under this alternative are the highest of the development rock stockpile alternatives.

4.2.3. Development Rock Stockpile Alternative 3: South Split

4.2.3.1. Description of Development Rock Stockpile Alternative 3: South Split

Development Rock Stockpile Alternative 3: South Split proposes the construction of two development rock stockpiles south of the Lone Star pit (***Figure 19***). The stockpiles are identified as the southeast and southwest stockpiles. The stockpiles would be constructed in approximately 50-foot lifts at an overall two and a half horizontal to one vertical (2.5H:1V) slope to facilitate reclamation. Construction of the stockpiles would involve initial lifts, smaller in area, which gradually increase to fill the overall proposed footprint of the stockpiles. The final overall footprint of the two stockpiles is 1,604 acres. The combined capacity of the two stockpiles is approximately 1.39 billion tons: 535 million tons in the southeast stockpile and 859 million tons in the southwest stockpile.

Development rock materials would be transported from the pit by haul truck and added to the stockpiles. Access to the stockpiles from the pit changes during the mine life, with the southeast stockpile being accessed mainly from a northern pit exit and the southwest stockpile accessed from a southern pit exit.

Both stockpiles would be located in the upper reaches of impacted drainage watersheds and no drainage diversion would be required. All stormwater control features required by the design would be located within the FMSI-managed lands of the Analysis Area under this alternative (see ***Figure 19***). Direct impacts to potential waters of the U.S. for this alternative total approximately 18.09 acres.

Table 12. Design for the Development Rock Stockpile under Alternative 3: South Split

Development Rock Stockpile Design Components	Acres of Land Impacted	Acres of Potential Waters Impacted
Southeast Stockpile	587	2.13
Southwest Stockpile	1,017	15.08
Stormwater Control Features	18	0.88
TOTAL	**1,622**	**18.09**

4.2.3.2. Practicability Determination

The Development Rock Stockpile design under Alternative 3: South Split is technologically practicable, but not logistically practicable. The mine plan requires several pit exit locations that change during the stages of pit development. Both stockpiles can be accessed from northern and southern pit exits during the mine life. However, this stockpile does not provide the approximately 1.6 billion tons of necessary development rock storage capacity, a volume which provides the flexibility to accommodate changes in the identified mineral resources of the Lone Star ore body. Impacts to potential waters of the U.S. under this alternative are the 2nd lowest of the development rock stockpile alternatives, and the same as those under Development Rock Stockpile Alternative 5: Backfill and South SP.

4.2.4. Development Rock Stockpile Alternative 4: Backfill and North SP

4.2.4.1. Description of Development Rock Stockpile Alternative 4: Backfill and North SP

Development Rock Stockpile Alternative 4: Backfill and North SP proposes the construction of a single development rock stockpile north of the Lone Star pit (***Figure 20***). The stockpile is identified as the northeast stockpile. Under this alternative, development rock materials would also be placed in the Dos Pobres pit as backfill. The northeast stockpile would be constructed in approximately 50-foot lifts at an overall two and a half horizontal to one vertical (2.5H:1V) slope to facilitate reclamation. Construction of the stockpile would involve initial lifts, smaller in area, which gradually increase to fill the overall proposed footprint of the stockpile. The stockpile has a final overall footprint of 1,648 acres with a capacity of 969 million tons. Approximately 522 million tons would be added as backfill to the existing Dos Pobres pit. The combined capacity under this alternative is approximately 1.49 billion tons.

Development rock materials would be transported from the pit by haul truck and added to the northeast stockpile. Access to this stockpile from the pit would not change during the mine life, with the stockpile being accessed only from a northern pit exit. A small laydown yard and access point would be constructed immediately south of the northeast stockpile. Access to the Dos Pobres in-pit stockpile from the Lone Star pit would not change during the mine life, with the stockpile being accessed via both proposed and existing haul roads.

The northeast stockpile would be located in the upper reaches of the impacted drainage watersheds and no drainage diversion would be required. No drainages would be impacted by the backfilling of the existing

Dos Pobres pit. All stormwater control features required by the design would be located within the FMSI-managed lands of the Analysis Area under this alternative (see ***Figure 20***). Direct impacts to potential waters of the U.S. for this alternative total approximately 20.44 acres.

Table 13. Design for the Development Rock Stockpile under Alternative 4: Backfill and North SP

Development Rock Stockpile Design Components	Acres of Land Impacted	Acres of Potential Waters Impacted
Northeast Stockpile	1,648	18.19
Dos Pobres	0	0
Laydown Yard/Access Point	63	1.42
Stormwater Control Features	11	0.83
TOTAL	**1,722**	**20.44**

4.2.4.2. Practicability Determination

The Development Rock Stockpile design under Alternative 4: Backfill and North SP is technologically practicable, but not logistically practicable. This alternative does not provide the approximately 1.6 billion tons of necessary development rock storage capacity, a volume which provides the flexibility to accommodate changes in the identified mineral resources of the Lone Star ore body. The mine plan requires several pit exit locations that change during the stages of pit development. The northeast stockpile can only be practicably accessed from a northern pit exit during the mine life, and does not allow flexibility in pit exits over the life of the Lone Star pit. Haul traffic during the mine life requires a southern exit from the pit, an exit not feasible under this design. Further, the backfill of development rock to the Dos Pobres pit covers known sulfide-ore milling resources, and this area is not available for receiving development rock materials. Impacts to potential waters of the U.S. under this alternative are the 3rd lowest of the development rock stockpile alternatives and the same as those under Development Rock Stockpile Alternative 6: North Side of Ridge.

4.2.5. Development Rock Stockpile Alternative 5: Backfill and South SP

4.2.5.1. Description of Development Rock Stockpile Alternative 5: Backfill and South SP

Development Rock Stockpile Alternative 5: Backfill and South SP proposes the construction of a single development rock stockpile south of the Lone Star pit (***Figure 21***). The stockpile is identified as the southwest stockpile. Under this alternative, development rock materials would also be placed in the Dos Pobres pit as backfill. The southwest stockpile would be constructed in approximately 50-foot lifts at an overall two and a half horizontal to one vertical (2.5H:1V) slope to facilitate reclamation. Construction of the stockpile would involve initial lifts, smaller in area, which gradually increase to fill the overall proposed footprint of the stockpile. The stockpile has a final overall footprint of 1,017 acres with a capacity of 859 million tons. Approximately 522 million tons would be added as backfill to the existing Dos Pobres pit. The combined capacity under this alternative is approximately 1.38 billion tons.

Development rock materials would be transported from the pit by haul truck and added to the northeast stockpile. Access to this stockpile from the pit would not change during the mine life, with the stockpile being accessed only from a southern pit exit. Access to the Dos Pobres in-pit stockpile from the Lone Star pit would not change during the mine life, with the stockpile being accessed via both proposed and existing haul roads.

The southwest stockpile would be located in the upper reaches of the impacted drainage watersheds and no drainage diversion would be required. No drainages would be impacted by the backfilling of the existing Dos Pobres pit. All stormwater control features required by the design would be located within the FMSI-managed lands of the Analysis Area under this alternative (see ***Figure 21***). Direct impacts to potential waters of the U.S for this alternative total approximately 15.72 acres.

Table 14. Design for the Development Rock Stockpile under Alternative 5: Backfill and South SP

Development Rock Stockpile Design Components	Acres of Land Impacted	Acres of Potential Waters Impacted
Southwest Stockpile	1,017	15.08
Dos Pobres Backfill	0	0
Stormwater Control Features	11	0.64
TOTAL	**1,028**	**15.72**

4.2.5.2. Practicability Determination

The Development Rock Stockpile design under Alternative 5: Backfill and South SP is technologically practicable, but not logistically practicable. This alternative does not provide the approximately 1.6 billion tons of necessary development rock storage capacity, a volume which provides the flexibility to accommodate changes in the identified mineral resources of the Lone Star ore body. The mine plan requires several pit exit locations that change during the stages of pit development. The northeast stockpile can only be practicably accessed from a southern pit exit during the mine life, and does not allow flexibility in pit exits over the life of the Lone Star pit. Additionally, the backfill of development rock to the Dos Pobres pit covers known sulfide-ore milling resources, and this area is not available for receiving development rock materials. Impacts to potential waters of the U.S. under this alternative are the lowest of the development rock stockpile alternatives, and the same as those under Development Rock Stockpile Alternative 3: South Split.

4.2.6. Development Rock Stockpile Alternative 6: North Side of Ridge

4.2.6.1. Description of Development Rock Stockpile Alternative 6: North Side of Ridge

Development Rock Stockpile Alternative 6: North Side of Ridge proposes the construction of two development rock stockpiles north and east of the Lone Star pit (***Figure 22***). The stockpiles are identified as the northeast and southeast stockpiles. The stockpiles would be constructed in approximately 50-foot lifts at an overall two and a half horizontal to one vertical (2.5H:1V) slope to facilitate reclamation.

Construction of the stockpiles would involve initial lifts, smaller in area, which gradually increase to fill the overall proposed footprint of the stockpiles. The final overall footprint of the two stockpiles is 2,235 acres. The combined capacity of the two stockpiles is approximately 1.5 billion tons: 969 million tons in the northeast stockpile and 535 million tons in the southeast stockpile.

Development rock materials would be transported from the pit by haul truck and added to the stockpiles. Access to the stockpiles from the pit would not change during the mine life, with the stockpiles being accessed only from a northern pit exit. A small laydown yard and access point would be constructed immediately south of the northeast stockpile.

Both stockpiles would be located in the upper reaches of impacted drainage watersheds and no drainage diversion would be required. All stormwater control features required by the design would be located within the FMSI-managed lands of the Analysis Area under this alternative (see ***Figure 22***). Direct impacts to potential waters of the U.S. for this alternative total approximately 22.82 acres.

Table 15. Design for the Development Rock Stockpile under Alternative 6: North Side of Ridge

Development Rock Stockpile Design Components	Acres of Land Impacted	Acres of Potential Waters Impacted
Northeast Stockpile	1,648	18.19
Southeast Stockpile	587	2.13
Laydown Yard/Access Point	63	1.42
Stormwater Control Features	18	1.08
TOTAL	**2,316**	**22.82**

4.2.6.2. Practicability Determination

The Development Rock Stockpile design under Alternative 6: North Side of Ridge is technologically practicable, but not logistically practicable. This alternative does not provide the approximately 1.6 billion tons of necessary development rock storage capacity, a volume which provides the flexibility to accommodate changes in the identified mineral resources of the Lone Star ore body. The mine plan requires several pit exit locations that change during the stages of pit development. The two stockpiles can only be accessed from a northern pit exit during the mine life, and do not allow flexibility in pit exits over the life of the Lone Star pit. Haul traffic during the mine life requires a southern exit from the pit, an exit not feasible under this design. Impacts to potential waters of the U.S. under this alternative are the 3rd highest of the development rock stockpile alternatives and the same as those under Development Rock Stockpile Alternative 4: Backfill and North SP.

4.3. CONVEYANCE ROUTE ALTERNATIVES

Using the Analysis Area and technical factors described above, three designs for the development of conveyance route alternatives for the Project were formulated for use in the analysis of Project alternatives. The three alternatives formulated and analyzed here are as follows:

Alternative 1: Haul Road Base Case
Alternative 2: Haul Road Half-Existing
Alternative 3: Haul Road All-Existing

These alternatives, along with their practicability determinations, are described in detail in the following subsections. During alternative development, the construction and use of a conveyor system between the Lone Star pit and the existing crushing facilities was contemplated. However, it was determined that the conveyor system would have similar impacts to potential waters of the U.S. as a haul road, but would require the construction of a new primary crusher rather than allowing the continued use of the existing primary crusher. Therefore, the inclusion of a conveyor as the sole means of conveyance from the Lone Star pit to the crushing facilities was not carried forward in this analysis.

Under each alternative, wash crossings would be constructed using culverts, as opposed to at-grade bridges or crossings. At-grade crossings are not feasible because of the steep and varied topography, the need for all-weather access, and the need to maintain consistent straight road grades for large mobile mining equipment. Bridged crossings are also impracticable because their construction and maintenance would be prohibitively expensive. Bridge crossings would need to be maintained at a width of up to 210 feet to accommodate the road bed and bridge heights would need to be at a sufficient elevation to maintain an acceptable grade for equipment operation. This would require prohibitively large structures to accommodate the mining equipment necessary for the Project. The impact footprints for the culverts are based on the necessary haulage access road footprint and the culverts are sized for a 50-year storm event.

4.3.1. Conveyance Route Alternative 1: Haul Road Base Case

4.3.1.1. Description of Conveyance Route Alternative 1: Haul Road Base Case

Conveyance Route Alternative 1: Haul Road Base Case proposes the construction of a haul road between the Lone Star pit and the existing crushing facilities (***Figure 23***). The Base Case haul road is an unpaved road with a drivable road surface of approximately 210 feet in width. The full width of the road bed prism, or the toe-to-toe length of the base of the road fill, varies along the length of the road, reaching a maximum of approximately 750 feet in width near the Lone Star pit. The overall footprint of the haul road is approximately 265 acres.

Under Conveyance Route Alternative 1: Haul Road Base Case, the haul road would have two termini at the Lone Star pit during mine life (see ***Figure 23***). The northernmost terminus is higher in elevation and would be constructed first, and the second, southern terminus constructed as the Lone Star pit increases in depth. The haul road extends west-northwest from the Lone Star pit, past the San Juan pit, to the existing crushing facilities. This haul road alignment would not reuse any of the existing haul road alignment between the San Juan pit and the crushing facilities.

A truck service complex that includes a heavy-duty truck lube shop and a fuel station would be built south of the haul road, near the split between the northern and southern arms of the proposed road. Drainage crossings for the haul road would be constructed using culverts to allow stormwater flows within the

ephemeral drainages to pass from the upgradient side of the haul road to the downgradient side. Direct impacts to potential waters of the U.S. for this alternative total approximately 3.28 acres.

Table 16. Design Criteria for the Conveyance Route under Conveyance Route Alternative 1: Haul Road Base Case

Conveyance Route Design Components	Acres of Land Impacted	Acres of Potential Waters Impacted
Haul Road	265	3.28
Service Complex	35	0
TOTAL	**300**	**3.28**

4.3.1.2. Practicability Determination

Conveyance Route Alternative 1: Haul Road Base Case is both technologically and logistically practicable. However, this haul road alignment would not reuse any of the existing haul road alignment between the San Juan pit and the crushing facilities. Impacts to potential waters of the U.S. under this alternative are the highest of the conveyance route alternatives.

4.3.2. Conveyance Route Alternative 2: Haul Road Half-Existing

4.3.2.1. Description of Conveyance Route Alternative 2: Haul Road Half-Existing

Conveyance Route Alternative 2: Haul Road Half-Existing proposes the construction of a haul road between the Lone Star pit and the existing crushing facilities (***Figure 24***). As for the Base Case haul road, the Half-Existing road is an unpaved road with a drivable road surface of approximately 210 feet in width. The full width of the road bed prism, or the toe-to-toe length of the base of the road fill, varies along the length of the road, reaching a maximum of approximately 750 feet in width near the Lone Star pit. The overall footprint of the haul road is approximately 266 acres.

Under Conveyance Route Alternative 2: Haul Road Half-Existing, the haul road would have two termini at the Lone Star pit during mine life (see ***Figure 24***). The northernmost terminus is higher in elevation and would be constructed first, and the second, southern terminus constructed as the Lone Star pit increases in depth. The haul road extends west-northwest from the Lone Star pit, past the San Juan pit, to the existing crushing facilities. The haul road utilizes approximately half of the existing haul road alignment between the San Juan pit and the existing crushing facilities. The new and existing haul road alignments intersect immediately east of the existing Cottonwood Wash crossing and the new, resulting haul road alignment would utilize this crossing.

A truck service complex that includes a heavy-duty truck lube shop and a fuel station would be built south of the haul road, near the split between the northern and southern arms of the proposed road. Drainage crossings for the haul road would be constructed using culverts to allow stormwater flows within the

ephemeral drainages to pass from the upgradient side of the haul road to the downgradient side. Direct impacts to potential waters of the U.S. for this alternative total approximately 3.10 acres.

Table 17. Design Criteria for the Conveyance Route under Conveyance Route Alternative 2: Haul Road Half-Existing

Conveyance Route Design Components	Acres of Land Impacted	Acres of Potential Waters Impacted
Haul Road	266	3.10
Service Complex	35	0
TOTAL	**301**	**3.10**

4.3.2.2. Practicability Determination

Conveyance Route Alternative 2: Haul Road Half-Existing is both technologically and logistically practicable. This haul road alignment would utilize approximately half of the existing haul road alignment between the San Juan pit and the crushing facilities, including the existing crossing of Cottonwood Wash. Impacts to potential waters of the U.S. under this alternative are the 2nd highest of the conveyance route alternatives.

4.3.3. Conveyance Route Alternative 3: Haul Road All-Existing

4.3.3.1. Description of Conveyance Route Alternative 3: Haul Road All-Existing

Conveyance Route Alternative 3: Haul Road All-Existing proposes the construction of a haul road between the Lone Star pit and the existing crushing facilities (***Figure 25***). As for the Base Case haul road, the All-Existing road is an unpaved road with a drivable road surface of approximately 210 feet in width. The full width of the road bed prism, or the toe-to-toe length of the base of the road fill, varies along the length of the road, reaching a maximum of approximately 750 feet in width near the Lone Star pit. The overall footprint of the haul road is approximately 250 acres.

Under Conveyance Route Alternative 3: Haul Road All-Existing, the haul road would have two termini at the Lone Star pit during mine life (see ***Figure 25***). The northernmost terminus is higher in elevation and would be constructed first, and the second, southern terminus constructed as the Lone Star pit increases in depth. The haul road extends west-northwest from the Lone Star pit, past the San Juan pit, to the existing crushing facilities. The haul road utilizes all of the existing haul road alignment between the San Juan pit and the existing crushing facilities. The new and existing haul road alignments intersect further east of the existing Cottonwood Wash crossing than that proposed under the Half-Existing alternative. The new, resulting haul road alignment would utilize this crossing.

A truck service complex that includes a heavy-duty truck lube shop and a fuel station would be built south of the haul road, near the split between the northern and southern arms of the proposed road. Drainage crossings for the haul road would be constructed using culverts to allow stormwater flows within the

ephemeral drainages to pass from the upgradient side of the haul road to the downgradient side. Direct impacts to potential waters of the U.S. for this alternative total approximately 2.99 acres.

Table 18. Design Criteria for the Conveyance Route under Conveyance Route Alternative 3: Haul Road All-Existing

Conveyance Route Design Components	Acres of Land Impacted	Acres of Potential Waters Impacted
Haul Road	250	2.99
Service Complex	35	0
TOTAL	**285**	**2.99**

4.3.3.2. Practicability Determination

Conveyance Route Alternative 3: Haul Road All-Existing is both technologically and logistically practicable. This haul road alignment would utilize all of the existing haul road alignment between the San Juan pit and the crushing facilities, including the existing crossing of Cottonwood Wash. Impacts to potential waters of the U.S. under this alternative are the lowest of the conveyance route alternatives.

4.4. SUMMARY OF ELEMENT ALTERNATIVES AND PRACTICABILITY DETERMINATIONS

A summary of the sets of alternatives formulated for each of the major elements of the Project and the practicability of each of the alternative is presented in this section. Anticipated impacts to potential waters of the U.S. under each alternative of the elements are also presented. Practicable alternatives of these elements were organized into Project design alternatives that could fulfill the Project purpose. The summary of the descriptions and analyses for nine heap leach alternatives, five development rock stockpile alternatives, and three conveyance route alternatives are shown in ***Table 19***.

Table 19. Summary Table of Mine Element Alternatives and Practicability Determinations

Alternative Name	Acres of Land Impacted	Acres of Potential Waters Impacted	Practicability Determination
Heap Leach Pad Alternatives			
Alternative 1: Base Case	2,466	60.40	Practicable
Alternative 2: Long Pad N-S	2,583	59.15	Not Practicable
Alternative 3: Tall Pad	Not Calculated	Not Calculated	Not Practicable
Alternative 4: L Pad West	2,457	62.41	Not Practicable
Alternative 5: L Pad East	Not Calculated	Not Calculated	Not Practicable
Alternative 6: Base Case Airport	Not Calculated	Not Calculated	Not Practicable
Alternative 7: Long Pad Airport	Not Calculated	Not Calculated	Not Practicable
Alternative 8: Long Pad E-W	Not Calculated	Not Calculated	Not Practicable
Alternative 9: Base Case Pivot	2,542	46.17	Practicable
Development Rock Stockpile Alternatives			
Alternative 1: Base Case	2,605	27.04	Practicable
Alternative 2: All South	1,540	27.99	Not Practicable
Alternative 3: South Split	1,622	18.09	Not Practicable
Alternative 4: Backfill and North SP	1,722	20.44	Not Practicable
Alternative 5: Backfill and South SP	1,028	15.72	Not Practicable
Alternative 6: North Side of Ridge	2,316	22.82	Not Practicable
Conveyance Route Alternatives			
Alternative 1: Haul Road Base Case	300	3.28	Practicable
Alternative 2: Haul Road Half-Existing	301	3.10	Practicable
Alternative 3: Haul Road All-Existing	285	2.99	Practicable

5. PROJECT ALTERNATIVES DESCRIPTION AND PRACTICABILITY DETERMINATION

5.1. PROJECT DESIGN ALTERNATIVES

Using the Analysis Area and practicable designs for each of the element alternatives described above, two designs for the Project were formulated for analysis. The two Project design alternatives formulated and analyzed here are as follows:

Project Design Alternative 1: Base Case
Project Design Alternative 2: Pivot Option

These Project design alternatives, along with their practicability determinations, are described in detail in the following sections. Mine elements anticipated as necessary for the development of the Project under all Project design alternatives include the open pit, a heap leach pad, development rock stockpile(s), the conveyance route between the pit and crusher, additional power distribution infrastructure, an expanded clay borrow pit, soil and growth medium stockpiles, a truck service complex, a communications tower, and additional stormwater management facilities. Alternatives for mine elements determined not to be practicable were not carried forward in for the development of Project design alternatives.

5.1.1. Project Design Alternative 1: Base Case

Project Design Alternative 1: Base Case (***Figure 26***) proposes the development of the Project using these components as analyzed in *Section 4*:

Heap Leach Pad Alternative 1: Base Case
Development Rock Stockpile Alternative 1: Base Case
Conveyance Route Alternative 3: Haul Road All-Existing

The complete description of this Project design alternative is as follows:

5.1.1.1. Lone Star Pit

The design of the Lone Star open pit is based on three factors: (1) the currently understood nature and extent of the economic ore body of the Lone Star deposit, (2) pit stability considerations, and (3) the removal of development rock to the extent necessary to access and mine the ore body. The location of the open pit for the Project is tied to the physical location of the mineral resource. The purpose of the Lone Star Project is the economic recovery of the mineral resources associated with the Lone Star ore body, and the current pit design estimates a body of approximately 785 million tons of leachable oxide and sulfide ores that is economically recoverable under current market prices. The design of the Lone Star pit contains a 1,100-foot setback to accommodate the potential future mining of sulfide-ore milling resources located beneath the leachable ore body.

Given these factors, the estimated dimensions of the Lone Star pit at the end-of-mine life are approximately 6,100 feet on the north-south axis and 5,800 on the east west access (see ***Figure 26***). At these dimensions, the pit has a surface footprint of approximately 645 acres and has an estimated maximum depth of about 2,000 feet. The design of the Lone Star open pit itself under Project Design Alternative 1: Base Case does not impact any potential waters of the U.S.

5.1.1.2. Heap Leach Pad

Project Design Alternative 1: Base Case proposes the construction of the 1-billion-ton lined heap leach pad, analyzed as Heap Leach Stockpile Alternative 1: Base Case, southwest of the existing heap leach pad (see ***Figure 26***). The heap leach pad would be constructed in multiple phases beginning at the southwest edge, and be typically stacked in 16- to 20-foot lifts using a radial stacking system. The leach pad would be constructed with setback benches to achieve a final overall slope of no greater than two and a half horizontal to one vertical (2.5H:1V). The final design height of the heap leach pad is 400 feet, with an overall design footprint of approximately 2,466 acres. The design of this leach pad provides for the ability to accommodate the effective leaching of an additional volume of 200 million tons of ore over the currently identified mineral resource associated with the Lone Star ore body. This additional volume provides the flexibility necessary to accommodate changes in the identified mineral resources of the Lone Star ore body, as well as changes in the leach-cycle time or lift thickness that may be necessitated by the physical and chemical properties of the processed ore. The leach pad would be lined in those areas where ore will be processed.

Construction of the liner system would require the cut or fill of the natural topography, and compaction of the resulting subgrade prior to liner installation. The liner system, from the ground up, would consist of: (1) a minimum of 12 inches of low-permeability compacted soil from the existing clay borrow pit, (2) a geomembrane layer of a minimum of 60 mil of LLDPE, (3) a minimum of 2 feet of minus 1.5-inch crushed and screened rock as overliner fill, and (4) a minimum of 2 feet of run-of-mine material. A construction materials stockpile would be placed to the north of the leach pad for the storage of materials from the Lone Star pit to be used in construction of the leach pad liner. A soil and growth medium stockpile would be located immediately adjacent to the southwest edge of the leach pad to hold soil excavated during leach pad construction.

The design and location of the heap leach pad facilitates the continued use of the existing crushing facilities, existing SX/EW processing facilities, and the majority of the existing support infrastructure for the current leach pad. Under this alternative, a ROM haul road would be constructed from the main haul road east and south of the existing leach pad to transport construction materials from the Lone Star pit. Two lined PLS ponds and two lined NSI ponds would be constructed at the southwest edge of the new leach pad. Each PLS pond would have a storage capacity of 114 acre feet (37.18 million gallons) plus two feet of freeboard (crest capacity is 134 acre feet), and each NSI pond would have a storage capacity of 395.5 acre feet (128.8 million gallons) plus two feet of freeboard (crest capacity is 427 acre feet). The NSI ponds would be designed to impound impacted runoff from the heap leach pad during events larger than the 100-year/24-hour storm event. A lined raffinate delivery pipe corridor would be constructed from the existing raffinate storage tanks to the new leach pad and a PLS collection pipe corridor constructed from the new PLS ponds to the existing SX plant. A laydown yard for the storage of construction equipment, materials, and operating supplies would be constructed atop the soil and growth materials stockpile.

The current overland conveyor on the west edge of the existing leach pad would be extended to the south, along the southeastern edge of the new leach pad. The lined overland conveyor would bring leach materials from the existing crushing facility and drum agglomerators to the new leach pad, where the material would be stacked using portable conveyors and a radial stacking system. Roads for the movement of large equipment would be located on either side of the overland conveyor and along the northeastern and southeastern edges of the new heap leach pad. Light equipment roads would be located on the southwestern and northwestern edges of the leach pad. Although new crossings of the existing access road would be required for the ROM haul road and overland conveyor corridor, the existing security gate and access road to the mine administration buildings would still be utilized under this alternative.

Development of this alternative would necessitate the construction of three diversion channels: the 3136 Diversion, the Minor Drainage Channel, and the Interim Diversion Channel. The 3136 Diversion and the

Minor Drainage Channel would be located upgradient of the new heap leach pad (see ***Figure 26***). The 3136 Diversion would intercept potential flows from the existing Upper West and Lower West Diversions (see ***Figure 3***) and transport them north and west to a tributary of Butler Wash. The Minor Drainage Channel would be constructed east of the 3136 Diversion, along the northeast edge of the leach pad, and would collect stormwater immediately north of the leach pad not captured by the 3136 Diversion. These potential stormwater flows would be moved east to a tributary of Talley Wash. The Interim Diversion Channel would be constructed above each phase of the leach pad as it advances to divert stormwater reporting from the area downgradient of the other two diversions until the leach pad reaches its ultimate footprint. As this Interim Diversion channel is entirely within the ultimate design footprint of the leach pad, it does not have additional impacts to potential waters of the U.S., and is not shown on ***Figure 26***.

Impacts to potential waters of the U.S. for this design of the leach pad and appurtenant features are 60.40 acres.

5.1.1.3. Development Rock Stockpiles

Project Design Alternative 1: Base Case proposes the construction of three development rock stockpiles around the Lone Star pit (see ***Figure 26***), as analyzed under Development Rock Stockpile Alternative 1: Base Case. The stockpiles are identified as the northeast, southeast, and southwest stockpiles. The stockpiles would be constructed in approximately 50-foot lifts at an overall two and a half horizontal to one vertical (2.5H:1V) slope to facilitate reclamation. Construction of the stockpiles would involve initial lifts, smaller in area, which gradually increased to fill the overall proposed footprint of the stockpiles. The final overall footprint of the three stockpiles is 2,518 acres, as the footprints of the northeast stockpile and the southeast stockpile will eventually merge. The combined capacity of the three stockpiles is approximately 1.6 billion tons: 969 million tons in the northeast stockpile, 535 million tons in the southeast stockpile, and 162 million tons in the southwest stockpile.

Development rock materials would be transported from the pit by haul truck and added to the stockpiles. Access to the stockpiles from the pit changes during the mine life, with the northeast and southeast stockpiles being accessed mainly from a northern pit exit and the southwest stockpile accessed from a southern pit exit. A small laydown yard and access point would be constructed immediately south of the northeast stockpile.

All stockpiles would be located in the upper reaches of impacted drainage watersheds and no drainage diversion would be required. All stormwater control features required by the design would be located within the FMSI-managed lands of the Analysis Area (see ***Figure 26***).

Impacts to potential waters of the U.S. for this design of the development rock stockpiles and appurtenant features are 27.04 acres.

5.1.1.4. Conveyance Route

Project Design Alternative 1: Base Case proposes the construction of a haul road between the Lone Star pit and the existing crushing facilities (see ***Figure 26***), as analyzed under Conveyance Route Alternative 3: Haul Road All-Existing. The proposed haul road is an unpaved road with a drivable road surface of approximately 210 feet in width. The full width of the road bed prism, or the toe-to-toe length of the base of the road fill, varies along the length of the road, reaching a maximum of approximately 750 feet in width near the Lone Star pit. The overall footprint of the haul road is approximately 250 acres.

The haul road would have two termini at the Lone Star pit during mine life (see ***Figure 26***). The northernmost terminus is higher in elevation and would be constructed first, and the second, southern terminus constructed as the Lone Star pit increases in depth. The haul road extends west-northwest from the Lone Star pit, past the San Juan pit, to the existing crushing facilities. The haul road utilizes all of the existing haul road alignment between the San Juan pit and the existing crushing facilities, and the new and existing haul road alignments intersect east of the existing Cottonwood Wash crossing. The new, resulting haul road alignment would utilize this crossing. A truck service complex that includes a heavy-duty truck lube shop and a fuel station would be built south of the haul road, near the split between the northern and southern arms of the proposed road. Drainage crossings for the haul road would be constructed using culverts to allow stormwater flows within the ephemeral drainages to pass from the upgradient side of the haul road to the downgradient side.

Impacts to potential waters of the U.S. for this design of the haul road are 2.99 acres.

5.1.1.5. Additional Project Elements

Additional proposed elements of Project Design Alternative 1: Base Case include continued use of the existing facilities as described under the element alternatives, including the existing crushing facilities, SX/EW facilities, the majority of the existing support infrastructure for the current leach pad, and the mine access road. The additional power distribution infrastructure required for the Project Design Alternative 1: Base Case consists of a new power line alignment (see ***Figure 26***) from the existing 69kV power line to the Lone Star pit. All other power distribution infrastructure would be located within the footprint of the Lone Star pit, and no components of this infrastructure would impact potential waters of the U.S. The fuel dock for the fueling of haul trucks would be mobile, but would be in the general vicinity of the Lone Star pit. Movement and stationing of this mobile fuel dock would not impact potential waters of the U.S.

Project Design Alternative 1: Base Case proposes the continued use and expansion of the existing clay borrow pit within the Analysis Area (see ***Figure 26***). The existing clay borrow pit is identified as the source for the compactible soil materials used as part of the lining system under the proposed heap leach pad. The proposed expansion of the borrow source is approximately 48 acres, for a resulting total footprint of approximately 144 acres. A soil and growth medium stockpile approximately 86 acres in size will be located immediately south of the clay borrow pit. Access to the clay borrow pit and soil stockpile would be from the existing Clay Haul road. There are no impacts to potential waters of the U.S. required for either the expansion of the borrow pit or construction of the soil stockpile.

The configurations of additional stormwater management facilities and the truck service complex under Project Design Alternative 1: Base Case were necessarily interdependent with the design of other mine elements. Stormwater management facilities were included where the run-on of unimpacted stormwater or the runoff of impacted stormwater were design criteria. Stormwater management facilities required by the proposed Project elements include diversion facilities upgradient of the heap leach pad and stormwater containment dams downgradient of the development rock stockpiles. Similarly, the truck service complex needs to be located in proximity to roads designed to accommodate haul trucks, in this case the proposed haul road between the Lone Star pit and the existing crusher. The designs of these facilities were included in the description of and calculation of impacts for each alternative of their associated elements.

Direct impacts to potential waters of the U.S. for Project Design Alternative 1: Base Case total approximately 90.43 acres.

Table 20. Project Design Alternative 1: Base Case

Project Design Components	Acres of Land Impacted	Acres of Potential Waters Impacted
Lone Star Pit	645	0
Heap Leach Pad Alt 1: Base Case	2,466	60.40
Development Rock Stockpile Alt 1: Base Case	2,605	27.04
Conveyance Route Alt 3: Haul Road All-Existing	285	2.99
Clay Borrow Pit Expansion	48	0
Soil and Growth Medium Stockpile	86	0
Communications Tower and Road	0.29	0
Power Distribution Infrastructure	5	0
TOTAL	**6,140**	**90.43**

5.1.1.6. Practicability Determination

Project Design Alternative 1: Base Case is both technically and logistically practicable. The design of the Project under this alternative meets the overall purpose of the Lone Star Project. Impacts to potential waters of the U.S. under this Project alternative are approximately 14.23 acres greater than the Project Design Alternative 2: Pivot Option.

5.1.2. Project Design Alternative 2: Pivot Option

Project Design Alternative 2: Pivot Option (***Figure 27***) proposes the development of the Project using these components as analyzed in *Section 4*:

Heap Leach Stockpile Alternative 9: Base Case Pivot
Development Rock Stockpile Alternative 1: Base Case
Conveyance Route Alternative 3: Haul Road All-Existing

The complete description of this Project design alternative is as follows:

5.1.2.1. Lone Star Pit

The design of the Lone Star open pit is based on three factors: (1) the currently understood nature and extent of the economic ore body of the Lone Star deposit, (2) pit stability considerations, and (3) the removal of development rock to the extent necessary to access and mine the ore body. The location of the open pit for the Project is tied to the physical location of the mineral resource. The purpose of the Lone Star Project is the economic recovery of the mineral resources associated with the Lone Star ore body, and the current pit design estimates a body of approximately 785 million tons of leachable oxide and sulfide ores that is economically recoverable under current market prices. The design of the Lone Star pit contains a 1,100-foot setback to accommodate the potential future mining of sulfide-ore milling resources located beneath the leachable ore body.

Given these factors, the estimated dimensions of the Lone Star pit at the end-of-mine life are approximately 6,100 feet on the north-south axis and 5,800 on the east west access (see ***Figure 27***). At these dimensions, the surface footprint of the pit is approximately 645 acres and has an estimated maximum depth of about 2,000 feet. The design of the Lone Star open pit itself under Project Design Alternative 2: Pivot Option does not impact any potential waters of the U.S.

5.1.2.2. Heap Leach Pad

Project Design Alternative 2: Pivot Option proposes the construction of a 1-billion-ton lined heap leach pad southwest of the existing heap leach pad (see ***Figure 27***), as analyzed under Heap Leach Pad Alternative 9: Base Case Pivot. The heap leach pad would be constructed in multiple phases beginning at the southwest edge, and typically stacked in 16- to 20-foot lifts using a radial stacking system. The leach pad would be constructed with setback benches to achieve a final overall slope of no greater than two and a half horizontal to one vertical (2.5H:1V). The final design height of the heap leach stockpile is 400 feet, with an overall design footprint of approximately 2,542 acres. The design of this stockpile provides for the ability to accommodate the effective leaching of an additional volume of 200 million tons of ore over the currently identified mineral resource associated with the Lone Star ore body. This additional volume provides the flexibility necessary to accommodate changes in the identified mineral resources of the Lone Star ore body, as well as changes in the leach-cycle time or lift thickness that may be necessitated by the physical and chemical properties of the processed ore. The leach pad would be lined in those areas where ore will be processed.

Construction of the liner system would require the cut or fill of the natural topography, and compaction of the resulting subgrade prior to liner installation. The liner system, from the ground up, would consist of: (1) a minimum of 12 inches of low-permeability compacted soil from the existing clay borrow pit, (2) a geomembrane layer of a minimum of 60 mil of LLDPE, (3) a minimum of 2 feet of minus 1.5-inch crushed and screen gravel as overliner fill, and (4) a minimum of 2 feet of run-of-mine material. A construction materials stockpile would be placed to the north of the leach pad for the storage of materials from the Lone Star pit to be used in construction of the leach pad liner. A soil and growth medium stockpile would be located along the southwestern edge of the heap leach pad to hold soil excavated during leach pad construction.

The heap leach pad design facilitates the continued use of the existing crushing facilities, existing SX/EW processing facilities, and the majority of the existing support infrastructure for the current leach pad. Under this alternative, a ROM haul road would be constructed from the main haul road east and south of the existing leach pad to transport construction materials from the Lone Star pit. Two lined PLS ponds and two lined NSI ponds would be constructed at the southeast corner of the new leach pad. Each PLS pond would have a storage capacity of 114 acre feet (37.18 million gallons) plus two feet of freeboard (crest capacity is 134 acre feet), and each NSI pond would have a storage capacity of 395.5 acre feet (128.8 million gallons) plus two feet of freeboard (crest capacity is 427 acre feet). The NSI ponds would be designed to impound impacted runoff from the heap leach pad during events larger than the 100-year/24-hour storm event. A lined raffinate delivery pipe corridor would be constructed from the existing raffinate storage tanks to the new leach pad and a lined PLS collection pipe corridor constructed from the new PLS ponds to the existing SX plant. A laydown yard for the storage of construction equipment, materials, and operating supplies would be constructed atop the soil and growth medium stockpile.

The current overland conveyor on the west edge of the existing leach pad would be extended to the southwest, towards the northeastern edge of the new leach pad. Optimal design of the angle of the conveyor and location where it meets the new leach pad is still in process, so the area within which it will be located is shown as a conveyor corridor on ***Figure 27***. All potential waters of the U.S. within this corridor are considered as impacted for this analysis. The lined overland conveyor would bring leach materials from the existing crushing facility and drum agglomerators to the new leach pad, where the material would be stacked using portable conveyors and a radial stacking system. Roads for the movement of large equipment would be located on either side of the overland conveyor and along the northeastern and southeastern edges of the new heap leach pad. Light equipment roads would be located on the southwestern and northwestern edges of the leach pad. Although new crossings of the existing access road would be required for the ROM haul road and overland conveyor corridor, the existing security gate and access road to the mine administration buildings would still be utilized under this alternative.

Development of this alternative would necessitate the construction of four diversion channels: the Coyote-Butler Diversion, the Lone Star Leach Pad (LSLP) Diversion, the Watson-Talley Diversion, and the Interim

Diversion Channel. The Coyote-Butler Diversion and the LSLP Diversion would be located upgradient of the new heap leach pad (see ***Figure 27***). The Coyote-Butler Diversion would intercept potential flows in Coyote Wash and transport them west into an unnamed tributary of Butler Wash. The LSLP Diversion would be constructed along most of the northeast edge of the new leach pad to route stormwater from upgradient of the leach pad to the natural channel of Watson Wash. The Watson-Talley Diversion would be located along the boundary of Watson and Talley Washes. The Watson-Talley Diversion would keep stormwater from significant storm events captured by the LSLP Diversion from overwhelming Watson Wash and affecting the neighboring Talley Wash (see ***Figure 27***).

The Interim Diversion Channel would be constructed above each phase of the leach pad as it advances to divert stormwater reporting from the area downgradient of the LSLP Diversion until the leach pad reaches its ultimate footprint. As this Interim Diversion channel is entirely within the ultimate design footprint of the leach pad, it does not have additional impacts to potential waters of the U.S., and is not shown on ***Figure 27***.

Impacts to potential waters of the U.S. for this design of the leach pad and appurtenant features are 46.17 acres.

5.1.2.3. Development Rock Stockpiles

Project Design Alternative 2: Pivot Option proposes the construction of three development rock stockpiles around the Lone Star pit (see ***Figure 27***), as analyzed under Development Rock Stockpile Alternative 1: Base Case. The stockpiles are identified as the northeast, southeast, and southwest stockpiles. The stockpiles would be constructed in approximately 50-foot lifts at an overall two and a half horizontal to one vertical (2.5H:1V) slope to facilitate reclamation. Construction of the stockpiles would involve initial lifts, smaller in area, which gradually increased to fill the overall proposed footprint of the stockpiles. The final overall footprint of the three stockpiles is 2,533 acres. The combined capacity of the three stockpiles is approximately 1.6 billion tons: 969 million tons in the northeast stockpile, 535 million tons in the southeast stockpile, and 162 million tons in the southwest stockpile.

Development rock materials would be transported from the pit by haul truck and added to the stockpiles. Access to the stockpiles from the pit changes during the mine life, with the northeast and southeast stockpiles being accessed mainly from a northern pit exit and the southwest stockpile accessed from a southern pit exit. A small laydown yard and access point would be constructed immediately south of the northeast stockpile.

All stockpiles would be located in the upper reaches of impacted drainage watersheds and no drainage diversion would be is required. All stormwater control features required by the design would be located within the FMSI-managed lands of the Analysis Area (see ***Figure 27***).

Impacts to potential waters of the U.S. for this design of the development rock stockpiles and appurtenant features are 27.04 acres.

5.1.2.4. Conveyance Route

Project Design Alternative 2: Pivot Option proposes the construction of a haul road between the Lone Star pit and the existing crushing facilities (see ***Figure 27***), as analyzed under Conveyance Route Alternative 3: Haul Road All-Existing. The proposed haul road is an unpaved road with a drivable road surface of approximately 210 feet in width. The full width of the road bed prism, or the toe-to-toe length of the base of the road fill, varies along the length of the road, reaching a maximum of approximately 750 feet in width near the Lone Star pit. The overall footprint of the haul road is approximately 250 acres.

The haul road would have two termini at the Lone Star pit during mine life (see ***Figure 27***). The northernmost terminus is higher in elevation and would be constructed first, and the second, southern terminus constructed as the Lone Star pit increases in depth. The haul road extends west-northwest from the Lone Star pit, past the San Juan pit, to the existing crushing facilities. The haul road utilizes all of the existing haul road alignment between the San Juan pit and the existing crushing facilities, and the new and existing haul road alignments intersect east of the existing Cottonwood Wash crossing. The new, resulting haul road alignment would utilize this crossing. A truck service complex that includes a heavy-duty truck lube shop and a fuel station would be built south of the haul road, near the split between the northern and southern arms of the proposed road. Drainage crossings for the haul road would be constructed using culverts to allow stormwater flows within the ephemeral drainages to pass from the upgradient side of the haul road to the downgradient side.

Impacts to potential waters of the U.S. for this design of the haul road are 2.99 acres.

5.1.2.5. Additional Project Elements

Additional proposed elements of Project Design Alternative 2: Pivot Option include continued use of the existing facilities as described under the element alternatives, including the existing crushing facilities, SX/EW facilities, the majority of the existing support infrastructure for the current leach pad, and the mine access road. The additional power distribution infrastructure required for the Project Design Alternative 2: Pivot Option consists of a new power line alignment (see ***Figure 27***) from the existing 69kV power line to the Lone Star pit. All other power distribution infrastructure would be located within the footprint of the Lone Star pit, and no components of this infrastructure would impact potential waters of the U.S. The fuel dock for the fueling of haul trucks would be mobile, but would be in the general vicinity of the Lone Star pit. Movement and stationing of this mobile fuel dock would not impact potential waters of the U.S.

Project Design Alternative 2: Pivot Option proposes the continued use and expansion of the existing clay borrow pit within the Analysis Area (see ***Figure 27***). The existing clay pit is identified as the source for the compactible soil materials used as part of the lining system under the proposed heap leach pad. The proposed expansion of the borrow source is approximately 48 acres, for a resulting total footprint of approximately 144 acres. A soil and growth medium stockpile approximately 86 acres in size will be located immediately south of the clay borrow pit. Access to the clay borrow pit and soil stockpile would be from the existing Clay Haul road. There are no impacts to potential waters of the U.S. required for either the expansion of the borrow pit or construction of the soil stockpile.

The configurations of additional stormwater management facilities and the truck service complex under Project Design Alternative 2: Pivot Option were necessarily interdependent with the design of other mine elements. Stormwater management facilities were included where the run-on of unimpacted stormwater or the runoff of impacted stormwater were design criteria. Stormwater management facilities required by the proposed Project elements include diversion facilities upgradient of the heap leach pad and stormwater containment dams downgradient of the development rock stockpiles. Similarly, the truck service complex needs to be located in proximity to roads designed to accommodate haul trucks, in this case the proposed haul road between the Lone Star pit and the existing crusher. The designs of these facilities were included in the description of and calculation of impacts for each alternative of their associated elements.

Direct impacts to potential waters of the U.S. for Project Design Alternative 2: Pivot Option total approximately 76.20 acres.

Table 21. Project Design Alternative 2: Pivot Option

Project Design Components	Acres of Land Impacted	Acres of Potential Waters Impacted
Lone Star Pit	645	0
Heap Leach Pad Alt 9: Base Case Pivot	2,542	46.17
Development Rock Stockpile Alt 1: Base Case	2,605	27.04
Conveyance Route Alt 3: Haul Road All-Existing	285	2.99
Clay Borrow Pit Expansion	48	0
Soil and Growth Medium Stockpile	86	0
Communications Tower and Road	0.29	0
Power Distribution Infrastructure	5	0
TOTAL	**6,216**	**76.20**

5.1.2.6. Practicability Determination

Project Design Alternative 2: Pivot Option is both technically and logistically practicable. The design of the Project under this alternative meets the overall purpose of the Lone Star Project. Impacts to potential waters of the U.S. under this Project alternative are approximately 14.23 acres less than the Project Design Alternative 1: Base Case.

5.2. SUMMARY OF PROJECT DESIGN ALTERNATIVES AND PRACTICABILITY DETERMINATIONS

A summary of the alternatives formulated for each of the Project designs and the practicability of each of the alternatives is presented in this section. Anticipated impacts to potential waters of the U.S. under each alternative for the Project design are also presented. Practicable alternatives for the Project were those that could fulfill the overall Project purpose. The summary of the descriptions and analyses for the two Project design alternatives are shown in ***Table 22***.

Table 22. Summary of Project Design Alternatives and Practicability Determinations

Alternative Name	Acres of Land Impacted	Acres of Potential Waters Impacted	Practicability Determination
Project Design Alternatives			
Alternative 1: Base Case	6,140	90.43	Practicable
Alternative 2: Pivot Option	6,216	76.20	Practicable

6. PRACTICABLE ALTERNATIVES – IDENTIFICATION OF IMPACTS TO WATERS OF THE U.S. AND OTHER ADVERSE ENVIRONMENTAL CONSEQUENCES

This section provides a comparative analysis of those alternatives determined to be practicable in the previous section. This comparative analysis includes a discussion of impacts to the aquatic ecosystem (waters of the U.S.) and other anticipated adverse environmental consequences under each of the practicable alternatives. Identification of these other adverse environmental consequences is based on information contained in the baseline resource reports and draft EIS prepared for the proposed Project. The analysis of these other adverse consequences is necessary to ensure that none is significant enough to justify selection of a Project alternative other than that with the least impact on the aquatic ecosystem, as required by the 404(b)(1) guidelines (40 CFR §230.10(a)). Cumulative impacts to the aquatic ecosystem from other past, present, and reasonably foreseeable future CWA Section 404 permitting actions are also included in this section.

6.1. PROJECT DESIGN ALTERNATIVE 1: BASE CASE

6.1.1. Impacts to the Aquatic Ecosystem

The estimated total permanent impacts to potential waters of the U.S. associated with this alternative are provided in ***Table 23*** and depicted in ***Figure 28***. All impacts would be to ephemeral waters; no special aquatic sites would be impacted. As described in *Section 2.5*, the impacts to potential waters of the U.S. considered in the analysis of alternatives for the proposed Project only include those impacts within the direct footprint of the alternative, and do not include indirect, downstream secondary effects. The analysis of data from the Downstream Monitoring Program (WestLand 2015) indicates there will be no significant indirect impacts to the function of any potential waters of the U.S. from development of Project Design Alternative 1: Base Case.

Table 23. Project Design Alternative 1: Base Case Impacts to Potential Waters of the U.S.

Type of Impact	Impact Area (ac)
Direct Impacts (Project footprint)	90.43
Indirect Impacts (downstream dewatering)	N/A
Total Impacts	**90.43**

6.1.2. Other Adverse Environmental Consequences

As indicated above, identification of the other adverse environmental consequences of the development of Project Design Alternative 1: Base Case is based on information contained in the baseline resource reports and draft EIS prepared for the proposed Project. These adverse environmental consequences are compared to those of the other Project alternatives to determine if selection of an alternative other than that identified as the least environmentally damaging practicable alternative is warranted (40 CFR §230.10(a)). These adverse environmental consequences include those direct and indirect effects of the Project on resources other than the aquatic ecosystem, and are as included in the draft EIS.

Most anticipated adverse direct effects of the Project include the loss of those resources within the footprint of Project Design Alternative 1: Base Case. Construction of the Project under this alternative will directly affect approximately 6,140 acres of previously undisturbed lands. Resources including soils, vegetation, wildlife habitat, cultural resources, and available watershed area will be lost in short-term use and, in some cases, long-term productivity. No adverse effects to species listed or proposed for listing as threatened or endangered under the Endangered Species Act (ESA) are anticipated. There will be long-term adverse impacts to the visual character of the Analysis Area from Project development under this alternative. No changes in land tenure are proposed under Project Design Alternative 1: Base Case and there will be no adverse changes to recreation or transportation. However, a small area of FMSI-owned private lands will no longer be leased for grazing due to the construction of new exclusion fencing around the proposed Project.

There will be a reduction in the watershed area contributing to surface water runoff in storm events, which would have the potential to affect the riparian vegetation along the Gila River. Indirect adverse effects to this riparian vegetation could potentially result in adverse effects to proposed or listed threatened or endangered species that utilize this vegetation during their life cycle. However, existing mitigation programs undertaken by FMSI provide a net benefit to the surface flows available to the Gila River and associated riparian vegetation even after removal of this contributing watershed area.

Adverse environmental consequences resulting from development of the Project under Project Design Alternative 1: Base Case are not demonstrably different from those anticipated adverse effects from Project Design Alternative 2: Pivot Option. Minor differences in the overall Project footprints result in Project Design Alternative 1: Base Case directly impacting approximately 76 less acres of land than Project Design Alternative 2: Pivot Option. In comparison, no significant difference in other adverse environmental consequences is anticipated between these two practicable alternatives.

6.1.3. Cumulative Impacts to the Aquatic Ecosystem

The 404(b)(1) guidelines require the consideration of other known and/or probable impacts in an analysis of the cumulative effects of Project alternatives on the aquatic system. To accomplish this, the Corps reviewed regulatory data for projects within affected watersheds to determine the magnitude of past permitted impacts to waters of the U.S. The Corps data was reviewed for the geography associated with appropriate 10-digit hydrologic unit codes (HUCs) over the past 25 years. Both Project design alternatives are located in the Yuma Wash – Upper Gila River and Cottonwood Wash – Upper Gila River Watersheds (HUCs 1504000505 and HUC 1504000507, respectively). Over the past 25 years, the Corps has authorized the fill of 212.7 acres of waters of the U.S. in these two watersheds. Information regarding the linear extent of historically impacted waters is not available. Approximately 90.43 acres of additional impacts to potential waters of the U.S. are proposed under Project Design Alternative 1: Base Case. No other pending or future CWA Section 404 permit applications within these two watersheds are known to exist at this time.

For the purposes of placing the impacts of the proposed Project design alternative in comparative scale and context, the USGS National Hydrography Database (NHD) was used to compare the total linear length of drainages occurring within respective watersheds with the linear length of the drainages to be impacted under each practicable alternative. Although this cannot provide an accurate estimate of the acreage of potential waters of the U.S. present in these watersheds, it places the proposed impacts to the ephemeral drainages from Project Design Alternative 1: Base Case within a regional resource context and provides a framework for comparison to the cumulative impacts of other practicable alternatives.

For Project Design Alternative 1: Base Case, an estimated 365,926 linear feet of potentially jurisdictional drainages would be impacted. Of these ephemeral drainages identified as potential waters of the U.S. by the Corps, approximately 213,191 linear feet are identified in the dataset of the NHD. In comparison, the NHD identifies an estimated 9,732,398 linear feet of drainage within the Yuma Wash – Upper Gila River and Cottonwood Wash – Upper Gila River Watersheds (***Figure 29***). No other known and/or probable cumulative impacts to the aquatic ecosystem have been identified at this time.

6.2. PROJECT DESIGN ALTERNATIVE 2: PIVOT OPTION

6.2.1. Impacts to the Aquatic Ecosystem

The estimated total permanent impacts to potential waters of the U.S. associated with this alternative are provided in ***Table 24*** and depicted in ***Figure 30***. All impacts would be to ephemeral waters; no special aquatic sites would be impacted. As described in *Section 2.5*, the impacts to potential waters of the U.S. considered in the analysis of alternatives for the proposed Project only include those impacts within the direct footprint of the alternative, and do not include indirect, downstream secondary effects. The analysis of data from the Downstream Monitoring Program (WestLand 2015) indicates there will be no significant indirect impacts to the function of any potential waters of the U.S. from development of Project Design Alternative 2: Pivot Option.

Table 24. Project Design Alternative 2: Pivot Option Impacts to Potential Waters of the U.S.

Type of Impact	Impact Area (ac)
Direct Impacts (Project footprint)	76.20
Indirect Impacts (downstream dewatering)	N/A
Total Impacts	**76.20**

6.2.2. Other Adverse Environmental Consequences

As indicated above, identification of the other adverse environmental consequences of the development of Project Design Alternative 2: Pivot Option is based on information contained in the baseline resource reports and draft EIS prepared for the proposed Project. These adverse environmental consequences are compared to those of the other Project alternatives to determine if selection of an alternative other than that identified as the least environmentally damaging practicable alternative is warranted (40 CFR §230.10(a)). These adverse environmental consequences include those direct and indirect effects of the Project on resources other than the aquatic ecosystem, and are as included in the draft EIS.

Most anticipated adverse direct effects of the Project include the loss of those resources within the footprint of Project Design Alternative 2: Pivot Option. Construction of the Project under this alternative will directly affect approximately 6,216 acres of previously undisturbed lands. Resources including soils, vegetation, wildlife habitat, cultural resources, and available watershed area will be lost in short-term use and, in some cases, long-term productivity. No adverse effects to species listed or proposed for listing as threatened or endangered under the ESA are anticipated. There will be long-term adverse impacts to the visual character of the Analysis Area from Project development under this alternative. No changes in land tenure are proposed under Project Design Alternative 2: Pivot Option and there will be no adverse changes to recreation or transportation. However, a small area of FMSI-owned private lands will no longer be leased for grazing due to the construction of new exclusion fencing around the proposed Project.

There will be a reduction in the watershed area contributing to surface water runoff in storm events, which would have the potential to affect the riparian vegetation along the Gila River. Indirect adverse effects to this riparian vegetation could potentially result in adverse effects to proposed or listed threatened or endangered species that utilize this vegetation during their life cycle. However, existing mitigation programs undertaken by FMSI provide a net benefit to the surface flows available to the Gila River and associated riparian vegetation even after removal of this contributing watershed area.

Adverse environmental consequences resulting from development of the Project under Project Design Alternative 2: Pivot Option are not demonstrably different from those anticipated adverse effects from Project Design Alternative 1: Base Case. Minor differences in the overall Project footprints result in Project Design Alternative 2: Pivot Option directly impacting approximately 76 more acres of land than Project Design Alternative 1: Base Case. In comparison, no significant difference in other adverse environmental consequences is anticipated between these two practicable alternatives.

6.2.3. Cumulative Impacts to the Aquatic Ecosystem

As described in *Section 6.1.3.*, over the past 25 years the Corps has authorized the fill of 212.7 acres of waters of the U.S. in the Yuma Wash – Upper Gila River and Cottonwood Wash – Upper Gila River Watersheds (HUCs 1504000505 and HUC 1504000507, respectively). Information regarding the linear extent of historically impacted waters was not available. Approximately 76.20 acres of additional impacts to potential waters of the U.S. are proposed under Project Design Alternative 2: Pivot Option. No other pending or future CWA Section 404 permit applications within these two watersheds are known to exist at this time.

For the purposes of placing the impacts of the proposed Project design alternative in comparative scale and context, the USGS NHD was used to compare the total linear length of drainages occurring within respective watersheds with the linear length of the drainages to be impacted under each practicable alternative. Although this cannot provide an accurate estimate of the acreage of potential waters of the U.S. present in these watersheds, it places the proposed impacts to the ephemeral drainages from Project Design Alternative 2: Pivot Option within a regional resource context and provides a framework for comparison to the cumulative impacts of other practicable alternatives.

For Project Design Alternative 2: Pivot Option, an estimated 296,015 linear feet of potentially jurisdictional drainages would be impacted. Of these ephemeral drainages identified as potential waters of the U.S. by the Corps, approximately 194,991 linear feet are identified in the dataset of the NHD. In comparison, the NHD identifies an estimated 9,732,398 linear feet of drainage within the Yuma Wash – Upper Gila River and Cottonwood Wash – Upper Gila River Watersheds (***Figure 31***). No other known and/or probable cumulative impacts to the aquatic ecosystem have been identified at this time.

7. SUMMARY AND CONCLUSIONS

Both Project Design Alternative 1: Base Case and Project Design Alternative 2: Pivot Option meet the CWA Section 404(b)(1) guidelines for availability and practicability. The alternatives analysis herein is intended to ensure that no discharge be permitted "if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences" (40 CFR §230.10(a)). An alternative is deemed practicable if it is “available and capable of being implemented after taking into consideration existing technology, logistics, and economics in light of overall project purpose” (40 CFR §230.10(a)).

For the development of alternatives to the proposed Project, the overall Project purpose is the construction of mining facilities, including development rock stockpiles and a heap leach pad, which will allow continued mining at the Safford Mine through the development of the mineral resources associated with the Lone Star ore body using conventional open-pit mining, heap leaching techniques, and SX/EW processing, and utilizing as much of the existing Safford Mine as practicable, for the purpose of producing copper. Both designs are practicable from a technical and logistical perspective in light of the Project purpose.

Direct impacts to potential waters of the U.S. under Project Design Alternative 2: Pivot Option total approximately 76.20 acres. Based on the analysis of alternatives provided here, it was determined that Project Design Alternative 2: Pivot Option is the least environmentally damaging practicable alternative for the development of the Lone Star Project that fulfills the Project purpose. As described in *Section 6*, there are no other significant adverse environmental consequences that would prevent selection of Project Design Alternative 2: Pivot Option as the preferred alternative for permitting.

8. REFERENCES

40 CFR §230. 2011. "Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material" Title 40 Code of Federal Regulations, Pt. 230. 2013 ed.

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FIGURES

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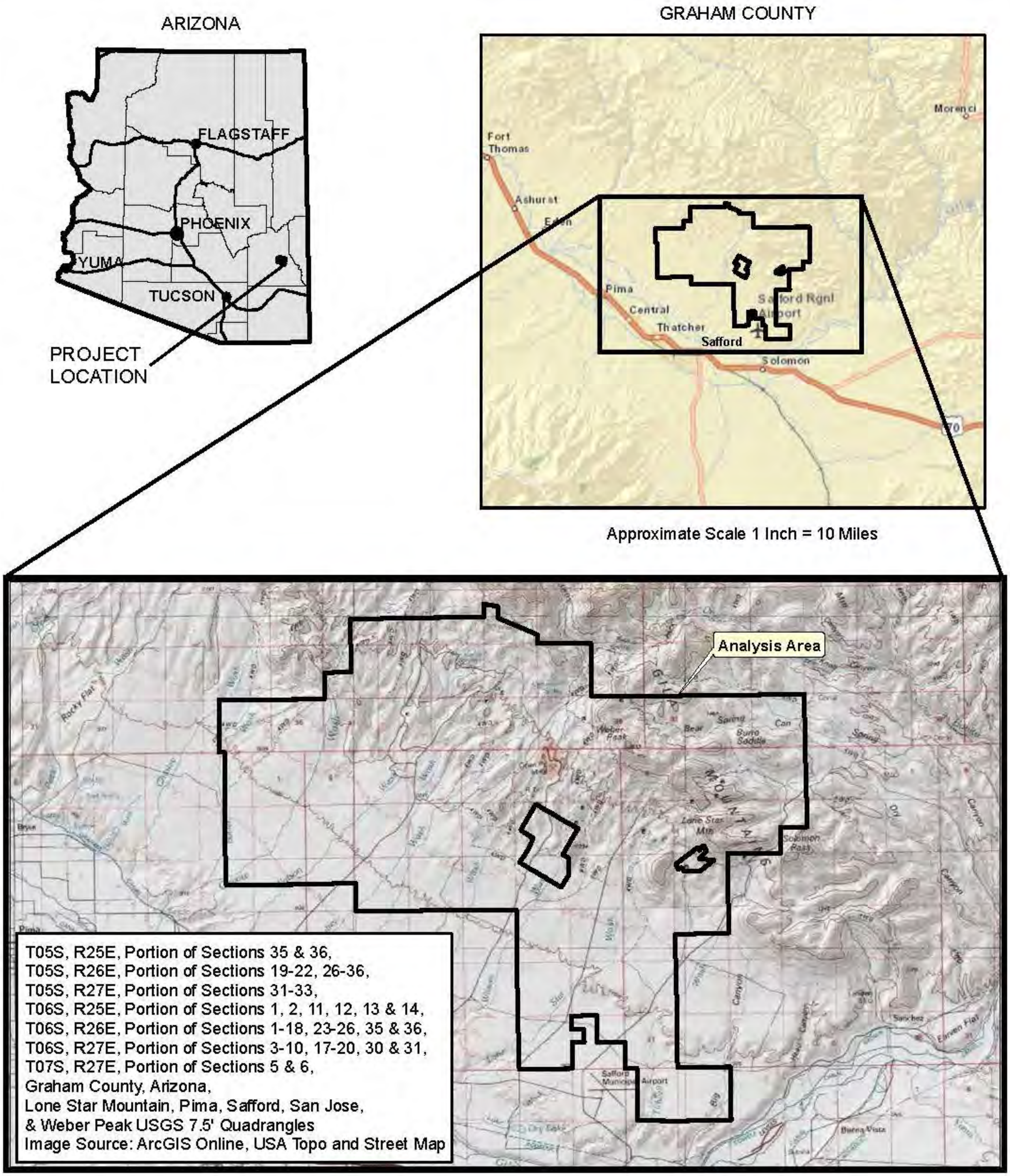

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0 1.5 3 Miles

0 2 4 Kilometers

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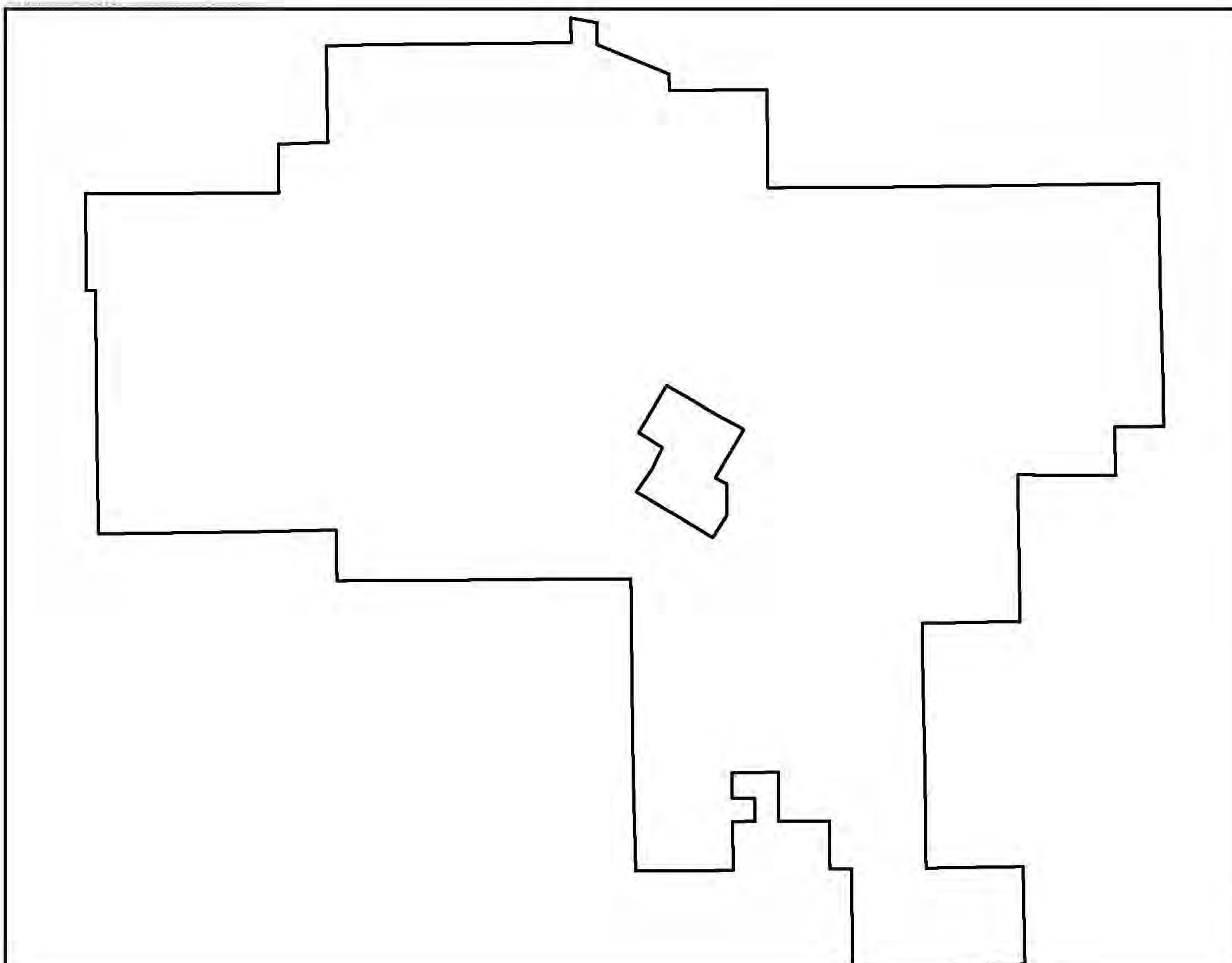
LONE STAR ORE BODY
DEVELOPMENT PROJECT

CWA Section 404(b)(1) Alternatives Analysis

Vicinity Map

Figure 1



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Analysis Area

N

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0 750 1,500 Meters

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T05S, R27E, Portion of Sections 31-33,
T06S, R25E, Portion of Sections 1, 2, 11, 12, 13 & 14,
T06S, R26E, Portion of Sections 1-18, 23-26, 35 & 36,
T06S, R27E, Portion of Sections 3-10, 17-20, 30 & 31,
T07S, R27E, Portion of Sections 5 & 6,
Graham County, Arizona,
Lone Star Mountain, Pima, Safford, San Jose,
& Weber Peak USGS 7.5' Quadrangles
Image Source: NAIP 2013

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LONE STAR ORE BODY
DEVELOPMENT PROJECT
CWA Section 404(b)(1) Alternatives Analysis

ANALYSIS AREA
Figure 2

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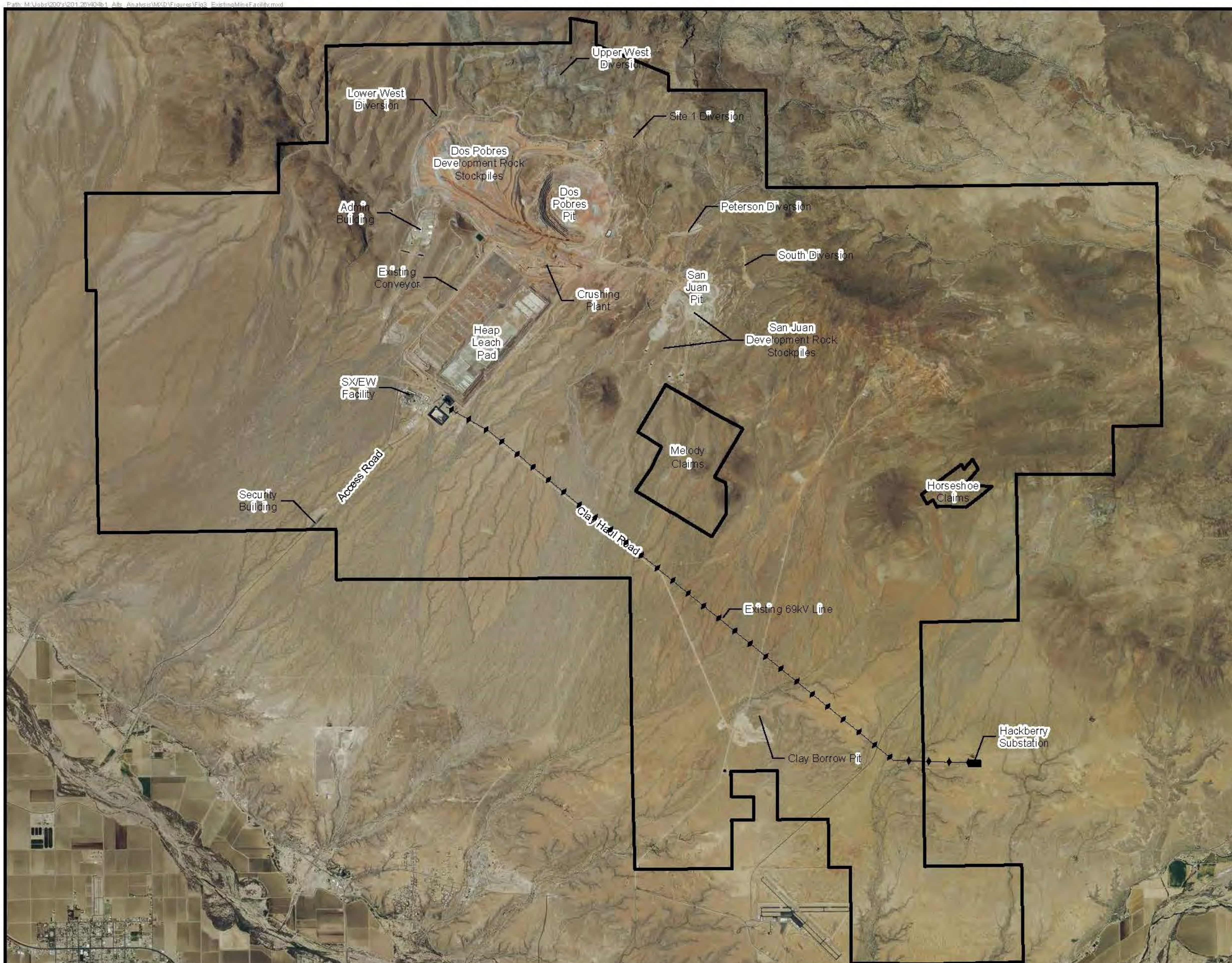

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Analysis Area

N

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0 750 1,500 Meters

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T05S, R26E, Portion of Sections 19-22, 26-36,
T05S, R27E, Portion of Sections 31-33,
T06S, R25E, Portion of Sections 1, 2, 11, 12, 13 & 14,
T06S, R26E, Portion of Sections 1-18, 23-26, 35 & 36,
T06S, R27E, Portion of Sections 3-10, 17-20, 30 & 31,
T07S, R27E, Portion of Sections 5 & 6,
Graham County, Arizona,
Lone Star Mountain, Pima, Safford, San Jose,
& Weber Peak USGS 7.5' Quadrangles
Image Source: NAIP 2013

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CWA Section 404(b)(1) Alternatives Analysis

EXISTING MINE FACILITY

Figure 3

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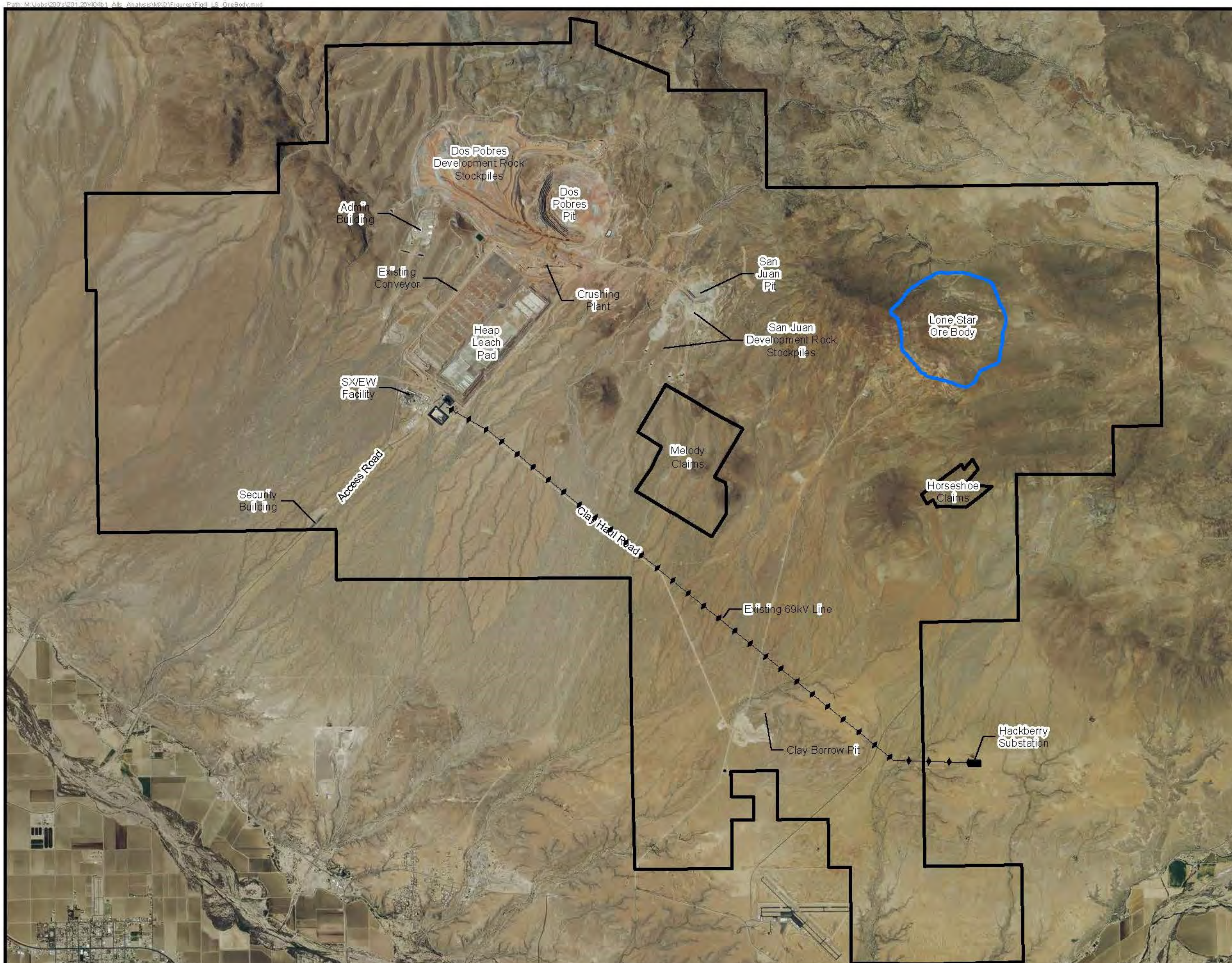

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Analysis Area

Lone Star Ore Body

N

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0 750 1,500 Meters

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T05S, R26E, Portion of Sections 19-22, 26-36,
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T06S, R25E, Portion of Sections 1, 2, 11, 12, 13 & 14,
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& Weber Peak USGS 7.5' Quadrangles
Image Source: NAIP 2013

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LONE STAR ORE BODY
DEVELOPMENT PROJECT

CWA Section 404(b)(1) Alternatives Analysis

LOCATION OF THE LONE STAR ORE BODY

Figure 4

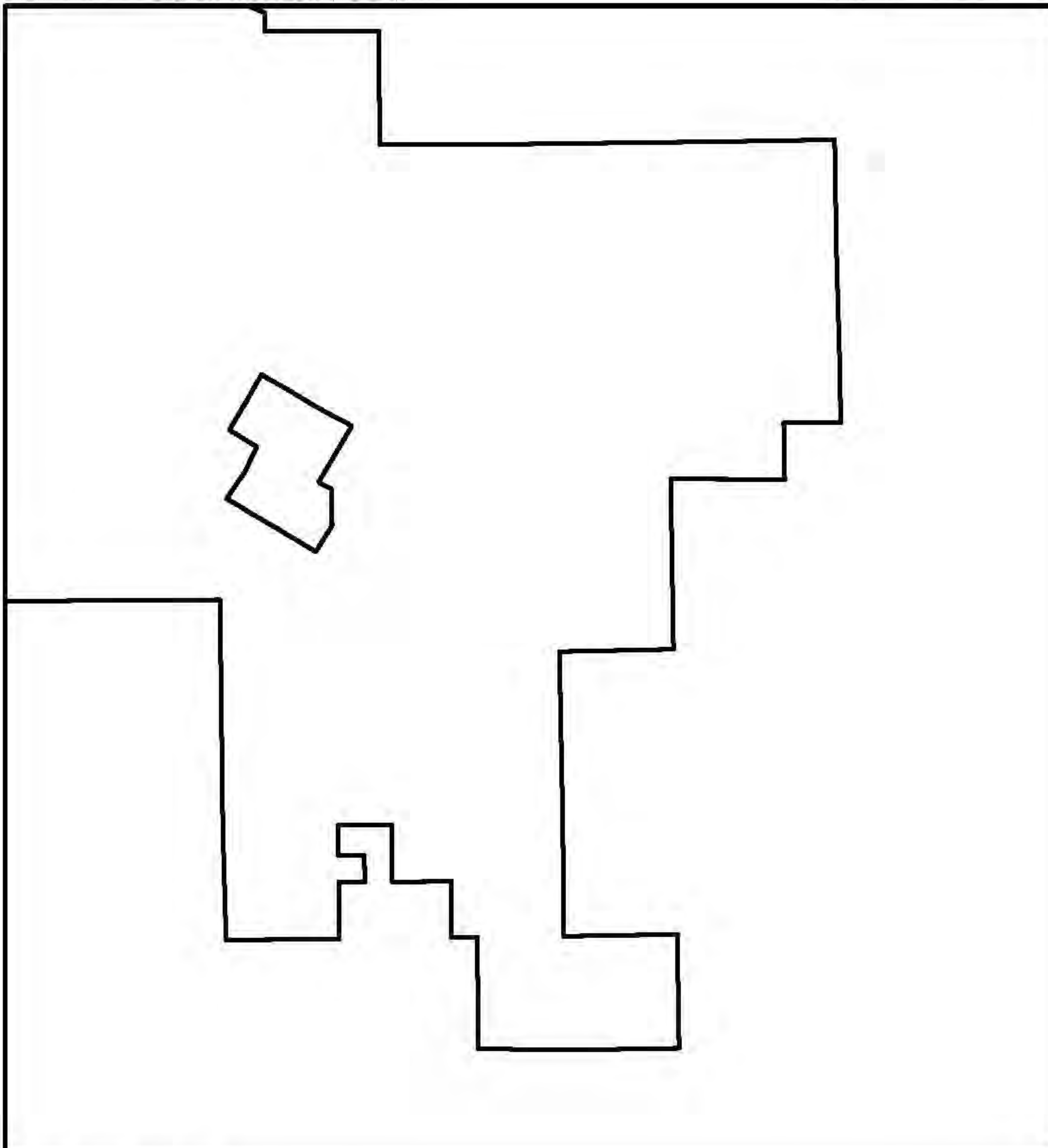

Image Source: NAIP 2013

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Analysis Area

N

0 3,250 6,500 Feet

0 1,000 2,000 Meters

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LONE STAR ORE BODY
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**CONCEPTUAL LONE STAR FOOTPRINT
FROM THE DP/SJ EIS**

Figure 5

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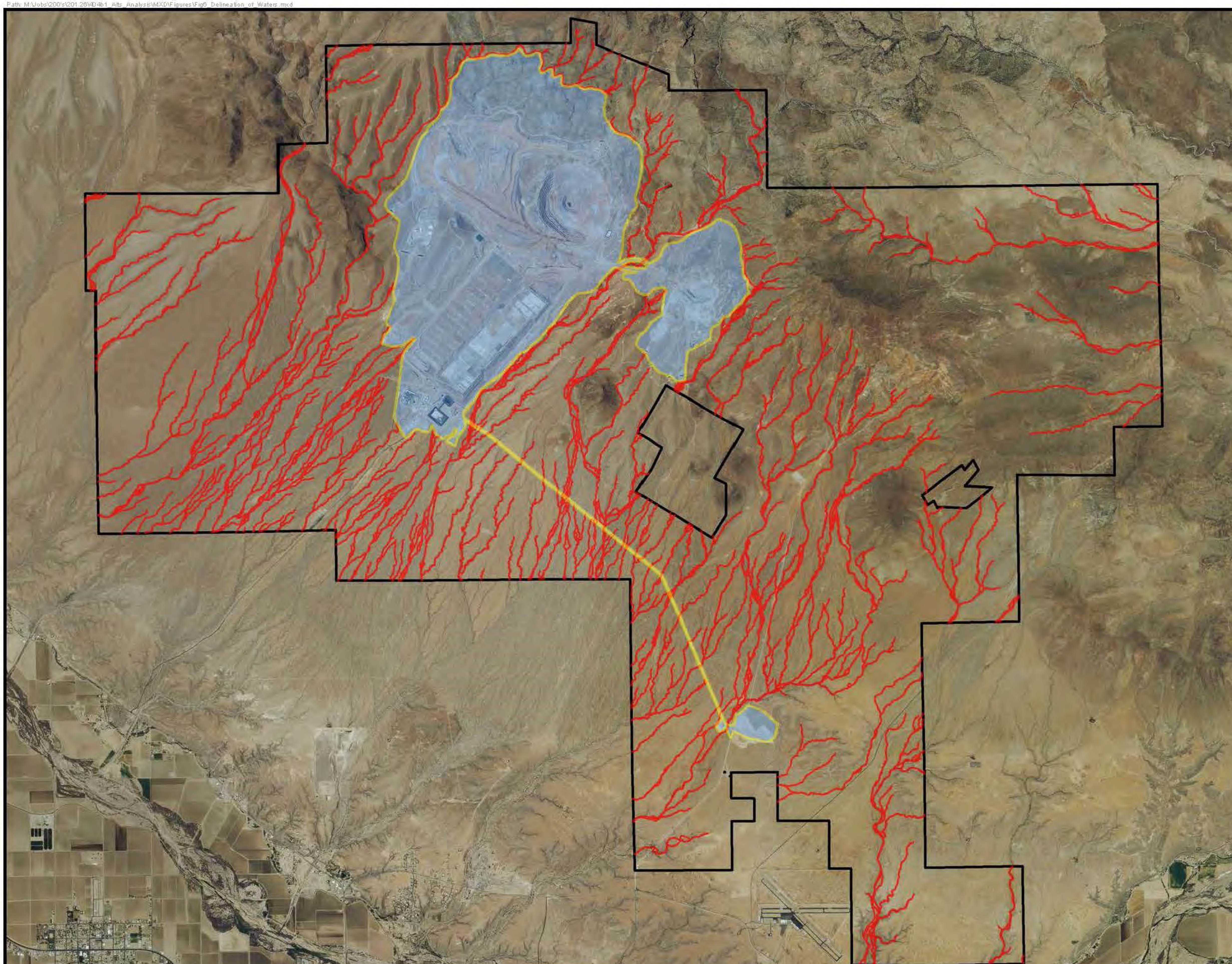

Legend

- Analysis Area
- 2004 404 Permit Area (964-0202-MB)
- Potential Waters (SPL-2014-0006-MWL)

N

0 2,600 5,200 Feet

0 750 1,500 Meters

T05S, R25E, Portion of Sections 35 & 36,
T05S, R26E, Portion of Sections 19-22, 26-36,
T05S, R27E, Portion of Sections 31-33,
T06S, R25E, Portion of Sections 1, 2, 11, 12, 13 & 14,
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T06S, R27E, Portion of Sections 3-10, 17-20, 30 & 31,
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Graham County, Arizona,
Lone Star Mountain, Pima, Safford, San Jose,
& Weber Peak USGS 7.5' Quadrangles
Image Source: NAIP 2013

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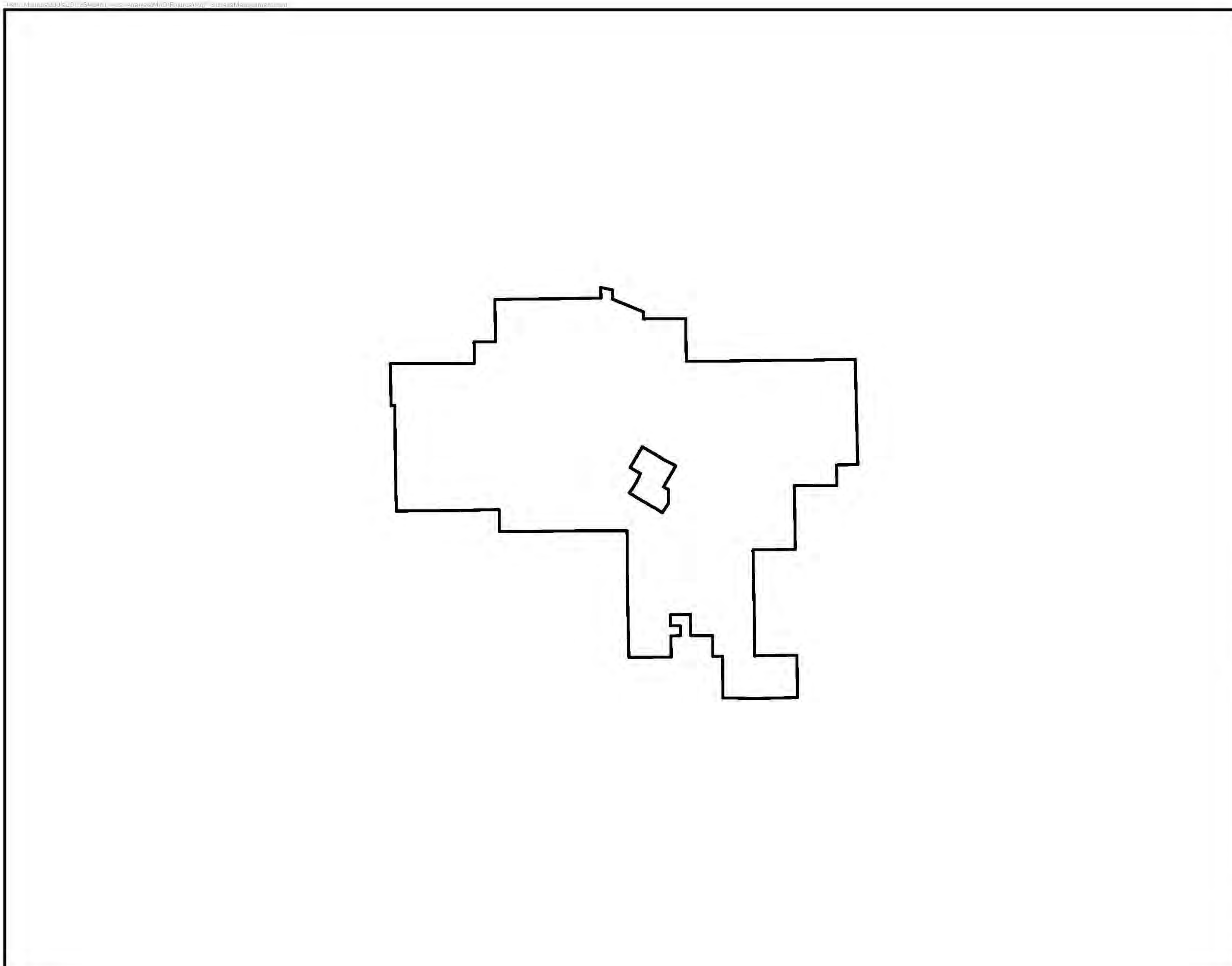
DEVELOPMENT PROJECT

CWA Section 404(b)(1) Alternatives Analysis

DELINEATION OF POTENTIAL WATERS
OF THE U.S. WITHIN THE ANALYSIS AREA

Figure 6



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Analysis Area

Surface Management (BLM 2012)

Bureau of Land Management (BLM)
Indian Lands
Military
Private Land (No Color)
State Trust Land
State Wildlife Area
US Forest Service (USFS)

N

0 1 2 Miles

0 2 4 Kilometers

T05S, R25E, Portion of Sections 35 & 36,
T05S, R26E, Portion of Sections 19-22, 26-36,
T05S, R27E, Portion of Sections 31-33,
T06S, R25E, Portion of Sections 1, 2, 11, 12, 13 & 14,
T06S, R26E, Portion of Sections 1-18, 23-26, 35 & 36,
T06S, R27E, Portion of Sections 3-10, 17-20, 30 & 31,
T07S, R27E, Portion of Sections 5 & 6,
Graham County, Arizona,
Lone Star Mountain, Pima, Safford, San Jose,
& Weber Peak USGS 7.5' Quadrangles
Image Source: ArcGIS Online, USA Topo Map

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DEVELOPMENT PROJECT

CWA Section 404(b)(1) Alternatives Analysis

ANALYSIS AREA VICINITY SURFACE MANAGEMENT
Figure 7

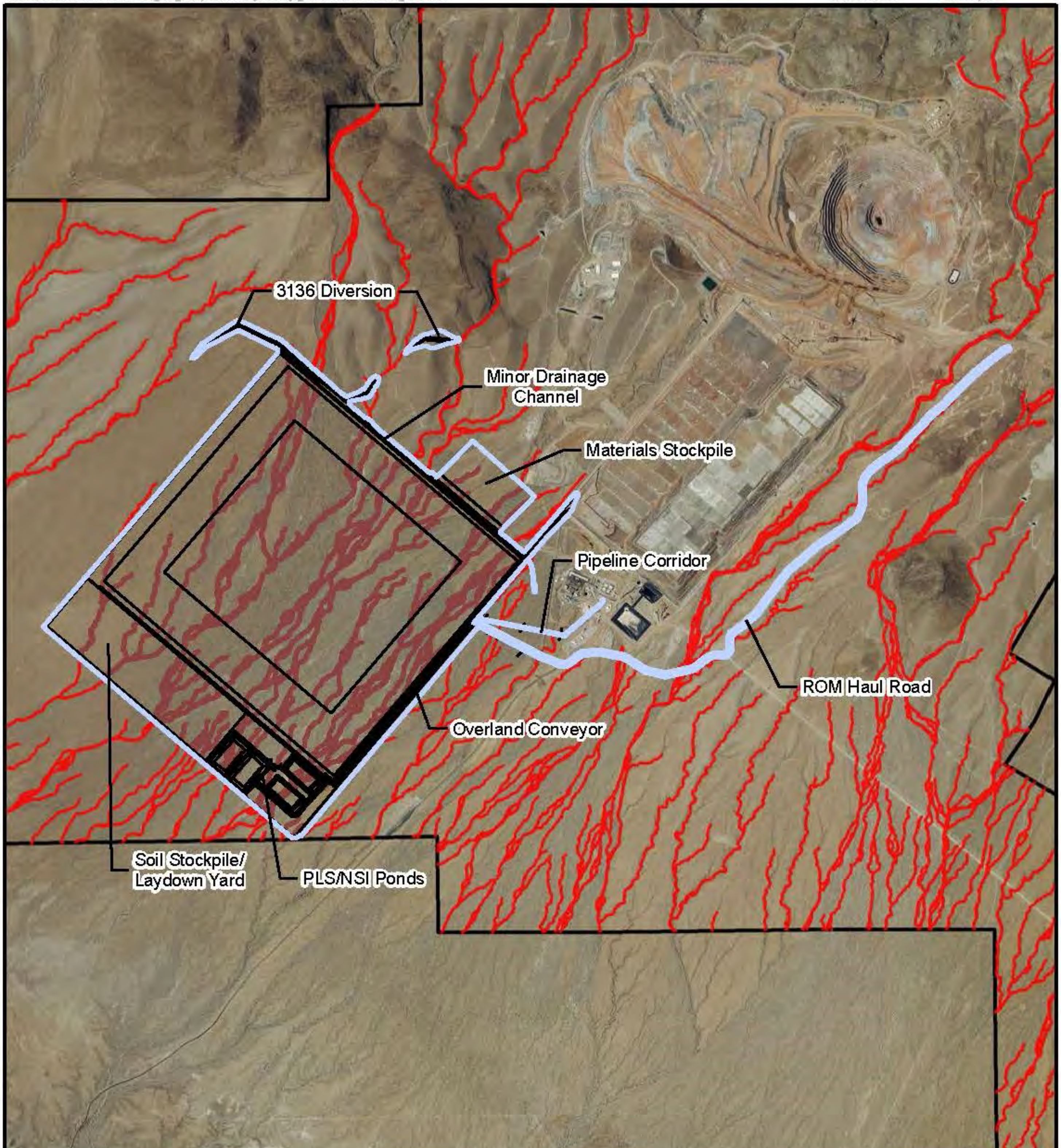

Image Source: NAIP 2013

0 2,000 4,000 Feet

0 500 1,000 Meters

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N

Legend

- Alternative 1 Footprint
- Alternative 1 Impacted Potential Waters
- Potential Waters
- Analysis Area

LONE STAR ORE BODY DEVELOPMENT PROJECT

CWA Section 404(b)(1) Alternatives Analysis

HEAP LEACH PAD
ALTERNATIVE 1: BASE CASE

Figure 8

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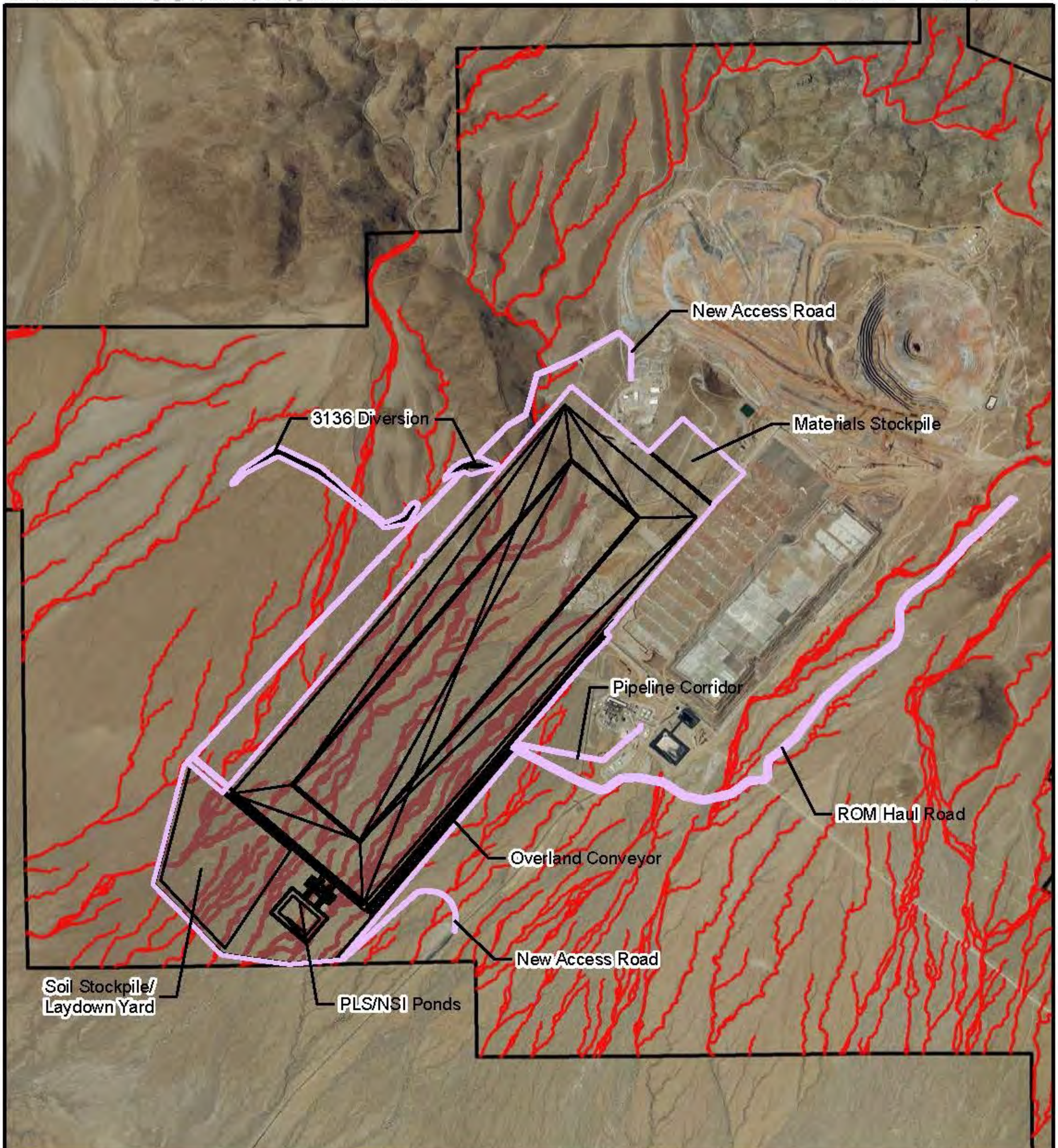

Image Source: NAIP 2013

0 2,000 4,000 Feet

0 500 1,000 Meters

Legend

- Alternative 2 Footprint
- Alternative 2 Impacted Potential Waters
- Potential Waters
- Analysis Area

N

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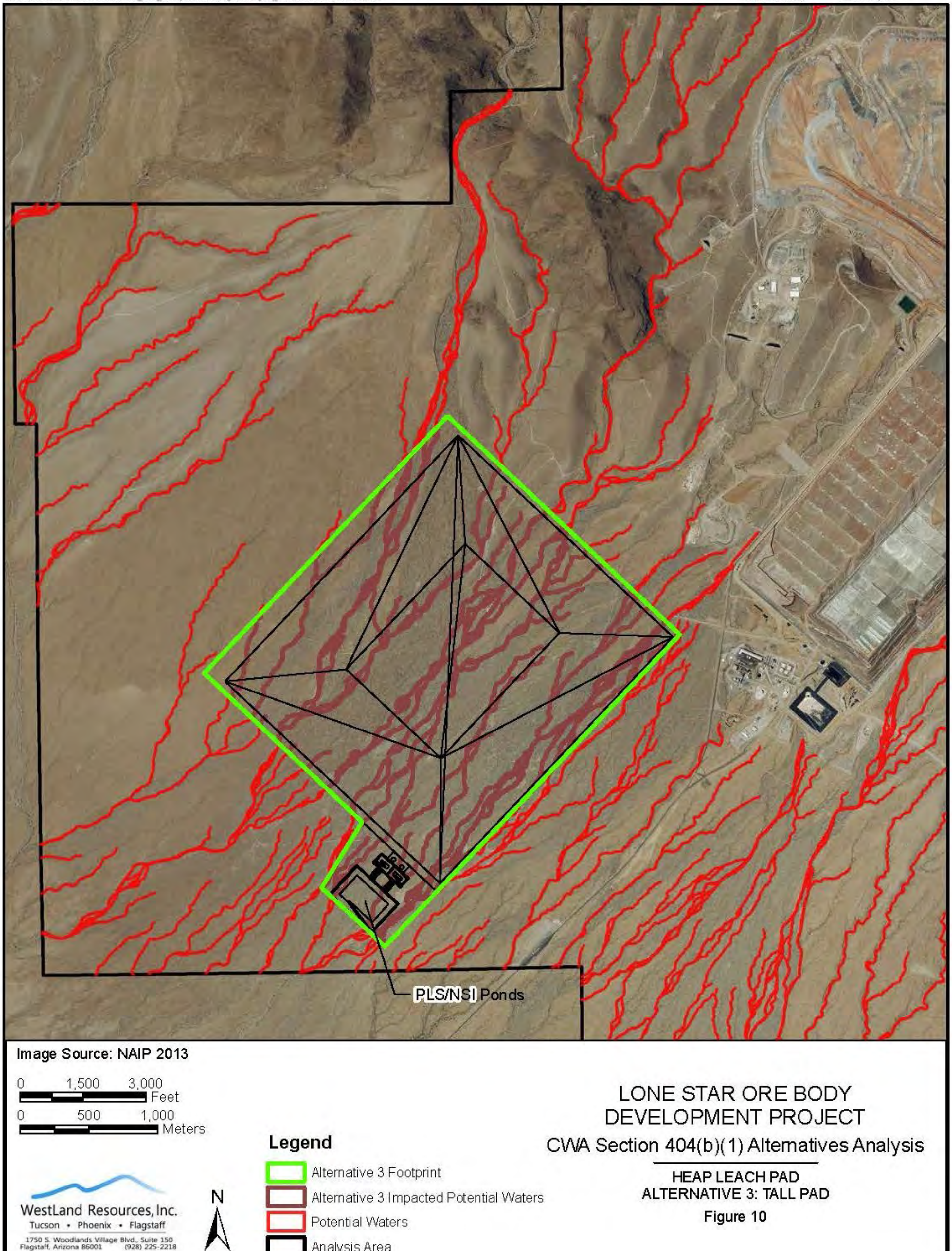
LONE STAR ORE BODY DEVELOPMENT PROJECT

CWA Section 404(b)(1) Alternatives Analysis

HEAP LEACH PAD

ALTERNATIVE 2: LONG PAD N-S

Figure 9



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LONE STAR ORE BODY DEVELOPMENT PROJECT

CWA Section 404(b)(1) Alternatives Analysis

HEAP LEACH PAD

ALTERNATIVE 3: TALL PAD

Figure 10

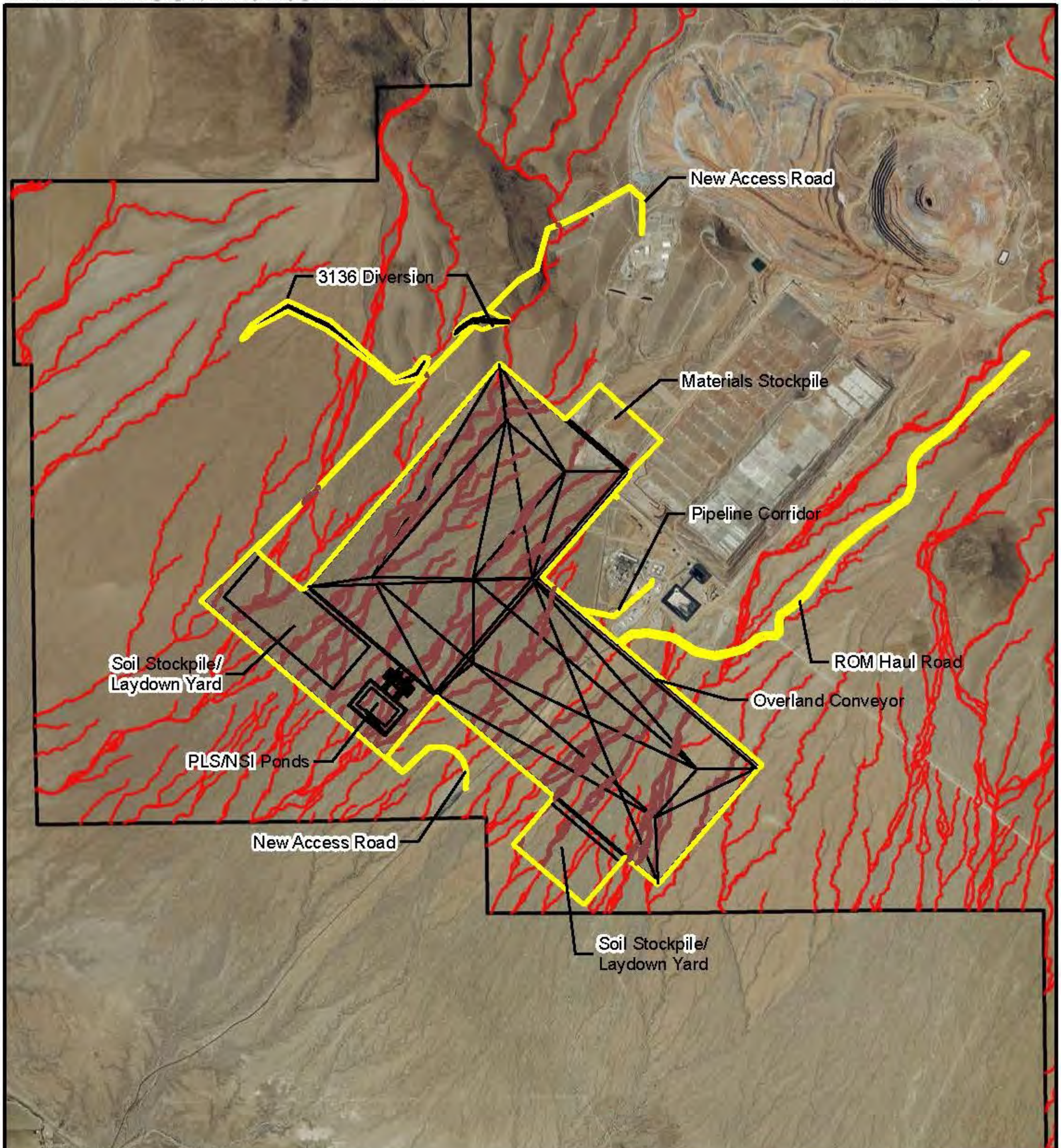

Image Source: NAIP 2013

0 2,000 4,000 Feet

0 500 1,000 Meters

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Legend

- Alternative 4 Footprint
- Alternative 4 Impacted Potential Waters
- Potential Waters
- Analysis Area

LONE STAR ORE BODY
DEVELOPMENT PROJECT
CWA Section 404(b)(1) Alternatives Analysis

HEAP LEACH PAD
ALTERNATIVE 4: L PAD WEST

Figure 11

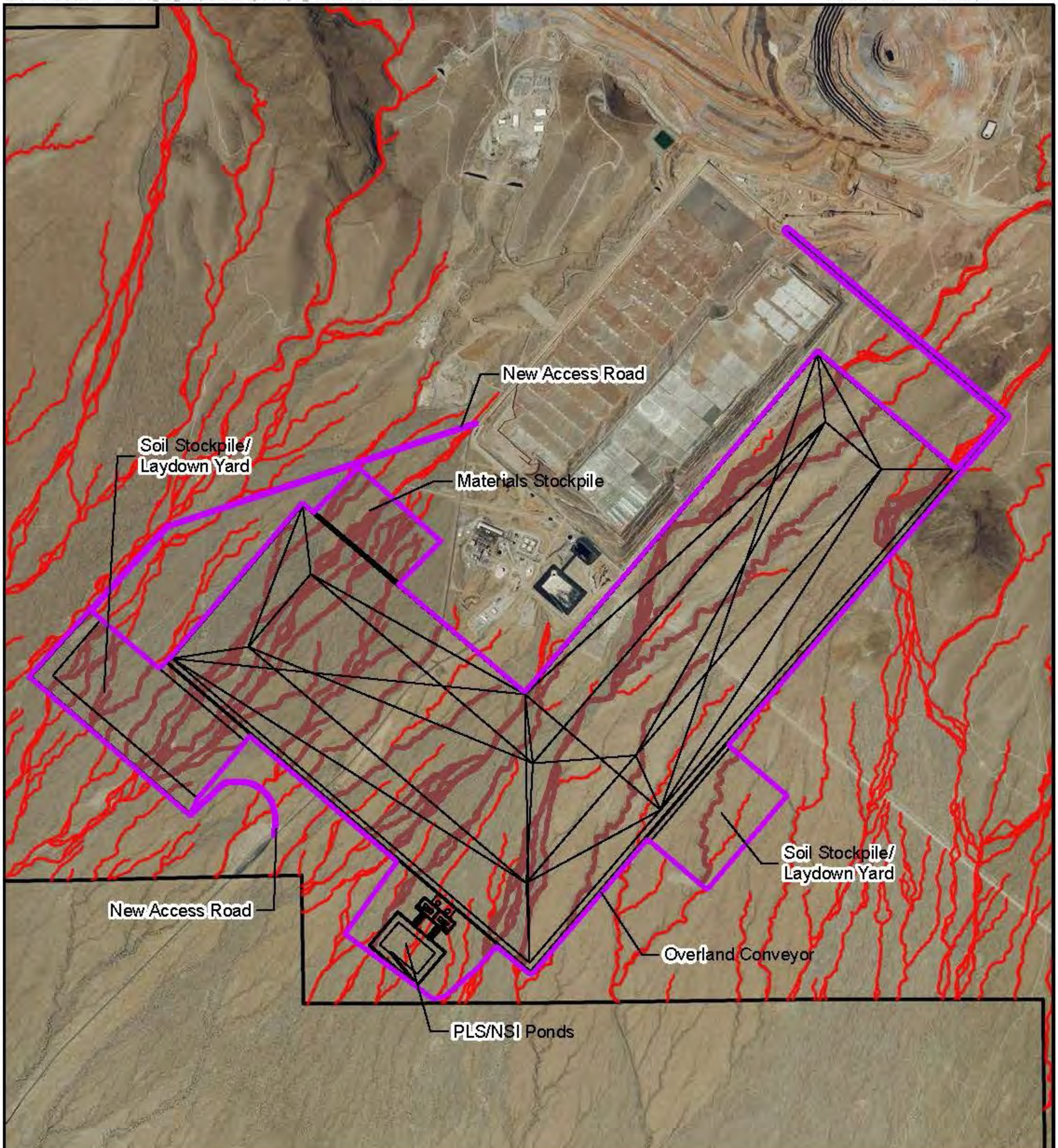

Image Source: NAIP 2013

0 1,500 3,000 Feet
0 500 1,000 Meters

Legend

- Alternative 5 Footprint
- Alternative 5 Impacted Potential Waters
- Potential Waters
- Analysis Area

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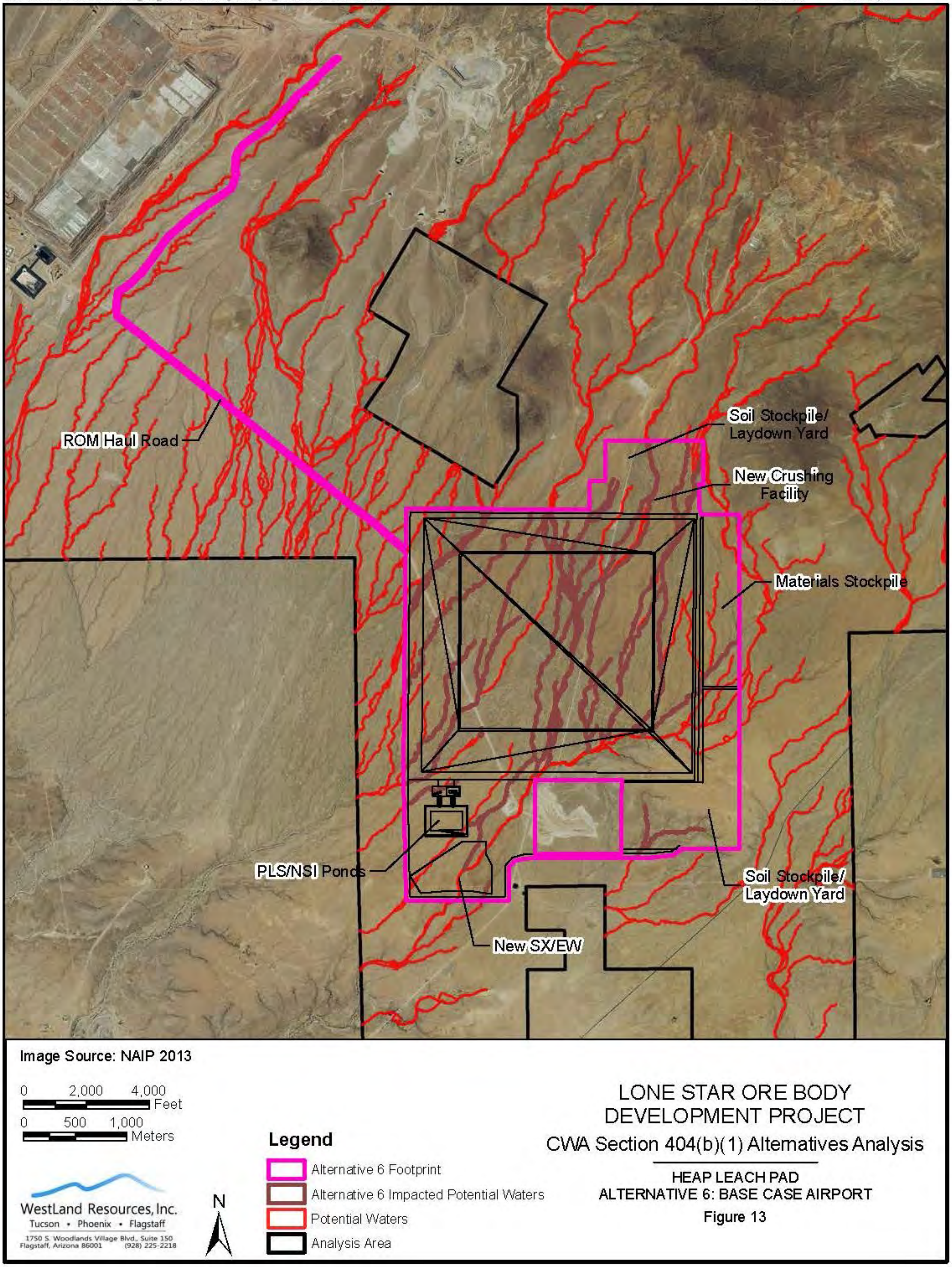
N

LONE STAR ORE BODY DEVELOPMENT PROJECT

CWA Section 404(b)(1) Alternatives Analysis

HEAP LEACH PAD
ALTERNATIVE 5: L PAD EAST

Figure 12



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DEVELOPMENT PROJECT
CWA Section 404(b)(1) Alternatives Analysis

HEAP LEACH PAD
ALTERNATIVE 6: BASE CASE AIRPORT
Figure 13

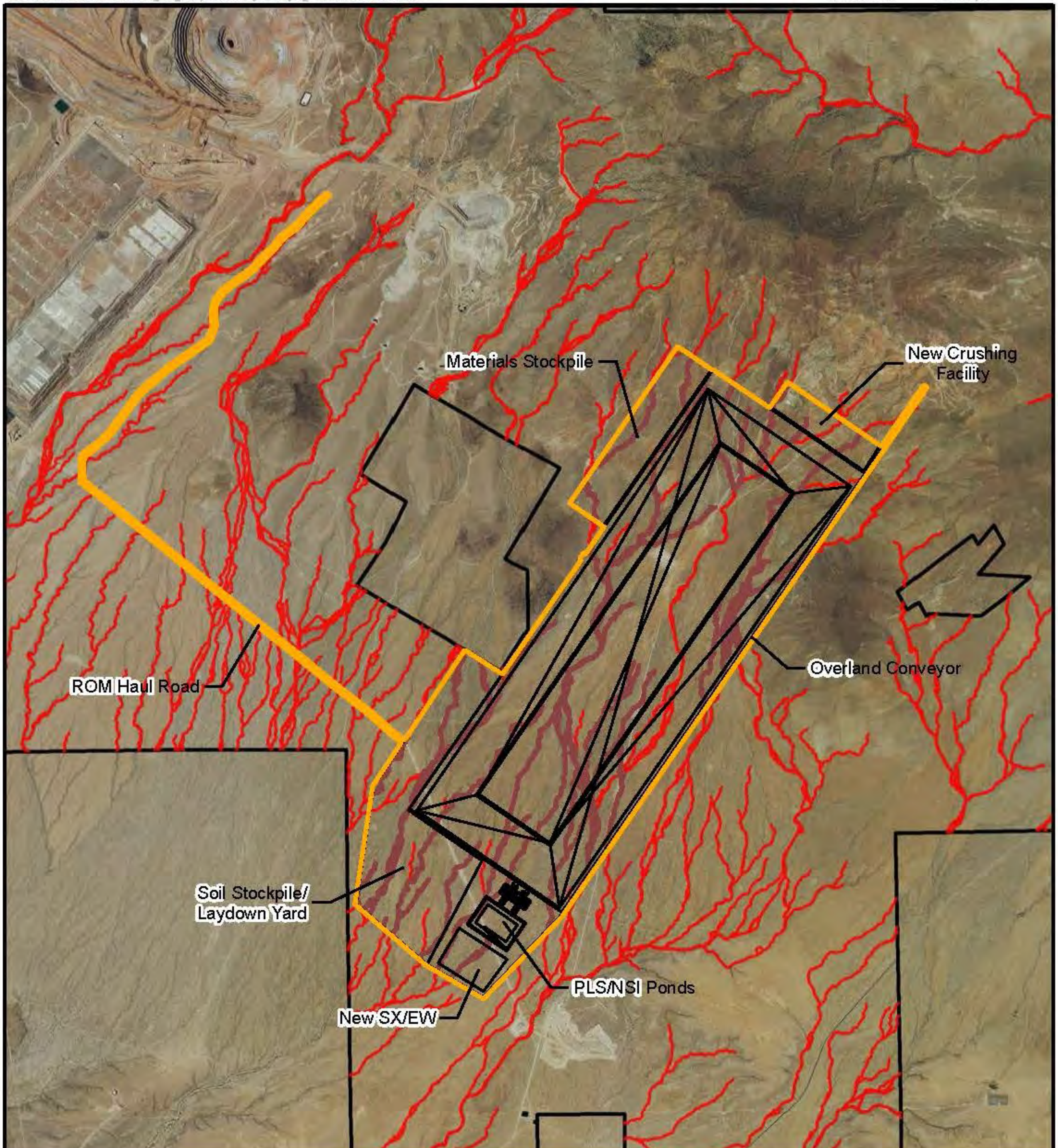

Image Source: NAIP 2013

0 2,000 4,000 Feet

0 500 1,000 Meters

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Legend

- Alternative 7 Footprint
- Alternative 7 Impacted Potential Waters
- Potential Waters
- Analysis Area

LONE STAR ORE BODY DEVELOPMENT PROJECT

CWA Section 404(b)(1) Alternatives Analysis

HEAP LEACH PAD
ALTERNATIVE 7: LONG PAD AIRPORT

Figure 14

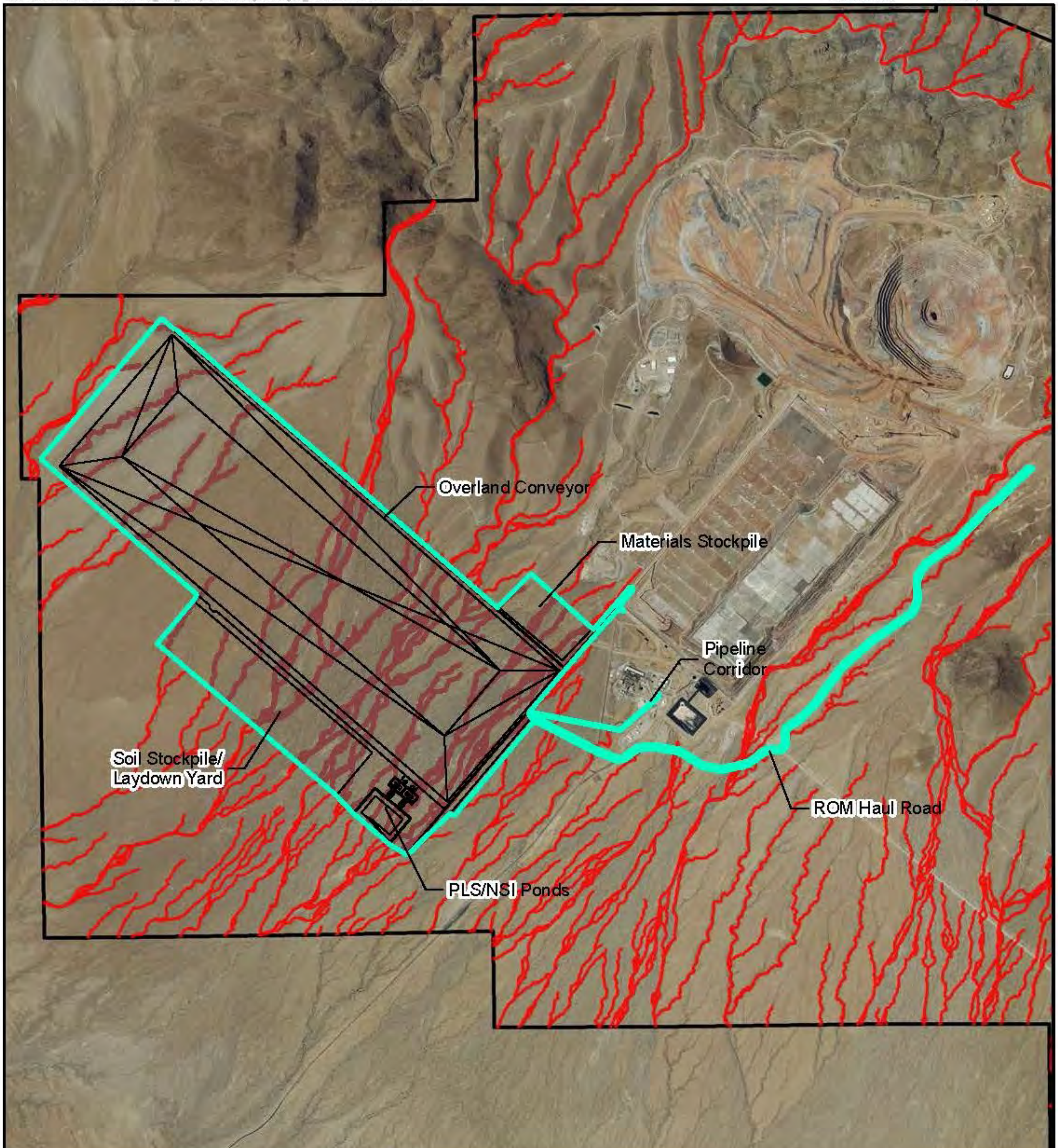

Image Source: NAIP 2013

0 2,000 4,000 Feet

0 500 1,000 Meters

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Legend

- Alternative 8 Footprint
- Alternative 8 Impacted Potential Waters
- Potential Waters
- Analysis Area

LONE STAR ORE BODY DEVELOPMENT PROJECT

CWA Section 404(b)(1) Alternatives Analysis

HEAP LEACH PAD

ALTERNATIVE 8: LONG PAD E-W

Figure 15

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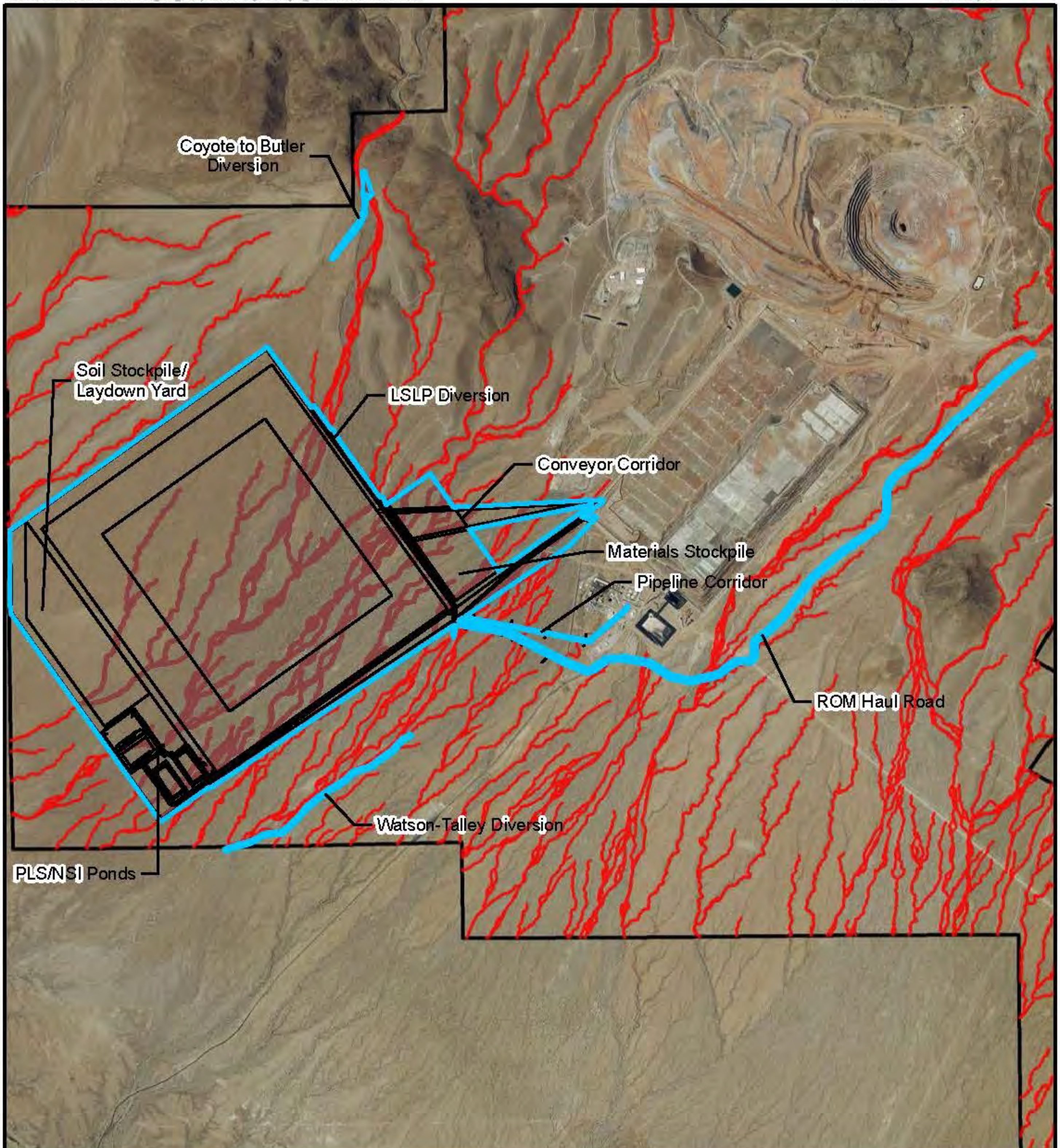

Image Source: NAIP 2013

0 2,000 4,000 Feet

0 500 1,000 Meters

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N

Legend

- Alternative 9 Footprint
- Alternative 9 Impacted Potential Waters
- Potential Waters
- Analysis Area

LONE STAR ORE BODY
DEVELOPMENT PROJECT
CWA Section 404(b)(1) Alternatives Analysis

HEAP LEACH PAD
ALTERNATIVE 9: BASE CASE PIVOT
Figure 16

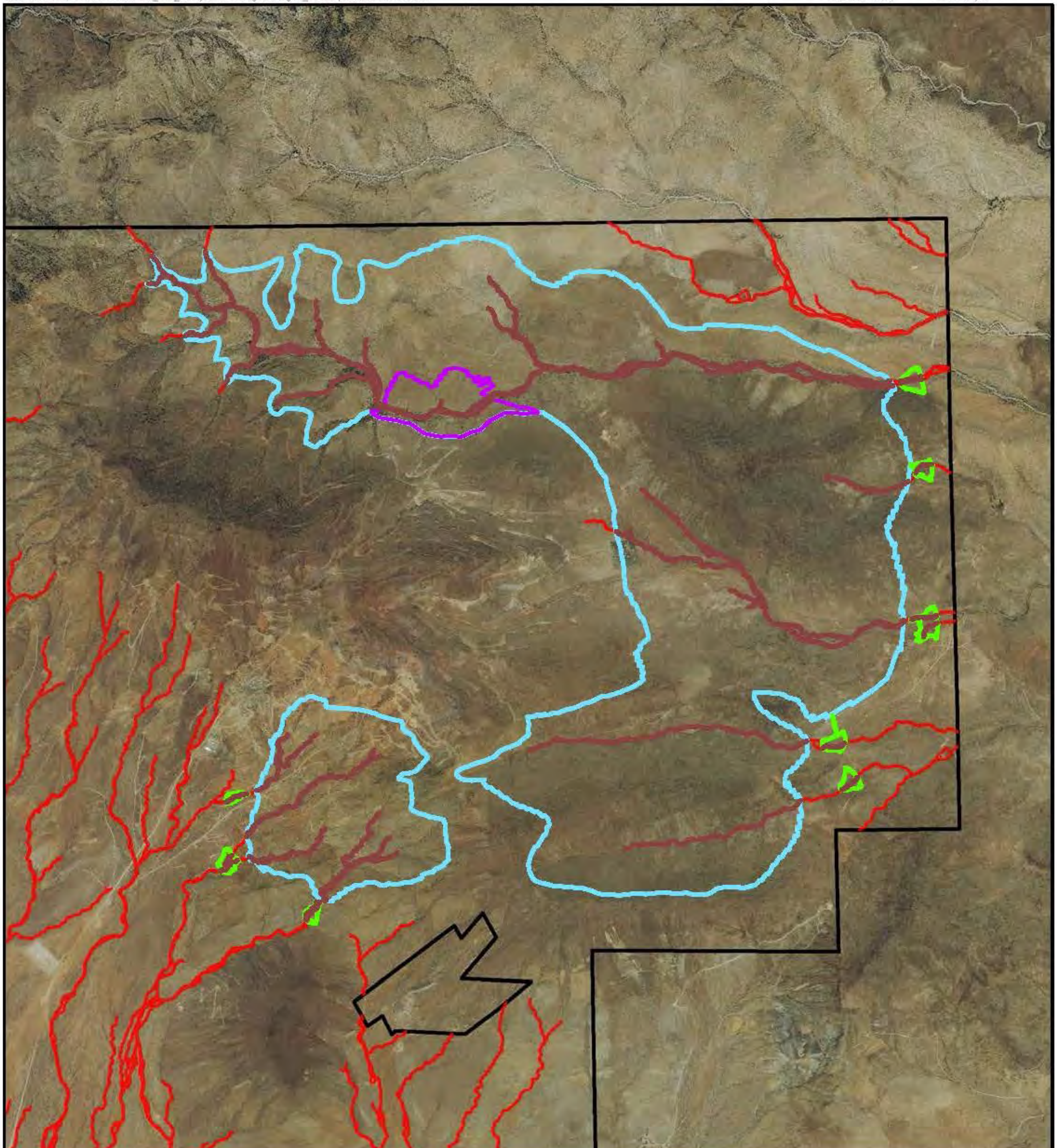

Image Source: NAIP 2013

0 1,500 3,000 Feet

0 500 1,000 Meters

Legend

- Laydown Yard
- Stormwater Dams
- Alternative 1 Footprint
- Alternative 1 Impacted Potential Waters
- Potential Waters
- Analysis Area

N

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CWA Section 404(b)(1) Alternatives Analysis

DEVELOPMENT ROCK STOCKPILE
ALTERNATIVE 1: BASE CASE

Figure 17

Path: M:\Jobs\200's\201.26\404b1_Alts_Analysis\MXD\Figures\Fig18_DevelopmentRockAllSouth.mxd Date: 3/20/2015 User: tanyao

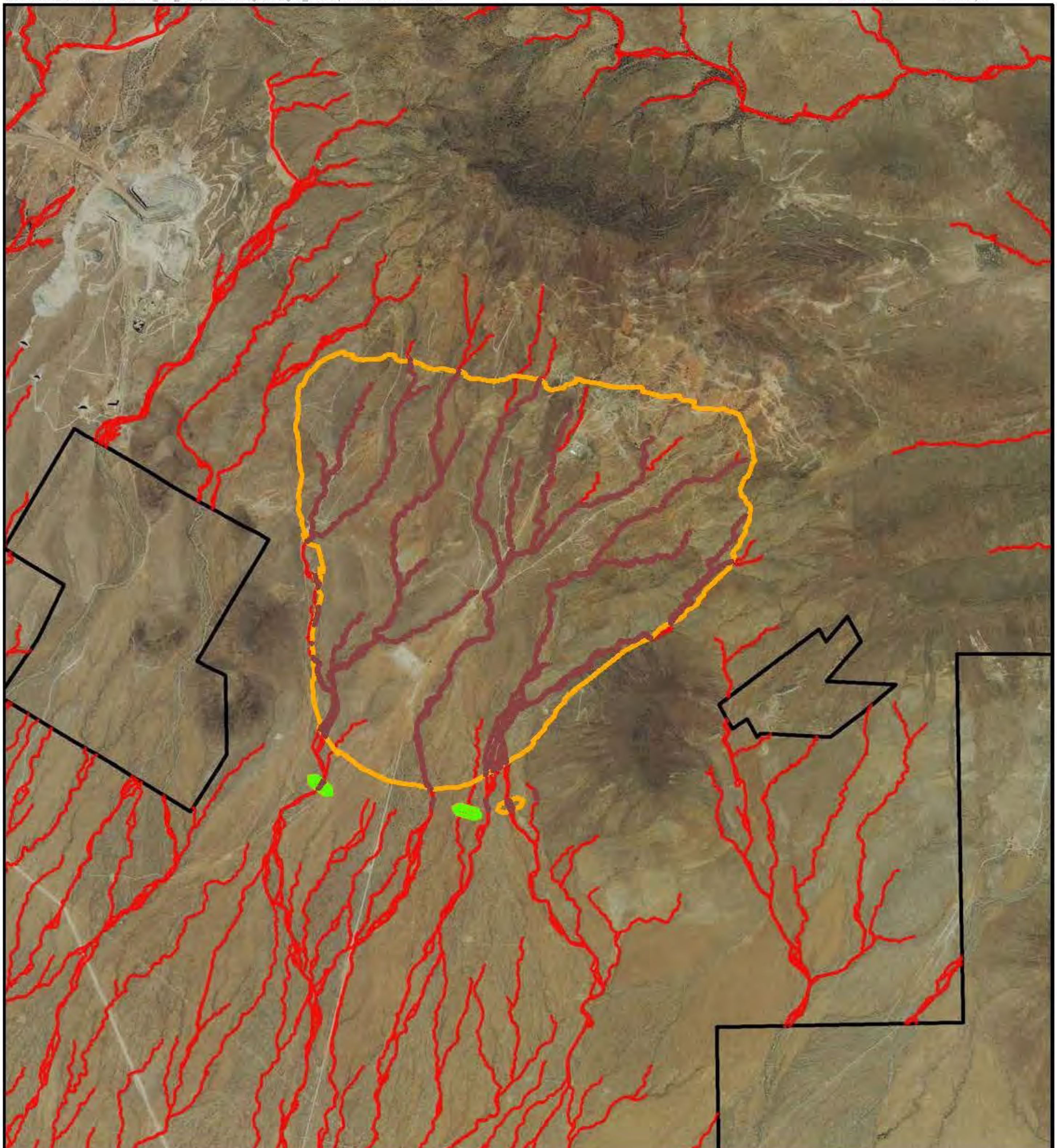

Image Source: NAIP 2013

0 1,500 3,000 Feet

0 500 1,000 Meters

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Legend

- Stormwater Dams
- Alternative 2 Footprint
- Alternative 2 Impacted Potential Waters
- Potential Waters
- Analysis Area

LONE STAR ORE BODY
DEVELOPMENT PROJECT
CWA Section 404(b)(1) Alternatives Analysis

DEVELOPMENT ROCK STOCKPILE
ALTERNATIVE 2: ALL SOUTH
Figure 18

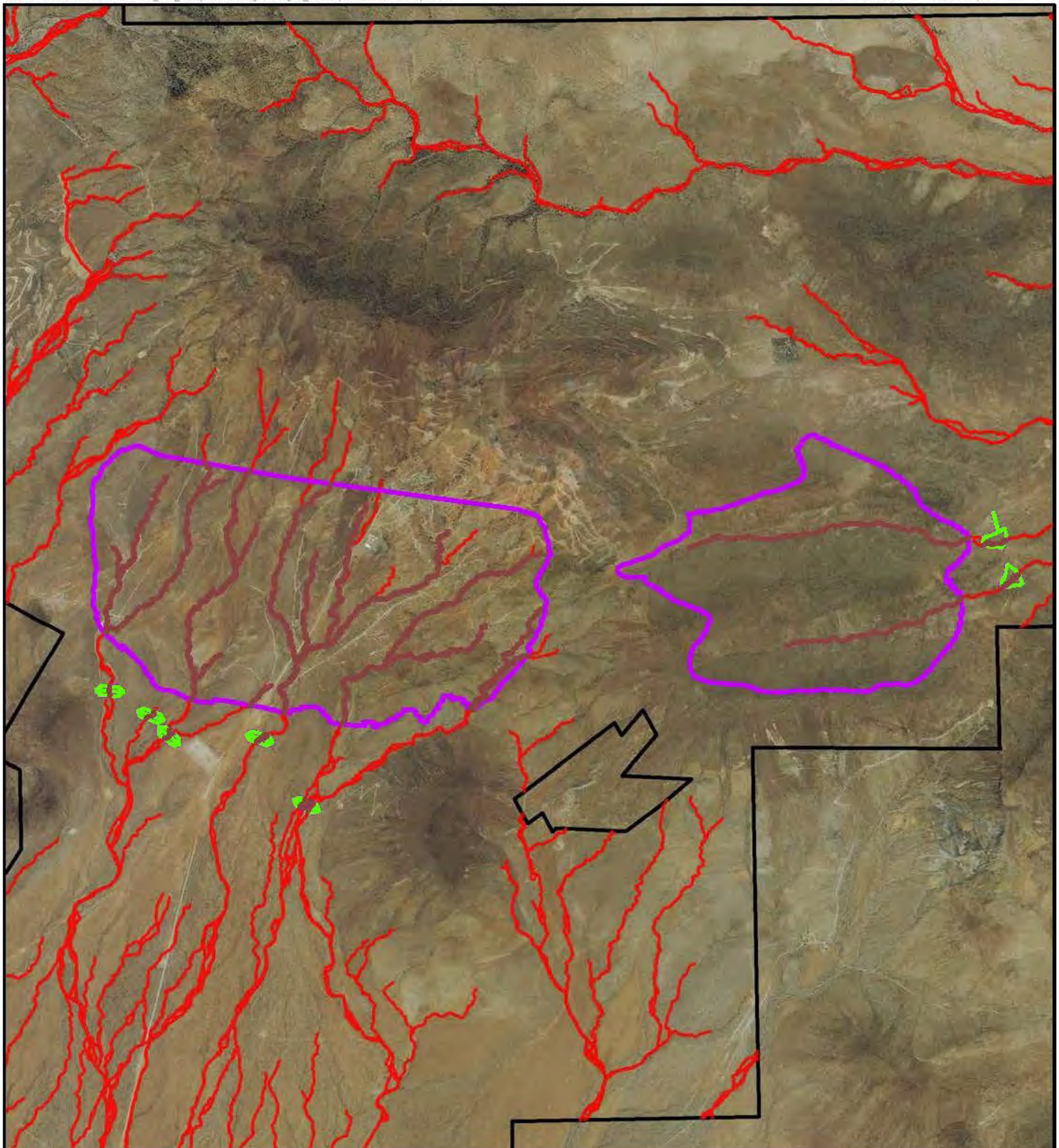

Image Source: NAIP 2013

0 1,500 3,000 Feet

0 500 1,000 Meters

Legend

- Stormwater Dams
- Alternative 3 Footprint
- Alternative 3 Impacted Potential Waters
- Potential Waters
- Analysis Area

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CWA Section 404(b)(1) Alternatives Analysis

DEVELOPMENT ROCK STOCKPILE
ALTERNATIVE 3: SOUTH SPLIT

Figure 19

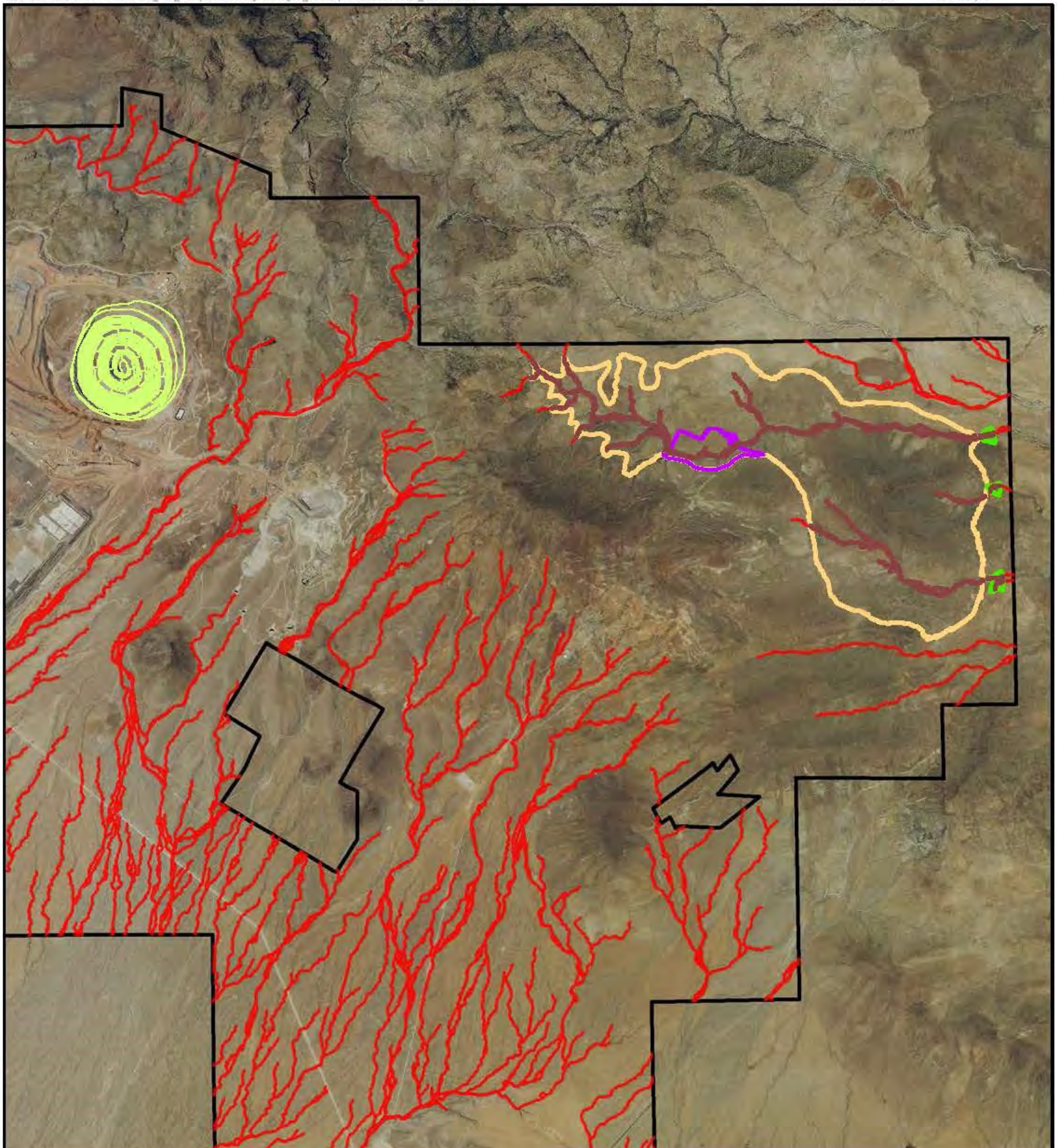

Image Source: NAIP 2013

0 2,500 5,000 Feet

0 600 1,200 Meters

Legend

- Laydown Yard
- Stormwater Dams
- Dos Pobres Pit/Backfill
- Alternative 4 Footprint
- Alternative 4 Impacted Potential Waters
- Potential Waters
- Analysis Area

N

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LONE STAR ORE BODY DEVELOPMENT PROJECT

CWA Section 404(b)(1) Alternatives Analysis

DEVELOPMENT ROCK STOCKPILE ALTERNATIVE 4: BACKFILL AND NORTH SP

Figure 20

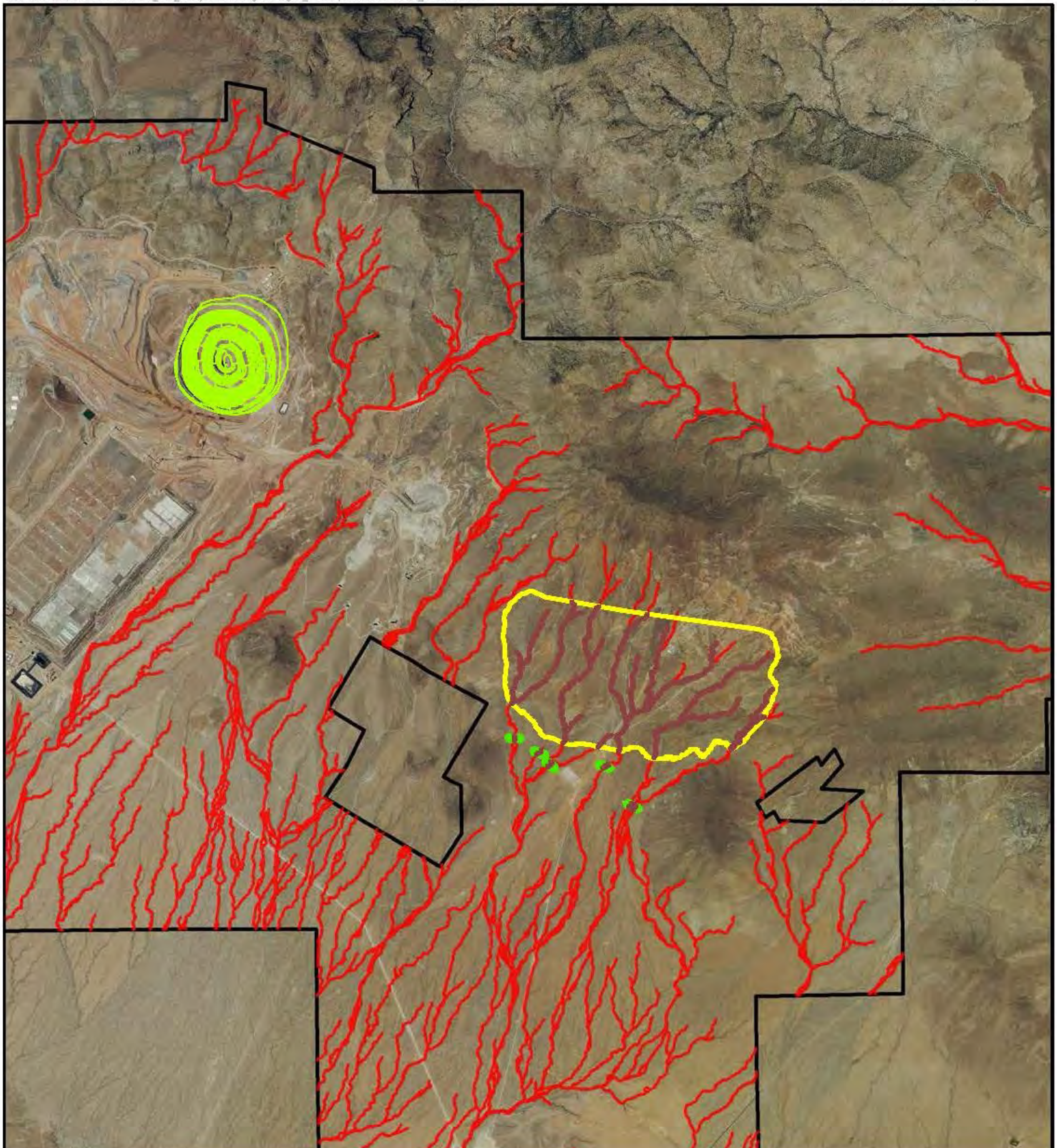

Image Source: NAIP 2013

0 2,500 5,000 Feet

0 600 1,200 Meters

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N

Legend

- Stormwater Dams
- Dos Pobres Pit/Backfill
- Alternative 5 Footprint
- Alternative 5 Impacted Potential Waters
- Potential Waters
- Analysis Area

LONE STAR ORE BODY
DEVELOPMENT PROJECT
CWA Section 404(b)(1) Alternatives Analysis

DEVELOPMENT ROCK STOCKPILE
ALTERNATIVE 5:
BACKFILL AND SOUTH SP

Figure 21

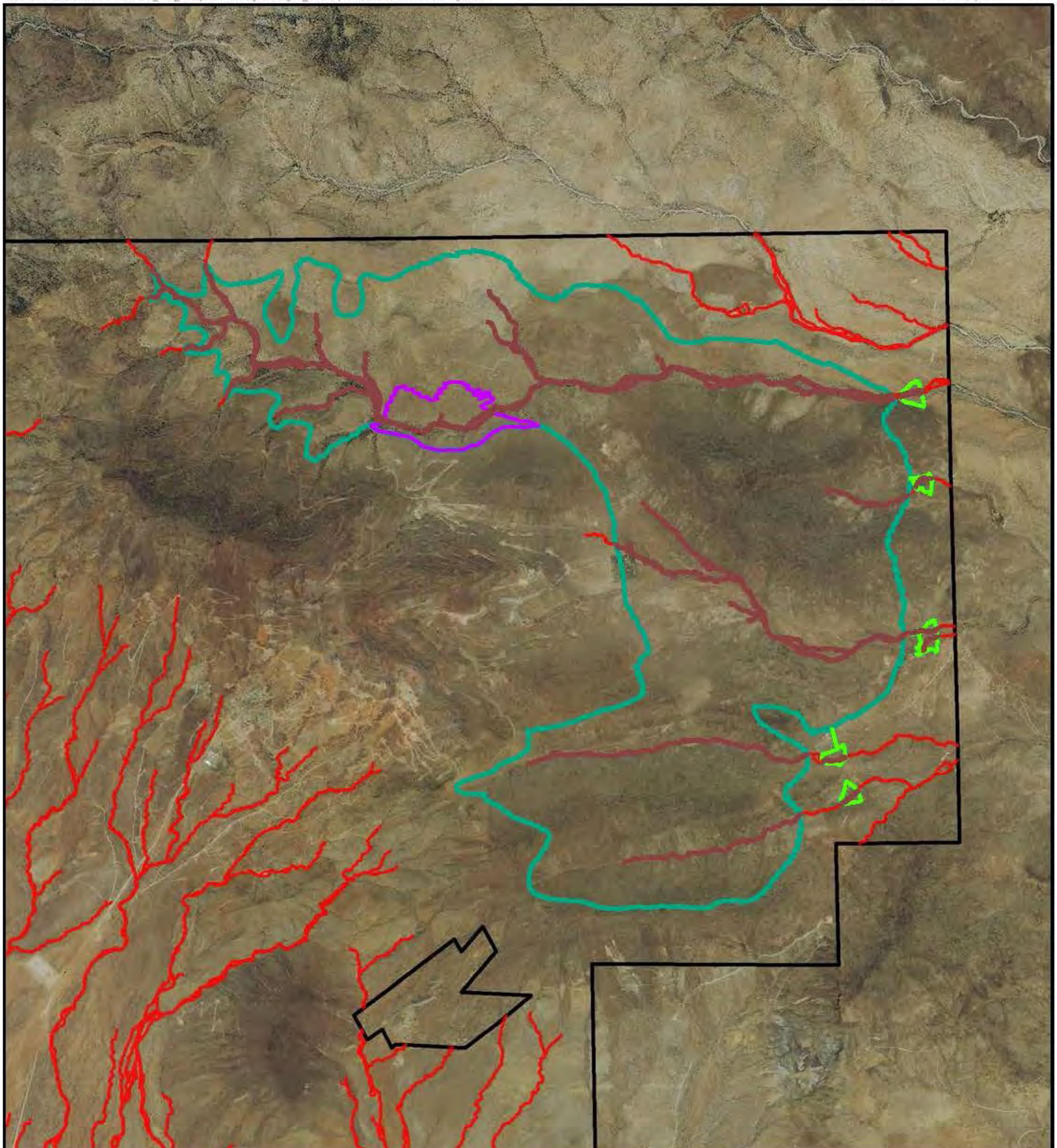

Image Source: NAIP 2013

Legend

- Laydown Yard
- Stormwater Dams
- Alternative 6 Footprint
- Alternative 6 Impacted Potential Waters
- Potential Waters
- Analysis Area

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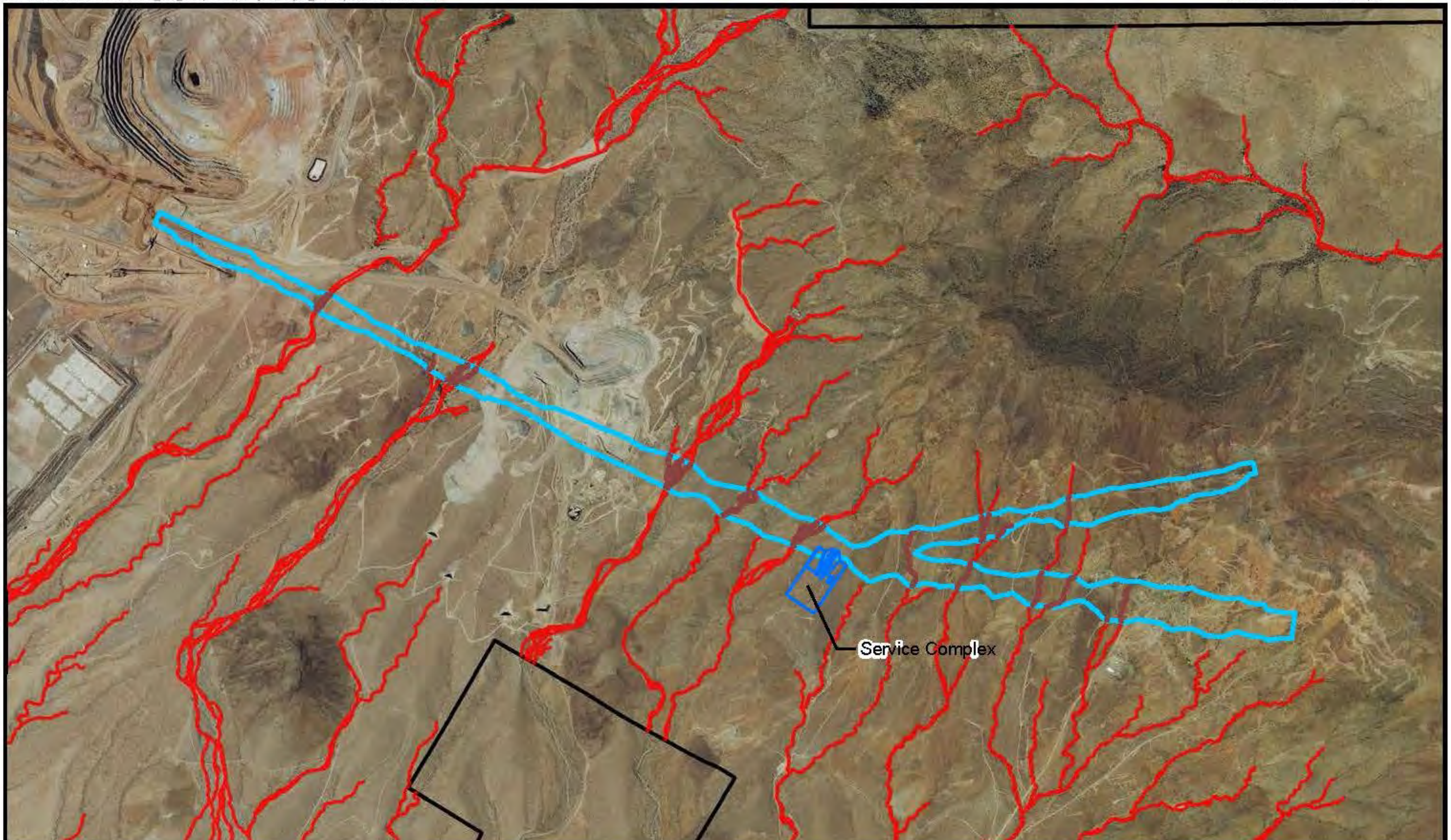
DEVELOPMENT ROCK STOCKPILE
ALTERNATIVE 6:
NORTH SIDE OF RIDGE

Figure 22



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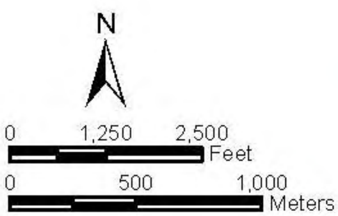

Legend

- Alternative 1 Footprint
- Alternative 1 Impacted Potential Waters
- Potential Waters
- Analysis Area

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LONE STAR ORE BODY
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CWA Section 404(b)(1) Alternatives Analysis

CONVEYANCE ROUTE ALTERNATIVE 1:
HAUL ROAD BASE CASE

Figure 23

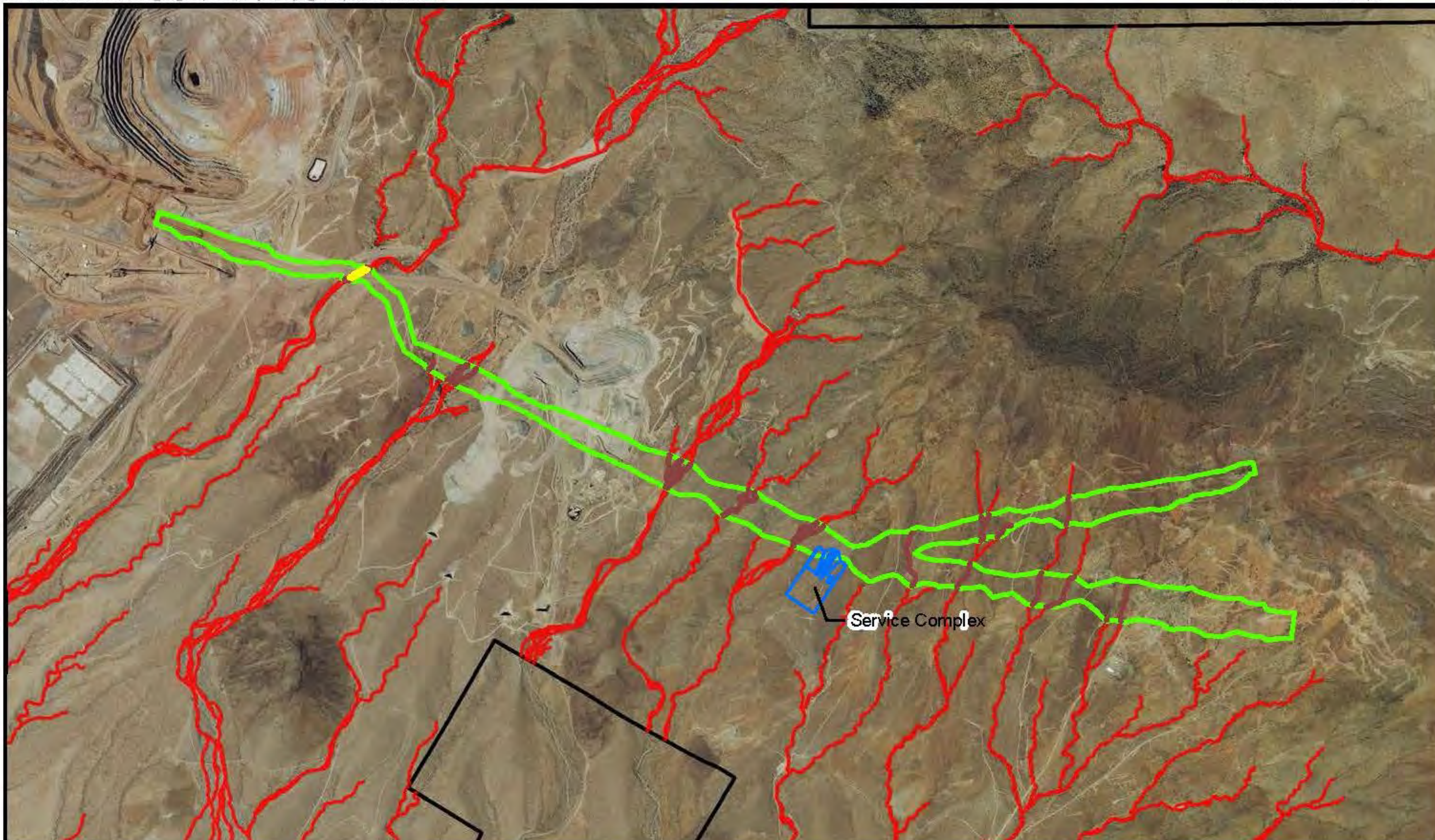

Image Source: NAIP 2013

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N

0 1,250 2,500 Feet
0 500 1,000 Meters

Legend
- Alternative 2 Footprint
- Alternative 2 Impacted Potential Waters
- Existing Crossing (No Impact)
- Potential Waters
- Analysis Area

LONE STAR ORE BODY
DEVELOPMENT PROJECT
CWA Section 404(b)(1) Alternatives Analysis

CONVEYANCE ROUTE ALTERNATIVE 2:
HAUL ROAD HALF-EXISTING

Figure 24

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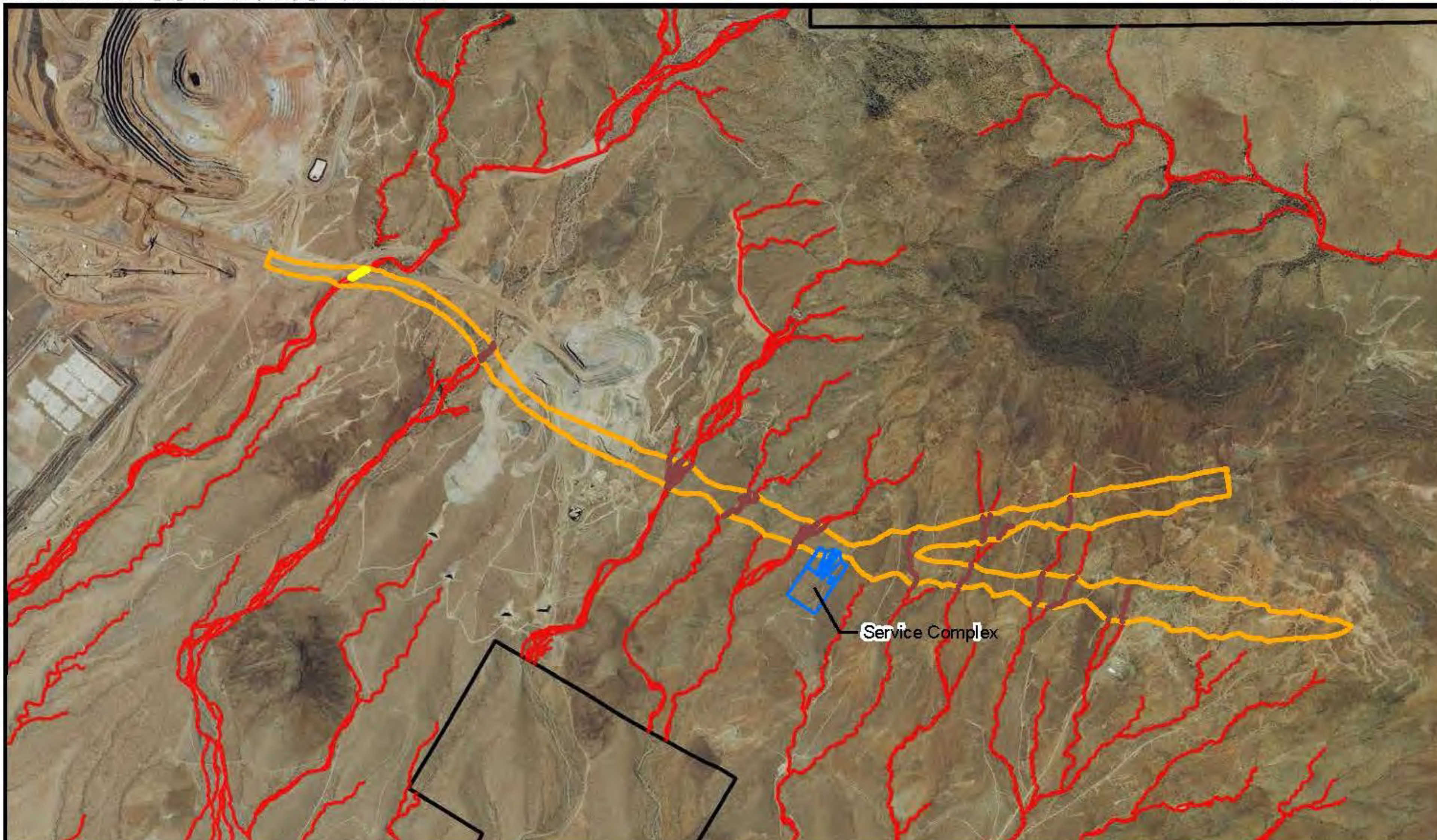

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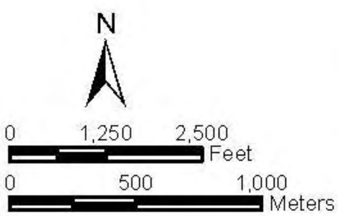

Legend

- Alternative 3 Footprint
- Alternative 3 Impacted Potential Waters
- Existing Crossing (No Impact)
- Potential Waters
- Analysis Area

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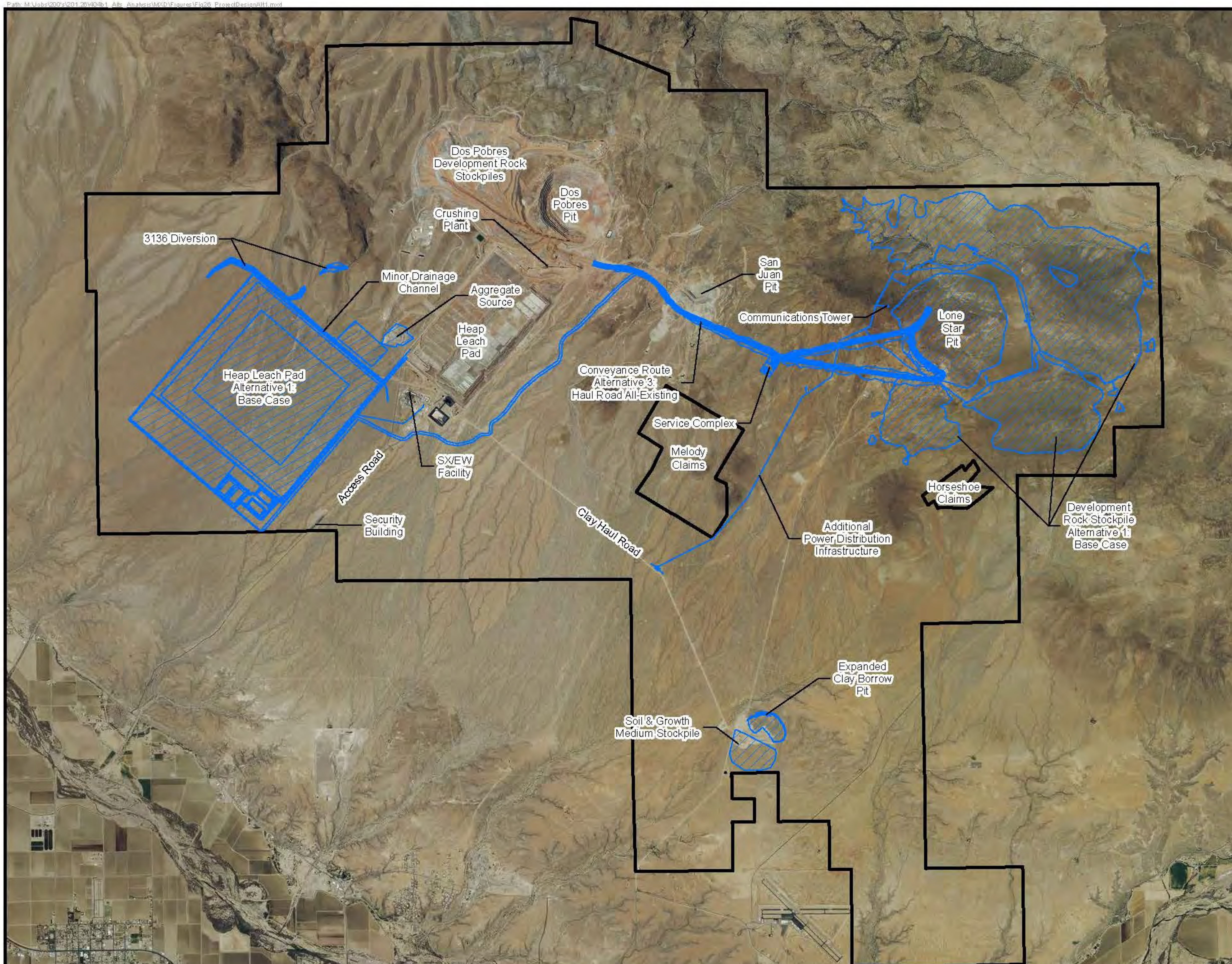
LONE STAR ORE BODY
DEVELOPMENT PROJECT

CWA Section 404(b)(1) Alternatives Analysis

CONVEYANCE ROUTE ALTERNATIVE 3:
HAUL ROAD ALL-EXISTING

Figure 25

Path: M:\Jobs\200's\201.26\404b1_Alts_Analysis\MXD\Figures\Fig26_ProjectDesignAlt1.mxd Date: 5/7/2015 User: tanyao



Legend

Analysis Area

N

0 2,600 5,200 Feet

0 750 1,500 Meters

T05S, R25E, Portion of Sections 35 & 36,
T05S, R26E, Portion of Sections 19-22, 26-36,
T05S, R27E, Portion of Sections 31-33,
T06S, R25E, Portion of Sections 1, 2, 11, 12, 13 & 14,
T06S, R26E, Portion of Sections 1-18, 23-26, 35 & 36,
T06S, R27E, Portion of Sections 3-10, 17-20, 30 & 31,
T07S, R27E, Portion of Sections 5 & 6,
Graham County, Arizona,
Lone Star Mountain, Pima, Safford, San Jose, & Weber Peak USGS 7.5' Quadrangles
Image Source: NAIP 2013

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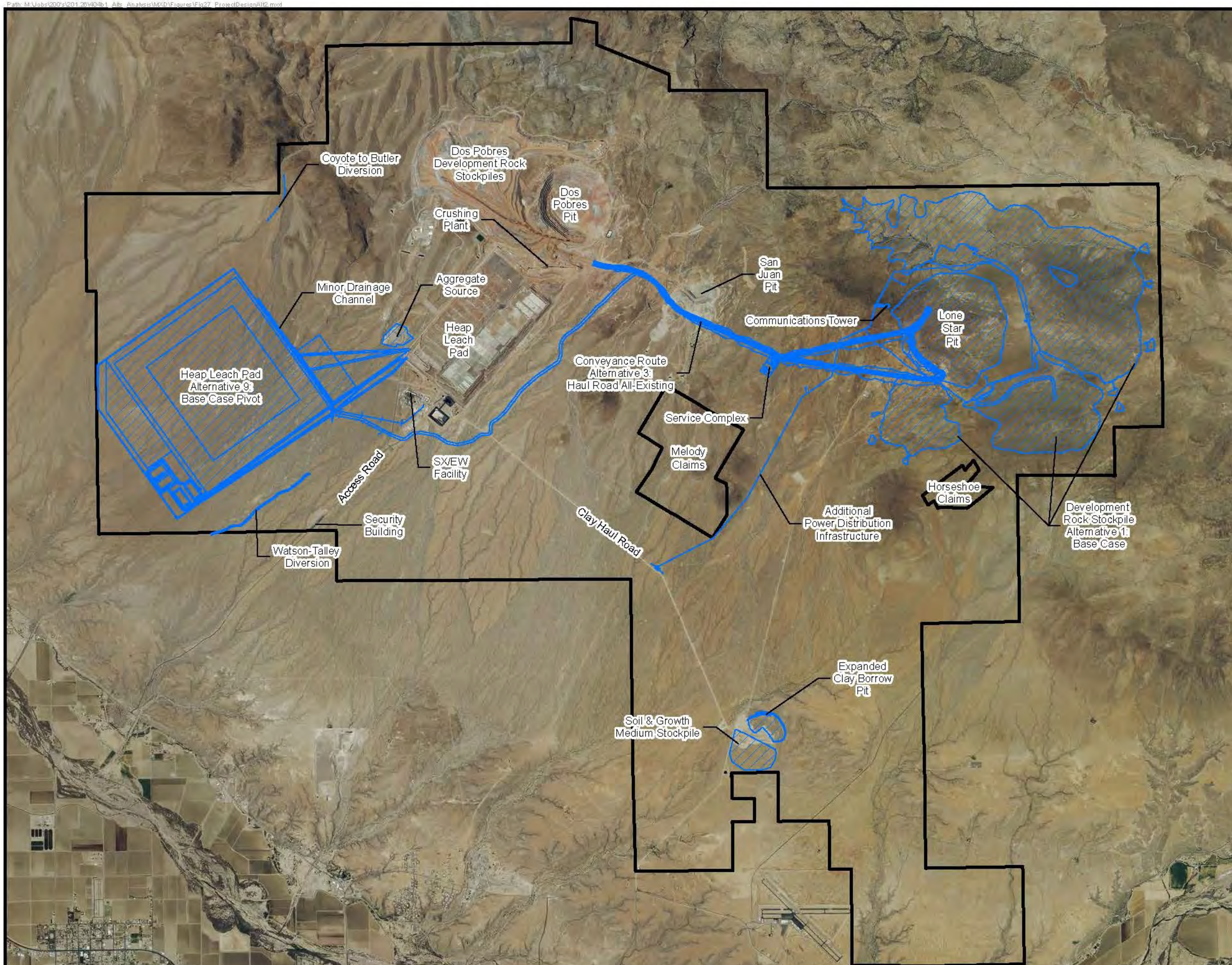
LONE STAR ORE BODY DEVELOPMENT PROJECT

CWA Section 404(b)(1) Alternatives Analysis

PROJECT DESIGN ALTERNATIVE 1: BASE CASE

Figure 26



Legend

Analysis Area

N

0 2,600 5,200 Feet

0 750 1,500 Meters

T05S, R25E, Portion of Sections 35 & 36,
T05S, R26E, Portion of Sections 19-22, 26-36,
T05S, R27E, Portion of Sections 31-33,
T06S, R25E, Portion of Sections 1, 2, 11, 12, 13 & 14,
T06S, R26E, Portion of Sections 1-18, 23-26, 35 & 36,
T06S, R27E, Portion of Sections 3-10, 17-20, 30 & 31,
T07S, R27E, Portion of Sections 5 & 6,
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Lone Star Mountain, Pima, Safford, San Jose,
& Weber Peak USGS 7.5' Quadrangles
Image Source: NAIP 2013

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LONE STAR ORE BODY DEVELOPMENT PROJECT

CWA Section 404(b)(1) Alternatives Analysis

PROJECT DESIGN ALTERNATIVE 2: PIVOT OPTION

Figure 27

Path: M:\Jobs\200's\201.26\404b1_Alts_Analysis\MXD\Figures\Fig28_PJD_ImpactsProjectDesignAlt1.mxd

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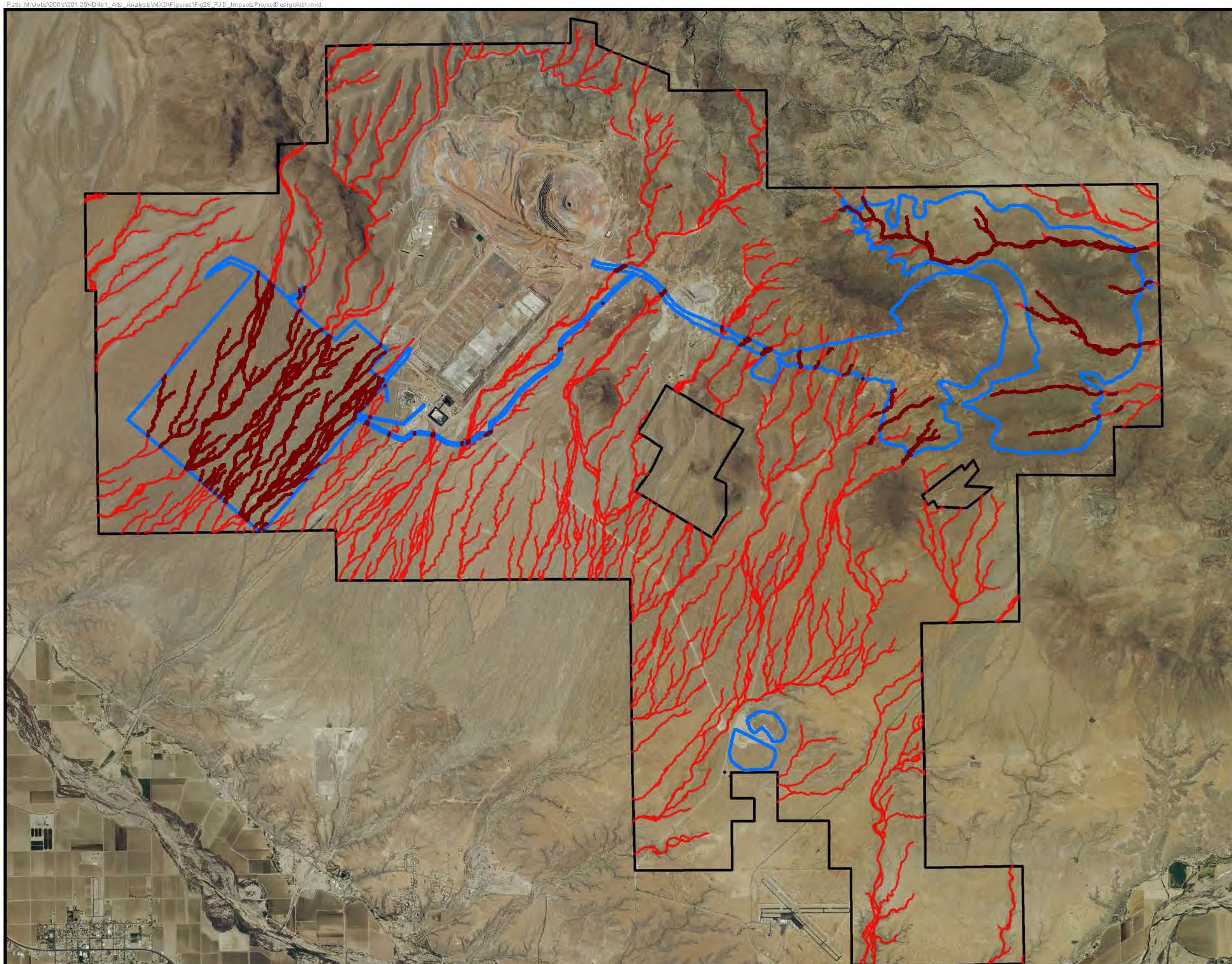

Legend

- Analysis Area
- Base Case Footprint
- Impacted Potential Waters
- Potential Waters

N

0 2,600 5,200 Feet

0 750 1,500 Meters

T05S, R25E, Portion of Sections 35 & 36,
T05S, R26E, Portion of Sections 19-22, 26-36,
T05S, R27E, Portion of Sections 31-33,
T06S, R25E, Portion of Sections 1, 2, 11, 12, 13 & 14,
T06S, R26E, Portion of Sections 1-18, 23-26, 35 & 36,
T06S, R27E, Portion of Sections 3-10, 17-20, 30 & 31,
T07S, R27E, Portion of Sections 5 & 6,
Graham County, Arizona,
Lone Star Mountain, Pima, Safford, San Jose,
& Weber Peak USGS 7.5' Quadrangles
Image Source: NAIP 2013

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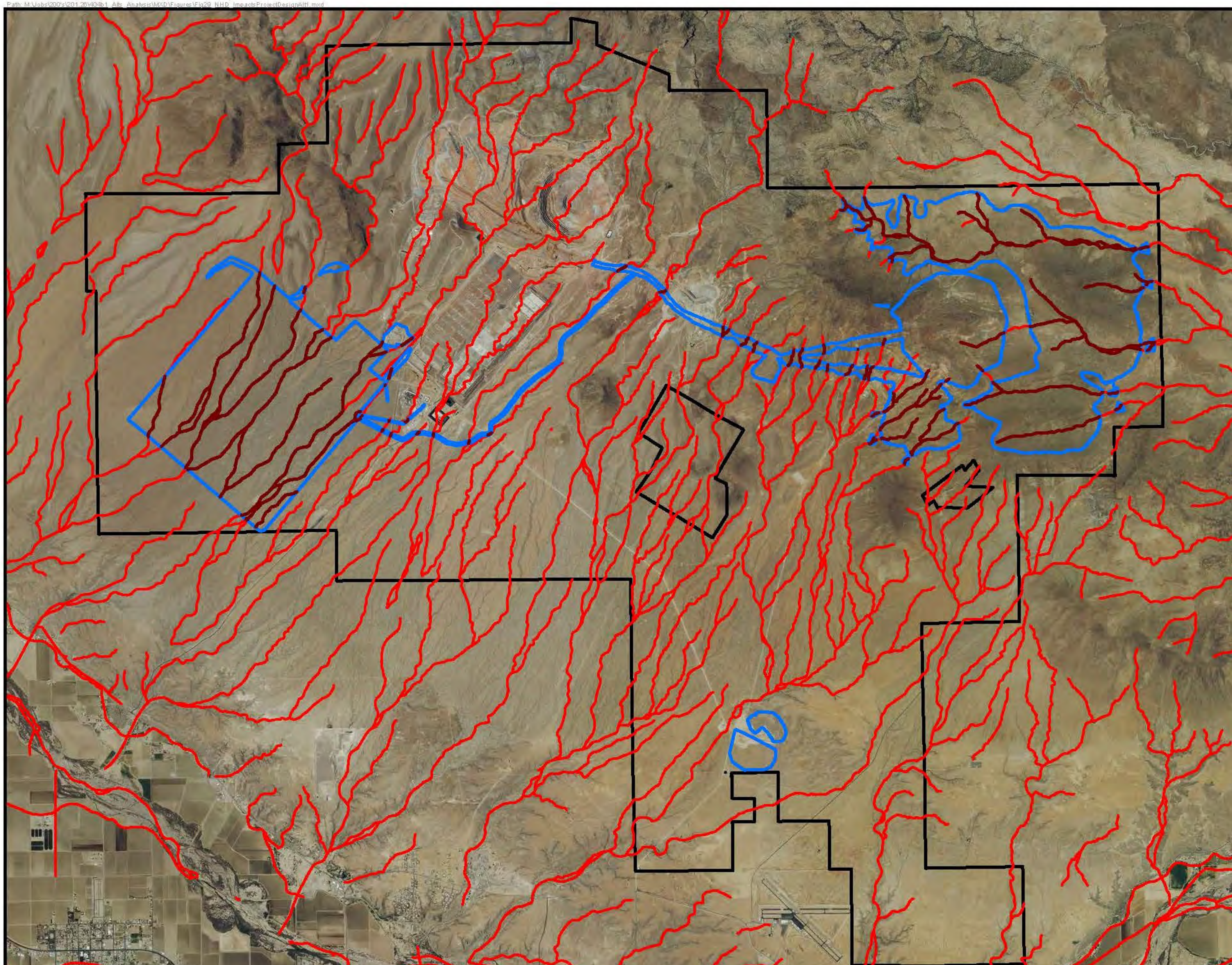
LONE STAR ORE BODY DEVELOPMENT PROJECT

CWA Section 404(b)(1) Alternatives Analysis

IMPACTS TO POTENTIAL WATERS OF THE U.S. UNDER PROJECT DESIGN ALTERNATIVE 1: BASE CASE

Figure 28

Path: M:\Jobs\200's\201.26\404b1_Alts_Analysis\MXD\Figures\Fig29_NHD_ImpactsProjectDesignAlt1.mxd Date: 5/7/2015 User: tanyao



Legend

- Impacted NHD Drainages
- NHD Drainages
- Analysis Area
- Base Case Footprint

N

0 2,600 5,200 Feet

0 750 1,500 Meters

T05S, R25E, Portion of Sections 35 & 36,
T05S, R26E, Portion of Sections 19-22, 26-36,
T05S, R27E, Portion of Sections 31-33,
T06S, R25E, Portion of Sections 1, 2, 11, 12, 13 & 14,
T06S, R26E, Portion of Sections 1-18, 23-26, 35 & 36,
T06S, R27E, Portion of Sections 3-10, 17-20, 30 & 31,
T07S, R27E, Portion of Sections 5 & 6,
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& Weber Peak USGS 7.5' Quadrangles
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LONE STAR ORE BODY
DEVELOPMENT PROJECT

CWA Section 404(b)(1) Alternatives Analysis

IMPACTS TO NHD DRAINAGES
OF THE U.S. UNDER
PROJECT DESIGN ALTERNATIVE 1:
BASE CASE

Figure 29

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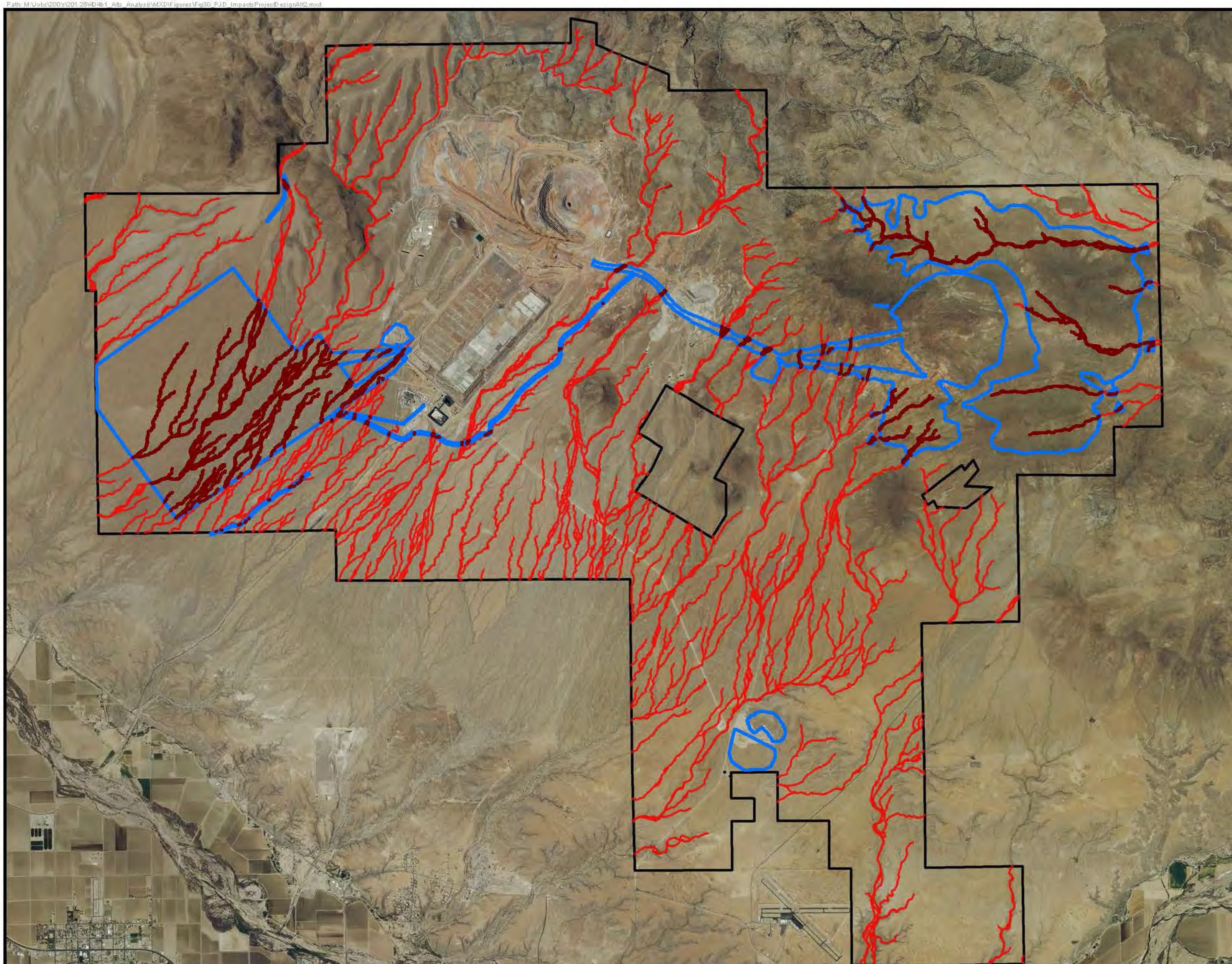

Legend

- Analysis Area
- Impacted Potential Waters
- Pivot Option Footprint
- Potential Waters

N

0 2,600 5,200 Feet

0 750 1,500 Meters

T05S, R25E, Portion of Sections 35 & 36,
T05S, R26E, Portion of Sections 19-22, 26-36,
T05S, R27E, Portion of Sections 31-33,
T06S, R25E, Portion of Sections 1, 2, 11, 12, 13 & 14,
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& Weber Peak USGS 7.5' Quadrangles
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LONE STAR ORE BODY
DEVELOPMENT PROJECT

CWA Section 404(b)(1) Alternatives Analysis

IMPACTS TO POTENTIAL WATERS
OF THE U.S. UNDER
PROJECT DESIGN ALTERNATIVE 2:
PIVOT OPTION

Figure 30

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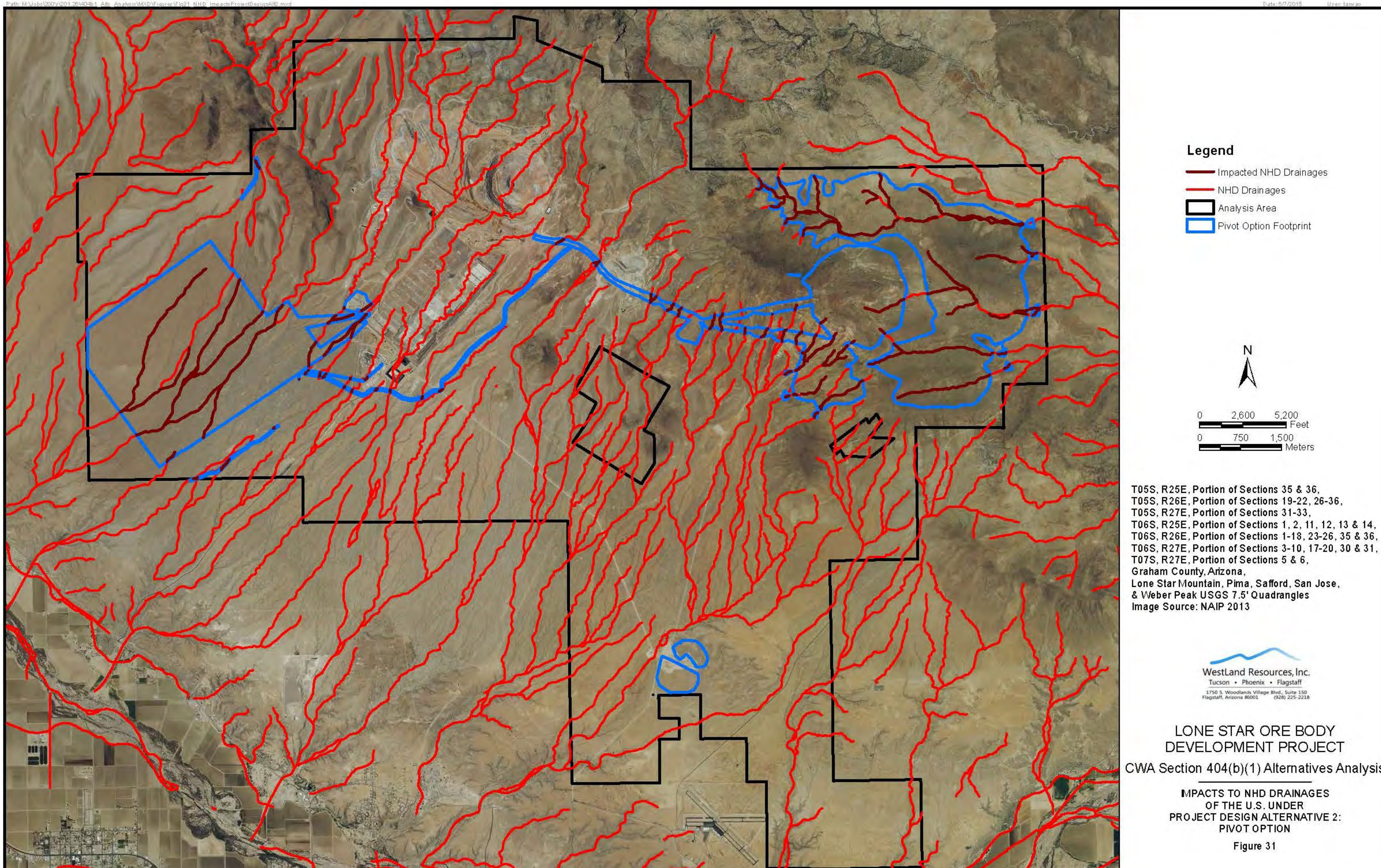

T05S, R25E, Portion of Sections 35 & 36,
T05S, R26E, Portion of Sections 19-22, 26-36,
T05S, R27E, Portion of Sections 31-33,
T06S, R25E, Portion of Sections 1, 2, 11, 12, 13 & 14,
T06S, R26E, Portion of Sections 1-18, 23-26, 35 & 36,
T06S, R27E, Portion of Sections 3-10, 17-20, 30 & 31,
T07S, R27E, Portion of Sections 5 & 6,
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Lone Star Mountain, Pima, Safford, San Jose,
& Weber Peak USGS 7.5' Quadrangles
Image Source: NAIP 2013

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LONE STAR ORE BODY DEVELOPMENT PROJECT

CWA Section 404(b)(1) Alternatives Analysis

IMPACTS TO NHD DRAINAGES OF THE U.S. UNDER PROJECT DESIGN ALTERNATIVE 2: PIVOT OPTION

Figure 31

Appendix B

Compensatory Mitigation Plan

CLEAN WATER ACT SECTION 404
CONCEPTUAL MITIGATION PLAN

LONE STAR ORE BODY
DEVELOPMENT PROJECT

Prepared for:

U.S. Army Corps of Engineers

On behalf of:

Freeport-McMoRan Safford Inc.

Prepared by:

WestLand Resources
4001 East Paradise Falls Drive
Tucson, Arizona 85712
(520) 206-9585

February 19, 2016 (Revised)
Project No. 201.26 D 04.2
Corps File No. SPL-2014-00065-MWL

TABLE OF CONTENTS

TABLES

FIGURES

(*follow text*)

1. INTRODUCTION AND BACKGROUND

1.1. DOCUMENT PURPOSE AND ORGANIZATION

Freeport-McMoRan Safford Inc. (FMSI) has proposed the development of the mineral resources associated with the Lone Star ore body, located on lands owned and managed by FMSI, and proximate to their existing copper mining operations near Safford, Arizona (***Figure 1***). Development of the mineral resources associated with the Lone Star ore body (the Project) will require several common components of an open-pit copper mine including development rock stockpiles, a heap leach pad, additional conveyance route infrastructure, an expanded compactible soil borrow source, related stormwater management facilities, and other appurtenant features, in addition to the open pit itself. The proposed Project requires the discharge of fill to surface drainage features that the U.S. Army Corps of Engineers (Corps) has preliminarily determined (SPL-2014-00065-MWL) may be jurisdictional waters of the United States (waters of the U.S.), and FMSI has made application for a Department of the Army permit for development of the Project.

As part of CWA Section 404 Individual Permit requirements for discharge into waters of the U.S., a mitigation plan must be prepared in accordance with the Corps' and the U.S. Environmental Protection Agency's (EPA) *Final Rule for Compensatory Mitigation for Losses of Aquatic Resources* (33 CFR Part 332 and 40 CFR Part 230; published in 73 FR 19594-19705 (April 10, 2008)), hereinafter referred to as the 2008 Mitigation Rule. This Conceptual Mitigation Plan has been prepared to describe FMSI's proposed mitigation as part of CWA Section 404 individual permit requirements. FMSI has coordinated with the Corps to identify potential mitigation opportunities for the Project. Following review and approval by the Corps of the concepts contained in this conceptual plan, a Final Mitigation Plan in compliance with the 2008 Mitigation Rule will be completed.

This Conceptual Mitigation Plan is presented in five sections: ***Section 1*** identifies the document's purpose and organization, introduces the Project, and summarizes Project impacts to potential waters of the U.S.; ***Section 2*** provides a description of the mitigation goals, including avoidance and minimization, compensatory mitigation, and other aquatic resource conservation measures that will provide functional benefits; ***Section 3*** outlines the specific conceptual plans for each proposed mitigation area and identifies the expected outcome, success criteria, and implementation plan for each; ***Section 4*** describes details of the long-term protection and management of the proposed mitigation site; and ***Section 5*** includes the references used in the preparation of this document.

1.2. PROJECT DESCRIPTION

Located in eastern Arizona, the Safford Mine has been in operation for almost 8 years under the ownership of FMSI, formerly Phelps Dodge Safford Inc. FMSI owns and manages approximately 36,050 acres of privately held lands within and surrounding the existing Safford Mine facility, north of the City of Safford, Graham County, Arizona (see ***Figure 1***). The existing Safford Mine is currently an open-pit copper mining operation consisting of two pits, the Dos Pobres Pit and the San Juan Pit, and the associated handling, processing, and support infrastructure for mineral resources recovered from the two pits (***Figure 2***). Existing features of this integrated system include a three-stage crushing system, two drum agglomerators, a heap leach pad, a solution extraction/electrowinning (SX/EW) processing facility, and support facilities (see ***Figure 2***). Development of the Lone Star ore body was originally considered as a Reasonably Foreseeable Future Action (RFFA) during National Environmental Policy Act (NEPA) review of the development of the current Safford Mine. The lands around the Lone Star ore body (as it was defined at that time) were identified in the 2003 Final Environmental Impact Statement (FEIS) as having mining operations as an anticipated future use.

Since that time, FMSI has undertaken additional evaluation of the Lone Star ore body to define the mineral resource associated with this porphyry copper deposit and has developed plans for the purpose of the economic recovery of these mineral resources. FMSI has designed the Project to make use of as much of the existing Safford Mine infrastructure as is practicable. New mine elements anticipated as necessary for the development of the Project include the open pit, a heap leach pad, development rock stockpile(s), the conveyance route between the pit and crusher, additional power distribution infrastructure, an expanded clay borrow pit, soil and growth medium stockpiles, a truck service complex, a communications tower, and additional stormwater management facilities.

1.3. JURISDICTIONAL IMPACTS

The development of the proposed design for the Project incorporated a substantial effort to avoid and minimize impacts to potential waters of the U.S., including the continued use of existing Safford Mine operational infrastructure wherever practicable. The full range of alternatives analyzed in the development of the proposed design of the Project is described in the draft 404(b)(1) Alternatives Analysis (WestLand 2015a) prepared for the Project. ***Table 1*** summarizes the unavoidable impacts to lands and to potential waters of the U.S. that would result from construction of either of the two alternatives identified as practicable in that analysis: Project Design Alternative 1: Base Case and Project Design Alternative 2: Pivot Option. Under Project Design Alternative 1: Base Case (***Figure 3***), only the heap leach pad, development rock stockpile(s), the conveyance route between the pit and crusher, and the stormwater management facilities have impacts to potential waters of the U.S. (***Figure 4***). These impacts to potential waters of the U.S. total approximately 90.43 acres. Under Project Design Alternative 2: Pivot Option (***Figure 5***), the same Project elements have impacts to potential waters of the U.S., but these impacts would total 76.20 acres (***Figure 6***), principally from realignment of the leach pad to avoid potential waters of the U.S. Neither Project alternative would adversely affect any special aquatic sites, including wetlands.

Table 1. Project Impacts to Lands and to Potential Waters of the U.S. by Project Component

Project Design Components	Acres of Land Impacted		Acres of Potential Waters Impacted	
	Alt 1	Alt 2	Alt 1	Alt 2
Lone Star Pit	645	645	0	0
Heap Leach Pad	2,466	2,522	60.40	46.17
Development Rock Stockpiles	2,605	2,605	27.04	27.04
Haul Road	285	285	2.99	2.99
Clay Borrow Pit Expansion	48	48	0	0
Soil and Growth Medium Stockpile	86	86	0	0
Communications Tower and Road	0.29	0.29	0	0
Power Distribution Infrastructure	5	5	0	0
TOTAL	**6,140**	**6,196**	**90.43**	**76.20**

The impacts considered during preparation of the Conceptual Mitigation Plan for the proposed Lone Star Project only include the direct impacts of Project development to waters of the U.S., and do not include indirect downstream "dewatering" effects. Authorization for development of the existing Safford Mine included the issuance of a CWA Section 404 permit, Permit Number 964-0202-MB, and the implementation of a CWA Section 404 Mitigation and Monitoring Plan (MMP), dated December 27, 2002 (WestLand 2002). This MMP includes a monitoring provision known as the Downstream Monitoring Program, developed to monitor those drainages considered dewatered, and therefore indirectly impacted, by stormwater diversion and mine development activities for a period of 15 years. Monitoring data was also collected from a set of unimpacted, or control, drainages for comparison and analysis. Downstream monitoring has been conducted in 2006, 2011, and 2015.

As detailed in the 2015 monitoring report provided to the Corps (WestLand 2015b), the analysis of monitoring data does not show a significant loss of function in those drainages described as dewatered, as compared to the control drainages. Both dewatered and control drainages showed an increase in live vegetation volume, or LVV, and the percent increase in LVV did not differ between the drainage groups (WestLand 2015b). Both the ground photos and geomorphological transects demonstrate there has been no functionally meaningful change in channel structure or configuration at the monitoring sites in either group of drainages. Based on these data, indirect impacts to the function of any potential waters of the U.S. are not anticipated from the development of the Lone Star Project, and are not considered further in the Conceptual Mitigation Plan for the Project.

2. MITIGATION SITE SELECTION AND ASSESSMENT

2.1. MITIGATION SITE SELECTION AND APPROACH

The 2008 Mitigation Rule identifies general classes of compensatory mitigation as well as clear preferences among these classes; specifically noting that Mitigation Banking and then In-Lieu-Fee Mitigation are preferred over applicant-sponsored onsite or offsite mitigation. As a general matter, in-kind mitigation is preferred over out-of-kind mitigation. FMSI considered these general classes of compensatory mitigation from a watershed perspective when developing this Conceptual Mitigation Plan.

There are currently no Mitigation Banks established in Arizona and only three approved In-Lieu-Fee Mitigation projects. The approved In-Lieu-Fee Mitigation projects are located in Yavapai County, Maricopa County, and Navajo County, well outside of the Upper Gila watershed (Hydrologic Unit Code [HUC] 15040005) within which the Project occurs. FMSI is aware of one In-Lieu-Fee Mitigation project proposed for development within the Upper Gila watershed, Cluff Ranch, but as of the drafting of this Conceptual Mitigation Plan, it does not have approval to sell mitigation credits and is therefore not available.

A number of onsite mitigation measures were incorporated into the Project design to address water quality and quantity functions. For Project Design Alternative 1: Base Case, these measures include the construction of three diversion channels: the 3136 Diversion, the Minor Drainage Channel, and the Interim Diversion Channel, to prevent run-on of stormwater flows and route them into drainages downgradient of the new heap leach pad. The 3136 Diversion and the Minor Drainage Channel would be located upgradient of the new heap leach pad (see ***Figure 3***), while the Interim Diversion Channel would be constructed above each phase of the leach pad as it advances to divert stormwater reporting from the area downgradient of the other two diversions until the leach pad reaches its ultimate footprint. Project Design Alternative 2: Pivot Option includes the construction of four diversion channels: the Coyote-Butler Diversion, the Leach Pad Diversion, the Watson-Talley Diversion, and the Interim Diversion Channel (see ***Figure 5***).

Stormwater containment dams were also included downgradient of the proposed development rock stockpiles for both Project Design Alternative 1: Base Case and Project Design Alternative 2: Pivot Option (see ***Figure 3*** and ***Figure 5***) to control the run-off of impacted stormwater. Given that the footprints of both practicable Project alternatives contain only ephemeral drainage channels and will be operated as an active copper mine, no opportunity exists for the development of onsite mitigation. Habitat functions that will be lost by development of the Project will be mitigated offsite.

FMSI is unaware of any watershed planning efforts for the HUC-6 or HUC-8 watersheds that contain the Project that identify specific compensatory mitigation goals for aquatic resources. Natural Resources Conservation Service (NRCS) Rapid Watershed Assessment of the Upper Gila watershed has not been completed (NRCS 2007). FMSI has reviewed the Arizona Non-point Education for Municipal Officials (NEMO) website for watershed plans for the Upper Gila (NEMO 2005) to gain perspective on the nature of the resources within the watershed, looked at previous Corps mitigation projects associated with the Safford Mine, and reviewed general conservation efforts along the Gila River being carried out by Non-

Governmental Organizations (NGOs), such as the Gila Watershed Partnership, to inform site selection and plan development.

FMSI has identified one site, the Emery Site (***Figure 7***), for mitigation activities. As outlined in greater detail below, this site and the mitigation opportunities at the site are able to compensate for all of the unavoidable Project impacts to potential waters of the U.S. under either Project Design Alternative 1: Base Case or Project Design Alternative 2: Pivot Option. The Emery Site is approximately 25 river miles downgradient of the Project and is within the same HUC-8 watershed. Located along the Gila River, the site has the potential to support high-value mesoriparian and hydroriparian habitats, and provides regional conservation benefit. While the mitigation measures proposed within the Emery Site will not create the xeroriparian habitat associated with the ephemeral drainages to be impacted by the Project, and is, strictly speaking, out-of-kind mitigation, the habitats within the mitigation site that will be preserved, enhanced, and restored are more rare within the regional landscape, have higher productivity, and possess higher wildlife values. ***Table 2*** provides a brief summary of the proposed mitigation areas within the Emery Site.

Table 2. Description of Mitigation Areas within the Emery Site

Mitigation Area and Proposed Treatment	Acreage	Description
Emery Site – Area A: Field to Riparian Restoration	50.00	Area A of the Emery Site includes approximately 50 acres, adjacent to both the Gila River and Area B (see ***Figure 7***). Most of Area A is composed of former agricultural fields, although the northwestern portion of the area is currently vegetated by patches of tamarisk and a few cottonwoods. Understory vegetation that includes forbs and shrubs is patchy throughout Area A. Proposed mitigation activities at Area A include the grading and re-contouring of the of the area to remove numerous manmade alterations, including berms, channels, and other agricultural features, which currently separate Area A from the active floodplain and channel of the Gila River. Other proposed activities include control of weedy plant species, planting and seeding of native mesquite trees, seeding for other native plant species, and grading of the area to restore natural contours, if necessary. These activities will restore the functional values of the site as a riparian area and as available active floodplain and possible overbank channel for the Gila River.
Emery Site – Area B: Tamarisk Control and Riparian Enhancement	59.00	Area B of the Emery Site encompasses approximately 59 acres of riparian corridor adjacent to Area A and a perennial reach of the Gila River (see ***Figure 7***). The riparian vegetation of Area B is almost exclusively exotic tamarisk. There is a concern that, if the expected colonization of the tamarisk leaf beetle occurs along this reach of the Gila River, the tamarisk within this site will be killed or substantially reduced over a very short period of time, resulting in the loss of the non-native riparian habitat that currently supports yellow-billed cuckoo and Southwestern willow flycatcher. Proposed mitigation activities at Area B consist of the removal of tamarisk and the planting and seeding of native species including cottonwood, willow, and mesquite. The replacement of tamarisk with native cottonwood, willow, and mesquite will create habitat suitable for native wildlife, including the endangered southwestern willow flycatcher and threatened yellow-billed cuckoo, and maintain these functions during the anticipated die-off of non-native tamarisk when the tamarisk leaf beetle arrives along this reach of the Gila River.
Emery Site – Area C: Buffer Preservation	42.00	Area C of the Emery Site consists of approximately 42 acres of lands covered by a site protection instrument (see ***Figure 7***). These lands surround Area B of the Emery Site and provide further protection for the enhancement activities undertaken in Area B. Although Area C may provide future mitigation opportunities adjacent to those enhancement activities undertaken in Area B, no further mitigation strategies are proposed for Area C at this time.

2.2. SITE ASSESSMENT AND DETERMINATION OF MITIGATION RATIOS

The South Pacific Division of the Corps has developed the *Standard Operating Procedure for the Determination of Mitigation Ratios* (Corps 2013) for determining compensatory mitigation requirements for the processing of CWA Section 404 permits. The substantive component of this procedure is completion of Attachment 12501.1-SPD, the Mitigation Ratio Setting Checklist (MRSC). The completed MRSC is intended to provide a ratio determining the amount of acreage necessary as compensatory mitigation to offset the acreage of authorized impacts, in compliance with the 2008 Mitigation Rule. Completion of the MRSC comprises a 10-step process that includes a functional analysis of impacted waters of the U.S. and proposed mitigation parcels, establishes baseline mitigation ratios, and authorizes adjustment of those ratios based on specified criteria. Completion of the MRSC for the ratios reported in this Conceptual Mitigation Plan was conducted by WestLand and documented as a technical memorandum under separate cover (WestLand 2015c).

The functional losses assessed entail impacts to ephemeral channel areas within the Project footprint. The mitigation areas of the Emery Site were assessed for their ability to provide functional gain through the active management, enhancement, and restoration activities. The functions were scored qualitatively on a six-category numeric scale, as follows: 0 = none, 1 = low, 2 = low-moderate, 3 = moderate, 4 = moderate-high, and 5 = high function (WestLand 2015c). ***Table 3*** provides the resulting functional scoring of two classes of potential waters of the U.S. that would be impacted by the Project, and the functional scoring at the proposed mitigation areas of the Emery Site upon achievement of mitigation success (WestLand 2015c).

Assessment of the functional losses from impacts and functional gain from mitigation is carried through the steps of the MRSC to calculate the final mitigation to impact acreage ratios required to replace lost functions. The final ratios determine the amount of acreage credits that are generated by each mitigation area when compared to each impacted drainage class (see ***Figure 4*** and ***Figure 6***). The final mitigation ratios comparing each impact class to each mitigation area from completion of the MRSC (WestLand 2015c) are summarized in ***Table 4***.

Table 3. Functional Assessment Scoring for Impacted Drainage Classes and Mitigation Areas*

Assessed Functions	Functional Scoring of Impact Drainage Classes		Functional Scoring of Mitigation Areas of Emery Site upon Achievement of Mitigation Success Criteria		
	Ephemeral Class A	Ephemeral Class B	Area A	Area B	Area C
Hydrologic Functions					
Hydrologic Connectivity	3	3	5	4	1
Subsurface Flow/Groundwater Recharge	2	1	4	4	1
Energy Dissipation	3	1	5	4	1
Sediment Transport/ Regulation	3	1	5	5	1
Chemical Functions					
Elements, Compounds, and Particulate Cycling	2	1	5	4	1
Organic Carbon Export/Sequestration	2	1	5	4	1
Biotic Functions					
Aquatic Invertebrate Fauna	0	0	0	5	1
Presence of Fish and Fish Habitat Structure	0	0	0	1	1
Riparian/Wetland Vegetation Structure	1	1	3	5	1
Age-Class Distribution of Woody Riparian or Wetland Vegetation	3	4	4	5	1
Native/Non-native Vegetation Species	5	5	5	3	1

*Impact drainages classes shown on ***Figure 4*** and ***Figure 6*** and mitigation areas shown on ***Figure 7***.

Table 4. Final Mitigation Ratios per Impacted Drainage Class and Mitigation Area*

Emery Site Area	Final Ephemeral Class A Mitigation Ratio	Final Ephemeral Class B Mitigation Ratio
Area A	1.59:1	1.43:1
Area B	1.16:1	1.10:1
Area C	6:1	6:1

*Ratios are reported as mitigation acres required for each acre of impact.

The total acres of impacted areas by drainage class are applied to the number of mitigation credits provided based on the final mitigation ratios. ***Table 5*** summarizes the application of the MRSC-derived mitigation ratios to the mitigation sites in a sequential fashion. Mitigation credits were applied to the higher functionally scoring Ephemeral Class A impacts first, then to the lower scoring Ephemeral Class B. Mitigation areas began with Emery Site – Area A and moved sequentially working through each area from A to C, as needed, until all of the functional impacts for each drainage class were mitigated. The completed MRSC worksheets, showing all of the steps described above, are provided in the MRSC document (WestLand 2015c).

As the impacts for Project Design Alternative 2: Pivot Option are less than those for Project Design Alternative 1: Base Case, only the mitigation credits that would potentially be required upon development of the latter alternative are shown in ***Table 5*** below. The comparison between impact areas and mitigation areas for calculation of mitigation ratios remains constant across alternatives. A site that contained mitigation acreage sufficient to mitigate the impacts for Project Design Alternative 1: Base Case would necessarily be sufficient to provide the reduced mitigation acreage required by the reduced impacts to potential waters of the U.S. under Project Design Alternative 2: Pivot Option.

Table 5. Final Mitigation Credits Applied by Impact Drainage Class and Mitigation Area

Impact Drainage Class	Impact Acres	Emery Site Mitigation Area	Mitigation Acres Available	Mitigation Ratio	Mitigation Acres Used	Mitigation Credits Provided	Remaining Impact Acres
Ephemeral Class A	60.40	Area A	50	1.59:1	50	31.45	28.95
		Area B	59	1.16:1	26	22.41	6.54
		Area C	42	6.00:1	40	6.67	0
Ephemeral Class B	30.03	Area A	0	1.43:1	0	0	30.03
		Area B	33	1.10:1	33	30	0.03
		Area C	2	6.00:1	2	0.33	0

3. SITE-SPECIFIC CONCEPTS

This section outlines the specific conceptual plans for each proposed mitigation area of the Emery Site and identifies the expected outcome and goals, success criteria, and implementation plan for each area. These concepts are included for a basis of discussion with the Corps in the development of a draft Final Mitigation Plan.

3.1. EMERY SITE – AREA A: FIELD TO RIPARIAN RESTORATION

Area A of the Emery Site includes approximately 50 acres, adjacent to both the Gila River and Area B (see ***Figure 7***). Most of Area A is composed of former agricultural fields, although the northwestern portion of the area is currently vegetated by patches of tamarisk and a few cottonwoods. Understory vegetation that includes forbs and shrubs is patchy throughout Area A.

Goals: Proposed mitigation activities at Area A include the grading and re-contouring of the of the area to remove numerous manmade alterations, including berms, channels, and other agricultural features, which currently separate Area A from the active floodplain and channel of the Gila River. This selective grading of the area to remove structures associated with the previous agricultural land use, together with proposed containerized planting and seeding of native trees and shrubs, will facilitate the restoration of natural successional processes and restore the functional values of the site. Final restoration goals for this area are the establishment of a mesquite-dominated riparian habitat. Implementation of the planting and management programs outlined here will achieve the functional values relied upon to calculate the mitigation ratios in the MRSC. These functional values will be achieved when the grading and re-contouring of the area has reestablished hydrologic functions, the management actions have established native tree and large shrub densities within Area A equal to or exceeding an average of 100 stems per acre, and the vegetation does not require supplemental water for maintenance.

Implementation: During the development of the Final Mitigation Plan, a detailed site inventory and restoration plan will be developed. This plan will identify the existing resources to be protected during restoration activities, soil conditions, planting strategies, preferred approaches for seeding, suitable seed mixes, the need for soil amendments, and any grading or other site stabilization that might be necessary to achieve the mitigation goals and objectives. Restoration activities at this site will commence with the construction of the fencing necessary to clearly delineate conservation area boundaries using Arizona Game and Fish Department (AGFD) wildlife-friendly fencing specifications.

Heavy equipment will be used to remove the numerous manmade alterations, including berms, channels, and other agricultural features, separating Area A from the currently constrained active floodplain of the Gila River. Soil from the work will be disposed of within Area A as far from the river as possible and contoured to provide transition from Area A to adjacent fallowed agricultural lands to the south. Within the area of disturbance, containerized tree plantings will be planted. Based upon depth to groundwater, these plantings will be comprised of a suitable mix of cottonwood, willow, and mesquite. The shallower the water table, the more hydric the proposed plant palette. Construction and operation of an irrigation system is not anticipated at this time. If used, cottonwood and willow containerized or pole plantings will be planted to the groundwater table. Mesquite plantings will be established using gel packs. The density of proposed plantings will be determined during the development of the Final Mitigation Plan. Following containerized tree plantings, a suitable seed mix of native riparian trees, shrubs, grasses, and forbs will be applied to the area using a suitable application technique that would not adversely impact tree plantings.

The remaining portions of Area A will be managed to establish mesquite-dominated riparian habitat. Within certain areas, natural regeneration of mesquite will be augmented by seeding with suitable seed mix and control of non-native tamarisk. In select areas to be identified during development of the Final Mitigation Plan, containerized plantings of mesquite and suitable large shrubs will augment seeding and active management efforts to achieve restoration objectives. Construction and operation of an irrigation system is not anticipated at this time for establishment of containerized or pole plantings. Containerized plantings will be established using Driwater or its equivalent.

Seeding will be applied by seed drill, a technique that provides good seed-to-soil contact and reduces loss through predation, or other suitable technique identified in the Final Mitigation Plan. The entire area will be mulched with straw, which helps to maintain higher levels of soil moisture as well as reduce soil temperatures and loss by predation.

Establishment Period Activities: The establishment period is the period of time within which FMSI and the Corps anticipate that all necessary work to implement the elements of this Conceptual Mitigation Plan will be completed and success criteria achieved. It is currently anticipated that the goals established for Area A will be achieved in a five-year period from implementation of the Final Mitigation Plan. If the goals are not achieved by that date, the establishment period will be extended until the success criteria and goals have been achieved, or new goals have been established in consultation with the Corps. During the establishment period, supplemental watering (likely gel packs) will be provided, as necessary, in a manner that facilitates plant establishment. Recent work near this mitigation site has seen high survivorship of planted one-gallon mesquites based on one application of gel packs at planting time. The site and plantings will be regularly monitored and issues that might affect plant health and riparian function will be identified. The fence around the site will also be inspected and maintained, as necessary, and the site will be inspected for erosion and undesirable vegetation. Maintenance to address any of these issues will take place as necessary.

3.2. Emery Site – Area B: Tamarisk Control and Riparian Enhancement

Area B of the Emery Site encompasses approximately 59 acres of riparian corridor adjacent to Area A and a perennial reach of the Gila River (see ***Figure 7***). The riparian vegetation of Area B is almost exclusively exotic tamarisk. There is a concern that, as the inevitable encroachment of the tamarisk leaf beetle occurs along the Gila River, the tamarisk within the Gila River corridor will be killed, resulting in the loss of the riparian habitat and creating a high fire risk.

Goals: Proposed mitigation activities in Area B consist of the removal of tamarisk and the planting and seeding of native species including cottonwood, willow, and mesquite. The replacement of tamarisk with native cottonwood, willow, and mesquite will create riparian refugia for wildlife and maintain the other functions of Area B during the eventual die-off from the beetle. The functional values relied upon in the MRSC will be achieved when management actions have established native tree and large shrub densities equal to or exceeding an average of 150 stems per acre within Area B, without requirement for supplemental water.

Implementation: During the development of a Final Mitigation Plan, a detailed site inventory and restoration plan will be developed. This plan will identify the existing resources to be protected during mitigation activities, depth to groundwater, soil conditions, planting strategies, preferred approaches for seeding, suitable seed mixes, the need for soil amendments, and tamarisk-control activities necessary to achieve the mitigation goals and objectives.

The cut-stump method of tamarisk control will be used. Suitable methods of removal will be determined during development of the Final Mitigation Plan, and selection of the final method will be determined by the responsible contractor. It is anticipated that mulching equipment mounted to heavy equipment will be used to clear and mulch the trunks and branches of the tamarisk trees in Area B. Concentrated herbicide will be applied to the cut stumps. Stump removal is not anticipated at this time. During the initial implementation period, multiple follow-up treatments of tamarisk re-sprouts are anticipated. Only herbicides approved for use in riparian habitats will be used.

Based upon depth to groundwater, plantings will be comprised of a suitable mix of cottonwood, willow, and mesquite. The shallower the water table, the more hydric the proposed plant palette. Species mix is expected to vary across this area. Construction and operation of an irrigation system is not anticipated at this time. If used, cottonwood and willow containerized plantings will be planted to the groundwater table. Mesquite plantings will be established using gel packs. The density of proposed plantings will be determined during the development of the Final Mitigation Plan. Following containerized tree plantings, a suitable seed mix of native riparian trees, shrubs, grasses and forbs will be applied to the restoration area using a suitable application technique that would not adversely impact tree plantings. The nature and extent of fire breaks which may be integrated into the plan will be determined during Final Mitigation Plan development. Given the proximity of Area B to the active channel of the Gila River, no fencing is proposed.

Establishment Period Activities: The establishment period is the period of time within which FMSI and the Corps anticipate that all necessary work to implement the elements of this Conceptual Mitigation Plan will be completed and success criteria achieved. It is currently anticipated that the goals established for Area B will be achieved in a five-year period from implementation of the Final Mitigation Plan. If the goals are not achieved by that date, the establishment period will be extended until the success criteria and goals have been achieved, or new goals have been established in consultation with the Corps. During the establishment period, supplemental watering (likely gel packs) may be provided, as necessary, in a manner that facilitates plant establishment. Recent work near this mitigation site has seen high survivorship of planted one-gallon mesquites based on one application of gel packs at planting time. The site and plantings will be regularly monitored and issues that might affect plant health and riparian function will be identified. The site will be inspected for erosion and undesirable vegetation. Maintenance to address any of these issues will take place as necessary.

3.3. EMERY SITE – AREA C: BUFFER PRESERVATION

Area C of the Emery Site consists of approximately 42 acres of lands (see ***Figure 7***) that will be managed to preserve their riparian and aquatic function and values through active management and monitoring and protected through establishment of a site protection instrument. These lands surround Area B of the Emery Site. Portions of Area C may be cleared of vegetation to act as a natural firebreak to lessen the chances of the spread of fire or to allow access to protect habitats within Area C and restoration efforts in Areas A and B in the event of fire.

Goals: The mitigation objectives and goals for Area C will be achieved when the site protection instrument is recorded and any cleared firebreaks identified in the Final Mitigation Plan are established.

Implementation: During the development of the Final Mitigation Plan any required fencing and the location and alignment of any proposed firebreaks will be identified. During implementation of restoration efforts in Area A and Area B, required fencing will be constructed and proposed firebreaks cleared in Area C.

Establishment Period Activities: The establishment period is the period of time within which FMSI and the Corps anticipate that all necessary work to implement the elements of this Conceptual Mitigation Plan will be completed and success criteria achieved. It is currently anticipated that the goals established for Area C will be achieved in the first implementation year of the Final Mitigation Plan. If the goals are not achieved by that date, the establishment period will extend until the success criteria and goals for this mitigation area have been achieved. During the establishment period, site monitoring will identify the need for maintenance of the fire breaks and requirements for fence repair.

4. LONG-TERM SITE PROTECTION AND MANAGEMENT

All of the mitigation parcels will have a suitable site-protection instrument (Conservation Easement or Restrictive Covenant) recorded to provide long-term protection of the conservation objectives outlined here and to comply with the Corps' 2008 Mitigation Rule. The details of the site-protection instrument to be recorded on the mitigation areas of the Emery Site have not been finalized at this time. The final site protection instrument will include prohibitions on other land uses, such as fuel wood harvesting, that are not compatible with maintaining the aquatic functions of the parcel. Some low-intensity public uses such as hiking, bird watching, and/or minor forms of hunting or fishing may be allowed.

The mitigation areas will be monitored and maintained to preserve their resource value in accordance with the 2008 Mitigation Rule. Any financial assurance required for this monitoring and maintenance will be established by FMSI. This financial assurance will be focused on ensuring that the compensatory mitigation project will be completed in accordance with applicable performance standards and must be phased out once a compensatory mitigation project has been determined by the Corps to be successful (33 CFR 332.3(n)(1), (3)).

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______. 2002. *Dos Pobres/ San Juan Project: Clean Water Act Section 404 Mitigation and Monitoring Plan*. Job No. 201.02, December 27, 2002.

FIGURES

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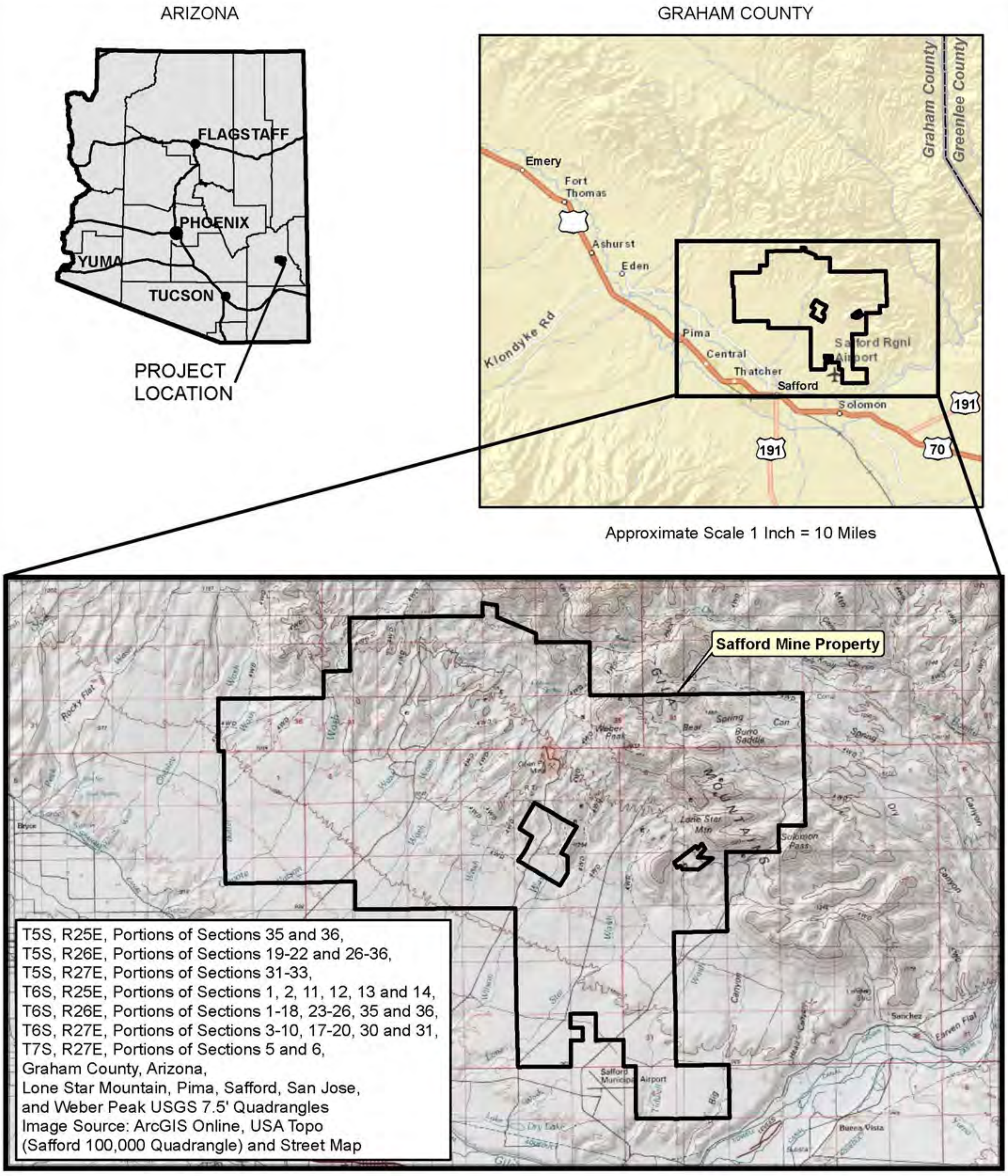

LONE STAR ORE BODY DEVELOPMENT PROJECT

Conceptual Mitigation Plan

Vicinity Map

Figure 1

N

0 1.5 3 Miles

0 2 4 Kilometers

WestLand Resources

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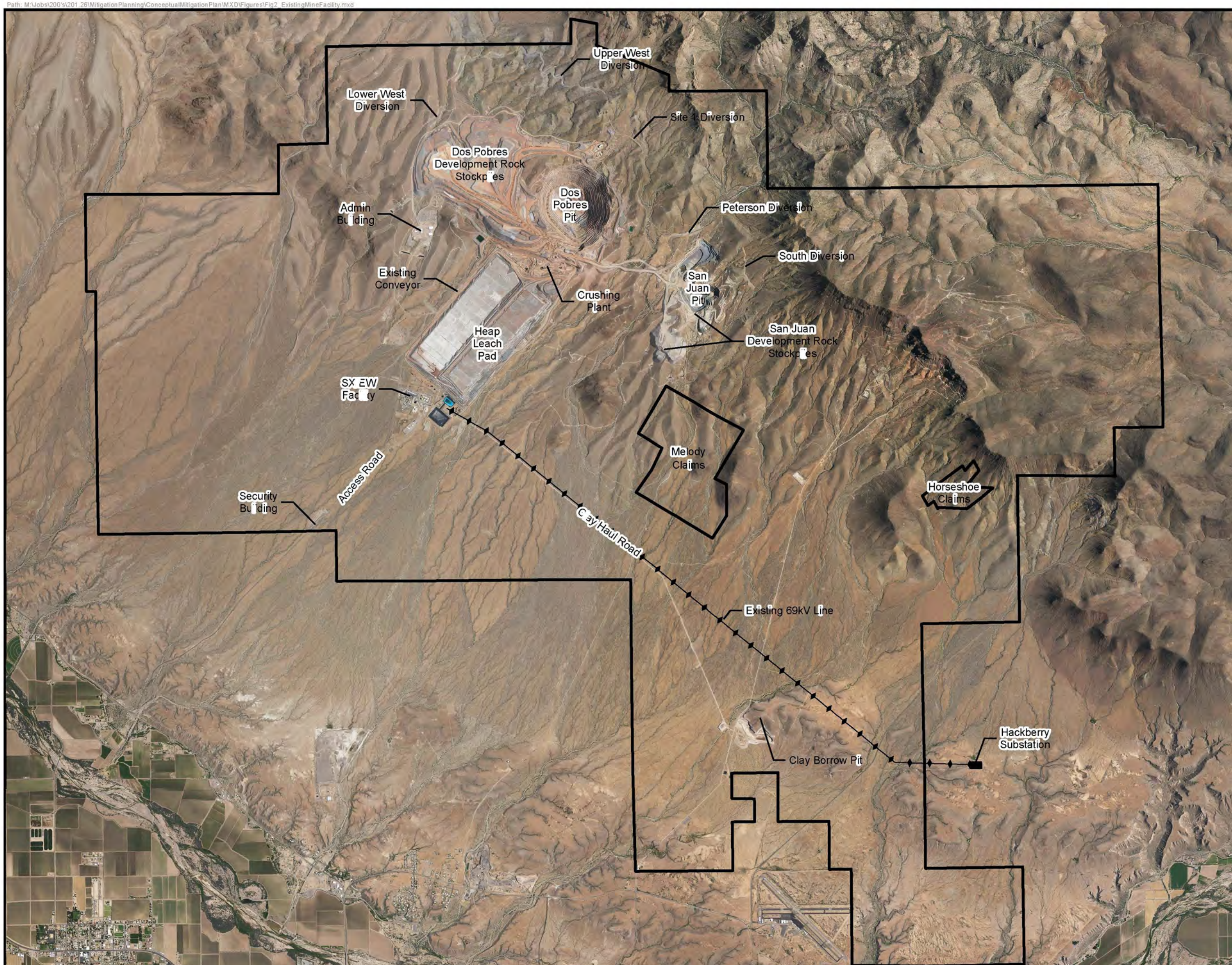

Legend

Safford Mine Property

N

0 2,600 5,200 Feet

0 750 1,500 Meters

T5S, R25E, Portions of Sections 35 and 36,
T5S, R26E, Portions of Sections 19-22 and 26-36,
T5S, R27E, Portions of Sections 31-33,
T6S, R25E, Portions of Sections 1, 2, 11, 12, 13 and 14,
T6S, R26E, Portions of Sections 1-18, 23-26, 35 and 36,
T6S, R27E, Portions of Sections 3-10, 17-20, 30 and 31,
T7S, R27E, Portions of Sections 5 and 6,
Graham County, Arizona,
Image Source: NAIP 2015

WestLand Resources

LONE STAR ORE BODY DEVELOPMENT PROJECT

Conceptual Mitigation Plan

EXISTING MINE FACILITY

Figure 2

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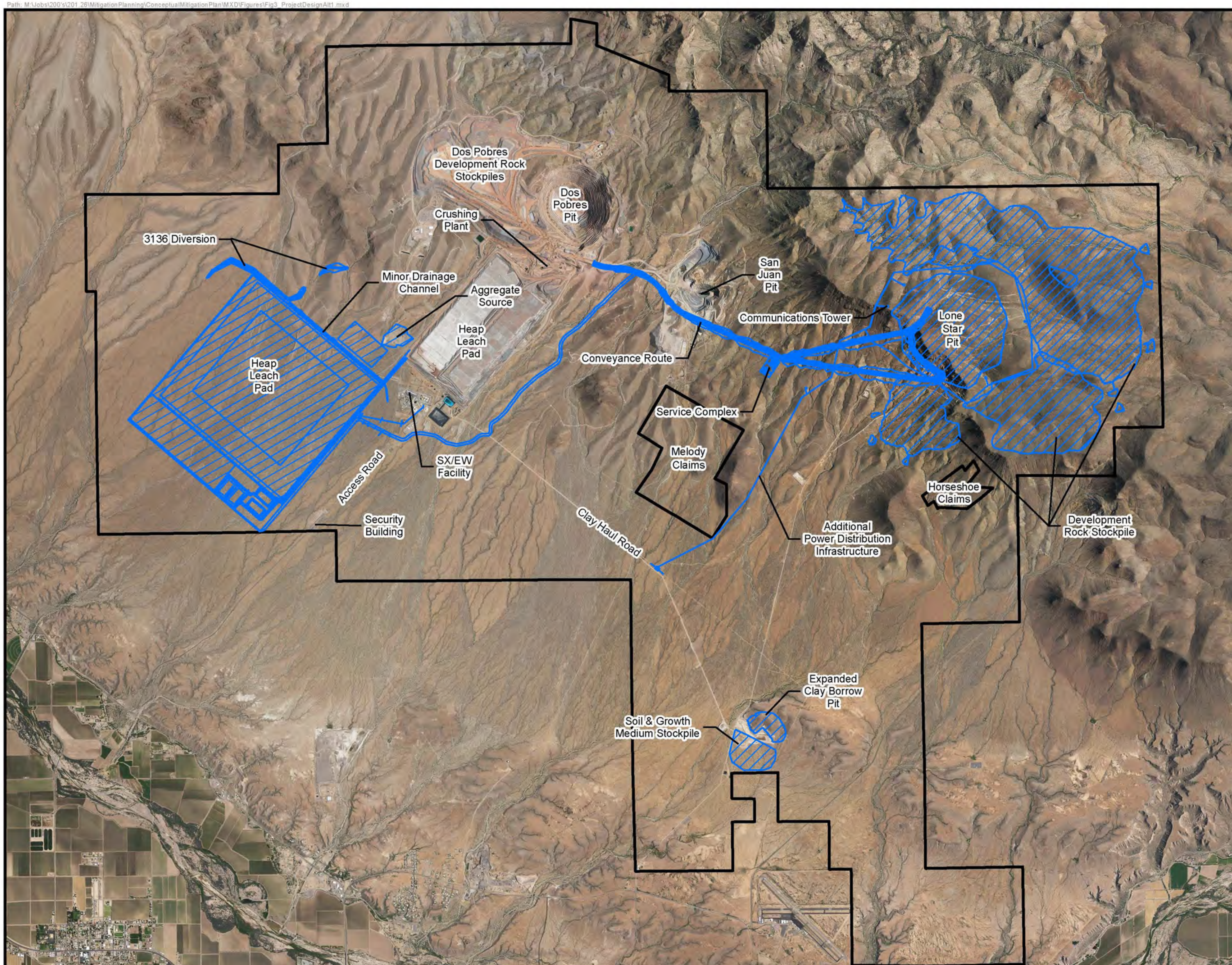

Legend

Proposed Project Features (FMSI)

Safford Mine Property

N

0 2,600 5,200 Feet

0 750 1,500 Meters

T5S, R25E, Portions of Sections 35 and 36,
T5S, R26E, Portions of Sections 19-22 and 26-36,
T5S, R27E, Portions of Sections 31-33,
T6S, R25E, Portions of Sections 1, 2, 11, 12, 13 and 14,
T6S, R26E, Portions of Sections 1-18, 23-26, 35 and 36,
T6S, R27E, Portions of Sections 3-10, 17-20, 30 and 31,
T7S, R27E, Portions of Sections 5 and 6,
Graham County, Arizona,
Image Source: NAIP 2015

WestLand Resources

LONE STAR ORE BODY DEVELOPMENT PROJECT

Conceptual Mitigation Plan

PROJECT DESIGN ALTERNATIVE 1: BASE CASE

Figure 3

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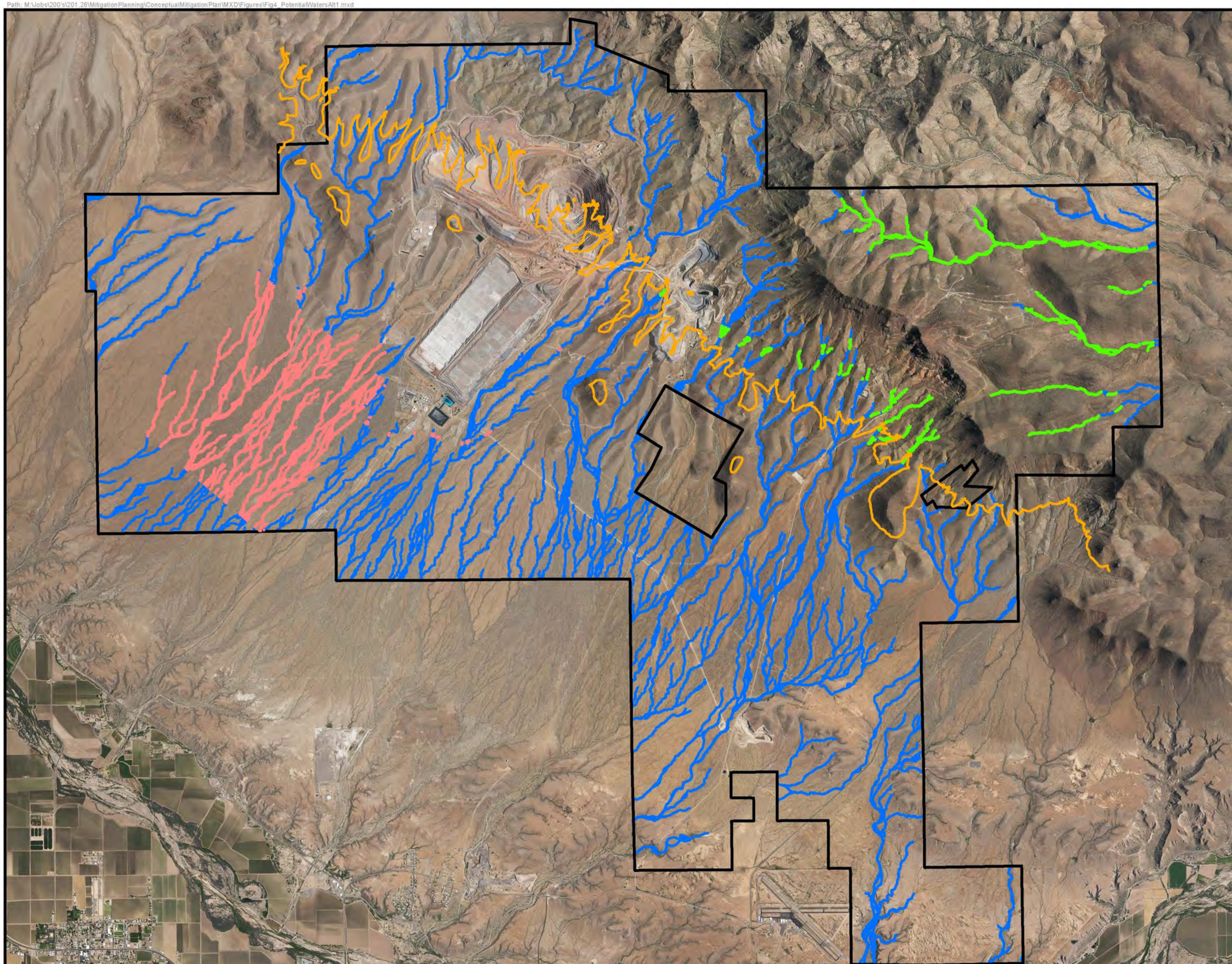
Date: 2/17/2016 User: towens



Legend

- 4000' Elevation Line
- Impacted Class A
- Impacted Class B
- No Classification Assigned (No Impacts Proposed)
- Safford Mine Property

N

0 2,600 5,200 Feet

0 750 1,500 Meters

T5S, R25E, Portions of Sections 35 and 36,
T5S, R26E, Portions of Sections 19-22 and 26-36,
T5S, R27E, Portions of Sections 31-33,
T6S, R25E, Portions of Sections 1, 2, 11, 12, 13 and 14,
T6S, R26E, Portions of Sections 1-18, 23-26, 35 and 36,
T6S, R27E, Portions of Sections 3-10, 17-20, 30 and 31,
T7S, R27E, Portions of Sections 5 and 6,
Graham County, Arizona,
Image Source: NAIP 2015

WestLand Resources

LONE STAR ORE BODY DEVELOPMENT PROJECT

Conceptual Mitigation Plan

POTENTIAL WATERS OF THE U.S. IMPACTS UNDER PROJECT DESIGN ALTERNATIVE 1: BASE CASE

Figure 4

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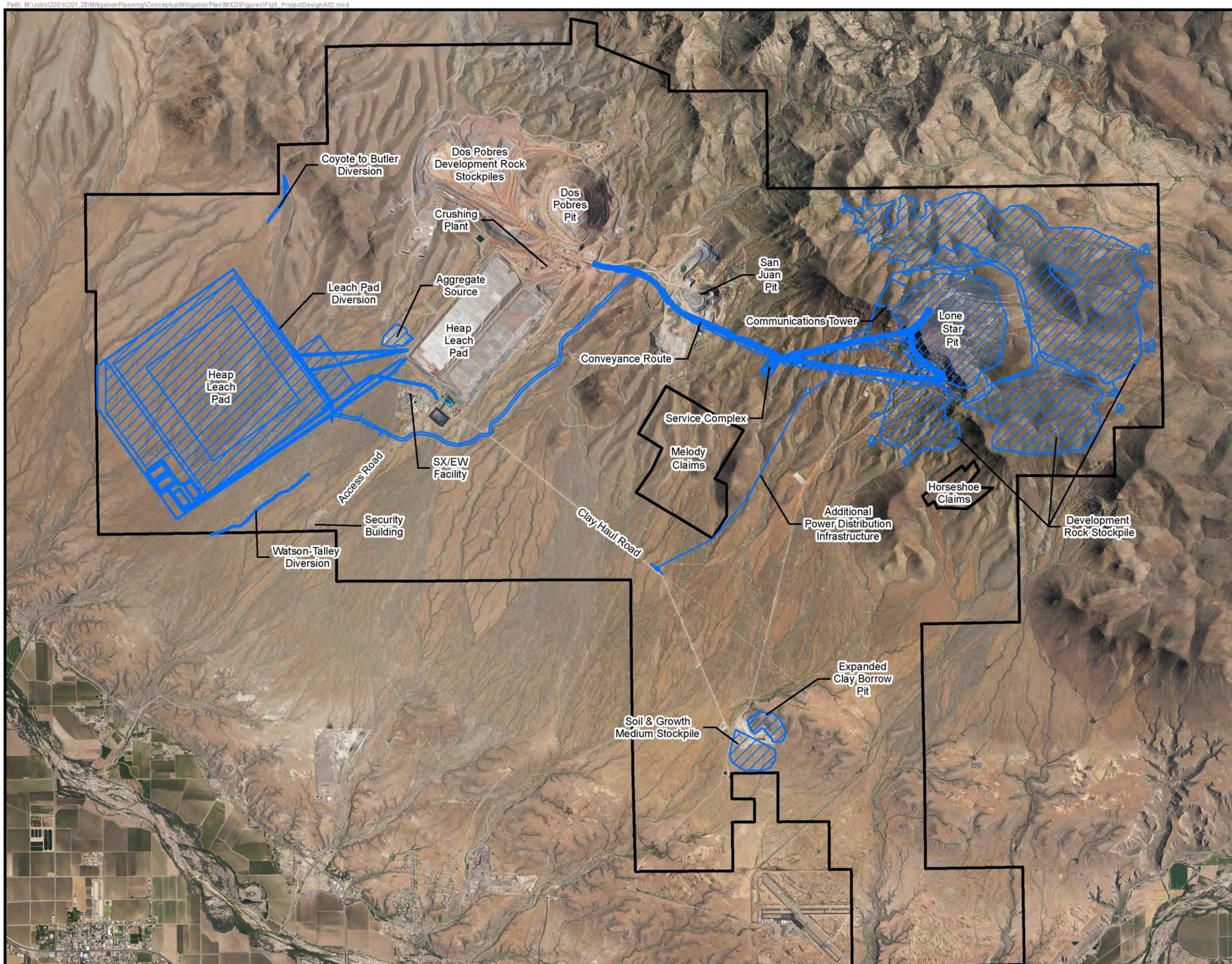

Legend

Proposed Project Features (FMSI)

Safford Mine Property

N

0 2,600 5,200 Feet

0 750 1,500 Meters

T05S, R25E, Portion of Sections 35 & 36,
T05S, R26E, Portion of Sections 19-22, 26-36,
T05S, R27E, Portion of Sections 31-33,
T06S, R25E, Portion of Sections 1, 2, 11, 12, 13 & 14,
T06S, R26E, Portion of Sections 1-18, 23-26, 35 & 36,
T06S, R27E, Portion of Sections 3-10, 17-20, 30 & 31,
T07S, R27E, Portion of Sections 5 & 6,
Graham County, Arizona,
Lone Star Mountain, Pima, Safford, San Jose,
& Weber Peak USGS 7.5' Quadrangles
Image Source: NAIP 2015

WestLand Resources

LONE STAR ORE BODY DEVELOPMENT PROJECT

Conceptual Mitigation Plan

PROJECT DESIGN ALTERNATIVE 2: PIVOT OPTION

Figure 5

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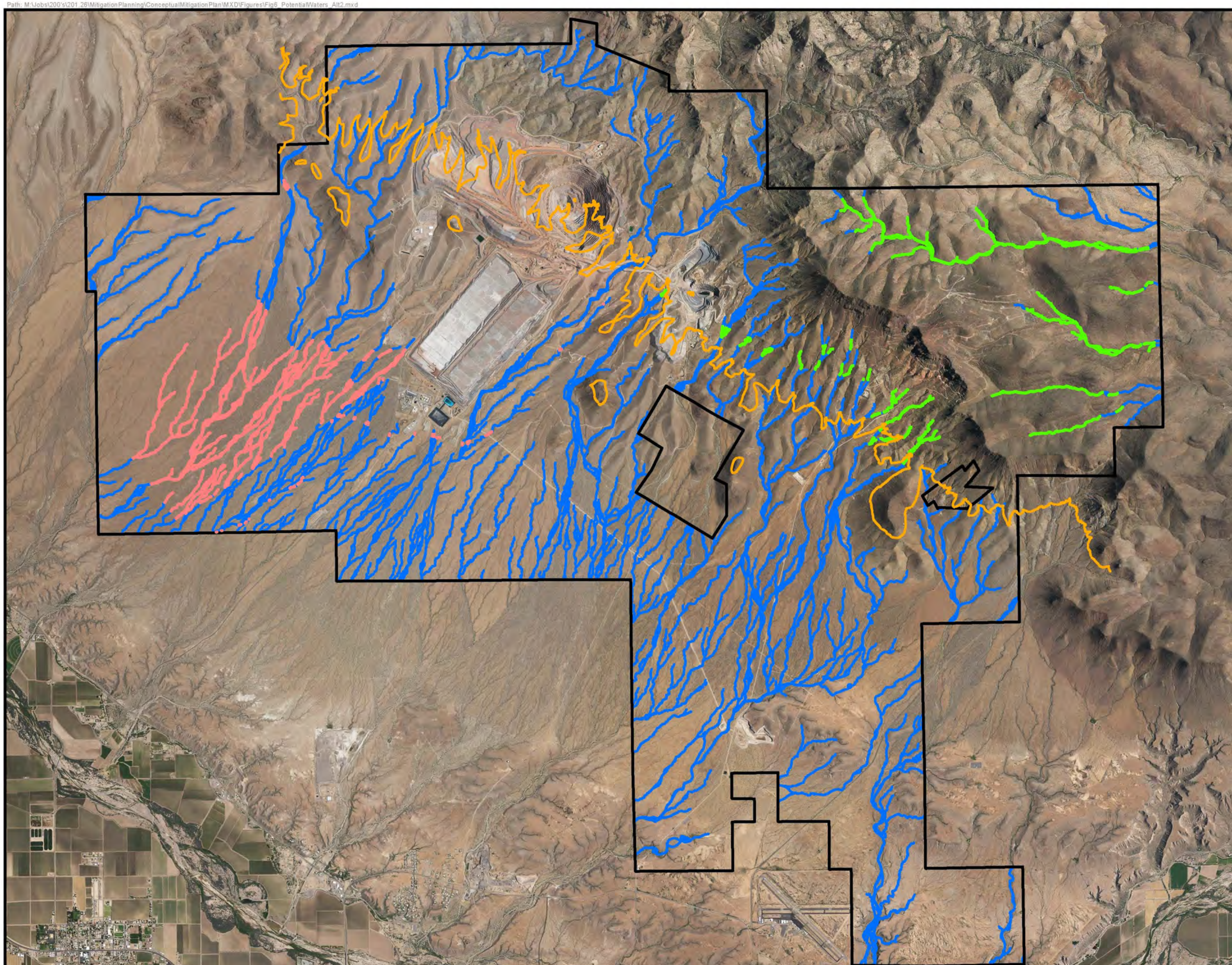


Legend

- 4000' Elevation Line
- Impacted Class A
- Impacted Class B
- No Classification Assigned (No Impacts Proposed)
- Safford Mine Property

N

0 2,600 5,200 Feet

0 750 1,500 Meters

T5S, R25E, Portions of Sections 35 and 36,
T5S, R26E, Portions of Sections 19-22 and 26-36,
T5S, R27E, Portions of Sections 31-33,
T6S, R25E, Portions of Sections 1, 2, 11, 12, 13 and 14,
T6S, R26E, Portions of Sections 1-18, 23-26, 35 and 36,
T6S, R27E, Portions of Sections 3-10, 17-20, 30 and 31,
T7S, R27E, Portions of Sections 5 and 6,
Graham County, Arizona,
Image Source: NAIP 2015

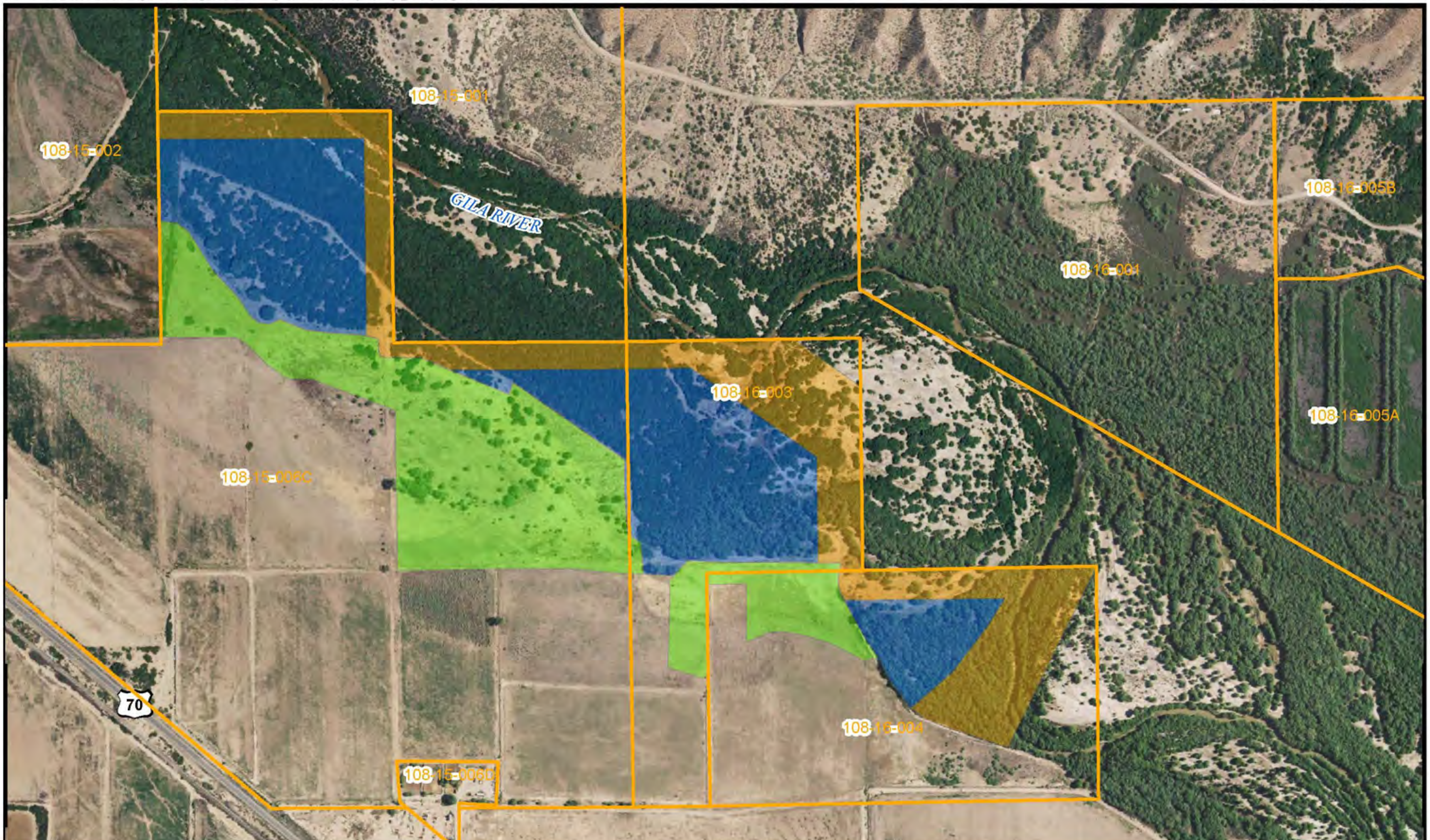
WestLand Resources

LONE STAR ORE BODY DEVELOPMENT PROJECT

Conceptual Mitigation Plan

POTENTIAL WATERS OF THE U.S. IMPACTS UNDER PROJECT DESIGN ALTERNATIVE 2: PIVOT OPTION

Figure 6



T4S, R23E, Portions of Sections 20 and 21,
Graham County, Arizona,
Geronimo and Fort Thomas USGS 7.5' Quadrangles
Image Source: NAIP 2015

WestLand Resources

0 400 800 Feet
0 200 400 Meters

N

Legend

Parcel (Graham County, 2014)

Emery Mitigation Site:

- Area A: Field to Riparian Restoration
- Area B: Tamarisk Control and Riparian Enhancement
- Area C: Buffer Preservation

LONE STAR ORE BODY DEVELOPMENT PROJECT

Conceptual Mitigation Plan

EMERY SITE

Figure 7

MITIGATION RATIO-SETTING CHECKLIST

LONE STAR ORE BODY DEVELOPMENT PROJECT

Prepared for:

United States Army Corps of Engineers

On Behalf Of:

Freeport-McMoRan Safford Inc.

Prepared by:

WestLand Resources

4001 E. Paradise Falls Drive
Tucson, Arizona 85712

February 12, 2016 (revised)
Project No. 201.26 D 04.2
Corps File No. SPL-2014-00065-MWL

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APPENDICES

1. INTRODUCTION AND BACKGROUND

1.1. DOCUMENT PURPOSE AND ORGANIZATION

Freeport-McMoRan Safford Inc. (FMSI) has proposed the development of the mineral resources associated with the Lone Star ore body, located on lands owned and managed by FMSI, and proximate to their existing copper mining operations near Safford, Arizona (***Figure 1***). Development of the mineral resources associated with the Lone Star ore body (the Project) will require several common components of an open-pit copper mine including development rock stockpiles, a heap leach pad, additional conveyance route infrastructure, an expanded compactible soil borrow source, related stormwater management facilities, and other appurtenant features, in addition to the open pit itself. The proposed Project requires the discharge of fill to surface drainage features that the U.S. Army Corps of Engineers (Corps) has preliminarily determined (SPL-2014-00065-MWL) may be jurisdictional waters of the United States (waters of the U.S.), and FMSI has made application for a Department of the Army permit for development of the Project.

As part of CWA Section 404 Individual Permit requirements for discharge into waters of the U.S., a mitigation plan must be prepared in accordance with the Corps' and the U.S. Environmental Protection Agency's (EPA) *Final Rule for Compensatory Mitigation for Losses of Aquatic Resources* (33 CFR Part 332 and 40 CFR Part 230; published in 73 FR 19594-19705 (April 10, 2008)), hereinafter referred to as the 2008 Mitigation Rule. The fundamental objective of the 2008 Mitigation Rule is to establish standardized compensatory mitigation criteria for all mitigation types to offset unavoidable impacts to waters of the U.S. authorized through the issuance of a CWA Section 404 permit. The South Pacific Division of the Corps has developed a standard operating procedure in the form of a Mitigation Ratio-Setting Checklist (MRSC) for determining compensatory mitigation requirements.

FMSI has coordinated with the Corps to identify potential mitigation opportunities for the Project. Following review and approval (or modification, as appropriate) by the Corps of the concepts contained in the Lone Star Ore Body Development Project Conceptual Mitigation Plan (submitted under separate cover), a final Mitigation Plan in compliance with the 2008 Mitigation Rule will be completed.

This MRSC report has been prepared to support the Conceptual Mitigation Plan for the Project. This report is presented in four sections: ***Section 1*** introduces the Project and summarizes Project impacts to waters; ***Section 2*** provides an overview of proposed mitigation actions; and ***Section 3*** describes the methods used for determining final mitigation ratios and acreages in this analysis, and provides the results of applying the checklist. ***Section 4*** lists the references used in developing the report.

1.2. PROJECT DESCRIPTION

Located in eastern Arizona, the Safford Mine has been in operation for almost 8 years under the ownership of FMSI, formerly Phelps Dodge Safford Inc. FMSI owns and manages approximately 36,050 acres of privately held lands within and surrounding the existing Safford Mine facility, north of the City of Safford, Graham County, Arizona (see ***Figure 1***). The existing Safford Mine is currently an open-pit copper mining operation consisting of two pits, the Dos Pobres Pit and the San Juan Pit, and the associated handling, processing, and support infrastructure for mineral resources recovered from the two pits (***Figure 2***). Existing features of this integrated system include a three-stage crushing system, two drum agglomerators, a heap leach pad, a solution extraction/electrowinning (SX/EW) processing facility, and support facilities (see ***Figure 2***). Development of the Lone Star ore body was originally considered as a Reasonably Foreseeable Future Action (RFFA) during National Environmental Policy Act (NEPA) review of the development of the current Safford Mine. The lands around the Lone Star ore body (as it was defined at that time) were identified in the 2003 Final Environmental Impact Statement (FEIS) as having mining operations as an anticipated future use.

Since that time, FMSI has undertaken additional evaluation of the Lone Star ore body to define the mineral resource associated with this porphyry copper deposit and has developed plans for the purpose of the economic recovery of these mineral resources. FMSI has designed the Project to make use of as much of the existing Safford Mine infrastructure as is practicable. New mine elements anticipated as necessary for the development of the Project include the open pit, a heap leach pad, development rock stockpile(s), the conveyance route between the pit and crusher, additional power distribution infrastructure, an expanded clay borrow pit, soil and growth medium stockpiles, a truck service complex, a communications tower, and additional stormwater management facilities.

1.3. JURISDICTIONAL IMPACTS

The development of the proposed design for the Project incorporated a substantial effort to avoid and minimize impacts to potential waters of the U.S., including the continued use of existing Safford Mine operational infrastructure wherever practicable. The full range of alternatives analyzed in the development of the proposed design of the Project is described in the draft 404(b)(1) Alternatives Analysis (WestLand 2015a) prepared for the Project. ***Table 1*** summarizes the unavoidable impacts to lands and to potential waters of the U.S. that would result from construction of either of the two alternatives identified as practicable in that analysis: Project Design Alternative 1: Base Case and Project Design Alternative 2: Pivot Option. Under Project Design Alternative 1: Base Case (***Figure 3***), only the heap leach pad, development rock stockpile(s), the conveyance route between the pit and crusher, and the stormwater management facilities have impacts to potential waters of the U.S. (***Figure 4***). These impacts to potential waters of the U.S. total approximately 90.43 acres. Under Project Design Alternative 2: Pivot Option (***Figure 5***), the same mine elements have impacts to potential waters of the U.S., but these impacts would total 76.20 acres (***Figure 6***), principally from realignment of the leach pad to avoid potential waters of the U.S. Neither Project alternative would adversely affect any special aquatic sites, including wetlands.

Table 1. Project Impacts to Lands and to Potential Waters of the U.S. by Project Component

Project Design Components	Acres of Land Impacted		Acres of Potential Waters Impacted	
	Alt 1	Alt 2	Alt 1	Alt 2
Lone Star Pit	645	645	0	0
Heap Leach Pad	2,466	2,522	60.40	46.17
Development Rock Stockpiles	2,605	2,605	27.04	27.04
Haul Road	285	285	2.99	2.99
Clay Borrow Pit Expansion	48	48	0	0
Soil and Growth Medium Stockpile	86	86	0	0
Communications Tower and Road	0.29	0.29	0	0
Power Distribution Infrastructure	5	5	0	0
TOTAL	**6,140**	**6,196**	**90.43**	**76.20**

The impacts considered during completion of the MRSC for the proposed Lone Star Project only include the direct impacts of Project development to waters of the U.S., and do not include indirect downstream "dewatering" effects. Authorization for development of the existing Safford Mine included the issuance of a CWA Section 404 permit, Permit Number 964-0202-MB, and the implementation of a CWA Section 404 Mitigation and Monitoring Plan (MMP), dated December 27, 2002. This MMP includes a monitoring provision known as the Downstream Monitoring Program, developed to monitor those drainages considered dewatered, and therefore indirectly impacted, by stormwater diversion and mine development activities for a period of 15 years. Monitoring data was also collected from a set of unimpacted, or control, drainages for comparison and analysis. Downstream monitoring has been conducted in 2006, 2011, and 2015.

As detailed in the 2015 Downstream Monitoring Program report provided to the Corps (WestLand 2015b), the analysis of monitoring data does not show a significant loss of function in those drainages described as dewatered, as compared to the control drainages. Both dewatered and control drainages showed an increase in live vegetation volume, or LVV, and the percent increase in LVV did not differ between the drainage groups (WestLand 2015b). Both the ground photos and geomorphological transects demonstrate there has been no functionally meaningful change in channel structure or configuration at the monitoring sites in either group of drainages. Based on these data, indirect impacts to the function of any potential waters of the U.S. are not anticipated from the development of the Lone Star Project, and are not considered further in the completion of the MRSC or the preparation of the Conceptual Mitigation Plan for the Project.

2. MITIGATION SITE SELECTION OVERVIEW

The 2008 Mitigation Rule identifies general classes of compensatory mitigation as well as clear preference among these classes, specifically noting that Mitigation Banking and then In-Lieu-Fee Mitigation are preferred over applicant-sponsored on-site or off-site mitigation. As a general matter, in-kind mitigation is also preferred over out-of-kind mitigation. FMSI considered these general classes of compensatory mitigation from a watershed perspective in the selection of proposed mitigation sites and the development of the draft Conceptual Mitigation Plan.

There are currently no Mitigation Banks established in Arizona and only three approved In-Lieu-Fee Mitigation projects. The Project is located within two subwatersheds of the Upper Gila watershed: 1) the Yuma Wash subwatershed (USGS Hydrologic Unit Code [HUC] 1504000505) and 2) the Cottonwood Wash subwatershed (HUC 1504000507). The approved In-Lieu-Fee Mitigation projects are located in Yavapai County, Maricopa County, and Navajo County, well outside of the Upper Gila watershed (HUC 15040005) within which the Project occurs. FMSI is aware of one In-Lieu-Fee Mitigation project proposed for development within the Upper Gila watershed, Cluff Ranch, but as of the drafting of this document, it does not have approval to sell mitigation credits and is therefore not available.

A number of on-site mitigation measures were incorporated into the Project design to address water quality and quantity functions. For Project Design Alternative 1: Base Case, these measures include the construction of three diversion channels: the 3136 Diversion, the Minor Drainage Channel, and the Interim Diversion Channel, to prevent run-on of stormwater flows and route them into drainages downgradient of the new heap leach pad. The 3136 Diversion and the Minor Drainage Channel would be located upgradient of the new heap leach pad (see ***Figure 3***), while the Interim Diversion Channel would be constructed above each phase of the leach pad as it advances to divert stormwater reporting from the area downgradient of the other two diversions until the leach pad reaches its ultimate footprint. Project Design Alternative 2: Pivot Option includes the construction of four diversion channels: the Coyote-Butler Diversion, the Leach Pad Diversion, the Watson-Talley Diversion, and the Interim Diversion Channel (see ***Figure 5***).

Stormwater containment dams were also included downgradient of the proposed development rock stockpiles for both Project Design Alternative 1: Base Case and Project Design Alternative 2: Pivot Option (see ***Figure 3*** and ***Figure 5***) to control the run-off of impacted stormwater. Given that the footprints of both practicable Project alternatives contain only ephemeral drainage channels and will be operated as an active copper mine, no opportunity exists for the development of onsite mitigation. Habitat functions that will be lost by development of the Project will be mitigated off-site.

FMSI is unaware of any watershed planning efforts for the HUC-6 or HUC-8 watersheds that contain the Project that identify specific compensatory mitigation goals for aquatic resources. Natural Resources Conservation Service (NRCS) Rapid Watershed Assessment of the Upper Gila watershed has not been completed (NRCS 2007). FMSI has reviewed the Arizona Non-point Education for Municipal Officials (NEMO) website for watershed plans for the Upper Gila (NEMO 2005) to gain perspective on the nature of the resources within the watershed, looked at previous Corps mitigation projects associated with the Safford Mine, and reviewed general conservation efforts along the Gila River being carried out by Non-Governmental Organizations (NGOs), such as the Gila Watershed Partnership, to inform site selection and plan development.

FMSI has identified one site, the Emery Site (***Figure 7***), for mitigation activities. As outlined in greater detail below, this site and the mitigation opportunities at the site are able to compensate for all of the unavoidable Project impacts to potential waters of the U.S. under either Project Design Alternative 1: Base Case or Project Design Alternative 2: Pivot Option. The Emery Site is approximately 25 river miles downgradient of the Project and is within the same HUC-8 watershed. Located along the Gila River, the site has the potential to support high-value mesoriparian and hydroriparian habitats, and provides regional conservation benefit. While the mitigation measures proposed within the Emery Site will not create the xeroriparian habitat associated with the ephemeral drainages to be impacted by the Project, and is, strictly speaking, out-of-kind mitigation, the habitats within the mitigation site that will be preserved, enhanced, and restored are more rare within the regional landscape, have higher productivity, and possess higher wildlife values. ***Table 2*** provides a brief summary of the proposed mitigation areas within the Emery Site.

Table 2. Description of Mitigation Areas within the Emery Site

Mitigation Area and Proposed Treatment	Acreage	Description
Emery Site – Area A: Field to Riparian Restoration	50.00	Area A of the Emery Site includes approximately 50 acres, adjacent to both the Gila River and Area B (see ***Figure 7***). Most of Area A is composed of former agricultural fields, although the northwestern portion of the area is currently vegetated by patches of tamarisk and a few cottonwoods. Understory vegetation that includes forbs and shrubs is patchy throughout Area A. Proposed mitigation activities at Area A include the grading and re-contouring of the of the area to remove numerous manmade alterations, including berms, channels, and other agricultural features, which currently separate Area A from the active floodplain and channel of the Gila River. Other proposed activities include control of weedy plant species, planting and seeding of native mesquite trees, seeding for other native plant species, and grading of the area to restore natural contours, if necessary. These activities will restore the functional values of the site as a riparian area and as available active floodplain and possible overbank channel for the Gila River.
Emery Site – Area B: Tamarisk Control and Riparian Enhancement	59.00	Area B of the Emery Site encompasses approximately 59 acres of riparian corridor adjacent to Area A and a perennial reach of the Gila River (see ***Figure 7***). The riparian vegetation of Area B is almost exclusively exotic tamarisk. There is a concern that, if the expected colonization of the tamarisk leaf beetle occurs along this reach of the Gila River, the tamarisk within this site will be killed or substantially reduced over a very short period of time, resulting in the loss of the non-native riparian habitat that currently supports yellow-billed cuckoo and Southwestern willow flycatcher. Proposed mitigation activities at Area B consist of the removal of tamarisk and the planting and seeding of native species including cottonwood, willow, and mesquite. The replacement of tamarisk with native cottonwood, willow, and mesquite will create habitat suitable for native wildlife, including the endangered southwestern willow flycatcher and threatened yellow-billed cuckoo, and maintain these functions during the anticipated die-off of non-native tamarisk when the tamarisk leaf beetle arrives along this reach of the Gila River.
Emery Site – Area C: Buffer Preservation	42.00	Area C of the Emery Site consists of approximately 42 acres of lands covered by a site protection instrument (see ***Figure 7***). These lands surround Area B of the Emery Site and provide further protection for the enhancement activities undertaken in Area B. Although Area C may provide future mitigation opportunities adjacent to those enhancement activities undertaken in Area B, no further mitigation strategies are proposed for Area C at this time.

3. MITIGATION RATIO-SETTING CHECKLIST METHODS AND RESULTS

The South Pacific Division of the Corps has developed the *Standard Operating Procedure for the Determination of Mitigation Ratios* (Corps 2013) for determining compensatory mitigation requirements for the processing of CWA Section 404 permits. The substantive component of this procedure is completion of Attachment 12501.1-SPD, the MRSC. The completed MRSC is intended to provide a ratio determining the amount of acreage necessary as compensatory mitigation to offset the acreage of authorized impacts, in compliance with the 2008 Mitigation Rule. Completion of the MRSC comprises a 10-step process that includes a functional analysis of impacted waters of the U.S. and proposed mitigation parcels, establishes baseline mitigation ratios, and authorizes adjustment of those ratios based on specified criteria.

The 10 steps for the completion of the MRSC are:

Step 1. Identification and Classification of Aquatic Resources
Step 2. Qualitative Impact-Mitigation Comparison
Step 3. Quantitative Impact-Mitigation Comparison
Step 4. Mitigation Site Location
Step 5. Net Loss of Aquatic Resource Surface Area
Step 6. Type Conversion
Step 7. Risk and Uncertainty
Step 8. Temporal Loss
Step 9. Final Mitigation Ratio
Step 10. Final Compensatory Mitigation Summary

The following section of this document describes the methods used for the application of these steps to determine the final mitigation ratios and acreages in this analysis, and provides the results of applying the MRSC to the calculation of compensatory mitigation required for the proposed impacts to potential waters of the U.S. from development of the Project.

3.1. IDENTIFICATION AND CLASSIFICATION OF AQUATIC RESOURCES (STEP 1)

Step 1 within the MRSC is the identification and classification of the aquatic resources present at and functions provided by the impact site and the proposed mitigation site. In order to assess the functions of the Project impact areas, the impacted drainages were grouped into two different classes based on physical parameters that may affect their hydrologic, chemical, and biotic function as assessed in Step 2. These classes, Ephemeral Class A and Ephemeral Class B, are described below and shown in ***Figure 4*** and ***Figure 6***.

Ephemeral Class A: Class A ephemeral washes consist of the low-gradient, braided, ephemeral drainages that occur on-site at elevations roughly at or below 4000 feet above mean seal level (amsl). Class A washes are presently mainly in the southern and western portions of the footprints of both Project alternatives, located on the bajada below the foothills of the Gila Mountains. Vegetation along Class A drainages consists primarily of creosote-dominated Sonoran desertscrub. Project Design Alternative 1: Base Case impacts 60.40 acres of Class A washes, entirely resulting from the development of the leach pad and appurtenant features (see ***Figure 4***). Project Design Alternative 2: Pivot Option impacts 46.17 acres of Class A washes, also entirely resulting from the development of the leach pad and appurtenant features (see ***Figure 6***).

Ephemeral Class B: Class B washes are the moderate- to high-gradient, relatively straight, ephemeral drainages that occur on-site roughly at or above 4000 feet amsl. Class B washes are presently mainly in the northern and eastern portions of the proposed Project footprint in the foothills of the Gila Mountains. Vegetation along Class B streams can be classified as typical of semi-desert grasslands. Both Project Design Alternative 1: Base Case and Project Design Alternative 2: Pivot Option impact 30.03 acres of Class B washes (see ***Figure 4*** and ***Figure 6***).

The total amount of impacted potential waters of the U.S. was determined to be 90.43 acres under Project Design Alternative 1: Base Case and 76.20 acres under Project Design Alternative 2: Pivot Option. These impacts are shown in ***Table 3***.

Table 3. Impacts to Potential Waters of the U.S. by Drainage Class

Impacted Drainage Class	Direct Impacts	
	Alt 1	Alt 2
Ephemeral Class A	60.40	46.17
Ephemeral Class B	30.03	30.03
TOTAL	**90.43**	**76.20**

The proposed mitigation site consists of a single contiguous site, the Emery Site. The Emery Site occupies a highly valuable and rare area within the Gila River watershed (see ***Figure 7***), and the proposed mitigation actions will help maintain or restore natural functions along this large perennial waterbody and its associated riparian buffers. The resources and functions present at the Emery Site were classified and evaluated by area, where areas were defined by existing physical characteristics and by the specific primary mitigation actions proposed. Defined areas within the Emery Site include Areas A, B, and C (see ***Figure 7***). Functional scoring of the mitigation site was done by area, and consists primarily of an evaluation of the functional gain that the area would provide upon achievement of mitigation success. Although Areas A, B, and C are summarized in ***Table 2***, a brief description of each is also provided here.

Emery Site – Area A: Area A of the Emery Site includes approximately 50 acres, adjacent to both the Gila River and Area B, and composed mostly of former agricultural fields. Mitigation activities proposed for Area A would restore these lands to the active floodplain of the Gila River and establish native riparian vegetation on the site.

Emery Site – Area B: Area B of the Emery Site encompasses approximately 59 acres of riparian corridor adjacent to Area A and a perennial reach of the Gila River. Mitigation activities proposed for Area B would create habitat suitable for native wildlife and maintain the other functions of Area B during the anticipated tamarisk die-off from the beetle.

Emery Site – Area C: Area C of the Emery Site consists of approximately 42 acres of lands surrounding Area B. Mitigation activities proposed Area C will provide further protection for the enhancement activities undertaken in Area B.

3.2. Qualitative Impact-Mitigation Comparison (Step 2)

Step 2 of the MRSC is a qualitative assessment that includes an assessment of the functions of potential waters of the U.S. that will be impacted by the proposed Project and an assessment of the functional gain from the proposed mitigation actions are provided. Eleven hydrologic, chemical, and biotic functions were developed for this purpose (***Table 4***). These functions are consistent with those identified in the South Pacific Division's *Standard Operating Procedure for the Determination of Mitigation Ratios* (Corps 2013). Scoring for these 11 functions was conducted based on available data, published literature, field data collected on potential waters of the U.S., general field observations, and aerial photography. The functions of each resource were scored qualitatively on a six-category numeric scale, as follows: 0 = none, 1 = low, 2 = low-moderate, 3 = moderate, 4 = moderate-high, and 5 = high function.

Table 4. Functions Evaluated in the Qualitative Comparison

Hydrologic Functions
Hydrologic Connectivity
Subsurface Flow and Groundwater Recharge
Energy Dissipation
Sediment Transport/ Regulation
Chemical Functions
Elements, Compounds, and Particulate Cycling
Organic Carbon Export/Sequestration
Biotic Functions
Aquatic Invertebrate Fauna
Presence of Fish and Fish Habitat Structure
Riparian/Wetland Vegetation Structure
Age Class Distribution of Wooded Riparian or Wetland Vegetation
Native/Non-native Vegetation Species

3.2.1. Function Definition and Scoring Methods

Definitions of each function and explanation of the scoring methods are provided below:

3.2.1.1. Hydrologic Functions

Hydrologic Connectivity: Hydrologic connectivity scoring assesses the connectivity between surface waters to downstream receiving waters through both surface and shallow subsurface flow.

Scoring for this category was based on the ability of a defined drainage class or mitigation area to transmit either perennial or ephemeral flows from an upstream source to the downstream receiving water. Any impedance in a channel would slow the flow rate of water whether that impedance was artificial, such as a roadbed or railroad, or natural, such as a broad, flat channel with a deep sand and gravel bed. A "5" or "high" score would be given to a system that transmits virtually all water from its upstream source to the downstream receiving water. A "1" or "low" score would be given to a system that transmits virtually no water from its upstream source to the downstream receiving water.

Subsurface Flow and Groundwater Recharge: Subsurface flow and groundwater recharge scoring assesses the potential for surface water to infiltrate into the channel bed and continue to move either vertically to recharge local or regional groundwater aquifers or laterally to support riparian vegetation and contribute to material cycling.

Scoring for this function was based on the permanence and volume of flow through the feature, coupled with the impedance of the channel. A "1" or "low" score would be given to a low-order ephemeral stream with compact bed soils; shallow bedrock, impenetrable horizons, or high clay content; and sparse xeroriparian buffer. A "5" or "high" score would be given to a large perennial stream with a silt or gravel bed substrate; meso-, hydroriparian, or wetland vegetation buffer; and, deep low-impedance soils promoting infiltration and hyporheic exchange through the streambed.

Energy Dissipation: Energy dissipation scoring assesses the ability of the watershed to dissipate the high energy of floodwaters leading to slower velocities, reduced potential for erosion, enhanced groundwater recharge, and support of riparian vegetation.

Scoring for this function was based on three parameters: the relative sinuosity of the channel, the roughness and gradient of the channel, and the ability of the adjacent floodplain to hold and attenuate flood flows. A "1" or "low" score would be given to a relatively straight, high-gradient stream with a sandy bottom or a constrained buffer and floodplain with minimal riparian vegetation. A "5" or "high" score would be given to a highly sinuous or braided channel with low gradient; cobbles, woody vegetation, and/or debris within the channel; and an accessible floodplain with a well-developed riparian buffer.

Sediment Transport Regulation: Sediment transport and regulation scoring assesses the ability of the features to regulate the transport of sediment downstream and the ability to minimize excessive sediment loss and gains.

Scoring for this function was based on a qualitative evaluation of the channel geometry, the ability of upstream and lateral features to provide sediment to the system, and the ability of the system to attenuate sediment loads. A "1" or "low" score would be given to feature with little ability to either provide sediment to the system and/or attenuate sediment loads. A "5" or "high" score would be given to a feature with strong abilities in these areas.

3.2.1.2. Chemical Functions

Elements, Compounds, and Particulate Cycling: Elements, compounds, and particulate cycling scores assess the ability of a stream class to regulate the transport of elements, compounds, and particulates. This function includes the capacity to reduce harmful pulses of nitrogen and phosphorus to downstream waters. Riparian vegetation aids in the sequestration of nutrients that can be released during flood events and through subsurface movement. Riparian vegetation is also a critical component in the denitrification process, which can prevent excessive nitrogen levels that lead to eutrophication and hypoxia.

The cycling of elements, compounds, and particulates was evaluated using channel width, upland and riparian vegetation volume and composition, stream gradient, and bed characteristics. A lower score was given to a high-gradient, low-order headwater stream with reduced or degraded riparian buffer and/or excessive chemical input. A higher score would be given to a higher order stream with a healthy riparian buffer, active hyporheic zone, and features that have the ability to retard excessive nutrient pulses through capture and storage (such as roughness, sinuosity, or vegetation).

Organic Carbon Export/Sequestration: Organic carbon export and/or sequestration evaluate(s) the production, retention, and transport of organic nutrients through the riparian system. Riparian vegetation is capable of producing and exporting significantly higher amounts of organic carbon than typical desert upland vegetation.

Scoring for this function includes an evaluation of channel geometry, frequency of flow, stream connectivity, stream and riparian area substrates, and riparian buffer width, density, and species composition. A lower score would be given to a narrow ephemeral stream with little to no connectivity and a minimal riparian buffer. A higher score would be given to a wide perennial stream with a well-defined riparian buffer, dense vegetation, and healthy soils that could generate large amounts of organic material for sequestration or export.

3.2.1.3. Biotic Functions

Aquatic Invertebrate Fauna: Aquatic invertebrate fauna scoring assesses the presence of aquatic invertebrate fauna within the water features. This score is also an indication of the extent of prey base available to higher order species, including aquatic-feeding amphibians, reptiles, and fish.

Scoring for this metric is based on the number of aquatic invertebrate orders that are estimated to be present within impact areas and mitigation sites. If no invertebrates are present, a score of "0" or "none" was given to the site. Scoring was then determined by the estimated average number of taxonomic orders present within a site, with one order scoring “1” or “low” and five or more orders scoring “5” or “high.”

Presence of Fish and Fish Habitat Structure: Scoring of this function assesses the presence and diversity of fish and the presence and quality of fish habitat based on methods outlined in Stacey et al. (2006).

A score of “none” was given for systems supporting no fish. A score of “1” or “low” was given for the presence of non-native fish only, while a score of “moderate” was given for the presence of both native and non-native species. A “5” or “high” score would be given for sites that have native species only. Fish habitat structure is an aggregate of three factors, including the presence of riffles and pools, the amount of underbank cover, and the amount of woody debris within the channel. The presence of riffles and pools was scored based on estimated area containing pools with a score of “0” or “none” for a lack of pools up to a score of “5” or “high” for pools that are present along at least 50 percent of the feature. Underbank cover was scored in the same manner. Large woody debris was a qualitative evaluation of the amount of large woody debris within each drainage class. The three rankings were considered and a composite score between “0” and “5” was assigned based on the combination of conditions noted within each impacted drainage class or mitigation site.

Riparian/Wetland Vegetation Structure: Riparian/wetland vegetative structure scoring evaluates the volume and density of vegetation within the riparian areas. The extent and density of riparian vegetation directly affects the ability of the riparian area to perform many of the functions in this analysis. The density of riparian vegetation is also important in determining the overall quality of the riparian ecosystem.

For this function, total vegetation volume (TVV) was measured within the impact areas, both instream (if present) and within riparian and upland habitat. Total vegetative volume is measured on a gradient scale and is expressed as cubic meters of vegetation per square meter of surface area. The scoring categories were given numeric values corresponding to ranges of the measured or estimated density of riparian vegetation on a similar six-category numeric scale to that used in the qualitative assessment for the other 10 functions.

These categories are as follows:

0 (None) = concrete or artificially lined wash
1 (Low) = TVV (< 0.25)
2 (Low-Moderate) = TVV (0.26 to 0.50)
3 (Moderate) = TVV (0.51 to 0.75)
4 (Moderate-High) = TVV (0.76 to 1.0)
5 (High) = TVV (> 1.0)

For the mitigation site, an estimate of the anticipated TVV upon achieving mitigation success was used.

Age-Class Distribution of Woody Riparian or Wetland Vegetation: This function ranks the age-class distribution structure of woody vegetation. A robust age-class distribution provides diverse habitat niches and demonstrates the health and permanency of the riparian and/or wetland community present at the site.

Scoring for this function was based on the measurement and classification of shrub and tree ages. The age classes considered include seedling, sapling, mature, and senescent. If one class is present, the feature is scored "1" or "low"; if two classes are present, "2" or "low-moderate"; three classes, "3" or "moderate"; and all four classes, "4" or "moderate-high". A "5" or "high" score was given if all four classes were present along with wetland vegetation. For restoration activities, estimates were based on anticipated growth and recruitment levels in each area upon achievement of mitigation success.

Native/Non-native Woody Vegetation Species: Native/non-native woody vegetation species scoring provides a qualitative evaluation of the proportion of non-native woody species in the community. Non-native vegetation can have detrimental impacts on other plant and animal species, and it can alter soil and chemical functions and compositions.

A "5" or "high" score is given for classes or areas with less than five percent cover of non-native species, and a "1" or low score indicates greater than 50 percent cover of non-native species. For the mitigation site, estimates were based on anticipated conditions in each area upon achievement of mitigation success.

3.2.2. Qualitative Comparison Functional Scores

The functional losses assessed entail impacts to ephemeral channel area within the footprints of the Project alternatives. The mitigation areas of the Emery Site were assessed for their ability to provide functional gain through the active management, enhancement, and restoration activities. ***Table 5*** provides the functional scoring of two classes of potential waters of the U.S. that would be impacted by the Project alternatives, and the functional scoring at the proposed mitigation areas of the Emery Site upon achievement of mitigation success. A full description of the scoring rationale for the two classes of ephemeral drainages and the three mitigation areas of the Emery Site is attached as ***Appendix A***.

Table 5. Functional Assessment Scoring for Impacted Drainage Classes and Mitigation Areas*

Assessed Functions	Functional Scoring of Impact Drainage Classes		Functional Scoring of Mitigation Areas of Emery Site upon Achievement of Mitigation Success Criteria		
	Ephemeral Class A	Ephemeral Class B	Area A	Area B	Area C
Hydrologic Functions					
Hydrologic Connectivity	3	3	5	4	1
Subsurface Flow/Groundwater Recharge	2	1	4	4	1
Energy Dissipation	3	1	5	4	1
Sediment Transport/ Regulation	3	1	5	5	1
Chemical Functions					
Elements, Compounds, and Particulate Cycling	2	1	5	4	1
Organic Carbon Export/Sequestration	2	1	5	4	1
Biotic Functions					
Aquatic Invertebrate Fauna	0	0	0	5	1
Presence of Fish and Fish Habitat Structure	0	0	0	1	1
Riparian/Wetland Vegetation Structure	1	1	3	5	1
Age-Class Distribution of Woody Riparian or Wetland Vegetation	3	4	4	5	1
Native/Non-native Vegetation Species	5	5	5	3	1

*Impact drainage classes shown on ***Figure 4*** and ***Figure 6*** and mitigation areas shown on ***Figure 7***.

The scores provided by the functional assessment are used to develop the mitigation baseline ratios for use in the MRSC worksheet included as Attachment 12501.6-SPD of the *Standard Operating Procedure for the Determination of Mitigation Ratios* (Corps 2013). Comparison of each impacted drainage class to each mitigation area of the Emery Site calculates the adjustment from the starting 1:1 mitigation to impact ratio, were a given mitigation area used to mitigate for a given impact. Mitigation provided for impacts can be higher or lower depending on the relative quality of the mitigation function compared to the quality of the impacted function. The ratios calculated from the complete list of comparisons are provided in ***Table 6***.

Table 6. Comparative Mitigation Baseline Ratios for MRSC Step 2*

Emery Site Area	Ephemeral Class A Mitigation Ratio	Ephemeral Class B Mitigation Ratio
Area A	0.37:1	0.50:1
Area B	0.35:1	0.50:1
Area C	5:1	5:1

*Ratios are reported as mitigation acres required for each acre of impact.

3.3. Quantitative Impact-Mitigation Comparison (Step 3)

Steps 2 and 3 of the MRSC are mutually exclusive, and provide a comparison of the impact and mitigation sites based on a set of defined functional values. Step 2 is qualitative comparison (used in this analysis and described above) and Step 3 is a quantitative comparison. In order to proceed using Step 3, the MRSC requires an accepted method for conducting the assessment quantitatively. In most cases, this requires a published, peer-reviewed assessment manual that is appropriate for the region and the aquatic functions present within all considered sites. Currently, there is no Corps-approved assessment method accepted for use in Arizona. Therefore, this analysis uses the qualitative assessment in Step 2 and omit Step 3.

3.4. Mitigation Site Location (Step 4)

Step 4 of the MRSC is a ratio adjustment based on the location of a mitigation site with respect to the impact site. This is generally determined based on whether both sites are located within the same watershed as defined by the appropriate HUC. Although there is no defined standard HUC level for use in completing the MRSC, HUC 8 or HUC 10 designations are typically considered appropriate. The impact area and the Emery Site are located within the Upper Gila (HUC 15040005) HUC 8 watershed. Due to the proximity and direct hydrologic connectivity of the impact site and mitigation property, no penalty for mitigation site location is applied.

3.5. Net Loss of Aquatic Resource Surface Area (Step 5)

Per the MRSC instructions, credit can only be given for this step if establishment or re-establishment of aquatic features is to be completed by proposed mitigation actions. Net loss of aquatic resources is scored with a modification of +0 for establishment mitigation and +1 for all remaining mitigation types.

No aquatic resource establishment is proposed at the Emery Site; therefore, an adjustment of +1 is added to the mitigation ratio for all mitigation areas.

3.6. Type Conversion (Step 6)

Out-of-kind mitigation can result in an increase to the mitigation ratio if the mitigation site presents lower quality or less valuable habitat. However, if it is determined that the mitigation site has or will have a rare, unique, or valuable resource type for the determined watershed, a decrease of the mitigation ratio could be applied. Scoring for this category can range from +4 for out-of-kind habitat that is common to -4 for restoration or conversion of rare and valuable habitat. The scoring for this category compares the impact sites and the mitigation sites by assessing the rarity of the stream or habitat type and the overall functional benefit to the watershed.

Project Design Alternative 1: Base Case and Project Design Alternative 2: Pivot Option are expected to result in the permanent impacts of 90.43 acres and 76.20 acres of ephemeral drainage, respectively. Neither alternative would adversely impact any special aquatic sites, including wetlands. The two defined classes of impacted drainages, Ephemeral Class A and Ephemeral Class B, consist only of ephemeral desert washes associated with vegetation densities that were typically less than 0.26 m^3/m^2, indicating that these areas are xeroriparian or upland with relatively sparse vegetation and temporary flow regimes. While these features play an important role in desert ecology, they are more common and provide less functional value when compared to the riparian areas along the Gila River offered by the proposed mitigation site.

The mitigation areas of the Emery Site provide opportunities for restoration, enhancement, preservation, and long-term management along the Gila River. Upon achievement of the mitigation success criteria, the Areas A and B within the Emery Site would provide dense riparian habitat that is both rare and important within Arizona. Riparian habitat within Area A is anticipated to be more mesquite dominated, while Area B is anticipated to be more mesic cottonwood/willow-dominated habitat. Area C will include preservation of such habitat, but does not propose additional functional lift to that habitat.

Due to the rare and regionally significant habitat provided by this mitigation, a ratio adjustment of -1 is applied for Area A of the Emery Site and a ratio adjustment of -2 applied for Area B. No ratio adjustment is made for Area C in this step.

3.7. RISK AND UNCERTAINTY (STEP 7)

Risk and uncertainty are assessed so that the mitigation ratio reflects the uncertainty inherent in some mitigation activities. Factors that are considered include: 1) permittee-responsible mitigation; 2) mitigation site did not formerly support targeted aquatic resources; 3) difficult-to-replace resources (see 33 CFR 332.3(e)(3) and (f)(2)); 4) modified hydrology (e.g., high-flow bypass); 5) artificial hydrology (e.g., pumped water source); 6) structures requiring long-term maintenance (e.g., outfalls, drop structures, weirs, bank stabilization structures); 7) planned vegetation maintenance (e.g., mowing, land-clearing, fuel modification activities); 8) e.g., shallow, buried structures (riprap, clay liners), and 9) absence of long-term preservation mechanism. Each element of risk is scored from +0.1 to +0.3 based on the amount of uncertainty.

The mitigation actions at Sites A and B will consist of the establishment of riparian vegetation that will have a high probability of success based on depth-to-water, rainfall, and soil characteristics. The usage of plants that prefer the conditions present within each area will ensure that the new riparian vegetation will have increased survivability, will recruit new individuals, and will inhibit invasion from exotic species.

These actions will result in stable riparian community with a robust age structure including mature trees and new recruits. The preservation actions in Area C will preserve riparian habitat already present and protect the actions undertaken in Area B.

Based on the factors considered as risk and uncertainty in the MRSC and described above, only factor 1, permittee-responsible mitigation, applies to all three areas. Factor 5, artificial hydrology, applies to the proposed use of dri-water gel packs during tree establishment. Factor 7, planned vegetation maintenance, applies only to Area B. The ratio adjustments for this step are +0.3 for Areas A and B and +0.0 for Area C.

3.8. TEMPORAL LOSS (STEP 8)

Temporal loss is associated with mitigation activities that begin after impacts are made, and considers the amount of time it takes for a mitigation activity to reach a full, functional potential. Ratio adjustments are applied based on the amount of time required for the planting, establishment, and growth of vegetation. The temporal adjustment to the mitigation ratio is .05 per month and generally assumes a 20-month period (adjustment of +1) for herbaceous growth, a 40-month period (adjustment of +2) for woody shrubs, and a 60-month, or 5-year, period (adjustment of +3) for tree species.

Based on the proposed establishment of tree species in Areas A and B, a +3 ratio adjustment was made for these two areas. The preservation actions in Area C require no ratio adjustment in this step.

3.9. FINAL MITIGATION RATIO (STEP 9)

The final ratios determine the amount of acreage credits that are generated by each mitigation area when compared to each impacted drainage class. Step 9 of the MRSC is the calculation of final mitigation scoring ratios from Steps 2-8 in the MRSC. The final mitigation ratios comparing each impact class to each mitigation area were compiled and are summarized in ***Table 7.***

Table 7. Final Mitigation Ratios Per Impacted Drainage Class and Mitigation Area

Emery Site Area	Final Ephemeral Class A Mitigation Ratio	Final Ephemeral Class B Mitigation Ratio
Area A	1.59:1	1.43:1
Area B	1.16:1	1.10:1
Area C	6:1	6:1

3.10. FINAL COMPENSATORY MITIGATION SUMMARY (STEP 10)

The total acres of impacted areas by drainage class are applied to the number of mitigation credits provided based on the final mitigation ratios. ***Table 8*** summarizes the application of the MRSC-derived mitigation ratios to the mitigation sites in a sequential fashion. Mitigation credits were applied to the higher functionally scoring Ephemeral Class A impacts first, then to the lower scoring Ephemeral Class B.

Mitigation areas began with Emery Site – Area A and moved sequentially working through each area from A to C, as needed, until all of the functional impacts for each drainage class were mitigated. The completed MRSC worksheets, showing all of the steps described above, are provided as ***Appendix B*** of this document.

As the impacts for Project Design Alternative 2: Pivot Option are less than those for Project Design Alternative 1: Base Case, only the mitigation credits that would potentially be required upon development of the latter alternative are shown in ***Table 8*** below. The comparison between impact areas and mitigation areas for calculation of mitigation ratios remains constant across alternatives. A site that contained mitigation acreage sufficient to mitigate the impacts for Project Design Alternative 1: Base Case would necessarily be sufficient to provide the reduced mitigation acreage required by the reduced impacts to potential waters of the U.S. under Project Design Alternative 2: Pivot Option.

Table 8. Final Mitigation Credits Applied by Impact Drainage Class and Mitigation Area

Impact Drainage Class	Impact Acres	Emery Site Mitigation Area	Mitigation Acres Available	Mitigation Ratio	Mitigation Acres Used	Mitigation Credits Provided	Remaining Impact Acres
Ephemeral Class A	60.40	Area A	50	1.59:1	50	31.45	28.95
		Area B	59	1.16:1	26	22.41	6.54
		Area C	42	6.00:1	40	6.67	0
Ephemeral Class B	30.03	Area A	0	1.43:1	0	0	30.03
		Area B	33	1.10:1	33	30	0.03
		Area C	2	6.00:1	2	0.33	0

4. REFERENCES

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FIGURES

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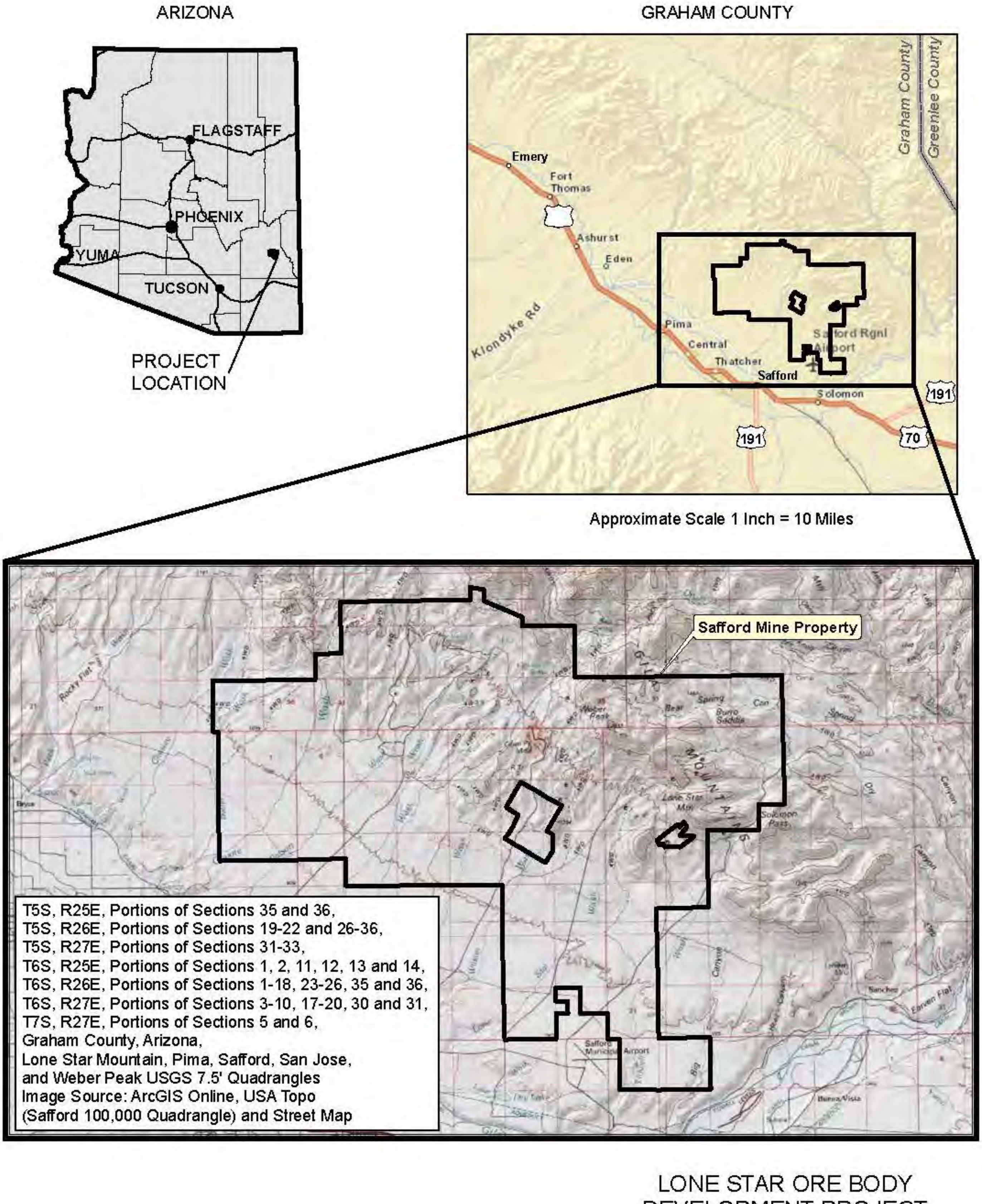


LONE STAR ORE BODY
DEVELOPMENT PROJECT

Mitigation Ratio-Setting Checklist

Vicinity Map

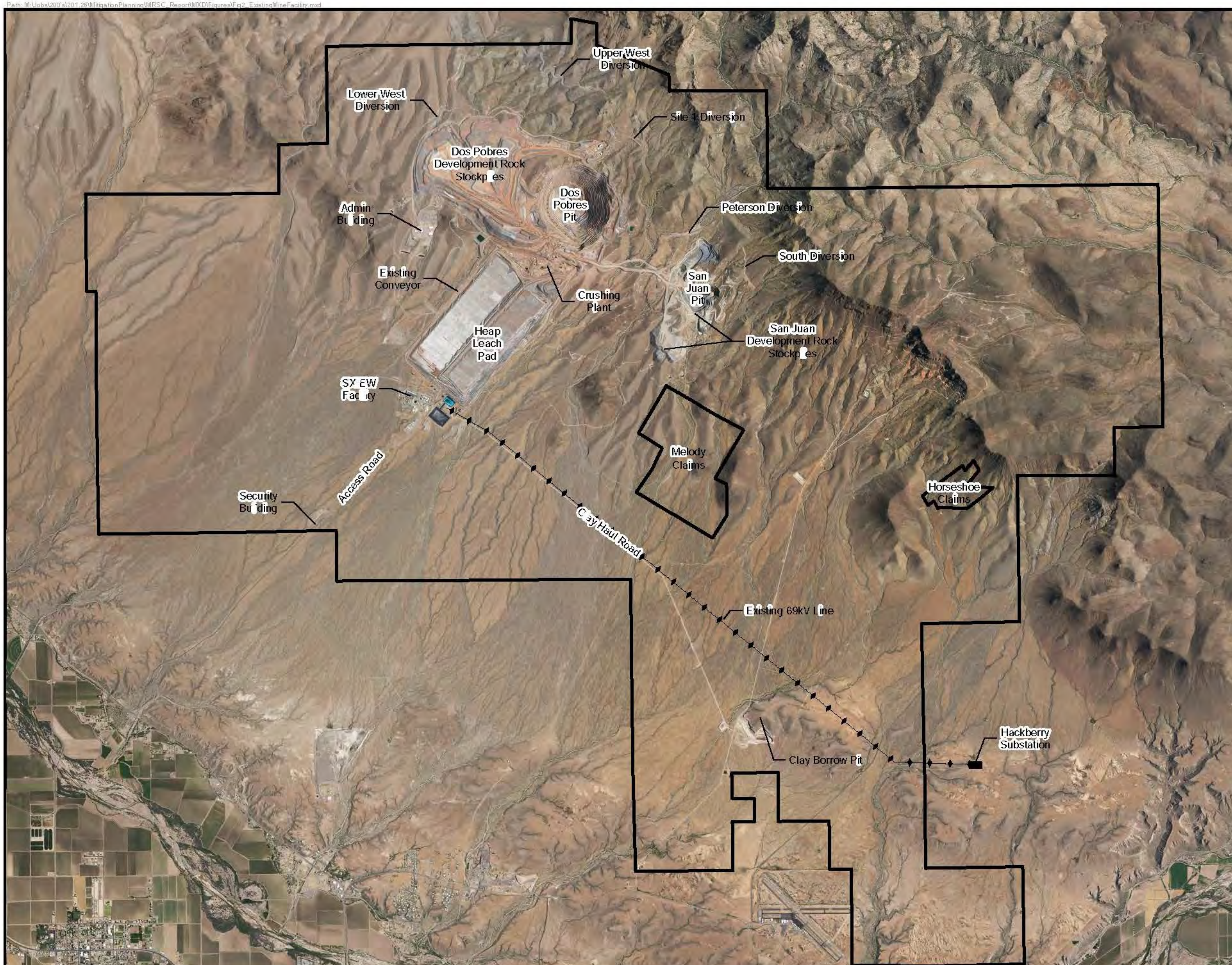
Figure 1

N

0 1.5 3 Miles

0 2 4 Kilometers

WestLand Resources



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Safford Mine Property

N

0 2,600 5,200 Feet

0 750 1,500 Meters

T5S, R25E, Portions of Sections 35 and 36,
T5S, R26E, Portions of Sections 19-22 and 26-36,
T5S, R27E, Portions of Sections 31-33,
T6S, R25E, Portions of Sections 1, 2, 11, 12, 13 and 14,
T6S, R26E, Portions of Sections 1-18, 23-26, 35 and 36,
T6S, R27E, Portions of Sections 3-10, 17-20, 30 and 31,
T7S, R27E, Portions of Sections 5 and 6,
Graham County, Arizona,
Image Source: NAIP 2015

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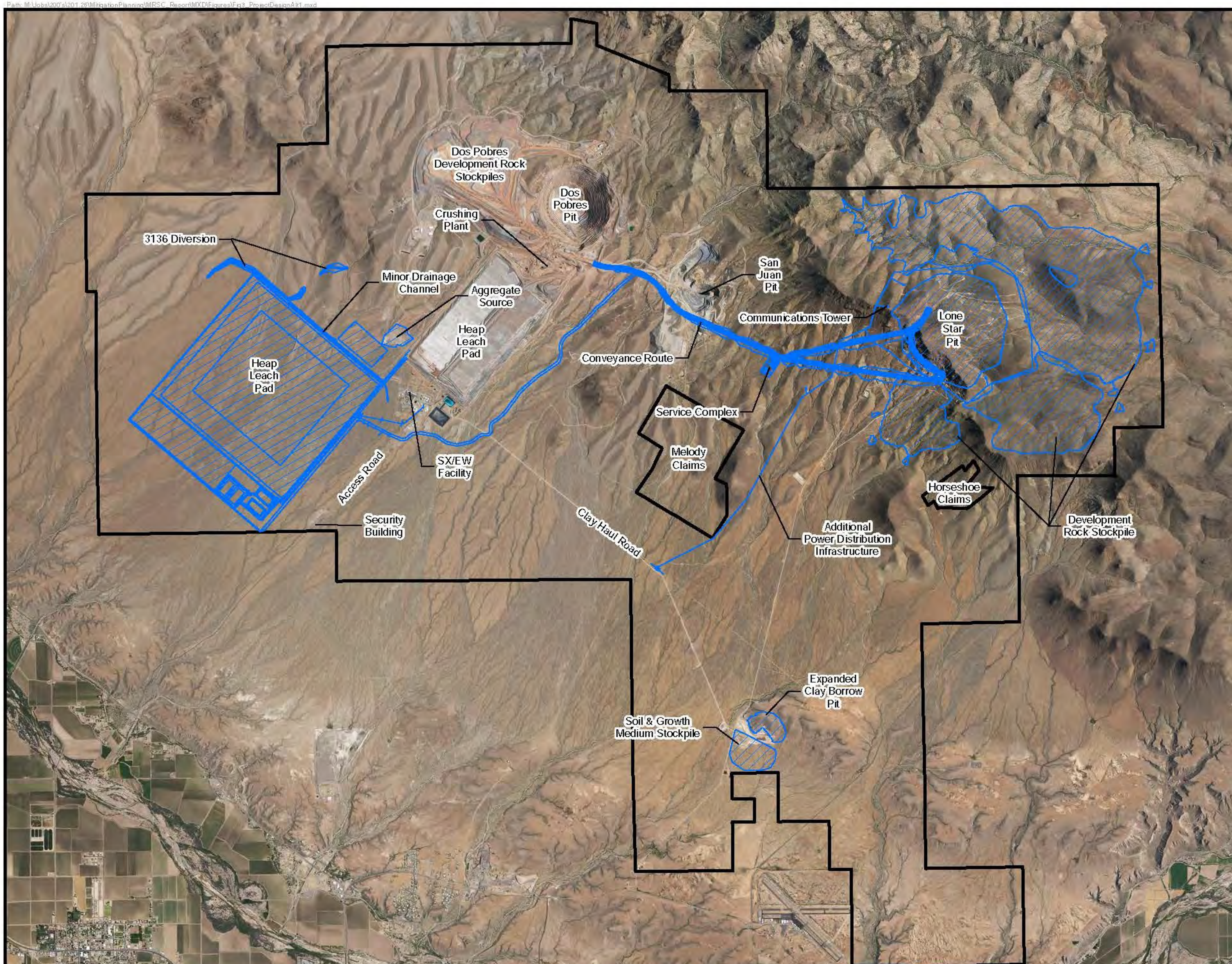
LONE STAR ORE BODY DEVELOPMENT PROJECT

Mitigation Ratio-Setting Checklist

EXISTING MINE FACILITY

Figure 2



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Proposed Project Features (FMSI)

Safford Mine Property

N

0 2,600 5,200 Feet

0 750 1,500 Meters

T5S, R25E, Portions of Sections 35 and 36,
T5S, R26E, Portions of Sections 19-22 and 26-36,
T5S, R27E, Portions of Sections 31-33,
T6S, R25E, Portions of Sections 1, 2, 11, 12, 13 and 14,
T6S, R26E, Portions of Sections 1-18, 23-26, 35 and 36,
T6S, R27E, Portions of Sections 3-10, 17-20, 30 and 31,
T7S, R27E, Portions of Sections 5 and 6,
Graham County, Arizona,
Image Source: NAIP 2015

WestLand Resources

LONE STAR ORE BODY DEVELOPMENT PROJECT

Mitigation Ratio-Setting Checklist

PROJECT DESIGN ALTERNATIVE 1: BASE CASE

Figure 3

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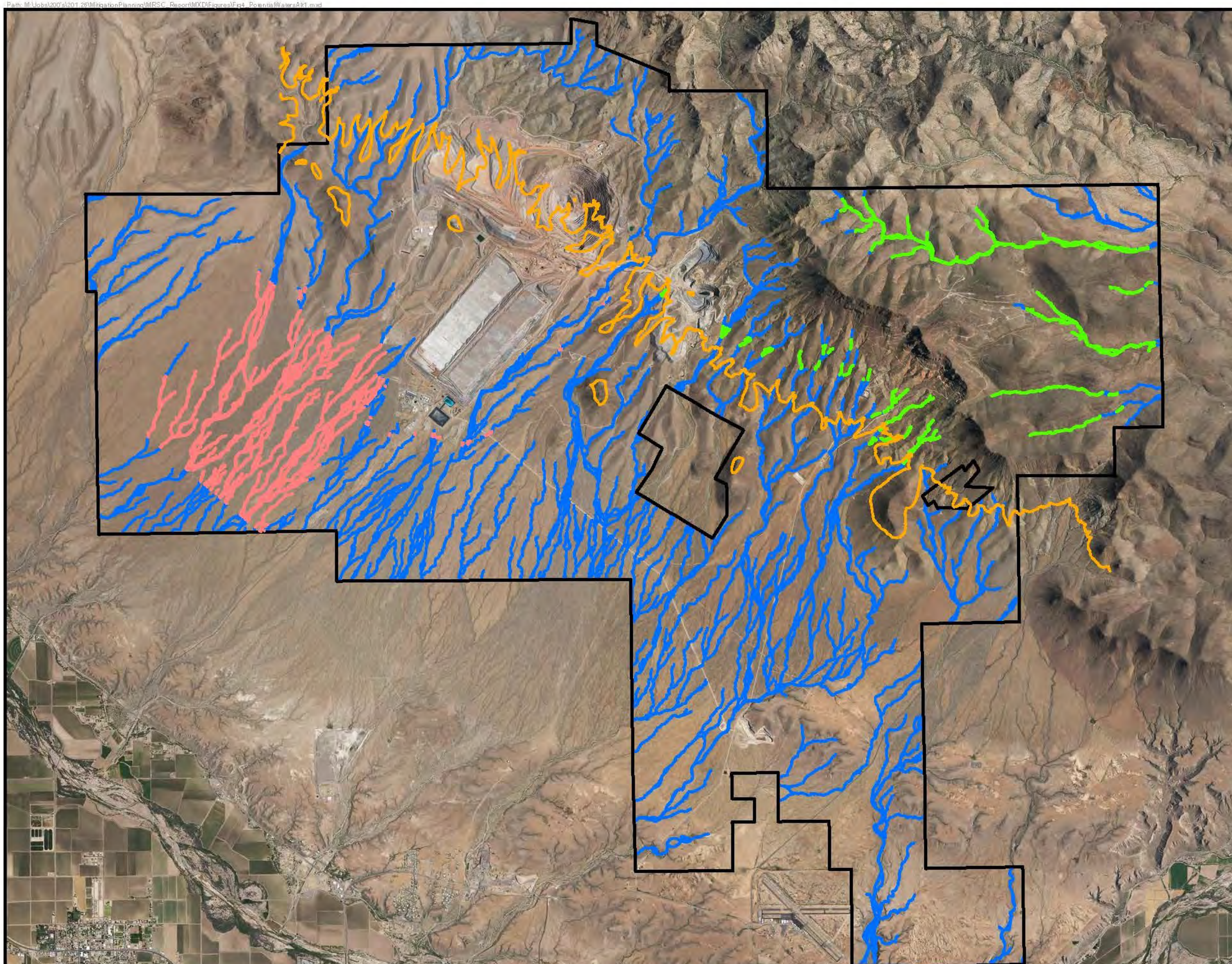

Legend

4000' Elevation Line

Impacted Class A

Impacted Class B

No Classification Assigned (No Impacts Proposed)

Safford Mine Property

N

0 2,600 5,200 Feet

0 750 1,500 Meters

T5S, R25E, Portions of Sections 35 and 36,
T5S, R26E, Portions of Sections 19-22 and 26-36,
T5S, R27E, Portions of Sections 31-33,
T6S, R25E, Portions of Sections 1, 2, 11, 12, 13 and 14,
T6S, R26E, Portions of Sections 1-18, 23-26, 35 and 36,
T6S, R27E, Portions of Sections 3-10, 17-20, 30 and 31,
T7S, R27E, Portions of Sections 5 and 6,
Graham County, Arizona,
Image Source: NAIP 2015

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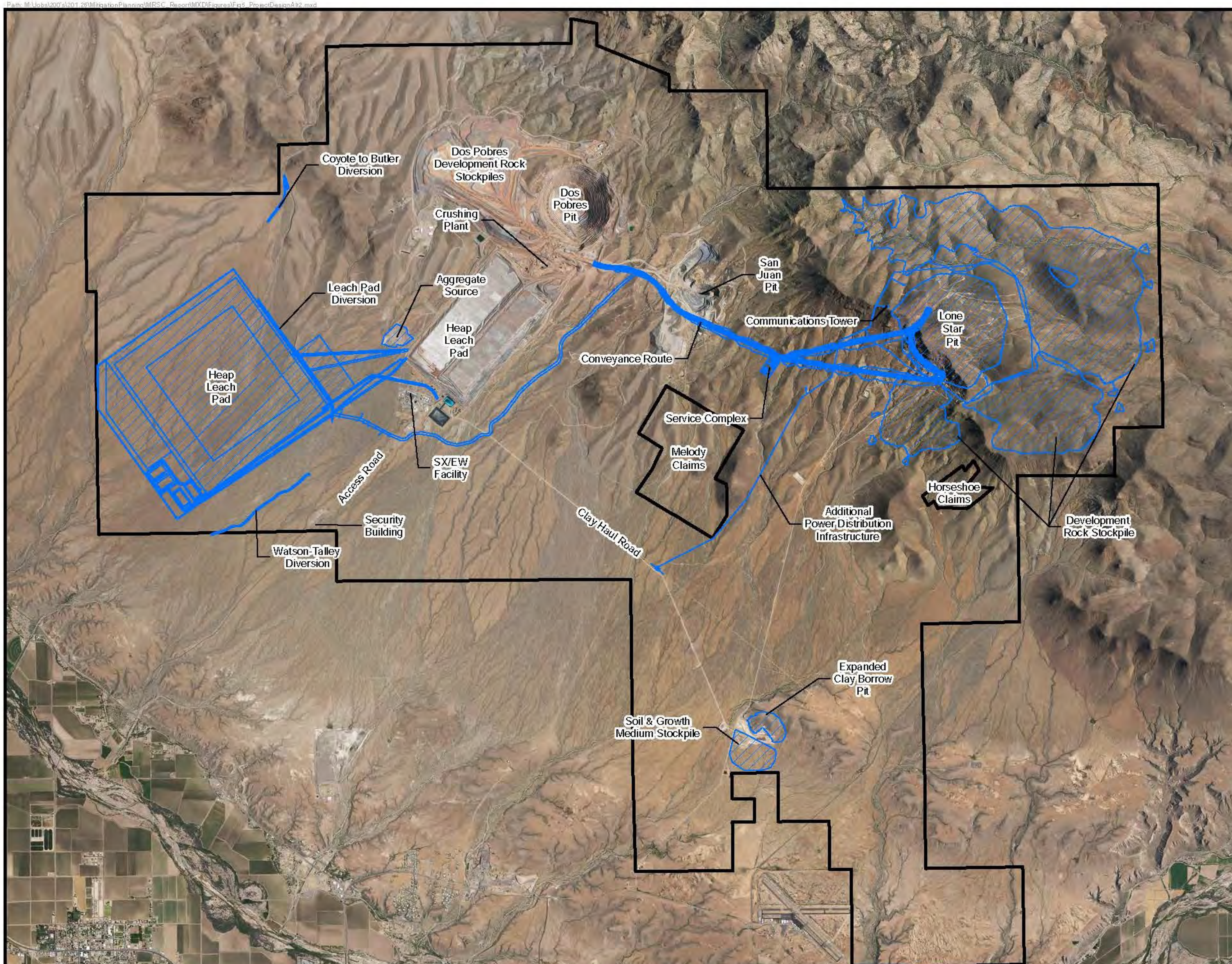
LONE STAR ORE BODY DEVELOPMENT PROJECT

Mitigation Ratio-Setting Checklist

POTENTIAL WATERS OF THE U.S. IMPACTS UNDER PROJECT DESIGN ALTERNATIVE 1: BASE CASE

Figure 4



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Proposed Project Features (FMSI)

Safford Mine Property

N

0 2,600 5,200 Feet

0 750 1,500 Meters

T05S, R25E, Portion of Sections 35 & 36,
T05S, R26E, Portion of Sections 19-22, 26-36,
T05S, R27E, Portion of Sections 31-33,
T06S, R25E, Portion of Sections 1, 2, 11, 12, 13 & 14,
T06S, R26E, Portion of Sections 1-18, 23-26, 35 & 36,
T06S, R27E, Portion of Sections 3-10, 17-20, 30 & 31,
T07S, R27E, Portion of Sections 5 & 6,
Graham County, Arizona,
Lone Star Mountain, Pima, Safford, San Jose,
& Weber Peak USGS 7.5' Quadrangles
Image Source: NAIP 2015

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LONE STAR ORE BODY DEVELOPMENT PROJECT

Mitigation Ratio-Setting Checklist

PROJECT DESIGN ALTERNATIVE 2: PIVOT OPTION

Figure 5

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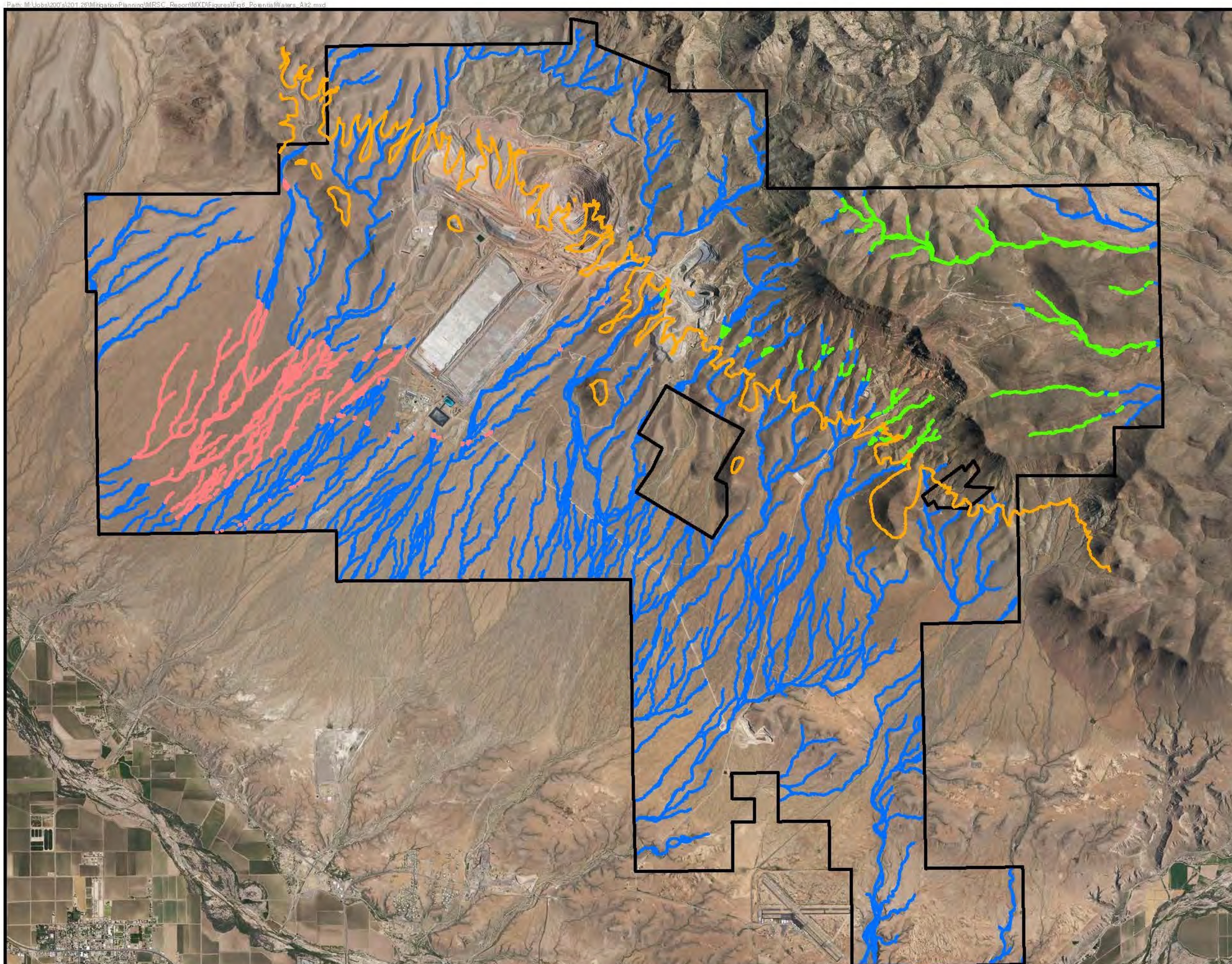

Legend

- 4000' Elevation Line
- Impacted Class A
- Impacted Class B
- No Classification Assigned (No Impacts Proposed)
- Safford Mine Property

N

0 2,600 5,200 Feet

0 750 1,500 Meters

T5S, R25E, Portions of Sections 35 and 36,
T5S, R26E, Portions of Sections 19-22 and 26-36,
T5S, R27E, Portions of Sections 31-33,
T6S, R25E, Portions of Sections 1, 2, 11, 12, 13 and 14,
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T7S, R27E, Portions of Sections 5 and 6,
Graham County, Arizona,
Image Source: NAIP 2015

WestLand Resources

LONE STAR ORE BODY DEVELOPMENT PROJECT

Mitigation Ratio-Setting Checklist

POTENTIAL WATERS OF THE U.S. IMPACTS UNDER PROJECT DESIGN ALTERNATIVE 2: PIVOT OPTION

Figure 6

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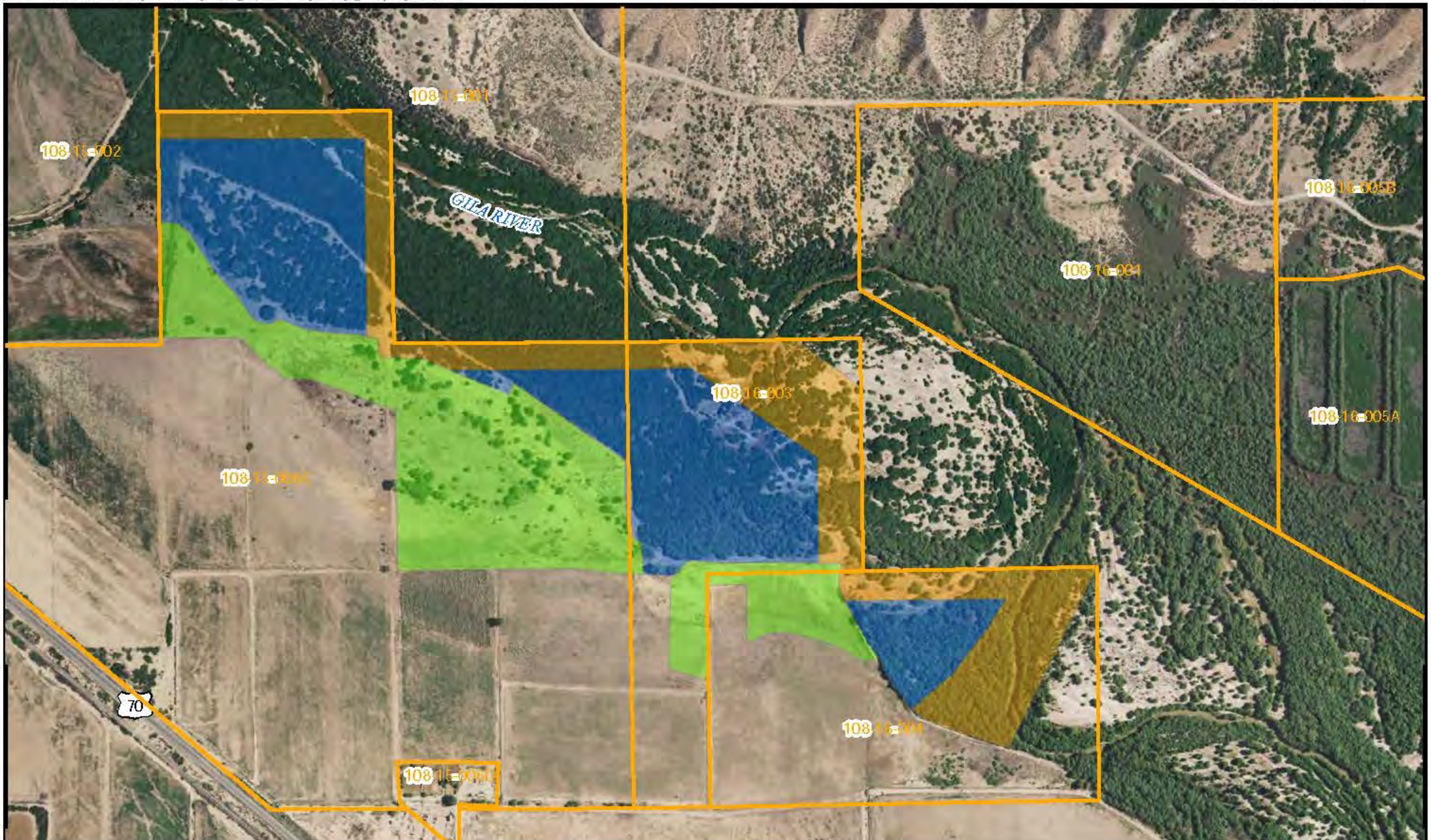

T4S, R23E, Portions of Sections 20 and 21,
Graham County, Arizona,
Geronimo and Fort Thomas USGS 7.5' Quadrangles
Image Source: NAIP 2015

WestLand Resources

0 400 800 Feet

0 200 400 Meters

N

Legend

Parcel (Graham County, 2014)

Emery Mitigation Site:

Area A: Field to Riparian Restoration

Area B: Tamarisk Control and Riparian Enhancement

Area C: Buffer Preservation

LONE STAR ORE BODY DEVELOPMENT PROJECT

Mitigation Ratio-Setting Checklist

EMERY SITE

Figure 7

APPENDIX A

Functional Scoring Summaries

1. EPHEMERAL CLASS A

Function	Score	Explanation
Hydrologic Functions		
Hydrologic Connectivity	3 Moderate	Class A features consist of low-gradient, braided, ephemeral channels. The channels are capable of transporting small volumes of water. These drainages and drainages that are immediately downstream and upstream from them, are ephemeral, indicating transport capacity is limited to precipitation events.
Subsurface Flow/Groundwater Recharge	2 Low-Moderate	Water flow through the loose alluvial soils in Class A channels provides some subsurface flow and limited potential to replenish shallow groundwater aquifers along the Gila River due to clay deposits. The lack of permanent or intermittent flow, coupled with evaporation and evapotranspiration, prevent a higher score. Limited xeroriparian vegetation indicates that, while lateral subsurface flow potential may exist, that flow is likely temporary and the result of precipitation events.
Energy Dissipation	3 Moderate	Class A features have low-gradient channels, a well-developed floodplain, and loose alluvium capable of reducing some flow intensities through evaporation and channel infiltration. However, the small channel size and sparse vegetation restrict this function to a score of "moderate."
Sediment Transport/Regulation	3 Moderate	Class A features have braided channels with high sediment loading during precipitation events.
Chemical Functions		
Elements, Compounds, and Particulate Cycling	2 Low-Moderate	Class A features consist of small- to moderate-sized channels with loose alluvium having the potential to store and mix nutrients and particles in subsurface soils and to provide downstream pulses when active flows are present. However, Class A features are ephemeral with limited riparian and upland vegetation, reducing the ability of the system to cycle nutrients.
Organic Carbon Export/Sequestration	2 Low-Moderate	Class A features consist of small- to moderately-sized channels with the potential to store organic matter in subsurface soils and to provide downstream pulses when active flows are present. However, Class A features, along with upstream and downstream adjacent waters, are ephemeral, limiting both the amount and timing of carbon sequestration and export through the system. Furthermore, the lack of significant riparian buffer, coupled with sparse upland vegetation, limits the ability of the system to generate or export significant amounts of organic carbon.
Biotic Functions		
Aquatic Invertebrate Fauna	0 None	No Class A features contain permanent or intermittent waters. Irruptive aquatic insects may be present in small pools or water collection areas that occur during significant precipitation events, but these temporary populations are not indicative of a stable prey community for aquatic-feeding species.
Presence of Fish and Fish Habitat Structure	0 None	Class A features do not contain any permanent or intermittent waters, and channel characteristics were not assessed for fish habitat suitability. Flow events within the ephemeral system will not result in the temporary presence of fish species.

Function	Score	Explanation
Riparian/Wetland Vegetation Structure	1 Low	Vegetation at sample sites along ephemeral Class A features produced vegetation volumes that were split between areas that contained between 0.26 and 0.5 m^3/m^2 and areas that contained below 0.25 m^3/m^2. These vegetation volumes indicate a score of “low” for this function.
Age Class Distribution of Woody Riparian or Wetland Vegetation	3 Moderate	A vegetation assessment of Ephemeral Class A features indicated the average presence of three age classes within the riparian vegetation. Wetland vegetation was absent. The presence of three ages classes, coupled with the absence of wetland vegetation, indicates a score for this function of “moderate.”
Native/Non-native Vegetation Species	5 High	Vegetation sampling along Class A features indicated an average of less than 5 to 10% of woody vegetation consisted of non-native species resulting in a score of “high” for this function.

2. EPHEMERAL CLASS B

Function	Score	Explanation
Hydrologic Functions		
Hydrologic Connectivity	3 Moderate	Ephemeral Class B features consist of moderate- to high-gradient ephemeral channels with substrates consisting of Gila conglomerate and underlying volcanics. The channels are headwaters capable of transporting small volumes of water. Class B features, along with downstream features, are ephemeral, indicating transport capacity is limited to precipitation events.
Subsurface Flow/Groundwater Recharge	1 Low	Class B channels likely provide a limited amount of subsurface flow and potential to replenish deeper groundwater aquifers due to their impervious substrates. Limited xeroriparian vegetation indicates that, while lateral subsurface flow potential may exist, that flow is likely temporary and the result of precipitation events.
Energy Dissipation	1 Low	Class B features consist of moderate- to high-gradient ephemeral channels with relatively impervious substrates.
Sediment Transport/Regulation	1 Low	Headwaters with little sediment, relatively impervious substrates; no sediment deposition likely.
Chemical Functions		
Elements, Compounds, and Particulate Cycling	1 Low	Moderate- to high-gradient, low-order headwater streams with narrow riparian buffer.
Organic Carbon Export/Sequestration	1 Low	Class B features consist of narrow ephemeral drainages with little to no connectivity and a minimal riparian buffer. These features have small channels with limited potential to store organic matter in subsurface soils or provide downstream pulses of carbon when active flows are present. Class B features, along with upstream and downstream adjacent waters, are ephemeral, limiting both the amount and timing of carbon sequestration and export through the system. The minimal amount of riparian buffer, coupled with sparse upland vegetation, limit the ability of the system to generate or export significant amounts of organic carbon.
Biotic Functions		
Aquatic Invertebrate Fauna	0 None	Class B features do not contain any permanent or intermittent waters. Irruptive aquatic insects may be present in small pools or water collection areas that occur during significant precipitation events, but these temporary populations are not indicative of a stable prey community for aquatic-feeding species.
Presence of Fish and Fish Habitat Structure	0 None	Class B features do not contain any permanent or intermittent waters, and channel characteristics were not assessed for fish habitat suitability. Flow events within the ephemeral system will not result in the temporary presence of fish species.
Riparian/Wetland Vegetation Structure	1 Low	Vegetation at sample sites along Class B features produced vegetation volumes that fall below 0.26 m^3/m^2. These vegetation volumes indicate a score of “low” for this function.
Age Class Distribution of Woody Riparian or Wetland Vegetation	4 Moderate-high	A vegetation assessment of Class B features indicated the average presence of four age classes within the riparian vegetation. Wetland vegetation was absent. The presence of four ages classes, coupled with the absence of wetland vegetation, indicates a score for this function of “moderate-high.”
Native/Non-native Vegetation Species	5 High	Vegetation sampling along Class B features indicated an average of less than 5 to 10% of woody vegetation consisted of non-native species resulting in a score of “high” for this function.

3. EMERY SITE – AREA A: FIELD TO RIPARIAN RESTORATION

Function	Score	Explanation
Hydrologic Functions		
Hydrologic Connectivity	5 High	The planned mitigation in Area A consists of returning the area to the active floodplain of the Gila River and significantly increasing the density of riparian vegetation throughout the site. The removal of the berm will allow high flows in the Gila River to access this portion of restored floodplain. The increase in native riparian vegetation will provide increased overland roughness, additional depressional storage, and increased surface infiltration. These factors will aid in the reduction of overland flow in the area lowering peak flow intensity and erosional damage. The return of this area to the active floodplain greatly increases the hydrologic connectivity to the Gila River, and along with the added function of the projected increase in riparian vegetation, provides for a functional score of "high."
Subsurface Flow/Groundwater Recharge	4 Moderate-High	The mitigation actions in Area A will result in the addition of riparian vegetation at this site. The increase in riparian vegetation will increase infiltration and allow additional water into the shallow water aquifer. The increased infiltration capacity provided by the additional root mass will also allow for increased subsurface flow through the riparian area supporting vegetation and reaching the Gila River. The increased infiltration will allow additional water to pass through the vadose zone into deeper groundwater aquifers. The projected density of riparian vegetation and increased subsurface water movement provides for a functional score of "moderate."
Energy Dissipation	5 High	The planned mitigation in Area A consists of returning the area to the active floodplain of the Gila River and significantly increasing the density of riparian vegetation throughout the site. The removal of the berm will allow the surface area of the site to provide an energy dissipation function during high flows in the Gila River. The increase in riparian vegetation will provide increased overland roughness, additional depressional storage, and increased surface infiltration. These factors will aid in the reduction of overland flow in the area lowering peak flow intensity and erosional damage. The anticipated encroachment of the tamarisk leaf beetle will also lead to the death of the current limited riparian vegetation in Area A. The projected effects of returning the area to the floodplain, significantly increasing the density of riparian vegetation, and maintaining the energy dissipation function during tamarisk die-off provides for a functional score of "high."

Function	Score	Explanation
Sediment Transport/Regulation	5 High	Returning the area to the active floodplain of the Gila River through removal of the existing berm will return the ability of Area A to both provide sediment during high flows and regulate sediment transport within the river during those flows. The increase in riparian vegetation in Area A will also provide enhanced regulation of sediment through the system. Riparian vegetation provides a regulatory mechanism that actively affects sediment mobility and flow magnitudes. Adding the sediment transport/regulation function of this site to the Gila River system supports a functional score of "high."
Chemical Functions		
Elements, Compounds, and Particulate Cycling	5 High	The mitigation actions in Area A will result in the establishment of riparian vegetation at much greater densities at this site. The anticipated increase in riparian vegetation will allow for the addition and enhanced sequestration of nutrients. The removal of the berm will allow these nutrients to be released to the Gila River during flood events and through subsurface travel. The increased riparian vegetation also aids in the denitrification process, which can prevent excessive nitrogen levels that lead to eutrophication and hypoxia from reaching the adjacent Gila River. The removal of tamarisk will also improve soil quality and reduce the potential for the build-up salts within surface soils and runoff. The creation of these functions within the site provide for a functional score of "high."
Organic Carbon Export/Sequestration	5 High	The mitigation actions in Area A will result in the establishment of riparian vegetation at much greater densities at this site. The anticipated increase in riparian vegetation will supply additional sources of organic carbon that are available to the adjacent Gila River. Removal of the berm will make this organic carbon available to the Gila River, adding this supply as a function of the mitigation site. The creation of this function within the site provide for a functional score of "high."
Biotic Functions		
Aquatic Invertebrate Fauna	0 None	Area A does not contain permanent or intermittent waters, and would not be expected to contain such, even after completion of the proposed mitigation actions. Irruptive aquatic insects may be present in small pools or water collection areas that occur during significant precipitation events, but these temporary populations are not indicative of a stable prey community for aquatic-feeding species. Improvements to Area A are expected to have negligible direct effects on aquatic invertebrate fauna.
Presence of Fish and Fish Habitat Structure	0 None	Area A does not contain any permanent or intermittent waters. Improvements to Area A are expected to have negligible direct effects on the presence and species diversity of fish or fish habitat structure beyond that captured under other listed functions related to the general health of the river system.

Function	Score	Explanation
Riparian/Wetland Vegetation Structure	3 Moderate	The mitigation actions in Area A are projected to result in the enhancement of riparian vegetation to relatively dense conditions at this site. Active management at this site will exclude anthropogenic and grazing disturbances and will prevent future degradation of the riparian area. The anticipated density of riparian vegetation in Area A is expected to exceed 0.5 m^3/m^2, providing for a functional score of "moderate."
Age Class Distribution of Woody Riparian or Wetland Vegetation	4 Moderate-High	The mitigation actions in Area A will increase the amount of riparian vegetation throughout the site and remove the at-risk non-native tamarisk, increasing recruitment and overall habitat diversity. The restoration in Area A is projected to result in a riparian community with a stable age structure consisting of all four age classes. Wetland vegetation is not expected to be present or become established. The increase in riparian vegetation and habitat structure in Area A and increased natural recruitment will allow for a functional score of "moderate-high."
Native/Non-native Vegetation Species	5 High	The mitigation actions in Area A will focus on the increase of native riparian species. The only significant existing vegetation in Area A consists of non-native tamarisk, which is anticipated to be lost after arrival of the tamarisk beetle. The establishment and addition of native species to the unvegetated portions of the site and the anticipated low long-term invasion potential of non-natives allows for a functional score of "high."

4. EMERY SITE – AREA B: TAMARISK CONTROL AND RIPARIAN ENHANCEMENT

Function	Score	Explanation
Hydrologic Functions		
Hydrologic Connectivity	4 Moderate-High	The planned mitigation in Area B consists of replacing stands of the non-native riparian vegetation. The projected encroachment of the tamarisk leaf beetle will lead to seasonal defoliation of this site, leading ultimately leading to the death of the current riparian vegetation. The replacement of tamarisk with native cottonwood, willow, and mesquite will create riparian refugia for wildlife during the eventual die-off from the beetle. The replacement of non-native riparian vegetation will provide increased overland roughness, additional depressional storage, and increased surface infiltration over conditions that would have developed if no mitigation activities were conducted. These factors will aid in the reduction of overland flow in the area lowering peak flow intensity and erosional damage. The projected increase in healthy native riparian vegetation provides for a functional score of "moderate-high."
Subsurface Flow/Groundwater Recharge	4 Moderate-High	The conversion of non-native riparian vegetation in Area B will maintain infiltration and allow additional water into the shallow water aquifer. The increased infiltration capacity provided by the additional root mass will also allow for increased subsurface flow through the riparian area, supporting vegetation and reaching the Gila River. The increased infiltration will also allow additional water to pass through the vadose zone into deeper groundwater aquifers. The projected final density of riparian vegetation provides for a functional score of "moderate-high."
Energy Dissipation	4 Moderate-High	The mitigation actions in Area B will convert at-risk non-native riparian tamarisk to native riparian vegetation. Area B is adjacent to the perennial Gila River. The conversion of riparian vegetation will ensure overland roughness, depressional storage, and surface infiltration are maintained or increased within the site. These factors will aid in the reduction of peak flow intensity and erosional damage. Furthermore, tamarisk can reach levels of excessive density that can retard the access of flood flows to the adjacent riparian floodplain. The projected effects of diversifying the riparian vegetation to maintain the energy dissipation function during tamarisk die-off provides for a functional score of "moderate-high."

Function	Score	Explanation
Sediment Transport/Regulation	5 High	A die-off in riparian vegetation caused by the tamarisk leaf beetle would limit the ability of the area to regulate sediment transport to the adjacent Gila River. A reduction of vegetation limits the ability of riparian areas to reduce damaging overland flows and prevents the trapping and deposition of sediment from overland flows. A lack of herbaceous ground cover and living root mass from herbaceous and woody plants also increases the amount of erosional loss within the site itself. The proposed mitigation will convert the at-risk tamarisk to a native and fully functioning native riparian area within the floodplain of the adjacent perennial Gila River. The projected effects of diversifying the riparian vegetation to maintain the sediment regulation function during tamarisk die-off supports a functional score of "high" for this site.
Chemical Functions		
Elements, Compounds, and Particulate Cycling	4 Moderate-High	The mitigation actions in Area B will result in the conversion of tamarisk to dense native riparian vegetation. The anticipated conversion of riparian vegetation at Area B will increase and maintain sequestration of nutrients that can be released to the Gila River during flood events and through subsurface travel. The restored riparian vegetation will also aid in the denitrification process, which can prevent excessive nitrogen levels that lead to eutrophication and hypoxia from reaching the adjacent Gila River. The removal of tamarisk will also improve soil quality and reduce the potential for the build-up salts within surface soils and runoff. The moderate density of riparian vegetation and distance to the adjacent aquatic feature provide for a functional score of "moderate-high" at this site.
Organic Carbon Export/Sequestration	4 Moderate-High	The planned mitigation in Area B will ensure the riparian vegetation at this site continues to be a highly functioning export and sequestration mechanism for carbon for the Gila River. The mitigation actions are projected to result in dense riparian vegetation and provide for a functional score of "moderate-high."
Biotic Functions		
Aquatic Invertebrate Fauna	5 High	Improvements to Area B include the replacement of the invasive riparian monoculture of tamarisk trees are expected to improve the diversity and of aquatic invertebrate fauna within the adjacent Gila River.
Presence of Fish and Fish Habitat Structure	1 Low	Both native and non-native fish are present within the perennial Gila River near Site B. Improvements to Area B are expected to have negligible direct effects on the presence and species diversity of fish or fish habitat structure beyond that captured under other listed functions related to the general health of the river system.

Function	Score	Explanation
Riparian/Wetland Vegetation Structure	5 High	The projected encroachment of the tamarisk leaf beetle will lead to seasonal defoliation of this site, leading ultimately leading to the death of the current riparian vegetation. The replacement of tamarisk with native cottonwood, willow, and mesquite in Area B is anticipated to keep vegetation volumes above 1 m^3/m^2, and will result in an enhancement of the overall riparian system, providing for a functional rating of "high."
Age Class Distribution of Woody Riparian or Wetland Vegetation	5 High	The mitigation actions in Area B will restore native riparian vegetation with a stable and robust age-class structure within an area that consists of a relative monoculture of invasive tamarisk. The proposed mitigation is expected to produce an age-class structure containing the seedling, sapling, and mature age classes of the riparian vegetation. The senescent age class will develop over time. Wetland vegetation is anticipated to develop and persist within this site. The eventual presence of all four ages classes, coupled with the likely presence of wetland vegetation, indicates a score for this function of "high."
Native/Non-native Vegetation Species	3 Moderate	The mitigation actions in Area B will focus on the restoration of native riparian species through active management of non-native woody species. The establishment of native species and active management are expected to limit encroachment of woody exotics. The projected encroachment of the tamarisk leaf beetle will lead to seasonal defoliation of this site, leading ultimately leading to the death of the current riparian vegetation. The replacement of tamarisk with native cottonwood, willow, and mesquite will create riparian refugia for wildlife and maintain the other functions during the eventual die-off from the beetle. However, the areas surrounding Area B contain significant densities of non-native species and limit this score to "moderate."

5. EMERY SITE – AREA C: BUFFER PRESERVATION

Function	Score	Explanation
Hydrologic Functions		
Hydrologic Connectivity	1 Low	The planned mitigation in Area C consists of the establishment of site protection instruments over lands surrounding Area B. Preservation of a buffer around the enhancement activities proposed for Area B will provide protection for those functions, but little enhancement of the function itself. The establishment of the site protection instrument provides for little enhancement of the hydrologic connectivity of Area C beyond its preservation and therefore only provides for a functional score of "low."
Subsurface Flow/Groundwater Recharge	1 Low	The establishment of the site protection instrument provides for little enhancement of the subsurface flow/groundwater recharge function of Area C beyond its preservation and therefore only provides for a functional score of "low."
Energy Dissipation	1 Low	The establishment of the site protection instrument provides for little enhancement of the energy dissipation function of Area C beyond its preservation and therefore only provides for a functional score of "low."
Sediment Transport/Regulation	1 Low	The establishment of the site protection instrument provides for little enhancement of the sediment transport/regulation function of Area C beyond its preservation and therefore only provides for a functional score of "low."
Chemical Functions		
Elements, Compounds, and Particulate Cycling	1 Low	The establishment of the site protection instrument provides for little enhancement of the cycling function of Area C beyond its preservation and therefore only provides for a functional score of "low."
Organic Carbon Export/Sequestration	1 Low	The establishment of the site protection instrument provides for little enhancement of the organic carbon export/sequestration function of Area C beyond its preservation and therefore only provides for a functional score of "low."
Biotic Functions		
Aquatic Invertebrate Fauna	1 Low	The establishment of the site protection instrument provides for little enhancement of the aquatic invertebrate fauna of the Gila River and therefore only provides for a functional score of "low."
Presence of Fish and Fish Habitat Structure	1 Low	The establishment of the site protection instrument provides for little enhancement to the fish present in the Gila River and therefore only provides for a functional score of "low."
Riparian/Wetland Vegetation Structure	1 Low	The establishment of the site protection instrument provides for little enhancement of the riparian/wetland vegetation structure of Area C beyond its preservation. Further, this function will be lost with the anticipated arrival of the tamarisk beetle. Preservation of Area C only provides for a functional score of "low."
Age Class Distribution of Woody Riparian or Wetland Vegetation	1 Low	The establishment of the site protection instrument provides for little enhancement of the age-class distribution of riparian and/or wetland vegetation of Area C beyond its preservation. Further, this function will be lost with the anticipated arrival of the tamarisk beetle. Preservation of Area C only provides for a functional score of "low."

Function	Score	Explanation
Native/Non-native Vegetation Species	1 Low	The establishment of the site protection instrument provides for little enhancement of the ratio of native to non-native vegetation of Area C beyond its preservation. Preservation of Area C only provides for a functional score of “low.”

APPENDIX B

MRSC WORKSHEETS

Attachment 12501.6 - SPD Mitigation Ratio Setting Checklist (See 12501-SPD for Revisions Sheet)

1 Date:04/24/15	Corps File No.: SPL-2014-00065-MWL	Project Manager:MWL		
Impact Site Name:	Ephemeral Class A	ORM Resource: River/Stream	Hydrology: Ephemeral	
Impact Cowardin or HGM type:	Riverine	Impact area : 60.40 acres	Impact distance: linear feet	
	Mitigation Sites			
	Mitigation Site Name: Emery Site - Area A Mitigation Type: Restoration ORM Resource Type: River/Stream Cowardin/HGM type: Hydrology:	Mitigation Site Name: Emery Site - Area B Mitigation Type: Enhancement ORM Resource Type: River/Stream Cowardin/HGM type: Hydrology:	Mitigation Site Name: Emery Site - Area C Mitigation Type: Preservation ORM Resource Type: River/Stream Cowardin/HGM type: Hydrology:	
2 **Qualitative impact-mitigation comparison**:	Starting ratio: **1.00 : 1.00** Ratio adjustment: **-1.71** Baseline ratio: **1.00 : 2.71** PM justification: See qualitative sheet for adjustment	Starting ratio: **1.00 : 1.00** Ratio adjustment: **-1.83** Baseline ratio: **1.00 : 2.83** PM justification: See qualitative sheet for adjustment	Starting ratio: **1.00 : 1.00** Ratio adjustment: **4.00** Baseline ratio: **5.00 : 1.00** PM justification: See qualitative sheet for adjustment	
3 **Quantitative impact-mitigation comparison**:	N/A :	N/A :	N/A :	
4 **Mitigation site location**:	Ratio adjustment: **0** PM justification: Impact site and mitigation site are within the same HUC 8.	Ratio adjustment: **0** PM justification: Impact site and mitigation site are within the same HUC 8.	Ratio adjustment: **0** PM justification: Impact site and mitigation site are within the same HUC 8.	
5 **Net loss of aquatic resource surface area**:	Ratio adjustment: **1** PM justification: No aquatic resource establishment is proposed.	Ratio adjustment: **1** PM justification: No aquatic resource establishment is proposed.	Ratio adjustment: **1** PM justification: No aquatic resource establishment is proposed.	
6 **Type conversion:**	Ratio adjustment: **-1** PM justification: Riparian habitat adjacent to perrenial aquatic resource is a rare and valuable resource in Arizona.	Ratio adjustment: **-2** PM justification: Riparian habitat adjacent to perrenial aquatic resource is a rare and valuable resource in Arizona.	Ratio adjustment: **0** PM justification: Riparian habitat adjacent to perrenial aquatic resource is a rare and valuable resource in Arizona.	
7 **Risk and uncertainty**:	Ratio adjustment: **0.3** PM justification: Permittee-responsible mitigation, vegetation maintenance, artifical hydrology (at least during establiment)	Ratio adjustment: **0.3** PM justification: Permittee-responsible mitigation, vegetation maintenance, artifical hydrology (at least during establiment)	Ratio adjustment: **0** PM justification: Permittee-responsible mitigation.	
8 **Temporal loss**:	Ratio adjustment: **3** PM justification: Tree species.	Ratio adjustment: **3** PM justification: Tree species.	Ratio adjustment: **0** PM justification: Preservation only.	
9 **Final mitigation ratio(s):**	Baseline ratio from 2 or 3: 1.00 : 2.71 Total adjustments (4-8): 3.3 Final ratio: **4.30 : 2.71** 1.59 : 1 to Resource type: River/Stream Cowardin or HGM: Riverine Hydrology: Total Acreage at Site 50.00 acres feet of Resource type: River/Stream Cowardin or HGM: Riverine Hydrology: 0 Mitigation Credits: 31.49 acres feet	Baseline ratio from 2 or 3: 1.00 : 2.83 Total adjustments (4-8): 2.3 Final ratio: **3.30 : 2.83** 1.16 : 1 to Resource type: River/Stream Cowardin or HGM: Riverine Hydrology: Total Acreage at Site 59.00 acres feet of Resource type: River/Stream Cowardin or HGM: 0 Hydrology: 0 Mitigation Credits: 50.66 acres feet	Baseline ratio from 2 or 3: 5.00 : 1.00 Total adjustments (4-8): 1 Final ratio: **6.00 : 1.00** 6.00 : 1 to Resource type: River/Stream Cowardin or HGM: Riverine Hydrology: Total Acreage at Site 42.00 acres linear feet of Resource type: River/Stream Cowardin or HGM: 0 Hydrology: 0 Mitigation Credits: 7.00 acres linear feet	
10 **Final compensatory mitigation requirements:**	Starting impact: 60.40 acres Remaining Impact: 28.91 acres Additional PM comments:	Starting impact: 60.40 acres Remaining Impact: 9.74 acres Additional PM comments:	Starting impact: 60.40 acres Remaining Impact: 53.40 acres Additional PM comments:	

Class A - Low-Gradient Ephemeral Class Features

	Function	Score
Physical	Hydrologic Connectivity	3
	Subsurface Flow\Groundwater Recharge	2
	Energy Dissipation	3
	Sediment Transport/Regulation	3
Chemical	Elements, Compounds, and Particulate Cycling	2
	Organic Carbon Export/Sequestration	2
Biotic	Aquatic Invertebrate Fauna	0
	Presence of Fish\Fish Habitat Structure	0
	Riparian/Wetland Habitat Structure	1
	Age Class Distribution of Wooded Riparian or Wetland Habitat	3
	Native/Non-native Vegetation Species	5

Area A - Field to Riparian Restoration

	Function	Functional Score of Impact Site	Functional Gain from Mitigation	Amount of Functional Loss (impact) or Functional Gain (mitigation)	Ratio Adjustment
Physical	Hydrologic Connectivity	3	5	↑	
	Subsurface Flow\Groundwater Recharge	2	4	↑	
	Energy Dissipation	3	5	↑	
	Sediment Transport/Regulation	3	5	↑	-0.79
Chemical	Elements, Compounds, and Particulate Cycling	2	5	↑↑	
	Organic Carbon Export/Sequestration	2	5	↑↑	-0.42
Biotic	Aquatic Invertebrate Fauna	0	0	↔	
	Presence of Fish\Fish Habitat Structure	0	0	↔	
	Riparian/Wetland Habitat Structure	1	3	↑	
	Age Class Distribution of Wooded Riparian or Wetland Habitat	3	4	↔	
	Native/Non-native Vegetation Species	5	5	↔	-0.50
	Total	24	41	↑	-1.71

Total Adjustment:	-1.71
PM Justification:	

Area B - Tamarisk Control and Riparian Enhancement

	Function	Functional Score of Impact Site	Functional Gain from Mitigation	Amount of Functional Loss (impact) or Functional Gain (mitigation)	Ratio Adjustment
Physical	Hydrologic Connectivity	3	4	↔	
	Subsurface Flow\Groundwater Recharge	2	4	↑	
	Energy Dissipation	3	4	↔	
	Sediment Transport/Regulation	3	5	↑	-0.71
Chemical	Elements, Compounds, and Particulate Cycling	2	4	↑	
	Organic Carbon Export/Sequestration	2	4	↑	-0.33
Biotic	Aquatic Invertebrate Fauna	0	5	↑↑↑	
	Presence of Fish\Fish Habitat Structure	0	1	↑	
	Riparian/Wetland Habitat Structure	1	5	↑↑	
	Age Class Distribution of Wooded Riparian or Wetland Habitat	3	5	↑	
	Native/Non-native Vegetation Species	5	3	↓	-0.79
	Total	24	44	↑	-1.83

Total Adjustment:	-1.83
PM Justification:	

Area C - Preservation

	Function	Functional Score of Impact Site	Functional Gain from Mitigation	Amount of Functional Loss (impact) or Functional Gain (mitigation)	Ratio Adjustment
Physical	Hydrologic Connectivity	3	1	↓	
	Subsurface Flow\Groundwater Recharge	2	1	↔	
	Energy Dissipation	3	1	↓	
	Sediment Transport/Regulation	3	1	↓	0.17
Chemical	Elements, Compounds, and Particulate Cycling	2	1	↔	
	Organic Carbon Export/Sequestration	2	1	↔	0.08
Biotic	Aquatic Invertebrate Fauna	0	1	↑	
	Presence of Fish\Fish Habitat Structure	0	1	↑	
	Riparian/Wetland Habitat Structure	1	1	↔	
	Age Class Distribution of Wooded Riparian or Wetland Habitat	3	1	↓	
	Native/Non-native Vegetation Species	5	1	↓↓	0.21
	Total	24	11	↓	0.46

Total Adjustment: 4.00

PM Justification: Per MRSC instructions, adjustments for preservation-only mitigation should generally fall towards the high end of the range.

1 Date:04/24/15	Corps File No.: SPL-2014-00065-MWL	Project Manager:MWL		
Impact Site Name:	Ephemeral Class B / ORM Resource	River/Stream	Hydrology: Ephemeral	
Impact Cowardin or HGM type:	Riverine / Impact area :	30.03 acres	Impact distance: linear feet	
	Mitigation Sites			
	Mitigation Site Name: Emery Site - Area A Mitigation Type: Restoration ORM Resource Type: River/Stream Cowardin/HGM type: Hydrology:	Mitigation Site Name: Emery Site - Area B Mitigation Type: Enhancement ORM Resource Type: River/Stream Cowardin/HGM type: Hydrology:	Mitigation Site Name: Emery Site - Area C Mitigation Type: Preservation ORM Resource Type: River/Stream Cowardin/HGM type: Hydrology:	
2 **Qualitative impact-mitigation comparison**:	Starting ratio: **1.00 : 1.00** Ratio adjustment: **-2.00** Baseline ratio: **1.00 : 3.00** PM justification: See qualitative sheet for adjustment	Starting ratio: **1.00 : 1.00** Ratio adjustment: **-2.00** Baseline ratio: **1.00 : 3.00** PM justification: See qualitative sheet for adjustment	Starting ratio: **1.00 : 1.00** Ratio adjustment: **4.00** Baseline ratio: **5.00 : 1.00** PM justification: See qualitative sheet for adjustment	
3 **Quantitative impact-mitigation comparison**:	N/A :	N/A :	N/A :	
4 **Mitigation site location**:	Ratio adjustment: **0** PM justification: Impact site and mitigation site are within the same HUC 8.	Ratio adjustment: **0** PM justification: Impact site and mitigation site are within the same HUC 8.	Ratio adjustment: **0** PM justification: Impact site and mitigation site are within the same HUC 8.	
5 **Net loss of aquatic resource surface area**:	Ratio adjustment: **1** PM justification: No aquatic resource establishment is proposed.	Ratio adjustment: **1** PM justification: No aquatic resource establishment is proposed.	Ratio adjustment: **1** PM justification: No aquatic resource establishment is proposed.	
6 **Type conversion:**	Ratio adjustment: **-1** PM justification: Riparian habitat adjacent to perrenial aquatic resource is a rare and valuable resource in Arizona.	Ratio adjustment: **-2** PM justification: Riparian habitat adjacent to perrenial aquatic resource is a rare and valuable resource in Arizona.	Ratio adjustment: **0** PM justification: Although this riparian habitat is adjacent to aperrenial aquatic resource, only preservation is proposed.	
7 **Risk and uncertainty**:	Ratio adjustment: **0.3** PM justification: Permittee-responsible mitigation	Ratio adjustment: **0.3** PM justification: Permittee-responsible mitigation and planned vegetation maintenance.	Ratio adjustment: **0** PM justification: Permittee-responsible mitigation.	
8 **Temporal loss**:	Ratio adjustment: **3** PM justification: Tree species.	Ratio adjustment: **3** PM justification: Tree species.	Ratio adjustment: **0** PM justification: Preservation only.	
9 **Final mitigation ratio(s):**	Baseline ratio from 2 or 3: 1.00 : 3.00 Total adjustments (4-8): 3.3 Final ratio: **4.30 : 3.00** 1.43 : 1 to Resource type: River/Stream Cowardin or HGM: Riverine Hydrology: Total Acreage at Site 50.00 acres feet of Resource type: River/Stream Cowardin or HGM: Riverine Hydrology: 0 Mitigation Credits: 34.88 acres feet	Baseline ratio from 2 or 3: 1.00 : 3.00 Total adjustments (4-8): 2.3 Final ratio: **3.30 : 3.00** 1.10 : 1 to Resource type: River/Stream Cowardin or HGM: Riverine Hydrology: Total Acreage at Site 59.00 acres feet of Resource type: River/Stream Cowardin or HGM: 0 Hydrology: 0 Mitigation Credits: 53.64 acres feet	Baseline ratio from 2 or 3: 5.00 : 1.00 Total adjustments (4-8): 1 Final ratio: **6.00 : 1.00** 6.00 : 1 to Resource type: River/Stream Cowardin or HGM: Riverine Hydrology: Total Acreage at Site 42.00 acres linear feet of Resource type: River/Stream Cowardin or HGM: 0 Hydrology: 0 Mitigation Credits: 7.00 acres linear feet	
10 **Final compensatory mitigation requirements:**	Starting impact: 30.03 acres Remaining Impact: -4.85 acres Additional PM comments:	Starting impact: 30.03 acres Remaining Impact: -23.61 acres Additional PM comments:	Starting impact: 30.03 acres Remaining Impact: 23.03 acres Additional PM comments:	

Class B - Moderate- to High-Gradient Ephemeral Class Features

	Function	Score
Physical	Hydrologic Connectivity	3
	Subsurface Flow\Groundwater Recharge	1
	Energy Dissipation	1
	Sediment Transport/Regulation	1
Chemical	Elements, Compounds, and Particulate Cycling	1
	Organic Carbon Export/Sequestration	1
Biotic	Aquatic Invertebrate Fauna	0
	Presence of Fish\Fish Habitat Structure	0
	Riparian/Wetland Habitat Structure	1
	Age Class Distribution of Wooded Riparian or Wetland Habitat	4
	Native/Non-native Vegetation Species	5

Area A - Field to Riparian Restoration

	Function	Functional Score of Impact Site	Functional Gain from Mitigation	Amount of Functional Loss (impact) or Functional Gain (mitigation)	Ratio Adjustment
Physical	Hydrologic Connectivity	3	5	↑	
	Subsurface Flow\Groundwater Recharge	1	4	↑	
	Energy Dissipation	1	5	↑↑	
	Sediment Transport/Regulation	1	5	↑↑	-1.06
Chemical	Elements, Compounds, and Particulate Cycling	1	5	↑↑	
	Organic Carbon Export/Sequestration	1	5	↑↑	-0.56
Biotic	Aquatic Invertebrate Fauna	0	0	↔	
	Presence of Fish\Fish Habitat Structure	0	0	↔	
	Riparian/Wetland Habitat Structure	1	3	↑	
	Age Class Distribution of Wooded Riparian or Wetland Habitat	4	4	↔	
	Native/Non-native Vegetation Species	5	5	↔	-0.67
	Total	18	41	↑	-2.28

Total Adjustment: -2.00

PM Justification: Per MRSC instructions, if for most functions I<M, the adjustment should not be less than -2.00.

Area B - Tamarisk Control and Riparian Enhancement

	Function	Functional Score of Impact Site	Functional Gain from Mitigation	Amount of Functional Loss (impact) or Functional Gain (mitigation)	Ratio Adjustment
Physical	Hydrologic Connectivity	3	4	↔	
	Subsurface Flow\Groundwater Recharge	1	4	↑	
	Energy Dissipation	1	4	↑	
	Sediment Transport/Regulation	1	5	↑↑	-0.94
Chemical	Elements, Compounds, and Particulate Cycling	1	4	↑	
	Organic Carbon Export/Sequestration	1	4	↑	-0.44
Biotic	Aquatic Invertebrate Fauna	0	5	↑↑↑	
	Presence of Fish\Fish Habitat Structure	0	1	↑	
	Riparian/Wetland Habitat Structure	1	5	↑↑	
	Age Class Distribution of Wooded Riparian or Wetland Habitat	4	5	↑	
	Native/Non-native Vegetation Species	5	3	↓	-1.06
	Total	18	44	↑	-2.44

Total Adjustment:	-2.00
PM Justification: Per MRSC instructions, if for most functions I<M, the adjustment should not be less than -2.00.	

Area C - Preservation

	Function	Functional Score of Impact Site	Functional Gain from Mitigation	Amount of Functional Loss (impact) or Functional Gain (mitigation)	Ratio Adjustment
Physical	Hydrologic Connectivity	3	1	↓	
	Subsurface Flow\Groundwater Recharge	1	1	↔	
	Energy Dissipation	1	1	↔	
	Sediment Transport/Regulation	1	1	↔	0.22
Chemical	Elements, Compounds, and Particulate Cycling	1	1	↔	
	Organic Carbon Export/Sequestration	1	1	↔	0.11
Biotic	Aquatic Invertebrate Fauna	0	1	↑	
	Presence of Fish\Fish Habitat Structure	0	1	↑	
	Riparian/Wetland Habitat Structure	1	1	↔	
	Age Class Distribution of Wooded Riparian or Wetland Habitat	4	1	↓	
	Native/Non-native Vegetation Species	5	1	↓↓	0.28
	Total	18	11		0.61

Total Adjustment:	4.00
PM Justification: Per MRSC instructions, adjustments for preservation-only mitigation should generally fall towards the high end of the range.	