USDA

United States Department of Agriculture

DRAFT Environmental Impact Statement

Resolution Copper Project and Land Exchange

Volume 4

Forest Service | Tonto National Forest | MB-R3-12-07 | August 2019

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Front Cover photo captions:
Top: Oak Flat Federal Parcel;
Bottom Left: Oak Flat Federal Parcel;
Bottom Right: Headframe of Shaft 10 at East Plant Site

Back Cover photo captions:
Top left: Shaft 9 and 10 at East Plant Site;
Top center: MARRCO corridor;
Top right: Picket Post mountain;
Bottom left: Oak Flat Federal Parcel ;
Bottom right: Overlooking West Plant Site, Town of Superior and Picket Post mountain

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APPENDIX F. ALTERNATIVES CONSIDERED BUT DISMISSED FROM DETAILED ANALYSIS

Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required under the National Environmental Policy Act (NEPA) to rigorously explore and objectively evaluate all reasonable alternatives which were eliminated from detailed study, and to briefly discuss the reasons for their having been eliminated (40 Code of Federal Regulations [CFR] 1502.14). All comments received from the public, cooperating agencies, tribes, and the project team during the scoping period in response to the proposed action that provided suggestions for alternative methods for achieving the purpose and need were considered for analysis (SWCA Environmental Consultants 2017b). Some of these alternatives were determined to be outside the scope of the project, duplicative of the alternatives already being considered in detail, unable to fulfill the purpose and need, technically or economically infeasible, or involved components or actions that would cause unnecessary environmental harm, and therefore, were not considered for detailed analysis. A number of alternatives were initially considered and analyzed but later dismissed from further detailed analysis in the environmental impact statement (EIS) for reasons summarized in the following text. Additional information can be found in the "Resolution Copper Project and Land Exchange Environmental Impact Statement Draft Alternatives Evaluation Report" (SWCA Environmental Consultants 2017a).

Alternative Mining Techniques

Substantial public comments were received concerning Resolution Copper Mining, LLC's (Resolution Copper's) proposed panel caving mining technique (panel caving is a form of block caving), in particular requesting that alternative mining techniques be considered or required. Public comments asked for alternatives considering the following items:

- use of traditional mining methods, including less-mechanized forms of mining,
- investigation of alternatives that would result in minimal surface disturbance, and
- use of alternative mining methods to reduce the volume of tailings produced.

The proposed panel caving mining method is seen as having two major drawbacks. First, panel caving results in the creation of a subsidence area at the surface, which impacts a variety of resources. Second, because panel caving does not leave any opening or cavity belowground, there is no opportunity to backfill tailings as a potential disposal alternative. The U.S. Department of Agriculture Forest Service (Forest Service) agreed that if an alternative mining method were found to be reasonable, it could reduce certain resource impacts, and the agency undertook an investigation into the technical and economic feasibility of using alternative mining techniques.

OPEN-PIT MINING

Open-pit mining was considered but eliminated from detailed analysis because it would result in surface disturbances greater than those in the proposed action (panel caving), causing unnecessary environmental harm. Specifically:

- The footprint of the open pit would need to be approximately 10,000 acres, which is eight times larger than the projected maximum disturbance from subsidence (approximately 1,200 acres).
- The resulting pit would result in the removal of all of Oak Flat, all of Apache Leap, approximately 4 miles of U.S. Route 60, approximately 3 miles of Queen Creek, and approximately 3 miles of Devil's Canyon.
- The pit would have a stripping ratio (waste rock to ore) of 35:1 and would result in approximately 205 billion tons of waste rock. This represents more than 100 times more volume than the

projected volume of tailings under the General Plan of Operations (GPO). The waste rock generated from mining would need to be disposed of at some surface location, and a tailings impoundment would still be required.

ALTERNATIVE UNDERGROUND MINING TECHNIQUES

The term "stope" used in mining simply indicates an underground excavation or room, and the term "stoping" refers to any underground mining technique that removes ore from these areas. A spectrum of underground mining techniques was assessed, including naturally supported stoping methods (open stoping, open stoping with pillars), artificially supported stoping methods (shrinkage stoping, overhand and underhand cut-and-fill), other caved stoping methods aside from panel caving (sub-level caving), and other stoping methods like vertical crater retreat. These alternative underground mining techniques are described in detail in the "Resolution Copper Project and Land Exchange Environmental Impact Statement Draft Alternatives Evaluation Report" (SWCA Environmental Consultants 2017a). Each of these stoping methods is suited to certain characteristics of an ore body, including ore and host rock strength, the depth and type of overburden or cap rock, and the size and shape of the ore body. As shown in table F-1, very few of these underground stoping methods have characteristics that are well suited to the Resolution copper deposit, even though technically these methods could be used.

Table F-1. Summary of underground stoping methods and their applicability to the Resolution Copper Mine ore deposit

Underground Stoping Method	Ideal Ore Body Characteristics	Ideal Ore Strength	Ideal Host Rock Strength	Backfill with Tailings Materials
Resolution Copper Mine Deposit	*Low grade, massive, thick*	*Weak–Moderate*	*Weak–Moderate*	*No*
Cut-and-fill	High grade, irregular, narrow to wide	Strong	Weak*	Yes
Open stoping	Small	Strong	Strong	Possible
Open stoping with pillar support	Low grade, horizontal or flat dipping	Strong	Strong	Possible
Shrinkage stoping	Fairly high grade, narrow to wide (4 to 100 feet) thick	Strong	Moderate*	Possible
Vertical crater retreat stoping	>40 feet thick	Strong	Strong	Possible

***** Indicates a match with the characteristics of the Resolution Copper Mine ore deposit

While there are other underground stoping techniques that could physically be applied to the Resolution copper deposit, each of the alternative underground mining methods assessed was found to have higher operational costs than panel caving. Higher operations costs would result in a shift in the "cutoff grade" of ore that could be profitably mined. The cutoff grade (given as a percentage) is the lowest grade of copper for a ton of ore that equals the cost of stripping, drilling, blasting, mining, hauling, crushing, and processing the ore (as well as administrative costs, taxes, and other overhead costs), given the current price and mill recovery.

The current cutoff grade as proposed by Resolution Copper is a greater-than-1-percent copper shell, which would result in the greatest potential volume of ore from within the deposit that can be profitably mined. The alternative underground techniques considered would shift the cutoff grade much higher and substantially reduce the amount of ore that could be profitably mined. As shown in table F-2, at a 2 percent cutoff grade, it is estimated that less than 20 percent of the deposit identified by Resolution Copper could be mined. At a 3 percent cutoff grade, it is estimated that less than 1 percent of the deposit

could be mined. For comparison, the average grade of ore removed from the historic Magma Mine has been reported to be 5 percent. This higher grade of ore was able to support a cut-and-fill mining technique.

Table F-2. Estimated volume of Resolution Copper Mine deposit at various cutoff grades

Cutoff Grade	Estimated Volume (tons)	Percentage of Volume Proposed to Be Mined in GPO (%)	Source	Average Grade of Ore above the Cutoff Grade
1%	1,969,000,000	100	Resolution Copper	1.54%
2%	386,437,500	19.6	Independent estimate from Resolution Copper data	Unknown
3%	7,545,919	0.4	Extrapolation from first two data points	Unknown
4%	1,478,469	0.08	Extrapolation from first two data points	Unknown
5%	289,676	0.02	Extrapolation from first two data points	Unknown

Reasonableness of Alternative Mining Techniques

The Forest Service recognizes and acknowledges scoping comments that suggest the use of mining techniques other than panel caving could substantially reduce impacts on surface resources, both by reducing or eliminating subsidence and by allowing the potential of backfilling tailings underground. For this reason, the potential for using alternative mining techniques was investigated explicitly during the alternatives development process.

In the end, alternative mining techniques as applied specifically to the Resolution Copper Mine deposit were not found to be reasonable, with the following rationale:

1. Panel caving is a standard mining method used in the industry and is commonly used for deposits with the grade, size, depth, and geological characteristics of the Resolution Copper Mine deposit.
2. While several underground stoping techniques could physically and technically be applied to the deposit, the ore and host rock characteristics typically favorable for these techniques differ from the characteristics of the Resolution Copper Mine deposit. While physically feasible, it is unlikely that any of these techniques would be chosen as a reasonable technique for a similar deposit.
3. Use of any of these alternative underground stoping techniques would result in higher per-ton mining costs, and as a result the cutoff grade for the deposit would need to be higher to be economically feasible. An increase in the cutoff grade from 1 percent to 2 percent removes an estimated 80 percent of the tonnage of the deposit from consideration for development. The tonnage is likely to be even lower at a 2 percent cutoff grade, as many of these areas of high-grade ore are not contiguous or continuous. Accepting this level of reduction to accommodate an alternative mining technique is not economically feasible and would not be reasonable.

This threshold of reasonableness is consistent with guidance contained in the Forest Service minerals and geology manual (Forest Service Manual [FSM] 2800) (U.S. Forest Service 2006):

> The claimant has the right to see or otherwise dispose of *all locatable minerals*, including uncommon varieties of mineral materials, on which the claimant has a valid claim. (FSM 2813.12, emphasis added)
>
> In managing the use of the surface and surface resources, the Forest Service should attempt to minimize or prevent, mitigate, and repair adverse environmental impacts on National Forest System surface and cultural resources as a result of lawful prospecting,

> exploration, mining, and mineral processing operations, as well as activities reasonably incident to such uses. This should be accomplished by imposition of reasonable conditions *which do not materially interfere with such operations.* (FSM 2817.02, emphasis added)

The Forest Service found the substantial decreases in ore development that would result by requiring an alternative mining technique would not meet the definition of reasonable, would not allow Resolution Copper to dispose of all locatable minerals on which it has valid claims, and would materially interfere with its operations. For the above reasons, alternative mining techniques were considered but eliminated from detailed analysis.

Brownfield Tailings Disposal

During scoping, public comments requested that the Forest Service identify a "brownfield" location (a site that is largely disturbed by previous activity) to store the tailings waste generated in the mining process. A list of potential brownfield sites was developed by reviewing possible mining brownfield sites in Arizona that could potentially hold all or a portion of the tailings anticipated to be produced through mining operations described in the GPO.

Fourteen existing pits or brownfield mine sites were originally considered for tailings disposal and are described in the following text.

AJO

The expected pumping distance to the Ajo pit is estimated to be over 120 miles and would cross numerous public and private jurisdictions. The environmental harm associated with long-distance transport corridors would be substantial, and this location offers only a partial disposal option and does not prevent the placement of a large tailings facility on Federal land. For these reasons, use of the Ajo pit was considered to be unreasonable and was dismissed.

CARLOTA

The Carlota site is over an existing heap leach pad and has minimal to no pit capacity for containing all of the potentially acid generating (PAG) material; tailings storage would require an embankment and expansion of this heap leach area. The site is located on a complex geological area that results in high geological and hydrogeological constraints, and tailings located here have the potential to impair water quality in Pinto Creek and would require creek diversions. Location of the tailings storage facility in this location would not address the water quality issues, and the alternative was therefore dismissed.

CASA GRANDE

Initial estimates showed that the Casa Grande pit potentially had the capacity to hold the PAG tailings material. Upon further investigation, it was determined that it does not have adequate capacity to store the PAG tailings material and is therefore not a suitable option for future tailings storage. This and other pits were also considered further as possible components of an alternative that would dispose of all tailings in multiple brownfield locations, but there was insufficient capacity to store all tailings, even with multiple locations.

COPPER QUEEN (BISBEE, ARIZONA)

Copper Queen Mine is a popular tourist attraction in Bisbee, Arizona. The mine hosts tours, includes a museum, and is visited by many tourists every year. The environmental harm associated with hundreds of miles of pipeline corridor disturbance across Federal, tribal, and other lands would be substantial. For these reasons, it was removed from further consideration for tailings storage.

COPPERSTONE

The Copperstone site does not have the capacity to store all or even the PAG-only portion of the Resolution Copper Mine tailings; this location was therefore removed from consideration for tailings storage.

GREEN VALLEY / SIERRITA

The Green Valley/Sierrita Mine has an ongoing mining operations; for that reason, it was dismissed from further investigation.

JOHNSON CAMP

The Johnson Camp mine has the potential for future mining operations and does not have the capacity to store all or the PAG portion of the tailings. For these reasons, the site was removed from further consideration for tailings storage.

MIAMI AND INSPIRATION / MIAMI UNIT AND COPPER CITY

The Miami and Inspiration / Miami Unit and Copper City mines are located within the Pinal Creek Water Quality Assurance Revolving Fund (WQARF), which is the State of Arizona's equivalent to Superfund. While not absolute, the legal concept of "joint and several liability" that drives Superfund means that use or ownership of these sites would potentially reflect liability on Resolution Copper Mining, LLC. Consideration of these sites was not considered reasonable and therefore they were dismissed.

PINTO VALLEY MINE

The anticipated Pinto Valley Mine operation and closure was considered; however, it was determined that the mine could still be operational at the time when tailings storage is required for the Resolution Copper Project. Because current mine life is projected through 2039, the project team dismissed this location from further investigation. Tailings storage would require an additional embankment and expansion of this area.

RAY MINE

The Ray Mine has an expected reserve life of between 2044 (ASARCO Grupo Mexico 2019) and 2066 (U.S. Army Corps of Engineers 2016) and is in the process of further expansion of a new tailings facility at Ripsey Wash as well as a land exchange with the U.S. Department of the Interior Bureau of Land Management (BLM). The Ray Mine was removed from further consideration because it is in operation and not available for tailings storage in the necessary project time frame.

RESOLUTION COPPER EAST PLANT SITE SUBSIDENCE AREA (POTENTIAL FUTURE BROWNFIELD SITE)

In addition to reviewing existing brownfields, scoping commenters recommended that the tailings be stored in the proposed Resolution Copper Project East Plant Site subsidence area. The feasibility of placement of tailings in the subsidence area, either as slurry or filtered tailings, was considered during alternatives development. In this scenario, the tailings would be placed initially on undisturbed land above the mining panels in the area that would gradually become a subsidence pit. The subsidence area would then be filled with tailings as it expanded over time. This option was dismissed for safety concerns, both aboveground and belowground. In panel caving, it is paramount to control the rate of panel caving and prevent air gaps from developing above the caved zone, which can lead to potentially catastrophic air blasts. Loading of tailings above the panel cave operation could change the rock dynamics in unexpected and unknown ways. If it involves slurry, the added aspect of drainage from above further complicates mining operations. Safety hazards exist for personnel placing tailings aboveground as well, given the active subsidence and earth movement. Overall, it was determined that this option represented unreasonable safety hazards and did not conform to industry norms.

SAN MANUEL

The expected pumping distance to the San Manuel pit is estimated to be approximately 50 miles (straight-line distance). A review of the site's geology shows a high-angle fault in the area. Hydrogeological conditions are unknown at this time but could present additional concerns. San Manuel was originally considered to represent a reasonable option; however, Resolution Copper raised concerns about its ability to control water quality after placement of PAG tailings in the existing pit, given the proximity to the San Pedro River. These concerns were further investigated by the project team, including review of Arizona Department of Environmental Quality (ADEQ) documents related to the closure of San Manuel. The best available information at this time suggests that use of the San Manuel pit would not successfully address the single driving issue of water quality. Specifically, the disposal methodology would not prevent oxidation of PAG material and current gradients would deliver acid drainage directly to the aquifer. Further, movement of seepage into groundwater and movement of groundwater away from the pit would not be controlled, as the current hydraulic sink would be expected to disappear without a pit lake present. The groundwater gradient would potentially deliver poor-quality groundwater directly to the San Pedro River. For these reasons, the San Manuel pit was eliminated from detailed analysis in the draft EIS (DEIS).

TOHONO CYPRUS

The Tohono Cyprus site does not have the capacity to store all or the PAG portion of the tailings and was therefore eliminated from further consideration.

TWIN BUTTES

Twin Buttes has ongoing operations and future operation plans that make it infeasible for future tailings storage. The location would also require tailings to be pumped almost 100 miles (straight-line distance).

Other Alternative Tailings Disposal Locations

In response to public scoping comments, the Forest Service investigated a number of alternative tailings disposal locations (figure F-1). During the alternative evaluation process, the Forest Service reviewed the regional landscape to identify alternative locations that could potentially solve resource issues. These

locations were then combined with the alternative locations previously identified by Resolution Copper (see section 3.3.10.1 of the GPO) and evaluated to determine which locations should be dismissed and which locations should be carried forward for inclusion in the DEIS. Table F-3 presents the dismissal rationale for the tailings facility alternative locations not carried forward in the DEIS. These locations were dismissed because they do not improve upon significant issues of concern over the proposed GPO location.

Agency-Identified Alternative Tailings Disposal Locations and Techniques Considered but Ultimately Dismissed from Detailed Analysis

As noted in table F-3, the alternative of using filtered (or "dry stack") tailings rather than slurry tailings was eventually brought forward for detailed analysis at the Silver King location, very near the West Plant Site, rather than at the GPO location. This is now Alternative 4 (described in section 2.2.6) in the DEIS.

Additionally, as a result of extensive meetings and consultations during the latter part of 2017 and early 2018, between the Tonto National Forest, the BLM, and Resolution Copper, together with information provided by the Arizona State Land Department (ASLD), BLM, and other cooperating agencies, four additional alternative tailings locations and/or alternative construction techniques came under serious consideration. The first two of these were proposed near, but not in the exact same location as, the previously considered "BGC C" alternative location shown in figure F-1 and described in table F-3.

This general location south of the Gila River came to be known as the "Peg Leg" site, after the name of a nearby wash. The major advantages it presented as an alternative tailings storage site included a) relative remoteness from population centers and other infrastructure; b) relative proximity to other ongoing and historic mining activities; c) generally level topography on a base primarily consisting of alluvial soils, rather than the more upland, rocky, steeper terrain characteristic of the GPO and Silver King locations; and d) lower recreational use and perceived scenic value than the GPO and Silver King areas.

The two "Peg Leg" alternatives that ultimately emerged were proposed to occupy approximately the same footprint south of the Gila River and west of State Route 177, but each would employ different construction techniques.

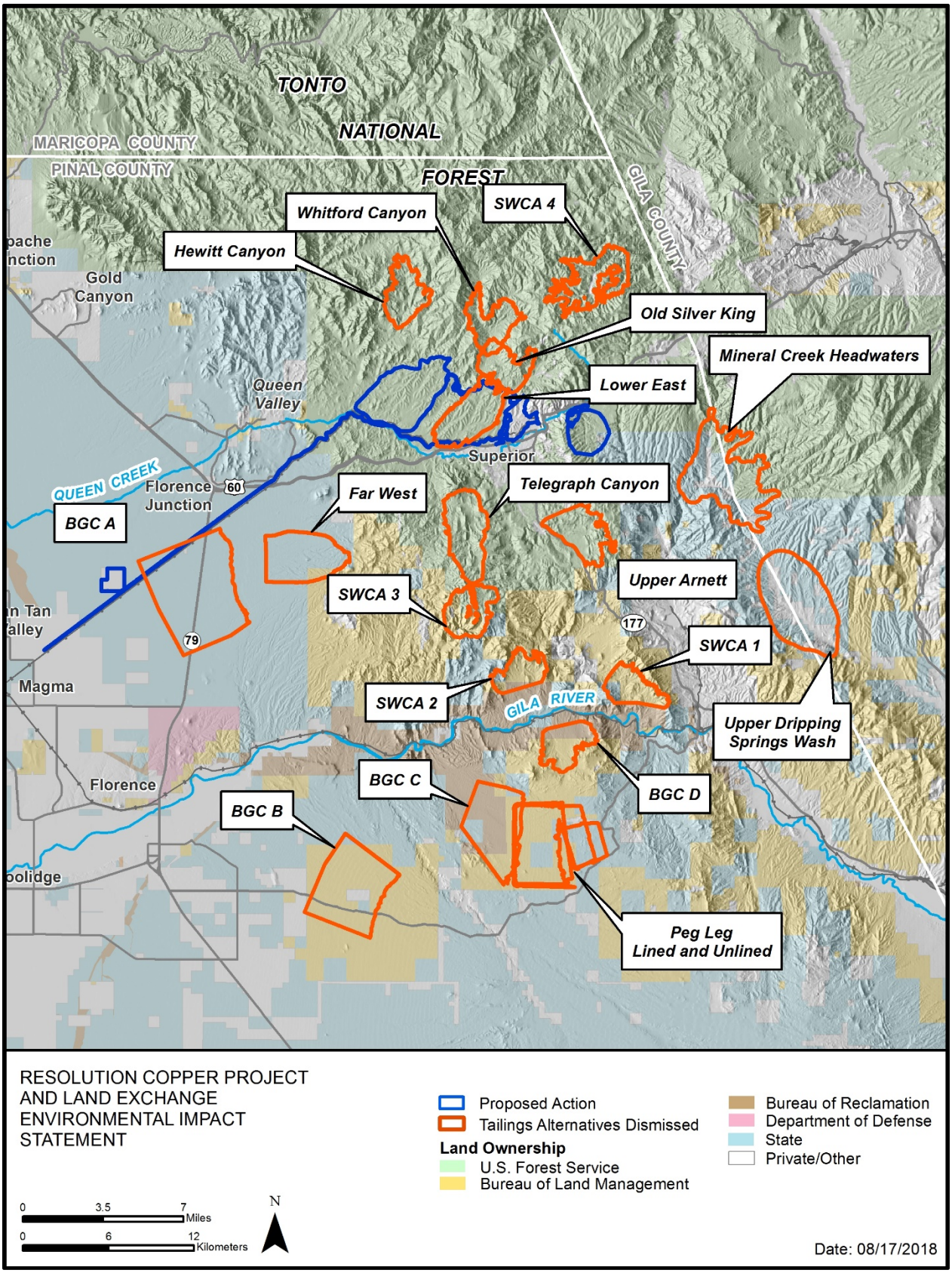

Figure F-1. Tailings facility alternative locations considered but dismissed from detailed study

Table F-3. Alternative tailings facility locations considered but dismissed from detailed analysis

Alternative Location	Rationale for Dismissal
Whitford Canyon	The location does not provide an overall improvement upon the GPO location for key resource issues: • Water resource impacts: higher tributary area relative to other alternative locations. • Very close to Superstition Wilderness designated Class II airshed; too close for permitting. • Recreation impacts: directly covers the Arizona National Scenic Trail and disrupts popular off-highway vehicle loop route connections. • Biological impacts on a larger variety of biotic communities than most of other alternatives, including on areas deemed sensitive vegetation communities.
Hewitt Canyon	The location does not provide an overall improvement upon the GPO location for key resource issues: • Water resource impacts: higher tributary area relative to other alternative locations. • Very close to Superstition Wilderness designated Class II airshed; too close for permitting. • Recreation impacts on trails and disrupts popular off-highway vehicle loop route connections. • Biological impacts on a larger variety of biotic communities than most of other alternatives, including on areas deemed sensitive vegetation communities. • Longer tailings pipeline/transfer corridor relative to other alternative locations in the Queen Creek watershed.
Telegraph Canyon	The location does not provide an overall improvement upon the GPO location for key resource issues (water resources, biological resources, recreation resources): • Water resource impacts; hydrology drainage impacts; biological impacts on Important Bird Areas and riparian areas. • Recreation impacts on roads and trails; would cover large portion of the Arizona National Scenic Trail.
Lower East	The location does not provide an overall improvement upon the GPO location for key resource issues: • Water resource impacts. • Closer to the receptor Boyce Thompson Arboretum. • Closer to U.S. Route 60 and town of Superior.
Far West	The Forest Service sent an inquiry to the Arizona State Land Department (ASLD), the landowner, regarding the potential availability at this location for a tailings facility. ASLD responded that the agency has plans for future residential development for the area and therefore it is not available at this time, or in the future, for locating a tailings facility. For this reason, the location was dismissed from further investigation.
BGC A	The location does not provide an overall improvement upon the GPO location for key resource issues: • Water resource impacts, higher number of wells nearby. • Closer to receptors (residential areas). • Potentially encroaches on area infrastructure (roads).
BGC B	The location does not provide an overall improvement upon the GPO location for key resource issues: • Water resource impact, proximity to Gila River (potentially already degraded water quality). • Closer to receptors (residential areas). • Visual resource impacts, proximity to Florence area and nearby residential areas.
BGC D	The location does not provide an overall improvement upon the GPO location for key resource issues: • Water resource impacts: stormwater management more difficult due to local terrain and proximity to the Gila River. • Recreation impacts, including proximity to the Arizona National Scenic Trail.
SWCA 1	The location does not provide an overall improvement upon the GPO location for key resource issues: • Water resource impacts: stormwater management more difficult due to local terrain and proximity to the Gila River. • Recreation impacts, including proximity to the Arizona National Scenic Trail.
SWCA 2	The location does not provide an overall improvement upon the GPO location for key resource issues: • Water resource impacts: stormwater management more difficult due to local terrain and proximity to the Gila River.

Alternative Location	Rationale for Dismissal
SWCA 3	The location does not provide an overall improvement upon the GPO location for key resource issues: • Landscape constraints (very steep terrain, occupy two watersheds, high probability of faults for landslides). • Recreation impacts, proximity to the Arizona National Scenic Trail.
SWCA 4	This location was removed from consideration for key resource issues: • Water resource impacts, drainage into Roosevelt Lake. • Encroaches on Superstition Wilderness, a Class I airshed.
Upper Arnett	This location was removed from consideration for key resource issues: • Water resource impacts, impacts Arnett Creek, higher upstream in the watershed. • Biological resources, contains more unfragmented wildlife habitat, compared with other alternatives. • Proximity to area infrastructure, State Route 177. • Design confined by highway and landscape features provides less design flexibility. • Longer tailings pipeline/transfer corridor relative to other alternative locations.
Filtered Tailings at the GPO Tailings Facility Location	In response to public scoping comments, the Forest Service considered a tailings alternative of filtered tailings (also commonly known as dry stack tailings) at the proposed GPO tailings facility location. Ultimately, the Forest Service determined that due to the logistical concerns associated with water management and the tailings pipeline/transfer corridor, the evaluation of this alternative tailings technique would occur at the Alternative 4 (Silver King) location.
Silver King	The original location as considered by Resolution Community Working Group was moved to avoid a historic cemetery, underground mine workings of Silver King, mineral estate, and private land. The Silver King location was eliminated as a suitable location for slurry impoundment for water resource concerns but is being moved forward for detailed analysis as a filtered tailings location.
BGC C	This alternative location represented the first iteration of what eventually became Alternative 5 – Peg Leg. This specific location was relocated to move off of U.S. Bureau of Reclamation withdrawn lands; once moved, it evolved into the Peg Leg – Lined and Peg Leg – Unlined alternatives (see below).
Peg Leg – Lined	See more detail in the following text.
Peg Leg – Unlined	See more detail in the following text.
Mineral Creek Headwaters	See more detail in the following text.
Upper Dripping Spring Wash	See more detail in the following text.

Peg Leg – Lined

The first, known as “Peg Leg – Lined,” would be located primarily on BLM- and ASLD-administered lands (figure F-2) and would be constructed behind a downstream-type embankment, rather than an upstream-type embankment as proposed at the GPO location, and would be fully lined.

Though not as efficient with space or materials necessary to construct as an upstream embankment, the downstream embankment configuration is considered robust and least prone to failure of all tailings embankment types. However, the great disadvantage of the downstream-type embankment is that it requires enormous amounts of non-tailings material (i.e., earthfill) to construct, and it must occupy in perpetuity a substantially greater surface area adjacent to the tailings impoundment itself. The issue with constructing a downstream embankment with borrow materials is that storage requirements would be increased by about one-third because the cyclone sand materials that are used to construct the other embankment options would need to be stored behind the borrow embankment.

Under the "Peg Leg – Lined" alternative, the PAG and non-potentially acid generating (NPAG) cells would be kept separate, rather than merging later during tailings facility development as under the GPO plan, and both cells would be fully lined with an engineered low-permeability liner or equivalent containment system that would continue to be enlarged vertically as the two cells grew in height over time. The PAG cell would be kept continuously saturated to reduce the chances for oxidation/metal leaching, and tailings would be deposited in both cells subaqueously. Any seepage from the PAG and NPAG cells would be collected via the tailings liners and recycled back into the process water, and if necessary treated prior to recycling.

All other major mine plan components such as the East Plant Site infrastructure, block-cave mining, West Plant Site processing, slurry concentrate delivery to the filter plant and loadout facility, and other utility corridors would remain unchanged from those proposed in the GPO, with the exception of a pipeline corridor needed to bring slurry tailings to the Peg Leg site.

Peg Leg – Unlined

Conscious of both the advantages and limitations presented by the downstream embankment type, the Tonto National Forest decided to conduct preliminary analysis of another embankment type and seepage control methodology at the Peg Leg site.

Rather than a downstream embankment configuration, the "Peg Leg – Unlined" alternative proposed a centerline-type embankment, in which subsequent "raises" or "lifts" to the embankment over time would be built atop earlier levels of compacted cycloned tailings and earthfill.

The decision to proceed with this alternative as an unlined facility was deliberate in that it would allow direct comparison of the environmental effects of an unlined facility at this location—i.e., on a primarily alluvial soil base—versus a fully lined facility at the same Peg Leg location, and also provide an opportunity to evaluate the effects of an unlined facility on alluvium versus an unlined facility at the GPO location, as described in the original GPO Alternative 2 – Proposed Action (since abandoned in favor of detailed analysis of the two GPO Modified Proposed Actions now presented in the DEIS in sections 2.2.4 and 2.2.5).

Under the "Peg Leg – Unlined" alternative, seepage would be controlled through a series of downstream collection embankments and ponds, monitoring wells, and pumpback systems.

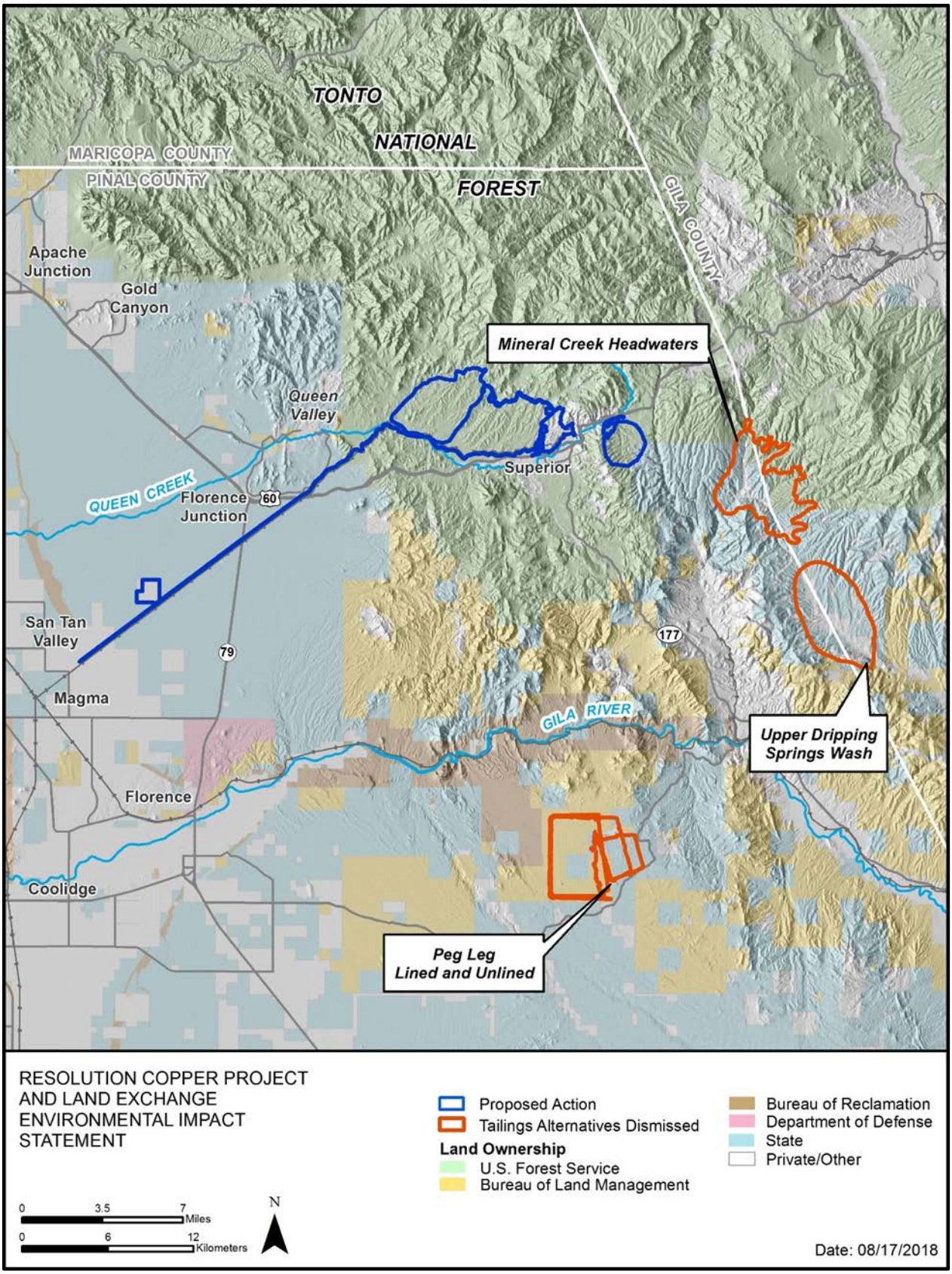

Figure F-2. Alternative tailings facility locations on BLM lands

RATIONALE FOR DISMISSAL FROM DETAILED ANALYSIS OF THE "PEG LEG – LINED" AND "PEG LEG – UNLINED" ALTERNATIVES

After several months of preliminary analysis by Forest Service resource specialists and Resolution Copper technical staff, it was determined that neither the Peg Leg – Lined nor the Peg Leg – Unlined alternatives warranted detailed analysis in the EIS.

Resolution Copper's engineering consultants estimated that generating the huge volumes of earthfill from within the Peg Leg tailings site's footprint in order to construct a downstream embankment would require excavating 0.9 billion tons of soil to a depth up to 160 feet from throughout the roughly 7,000-acre facility—essentially creating a major open-pit aggregate mining operation in addition to the underground mining proposed at the Oak Flat/East Plant Site. Further calculations estimated the effort would require full-time use of more than 140 earthmoving vehicles (dozers, backhoes, haul trucks, etc.), an increase over the amount of equipment needed for other slurry tailings alternatives. The direct carbon dioxide equivalent (CO_{2e}) emissions are 80 to 132 percent higher than the emissions expected at any other alternative embankment types under consideration. The project would have emissions of carbon monoxide (CO), sulfur dioxide (SO_2), nitric oxide (NO), volatile organic compounds (VOCs), and particulate matter (PM_{10} and $PM_{2.5}$). The Tonto National Forest therefore decided to eliminate this alternative because the adverse environmental effects of implementing it were determined to be substantially greater than either the GPO Proposed Action or the other tailings site alternatives already under consideration.

Similarly, the Peg Leg – Unlined alternative was eliminated from further consideration because preliminary analysis had shown the subsurface seepage resulting from having an unlined facility atop an alluvial soil base would be so great as to not be controllable, which would in turn require substantial additional pumping of fresh water to make up the lost seepage.

However, after several months of study, Resolution Copper approached officials at the Tonto National Forest with a proposal for yet a third alternative tailings facility design at the Peg Leg site that combined best practice tailings management aspects from both the Peg Leg lined and unlined alternatives. Their recommended design would shift the entire facility slightly to the east so that the PAG cells could be constructed as a physically separate facility atop a broad outcropping of predominately consolidated rock, retained behind a downstream embankment, while the much greater volume of NPAG tailings would remain on the alluvial base immediately to the west, retained behind a centerline-type embankment. The entire PAG facility would be lined with an engineered low-permeability barrier, while the NPAG facility would be partially lined with an engineered low-permeability liner along the interior, upstream side of the embankment. This design preserves an alternative at the Peg Leg location and incorporates key components of the downstream embankment, centerline embankment, and lining.

This new alternative Peg Leg design has been carried forward for detailed analysis in the DEIS as Alternative 5 – Peg Leg (see section 2.2.7).

In late 2017 and early 2018, meetings between Tonto National Forest managers and BLM managers and resource specialists resulted in two additional tailings storage facility locations being put forth for consideration—neither of which either the Tonto National Forest or Resolution Copper had previously evaluated. These two alternative locations, which were initially referred to as the Mineral Creek Headwaters and Upper Dripping Spring alternatives, are described in greater detail in the following text.

Mineral Creek Headwaters

The BLM identified two general locations in watersheds approximately 7 and 11 miles, respectively, to the southeast of the town of Superior and approximately 3 miles northeast and directly east of the ASARCO Ray Mine as potential tailings sites that the agency believed warranted at least preliminary investigation (see figure F-2).

The first of these, which BLM referred to for planning purposes as the Mineral Creek Headwaters site, is a 6,077-acre area comprising 2.3 acres of BLM-administered public lands, 662 acres of Arizona State Trust surface with Federal mineral estate, 4,304 acres of Arizona State Trust lands with no Federal mineral estate, 80 acres of private surface with Federal mineral estate, and 1,029 acres of private lands with no Federal mineral estate. BLM stated that mining company ASARCO presently holds 21 mining claims within the area. The topography is a steep canyon with smaller side canyons.

Resource specialists and planners at the Tonto National Forest conducted a first-stage screening of the suitability of the Mineral Creek Headwaters area as a site for a future tailings storage facility. Although presumably of sufficient size to store the requisite volume of tailings, the site lies directly atop a perennial reach of Mineral Creek and abundant riparian vegetation. It would also occupy designated critical habitat for Gila chub. For these reasons the Mineral Creek Headwaters site was eliminated from further consideration as a viable alternative for detailed analysis in the EIS.

Upper Dripping Spring Wash

The second potential site identified by the BLM is known as Upper Dripping Spring Wash, a 7,058-acre area directly east of the ASARCO Ray Mine. The site consists of a broad ephemeral wash bounded on the west by the Dripping Spring Mountains and on the east by the Mescal Mountains and the Pinal Mountains, approximately 13 miles north of the confluence of Dripping Spring Wash and the Gila River.

In terms of jurisdiction, the area identified by the BLM comprises 69 acres of BLM-administered public lands, 800 acres of Arizona State Trust surface with Federal mineral estate, 3,762 acres of Arizona State Trust lands with no Federal mineral estate, and 2,427 acres of private lands with no Federal mineral estate. The BLM identified 13 existing mining claims located within the proposed general boundaries of the site. Resolution Copper considered their initial hydrologic and geological assessments of the area highly promising and they engaged their engineering staff and contractors to develop a preliminary design for a tailings facility near this location. The Upper Dripping Spring Wash alternative was eliminated from further consideration as an alternative for detailed analysis in the EIS. However, based on a design for a 3,995-acre tailings impoundment (exclusive of roads, pipeline corridors, and other auxiliary facilities) on only private and Arizona State Trust lands, the Tonto National Forest approved detailed analysis in the DEIS for Alternative 6 and named it “Skunk Camp” for the nearby Skunk Camp Wash. Please see chapter 2 of the DEIS, section 2.2.8.

APPENDIX G. FURTHER DETAILS OF EAST PLANT SITE, WEST PLANT SITE, MARRCO CORRIDOR, AND FILTER PLANT AND LOADOUT FACILITY INFRASTRUCTURE

East Plant Site

Existing East Plant Site Facilities

Several of the existing mine facilities were constructed as part of the Magma Mine, which ceased operations in the mid-1990s, and are either being used by Resolution Copper Mining, LLC (Resolution Copper) to support mineral exploration or are unused legacy facilities. The unused legacy facilities include buildings, cooling towers, a descalant tank, and a wastewater treatment plant. Many of the existing East Plant Site facilities would continue to be used for mining operations and would need to be expanded. Table G-1 identifies the existing East Plant Site facilities and their proposed operations function.

Table G-1. Existing East Plant Site facilities

Facility	Current Function	Proposed Function and/or Changes During Operations
Magma Mine Road	Access to East Plant Site from U.S. Route 60	Access to East Plant Site from U.S. Route 60 (would be realigned at approximately year 8 of operations [mine year 14])
Mine Shaft 9	Supports ongoing installation of Shaft 10	Upcast exhaust shaft
Mine Shaft 10	Under construction, provides development rock for geochemical testing	Upcast exhaust shaft
Decline portal	Provides access to Shaft 10 and ventilation and refrigeration	No functional change
Batch plant	Produces concrete and shotcrete	No functional change; may be expanded, if needed
Electrical and mechanical building	Houses drill core processing and maintenance facilities	No functional change
Compressor building	Houses air compressors and water chillers	No functional change; additional compressor buildings would be constructed near new mine shafts
Water chilling plant	Chills water for Shaft 10	Would be eliminated and replaced by new refrigeration system for downcast Shafts 11, 12, and 13
115-kV Salt River Project (SRP) transmission line	Provides electricity to East Plant Site facilities	Would provide back-up redundancy to the 230-kV SRP transmission lines
115-kV Oak Flat electrical substation	Provides electricity to East Plant Site facilities	Would provide backup power for the underground mining area
Dry facilities	Provides showers, lavatories, and locker facilities for employees and contractors	No functional change; supplemental dry facility would be constructed
General administration building	Offices for mine management, operations, engineering, safety, and environmental personnel	No functional change; would be relocated and expanded
Storage and maintenance facilities	Materials and equipment storage and workshops for equipment maintenance	No functional change; additional storage and equipment maintenance workshops would be constructed
Explosives storage	Storage for explosives in accordance with ATF standards	No functional change; a storage area for surface explosives magazines would be constructed away from the main East Plant Site footprint
Contractor yards	Laydown yards for contractor deliveries	No functional change; laydown yard would be expanded
Chemical storage and containment areas	Containment area for the storage of chemicals	No functional change; chemical storage and containment areas would be located at several of the East Plant Site facilities

Facility	Current Function	Proposed Function and/or Changes During Operations
Water tanks	Two potable water tanks supplying East Plant Site with water delivered by the Never Sweat Tunnel	No functional change; a new mine service water tank would be constructed
Fuel tanks	Storage of fuel	No functional change; additional aboveground and underground fuel tanks would be constructed
Laydown areas	Areas for equipment sorting and stockpiling and materials delivery	No functional change; laydown area locations would change throughout mining phases
Stormwater management	Retention basins for stormwater runoff from impervious areas	No functional change; additional stormwater management facilities would be constructed for expanded East Plant Site footprint
Parking lot	Parking area for employees, contractors, and visitors for approximately 100 vehicles	No functional change; would be relocated and expanded to accommodate approximately 320 vehicles
Security trailer	Controls access to the East Plant Site from Magma Mine Road	No functional change
Public viewing terrace	Terrace overlooking the subsidence area with mine information	Closed to public, mine roads at East Plant Site would be closed to the public
Helicopter pad	Helicopter pad for transporting individuals to advanced medical facilities	No functional change; would be relocated
National Forest System (NFS) Roads	NFS Roads 2432, 2433, 2434, 315, and 469	Segments of these roads that are within the disturbance area and subsidence area would be closed to public access and/or decommissioned.

The Never Sweat Tunnel, an additional existing facility, connects the East Plant Site to the West Plant Site. The Never Sweat Tunnel currently serves two primary functions: (1) the tunnel transports development rock[1] via railcar to the West Plant Site from the underground exploratory development activities at the East Plant Site, and (2) the tunnel transports water to and from the West Plant Site and the East Plant Site. The Never Sweat Tunnel would continue with these functions during mine construction and operations phases.

New East Plant Site Facilities

The primary proposed new mine facilities at the East Plant Site include four additional mine shafts and associated hoisting facilities, the realignment of Magma Mine Road, a wastewater treatment plant, a new Oak Flat substation, the Resolution Copper North substation, and various other facilities (see figure 2.2.2-7). Two new 230-kV power lines, both operated by the Salt River Project (SRP), would be built to support the power demands and to increase the safety and reliability of underground operations.

MINE SHAFTS

Four new mine shafts and associated facilities (hoist houses and a winder house) would be constructed for ore production, hoisting employees in and out of the mine, refrigeration and ventilation purposes, and the construction of mine levels during mine development. Three of the new shafts (Shafts 11, 13, and 14) would be constructed on Resolution Copper–owned land, and one shaft would be constructed on lands currently managed by the Tonto National Forest (Shaft 12) but would be private after the execution of the land exchange.

[1] "Development rock" is rock removed during construction of tunnels and shafts. It may or may not have economic levels of copper. For the most part, development rock is stockpiled and then used during startup of the processing plant.

Table G-2 provides an overview of the six mine shafts that would be used during operations.

Table G-2. Mine shaft overview

Mine Shaft	Surface Ownership	New or Existing	Full Production Phase Function
9	Resolution Copper	Existing (currently being deepened and rehabilitated)	Upcast exhaust shaft
10	Resolution Copper	Existing	Upcast exhaust shaft
11	Resolution Copper	New	Production/downcast fresh air intake
12	Forest Service	New	Production/downcast fresh air intake
13	Resolution Copper	New	Service (employees and equipment)/downcast fresh air intake
14	Resolution Copper	New	Upcast exhaust shaft

MAGMA MINE ROAD REALIGNMENT AND EAST PLANT SITE ROADS

The existing Magma Mine Road is a two-lane paved road that provides access to the East Plant Site from U.S. Route 60. A segment of the existing Magma Mine Road would be located within the anticipated mining subsidence area. At approximately year 8 of mine operations (mine year 14), the segment of the Magma Mine Road within the subsidence area would be relocated outside the subsidence area to the north. The realigned roadway would be a two-lane paved road and would be used by mine employees, contractors, deliveries, and visitors to the mine. The proposed realignment of the Magma Mine Road is depicted in figure 2.2.2-5.

New paved and dirt roads would be constructed within the 133-acre East Plant Site that would connect the various facilities within the site. The roads would not be open for public access and would be used by mine employees and contractors only.

REFRIGERATION PLANT

A primary refrigeration system would be constructed to produce cool air and water for the underground mining operation. This system would consist of a bulk air cooler supplying each downcast shaft, a central refrigeration plant with a service water refrigeration system to provide chilled water, and thermal storage via a chilled water tank. All cooling systems would be equipped by multiple-cell condenser cooling towers for heat rejection.

WASTEWATER TREATMENT PLANT

Sewage from aboveground and underground facilities would be treated at a newly constructed wastewater treatment plant. Sewage from underground mine facilities would be transported to the plant on the surface via a system of pumps. The plant would be an extended aeration biological plant that uses a biological process for treating wastewater and separating the solids from liquid portion of the waste. Designed by the manufacturer, the “packaged plant” would provide treatment to secondary standards as defined by the Arizona Department of Environmental Quality (ADEQ).

ELECTRICAL SUBSTATIONS AND POWER LINES

Two new substations would be constructed at the East Plant Site: the Oak Flat substation and the Resolution Copper North substation and backup. The primary substation for the East Plant Site would be the 230-kV Oak Flat substation, which would be constructed north of the new production shafts to

provide power for aboveground and belowground activities. The substation would be powered by a new 230-kV transmission line originating from the SRP Silver King Substation north of U.S. Route 60.

The North substation and backup would be an alternate power substation and emergency generators would be located next to the production power to provide a backup electricity system. The emergency generators would be capable of backfeeding the main distribution system and would be able to operate the service auxiliary hoist in Shaft 13, partial mine cooling/ventilation system, and other essential services. The emergency generator system would have sufficient capacity to supply the total essential mine load with one of the generators out of service for maintenance.

Two new 230-kV power lines would be built by SRP within a 150-foot corridor with tower heights not typically exceeding 140 feet. Two lines are needed to increase safety and reliability of underground operations. The Silver King to Oak Flat 230-kV transmission main would provide power from the existing Silver King substation north of U.S. Route 60 to the new Oak Flat substation at the East Plant Site. The Superior to Oak Flat 230-kV power line main would provide redundant power from the East Plant Site to the new Superior substation at the West Plant Site.

OTHER NEW EAST PLANT SITE FACILITIES

Other new facilities that would be constructed at the expanded East Plant Site include a wash bay, a standalone first aid building, and a training building. The wash bay would use high-pressure water hoses and oil-water separators to clean vehicles and equipment. Wastewater from the wash bay would be sent to the Never Sweat Tunnel, where it would be combined with East Plant Site contact water and delivered to the West Plant Site process water system. Table G-3 identifies the major consumables, materials, and supplies that would be used at the East Plant Site, their delivered form, and their storage method.

Table G-3. Consumables, materials, and supplies used at East Plant Site

Material/Supply	Delivered Form	Considered Hazardous*	Storage Method
Diesel fuel	Liquid	Yes	Tanks
Propane	Gas	Yes	Tanks
Oils/Lubricants	Liquid	Yes	Sealed drums/totes
Antifreeze	Liquid	Yes	Individual containers
Solvents	Liquid	Yes	Individual containers
Explosives (emulsion product)	Solid	Yes	Locked magazines
Explosives (blasting detonators)	Solid	Yes	Locked magazines
Welding cylinders (argon gas, acetylene, etc.)	Gas	Yes	Cylinder storage corral
Hardware	Solid	No	General stores shelving
Carpentry supplies	Solid	No	General stores shelving

* Potential for physical, chemical, and/or environmental hazard

West Plant Site

Existing West Plant Site Facilities

Currently, the West Plant Site receives development rock from construction of tunnels, shafts, and underground infrastructure at the East Plant Site via the Never Sweat Tunnel. The development rock is sorted at the West Plant Site, tested for mineral composition, and stored at stockpiles. Development rock

is later processed as part of the startup of the concentrator complex. Similar to the East Plant Site, the West Plant Site consists of existing mine facilities constructed during historic mining operations that are either being used by Resolution Copper to support mineral exploration or are unused legacy facilities. The unused legacy facilities include tailings ponds, houses and offices in the upper basin, and the smelter complex. Of these legacy facilities, several have been reclaimed, including the 500-yard waste rock facility, smelter pond, depot pond, Settling Pond 2, and Tailings Pond 5. Several additional legacy facilities at the West Plant Site are currently in the process of being reclaimed, including the smelter facility and Tailings Ponds 6 and 7.

Table G-4 identifies the existing West Plant Site facilities that are currently used for mineral exploration and would continue to be used during mining operations and the facility's proposed function.

Table G-4. Existing West Plant Site facilities

Facility	Current Function	Proposed Function and/or Changes during Operations
Development rock stockpile	Storage of inert NPAG development rock from the East Plant Site for use in construction and reclamation	No functional change; stockpile would expand to a maximum capacity of 10.3 million cubic yards
Intermediate rock stockpiles	Storage of mineralized development rock delivered from the East Plant Site; maximum capacity of up to 774,000 tons or 498,000 cubic yards	No change
Staging areas	Temporary storage of development rock	No functional change; additional staging areas would be constructed near new mine entrance and other facilities
Borrow areas	Aggregate material supply for ongoing closure, redevelopment, and erosion control	No functional change or change in location
General administration building	Offices for mine management, operations, engineering, safety, and environmental personnel	No functional change; a larger additional administration building would be constructed near the new main entrance
Chemical storage facility	Chemicals used in mining activities are stored in Building 203	No functional change; chemical storage and containment areas would be located at several of the West Plant Site facilities
High-density sludge treatment system	Treatment of dewatering water to reduce total dissolved solids, metals, and pH	Dewatering water would be used in the processing cycle
Apex tunnel	Stormwater diversion	No change
Parking lots	Employee, contractor, and visitor parking	New parking areas would be constructed throughout the expanded West Plant Site; new main entrance at Lone Tree; parking for 650 vehicles
Security buildings and gates at access points	Controls access at Main Gate and Lone Tree access points	No functional change; two new security buildings and gates would be constructed: (1) at the relocated main entrance at Main Street and Magma Heights Road, and (2) NFS Road 229 to control access during construction of new substation
Arizona Water Company CAP water tank	500,000-gallon potable water and fire flow supply for West Plant Site and East Plant Site; receives water from a 36-inch water pipeline	No change
Water supply pipelines	Distributes water throughout the West Plant Site and to the mine supply water tank for delivery to East Plant Site via a 16-inch pipeline in the Never Sweat Tunnel	Additional water supply pipelines would be constructed for new and expanded facilities
SRP 115-kV Trask substation	Distribute electricity throughout West Plant Site	Power supplied from the substation would be replaced with a 34.5-kV overhead transmission line to a new 34.5/4.16-kV transformer

Facility	Current Function	Proposed Function and/or Changes during Operations
115-kV SRP transmission line	Electrical supply for West Plant Site	Rerouted to new Superior substation
Stormwater management	Controls and contains stormwater drainage from West Plant Site	Stormwater management system would be expanded to accommodate new and expanded facilities
Laydown yards	Temporary storage for construction deliveries	New laydown yards would be constructed for new and expanded facilities
Private roads	Roads within West Plant Site connecting facilities	New roads would be constructed to connect new and expanded facilities
NFS Road 229 (Silver King Mine Road) and NFS Road 1010	Provides secondary road access to the West Plant Site	NFS Road 229 would be reconstructed between U.S. Route 60 and the West Plant Site to allow for use by construction and mine equipment
Never Sweat Tunnel substation	Provides electricity to Never Sweat Tunnel	No change
Never Sweat Tunnel ventilation	Provides cooling for the Never Sweat Tunnel	No change

New West Plant Site Facilities

The proposed action would expand the West Plant Site from 422 acres to 980 acres to accommodate new facilities. The proposed new mine facilities at the West Plant Site include a new concentrator complex, reconstructed NFS Road 229, new administrative facilities, a water treatment plant, retention and contact water ponds, and electrical substations (see figure 2.2.2-9).

CONCENTRATOR COMPLEX

The concentrator complex at the West Plant Site would employ a traditional sulfide ore processing technique to process up between 132,000 to 165,000 tons of ore per day. The primary structural components of the concentrator complex would be the water process pond, the ore stockpile facility, the grinding circuit, the flotation circuit, and the molybdenum plant.

Process Water Pond and Storage Tank

The process water pond would hold up to 50 million gallons of water for use at the concentrator complex. The pond would be located west of the concentrator complex buildings and be used to pump process water to a 1-million-gallon storage tank at elevation above the concentrator. The tank provides the required head pressure needed at the concentrator. The pond would receive water from a variety of water sources, including Central Arizona Project (CAP) water, return water from the underground mine, and recovered water from the filter plant. The pond would be equipped with emergency overflow and a diversion ditch would be provided to route any potential overflows to a contact water pond south of the concentrator complex. The pond would be constructed so that it is double lined with leak detection and collection in accordance with the ADEQ best available demonstrated control technology requirements. Personnel and wildlife would be protected from entering the pond site with a chain-link fence surrounding the designated area. An emergency overflow containment downstream of the pond located on Resolution Copper property would be required.

Fresh Water Storage Tank

Fresh water would be supplied to the mine from the CAP water canal and wells along the Magma Arizona Railroad Company (MARRCO) corridor. Water is pumped to the West Plant Site along the MARRCO

rail line to a 2-million-gallon CAP water distribution tank. This tank would be located above the concentrator.

Ore Stockpile

Crushed ore from the East Plant Site would be delivered to the West Plant Site via a conveyor system. The conveyor would unload the crushed ore at a covered ore stockpile adjacent to the concentrator complex. The ore stockpile would have a living capacity of 132,000 tons of ore and a total capacity of 441,000 tons. The ore stockpile is a surge facility for the mining operation to allow for short-term shutdowns of either the active mining operations at the East Plant Site or the concentrator operations while the other facility is still in operation.

Grinding Circuit

Ore from the East Plant Site and the ore stockpile would be delivered to the grinding circuit, where the crushed ore would be further ground with water into a slurry before being sent to the flotation circuit. Final grinding circuit design would be determined closer to operations, but according to the General Plan of Operations (GPO) (2016d), the grinding circuit is currently expected to consist of either two semi-autogenous grinding mills and four ball mills or three semi-autogenous mills and six ball mills. Once ore is processed at the semi-autogenous mills and ball mills, the slurry would be distributed to hydrocyclone classifiers (cyclones). Cyclone overflow, the final grinding circuit product, would then be delivered to the flotation circuit for further concentrate processing.

Flotation Circuit

After leaving the grinding circuit, copper and molybdenum would be concentrated in the bulk copper-molybdenum flotation circuit. The flotation circuit would consist of flotation tank cells, a regrind mill, cleaner cells, and copper and molybdenum thickening tanks. Chemical reagents would be used at the thickening tanks to further concentrate the copper and molybdenum and cause it to float to the surface of the slurry where it can be recovered. Chemical reagents would be stored and handled at a separate enclosed reagent building adjacent to the concentrator complex. Recovered molybdenum would be sent to the molybdenum plant at the concentrator complex for further processing. Recovered copper would be sent to the filter plant via the MAARCO corridor for further processing. Tailings—the processed non-economic waste material that results from copper ore processing—would be sent to the tailings storage facility approximately 3 miles west of the West Plant Site via two pipelines. The GPO (2016d) indicates that tailings slurry would be thickened to solids content of approximately 55 to 65 percent. Tailings low in sulfide or pyrite are considered non-potentially acid generating (NPAG). Tailings high in sulfide or pyrite are considered potentially acid generating (PAG). For a list of reagents that would be used in the concentrator complex's flotation circuit, see GPO table 3.9-3.

Molybdenum Plant

Molybdenum concentrate recovered in the flotation circuit would be further concentrated at the molybdenum plant, where it would be turned into molybdenum filter cake and packaged into sacks or containers. These sacks or containers would be ready for shipment to customers from the molybdenum plant. Approximately four shipments of molybdenum concentrate would be shipped by truck every day from the West Plant Site.

RECONSTRUCTED NFS ROAD 229 (SILVER KING MINE ROAD)

Approximately 1.3 miles of Silver King Mine Road (NFS Road 229) would be reconstructed between U.S. Route 60 and the West Plant Site to provide construction access to the new 230-kV substation. The road would also serve as a secondary access to the West Plant Site that would be designed for use by large construction and mining vehicles and equipment, and would be the main access for large deliveries to and from the West Plant Site.

ADMINISTRATIVE FACILITIES

The existing administrative building would be retained for continued use, and a larger additional administrative building would be constructed near the new main entrance to the West Plant Site. The new administrative building would provide office space for reception, mine management, document control, operations, engineering, safety, and environmental personnel. Space would also be available for conference and safety training rooms, a metallurgical laboratory, a first aid clinic, and dry change house facility.

WATER TREATMENT PLANT

An existing water treatment system is located at the West Plant Site for the treatment water from mine dewatering water at the East Plant Site. Treatment reduces total dissolved solids, metals, and pH prior to delivery to the new Magma Irrigation and Drainage District. During mine operations, water from mine dewatering would be incorporated into the tailings thickener process; however, the water treatment system would remain in place for use as needed.

RETENTION AND CONTACT WATER PONDS

Three new retention and contact water ponds would be constructed to collect and control stormwater flowing from the concentrator and stockpile facilities. The ponds would be located at the foot of the development rock pile and would be designed to collect stormwater for 100-year, 24-hour storm events.

ELECTRICAL SUBSTATIONS AND POWER LINES

A new 230-kV Superior substation would be constructed to provide electricity to West Plant Site facilities. The proposed realignment of Silver King Mine Road would provide access to the new substation during construction. Electricity would be delivered to the new 230-kV substation via a transmission line connection to the existing 230- and 500-kV transmission lines west of the West Plant Site. A redundant electricity supply from the existing Silver King Substation, via the new Oak Flat substation at the East Plant Site, would connect to the new 230-kV substation at the West Plant Site. As needed, several smaller substations would be constructed and connected to the new 230-kV substation to provide electricity to facilities in the West Plant Site.

The existing 115-kV transmission line would be rerouted within the existing West Plant Site boundary to avoid new facilities. A 34.5-kV transmission line would provide power from the West Plant Site along the tailings conveyance corridor to the tailings storage facility. This would power the new facilities at the tailings storage facility.

CONSUMABLES, MATERIALS, AND SUPPLIES USED AT THE WEST PLANT SITE

Table G-5 identifies the major consumables, materials, and supplies that would be used at the West Plant Site, their delivered form, and their storage method. Table G-6 identifies the reagents that would be delivered to, stored, and used at the concentrator complex.

Table G-5. Consumables, materials, and supplies used at the West Plant Site

Material/Supply	Delivered Form	Considered Hazardous*	Storage Method
Diesel fuel	Liquid	Yes	Tanks
Oils/lubricants	Liquid	Yes	Sealed drums/totes
Antifreeze	Liquid	Yes	Individual containers
Solvents	Liquid	Yes	Individual containers
Office supplies	Solid	No	Individual containers
Propane	Gas	Yes	Tanks
Grinding balls	Solid	Yes	Locked magazines
Lab chemicals	Solid	Yes	Locked magazines
Welding cylinders (argon gas, acetylene, etc.)	Gas	Yes	Cylinder storage corral
Hardware	Solid	No	General stores shelving
Carpentry supplies	Solid	No	General stores shelving

* Potential for physical, chemical, and/or environmental hazard

Table G-6. Concentrator complex reagents

Material/Supply	Delivered Form	Considered Hazardous*	Storage Method
Dithiophosphate/monothiosulfate (Cytec 8989; collector) or equivalent copper collector	Bulk truck (liquid)	Yes	Storage tank
Sodium isopropyl xanthate (SIPX; collector)	Drums (dry)	Yes	Drums on pallets
Methyl isobutyl carbinol (MIBC; frother)	Bulk truck (liquid)	Yes	Storage tank
MCO (non-polar flotation oil; molybdenum collector) or #2 Diesel Fuel	Bulk truck (liquid)	Yes	Storage tank
Sodium hydrosulfide (NaHS; copper mineral depressant)	Bulk truck (liquid 30% concentration)	Yes	Storage tank
Flocculant (settling agent)	Bags or super sacks (dry)	Yes	Bags or sacks on pallet
Lime (90% CaO; pH modifier)	Bulk truck (dry)	Yes	Dry storage silos
Antiscalant (water treatment)	Drums (dry) or liquid (totes)	Yes	Drums or totes on pallets
Nitrogen (molybdenum sparge gas)	Vendor or Resolution Copper–owned nitrogen plant	Yes	Nitrogen tank

* Potential for physical, chemical, and/or environmental hazard

MARRCO CORRIDOR

Existing MARRCO Corridor Facilities

The MARRCO corridor is a historic mining railroad corridor that was originally built in the 1920s and ceased operations in the mid-1990s after the closure of the Magma Mine. Several utilities are currently collocated within the MARRCO corridor, including a buried fiber-optic line, an overhead transmission line and telephone line, and buried natural gas pipelines. In addition, the Arizona Water Company maintains a water pipeline and associated facilities within the corridor that supplies the town of Superior with CAP water. More recently, Resolution Copper installed an 18-inch dewatering line within the corridor that delivers treated water from the water treatment plant at the West Plant Site to the new Magma Irrigation and Drainage District. The proposed action would not require these utilities to be relocated or significantly modified.

New MARRCO Corridor Facilities

The proposed action would install several new facilities within or adjacent to the MARRCO corridor. Table G-7 identifies the proposed new facilities in the MARRCO corridor and their function.

Table G-7. New MARRCO corridor facilities

New Facility	Function	Upgrade Needed
CAP water pipeline and associated pump stations and recovery wells	Transport CAP water from CAP canal and recovered filter plant water to West Plant Site through new aboveground 36-inch steel pipeline.	New pump stations would be constructed along corridor to pump CAP water and pressurize pipeline for upgradient delivery to West Plant Site. Locations within the MARRCO corridor between the Queen Creek pump station and West Plant Site would need to be improved by grading and slope stabilization.
Concentrator pipelines	Transport copper concentrate from the West Plant Site to the filter plant and loadout facility through two new 8-inch HDPE-lined steel pipelines.	Grading and slope stabilization would be required at various locations. Depending on site conditions, pipelines would be built aboveground or belowground. The aboveground segments would be located within a containment ditch.
Containment basins	Allow for the emergency storage of concentrate if the pipeline needs to be emptied.	Various locations within the corridor would be excavated and lined with concrete to accommodate upstream volume of concentrate should the pipeline need to be emptied.
Access roads	Provide access to the facilities within the corridor and to the filter plant and loadout facility.	Access roads are described in detail in the Transportation and Access section in chapter 3.
Upgraded rail line and connection to Union Pacific Railroad	Transport copper concentrate from filter plant and loadout facility to the Union Pacific Railroad connection at Magma.	Segment of the rail line between the filter plant and loadout facility and Magma would be upgraded to handle the increase load weight, including an associated upgrade of the rail connection to the Union Pacific Railroad rail line.
Electric lines	Provide electricity to the recovery wells, pump stations, and the filter plant and loadout facility.	Double-circuit 69-kV power lines would be constructed adjacent to the MARRCO corridor to power lines within a new utility easement. The power lines would originate from the Abel substation near the MARRCO corridor's intersection with the CAP canal to the filter plant and loadout facility. A 12-kV power line on the same poles would provide power for the recovery wells within the MARRCO corridor. The power lines would require an additional 50-foot easement adjacent to the northern side of the MARRCO corridor.

FILTER PLANT AND LOADOUT FACILITIES

New Filter Plant and Loadout Facilities

The filter plant (see figure 2.2.2-14) would include a control room, three concentrate stock tanks, up to six concentrate filters, a filtrate clarifier, and compressors. The concentrate would be pumped to the stock tanks and then to the filters. The filtered concentrate would feed via conveyor to the adjacent loadout facility. The filtrate (water) would be separated in the filters and sent to the filtrate clarifier for thickening. Recovered filter water would be sent to a 3-million-gallon water storage tank, where it would mix with CAP water or groundwater before returning to the process water pond at the West Plant Site via a new water supply pipeline within the MARRCO corridor.

The loadout facility (see figure 2.2.2-14) would have a covered stockpile with a capacity of 110,000 tons of concentrate from the filter plant. Concentrate would be loaded into railcars through four hoppers. From the loadout facility, the concentrate would be shipped southwest into Magma Junction, where it would be loaded onto container cars for delivery via the Union Pacific Railroad to an off-site smelter.

As a precautionary measure, a concrete containment basin would also be constructed at the filter plant and loadout facility. The containment basin would allow for the emergency storage of concentrate if the concentrate pipeline in the MARRCO corridor needs to be emptied. The basin would be designed to contain the full volume of both concentrate pipelines.

The filter plant and loadout facility would be accessible from the west by East Skyline Road, east of San Tan Valley, and from the east by State Route 79 and the existing road in the MARRCO corridor. Auxiliary facilities to the filter plant and loadout facility would include a new electrical substation receiving electricity from a transmission line that runs within the MARRCO corridor, a security building, an employee and visitor parking lot, internal roadways, and potable water and wastewater treatment facilities.

CONSUMABLES, MATERIALS, AND SUPPLIES USED AT THE FILTER PLANT AND LOADOUT FACILITY

Table G-8 identifies the major consumables, materials, and supplies that would be used at the filter plant and loadout facility, their delivered form, and their storage method.

Table G-8. Consumables, materials, and supplies used at filter plant and loadout facility

Material/Supply	Delivered Form	Considered Hazardous*	Storage Method
Hardware	Solid	No	General stores shelving
Carpentry supplies	Solid	No	General stores shelving
Office supplies	Solid	No	General stores shelving
Flocculant	Bags or super sacks (dry)	Yes	Bags or sacks on pallets

* Potential for physical, chemical, and/or environmental hazard

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APPENDIX H. FURTHER DETAILS OF MINE WATER BALANCE AND USE

Data Sources

The General Plan of Operations (GPO) describes an initial water budget for the mine, organized by three periods: construction (mine years 1–7), operations (mine years 8–36), and operations rampdown to closure (mine years 37–45) (Resolution Copper 2016d) (GPO figures 3.6-1a–c).

The initial water budget was later reproduced separately for each alternative (WestLand Resources Inc. 2018b). The tables included in this appendix reflect the later alternative water budgets. In some cases, minor differences in amount (within 5 percent) have been ignored for the purposes of simplicity. The water balance for each major mine component (East Plant Site, West Plant Site, filter plant and loadout facility, tailings storage facility, and the makeup water supply from the Desert Wellfield) is described separately.

For the purposes of the draft environmental impact statement (DEIS), a consistent terminology was selected for describing mine phases (Rigg 2017). The alternatives differ from the GPO in that active mining is estimated to only last 40 years, instead of 45 years as described in the GPO. Table H-1 shows the correlation between the various phases from different sources.

Table H-1. Comparison of mine life phases from different water balance data sources

GPO Water Use Phase	GPO Duration	GPO, Translated into EIS Terminology ("Mine Years")	WestLand 2018 Duration	WestLand 2018 Translated into EIS Terminology ("Mine Years")
Construction	9 years	Mine years 1–9		
Mine development/rampup	7 years	Mine years 6–12	7 years	Mine years 6–12
Peak mining	29 years	Mine years 13–41	24 years	Mine years 13–36
Mine rampdown	9 years	Mine years 42–50	10 years	Mine years 37–46

Sources: Resolution Copper (2016d), see table 1.8-1 and figures 3.6-1a–c; WestLand Resources Inc. (2018b), see page 1 and figures 1–15

East Plant Site Water Use

Water input at the East Plant Site would come from two major sources: (1) groundwater inflow, and (2) mine service water. All groundwater inflow into the East Plant Site would be pumped in order to dewater the underground mine infrastructure, and sent through a pipeline to be used in the West Plant Site through the Never Sweat Tunnel. The mine service water could consist of fresh water from the Central Arizona Project (CAP) and recovery wells, combined with filtrate return from the filter plant and loadout facility. Mine service water would be delivered from the West Plant Site through a pipeline in the Never Sweat Tunnel.

Water would leave the East Plant Site in four ways: (1) mine dewatering sent to the West Plant Site, (2) as ore moisture, (3) as water lost through the shaft and vent, and (4) as water lost through refrigerant evaporation. Table H-2 identifies the acre-feet per year (AF/year) of water inflow and outflow for the East Plant Site during the construction, operations, and operations rampdown to closure phases.

Table H-2. East Plant Site water inflow and outflow by source per mine phase

	Operations Rampup (Mine Years 6–12)	Peak Operations (Mine Years 13–36)	Operations Rampdown to Closure (Mine Years 37–46)
Inflow Sources			
Groundwater inflow	2,118	1,772	1,298
Mine service water	5,874	6,944	4,081
Total AF/Year	**7,992**	**8,716**	**5,379**
Total AF/Phase	**55,944**	**209,184**	**53,790**
Outflow Sources			
Mine dewatering	4,967	3,992	2,979
Ore moisture	652	1,476	489
Evaporation from shaft, vent, and refrigeration	2,374	3,247	1,911
Total AF/year	**7,993**	**8,715**	**5,379**
Total AF/Phase	**55,951**	**209,160**	**53,790**

West Plant Site Water Use

The water balances for the West Plant Site and the tailings storage facility are closely related, and both change substantially based on the alternative and changes in tailings deposition and location. Water inputs at the West Plant Site that do not vary by alternative include the following: (1) dewatering from East Plant Site, (2) ore moisture, and (3) treated effluent. Water inputs at the West Plant Site that vary based on the tailings facility include the following: (1) process makeup water and (2) reclaimed water from tailings. Process makeup water would be delivered to the West Plant Site from the CAP recovery wells and recycled from the filter plant through a water pipeline in the Magma Arizona Railroad Company (MARRCO) corridor.

Similarly, some components of water leaving the West Plant Site do not vary by alternative and include the following: (1) evaporation and molybdenum plant losses, and (2) concentrate slurry to the filter plant. Water leaving as (3) tailings slurry (non-potentially acid generating [NPAG] and potentially acid generating [PAG] tailings) varies by alternative. Note that for Alternative 4 (filtered tailings), rather than requiring process water for the West Plant Site, an excess of process water is delivered back to the system.

Table H-3 identifies the AF/year of water inflow and outflow for the West Plant Site during the construction, operations, and operations rampdown to closure phases.

Table H-3. West Plant Site water inflow and outflow by source per mine phase

		Operations Rampup (Mine Years 6–12)	Peak Operations (Mine Years 13–36)	Operations Rampdown to Closure (Mine Years 37–46)
Inflow Sources				
East Plant Site dewatering	All alternatives	4,967	3,992	2,979
Ore moisture	All alternatives	652	1,476	489
Treated effluent	All alternatives	36	36	36
Process makeup water	Alternative 2	3,400	13,757	752
Process makeup water	Alternative 3	1,646	10,076	1,592

		Operations Rampup (Mine Years 6–12)	Peak Operations (Mine Years 13–36)	Operations Rampdown to Closure (Mine Years 37–46)
Process makeup water	Alternative 5	1,884	11,074	4,077
Process makeup water	Alternative 6	46	11,779	3,682
Tailings recycled water	Alternative 2	434	2,989	2,365
Tailings recycled water	Alternative 3	2,181	6,670	1,525
Tailings recycled water/collection pond	Alternative 4	7,365	17,017	4,923
Tailings recycled water	Alternative 5	3,850	9,315	1,724
Tailings recycled water	Alternative 6	5,378	8,598	464
Total AF In/Year	Alternative 2	**9,489**	**22,250**	**6,621**
Total AF Inflow/Phase	Alternative 2	**66,423**	**534,000**	**66,210**
Total AF In/Year	Alternative 3	**9,482**	**22,250**	**6,621**
Total AF Inflow/Phase	Alternative 3	**66,374**	**534,000**	**66,210**
Total AF In/Year	Alternative 4	**13,020**	**22,521**	**8,427**
Total AF Inflow/Phase	Alternative 4	**91,140**	**540,504**	**84,270**
Total AF In/Year	Alternative 5	**11,389**	**25,893**	**9,305**
Total AF Inflow/Phase	Alternative 5	**79,723**	**621,432**	**93,050**
Total AF In/Year	Alternative 6	**11,079**	**25,881**	**7,650**
Total AF Inflow/Phase	Alternative 6	**77,553**	**621,144**	**76,500**
Outflow Sources				
Concentrate slurry	All alternatives	416	942	312
Evaporation and molybdenum plant	All alternatives	490	497	488
Tailings slurry (PAG and NPAG)	Alternative 2	8,582	20,810	5,820
Tailings slurry (PAG and NPAG)	Alternative 3	8,575	20,810	5,820
Tailings slurry (PAG and NPAG)	Alternative 4	8,765	20,830	5,650
Tailings slurry (PAG and NPAG) plus makeup water	Alternative 5	10,481	24,454	8,503
Tailings slurry (PAG and NPAG)	Alternative 6	10,172	24,441	6,849
Process water back to system	Alternative 4 only	3,348	251	1,976
Total AF Out/Year	Alternative 2	**9,488**	**22,249**	**6,620**
Total AF Outflow/Phase	Alternative 2	**66,416**	**533,976**	**66,200**
Total AF Out/Year	Alternative 3	**9,481**	**22,249**	**6,620**
Total AF Outflow/Phase	Alternative 3	**66,367**	**533,976**	**66,200**
Total AF Out/Year	Alternative 4	**13,019**	**22,520**	**8,426**
Total AF Outflow/Phase	Alternative 4	**91,133**	**540,480**	**84,260**

		Operations Rampup (Mine Years 6–12)	Peak Operations (Mine Years 13–36)	Operations Rampdown to Closure (Mine Years 37–46)
Total AF Out/Year	Alternative 5	**11,387**	**25,893**	**9,303**
Total AF Outflow/Phase	Alternative 5	**79,709**	**621,432**	**93,030**
Total AF Out/Year	Alternative 6	**11,078**	**25,880**	**7,649**
Total AF Outflow/Phase	Alternative 6	**77,546**	**621,120**	**76,490**

Tailings Storage Facility Water Use

Water input at the tailings storage facility would come from two sources: (1) delivered with tailings (NPAG and PAG) from the West Plant Site, or (2) as captured precipitation and stormwater runoff from the facility or collection ponds.

Water would leave the tailings storage facility in four ways: (1) water reclaimed and sent back to the West Plant Site, (2) water lost through evaporation, (3) water that is entrained with the tailings, and (4) seepage lost to the aquifer. One additional component—change in storage—reflects the fact that the tailings storage facility water balance is dynamic, and during the first two phases more water is coming into the facility than leaving, while during the last phase more water is leaving than coming in.

The inflows for Alternative 4 exceed the outflows by about 8,700 acre-feet during peak operations. This reflects the fact that more water is recovered than can be used. This water may require additional collection, treatment, and disposal.

Tables H-4 through H-8 identify the AF/year of water inflow and outflow for each tailings storage facility alternative during the construction, operations, and operations rampdown to closure phases.

Table H-4. Alternative 2 tailings storage facility water inflow and outflow by source per mine phase

	Operations Rampup (Mine Years 6–12)	Peak Operations (Mine Years 13–36)	Operations Rampdown to Closure (Mine Years 37–46)
Inflow Sources			
Tailings from West Plant Site	8,582	20,810	5,820
Precipitation and stormwater runoff	1,110	1,865	1,625
Change in storage	0	0	543
Total AF In/Year	**9,692**	**22,675**	**7,988**
Total AF Inflow/Phase	**67,844**	**544,200**	**79,980**
Outflow Sources			
Reclaim to West Plant Site	434	2,989	2,365
Evaporation	3,779	9,705	4,853
Entrainment	4,723	9,692	617
Lost seepage	77	153	153
Change in storage	679	136	0
Total AF Out/Year	**9,692**	**22,675**	**7,988**
Total AF Outflow/Phase	**67,844**	**544,200**	**79,880**

Table H-5. Alternative 3 tailings storage facility water inflow and outflow by source per mine phase

	Operations Rampup (Mine Years 6–12)	Peak Operations (Mine Years 13–36)	Operations Rampdown to Closure (Mine Years 37–46)
Inflow Sources			
Tailings from West Plant Site	8,575	20,810	5,820
Precipitation and stormwater runoff	1,007	1,573	1,573
Change in storage	0	0	256
Total AF In/Year	**9,582**	**22,383**	**7,649**
Total AF Inflow/Phase	**67,074**	**537,192**	**76,490**
Outflow Sources			
Reclaim to West Plant Site	2,181	6,670	1,525
Evaporation	2,296	5,270	3,219
Entrainment	4,421	10,259	2,828
Lost seepage	39	77	77
Change in storage	645	107	0
Total AF Out/Year	**9,582**	**22,383**	**7,649**
Total AF Outflow/Phase	**67,074**	**537,192**	**76,490**

Table H-6. Alternative 4 tailings storage facility water inflow and outflow by source per mine phase

	Operations Rampup (Mine Years 6–12)	Peak Operations (Mine Years 13–36)	Operations Rampdown to Closure (Mine Years 37–46)
Inflow Sources			
Tailings from West Plant Site	8,765	20,830	5,650
Precipitation and stormwater runoff	1,298	2,747	3,584
Total AF In/Year	**10,063**	**23,577**	**9,234**
Total AF Inflow/Phase	**70,441**	**565,848**	**92,340**
Outflow Sources			
Reclaim to West Plant Site, including collection ponds	7,562	17,197	5,370
Evaporation	1,414	3,911	3,134
Entrainment	1,021	2,390	651
Lost seepage	66	79	79
Total AF Out/Year	**10,063**	**23,577**	**9,234**
Total AF Outflow/Phase	**70,441**	**565,848**	**92,340**

Table H-7. Alternative 5 tailings storage facility water inflow and outflow by source per mine phase

	Operations Rampup (Mine Years 6–12)	Peak Operations (Mine Years 13–36)	Operations Rampdown to Closure (Mine Years 37–46)
Inflow Sources			
Tailings from West Plant Site (plus makeup water)	10,481	24,454	8,503

	Operations Rampup (Mine Years 6–12)	Peak Operations (Mine Years 13–36)	Operations Rampdown to Closure (Mine Years 37–46)
Precipitation and stormwater runoff	2,819	6,769	9,645
Change in storage	0	0	15
Total AF In/Year	**13,300**	**31,223**	**18,163**
Total AF Inflow/Phase	**93,100**	**749,352**	**181,630**
Outflow Sources			
Reclaim to West Plant Site	3,850	9,315	1,724
Evaporation	3,028	9,929	12,521
Entrainment	4,822	10,335	2,661
Lost seepage	1,218	1,337	1,257
Change in storage	383	308	0
Total AF Out/Year	**13,301**	**31,224**	**18,163**
Total AF Outflow/Phase	**93,107**	**749,376**	**181,630**

Table H-8. Alternative 6 tailings storage facility water inflow and outflow by source per mine phase

	Operations Rampup (Mine Years 6–12)	Peak Operations (Mine Years 13–36)	Operations Rampdown to Closure (Mine Years 37–46)
Inflow Sources			
Tailings from West Plant Site	10,172	24,441	6,849
Precipitation and stormwater runoff	2,589	5,111	6,451
Change in storage	0	0	306
Total AF In/Year	**12,761**	**29,552**	**13,606**
Total AF Inflow/Phase	**89,327**	**709,248**	**136,060**
Outflow Sources			
Reclaim to West Plant Site	5,378	8,598	464
Evaporation	3,221	11,110	9,524
Entrainment	3,600	9,275	2,991
Lost seepage	114	453	627
Change in storage	448	116	0
Total AF Out/Year	**12,761**	**29,552**	**13,606**
Total AF Outflow/Phase	**89,327**	**709,248**	**136,060**

Filter Plant and Loadout Facility Water Use

Water input at the filter plant and loadout facility would come from a single source: as copper thickener underflow delivered from the West Plant Site through the MARRCO corridor.

Water would leave the filter plant and loadout facility in two ways: (1) as filter return water sent back to the West Plant Site and East Plant Site, and (2) as water lost within concentrate.

Table H-9 identifies the AF/year of water inflow and outflow for the filter plant and loadout facility during the construction, operations, and operations rampdown to closure phases.

Table H-9. Filter plant and loadout facility inflow and outflow by source per mine phase

	Operations Rampup (Mine Years 6–12)	Peak Operations (Mine Years 13–36)	Operations Rampdown to Closure (Mine Years 37–46)
Inflow Sources			
Copper thickener underflow	416	942	312
Total AF per Phase	**2,912**	**22,608**	**3,120**
Outflow Sources			
Filter return to West Plant Site and East Plant Site	342	774	257
Concentrate	74	168	56
Total AF/year	**416**	**942**	**313**
Total AF per Phase	**2,912**	**22,608**	**3,130**

Makeup Water Supply from Desert Wellfield

The overall water balances are complex, with the need to account for multiple reclaim/recycle loops and water sources. However, ultimately the mine water supply for each alternative can be reduced to the need for fresh groundwater to be pumped or recovered from the Desert Wellfield, as shown in table H-10. In the event Resolution Copper Mining, LLC, is successful in obtaining a Non-Indian Agriculture Central Arizona Project contract, this could offset groundwater pumping through direct delivery of water; however, this contract has not been approved or completed and therefore CAP water use is not considered in this appendix.

Table H-10. Fresh groundwater supply requirements per mine phase

		Operations Rampup (Mine Years 6–12)	Peak Operations (Mine Years 13–36)	Operations Rampdown to Closure (Mine Years 37–46)	Total Water Use All Phases
Desert Wellfield pumping (AF/year)	Alternative 2	8,932	19,926	4,576	
Total AF per Phase	**Alternative 2**	**62,524**	**478,224**	**45,760**	**586,508**
Desert Wellfield pumping (AF/year)	Alternative 3	7,178	16,245	5,416	
Total AF per Phase	**Alternative 3**	**50,246**	**389,880**	**54,160**	**494,286**
Desert Wellfield pumping (AF/year)	Alternative 4	2,184	5,918	1,848	
Total AF per Phase	**Alternative 4**	**15,288**	**142,032**	**18,480**	**175,800**
Desert Wellfield pumping (AF/year)	Alternative 5	7,416	17,244	7,901	
Total AF per Phase	**Alternative 5**	**51,912**	**413,856**	**79,010**	**544,778**

		Operations Rampup (Mine Years 6–12)	Peak Operations (Mine Years 13–36)	Operations Rampdown to Closure (Mine Years 37–46)	Total Water Use All Phases
Desert Wellfield pumping (AF/year)	Alternative 6	5,578	17,948	7,506	
Total AF per Phase	**Alternative 6**	**39,046**	**430,752**	**75,060**	**544,858**

APPENDIX I. SUMMARY OF EFFECTS OF THE LAND EXCHANGE

COMPARISON OF 36 CFR 228 REGULATIONS WITH OTHER RELATED STATE (ARIZONA) AND FEDERAL ENVIRONMENTAL REGULATIONS

In virtually all cases, some level of regulatory requirements apply to mining operations, regardless of whether they are taking place on private lands or National Forest System lands (see table I-1). U.S. Department of Agriculture Forest Service (herein called Forest Service) Title 36 Code of Federal Regulations (CFR) Part 228 surface management regulations (columns 1 and 2 in the table) apply only to Federal lands administered by the Forest Service. Other applicable laws, regulations, and rules (column 3) apply to both Federal and private lands, except for State mined land reclamation rules which apply only to private lands.

Unless otherwise indicated in the table, surface resource management regulations are taken from 36 CFR 228. Aquifer Protection Permit (APP) laws and regulations are taken from Arizona Revised Statutes (ARS) 49-241 through 49-252 and Arizona Administrative Code (AAC) R18-9-101 through R18-9-403. Arizona State Mine Inspector laws and regulations are taken from Arizona State reclamation statutes at ARS 27-901, et seq., and rules at R11-2-201, et seq. Other regulations and rules are indicated in table I-1.

Table I-1. Comparison of 36 CFR 228 with Other Applicable Laws, Statutes, Regulations, and Rules

Forest Service Regulations 36 CFR 228 Subpart A – Locatable Minerals	Description	Other Applicable Laws, Statutes, Regulations, and Rules that are comparable to 36 CFR 228 Subpart A – Locatable Minerals
36 CFR 228.4	*Description of Operations.* In a notice of intent submitted to the appropriate District Ranger, sufficient description of the proposed area of activity, route(s) of access, equipment, devices, or practices proposed for use during operations including, where applicable—	None
36 CFR 228.4(c)(2) 36 CFR 228.4(c)(3)	A map or sketch showing information sufficient to locate the proposed area of operations on the ground, existing and/or proposed roads or access routes to be used in connection with the operations as set forth in §228.12, and the approximate location and size of areas where surface resources will be disturbed. Information sufficient to describe or identify the type of operations proposed and how they would be conducted, the type and standard of existing and proposed roads or access routes, the means of transportation used or to be used as set forth in §228.12, the period during which the proposed activity will take place, and measures to be taken to meet the requirements for environmental protection in §228.8.	APP R18-9-A.202.A Technical Requirements Mined Land Reclamation R11-2-501. Mining unit reclamation plan content. Clean Water Act 33 CFR 320 through 332 40 CFR 122
36 CFR 228.8(a)	*Air quality.* Operator shall comply with applicable Federal and State air quality standards, including the requirements of the Clean Air Act, as amended (42 USC 1857 et seq.).	Clean Air Act: Certification by ADEQ; ARS 49-401 et seq.; R18-2-101 et seq.
36 CFR 228.8(b)	*Water quality.* Operator shall comply with applicable Federal and State water quality standards, including regulations issued pursuant to the Federal Water Pollution Control Act, as amended (33 U.S.C. 1151 et seq.).	APP R18-9-A.202.A Technical Requirements Clean Water Act 33 CFR 320 through 332 40 CFR 122 AZPDES (Arizona delegated program) R18-9-B901 et seq.

Forest Service Regulations 36 CFR 228 Subpart A – Locatable Minerals	Description	Other Applicable Laws, Statutes, Regulations, and Rules that are comparable to 36 CFR 228 Subpart A – Locatable Minerals
36 CFR 228.8(c)	*Solid wastes*. Operator shall comply with applicable Federal and State standards for the disposal and treatment of solid wastes. All garbage, refuse, or waste, shall either be removed from National Forest lands or disposed of or treated so as to minimize, so far as is practicable, its impact on the environment and the forest surface resources. All tailings, dumpage, deleterious materials, or substances and other waste produced by operations shall be deployed, arranged, disposed of, or treated so as to minimize adverse impact upon the environment and forest surface resources.	APP R18-9-A.202.A Technical Requirements Clean Water Act 33 CFR 320 through 332 40 CFR 122 AZPDES (Arizona delegated program) R18-9-B901 et seq.
36 CFR 228.8(d)	*Scenic values.* Operator shall, to the extent practicable, harmonize operations with scenic values through such measures as the design and location of operating facilities, including roads and other means of access, vegetative screening of operations, and construction of structures and improvements which blend with the landscape.	None [On most public lands there are no State or other Federal requirements for the protection of scenic values that are comparable to 36 CFR 228.8(d). However, lands having special management designations, such as Wilderness, National Monument, Wild and Scenic River, State Park, and the like are usually bound by particular restrictions on human development and other activities that would tend to alter natural scenic values.]
36 CFR 228.8(e)	*Fisheries and wildlife habitat.* In addition to compliance with water quality and solid waste disposal standards required by this section, operator shall take all practicable measures to maintain and protect fisheries and wildlife habitat which may be affected by the operations.	ARS 27-971. Submission and contents of reclamation plan.
36 CFR 228.8(f)	*Roads.* Operator shall construct and maintain all roads so as to assure adequate drainage and to minimize or, where practicable, eliminate damage to soil, water, and other resource values. Unless otherwise approved by the authorized officer, roads no longer needed for operations: (1) Shall be closed to normal vehicular traffic, (2) Bridges and culverts shall be removed, (3) Cross drains, dips, or water bars shall be constructed, and (4) The road surface shall be shaped to as near a natural contour as practicable and be stabilized.	Mined Land Reclamation R11-2-603. Mining unit reclamation plan content.
36 CFR 228.8(g)	*Reclamation.* Upon exhaustion of the mineral deposit or at the earliest practicable time during operations, or within 1 year of the conclusion of operations, unless a longer time is allowed by the authorized officer, operator shall, where practicable, reclaim the surface disturbed in operations by taking such measures as will prevent or control on-site and off-site damage to the environment and forest surface resources including: (1) Control of erosion and landslides; (2) Control of water runoff; (3) Isolation, removal or control of toxic materials; (4) Reshaping and revegetation of disturbed areas, where reasonably practicable; and (5) Rehabilitation of fisheries and wildlife habitat.	Mined Land Reclamation R11-2-201 through R11-2-207 General regulatory provisions for plan documents. Mined Land Reclamation R11-2-602. Erosion control and topographic contouring.

Forest Service Regulations 36 CFR 228 Subpart A – Locatable Minerals	Description	Other Applicable Laws, Statutes, Regulations, and Rules that are comparable to 36 CFR 228 Subpart A – Locatable Minerals
36 CFR 228.9	*Maintenance during operations, public safety.* During all operations, operator shall maintain his structures, equipment, and other facilities in a safe, neat, and workmanlike manner. Hazardous sites or conditions resulting from operations shall be marked by signs, fenced, or otherwise identified to protect the public in accordance with Federal and State laws and regulations.	Mined Land Reclamation R11-2-601. Public safety standards. ARS 27-318. State requirements to cover, fence, fill, or otherwise secure areas around active or inactive/abandoned mining operations and to post warning signs.
36 CFR 228.10	*Cessation of operations, removal of structures and equipment.* Unless otherwise agreed to by the authorized officer, operator shall remove within a reasonable time following cessation of operations all structures, equipment, and other facilities and clean up the site of operations. Other than seasonally, where operations have ceased temporarily, an operator shall file a statement with the District Ranger which includes: (a) Verification of intent to maintain the structures, equipment and other facilities, (b) The expected reopening date, and (c) An estimate of extended duration of operations. A statement shall be filed every year in the event operations are not reactivated. Operator shall maintain the operating site, structures, equipment, and other facilities in a neat and safe condition during nonoperating periods.	Mined Land Reclamation ARS 27-971. Submission and contents of reclamation plan. R11-2-501. Mining unit reclamation plan content.
36 CFR 228.11	*Prevention and control of fire.* Operator shall comply with all applicable Federal and State fire laws and regulations and shall take all reasonable measures to prevent and suppress fires on the area of operations and shall require his employees, contractors, and subcontractors to do likewise.	Mined Land Reclamation ARS 27-311. Fire prevention and protection.
36 CFR 228.12	*Access*. An operator is entitled to access in connection with operations, but no road, trail, bridge, landing area for aircraft, or the like, shall be constructed or improved, nor shall any other means of access, including but not limited to off-road vehicles, be used until the operator has received approval of an operating plan in writing from the authorized officer when required by §228.4(a). Proposals for construction, improvement, or use of such access as part of a plan of operations shall include a description of the type and standard of the proposed means of access, a map showing the proposed route of access, and a description of the means of transportation to be used. Approval of the means of such access as part of a plan of operations shall specify the location of the access route, design standards, means of transportation, and other conditions reasonably necessary to protect the environment and forest surface resources, including measures to protect scenic values and to ensure against erosion and water or air pollution.	Mined Land Reclamation R11-2-501. Mining unit reclamation plan content. R11-2-603. Roads.

Forest Service Regulations 36 CFR 228 Subpart A – Locatable Minerals	Description	Other Applicable Laws, Statutes, Regulations, and Rules that are comparable to 36 CFR 228 Subpart A – Locatable Minerals
36 CFR 228.13	*Bonds.* (a) Any operator required to file a plan of operations shall, when required by the authorized officer, furnish a bond conditioned upon compliance with §228.8(g), prior to approval of such plan of operations. In lieu of a bond, the operator may deposit into a Federal depository, as directed by the Forest Service, and maintain therein, cash in an amount equal to the required dollar amount of the bond or negotiable securities of the United States having market value at the time of deposit of not less than the required dollar amount of the bond. A blanket bond covering nationwide or statewide operations may be furnished if the terms and conditions thereof are sufficient to comply with the regulations in this part. (b) In determining the amount of the bond, consideration will be given to the estimated cost of stabilizing, rehabilitating, and reclaiming the area of operations. (c) In the event that an approved plan of operations is modified in accordance with §228.4 (d) and (e), the authorized officer will review the initial bond for adequacy and, if necessary, will adjust the bond to conform to the operations plan as modified. (d) When reclamation has been completed in accordance with §228.8(g), the authorized officer will notify the operator that performance under the bond has been completed, provided, however, that when the Forest Service has accepted as completed any portion of the reclamation, the authorized officer shall notify the operator of such acceptance and reduce proportionally the amount of bond thereafter to be required with respect to the remaining reclamation.	Mined Land Reclamation ARS 27-991 through 27-997. Financial assurance. R11-2-801 through R11-2-822. Financial assurance.
36 CFR 228.14	*Appeals.* Any operator aggrieved by a decision of the authorized officer in connection with the regulations in this part (i.e., 36 CFR part 228) may file an appeal under the provisions of 36 CFR part 251, subpart C.	Mined Land Reclamation ARS 27-933. Denials; appeals.

Abbreviations: ADEQ = Arizona Department of Environmental Quality, APP = Aquifer Protection Permit, ARS = Arizona Revised Statutes, AZPDES = Arizona Pollutant Discharge Elimination System, CFR = Code of Federal Regulations, R = Arizona Administrative Code Rule.

APPENDIX J. MITIGATION AND MONITORING PLAN

Introduction

This mitigation and monitoring plan has been developed by the Tonto National Forest using information from a number of sources. As stated in section 2.3 of the environmental impact statement (EIS), the Council on Environmental Quality states that agencies should not commit to mitigation measures absent the authority or expectation of necessary resources to ensure the mitigation is performed (Council on Environmental Quality 2011). This mitigation and monitoring plan is designed to clearly disclose which mitigation and monitoring items are within the authority of the U.S. Department of Agriculture Forest Service (Forest Service) or other regulatory permitting agency (e.g., U.S. Army Corps of Engineers, Bureau of Land Management [BLM], Arizona Department of Environmental Quality, or Arizona Department of Water Resources).

This appendix discusses the following items:

- Design Features and Applicant-Committed Environmental Protection Measures
- Mitigation and Monitoring Measures Considered in Chapter 3 Impacts Analysis
- Other Mitigation and Monitoring Measures Not Considered in Chapter 3 Impacts Analysis

Design Features and Applicant-Committed Environmental Protection Measures

The environmental analysis considered for this EIS includes the implementation of Applicant-Committed Environmental Protection Measures. These measures are listed in each resource section of chapter 3 in a section titled: “Summary of Applicant-Committed Environmental Protection Measures.” Applicant-Committed Environmental Protection Measures are features incorporated into the design of the project by Resolution Copper Mining, LLC (Resolution Copper) to reduce potential impacts on resources. These measures would be non-discretionary as they are included in the project design, and their effects are accounted for in the analysis of environmental consequences disclosed in each resource section of chapter 3.

Many of these features are either specified in the General Plan of Operations (GPO) or were developed as part of the action alternatives. Resolution Copper has created the following plans to detail the protection measures they will employ under the action alternatives:

- Subsidence management plan (appendix to GPO; also updated in May 2018 in response to the Geology and Subsidence Workgroup [Tshishens 2018a])
- Groundwater mitigation and monitoring plan (created in April 2019 in response to the Groundwater Modeling Workgroup [Montgomery & Associates 2019])
- Road use plan—updating for tailings storage facility alternatives (appendix to GPO)
- Environmental emergency and response and contingency plan (appendix to GPO)
- Fire prevention and response plan (appendix to GPO)
- Preliminary spill prevention control and countermeasures plan (SPCC) (appendix to GPO)
- Explosives management plan (appendix to GPO)
- Acid rock drainage management plan (appendix to GPO)

- Hydrocarbon management plan (appendix to GPO)
- Environmental materials management plan (appendix to GPO)
- Preliminary stormwater pollution prevention plan (SWPPP) (appendix to GPO)
- Wildlife management plan (appendix to GPO)
- Noxious weed and invasive species plan (created May 2019 in response to EIS analysis [Resolution Copper 2019])
- Historic properties treatment plan, Oak Flat land exchange parcel (currently under development as part of tribal consultation and Section 106 consultation)
- Historic properties treatment plan for GPO (currently under development as part of tribal consultation and Section 106 consultation)
- Tailings Pipeline Management Plan (AMEC Foster Wheeler Americas Limited 2019)
- Concentrate Pipeline Management Plan (M3 Engineering and Technology Corporation 2019)

The implementation and effectiveness of Applicant-Committed Environmental Protection Measures are considered integral to the analysis considered in this EIS. These design features would be a requirement of the final Record of Decision (ROD) and final mining plan of operations. As these measures are considered part of the proposed project, they are not reiterated in this appendix.

Mitigation and Monitoring Measures Considered in Chapter 3 Impacts Analysis

Mitigation and Monitoring Required by Forest Service

The role of the Tonto National Forest under its primary authorities in the Organic Administration Act, Locatable Regulations (36 Code of Federal Regulations [CFR] 228 Subpart A), and Multiple-Use Mining Act is to ensure that mining activities minimize adverse environmental effects on National Forest System (NFS) surface resources. The Forest Service authority related to mitigation is limited to protection of surface resources of NFS lands (see 30 United States Code [U.S.C.] 612, 5 U.S.C. 551, and 36 CFR 228.1).

In order for the Forest Service to require implementation of mitigation, the mitigation must have a direct connection to avoiding, mitigating, or minimizing effects on NFS surface resources. The Forest Service has no authority, obligation, or expertise to determine or enforce compliance with other agencies' laws or regulations. However, it is the operator's responsibility to ensure that its actions comply with applicable laws. The Forest Service will only approve a final plan of operations once all other necessary permits are approved.

Mitigation and monitoring items under this heading are within the authority of the Forest Service, the U.S. Fish and Wildlife Service through the Biological Opinion resulting from consultation under Section 7 of the Endangered Species Act, or the Arizona State Historic Preservation Office (SHPO) through the current programmatic agreement (PA) and associated historic properties treatment plan (HPTP). These measures would be specified as a requirement of the final ROD and incorporated into the final mining plan of operations. The Forest Service is responsible for determining whether the implementation of mitigation and the results of monitoring in this category are in compliance with the decision that will be

documented in the final ROD and final mining plan of operations, and it has a legal obligation to ensure that the requirements of the biological opinion and PA/HPTP are implemented. Resolution Copper would submit reports to the Tonto National Forest for review of work done in the previous year and be subject to routine inspections to verify mitigation and monitoring effectiveness.

Mitigation and Monitoring Agreed to by Resolution Copper Mining, LLC

Resolution Copper has publicly agreed to implement the mitigation and monitoring items under this heading. These include contractual, financial, and other agreements over which the Forest Service and other regulatory agencies have no jurisdiction. The Forest Service and regulatory agencies have no authority, obligation, or expertise to determine or enforce compliance of the measures included in this category. They are presented here to facilitate disclosure of currently known mitigation and monitoring and their consideration in impacts analyses.

These measures differ from the Applicant-Committed Environmental Protection Measures in that they were not proposed as part of the project or alternatives and in many cases were developed directly in response to the EIS analysis in order to reduce resource impacts. Since the Forest Service and regulatory permitting agencies cannot require implementation of the mitigation and monitoring measures in this category, their implementation is not assured. The effectiveness of these mitigation measures is included in chapter 3 of the EIS. At the current point in the National Environmental Policy Act (NEPA) process, it is recognized that these are measures that may occur, as opposed to measures that would occur. However, once these measures are included in the signed Final ROD and final mining plan of operations, they would be legally binding on Resolution Copper.

Reporting and Evaluation

Monitoring would be evaluated annually after reports are reviewed by the appropriate land-managing agency to determine whether the level of monitoring and/or reporting is appropriate for the current conditions. This review may result in a change in the monitoring requirements. Please refer to section 2.3 of the EIS for a discussion of mitigation-related monitoring and evaluation.

Detail of Mitigation and Monitoring Measures Analyzed in Chapter 3 Impacts Analysis

At this time, the mitigation and monitoring measures analyzed are conceptual in nature. The following information is included, with additional implementation details to be developed prior to the Record of Decision:

- Unique identification number
- Title of mitigation/monitoring measure
- Description/overview of measure
- Source of measure
- Resource affected/impacts being mitigated
- Alternatives to which the measure is applicable

Geology, Minerals, Subsidence (1 measure)

FS-222: Subsidence Monitoring Plan
Description/overview: The subsidence monitoring plan proposed by Resolution Copper has been included in the EIS as an Applicant-Committed Environmental Protection Measure, however, as subsidence has the potential to impact Tonto National Forest surface resources, the Forest Service will require that a final subsidence monitoring plan be completed and approved by the Forest Service prior to signing a decision.
Source of measure: The preliminary subsidence monitoring plan is included by Resolution Copper as an Applicant-Committed Environmental Protection Measure. The requirement for a final subsidence monitoring plan was identified by the Forest Service as a required mitigation measure.
Resource affected/impacts being mitigated: This statement seeks to mitigate impacts of subsidence on Forest Service surface resources, including the Apache Leap Special Management Area.
Applicable alternatives: All
Authority to require: As subsidence would impact Forest Service surface resources, authority exists under 36 CFR 228.8.
Additional ground disturbance: No additional ground disturbance anticipated.

Soils and Vegetation (5 measures)

RC-208: Salvage of select vegetation and trees within the Tailings Storage Facility footprint
Description/overview: To the extent practicable, Resolution Copper will salvage select vegetation and select suitable trees within the tailings storage facility footprint.
Source of measure: Resolution Copper
Resource affected/impacts being mitigated: This statement seeks to mitigate impacts on vegetation by directly salvaging individual plants, but also through improving reclamation success and recovery of habitat after closure.
Applicable alternatives: All
Authority to require: As an applicant-proposed measure, implementation is not assured; however, once this measure is included in the ROD/Final mining plan of operations it would be required by the Forest Service.
Additional ground disturbance: While this would require ground disturbance, it would be within the existing area of analysis of the project fence line.

FS-223: Conduct soil surveys within the area to be disturbed by the Preferred Alternative Tailings Storage Facility footprint
Description/overview: While adequate soil and vegetation information exists to conduct an assessment for the purposes of disclosing impacts under NEPA and comparing between alternatives, the level of information may not be sufficient to support detailed final reclamation plans and a final mining plan of operations. To support these documents, soil surveys need to be conducted within the disturbance footprint of the Preferred Alternative tailings storage facility. The specific purpose of the surveys would be identify general soil characteristics, estimate the amount of soil or unconsolidated material that would be available for salvage to support reclamation activities, and inform the ability of salvaged material to support reclamation efforts. The appropriate level of detail for the soil survey would be determined in conjunction with the Tonto National Forest. The Forest Service is requiring that these surveys be conducted between the draft EIS (DEIS) and final EIS (FEIS).
Source of measure: Forest Service
Resource affected/impacts being mitigated: This statement seeks to mitigate impacts on long-term reclamation and vegetation.
Applicable alternatives: Preferred Alternative
Authority to require: While the footprint of the Preferred Alternative may not involve Forest Service surface resources, other aspects of the project still involve Forest Service surface resources, and the information collected under this measure is considered necessary for the development of reclamation plans supporting the final mining plan of operations.
Additional ground disturbance: While this would require ground disturbance, it would be within the existing area of analysis of the project fence line.

FS-224: Conduct appropriate testing of soil materials within the Preferred Alternative Tailings Storage Facility footprint
Description/overview: Similarly, in order to support detailed final reclamation plans and a final mining plan of operations, appropriate testing would be conducted on soil samples collected from within the Preferred Alternative footprint. These tests could include such parameters as soil organic carbon, moisture capacity, nutrients, pH/acidity/alkalinity. Tests would also include those appropriate to estimate post-closure water quality of stormwater runoff interacting with the salvaged soil. The appropriate suite of tests to be conducted would be determined in conjunction with the Tonto National Forest. The Forest Service is requiring that these tests be conducted between the DEIS and FEIS.
Source of measure: Forest Service
Resource affected/impacts being mitigated: This statement seeks to mitigate impacts on long-term reclamation and vegetation.
Applicable alternatives: Preferred Alternative

Authority to require:
While the footprint of the Preferred Alternative may not involve Forest Service surface resources, other aspects of the project still involve Forest Service surface resources, and the information collected under this measure is considered necessary for the development of reclamation plans supporting the final mining plan of operations.

Additional ground disturbance:
While this would require ground disturbance, it would be within the existing area of analysis of the project fence line.

FS-225: Conduct vegetation surveys within the Preferred Alternative Tailings Storage Facility footprint

Description/overview:
In order to support detailed final reclamation plans and a final mining plan of operations, vegetation surveys need to be conducted within the disturbance footprint of the Preferred Alternative tailings storage facility. These surveys would identify general vegetation present, density, abundance of native/non-native species, and any special status plant species for which site characteristics are appropriate for occurrence. The appropriate level of detail for these surveys would be determined in conjunction with the Tonto National Forest. The Forest Service is requiring that these surveys be conducted between the DEIS and FEIS.

Source of measure:
Forest Service

Resource affected/impacts being mitigated:
This statement seeks to mitigate impacts on long-term reclamation and vegetation.

Applicable alternatives:
Preferred Alternative

Authority to require:
While the footprint of the Preferred Alternative may not involve Forest Service surface resources, other aspects of the project still involve Forest Service surface resources, and the information collected under this measure is considered necessary for the development of reclamation plans supporting the final mining plan of operations.

Additional ground disturbance:
No ground disturbance anticipated.

FS-226: Preparation of detailed reclamation plans for the Preferred Alternative
Description/overview: Information derived from the soil surveys, vegetation surveys, and soil testing would be used to develop detailed reclamation plans for the Preferred Alternative. These reclamation plans would be more specific than those included in the GPO, and would include such details as: maps of the post-closure landform depicting the type of final closure cover for each area (depth of material, type of material, anticipated source of material and preparation methods like crushing or sorting, and need for/presence of armoring); anticipated reclamation techniques such as surface preparation, seeding, planting, watering (if any), soil amendments; soil salvage storage locations and storage management techniques; maps of the post-closure landform or the landform over time, depicting phasing of revegetation or reclamation activities; monitoring details including proposed success criteria and the potential use of comparison reference plots. The detailed reclamation plans would also include more specific information on post-closure stormwater controls, the anticipated longevity of engineered control systems, and criteria for when stormwater would be deemed appropriate for release back to the downstream drainages. The appropriate level of detail for the final reclamation plans would be determined in conjunction with the Tonto National Forest. The Forest Service is requiring that these plans be prepared between the DEIS and FEIS.
Source of measure: Forest Service
Resource affected/impacts being mitigated: This statement seeks to mitigate impacts on long-term reclamation and vegetation.
Applicable alternatives: Preferred Alternative
Authority to require: While the footprint of the Preferred Alternative may not involve Forest Service surface resources, other aspects of the project still involve Forest Service surface resources, and the information collected under this measure is considered necessary to support the final mining plan of operations.
Additional ground disturbance: No additional ground disturbance anticipated.

Noise and Vibration (1 measure)

RC-218: Alternate road access to Skunk Camp Tailings Storage Facility
Description/overview: Alternate access to Skunk Camp tailings storage facility to reduce noise impacts on residences along Dripping Springs Road. Two road corridors have been proposed and are shown in Attachment 2. Initial corridors are based on a 1,000-foot right-of-way (ROW), but road width would likely be smaller or the corridor could be changed based on ground surveys. Cultural and biological surveys would be required as well as consultation with the adjacent landowners or land-managing agencies.
Source of measure: Resolution Copper
Resource affected/impacts being mitigated: This statement seeks to mitigate impacts from noise, dust, and traffic along Dripping Springs Road.
Applicable alternatives: Alternative 6 only

Authority to require:
As an applicant-proposed measure, implementation is not assured; however, once this measure is included in the ROD/Final mining plan of operations it would be required by the Forest Service.

Additional ground disturbance:
Yes. The shorter road would include 364 acres based on 1,000-foot ROW for construction and 3.12 miles in length. The longer road would include 1,391 acres based on 1,000-foot ROW for construction and 11.92 miles in length.

Transportation and Access (none)

Air Quality (none)

Water Resources (1 measure)

RC-211: Seeps and Spring Monitoring and Mitigation Plan (GDE plan)

Description/overview:
In April 2019, the Forest Service received from Resolution Copper a document titled "Monitoring and Mitigation Plan for Groundwater Dependent Ecosystems and Water Wells" (Montgomery and Associates Inc. 2019). This document outlines monitoring plan to assess potential impacts on each groundwater-dependent ecosystem (GDE), identifies triggers and associated actions to be taken by Resolution Copper to ensure that GDEs are preserved, and suggested mitigation measures for each GDE if it is shown to be impacted by future mine dewatering. Note that this plan includes actions both for GDEs and water supply wells.

The plan focuses on the same GDEs described in this section of the EIS, as these are the GDEs that are believed to rely on regional groundwater that could be impacted by the mine. The stated goal of the plan is "to ensure that groundwater supported flow that is lost due to mining activity is replaced and continues to be available to the ecosystem." The plan specifically notes that it is not intended to address water sources associated with perched shallow groundwater in alluvium or fractures.

The specific GDEs addressed by this plan include

- Bitter, Bored, Hidden, Iberri, Kane, McGinnel, McGinnel Mine, No Name, Rock Horizontal, and Walker Springs;
- Queen Creek below Superior (reach km 17.39 to 15.55) and at Whitlow Ranch Dam;
- Arnett Creek in two locations;
- Telegraph Canyon in two locations;
- Devil's Canyon springs (DC4.1E, DC6.1E, DC6.6W, and DC8.2W)
- Devil's Canyon surface water in two locations (reach km 9.1 to 7.5, and reach km 6.1 to 5.4)
- Mineral Creek springs (Government Springs, MC3.4W)
- Mineral Creek surface water in two locations (MC8.4C, and reach km 6.9 to 1.6)

Monitoring frequency and parameters are discussed in the plan, and include such things as groundwater level or pressure, surface water level, presence of water or flow, extent of saturated reach, and phreatophyte area. In general, groundwater level or pressure and surface water level would be monitored daily (using automated equipment), while other methods would be monitored quarterly or annually.

Water supplies to be monitored are Superior (using well DHRES-16_743 as a proxy), Boyce Thompson Arboretum (using the Gallery Well as a proxy), and Top-of-the-World (using HRES-06 as a proxy).

A variety of potential actions are identified that could be used to replace water sources if monitoring reaches a specified trigger. Specific details (likely sources and pipeline corridor routes) are shown in the plan. These include the following:

- Drilling new wells, applicable to both water supplies and GDEs. The intent of installing a well for a GDE is to pump supplemental groundwater that can be used to augment flow. The exact location and construction of the well would vary; it is assumed in many cases groundwater would be transported to GDEs via an overland pipeline to minimize ground disturbance. Wells require maintenance in perpetuity, and likely would be equipped with storage tanks and solar panels, depending on specific site needs.
- Installing spring boxes. These are structures installed into a slope at the discharge point of an existing spring, designed to capture natural flow. The natural flow is stored in a box and discharged through a pipe. Spring boxes can be deepened to maintain access to water if the water level decreases. Spring boxes require little ongoing maintenance to operate.
- Installing guzzlers. Guzzlers are systems for harvesting rainwater for wildlife consumption. Guzzlers use an impermeable apron, typically installed on a slope, to collect rainwater which is then piped to a storage tank. A drinker allows wildlife and/or livestock to access water without trampling or further degrading the spring or water feature. Guzzlers require little ongoing maintenance to operate.
- Installing surface water capture systems such as check dams, alluvial capture, recharge wells, or surface water diversions. All of these can be used to supplement diminished groundwater flow at GDEs by retaining precipitation in the form of runoff or snowmelt, making it available for ecosystem requirements.
- Providing alternative water supplies from a non-local source. This would be considered only if no other water supply is available, with Arizona Water Company or the Desert Wellfield being likely sources of water.

Source of measure:
Resolution Copper

Resource affected/impacts being mitigated:
This statement seeks to mitigate impacts on water resources.

Applicable alternatives:
All

Authority to require:
As an applicant-proposed measure, implementation is not assured; however, once this measure is included in the ROD/Final mining plan of operations it would be required by the Forest Service. As some GDEs impacted are Forest Service surface resources, authority exists under 36 CFR 228.8 for part of this measure.

Additional ground disturbance:
Yes, quantified in Seeps and Springs Plan

Wildlife (6 measures)

GP-125: Follow AGFD and FWS guidance for mitigation of impacts on wildlife
Description/overview: Follow guidance from the Arizona Game and Fish Department (AGFD) and U.S. Fish and Wildlife Service (FWS) regarding avoidance, minimization, and mitigation measures for wildlife. The AGFD's Heritage Data Management System (HDMS) and Project Evaluation Program work together to provide current, reliable, objective information on Arizona's plant and wildlife species to aid in the environmental decision-making process. The information can be used to guide preliminary decisions and assessments for the Resolution Copper Project. Similarly, the FWS provides guidance for protecting wildlife.
Source of measure: Public comment submittal during scoping period
Resource affected/impacts being mitigated: These statements seek to mitigate potential adverse effects to wildlife.
Applicable alternatives: All
Authority to require: While the measure specifies guidance from other agencies, the habitats impacted are Forest Service surface resources for Alternatives 2, 3, and 4, and authority exists under 36 CFR 228.8 for these areas. In addition, the Forest Service is responsible for implementing any conservation measures brought forward during Section 7 Endangered Species Act (ESA) consultation, or any conditions specified in a Biological Opinion by FWS. For Alternative 5, 43 CFR 3809.2 provides similar authority to BLM to regulate mining to prevent unnecessary or undue degradation. For Alternative 6, the Forest Service would not have jurisdiction over the tailings storage facility, but would have authority over the pipeline corridors.
Additional ground disturbance: No additional ground disturbance anticipated.

GP-131: Implement a wildlife management plan for stormwater ponds, including wildlife exclusion fencing
Description/overview: Implement a wildlife management plan for stormwater ponds, including wildlife exclusion fencing.
Source of measure: Public comment submittal during scoping period
Resource affected/impacts being mitigated: These statements seek to mitigate potential adverse effects to wildlife.
Applicable alternatives: Alternatives 2, 3, 4, and 5
Authority to require: The habitats impacted are Forest Service surface resources for Alternatives 2, 3, and 4, and authority exists under 36 CFR 228.8 for these areas. In addition, the Forest Service is responsible for implementing any conservation measures brought forward during Section 7 ESA consultation, or any conditions specified in a Biological Opinion by FWS. For Alternative 5, 43 CFR 3809.2 provides similar authority to BLM to regulate mining to prevent unnecessary or undue degradation.
Additional ground disturbance: No additional ground disturbance anticipated.

CA-191: Reptile and Sonoran Desert Tortoise (ESA-CCA) Plan
Description/overview: Implement conservation actions detailed in the Candidate Conservation Agreement (CCA). The Candidate Conservation Agreement would be a formal agreement between the FWS and Resolution Copper to address the conservation needs of proposed or candidate species, or species likely to become candidates, before they become listed as endangered or threatened. Resolution Copper would voluntarily commit to conservation actions that would help stabilize or restore the species with the goal that listing would become unnecessary.
Source of measure: Arizona Game and Fish Department
Resource affected/impacts being mitigated: This statement seeks to mitigate potential adverse effects to wildlife.
Applicable alternatives: All
Authority to require: If solely a voluntary agreement entered into by Resolution Copper, implementation is not assured; however, once this measure is included in the ROD/Final mining plan of operations it would be required by the Forest Service. The habitats impacted are Forest Service surface resources for Alternatives 2, 3, and 4, and authority exists under 36 CFR 228.8 for these areas. In addition, the Forest Service is responsible for implementing any conservation measures brought forward during Section 7 ESA consultation, or any conditions specified in a Biological Opinion by FWS. For Alternative 5, 43 CFR 3809.2 provides similar authority to BLM to regulate mining to prevent unnecessary or undue degradation. For Alternative 6, the Forest Service would not have jurisdiction over the tailings storage facility, but would have authority over the pipeline corridors.

Additional ground disturbance:
No additional ground disturbance anticipated.

CA-172: Mitigation of loss of abandoned mine or cave habitat for bats

Description/overview:
Mitigate impacts on bat habitat by conducting pre-closure surveys over multiple years and multiple visits per year, to document species presence/absence and develop appropriate closure methods in coordination with AGFD, Bat Conservation International, and Forest Service biologists; implement wildlife exclusion measures pre-closure to minimize wildlife entrapment and mortality during closure; consider seasonal timing of closure on any sites with suitable maternity roosts; and identify mines, adits, and/or shafts with known bat roosting areas. If activities are adjacent to bat roosting/maternity sites, develop best management practices to reduce human encroachment.

Source of measure:
Arizona Game and Fish Department

Resource affected/impacts being mitigated:
These actions seek to mitigate potential adverse effects to wildlife habitat.

Applicable alternatives:
Alternatives 2, 3, 4, and 5

Authority to require:
If solely a voluntary agreement entered into by Resolution Copper, implementation is not assured; however, once this measure is included in the ROD/Final Mining Plan of Operations it would be required by the Forest Service.

The habitats impacted are Forest Service surface resources for Alternatives 2, 3, and 4, and authority exists under 36 CFR 228.8 for these areas. In addition, the Forest Service is responsible for implementing any conservation measures brought forward during Section 7 ESA consultation, or any conditions specified in a Biological Opinion by FWS. For Alternative 5, 43 CFR 3809.2 provides similar authority to BLM to regulate mining to prevent unnecessary or undue degradation.

Additional ground disturbance:
No additional ground disturbance anticipated.

CA-175: Maintain or replace access to stock tanks and Arizona Game and Fish Department wildlife waters

Description/overview: Resolution Copper would maintain or replace access to stock tanks and AGFD wildlife waters impacted by the project. Stock tanks are used to provide drinking water for livestock. AGFD constructs wildlife water developments to support a variety of wildlife, including game species. Benefits of AGFD wildlife water developments include a long lifespan; year-round, acceptable water quality for wildlife use; require no supplemental water hauling, except in rare or exceptional circumstances; minimal visual impacts and blends in with the surrounding landscape; accessible to and used by target species and excludes undesirable/feral species to the greatest extent possible; and minimized risk of animal entrapment and mortality.

Source of measure:
Arizona Game and Fish Department

Resource affected/impacts being mitigated: These actions seek to mitigate potential adverse effects to livestock grazing, recreation, and wildlife habitat.
Applicable alternatives: All
Authority to require: If solely a voluntary agreement entered into by Resolution Copper, implementation is not assured; however, once this measure is included in the ROD/Final mining plan of operations it would be required by the Forest Service. The habitats impacted are Forest Service surface resources for Alternatives 2, 3, and 4, and authority exists under 36 CFR 228.8 for these areas. In addition, the Forest Service is responsible for implementing any conservation measures brought forward during Section 7 ESA consultation, or any conditions specified in a Biological Opinion by FWS. For Alternative 5, 43 CFR 3809.2 provides similar authority to BLM to regulate mining to prevent unnecessary or undue degradation. For Alternative 6, the Forest Service would not have jurisdiction over the tailings storage facility, but would have authority over the pipeline corridors.
Additional ground disturbance: No additional ground disturbance anticipated.

CA-176: Use of best management practices during pipeline construction and operations
Description/overview: Resolution Copper would adhere to best management practices during pipeline construction and operation. During pipeline construction, Resolution Copper would cover open trenching; inspect trenches routinely for entrapped wildlife and remove; provide wildlife escape ramps; inspect under construction equipment prior to use and remove any wildlife seeking cover. Resolution Copper would also include wildlife crossing structures along the pipeline corridor (overpass or underpass) and coordinate with AGFD and Forest Service biologists to determine the location, frequency, and design of wildlife crossing structures.
Source of measure: Arizona Game and Fish Department
Resource affected/impacts being mitigated: These actions seek to mitigate potential adverse effects to wildlife.
Applicable alternatives: All
Authority to require: If solely a voluntary agreement entered into by Resolution Copper, implementation is not assured; however, once this measure is included in the ROD/Final Mining Plan of Operations it would be required by the Forest Service. The habitats impacted are Forest Service surface resources for Alternatives 2, 3, and 4, and authority exists under 36 CFR 228.8 for these areas. In addition, the Forest Service is responsible for implementing any conservation measures brought forward during Section 7 ESA consultation, or any conditions specified in a Biological Opinion by FWS. For Alternative 5, 43 CFR 3809.2 provides similar authority to BLM to regulate mining to prevent unnecessary or undue degradation. For Alternative 6, the Forest Service would not have jurisdiction over the tailings storage facility, but would have authority over the pipeline corridors.
Additional ground disturbance: No additional ground disturbance anticipated.

Recreation (5 measures)

RC-212: Relocation of Arizona National Scenic Trail
Description/overview: Resolution Copper has proposed to fund the relocation of a segment of the Arizona National Scenic Trail as well as the construction of new trailheads. Approximately 9 miles of new trail would need to be built between U.S. Route 60 and NFS Road 650 near Whitford Canyon. This measure was proposed by Resolution Copper and seeks to mitigate impacts on recreational opportunities on the trail. This measure is only applicable to Alternatives 2, 3, and 4. Relocating the trail and constructing new trailheads would require additional ground disturbance but the exact area of new disturbance has yet to be determined, although it is assumed the new trail would be about 2 to 3 feet in width and approximately 3 acres of total surface area.
Source of measure: Resolution Copper
Resource affected/impacts being mitigated: These actions seek to mitigate potential adverse effects to recreation.

Applicable alternatives:
Alternative 2, 3, and 4

Authority to require:
As an applicant-proposed measure, implementation is not assured; however, once this measure is included in the ROD/Final mining plan of operations it would be required by the Forest Service.

Additional ground disturbance:
Yes, to be determined, but roughly can be assumed that a new trail would be about 2 to 3 feet in width, and would account for approximately 3 acres of additional ground disturbance.

RC-213: Mitigate loss of bouldering at Oak Flat by establishing access to "Inconceivables"

Description/overview:
To mitigate impacts on recreation through the loss of bouldering areas at Oak Flat, Resolution Copper has proposed to establish access to an alternative area known as "Inconceivables." This area extends along cliffs for approximately 3 miles on Tonto National Forest land and is located off State Route 177. This mitigation measure is applicable to all alternatives.

Source of measure:
Resolution Copper

Resource affected/impacts being mitigated:
These actions seek to mitigate potential adverse effects to recreation.

Applicable alternatives:
All

Authority to require:
As an applicant-proposed measure, implementation is not assured; however, once this measure is included in the ROD/Final mining plan of operations it would be required by the Forest Service.

Additional ground disturbance:
Yes, to be determined after further development of the proposed idea.

RC-214: Implement RUG and Superior Trail Network Plan

Description/overview:
Resolution Copper has proposed to implement the Recreation User Group (RUG) and the Superior Trail Network Plan to offset loss of public roads at Oak Flat. The RUG was formed to develop a recreational trail design in the town of Superior area. The RUG has developed a conceptual plan for a trail system on the Tonto National Forest that would meet the needs and interests of different stakeholders. Within the vicinity of Superior there is a network of unpaved roads and trails, many of which are not authorized by the Tonto National Forest, that are contributing to ongoing resource degradation. The development of a trail system would help with reducing continued development of unauthorized trails. The purposes of the RUG and Superior Trail Network Plan are to provide recreation opportunities for hikers, equestrians, mountain bicyclists, and off-highway vehicle enthusiasts; provide readily accessible recreation opportunities to the Superior and Phoenix metropolitan area; offer long-term, sustainable economic benefits to the local community through recreation and ecotourism; protect soil resources in the area from erosion; and provide access to uniquely beautiful viewsheds within Tonto National Forest that are not currently accessible by authorized trails.

Attachment 1 of this Appendix has the Proposed RUG Recreation Project Conceptual Plan submitted to the Forest Service in 2019.
Source of measure: Resolution Copper
Resource affected/impacts being mitigated: These actions seek to mitigate potential adverse effects to recreation.
Applicable alternatives: All
Authority to require: As an applicant-proposed measure, implementation is not assured; however, once this measure is included in the ROD/Final Mining Plan of Operations it would be required by the Forest Service.
Additional ground disturbance: Yes, the full plan would encompass 66.5 acres; however, it is unknown whether the full plan would be approved in its entirety.

RC-215: Provide replacement campground
Description/overview: Resolution Copper has proposed to establish an alternative campground site, known as Castleberry, to mitigate the loss of Oak Flat Campground. The development of the new campground as well as access to the property would require additional ground disturbance of 41 acres.
Source of measure: Resolution Copper
Resource affected/impacts being mitigated: These actions seek to mitigate potential adverse effects to recreation.
Applicable alternatives: All
Authority to require: As an applicant-proposed measure, implementation is not assured; however, once this measure is included in the ROD/Final Mining Plan of Operations it would be required by the Forest Service.
Additional ground disturbance: Yes, additional disturbance on the Castleberry property and access to property could include up to 41 acres.

RC-216: Develop access to Oak Flat Campground while safe per MSHA regulations
Description/overview: To mitigate the future permanent loss of Oak Flat Campground, Resolution Copper has proposed to develop an access plan for the campground as long as it is safe per MSHA regulations. This would allow access to Oak Flat Campground after the land exchange has occurred and the parcel is privately owned by Resolution Copper. The exact duration and extent of access would be determined later per safety requirements by MSHA. This measure would mitigate both losses to recreation as well as impacts on tribal values, would be applicable to all alternatives, and would require no additional ground disturbance.
Source of measure: Resolution Copper
Resource affected/impacts being mitigated: These actions seek to mitigate potential adverse effects to recreation and tribal values.
Applicable alternatives: All
Authority to require: As an applicant-proposed measure, implementation is not assured; however, once this measure is included in the ROD/Final Mining Plan of Operations it would be required by the Forest Service.
Additional ground disturbance: No additional ground disturbance anticipated.

Public Health & Safety (5 measures)

FS-01: Satellite Monitoring of Tailings Storage Facility
Description/overview: High-resolution satellite imagery would be collected and processed at regular intervals. Processed output provided to the Forest Service or BLM would include beach width, tailings surface slope contours, and constructed site topography. This output could be provided for land manager verification of adherence to design criteria, as well as long-term monitoring of facility performance over time.
Source of measure: Tonto National Forest Interdisciplinary Team
Resource affected/impacts being mitigated: This statement seeks to mitigate impacts on tailings safety, which in turn is protective of human life, property, and numerous downstream resources.
Applicable alternatives: Alternatives 2, 3, 4, and 5
Authority to require: Alternatives 2, 3, and 4: 36 CFR 228.8 (Forest Service authority to regulate mining to minimize adverse environmental impacts on NFS surface resources) Alternative 5: 43 CFR 3809.2 (BLM authority to regulate mining to prevent unnecessary or undue degradation) Alternative 6: As facility would ultimately be located on private land, Forest Service would not have authority to require long-term monitoring of the tailings storage facility.

If this were to be an applicant-proposed measure for this alternative, implementation is not assured; however, once this measure is included in the ROD/Final mining plan of operations it would be required by the Forest Service.
Additional ground disturbance: No additional ground disturbance anticipated.

GP-26: Improve Resiliency of Tailings Storage Facility
Description/overview: Some recommended mitigation measures regarding the tailings storage facility to include where appropriate include the use of a liner, constructing a secondary backup containment facility, developing a mitigation plan for tailings storage facility embankment breach, implementing a cease operation plan in the event of a tailings embankment failure, requiring an environmental damage assessment in the event of a tailings embankment release, and identifying alternative energy sources for the tailings storage facility in the event of an electrical outage.
Source of measure: Public comment submittal during scoping period
Resource affected/impacts being mitigated: This statement seeks to mitigate impacts on tailings safety, which in turn is protective of human life, property, and numerous downstream resources.
Applicable alternatives: All
Authority to require: The suggestions noted in this measure are general in nature, and many of the concepts are already incorporated into the facility designs. In addition, further facility design requirements that may overlap this measure would be developed under other measures (see for example FS-227 and FS-228). To the extent additional components are developed and incorporated by the applicant into the design, they would be included in the ROD/Final mining plan of operations and would be required by the Forest Service.
Additional ground disturbance: No additional ground disturbance anticipated.

FS-227: Conduct Refined FMEA before Final EIS for the Preferred Alternative
Description/overview: The failure modes and effects analysis (FMEA) conducted by Resolution Copper is based on the DEIS alternative design documents. With more refined designs and site-specific information, a more robust and refined FMEA can be conducted. The Forest Service is requiring that this refined FMEA be conducted between the DEIS and FEIS. This exercise will inform the requirements to be specified in the ROD and ultimately incorporated into a final plan of operations. The refined FMEA would be a collaborative group process that would be led by the Forest Service. It is likely to include Forest Service personnel, cooperating agency representatives, Resolution Copper and their tailings experts and contractors, and the NEPA team and their tailings experts. This group would identify possible failure modes, their likelihood of occurring, the level of confidence in the predictions, the severity of the consequences if that failure mode were to occur, and possible controls to reduce the risk of failure. The collaborative group would likely also be asked to identify a reasonable failure scenario to use in a refined breach analysis. During an FMEA, the tailings storage facility is considered as a complete system with a number of components, including geology, foundation, engineered structures, seepage controls, drains, containment, diversions, and spillways. Sufficient information on the design and specifications of each component is needed in order to understand how they would function as a system, and how they might respond to the anticipated stresses on the system. The information needed to support a collaborative, refined FMEA would include the results of site investigations (geology and foundation), lab testing, engineering analyses, borrow material analyses and specifications, and engineered drawings and specifications. The less information available during the FMEA process, the more assumptions have to be made, leading to a less meaningful assessment that may not be representative of the true risks for the ultimate designed facility.
Source of measure: Tonto National Forest Interdisciplinary Team and Cooperating Agencies
Resource affected/impacts being mitigated: This statement seeks to mitigate impacts on tailings safety, which in turn is protective of human life, property, and numerous downstream resources.
Applicable alternatives: Preferred Alternative
Authority to require: While the footprint of the Preferred Alternative may not involve Forest Service surface resources, other aspects of the project still involve Forest Service surface resources, and the information collected under this measure is considered necessary to support both the FEIS and the final mining plan of operations.
Additional ground disturbance: No additional ground disturbance anticipated.

FS-228: Adherence to National Dam Safety Program Standards
Description/overview: For a tailings storage facility built on Federal land, the Forest Service is requiring that Resolution Copper adhere, at a minimum, to the requirements of the National Dam Safety Program discussed in "Relevant Laws, Regulations, Policies, and Plans" in section 3.10.1.3.
Source of measure: Tonto National Forest Interdisciplinary Team
Resource affected/impacts being mitigated: This statement seeks to mitigate impacts on tailings safety, which in turn is protective of human life, property, and numerous downstream resources.
Applicable alternatives: Alternatives 2, 3, 4, and 5
Authority to require: Alternatives 2, 3, and 4: 36 CFR 228.8 (Forest Service authority to regulate mining to minimize adverse environmental impacts on NFS surface resources) Alternative 5: 43 CFR 3809.2 (BLM authority to regulate mining to prevent unnecessary or undue degradation) Alternative 6: As facility would ultimately be located on private land, Forest Service would not have authority to require these specific design standards. If this were to be an applicant-proposed measure for this alternative, implementation is not assured; however, once this measure is included in the ROD/Final mining plan of operations it would be required by the Forest Service.
Additional ground disturbance: No additional ground disturbance anticipated.

FS-229: Development of an Emergency Action Plan for the Tailings Storage Facility for the Preferred Alternative
Description/overview: For a tailings storage facility built on Federal land, the Forest Service is requiring that Resolution Copper undertake Emergency Action Planning, as required under the National Dam Safety Program (Federal Emergency Management Agency 2004). The FMEA would provide key information to this process. Emergency Action Planning would include evaluation of emergency potential, inundation mapping and classification of downstream inundated areas, response times, notification plans, evacuation plans, and plans for actions upon discovery of a potentially unsafe condition. The breach analysis prepared for the DEIS is not sufficient to meet National Dam Safety Standards for emergency planning. The Forest Service will require a refined breach analysis be conducted between the DEIS and FEIS, using appropriate models, based on the outcome of the FMEA and a selected failure scenario.
Source of measure: Tonto National Forest Interdisciplinary Team
Resource affected/impacts being mitigated: This statement seeks to mitigate impacts on tailings safety, which in turn is protective of human life, property, and numerous downstream resources.
Applicable alternatives: Preferred Alternative

Authority to require: While the footprint of the Preferred Alternative may not involve Forest Service surface resources, other aspects of the project still involve Forest Service surface resources, and the information collected under this measure is considered necessary to support both the FEIS and the final mining plan of operations.
Additional ground disturbance: No additional ground disturbance anticipated.

Scenic (1 measure)

FS-03: Transmission Lines
Description/overview: Use best management practices or other guidelines (on NFS lands) that would minimize visual impacts from transmissions lines that could include: • Non-specular transmission lines, transformers, and towers; • Avoid use of monopole transmission structures; • Avoid "skylining" of transmission/communication towers and other structures. Consider topography when siting transmission structures to avoid "skylining" of structures on high ridges in the landscape; • In areas of the highest visual sensitivity with difficult access, air transport capability should be used to mobilize equipment and materials for clearing, grading, and erecting transmission towers.
Source of measure: Internal NEPA Team Scoping
Resource affected/impacts being mitigated: These measures seek to reduce and minimize the scenery impacts and project contrast of mining operations in the surrounding landscape and impacts upon sensitive viewers. All recommendations would be effective in reducing the form, line, and color contrasts presented by the project elements.
Applicable alternatives: All
Authority to require: Power line corridors occur mainly on Forest-managed lands and mitigation can be required regardless of alternative under 36 CFR 228.8 (Forest Service authority to regulate mining to minimize adverse environmental impacts on NFS surface resources)
Additional ground disturbance: No additional ground disturbance anticipated.

Cultural/Historical Resources and Tribal Values (2 measures)

RC-209: Cultural and Archaeological Data Recovery – Oak Flat HPTP
Description/overview: The "Resolution Copper Oak Flat Land Exchange Treatment Plan" (Oak Flat Historic Properties Treatment Plan [HPTP]) (Deaver and O'Mack 2019) sets out a plan for treatments to resolve the adverse effects to 42 historic properties that have been identified within the Oak Flat Federal Parcel. In accordance with the plan, Resolution Copper would conduct archaeological data recovery on sites eligible under Criterion D that would be adversely affected. Project materials and archaeological collections would be curated in accordance with 36 CFR 79 (Curation of Federally-Owned and Administered Archaeological Collections) with Gila River Indian Community, Salt River Pima-Maricopa Indian Community, and the Arizona State Museum. This measure is applicable to all alternatives and would be noted in the ROD/Final Mining Plan of Operations.
Source of measure: Resolution Copper
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on cultural resources.
Applicable alternatives: All
Authority to require: Ultimately, the land exchange removes the Oak Flat parcel from Federal ownership and oversight. However, the data recovery plans are being developed as part of the Programmatic Agreement and, when signed, would be required to occur.
Additional ground disturbance: Yes, but data recovery activities would take place within the area already assumed to be disturbed in the EIS.

RC-210: Cultural and Archaeological Data Recovery – GPO HPTP
Description/overview: The GPO Research Design and data recovery plans detail treatments to resolve adverse effects on historic properties within the GPO project area with the exception of those in the Oak Flat Federal Parcel. Data recovery would be conducted on archaeological sites eligible under Criterion D within the GPO project area. Project materials and archaeological collections would be curated in accordance with 36 CFR 79 (Curation of Federally-Owned and Administered Archaeological Collections) with Gila River Indian Community, Salt River Pima-Maricopa Indian Community, and the Arizona State Museum. This measure is applicable to all alternatives and would be noted in the ROD/Final Mining Plan of Operations.
Source of measure: Resolution Copper
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on cultural resources.
Applicable alternatives: All

Authority to require: Authority varies by alternative; however, the data recovery plans are being developed as part of the Programmatic Agreement and, when signed, would be required to occur.
Additional ground disturbance: Yes, but data recovery activities would take place within the area already assumed to be disturbed in the EIS.

Socioeconomics/Environmental Justice (none)

Grazing (none)

Reclamation/Other Plans (1 measure)

CA-166: BLM offered lands preservation/improvement
Description/overview: Proposed mitigation for offered lands: 7B Ranch/Lower San Pedro River Parcels • Assure that water monitoring area is preserved, and species protection features remain in place. • Remove all graffiti, commercial use, billboards, remove refuse. • Prevent unauthorized uses. • Prevent and mitigate new hazardous material that may occur on property. Appleton Ranch • Ensure water features are preserved and left intact.
Source of measure: BLM
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on recreation, wildlife habitat, visual resources, and water quality.
Applicable alternatives: All
Authority to require: With respect to the offered lands, these proposed measures apply to actions Resolution Copper would take prior to the land exchange, would take place through the ongoing appraisal and exchange process, and would no longer be applicable after the exchange occurs.
Additional ground disturbance: Yes, but within the land exchange parcels as disclosed in the DEIS.

Other Mitigation and Monitoring Measures Not Considered in Chapter 3 Impacts Analysis

While not analyzed for effectiveness in the EIS, other mitigation and monitoring measures were suggested during the scoping process, during alternatives development, or would be likely under a permit or authorization required for the mine. As stated above, the Forest Service has the authority to limit

impacts on Forest Service surface resources, but not those imposed by another regulating authority or on private land outside of regulating authorities.

The Forest Service would not have authority to require the items listed below, but they could be implemented in the future to limit impacts. These measures were not considered within the analysis of the EIS.

The Forest Service welcomes comments on these ideas for future consideration of incorporation by other agencies with permitting authority or Resolution Copper as an Applicant-Committed Environmental Protection Measure.

Mitigation and Monitoring Required by Other Regulatory and Permitting Agencies

Mitigation and monitoring items under this heading are within the authority of other regulatory permitting agencies, including the Arizona Department of Environmental Quality and Arizona Department of Water Resources. At this point in the NEPA process, the Forest Service has no authority, obligation, or expertise to determine or enforce compliance for the measures included in this category, as they have neither been required by other agencies or agreed to by Resolution Copper. However, as with other measures discussed, if these measures are eventually included in the ROD/Final Mining Plan of Operations, they would be required by the Forest Service. They are presented here to facilitate disclosure of currently known mitigation and monitoring and their consideration in impacts analyses. The mitigation and monitoring measures in this category include permit requirements and stipulations from legally binding permits and authorizations such as the air quality permit, Aquifer Protection Permit, and groundwater withdrawal permit.

Many of these permits are not yet issued but would be issued prior to approval of the final mining plan of operations. Those permits received prior to the issuance of the final ROD may need to be modified to reflect the alternative selected by the deciding official. These regulatory and permitting agencies would share monitoring results and any instances of noncompliance with the Forest Service. The Forest Service would use the information provided by the regulatory and permitting agencies to determine compliance with the decision that would be documented in the final ROD and compliance with the final mining plan of operations. Some of the other permits, licenses, and authorizations (see table 1.5.4-1 in chapter 1) that would be required for the mine to be operational (and may include additional mitigations in addition to those noted here) include:

- Aquifer Protection Permit (APP)
- Arizona Pollutant Discharge Elimination System (AZPDES) Permit
- Clean Water Act Section 401 Certification
- Special Use Permits
- Project-Specific Section 404 Clean Water Act Permit
- Air Quality Control Permit

Geology, Minerals, Subsidence (none)

Soils and Vegetation (none)

Noise and Vibration (3 measures)

GP-132: Maintain equipment regularly to reduce noise from heavy machinery operations
Description/overview: Maintain equipment regularly to reduce noise from heavy machinery operations
Source of measure: Public comment submittal during scoping period
Resource affected/impacts being mitigated: This statement seeks to reduce impacts from noise.
Applicable alternatives: All
Possible authority to require: Pinal County
Additional ground disturbance: No additional ground disturbance anticipated.

GP-133: Establish procedures for reporting noise complaints
Description/overview: Establish procedures for reporting noise complaints, such as providing a telephone number for the public to report noise complaints and posting the number at various locations
Source of measure: Public comment submittal during scoping period
Resource affected/impacts being mitigated: This statement seeks to reduce impacts from noise.
Applicable alternatives: All
Possible authority to require: Pinal County
Additional ground disturbance: No additional ground disturbance anticipated.

GP-134: Develop noise limits and a fine structure for noise violations
Description/overview: Develop noise limits and a fine structure for noise violations
Source of measure: Public comment submittal during scoping period
Resource affected/impacts being mitigated: This statement seeks to reduce impacts from noise.
Applicable alternatives: All
Possible authority to require: Pinal County
Additional ground disturbance: No additional ground disturbance anticipated.

Transportation and Access (none)

Air Quality (3 measures)

GP-111: Identify monitoring thresholds for fugitive dust pollution
Description/overview: Identify monitoring thresholds for fugitive dust pollution
Source of measure: Public comment submittal during scoping period
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on air quality.
Applicable alternatives: All
Possible authority to require: Pinal County Air Quality Control District
Additional ground disturbance: No additional ground disturbance anticipated.

GP-112: Implement enforcement strategies for air quality mitigation
Description/overview: Implement enforcement strategies for air quality mitigation.
Source of measure: Public comment submittal during scoping period
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on air quality.

Applicable alternatives: All
Possible authority to require: Pinal County Air Quality Control District
Additional ground disturbance: No additional ground disturbance anticipated.

GP-110: Reevaluate GPO dust abatement strategy
Description/overview: Reevaluate the GPO dust abatement strategy and implement additional mitigation measures as needed
Source of measure: Public comment submittal during scoping period
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on air quality.
Applicable alternatives: All
Possible authority to require: Pinal County Air Quality Control District
Additional ground disturbance: No additional ground disturbance anticipated

Water Resources (9 measures)

RC-217: Compensatory mitigation plan (404 permit)
Description/overview: Appendix to EIS for impacts on ephemeral drainages and waters of the U.S.
Source of measure: Resolution Copper
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on water resources.
Applicable alternatives: Alternative 5 and 6 that would require a 404 permit
Possible authority to require: As noted in chapter 1 of the EIS, the U.S. Army Corps of Engineers would have a permitting role if either Alternative 5 or 6 is pursued and would rely on this EIS to support their decision. Compensatory mitigation is a required component, and preliminary concepts have been included as part of the EIS.
Additional ground disturbance: Yes, negligible and not quantifiable, more details found within Draft Resolution Copper Project Clean Water Act Section 404 Conceptual Compensatory Mitigation Plan (see appendix D to EIS)

GP-76: Test stormwater runoff through running washes
Description/overview: Test stormwater runoff for toxins to prevent recreational exposure through running washes
Source of measure: Public comment submittal during scoping period
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on water resources and public health and safety.
Applicable alternatives: All
Possible authority to require: Arizona Department of Environmental Quality under the AZPDES permit
Additional ground disturbance: No additional ground disturbance anticipated.

GP-79: Disclose results of water monitoring
Description/overview: Monitor groundwater and surface water quality and publicly disclose the results quarterly.
Source of measure: Public comment submittal during scoping period
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on water resources.
Applicable alternatives: All
Possible authority to require: Arizona Department of Environmental Quality under the APP or AZPDES permits
Additional ground disturbance: No additional ground disturbance anticipated.

GP-91: Clarify “interim shutdown”
Description/overview: Clarify “interim shutdown” mitigation measures relative to water discharge.
Source of measure: Public comment submittal during scoping period
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on water resources.
Applicable alternatives: All
Possible authority to require: Arizona Department of Environmental Quality under the APP or AZPDES permits

Additional ground disturbance: No additional ground disturbance anticipated.

GP-92: Detail methodology for monitoring and mitigation of discharge water
Description/overview: Describe the methods and regulatory oversight that will be applied to monitor and mitigate the quality of mine and tailings discharge water.
Source of measure: Public comment submittal during scoping period
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on water resources.
Applicable alternatives: All
Possible authority to require: Arizona Department of Environmental Quality under the APP or AZPDES permits
Additional ground disturbance: No additional ground disturbance anticipated.

FS-151: Implement a long-term monitoring and mitigation plan for releases
Description/overview: A long-term monitoring and mitigation plan for such releases (i.e., long-term seepage to groundwater and surface waters) is an essential element of a Forest Service–approved mining plan of operations.
Source of measure: Internal scoping
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on water resources.
Applicable alternatives: All
Possible authority to require: The first part of this appendix focuses on the Forest Service mitigation and monitoring. Additional monitoring plans could be associated with other agencies and coordinated with the Forest Service, including plans required by the Arizona Department of Environmental Quality under the APP or AZPDES permits.
Additional ground disturbance: No additional ground disturbance anticipated.

CA-206: Wells up- and down-gradient of site
Description/overview: Installing wells up- and down-gradient of the site would allow analysis of the groundwater elevation contours, discontinuities within the bedrock with seepage potential, and would establish baseline groundwater quality data to support further analysis of impacts and mitigation
Source of measure: Arizona Department of Environmental Quality
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on water resources.
Applicable alternatives: All
Possible authority to require: Monitoring wells are an integral part of the Arizona Department of Environmental Quality APP permitting process. Additional wells that extend beyond the area required under the APP may also be considered as part of monitoring efforts.
Additional ground disturbance: No additional ground disturbance anticipated.

GP-37: Install Additional Deep Monitoring Wells
Description/overview: Additional deep monitoring wells should be installed with “clearly defined water quality goals” for groundwater geochemistry.
Source of measure: Public comment submittal during scoping period
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on water resources.
Applicable alternatives: All
Possible authority to require: Monitoring wells are an integral part of the Arizona Department of Environmental Quality APP permitting process. Additional wells that extend beyond the area required under the APP may also be considered as part of monitoring efforts.
Additional ground disturbance: Yes, with some impacts of drilling additional wells quantified in the seeps and spring monitoring and mitigation plan (see RC-211)

CA-168: Streams and Riparian Ecosystem mitigation of impacts
Description/overview: Contribution to ongoing restoration efforts in the Middle Gila HUC 8 watershed could be appropriate for inclusions in mitigation plans. Where unavoidable impacts on aquatic resources cannot be restored or replaced where the effects occur, suggest compensation within the same and then adjacent watersheds be prioritized over more distant options. Such projects could include 1) restoration work via vegetation removal within the Gila River Indian Community along the Lower Salt and Agua Fria Rivers; 2) BLM restoration work via mesquite removal and establishment of native grasses within the San Pedro Riparian National Conservation area near the Upper San Pedro HUC.
Source of measure: Environmental Protection Agency
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on water resources and riparian ecosystems.
Applicable alternatives: All
Possible authority to require: As noted in chapter 1 of the EIS, the U.S. Army Corps of Engineers would have a permitting role if either Alternative 5 or 6 is pursued and would rely on this EIS to support their decision. Compensatory mitigation is a required component, and preliminary concepts have been included as part of the EIS. The types of measures discussed are similar in nature to those included in the conceptual compensatory mitigation, and may form part of further changes to that mitigation package. There would be no permitting role for the U.S. Army Corps of Engineers for Alternatives 2, 3, or 4, and these measures would only be implemented if brought forth voluntarily by Resolution Copper.
Additional ground disturbance: Yes, ground disturbance would be preliminarily estimated in the Draft Resolution Copper Project Clean Water Act Section 404 Conceptual Compensatory Mitigation Plan (see appendix D to EIS)

Wildlife (6 measures)

CA-185: Reduce impacts on Golden Eagles
Description/overview: **Golden eagle –** Near West and Peg Leg tailings storage facility sites are within 10 miles of two active nest sites and one potential nest site; impacts include loss of foraging habitat at tailings storage facility and mine facilities. • Identify raptor resources potentially affected; recommend minimum 3-year monitoring period prior to construction to identify nesting, foraging, and wintering habitats and, if feasible, include one cycle of prey population fluctuations (FWS guidelines 2002) • Monitor nest productivity at active nest sites within 5 miles of project boundaries pre- and post-construction to see if land conversion and habitat loss impact nest productivity; document changes. Carry into reclamation phase and evaluate post-closure reclamation and raptor response. • Utilize seasonal and/or spatial buffer zones for level and duration of construction activities during nesting period at occupied versus unoccupied nest sites (see Utah Field Office Guidelines for Raptor Protection from Human and Land Use Disturbances (USFWS 2002); and time construction outside breeding season if feasible.

• Prevent additional encroachment of human activity on nest sites (i.e., new roads, trails etc.); acquire lands around nest sites; create habitat management plans around nest sites
Source of measure: Arizona Game and Fish Department
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on wildlife.
Applicable alternatives: All
Possible authority to require: This type of mitigation could be required as an outcome of Section 7 ESA consultation with FWS. If so, the Forest Service is responsible for implementing any conservation measures brought forward during Section 7 ESA consultation, or any conditions specified in a Biological Opinion by FWS.
Additional ground disturbance: No additional ground disturbance anticipated.

CA-186: Reduce impacts on Peregrine Falcon
Description/overview: **Peregrine Falcon –** active breeding along Apache Leap; tier mitigation to USFWS 2003 Monitoring Plan for the American Peregrine Falcon. A species recovered under the Endangered Species Act. • Monitor nest productivity along Apache Leap.
Source of measure: Arizona Game and Fish Department
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on wildlife.
Applicable alternatives: All
Possible authority to require: This type of mitigation could be required as an outcome of Section 7 ESA consultation with FWS. If so, the Forest Service is responsible for implementing any conservation measures brought forward during Section 7 ESA consultation, or any conditions specified in a Biological Opinion by FWS.
Additional ground disturbance: No additional ground disturbance anticipated.

CA-187: Reduce impacts on Migratory and Breeding Birds
Description/overview: Migratory and breeding birds – tied to impacts and mitigation for riparian habitats. During the initial project construction and startup and delivery of tailings material to tailings storage facility site(s), adult migratory bird species that are currently nesting are likely to abandon nests during tailings delivery/deposit. This impact is likely to be lessened once delivery starts as birds are not likely to begin nesting while materials are being deposited.

• Initiate construction outside breeding periods for species that use saguaros (SGCN: elf owl, Gila woodpecker, gilded flicker, white-winged dove), key riparian habitats • Develop an Avian and Bat Protection Plan in coordination with the AGFD.
Source of measure: Arizona Game and Fish Department
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on wildlife.
Applicable alternatives: All
Possible authority to require: This type of mitigation could be required as an outcome of Section 7 ESA consultation with FWS. If so, the Forest Service is responsible for implementing any conservation measures brought forward during Section 7 ESA consultation, or any conditions specified in a Biological Opinion by FWS. The habitats impacted are Forest Service surface resources for Alternatives 2, 3, and 4, and authority exists under 36 CFR 228.8 for these areas. For Alternative 5, 43 CFR 3809.2 provides similar authority to BLM to regulate mining to prevent unnecessary or undue degradation. For Alternative 6, the Forest Service would not have jurisdiction over the tailings storage facility, but would have authority over the pipeline corridors.
Additional ground disturbance: No additional ground disturbance anticipated.

GP-122: Implement impact avoidance and minimization measures for special status species
Description/overview: Implement impact avoidance and minimization measures for special status species
Source of measure: Public comment submittal during scoping period
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on wildlife.
Applicable alternatives: All
Possible authority to require: This type of mitigation could be required as an outcome of Section 7 ESA consultation with FWS. If so, the Forest Service is responsible for implementing any conservation measures brought forward during Section 7 ESA consultation, or any conditions specified in a Biological Opinion by FWS. The habitats impacted are Forest Service surface resources for Alternatives 2, 3, and 4, and authority exists under 36 CFR 228.8 for these areas. For Alternative 5, 43 CFR 3809.2 provides similar authority to BLM to regulate mining to prevent unnecessary or undue degradation. For Alternative 6, the Forest Service would not have jurisdiction over the tailings storage facility, but would have authority over the pipeline corridors.
Additional ground disturbance: No additional ground disturbance anticipated.

CA-189: Surveys of Riparian and Aquatic Species
Description/overview: Riparian and Aquatic Species – native fish, lowland leopard frogs, Sonoran mud turtle, southwestern willow flycatcher, western yellow-billed cuckoo, common black-hawk, Arizona Bell's vireo • Conduct pre-construction species and habitat surveys and monitoring for riparian and aquatic species.
Source of measure: Arizona Game and Fish Department
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on wildlife
Applicable alternatives: All
Possible authority to require: This type of mitigation could be required as an outcome of Section 7 ESA consultation with FWS. If so, the Forest Service is responsible for implementing any conservation measures brought forward during Section 7 ESA consultation, or any conditions specified in a Biological Opinion by FWS. The habitats impacted are Forest Service surface resources for Alternatives 2, 3, and 4, and authority exists under 36 CFR 228.8 for these areas. For Alternative 5, 43 CFR 3809.2 provides similar authority to BLM to regulate mining to prevent unnecessary or undue degradation. For Alternative 6, the Forest Service would not have jurisdiction over the tailings storage facility, but would have authority over the pipeline corridors.
Additional ground disturbance: No additional ground disturbance anticipated.

CA-177: Special Species Surveys prior to construction and site-specific plans
Description/overview: Conduct special status species surveys prior to construction of tailings pipeline corridors across perennial or intermittent streams and rivers (e.g., Gila River, Mineral Creek, Devil's Canyon) and designated Critical Habitats to determine species presence/absence. Develop site-specific wildlife mitigation plan in coordination with Arizona Game and Fish Department, FWS, and Forest Service biologists to address construction-related actions to avoid, minimize, and mitigate impacts on special status species (e.g., timing of construction, species relocations, etc.).
Source of measure: Arizona Game and Fish Department
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on wildlife.
Applicable alternatives: All
Possible authority to require: This type of mitigation could be required as an outcome of Section 7 ESA consultation with FWS. If so, the Forest Service is responsible for implementing any conservation measures brought forward during Section 7 ESA consultation, or any conditions specified in a Biological Opinion by FWS. The habitats impacted are Forest Service surface resources for Alternatives 2, 3, and 4, and authority exists under 36 CFR 228.8 for these areas. For Alternative 5, 43 CFR 3809.2 provides similar authority to BLM to regulate mining to prevent unnecessary or undue degradation. For Alternative 6, the Forest Service would not have jurisdiction over the tailings storage facility, but would have authority over the pipeline corridors.
Additional ground disturbance: No additional ground disturbance anticipated.

Recreation (1 measure)

GP-230 Arizona Trail construction considerations
Description/overview: Incorporate construction measures into any road crossings, pipeline crossings, or reroutes of the Arizona National Scenic Trail to minimize impediments to trail use and minimize visual impacts on trail users.
Source of measure: Arizona Trail Association comment
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on recreation.
Applicable alternatives: All
Possible authority to require: This would likely be an applicant-proposed measure, and if so implementation is not assured; however, once this measure is included in the ROD/Final Mining Plan of Operations it would be required by the Forest Service. Depending on the location of the crossing, there could be authority under 36 CFR 228.8 for these areas.
Additional ground disturbance: Yes, additional ground disturbance would be expected in order to bury the pipeline near the Arizona Trail.

Public Health & Safety (1 measure)

GP-113: Provide PPE to employees
Description/overview: Provide employees with personal protective equipment specific to deep shaft mining hazards.
Source of measure: Public comment submittal during scoping period
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on public health and safety.
Applicable alternatives: All.
Possible authority to require: MSHA and OSHA
Additional ground disturbance: No additional ground disturbance anticipated.

Scenic (none)

Cultural/Historical Resources and Tribal Values (none)

Socioeconomic/Environmental Justice (none)

Livestock and Grazing (none)

Reclamation/Other Plans (1 measure)

GP-102: Require adequate bond amount
Description/overview: Require an adequate bond amount for mine reclamation.
Source of measure: Public comment submittal during scoping period
Resource affected/impacts being mitigated: This statement seeks to reduce impacts on long-term reclamation, soils, and vegetation post-closure.
Applicable alternatives: All
Possible authority to require: U.S. Forest Service, BLM, Arizona Department of Environmental Quality (APP program), and Arizona State Mine Inspector would all require bonding on the project for various components.
Additional ground disturbance: No additional ground disturbance anticipated.

Attachment 1 – RUG Recreation Project Conceptual Plan

Attachment 2 – Alternative 6 Proposed Mitigation Routes Map

SUPERIOR, ARIZONA
RECREATION PROJECT CONCEPTUAL PLAN
Recreation User Group

Prepared for:

Recreation User Group

Project Number: 807.135

March 2019

WestLand Resources

WestLand Resources, Inc. • 4001 E. Paradise Falls Drive • Tucson, Arizona 85712 • 520•206•9585

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(follow text)

1. INTRODUCTION

In 2016, the Recreation User Group (the Group) was formed to develop a recreational trail design within the vicinity of Superior, in Pinal County, Arizona (the Project Area; **Figure 1**). The Group was charged with developing a conceptual plan for a trail system on the Tonto National Forest (TNF) that will meet the needs and interests of different stakeholder groups while also meeting the management priorities of the U.S. Forest Service (USFS). The proposed trail network occurs on a mixture of public lands or public rights-of-way and private land within portions of Township 2 South, Range 11-13 East, and Township 3 South, Range 12 East (**Figure 2**). The majority occur on the Globe Range District of the TNF, and a small portion occurs on private land owned or managed by Resolution Copper (Resolution).

A network of unpaved roads and trails, many of which are user-created alignments that are not authorized by the USFS, currently exists within the Project Area. These trails and roads have resulted in ongoing resource degradation. The Group, which is comprised of representatives from the Town of Superior's intended recreational users, including hikers, equestrians, mountain bicyclists and off-highway vehicle (OHV) enthusiasts, was created to identify recreational resources and develop a conceptual layout for the recreational trail design (the Project). On July 25, 2018, the Group voted to move forward with the preparation of the conceptual plan for submittal to the USFS.

This report has been prepared to detail the review process used to develop the conceptual plan; the existing conditions within the Project Area; the project construction, maintenance, and funding; the members of the Group; and references cited.

2. BACKGROUND

2.1. HISTORY OF THE AREA

The proposed trail system is located on TNF lands adjacent to Superior, Arizona, a mining town that like many mining towns has been subject to the inherently cyclical nature of the mining industry. The Superior area is a one-hour drive from Phoenix, a city with a population of more than 4.73 million in the greater metropolitan area. With its proximity to Phoenix, the TNF is "one of the most-visited 'urban' forests in the United States (approximately 5.8 million visitors annually)" (TNF 2019)[1].

Superior, which serves as a gateway to the TNF, is surrounded by natural beauty and world class recreation opportunities on the TNF that are currently unrecognized, underdeveloped, and subject to misuse, including unauthorized roads and trails, wildcat dumping, and informal target practice sites.

[1] https://www.fs.usda.gov/tonto/; accessed on February 7, 2019.

2.2. PROJECT PURPOSE

There is a need for a trail system in the vicinity of Superior, Arizona, in order to reduce the haphazard development of unauthorized trails that has led to the degradation of riparian habitat and impacts to wildlife and plant species. The purpose of the Project is to provide a recreational trail system within the TNF with the following characteristics:

- Provides recreation opportunities for hikers, equestrians, mountain bicyclists and OHV enthusiasts.
- Is readily accessible to Superior and the Phoenix metropolitan area
- Offers long-term, sustainable economic benefits to the local community through recreation and ecotourism
- Protects soil resources in this area from erosion, thus preventing sediment yield into surface waters
- Provides access to uniquely beautiful viewsheds within TNF that are not currently accessible by authorized trails

3. PROJECT AREA DESCRIPTION

3.1. EXISTING LAND USES

Land uses within TNF lands near the Project Area consist predominantly of livestock grazing, mining, and outdoor recreation including hiking, birding, horseback riding, mountain biking and off-roading. Additionally, hunting regulated by Arizona Game and Fish Department occurs on TNF lands within and adjacent to the Project Area (Game Units 24A and 37B), and an informal shooting area is located near the upper reach of Arnett Canyon. There are a number of areas devoid of vegetation that appear to be dispersed camp sites or staging areas. Several isolated illegal trash dumps are also scattered around the Project Area. Where the terrain is rocky and steep, and access is more challenging, the landscape remains relatively undisturbed. With the exception of the portion of the Arizona National Scenic Trail (AZNST) that crosses through the Project Area, existing trails on TNF lands are primarily unauthorized motorized and non-motorized trails (**Table 1**).

Table 1. Existing Unauthorized Trails on USFS Lands within the Project Area

Trail Type	Existing (miles)
Motorized	24.6
Motorized (single track)	0
Non-Motorized	17.3
TOTAL	**41.9**

Land uses on private and state lands adjacent to the Project Area include rural and suburban residential neighborhoods, livestock grazing, recreation, industrial activities such as mining and an active quarry. The Boyce Thompson Arboretum State Park, an Important Bird and Biodiversity Area recognized by Audubon Arizona, is located immediately north of the northwestern extent of the proposed trail system. The northeast portion of the proposed trail system consists of private property in Superior and includes facilities such as the Town of Superior waste water treatment plant, Superior Municipal Airport, and the Superior Unified School District. The Perlite Superior Plant is located east of Picketpost Mountain, immediately north of the north central portion of the trail system. Two private inholdings are located along Arnett Creek in the central east portion of the Project Area owned by a cattle company and a living trust.

In general, more extensive human disturbance occurs within the eastern portion of the Project Area, while the western portion remains relatively undisturbed.

3.2. PHYSICAL FEATURES

The Project Area is located in the Central Highlands Physiographic Province, a transitional area between the Colorado Plateau Physiographic Province and the Basin and Range Physiographic Province (Ffolliott 1999). Elevations within the Project Area range from approximately 2,400 feet (ft) above mean sea level (amsl) in the lower reach of Arnett Creek to the summit of Picketpost Mountain at approximately 4,375 ft amsl. Topography within the Project Area is associated with the foothills of surrounding mountains and is dominated by steep to rolling terrain and includes highly scenic features such as standing boulders and other rock outcrops, dramatic rock faces, narrow rocky ridges, and sharply incised canyons.

The terrain within the Project Area can be generally divided into two areas. The eastern portion of the Project Area, between State Route 177 and the eastern ridge of Wood Canyon, is characterized by gently rolling hills. This lowland area affords extensive views of the Apache Leap formation to the east and Picketpost Mountain to the west. The portion of the Project Area located to the west, between Wood and Telephone Canyons, is characterized by more rugged terrain created by the ridges and drainages of the Canyons. These formations follow a roughly parallel course until the two canyons reach the lower slopes of Picketpost Mountain.

3.3. CLIMATE AND AIR

The regional climate in the vicinity of the Project Area is characterized as semiarid, with long periods of little or no precipitation (Western Regional Climate Center 2019)[2]. Precipitation falls in a bimodal pattern: most of the annual rainfall within the region occurs during the winter and summer months,

[2] https://wrcc.dri.edu/Climate/west_coop_summaries.php; accessed on February 7, 2019.

with dry periods characterizing spring and fall. The average annual precipitation in the Superior region is 20.22 inches, with just over half occurring between November and April (U.S. Climate Data 2019)[3].

Air quality within the vicinity of the Project Area currently meets National Ambient Air Quality Standards (NAAQS) standards for the seven "criteria pollutants": carbon monoxide (CO), sulfur dioxide (SO_2), particulates with an aerodynamic diameter less than or equal to a nominal 10 µm (PM_{10}), particulates with an aerodynamic diameter less than or equal to a nominal 2.5 µm ($PM_{2.5}$), ozone (O_3), nitrogen dioxide (NO_2), and lead (Pb). The National Park Service has a long-term air quality dataset for the Tonto National Monument located to characterize the air quality in the Superstition Wilderness, located north of the Project Area, which indicates air quality is good and air pollution levels are lower than in populated areas. All of the areas within the Project Area are in attainment status. The nearest non-attainment areas include the Hayden airshed, which is in non-attainment for PM_{10} immediately east of the Project Area, and the Phoenix airshed, which is in non-attainment for O_3.

3.4. VEGETATION

Based on the broad scale biotic community mapping of Brown and Lowe (Brown and Lowe 1980), the majority of the Project Area is mapped as the Arizona Upland Subdivision of Sonoran Desertscrub (Turner and Brown 1982), with vegetation characteristic of that biotic community present, including saguaro (*Carnegiea gigantea*), paloverde (*Parkinsonia* spp.), jojoba (*Simmondsia chinensis*) and occasional crucifixion thorn (*Canotia holacantha*).

Telegraph Canyon, Arnett Creek, Queen Creek, and some of the unnamed side canyons and springs within the Project Area support relatively narrow bands or patches of riparian vegetation consistent with Interior Riparian Deciduous Forests and Woodlands (Minckley and Brown 1994). Fremont cottonwood (*Populus fremontii*), Goodding's willow (*Salix gooddingii*), Arizona sycamore (*Platanus wrightii*), Arizona walnut (*Juglans major*), netleaf hackberry (*Celtis reticulata*), seepwillow (*Baccharis salicifolia*), California buckthorn (*Rhamnus californica*), and the nonnative saltcedar (*Tamarix* sp.) are the dominant species in these areas. The other ephemeral drainages, exhibit xeroriparian vegetation, with plant species composition similar to that of the surrounding upland areas, but in higher stature and densities.

3.5. SURFACE WATER FEATURES

Intermittent and near-perennial surface waters in Arnett and Queen creeks support riparian plant communities and aquatic and wetland features within portions of the Project Area. The riparian woodlands are represented by narrow, linear stands comprised of Fremont cottonwood, Goodding's willow, Arizona walnut, and Arizona sycamore and salt cedar. The linear stands are largely contiguous with occasional breaks in the canopy.

[3] https://www.usclimatedata.com/climate/superior/arizona/united-states/usaz0228; accessed on February 7, 2019.

4. PROJECT DESCRIPTION

4.1. CONCEPTUAL PLAN DEVELOPMENT AND COMMUNITY INVOLVEMENT

The Project was first proposed by Resolution to TNF as a mitigation measure for Resolution's planned mining activities. The Group was developed as part of TNF's efforts to engage the local community throughout the planning and development process. Stakeholders were identified for the Group with the intention of creating a well-designed and well-implemented trail system that meets stakeholder needs. The Group ultimately included representatives from the Town of Superior, the local community, Resolution, and members of the outdoor recreation community (see **Table 3** for Group members). Additionally, TNF representatives attended regularly to provide input and direction for the Group.

The Project is located within Forest Plan Management Area 2F, and the proposed trail system must conform with the management priorities for this management area, which predominantly focuses on wildlife habitat improvement, water quality maintenance, livestock forage production, and dispersed recreation. The Forest plans to manage watersheds to improve them to a satisfactory or better condition and improve and manage adjacent riparian areas to benefit riparian dependent resources (USFS 1985, page 85).

The following is direction provided directly from the TNF Plan (USFS 1985) for the Project Area:

- Continue periodic inspection and maintenance of existing wildlife exclusions and restoration projects. Develop reports as needed to describe results of studies. Improve the level of protection and maintenance at these sites to ensure their continued informational value for wildlife management (USFS 1985, page 87).
- Based on Transportation Operation and Maintenance (O&M) Plans, identify alternative routes for new trails near urban centers and/or main travel routes. Gather information for cost estimating and design criteria. Includes trail location and selection, survey design and field review (USFS 1985, page 89).
- O&M of entire trail system to provide for a variety of user experience levels, resource protection and public safety. Includes trail condition surveys and maintenance plans (USFS 1985, page 89).

During the conceptual plan development for the Project Area, the Group balanced TNF management and recreation priorities with the priorities identified by the stakeholders. Ultimately, the following goals for the trail network design were identified:

(a) consolidate the existing trail network to reduce unauthorized disturbance;
(b) allow for a diverse range of trail types for both motorized and non-motorized uses;
(c) maximize and preserve views of the outstanding natural scenery of the area;

(d) segregate use types as necessary to minimize conflicts and facilitate public safety;
(e) be sustainable and require minimal maintenance;
(f) be able to be constructed in phases.

The Group has met on a regular basis since 2016 (**Table 2**). Conceptual trail routes were developed using aerial imagery, topographic information and the local expertise of Group members. The Group engaged an environmental consultant (WestLand Resources, Inc.) to review cultural and biological resources within the proposed trail routes as well as a trail design consultant (Southwest Trail Solutions) to assist with the development of the trail design and resource review process.

Table 2. Recreation User Group Meeting Dates *

Day	Year
September 24	2015
November 30	2015
February 10	2016
April 13	2016
September 14	2016
December 7	2016
February 8	2017
April 12	2017
October 10	2017
November 9	2017
December 13	2017
February 14	2018
April 11	2018
July 25	2018
November 14	2018
January 9	2019

* List of meeting dates is based on information provided on the Superior Arizona Community Working Group website: https://superiorazcwg.org/category/meeting-notes/recreation-user-group/. CWG Recreation & Access Task Force Meeting dates are excluded from this list.

The stakeholder representatives comprising the Group membership are listed in **Table 3**.

Table 3. Recreation User Group Members

Representative	Organization
John Bricker	Tonto Recreation Alliance
Rich Smith	Tonto Recreation Alliance
Kevin Patterson	Tonto Recreation Alliance
Mila Besich-Lira	Town of Superior
Todd Pryor	Town of Superior
Elizabeth Butler	Friends of Tonto National Forest & Equestrians
Jim Schenck	Superior Community Working Group
Greg Waterman	Sun City Anthem Hiking Club
Bruce Odegaard	Sun City Anthem Hiking Club
Lynn Martin	Ranching community
George Martin	Ranching community
Rick Schonfeld	WestLand Resources, Inc.
Mark Flint	WestLand Resources, Inc./Southwest Trail Solutions
Mary Morissette	Resolution Copper
Erik Filsinger	Queen Creek Coalition
Patrick Kell	International Mountain Bicycling Association
John Godec	Godec, Randall & Associates
Debra Duerr	Godec, Randall & Associates
Bill Volger	Legends of Superior Trails (LOST)
Nancy Volger	Legends of Superior Trails (LOST)

4.2. DESIGN

The preliminary trail designs were developed by the Group stakeholders and then refined based on field reconnaissance and cultural resources identified for avoidance. The trail alignments and trailhead areas were surveyed for impacts to cultural resources. For the trail alignments, a corridor width of 10 meters to either side of the proposed travel way (20 meters total) was surveyed to ensure the conceptual plan does not conflict with cultural resources that are eligible for the National Register of Historic Places. The preliminary designs were adjusted where needed to ensure each trail alignment is constructible, consistent with USFS construction standards, sustainable, and navigable.

During field reconnaissance, trail designers identified the opportunity to segregate the two major trail use categories – motorized and non-motorized – into different sections of the trail system. The ridge line extending approximately north/south separating Telegraph Canyon and Wood Canyon serves as a natural boundary between the two use areas (**Figure 2**). One portion of the trail system, north and

east of Wood Canyon, was designed primarily for operation of motorized equipment, both two-wheeled (motorcycles) and four-wheeled (small all-terrain vehicles and larger jeeps and sport-utility vehicles). The other portion of the trail, to the west of Wood Canyon, was designed primarily for non-motorized recreation (equestrian, mountain biking, and hiking).

Physically separating the two categories of trail use meets the Groups' goals of providing a diverse range of trail types in a safe and sustainable way. There are two exceptions to this segregation, however. A single new non-motorized trail has been proposed within the lowlands of the primarily-motorized section to provide a more moderate non-motorized trail with easy access from Superior and the highways. The other exception is the presence of an existing designated motorized USFS road within the portion western portion of the Project Area that is primarily non-motorized. A short segment of new motorized trail is proposed to connect the motorized trail system through the primarily non-motorized portion of the Project Area to the existing USFS road.

Potential locations for trailhead parking areas which were also segregated for motorized and non-motorized (primarily equestrian) uses. Users of both types of trails often use trailers, so the trailhead for each type of trail was designed to provide ample room for parking and unloading. All trailheads will be located within the lowlands in the northeast of the Project Area to provide easy access to the trailheads from Superior and the highways.

All trails are designed to maximize long-term sustainability and minimize erosion with consideration given to grade, angle, slope, and clearance. The trail system design also considers existing roads, unauthorized trails, and other sources of resource degradation and/or public safety concerns within the Project Area and identifies strategies for addressing these issues. The trail system is also designed to provide a variety of trail difficulty levels ranging from novice to expert. Design standards for the two user types (motorized vs. non-motorized) are identical, with the exception that sight-line distances and turning radii will be greater on motorized trails to accommodate the greater speeds and power associated with motorcycle use.

Final trail design and construction will take into consideration the local hydrology, soil types, cultural sites, and sensitive species that are listed, proposed or candidate for listing as threatened or endangered under the Endangered Species Act (ESA) within the area of the desired trail location. Known caves within the immediate vicinity of the proposed trail routes will continued to be managed by the USFS to protect culturally significant sites and follow U.S. Fish and Wildlife Service white nose syndrome protocols for bat populations that may frequent the caves. Trail designers will also identify sources of erosion, assess the potential impacts, and ensure that water and wind will not adversely affect the intended travel way.

4.3. LAYOUT

The trail system has been laid out as a standalone recreation system for both motorized and non-motorized users in the Superior region. The trail system has been designed to deliberately limit AZNST tie-ins to already-designated locations in an effort to avoid additional unplanned pressures on AZNST usage.

The trail layout is designed to encourage the use of the proposed trail system while discouraging the use of the existing unauthorized trails and the creation of new unauthorized trails. The is accomplished through two primary approaches: signage placement and route design. First, signs will be strategically placed at trail heads to indicate the authorized paths and reinforce good trail stewardship by stressing the importance of staying on designated trails. Signs will also be placed as a deterrent, along with boulders, railings, etc., at unauthorized access points to discourage off-trail usage. Second, the trail route has been located such that turns in the trail (a common point where unauthorized trail usage occurs) will be placed adjacent to features that will serve as natural deterrents to off-trail use, such as large boulders, steep inclines or drop-offs, etc.

Three staging areas are planned on TNF lands (**Figure 3**) totaling 2.9 acres of disturbance. These staging areas are strategically located to be close to desirable recreation areas while also being accessible to passenger vehicles and close enough to Superior to encourage visitor use of the town.

Table 4 provides a summary of the of trail lengths segregated by trail type. Motorized trails include two track routes appropriate for four-wheeled vehicles and single-track routes appropriate for off-highway motorcycles. Non-motorized trails are proposed single-track routes that are intended for hikers, cyclists, and equestrians.

Table 4. New Trails Proposed on TNF Lands

Trail Type	Trail Length (miles)
Motorized (two track)*	14.7
Motorized (single track)	28.7
Non-Motorized	25.6
TOTAL	**69.0**

* Existing unauthorized two-track trails

The layout of existing trails on private land with the potential to be connected to the proposed network on TNF lands are not included in the estimated trail lengths, as private trails are not included in this plan unless an easement already exists or the land owner has agreed to grant an easement for the trail.

4.4. CONSTRUCTION

Most proposed trail construction within the lowlands of the Project Area (in the northeast portion) will consist of improvements to existing unauthorized two-track roads to reduce ongoing erosion and increase public safety. Redundant existing roads will be obliterated and reclaimed to the extent possible. The construction of one new non-motorized single-track trail and three trailhead parking areas are proposed within this section (**Figure 2**).

Typical activities associated with the construction of the new trail alignments will include shaping the thin soil layer where present and moving and/or reducing the sizes of boulders where they conflict with the intended users. Where possible, boulders and rock ledges will be incorporated into the trail alignments in accordance with the skill level of the anticipated users. Vegetation along proposed new single track alignments will be pruned to an approximate height of 10 feet and an approximate width of 6 to 8 feet to allow sufficient space for users to pass in opposite directions.

The bulk of construction will be done manually by volunteer crews, including youth, veteran, and ancestral lands crews, during the cooler months of the year. Most of the new trails will be constructed in the upland areas on top of solid rock. Manual construction activities will include shaping the thin soil layer where possible, moving boulders out of the planned trail route, and breaking rock to allow for passage where necessary. Some rocks and rock ledges will be preserved to provide a more challenging terrain for bicyclists.

Where necessary, professional operators will use mechanized equipment for trail construction. This will likely be limited primarily to the lowlands along the northern extent of the Project. In these cases (and where feasible) a SWECO trail dozer and mini excavator (or equivalent) would be used to construct the trail. Construction will proceed in phases.

The majority of new motorized trails will be for single-track (motorcycle) use only.[4] Design and construction standards will be essentially the same as for non-motorized use trails. Because of the greater speed and power associated with motorcycle use, sight-line distances, turning radii and switchback construction will all be adjusted accordingly.

4.5. MAINTENANCE

Sustainable trail design and construction are being applied from the outset to minimize trail maintenance. As a result, most of the maintenance is anticipated to consist of pruning vegetation and maintaining drainage crossings. Unusually severe weather events may require more intensive maintenance and possible trail reconstruction.

[4] Approximately 3.2 miles of existing unauthorized trails are two track.

The success of numerous volunteer groups, such as the Arizona Trail Association (which maintains the AZNST), illustrates the fact that non-profit organizations can provide ongoing maintenance for recreational trails. It is anticipated that at least one such organization will be formed to recruit, train, and manage trail stewards and to raise funds for major repair projects.

4.6. FUNDING

It is anticipated that all final design and construction costs will be provided by at least one dedicated non-profit organization with additional funding provided by other entities. Construction and maintenance work will be conducted mainly by volunteers, such as youth, veteran, and ancestral lands volunteer crews. The bulk of construction expenses will come from the development of the final design and field layout by professional contractors, and the professional crews needed for more challenging trail sections. Possible funding sources include Resolution as well as grants, donations, and special organized events.

4.7. TRAIL BENEFITS

The trail is anticipated to provide benefits to the local economy in the form of long-term sustainable recreation and ecotourism, to reduce resource degradation from unauthorized trail use, and to better employ the currently underdeveloped recreational opportunities of National Forest lands located in proximity to a major metropolitan area.

The economic impacts that outdoor recreation provide to rural communities are well documented, and it is anticipated that development of the Project will be no exception for Superior, Arizona. Because the Project contains such a diverse range of scenic terrain within a relatively small area, it has the potential to become a popular destination for the growing number of outdoor recreation enthusiasts not only from the greater Phoenix area but also from across the country. In order to encourage visitors to use the town as a starting point, the Project includes the extension of an existing trail from town to the Picketpost trailhead on the Arizona National Scenic Trail (**Figure 2**), thereby providing a direct non-motorized connection to the Project Area. It is anticipated that the local business community will promote and participate in volunteer trail construction and maintenance efforts. The phasing of Project construction will allow for existing businesses to adapt to an expanding clientele and for new businesses to take advantage of new opportunities.

Developing a planned trail with appropriate signage and design elements will reduce the impacts to soil erosion, wildlife, plant life, and riparian habitat that the area is currently experiencing from the haphazard and unauthorized trail use that is occurring due to the lack of a planned system. The plan has identified sensitive resources and designed the trail system to avoid or minimize impacts to these resources.

The Group was developed specifically to ensure the trail system plan is one that meet the interests of the current users in a sustainable way that is in line with USFS management priorities. As a result, the proposed Project provides recreation opportunities currently unavailable in this location that are of interest to potential users. Furthermore, the Project's proximity to a major metropolitan area will facilitate access to these resources to in a more deliberate and environmentally sustainable way.

The proposed plan addresses ongoing management concerns for the TNF while providing a service and recreation opportunities that are currently underdeveloped to the local and regional communities, creating long-reaching benefits to the region.

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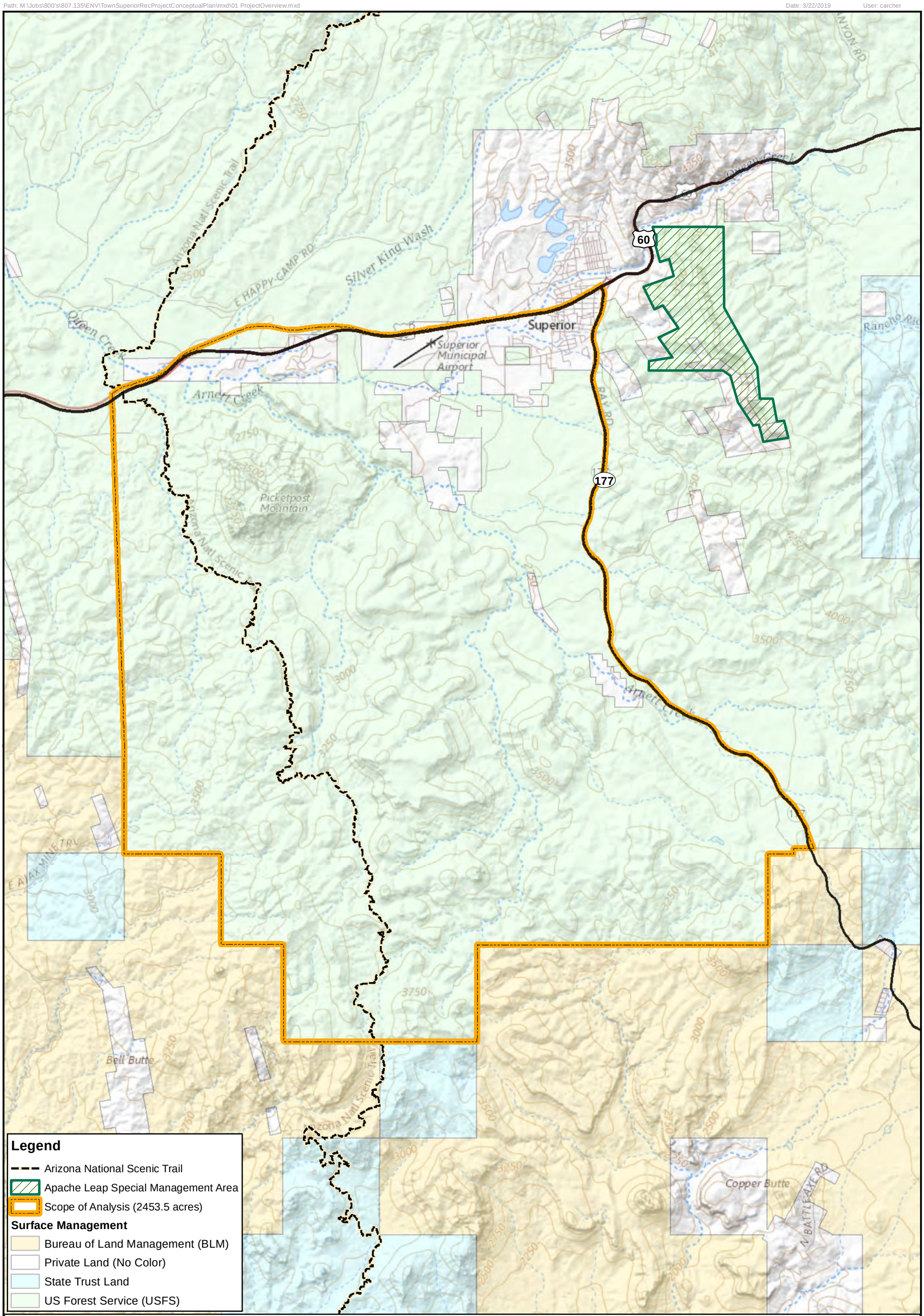
FIGURES



Scope of Analysis within:
T2S, R11-13E, and T3S, R12E,
Pinal County, Arizona,
Data Source: AZ Trail Association and
Surface Management: BLM 2018, WRI modified 2018
Image Source: ArcGIS Online USGS National Map

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N

0 2,500 5,000 Feet

0 1,000 2,000 Meters

RECREATION USER GROUP
SUPERIOR, AZ
Conceptual Plan

PROJECT OVERVIEW
Figure 1

Picketpost Trailhead

Proposed Trailhead/Parking Lot 1
Off-Highway Vehicle Users

Proposed Trailhead/Parking Lot 2
Equestrians and Mountain Bicyclists

Proposed Trailhead/Parking Lot 3
Equestrians and Mountain Bicyclists

Scope of Analysis within:
T2S, R11-13E, and T3S, R12E,
Pinal County, Arizona,
Mesa USGS 1:100,000 USGS Quadrangle
Data Source: Surface Management (BLM 2018, WRI Modified 2018),
Recreation User Group (RUG)
Road Classification: ArcGIS Online, USA Major Roads

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N

0 1,250 2,500 Feet

0 500 1,000 Meters

Legend

Recreation Use Trail
- Proposed Trail, Motorized (Single Track)
- Existing Forest Road, Motorized
- Proposed Road, Motorized
- Existing Trail, Non-Motorized
- Proposed Trail, Non-Motorized
- Telegraph Canyon/Wood Canyon Ridgeline

Road Classification
- Other Major Road
- Secondary Road
- Important Local Road
- Scope of Analysis (2453.5 acres)

Surface Management
- Bureau of Land Management (BLM)
- Private Land (No Color)
- State Trust Land
- US Forest Service (USFS)

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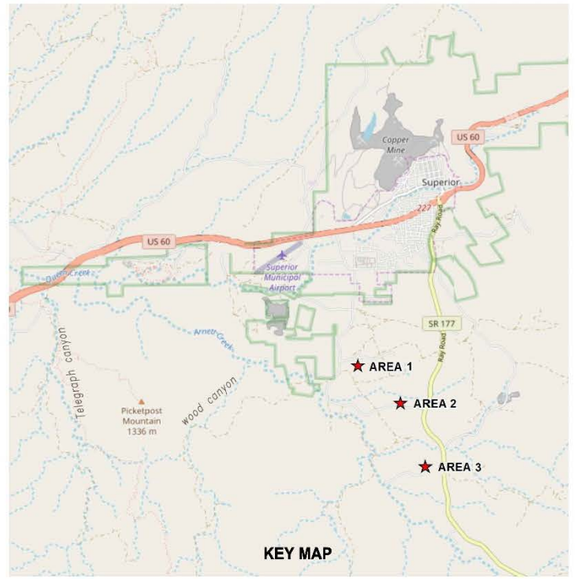
SUPERIOR, AZ
Conceptual Plan

TRAIL DESIGN
Figure 2

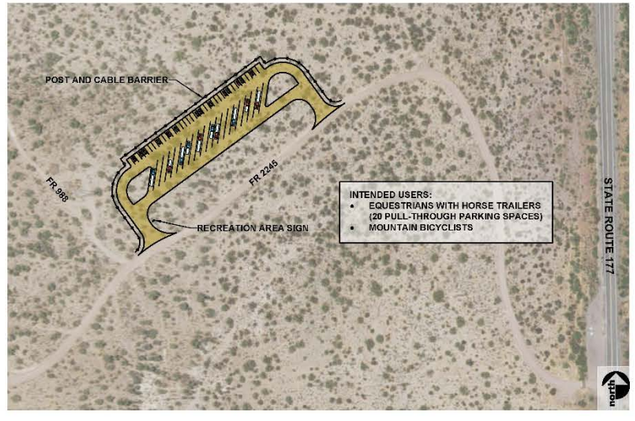
1 **TRAILHEAD PARKING AREA (FOREST ROADS 2421 & 2422) : OFF-HIGHWAY VEHICLES**

SCALE: 1" = 200'



2 **TRAILHEAD PARKING AREA (ARNETT DRIVE/ FOREST ROAD 230) : EQUESTRIAN & MOUNTAIN BICYCLIST**

SCALE: 1" = 200'



3 **TRAILHEAD PARKING AREA (FOREST ROAD 2245) : EQUESTRIAN & MOUNTAIN BICYCLIST**

SCALE: 1" = 200'

WestLand Resources Inc.
Engineering and Environmental Consultants
4001 E. Paradise Falls Drive
Tucson, Az 85712 (520) 206-9585

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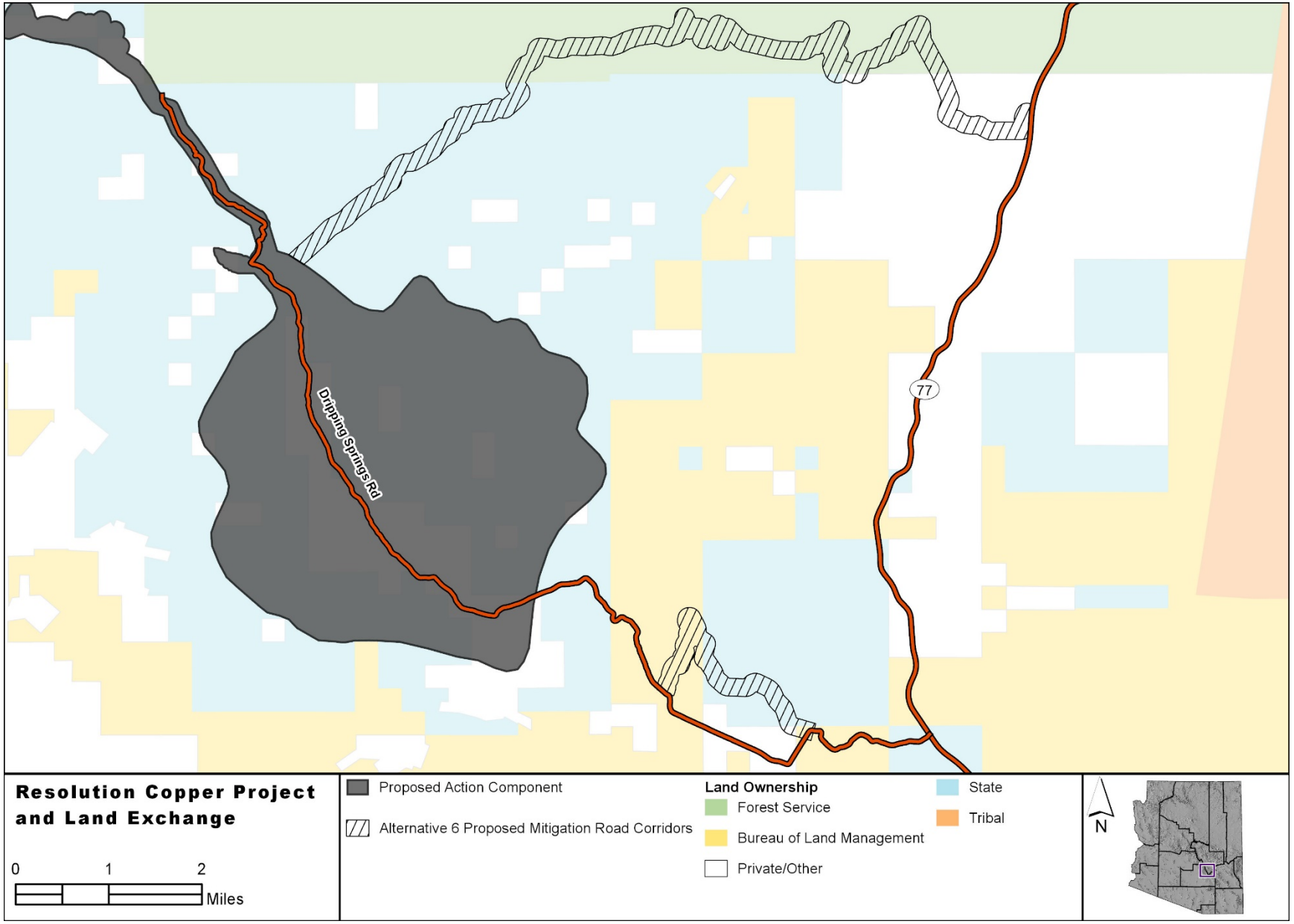
TRAILHEAD PARKING AREAS

Figure 3


Dripping Springs Rd
77
Resolution Copper Project and Land Exchange
0
1
2
Miles
Proposed Action Component
Alternative 6 Proposed Mitigation Road Corridors
Land Ownership
Forest Service
Bureau of Land Management
Private/Other
State
Tribal
N

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APPENDIX K. SUMMARY OF CONTENT OF RESOURCE ANALYSIS PROCESS MEMORANDA

Analysis Process Memoranda

Overview of Process

Under the National Environmental Policy Act of 1969, as amended (NEPA), the U.S. Department of Agriculture Forest Service (Forest Service) is responsible for taking a "hard look" at potential impacts from the Resolution Copper Project and Land Exchange (project) using the best available information and science. The project involves multiple facilities, multiple phases, a large and diverse geographic area, and several exceptionally complex analyses, including subsidence modeling, groundwater modeling, and geochemical modeling. A substantial amount of detailed documentation is necessary to describe the analysis approaches, assumptions, and results.

At the same time, the Forest Service has strived to make the environmental impact statement (EIS) accessible and understandable, as is made clear in the Council on Environmental Quality (CEQ) regulations (emphasis added):

> 40 Code of Federal Regulations (CFR) 1502.2 – Implementation
>
> To achieve the purposes set forth in §1502.1 agencies shall prepare environmental impact statements in the following manner:
>
> (a) Environmental impact statements shall be *analytic rather than encyclopedic*.
>
> (b) Impacts shall be discussed in proportion to their significance. There shall be *only brief discussion of other than significant issues.* As in a finding of no significant impact, there should be only enough discussion to show why more study is not warranted.
>
> (c) Environmental impact statements shall be *kept concise and shall be no longer than absolutely necessary* to comply with NEPA and with these regulations. Length should vary first with potential environmental problems and then with project size.
>
> 40 CFR 1502.8 – Writing
>
> Environmental impact statements shall be *written in plain language and may use appropriate graphics* so that decisionmakers and the public can readily understand them. Agencies should employ writers of clear prose or editors to write, review, or edit statements, which will be based upon the analysis and supporting data from the natural and social sciences and the environmental design arts.

To accomplish this balance, some details of the complex analysis have been left out of the EIS itself. These details are still available to the public in a series of memoranda, one for each resource in chapter 3. This is consistent with CEQ regulations:

> 40 CFR 1502.21 – Incorporation by reference
>
> Agencies shall incorporate material into an environmental impact statement by reference when the effect will be to cut down on bulk without impeding agency and public review of the action. The incorporated material shall be cited in the statement and its content briefly described. No material may be incorporated by reference unless it is reasonably available for inspection by potentially interested persons within the time allowed for

comment. Material based on proprietary data which is itself not available for review and comment shall not be incorporated by reference.

The purpose of this appendix is to summarize the available memoranda and the contents in each. Table K-1 shows a summary of the available process memoranda. Each subsection briefly summarizes the topics included in the individual process memoranda.

Table K-1. Summary of analysis process memoranda

Resource	Reference
Geology, Minerals, and Subsidence	(Newell and Garrett 2018b)
Soils and Vegetation	(Newell 2018h)
Noise and Vibration	(Newell 2018d)
Transportation and Access	(Newell 2018i)
Air Quality	(Newell and Garrett 2018a)
Water Resources	(Newell and Garrett 2018d)
Wildlife	(Newell 2018k)
Recreation	(Newell 2018e)
Public Health and Safety	(Newell and Garrett 2018c)
Scenic Resources	(Newell 2018f)
Cultural Resources	(Newell 2018a)
Socioeconomics	(Newell 2018g)
Tribal Values and Concerns	(Newell 2018j)
Environmental Justice	(Newell 2018b)
Livestock and Grazing	(Newell 2018c)

Geology, Minerals, and Subsidence

The contents of the process memorandum that supports the "Geology, Minerals, and Subsidence" section of chapter 3 includes the following:

- Detailed Information Supporting EIS Analysis
    - Resource Analysis Area
    - Analysis Methodology
        - Approach – Baseline Data
        - Approach – Subsidence Modeling
        - Approach – Vetting of Geologic and Subsidence Modeling
        - Status of Geology and Subsidence Workgroup
    - Detailed Information on Geologic Framework and Geologic Units
        - Regional Geology
        - Regional Geologic Units
        - Structural Geology and Faults

        - Local Geology of Mine Area and Associated Infrastructure
        - Mineral Deposit
        - Tailings Storage Facility Area – Alternatives 2 and 3
        - Tailings Storage Facility Area – Alternative 4
        - Tailings Storage Facility Area – Alternative 5
        - Tailings Storage Facility Area – Alternative 6
        - East Plant Site
        - West Plant Site
        - Tunnels between East and West Plant Sites
        - Magma Arizona Railroad Company (MARRCO) Corridor
        - Filter/Loadout Facility
        - Pipeline Corridors
- Regulations, Laws, and Guidance
- Key Documents and References Cited for Geology, Minerals, and Subsidence

Soils and Vegetation

The contents of the process memorandum that supports the "Soils and Vegetation" section of chapter 3 includes the following:

- Detailed Information Supporting EIS Analysis
    - Resource Analysis Area
    - Analysis Methodology and Selected Outcomes
        - Soils
        - Revegetation
        - Vegetation Communities, Noxious Weeds, and Special Status Plant Species
        - Concern for Impacts to Stability from Revegetation
        - Previous and Existing Disturbance
        - Assessment of Need to Collect Additional Information
- Regulation, Laws, and Guidance
- Key Documents and References Cited for Soils and Vegetation
- Appendix 1: Additional Information for Vegetation Communities Affected Environment
- Appendix 2: Detailed Soil Analysis Results

Noise and Vibration

The contents of the process memorandum that supports the "Noise and Vibration" section of chapter 3 includes the following:

- Detailed Information Supporting EIS Analysis
    - Resource Analysis Area
    - Analysis Methodology
        - Noise Modeling
        - Non-Blasting Noise Modeling
        - Blasting Noise Modeling
        - Blasting Vibration Modeling
        - Non-Blasting Vibration Modeling
        - Noise and Vibration Metrics
- Regulation, Laws, and Guidance
- Key Documents and References for Noise and Vibration

Transportation and Access

The contents of the process memorandum that supports the "Transportation and Access" section of chapter 3 includes the following:

- Detailed Information Supporting EIS Analysis
    - Resource Analysis Area
    - Analysis Methodology
- Regulation, Laws, and Guidance
- Key Documents and References Cited for Transportation and Access

Air Quality

The contents of the process memorandum that supports the "Air Quality" section of chapter 3 includes the following:

- Detailed Information Supporting EIS Analysis
    - Resource Analysis Area
        - Temporal Analysis
        - Spatial Analysis Area
    - Analysis Methodology
        - Standard Source/Distance (Q/D) Analysis for Class I Areas
        - Ambient Air Quality Monitoring
        - Conformity Analysis for Alternatives 5 and 6 for PM_{10} Non-Attainment Area
        - Emissions of Hazardous Air Pollutants
        - Lead Emissions
        - Secondary $PM_{2.5}$ and Ozone Formation

        - Estimate of Indirect Emissions
        - Health Based Risk Assessment Screening
- Regulation, Laws, and Guidance
- Key Documents and References Cited for Air Quality

Water Resources

The contents of the process memorandum that supports the "Water Resources" section of chapter 3, which has three subsections, includes the following:

GROUNDWATER QUANTITY AND GROUNDWATER-DEPENDENT ECOSYSTEMS

- Detailed Information Supporting EIS Analysis – Groundwater Quantity and Groundwater-Dependent Ecosystems
    - Resource Analysis Area
        - Temporal Analysis
        - Spatial Analysis Area
    - Analysis Methodology
        - Status of Groundwater Modeling Workgroup
        - Detailed Modeling Results for GDEs Summarized in DEIS
        - Assumption of Hydrologic Connection
        - Assessment of Need to Collect Additional Information
        - Rationale for Use of East Salt River Valley Model for Desert Wellfield
        - Subsidence Related to Groundwater Withdrawal – Desert Wellfield
        - Subsidence Related to Groundwater Withdrawal – East Plant Site
        - Inability to Analyze Individual Wells
        - Available Groundwater in East Salt River Valley
        - Full Detail for Tailings Water Balances
        - Percent Contribution of Spring DC6.6W to Devil's Canyon
    - Regulation, Laws, and Guidance – Groundwater Quantity
    - References and Key Documents – Groundwater Quantity and Groundwater Modeling

GROUNDWATER AND SURFACE WATER QUALITY

- Detailed Information Supporting EIS Analysis – Groundwater and Surface Water Quality
    - Resource Analysis Area
        - Temporal Analysis
        - Spatial Analysis Area
    - Analysis Methodology
        - Details of Geochemistry Workgroup

        - Assimilative Capacity Calculations
        - Reduced Assimilative Capacity from Reductions in Runoff
        - Existing Groundwater Quality – Frequency of Samples with Concentrations above Standards
        - Evolution of the Fully-Lined Alternative
        - Estimate of Seepage from a Fully-Lined Facility
        - Evaluation of Filtered Tailings at Other Tailings Locations
        - Consideration of Consolidation of Tailings in Seepage Analysis
        - Comparison of Alternative 5 and 6 surface water samples to additional Gila River water quality samples
        - Calculations of Pollutant Loading for Constituents of Concern from Each Alternative
        - Analysis for Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM)
- Regulation, Laws, and Guidance – Groundwater and Surface Water Quality
- Key Documents and References Cited for Groundwater and Surface Water Quality

SURFACE WATER QUANTITY

- Detailed Information Supporting EIS Analysis – Surface Water Quantity
    - Resource Analysis Area
    - Analysis Methodology
        - Surface Water Effects – Modeling Approaches
        - Floodplains and Lack of Available Data
        - Detailed Floodplain Impacts
        - Detailed Wetland Impacts
        - Acreage Differences
        - Differences in Stormwater and Erosion Control between Alternatives
            - General Sediment and Erosion Control Measures
            - East Plant Site Facility Stormwater Controls
            - West Plant Site Facility Stormwater Controls
            - Filter Plant and Loadout Facility Stormwater Controls
            - Alternatives 2 and 3 Tailings Storage Facility Stormwater Controls
            - Alternative 4 Tailings Storage Facility Stormwater Controls
            - Alternative 5 Tailings Storage Facility Stormwater Controls
            - Alternative 6 Tailings Storage Facility Stormwater Controls
        - Full Details of Streamflow Discharge-Duration-Frequency Analysis

- Regulation, Laws, and Guidance – Surface Water Quantity
- Key Documents and References Cited for Surface Water Quantity

Wildlife

The contents of the process memorandum that supports the "Wildlife" section of chapter 3 includes the following:

- Detailed Information Supporting EIS Analysis
    - Resource Analysis Area
    - Analysis Methodology
- Regulation, Laws, and Guidance
- Key Documents and References Cited for Wildlife
- Appendix A – Wildlife Screening Tables

Recreation

The contents of the process memorandum that supports the "Recreation" section of chapter 3 includes the following:

- Detailed Information Supporting EIS Analysis
    - Resource Analysis Area
    - Analysis Methodology
- Regulation, Laws, and Guidance
- Key Documents and References Cited for Recreation

Public Health and Safety

The contents of the process memorandum that supports the "Public Health and Safety" section of chapter 3, which has three subsections, includes the following:

TAILINGS AND PIPELINE SAFETY

- Detailed Information Supporting EIS Analysis – Tailings and Pipeline Safety
    - Resource Analysis Area
        - Temporal Analysis
        - Spatial Analysis Area
    - Analysis Methodology
        - Available Options for Breach Analysis
            - Empirical Method
            - Rheological and Energy Balance Methods
            - Advanced Modeling

        - Forest Service Chosen Methodology
        - Assessment of Need to Collect Additional Information
- Regulation, Laws, and Guidance – Tailings and Pipeline Safety
- Key Documents and References Cited for Tailings and Pipeline Safety

FUELS AND FIRE MANAGEMENT

- Detailed Information Supporting EIS Analysis – Fuels and Fire Management
    - Resource Analysis Area
    - Analysis Methodology
- Regulation, Laws, and Guidance – Fuels and Fire Management
- Key Documents and References Cited for Fuels and Fire Management

HAZARDOUS MATERIALS

- Detailed Information Supporting EIS Analysis – Hazardous Materials
    - Resource Analysis Area
    - Analysis Methodology
- Regulation, Laws, and Guidance – Hazardous Materials
- Key Documents and References Cited for Hazardous Materials

Scenic Resources

The contents of the process memorandum that supports the "Scenic Resources" section of chapter 3 includes the following:

- Detailed Information Supporting EIS Analysis
    - Resource Analysis Area
    - Analysis Methodology
        - Viewshed Analysis
        - Key Observation Points and Contrast Rating Analysis
        - Visual Simulation
        - Additional Detail for Scenery Resources in the Analysis Area
- Regulation, Laws, and Guidance
- Key Documents and References Cited for Scenic Resources
- Appendix A: Viewshed Analyses for each Alternative
- Appendix B: Contrast Rating Worksheets for Each Key Observation Point
- Appendix C: Visual Simulations

Cultural Resources

The contents of the process memorandum that supports the "Cultural Resources" section of chapter 3 includes the following:

- Detailed Information Supporting EIS Analysis
    - Resource Analysis Area
    - Analysis Methodology
        - Impact Indicators
- Regulation, Laws, and Guidance
- Key Documents and References Cited for Cultural Resources

Socioeconomics

The contents of the process memorandum that supports the "Socioeconomics" section of chapter 3 includes the following:

- Detailed Information Supporting EIS Analysis
    - Resource Analysis Area
    - Analysis Methodology
- Regulation, Laws, and Guidance
- Key Documents and References Cited for Socioeconomics

In addition, a key technical report was prepared by BBC Research and Consulting to document the details of the economic modeling and analysis, titled " Socioeconomic Effects Technical Report: Resolution Copper Mine Environmental Impact Statement," and dated November 12, 2018 (BBC Research and Consulting 2018).

Tribal Values and Concerns

The contents of the process memorandum that supports the "Tribal Values and Concerns" section of chapter 3 includes the following:

- Detailed Information Supporting EIS Analysis
    - Resource Analysis Area
    - Analysis Methodology
        - Impact Indicators
- Regulation, Laws, and Guidance
- Key Documents and References Cited for Tribal Values and Concerns

Environmental Justice

The contents of the process memorandum that supports the "Environmental Justice" section of chapter 3 includes the following:

- Detailed Information Supporting EIS Analysis
    - Resource Analysis Area
    - Analysis Methodology
- Regulation, Laws, and Guidance
- Key Documents and References Cited for Environmental Justice

Livestock and Grazing

The contents of the process memorandum that supports the "Livestock and Grazing" section of chapter 3, includes the following:

- Detailed Information Supporting EIS Analysis
    - Analysis Area
    - Analysis Methodology
        - Reduction in AUMs
- Regulation, Laws, and Guidance
- Key Documents and References Cited for Livestock and Grazing

APPENDIX L. DETAILED HYDROGRAPHS DESCRIBING IMPACTS ON GROUNDWATER-DEPENDENT ECOSYSTEMS

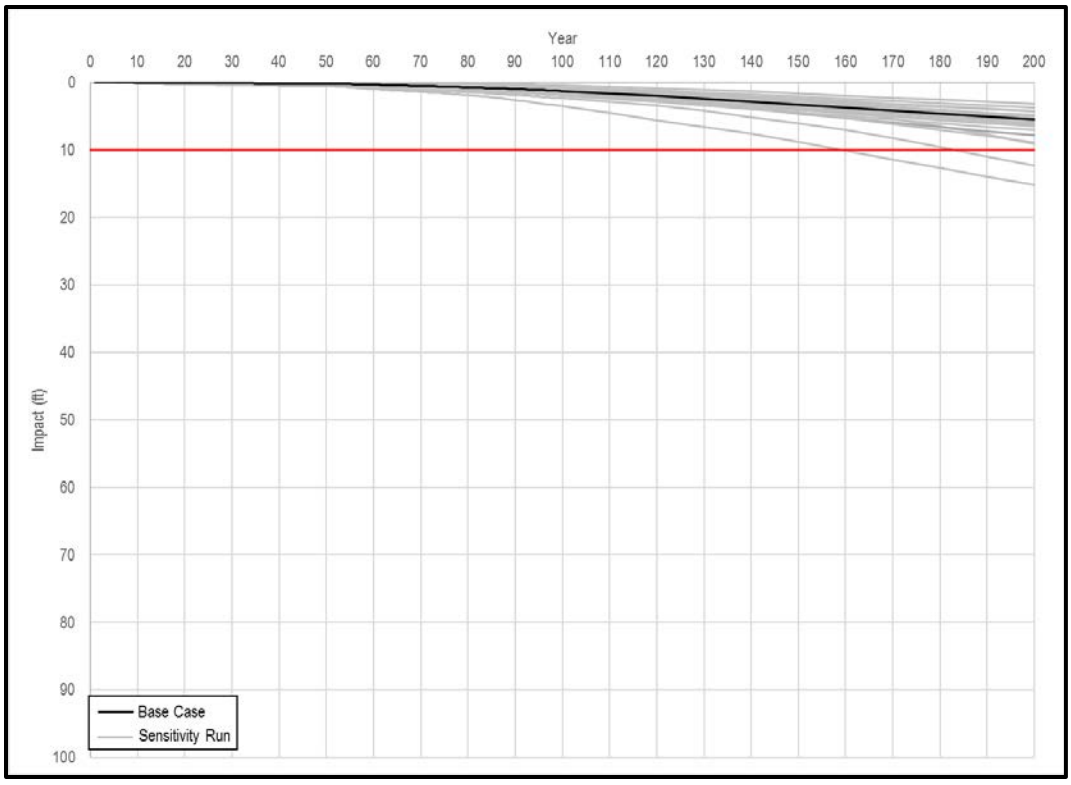

Figure L-1. Queen Creek – Flowing reach from km 17.39 to km 15.55

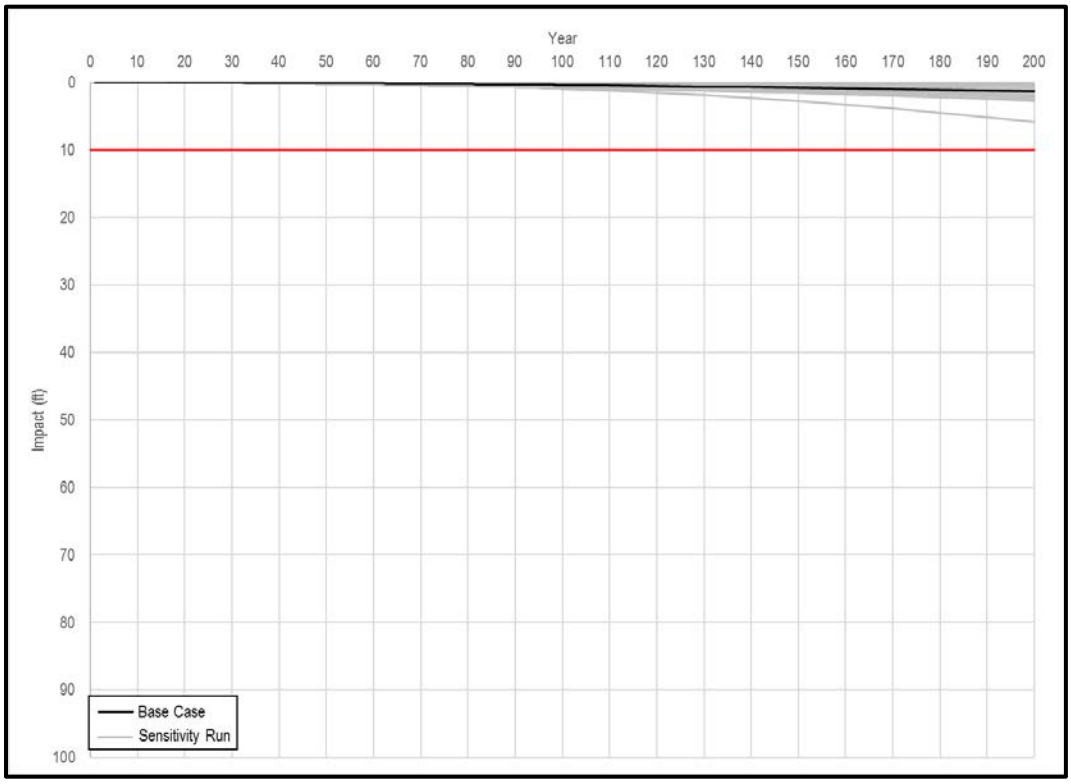

Figure L-2. Arnett Creek (from Blue Spring to confluence with Queen Creek). Specific location: AC-12.49

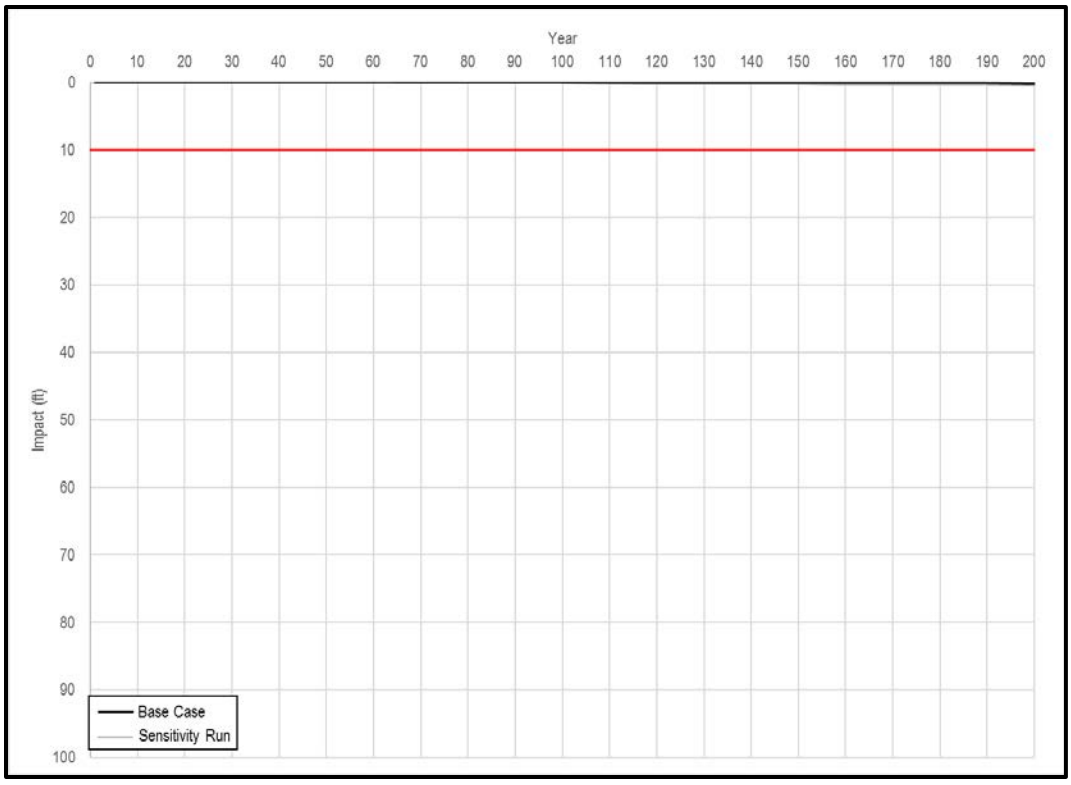

Figure L-3. Arnett Creek (from Blue Spring to confluence with Queen Creek). Specific location: AC-4.54

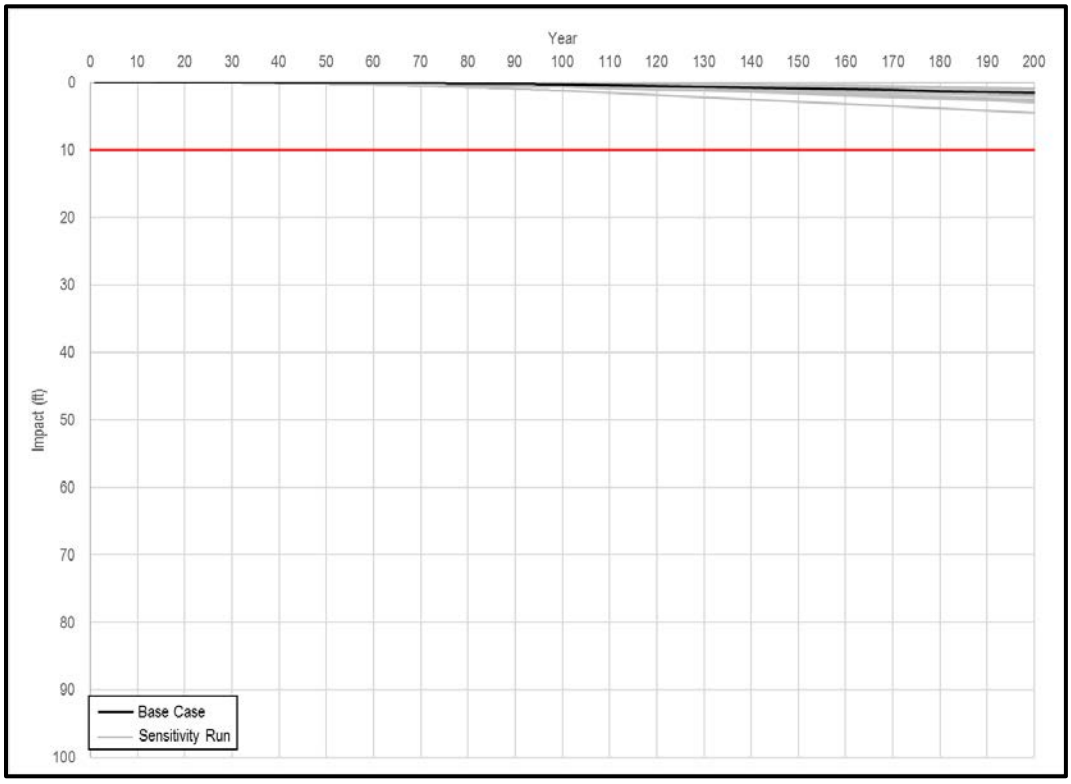

Figure L-4. Telegraph Canyon (near confluence with Arnett Creek)

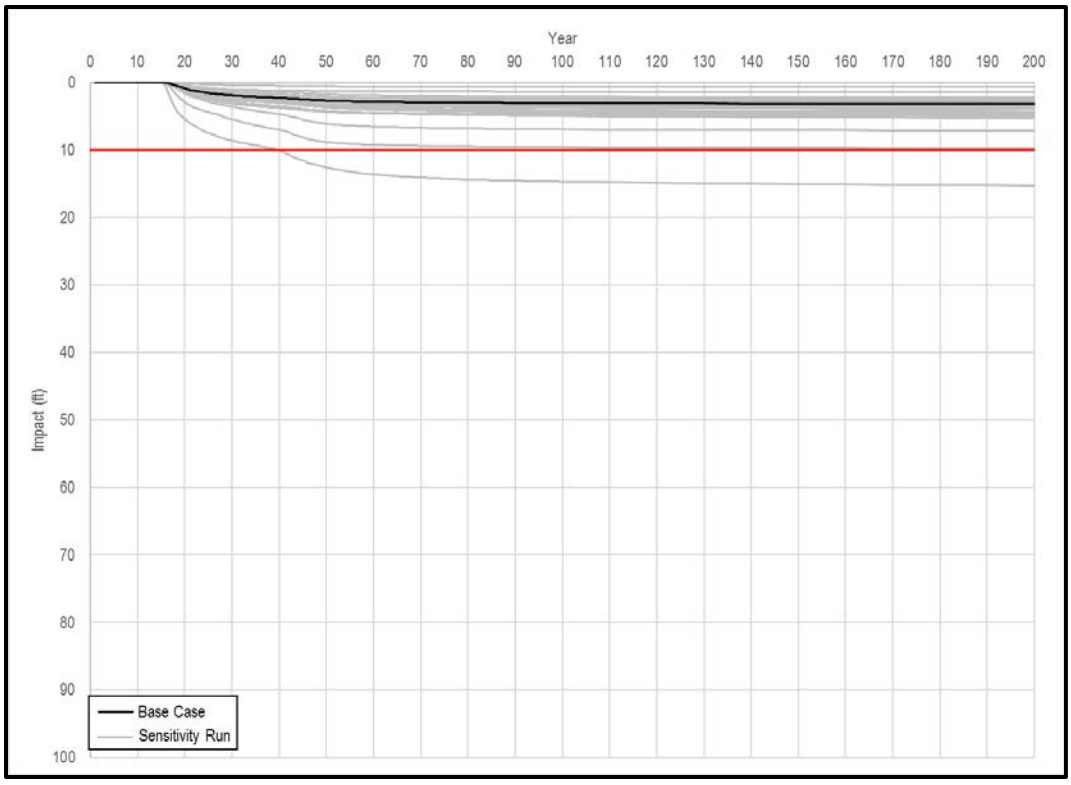

Figure L-5. Middle Devil's Canyon (from km 9.3 to km 6.1). Specific location: DC-8.8C

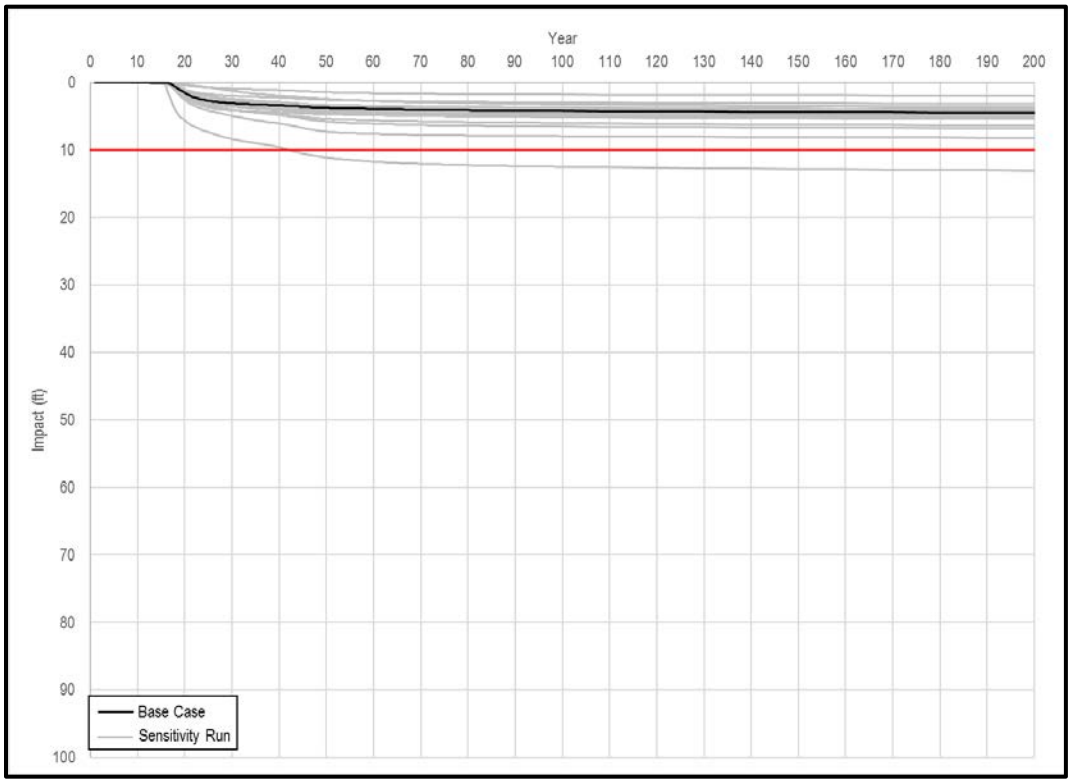

Figure L-6. Middle Devil's Canyon (from km 9.3 to km 6.1). Specific location: DC-8.2W

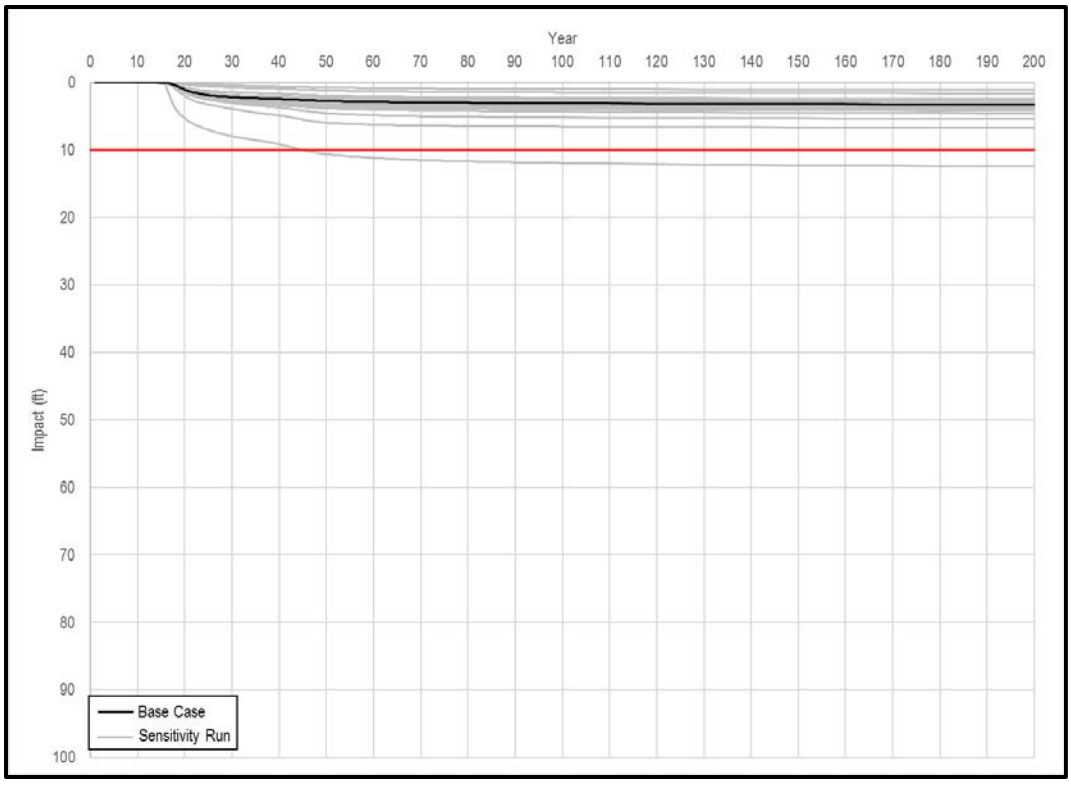

Figure L-7. Middle Devil's Canyon (from km 9.3 to km 6.1). Specific location: DC-8.1C

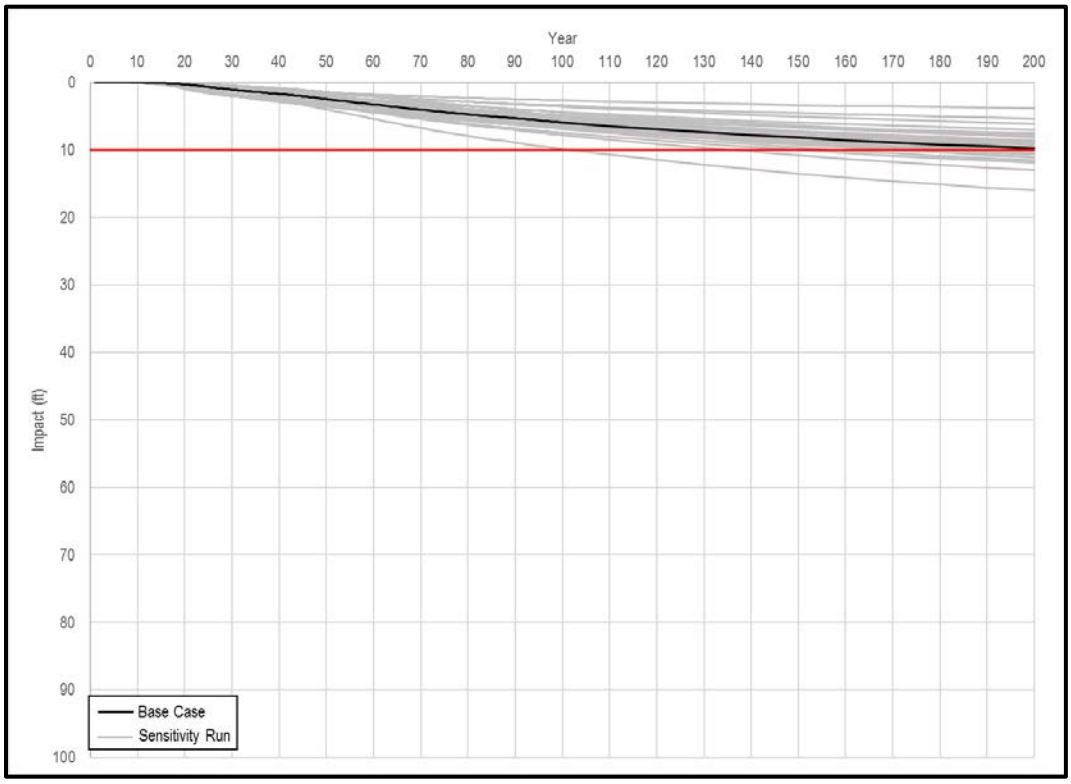

Figure L-8. Middle Devil's Canyon (from km 9.3 to km 6.1). Specific location: DC-6.6W

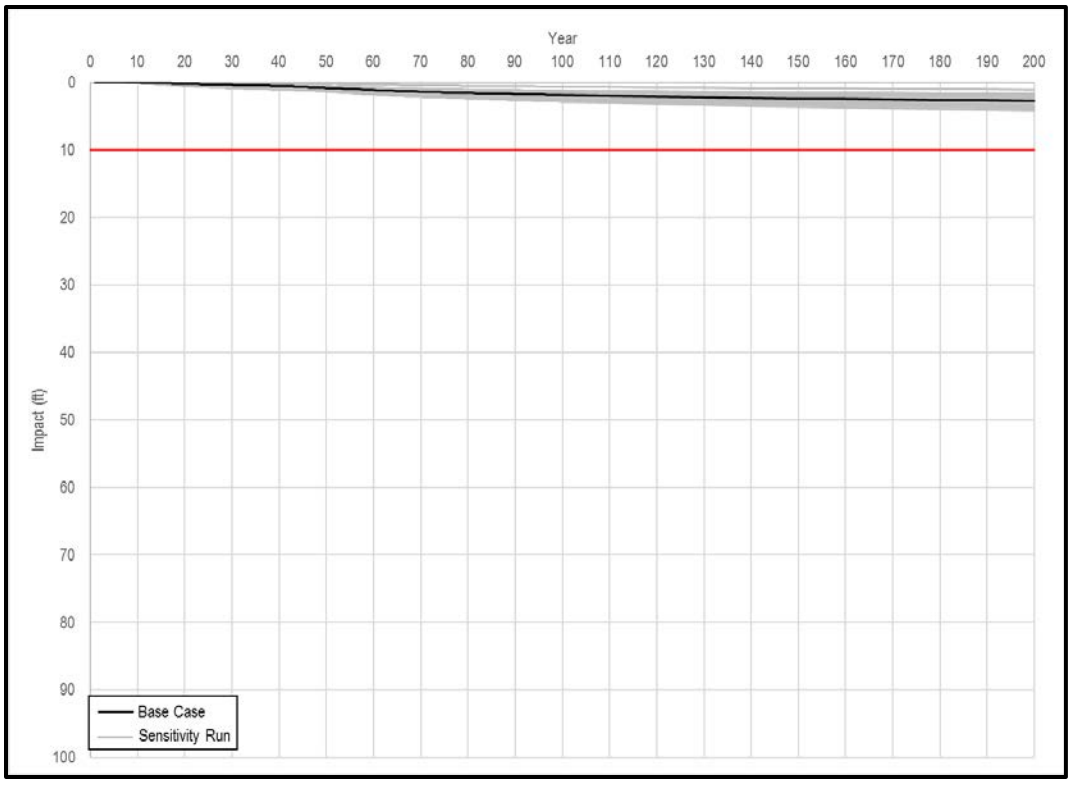

Figure L-9. Middle Devil's Canyon (from km 9.3 to km 6.1). Specific location: DC-6.1E

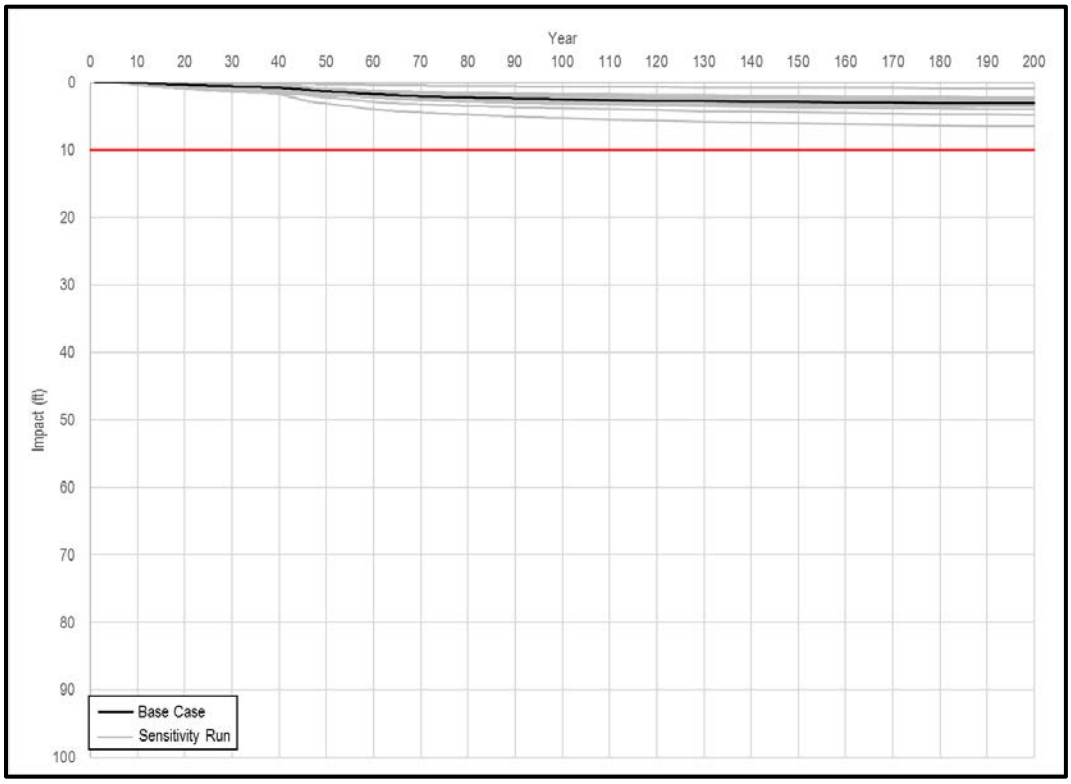

Figure L-10. Lower Devil's Canyon (from km 6.1 to confluence with Mineral Creek). Specific location: DC-5.5C

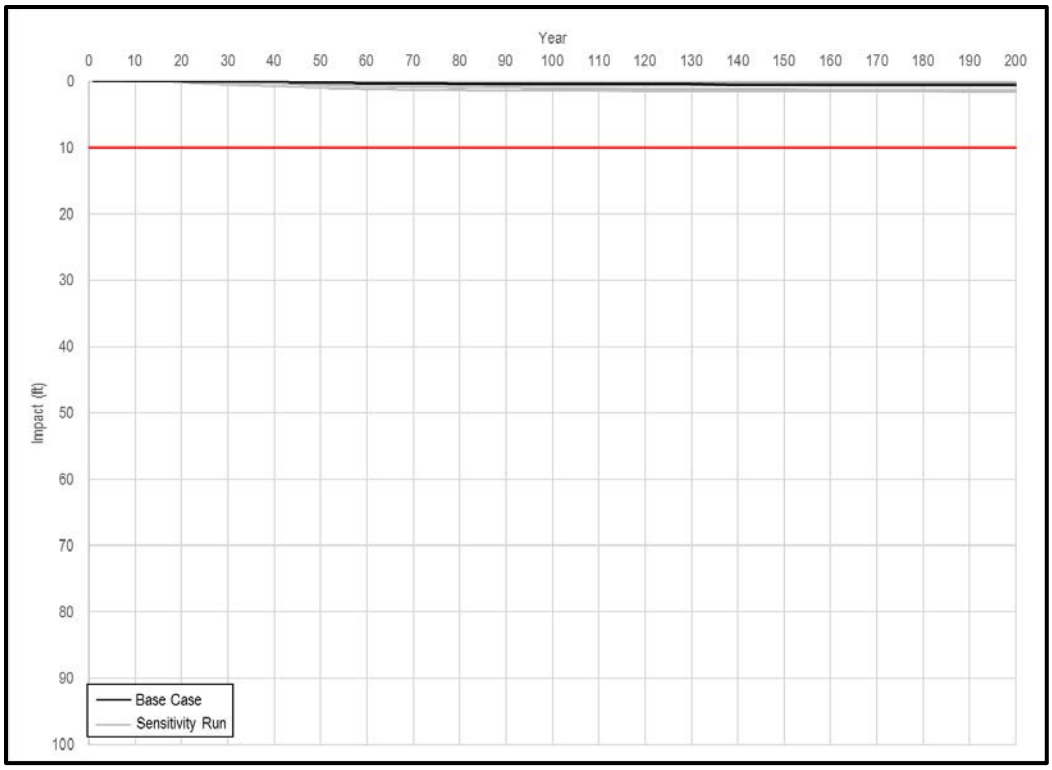

Figure L-11. Lower Devil's Canyon (from km 6.1 to confluence with Mineral Creek). Specific location: DC-4.1E

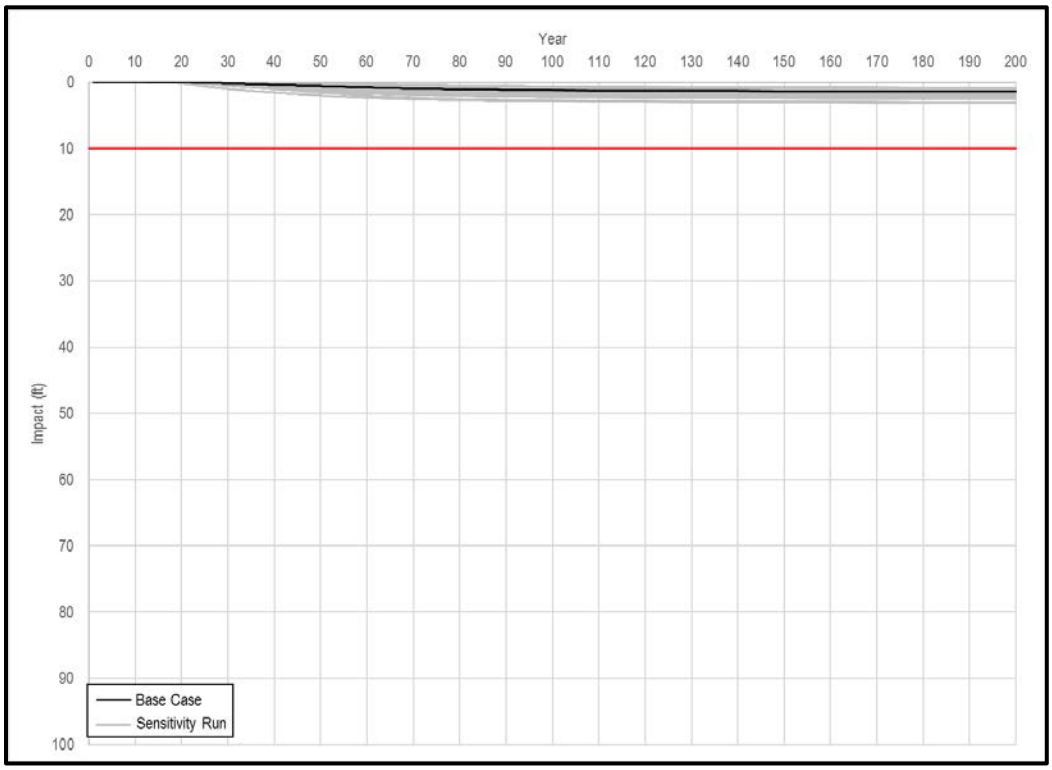

Figure L-12. Mineral Creek (from Government Springs [km 8.7] to confluence with Devil's Canyon). Specific location: MC-6.9

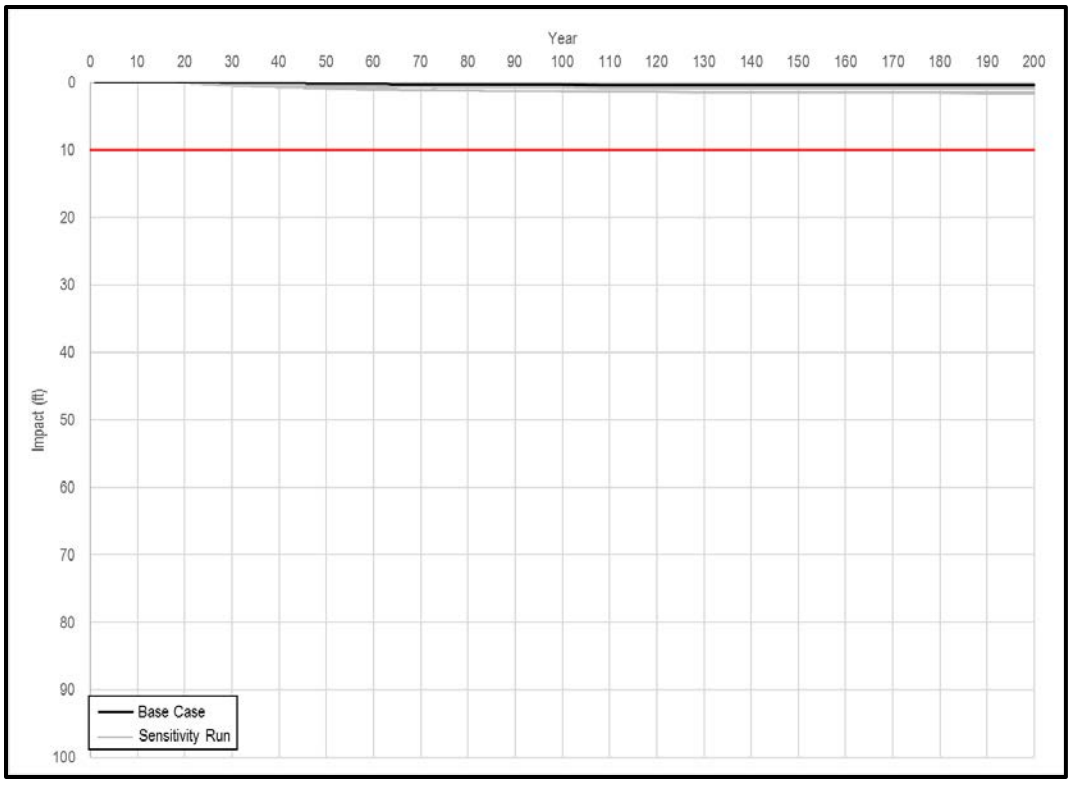

Figure L-13. Mineral Creek (from Government Springs [km 8.7] to confluence with Devil's Canyon). Specific location: Lower Mineral Creek

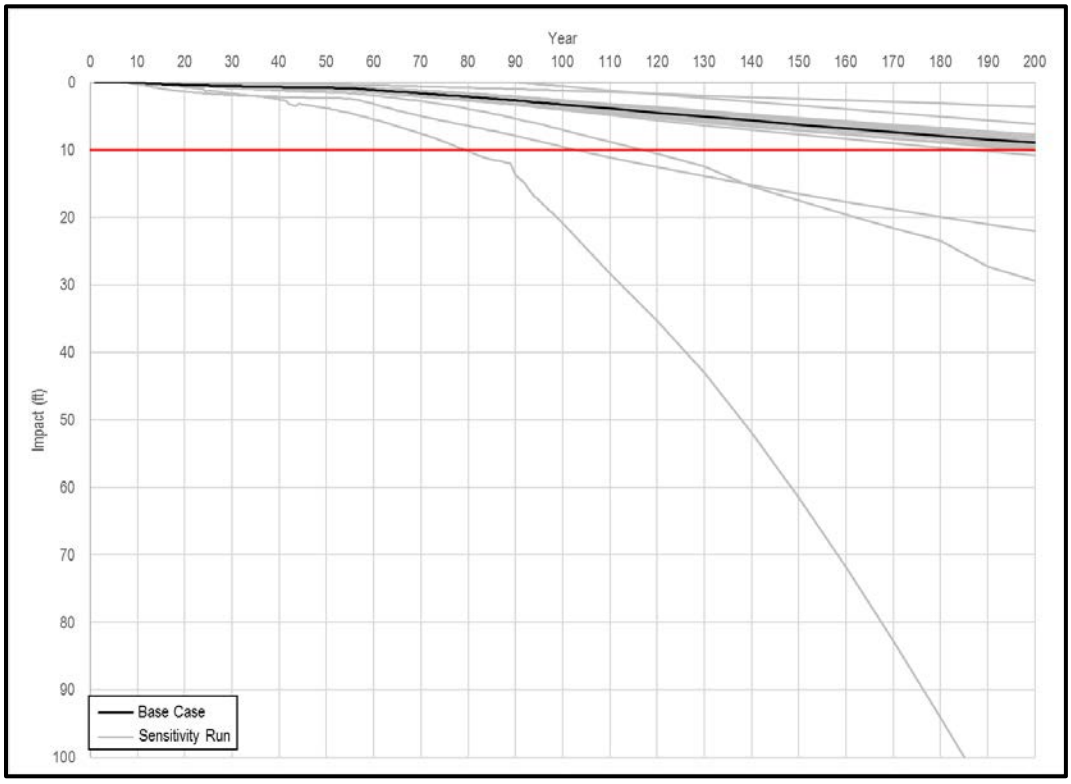

Figure L-14. Bitter Spring

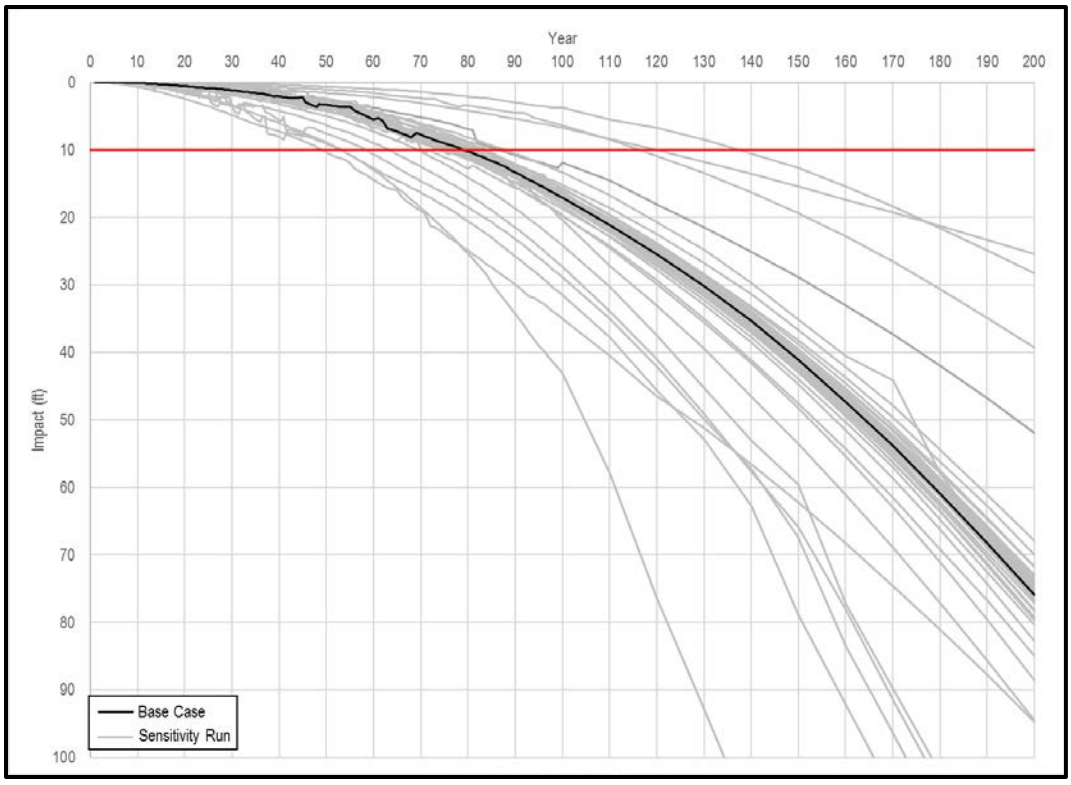

Figure L-15. Bored Spring

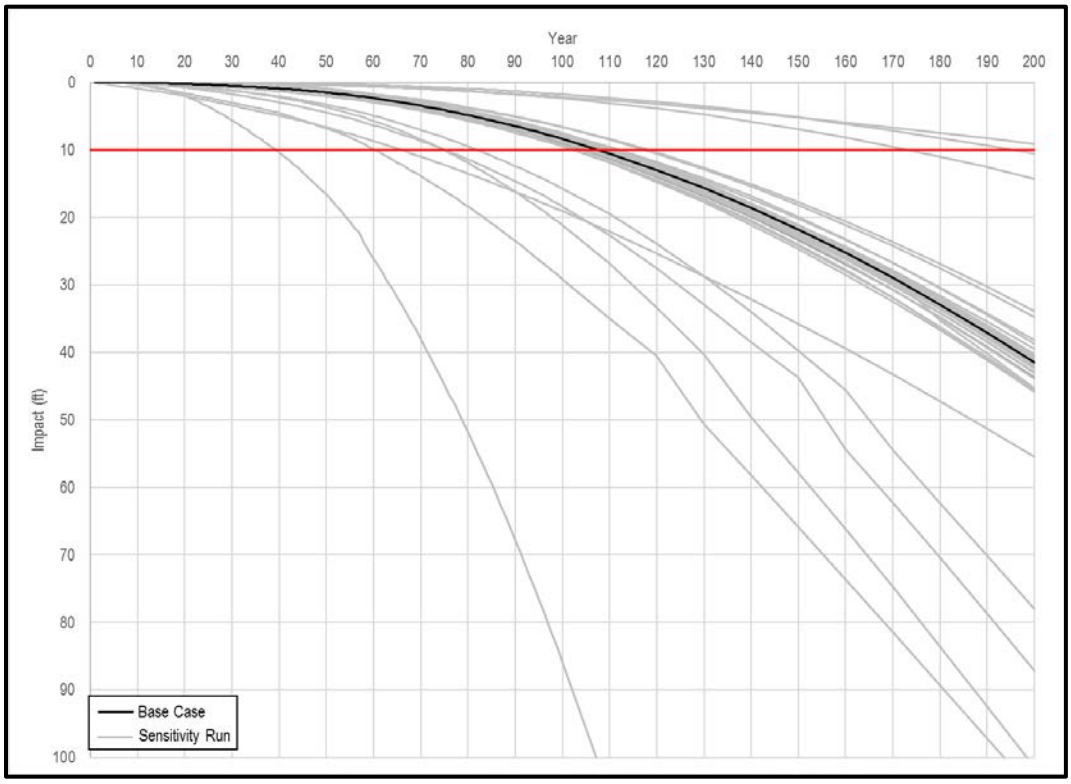

Figure L-16. Hidden Spring

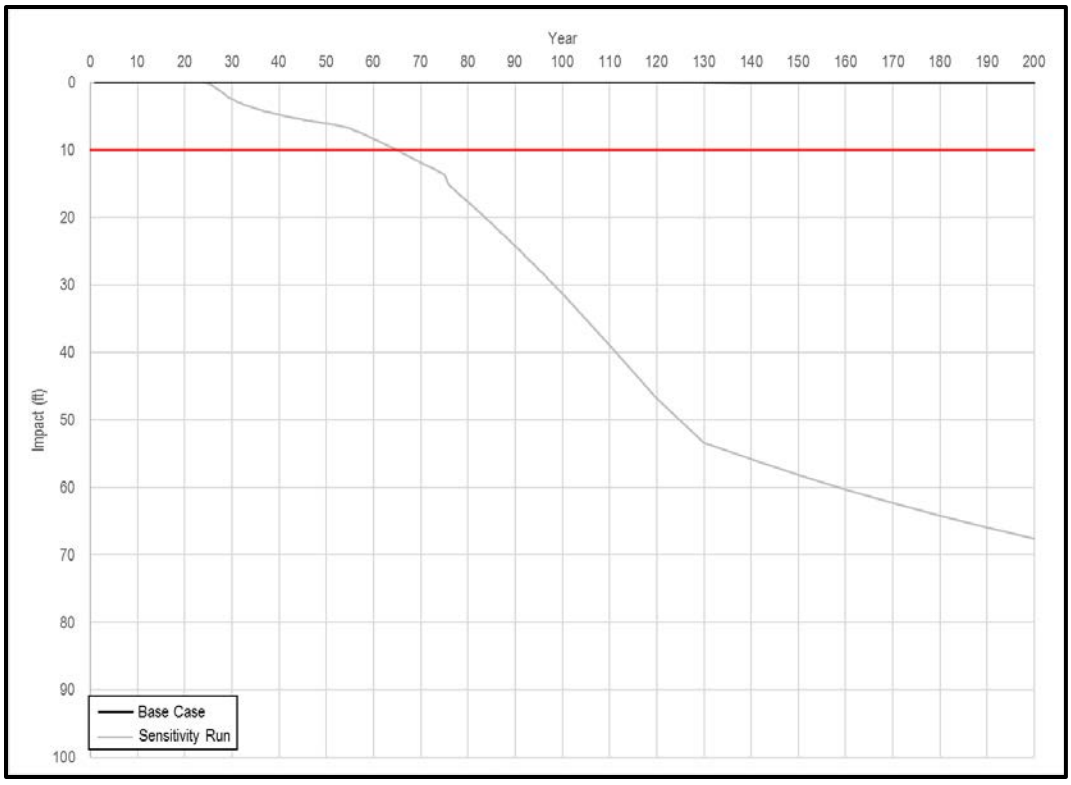

Figure L-17. Iberri Spring

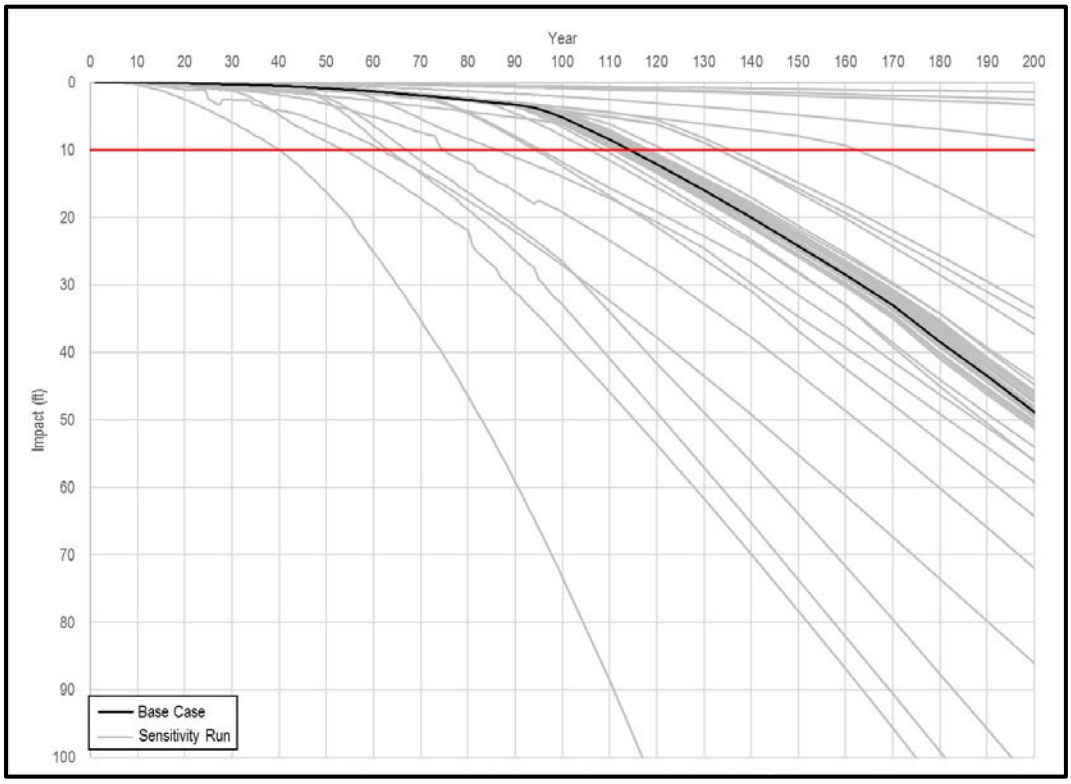

Figure L-18. Kane Spring

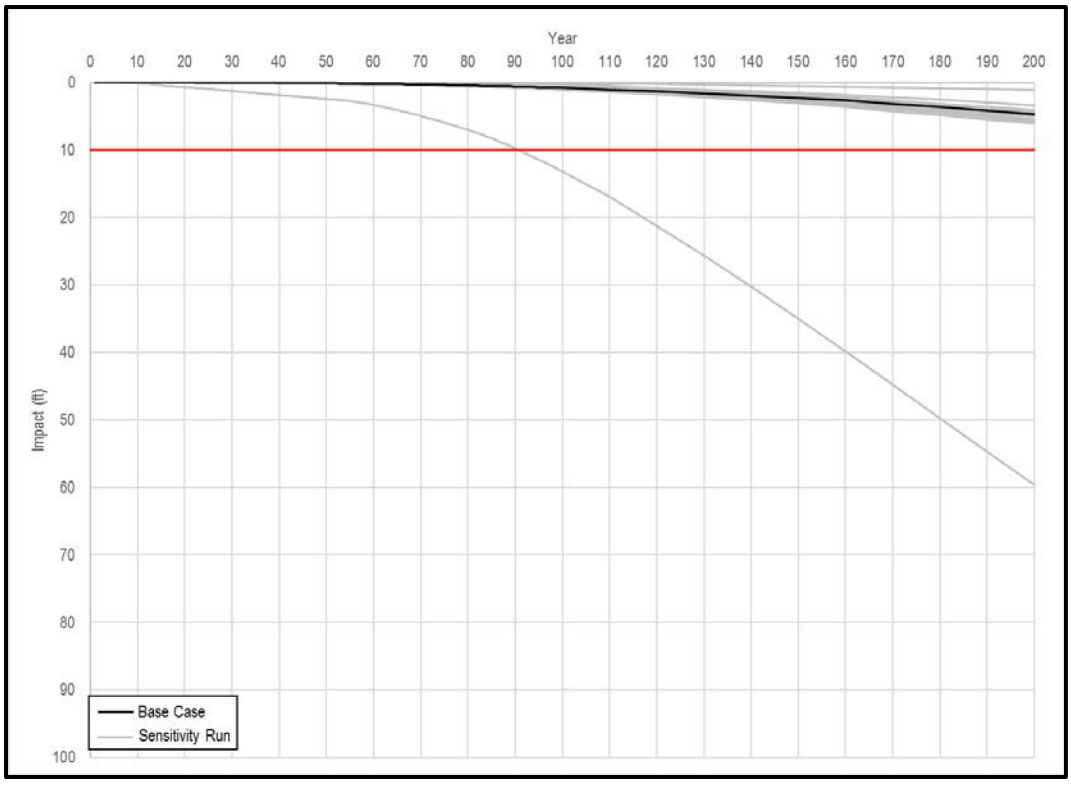

Figure L-19. McGinnel Mine Spring

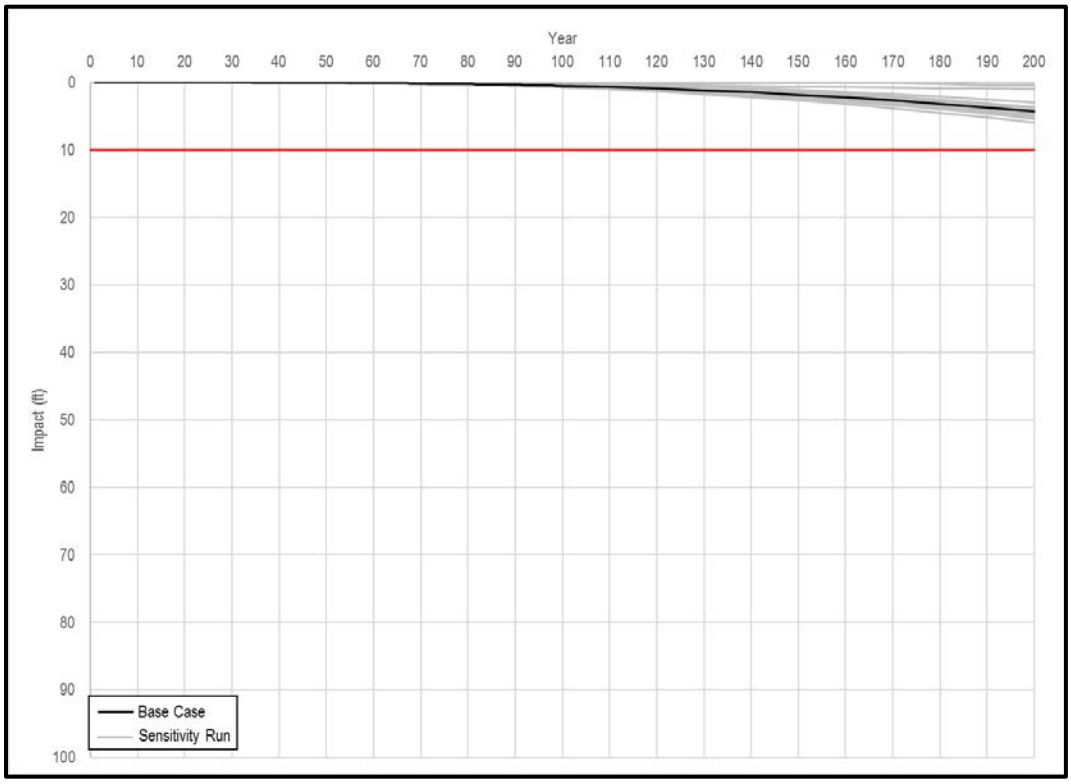

Figure L-20. McGinnel Spring

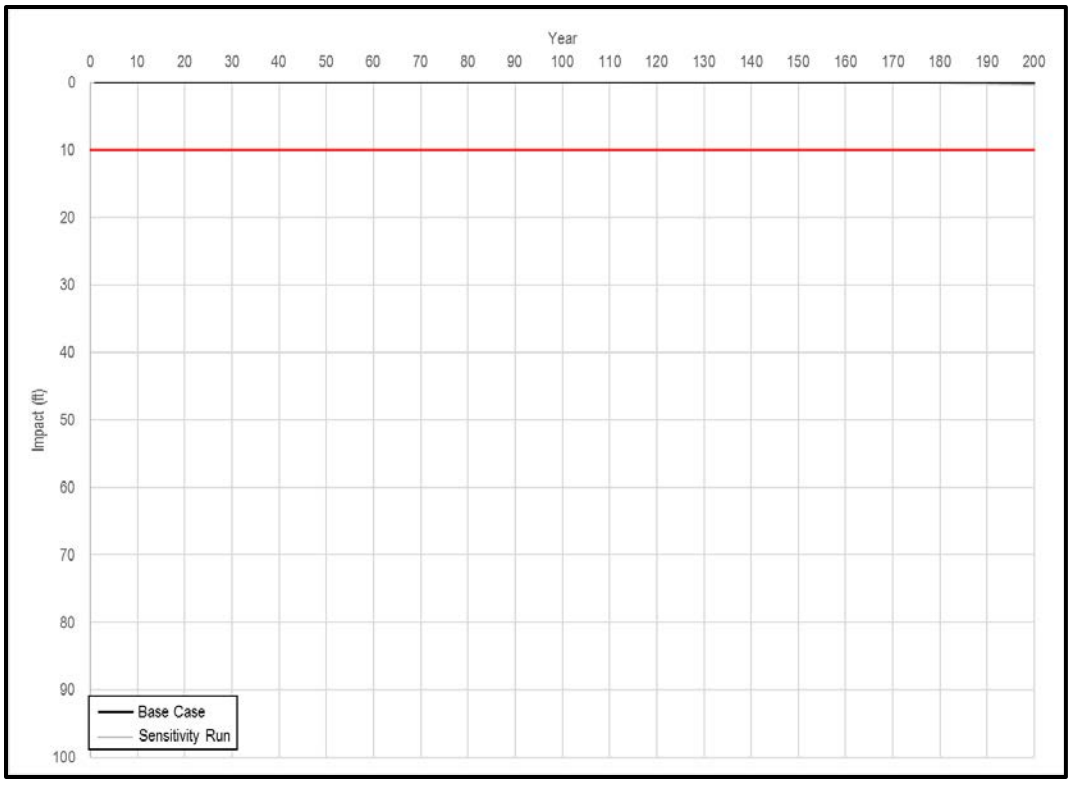

Figure L-21. No Name Spring

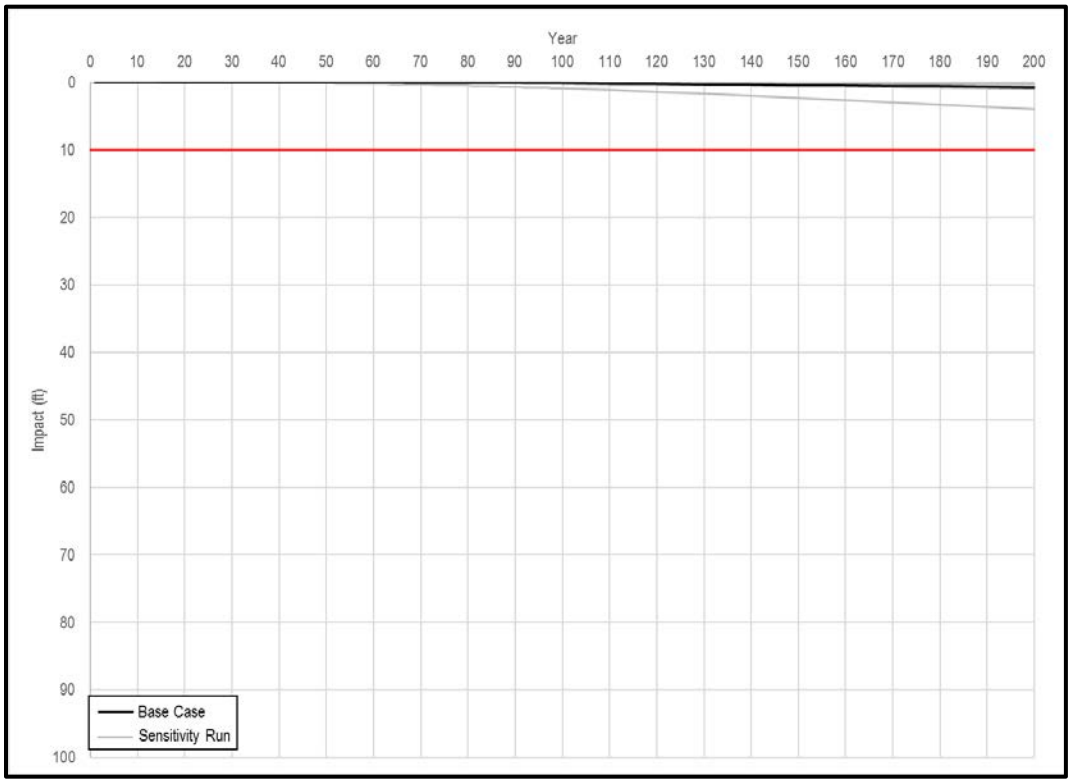

Figure L-22. Rock Horizontal Spring

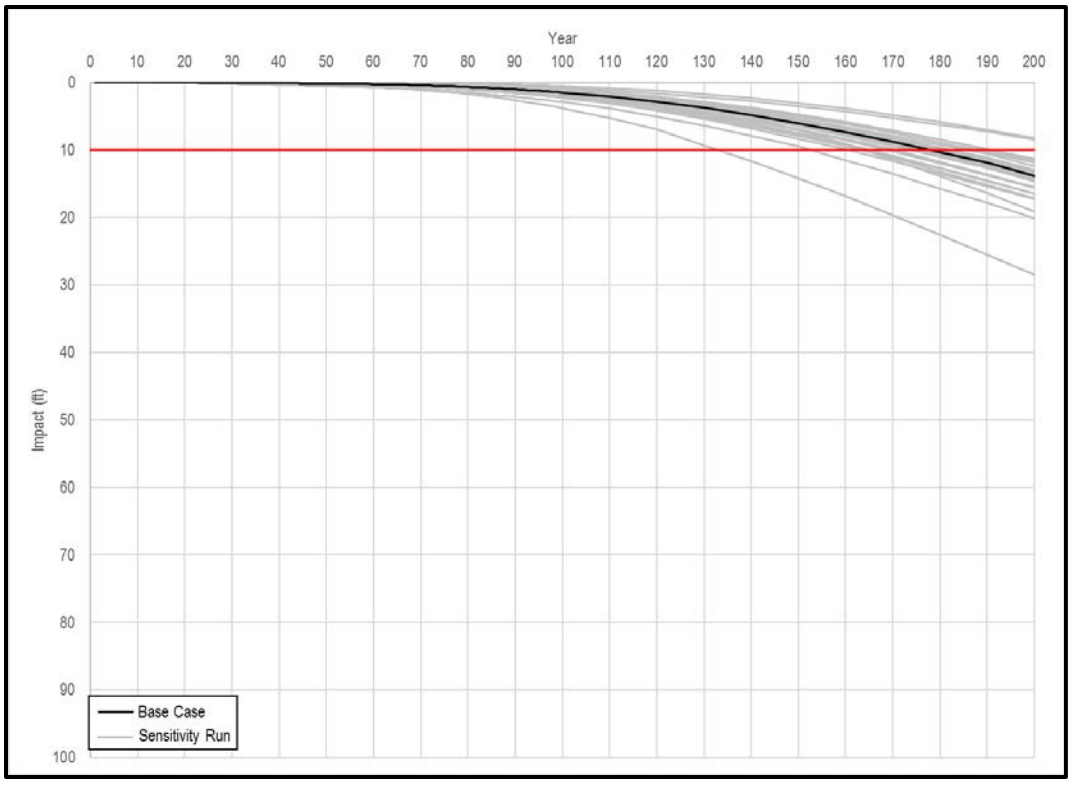

Figure L-23. Walker Spring

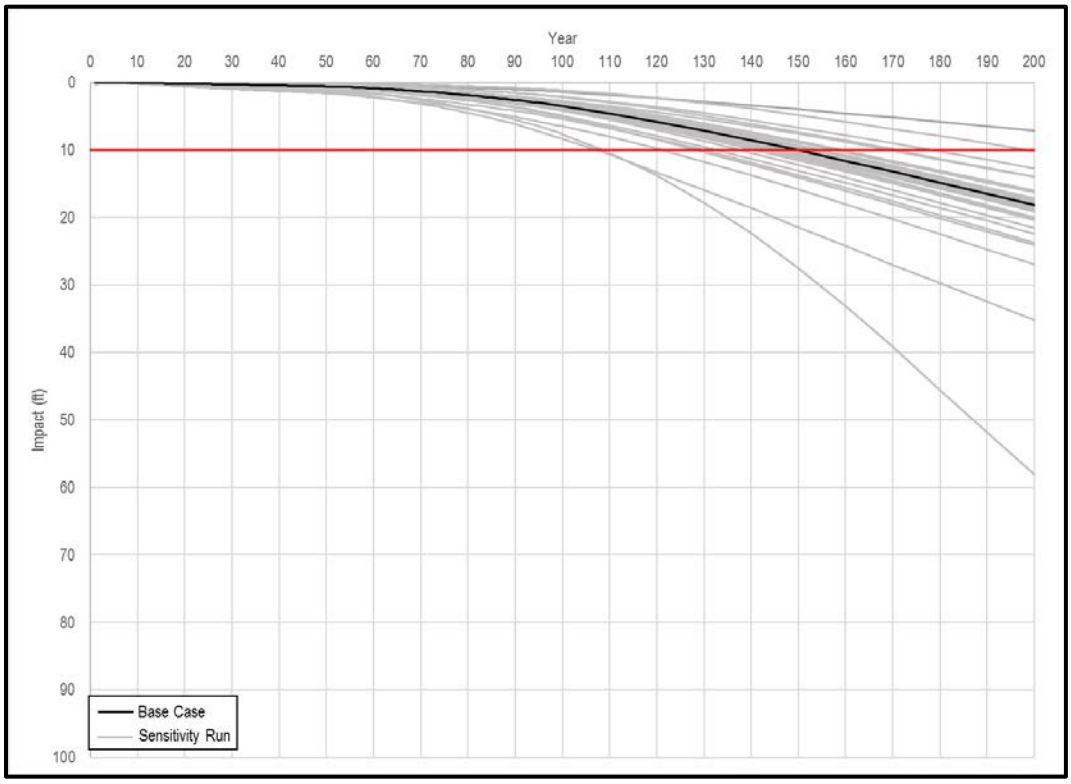

Figure L-24. DHRES-16_743 (Town of Superior)

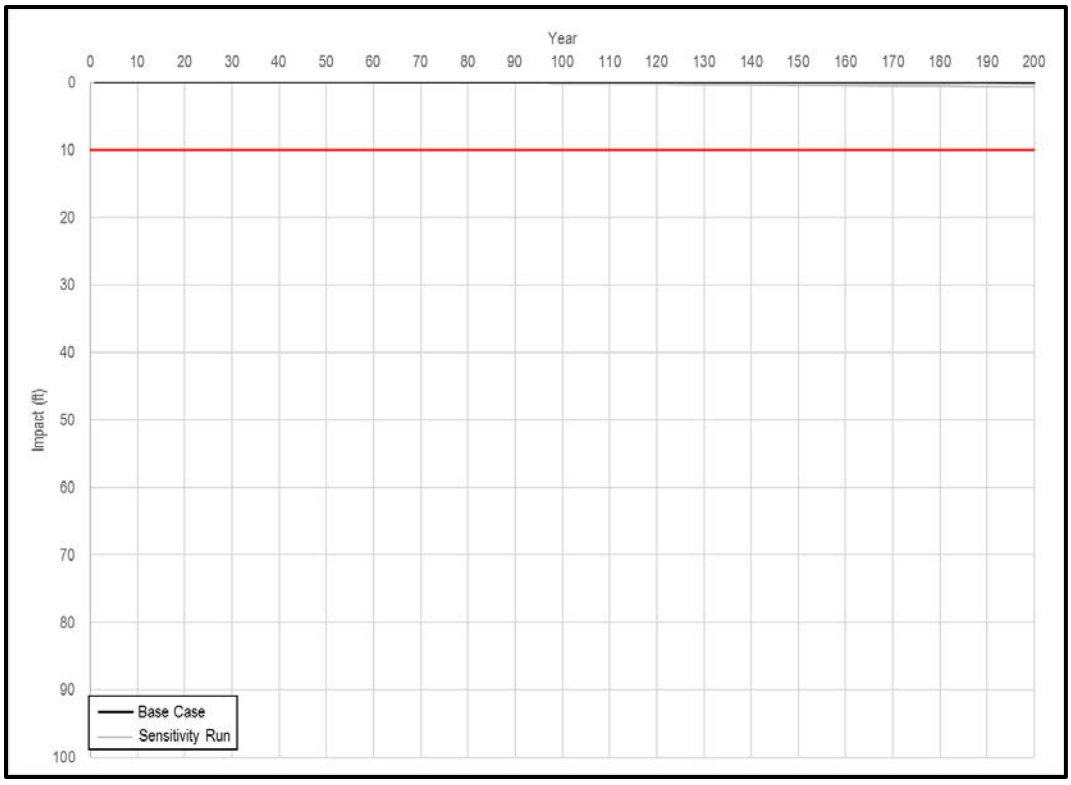

Figure L-25. Gallery Well (Boyce Thompson Arboretum)

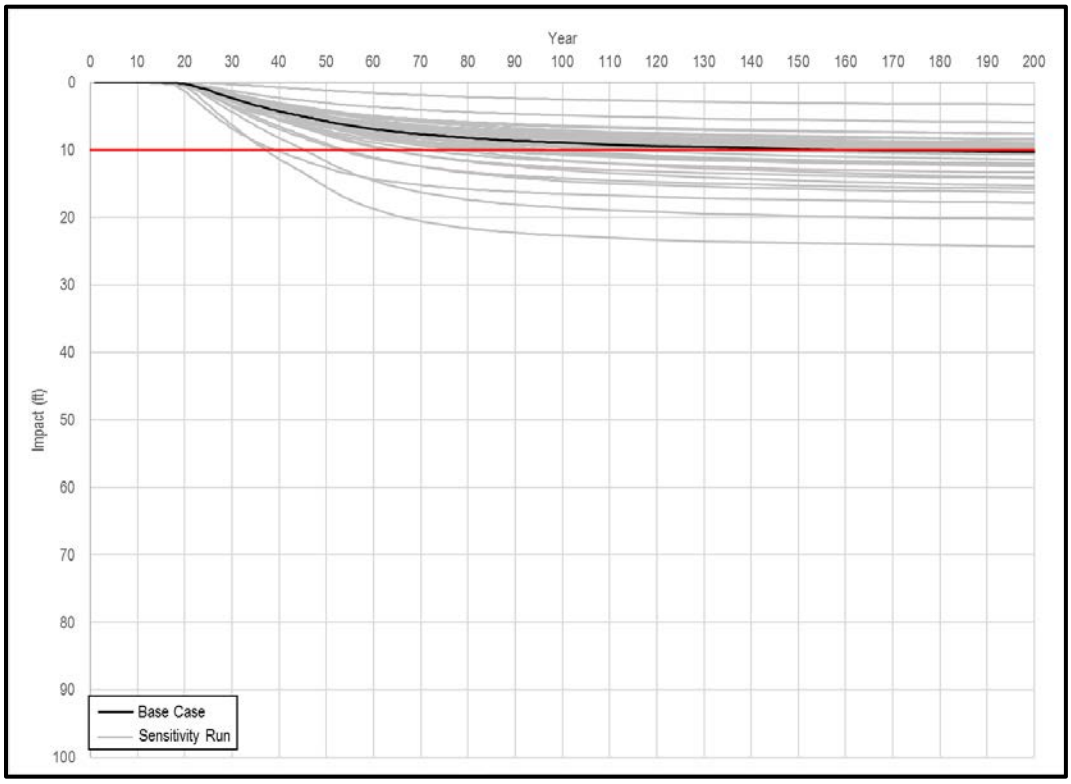

Figure L-26. HRES-06 (Top-of-the-World)

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APPENDIX M. WATER QUALITY MODELING RESULTS FOR CONSTITUENTS OF CONCERN

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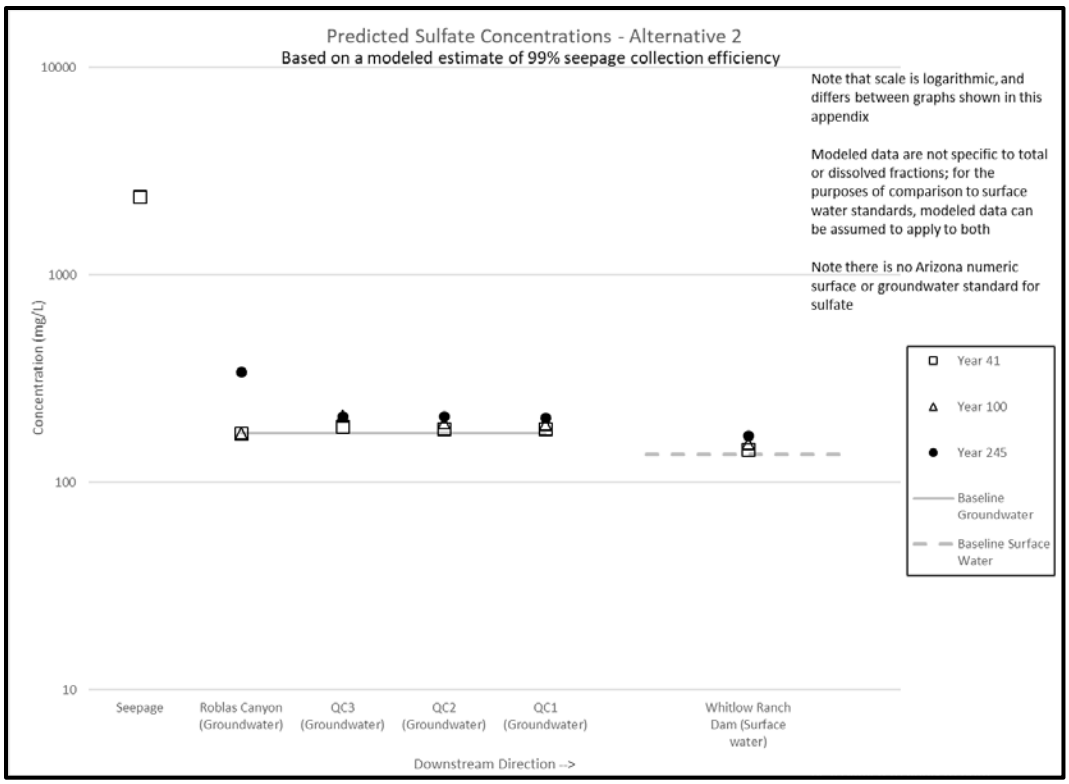

Figure M-1. Predicted sulfate concentrations, Alternative 2

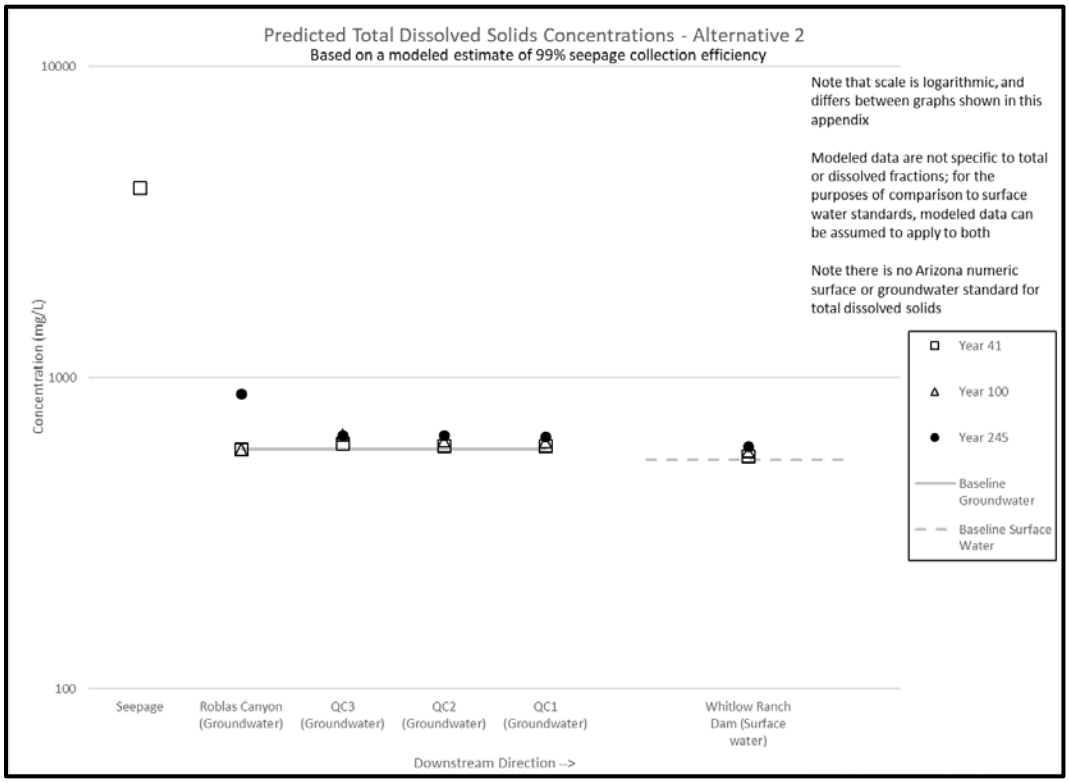

Figure M-2. Predicted total dissolved solids concentrations, Alternative 2

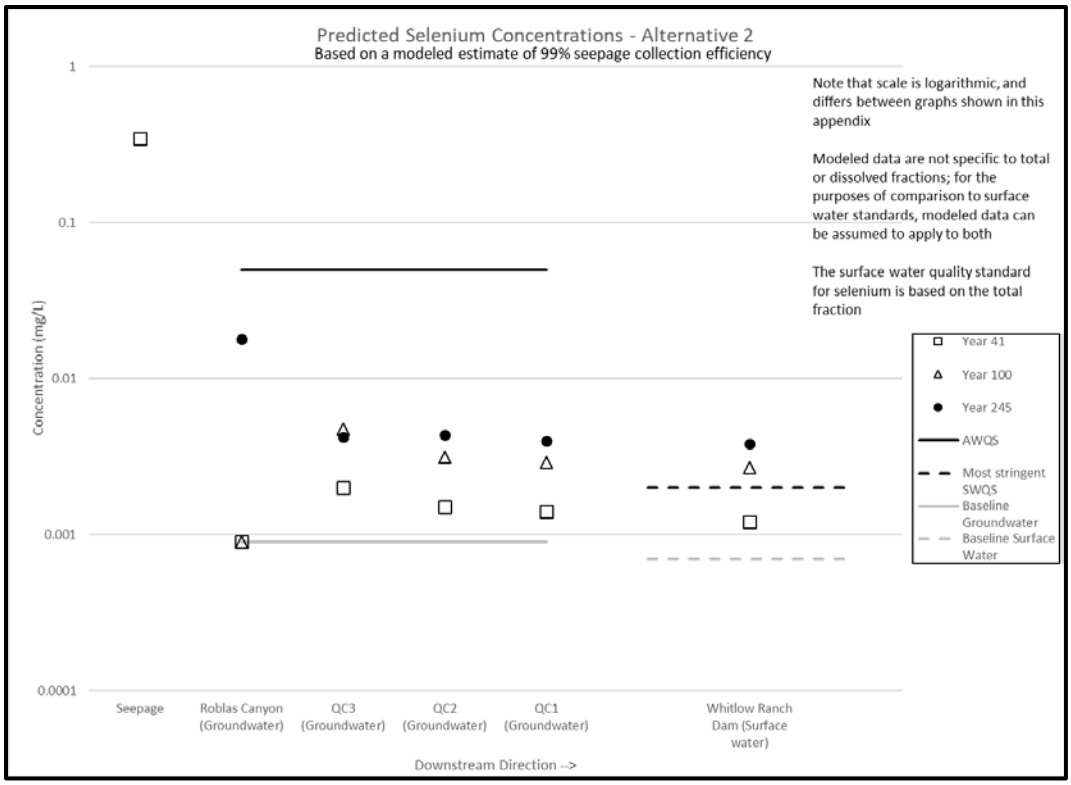

Figure M-3. Predicted selenium concentrations, Alternative 2

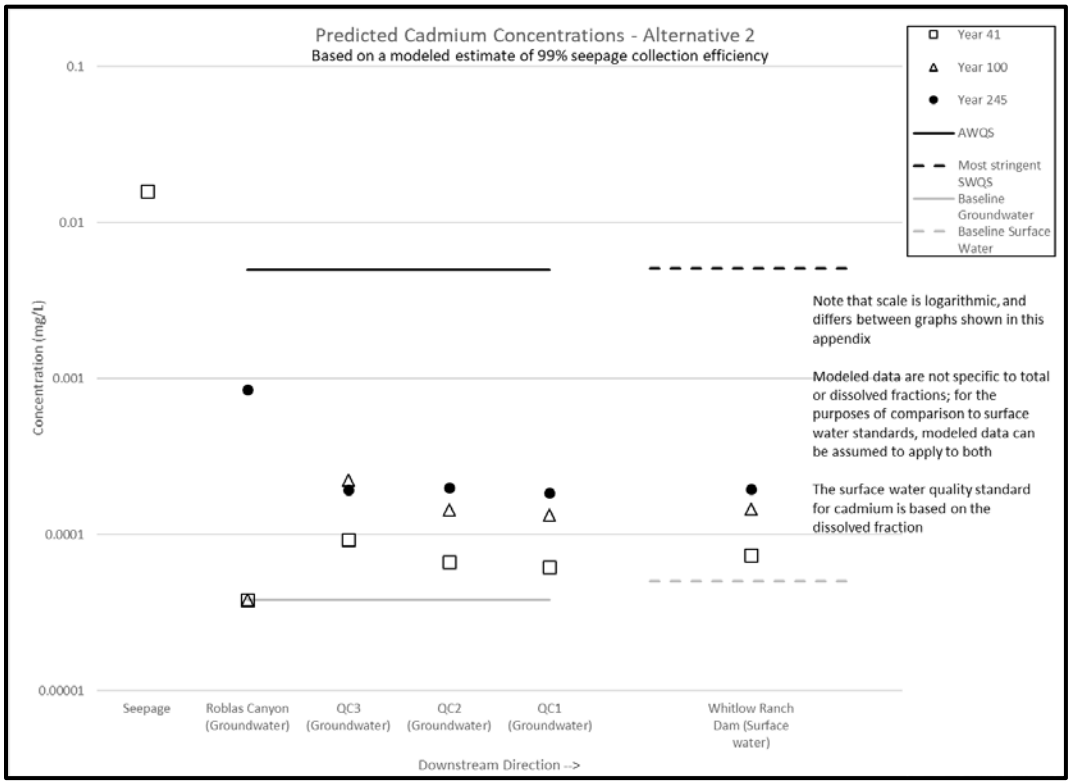

Figure M-4. Predicted cadmium concentrations, Alternative 2

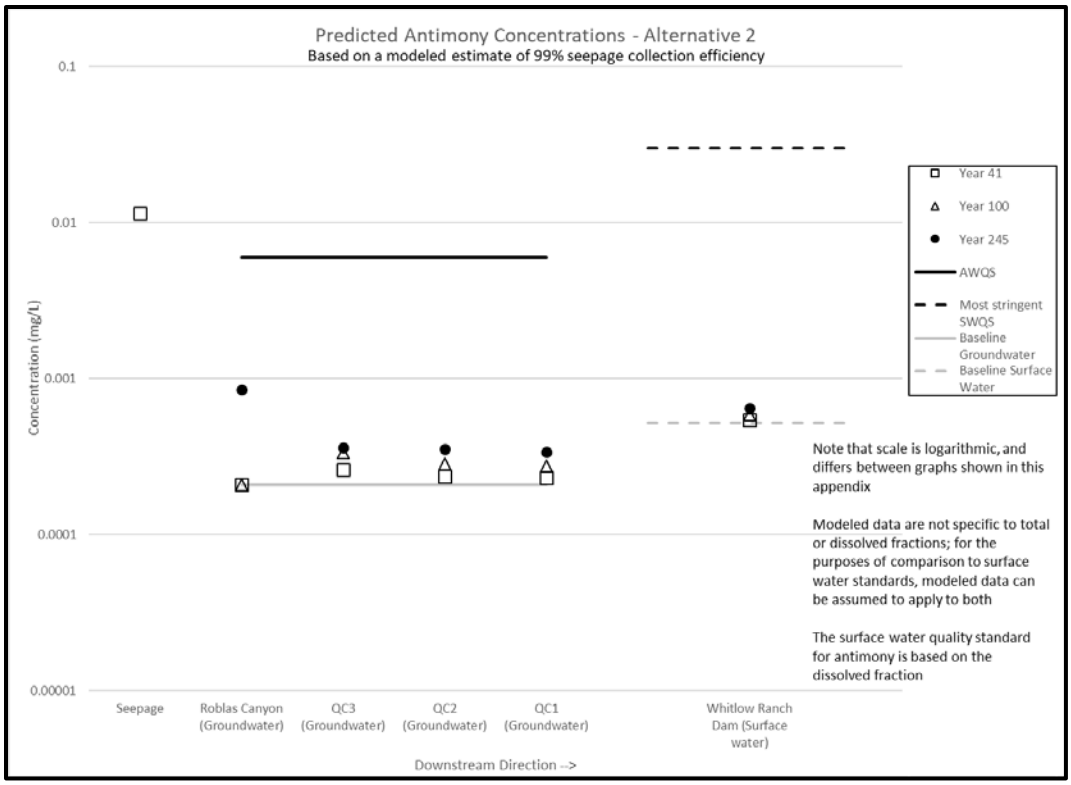

Figure M-5. Predicted antimony concentrations, Alternative 2

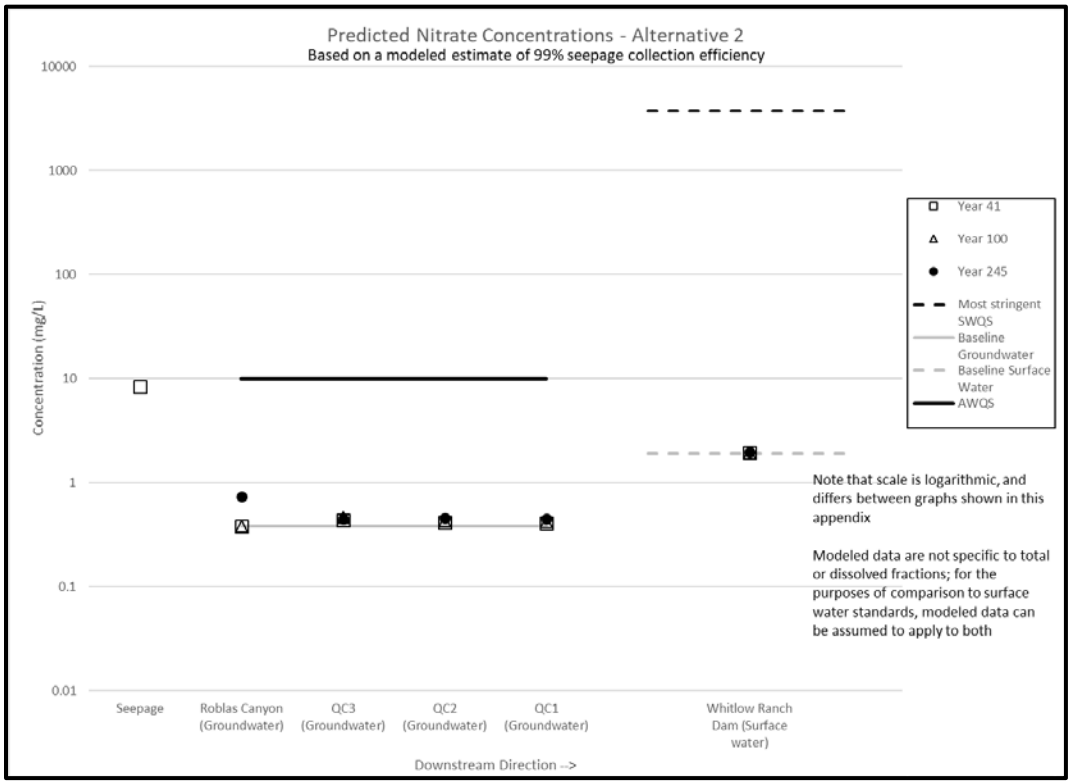

Figure M-6. Predicted nitrate concentrations, Alternative 2

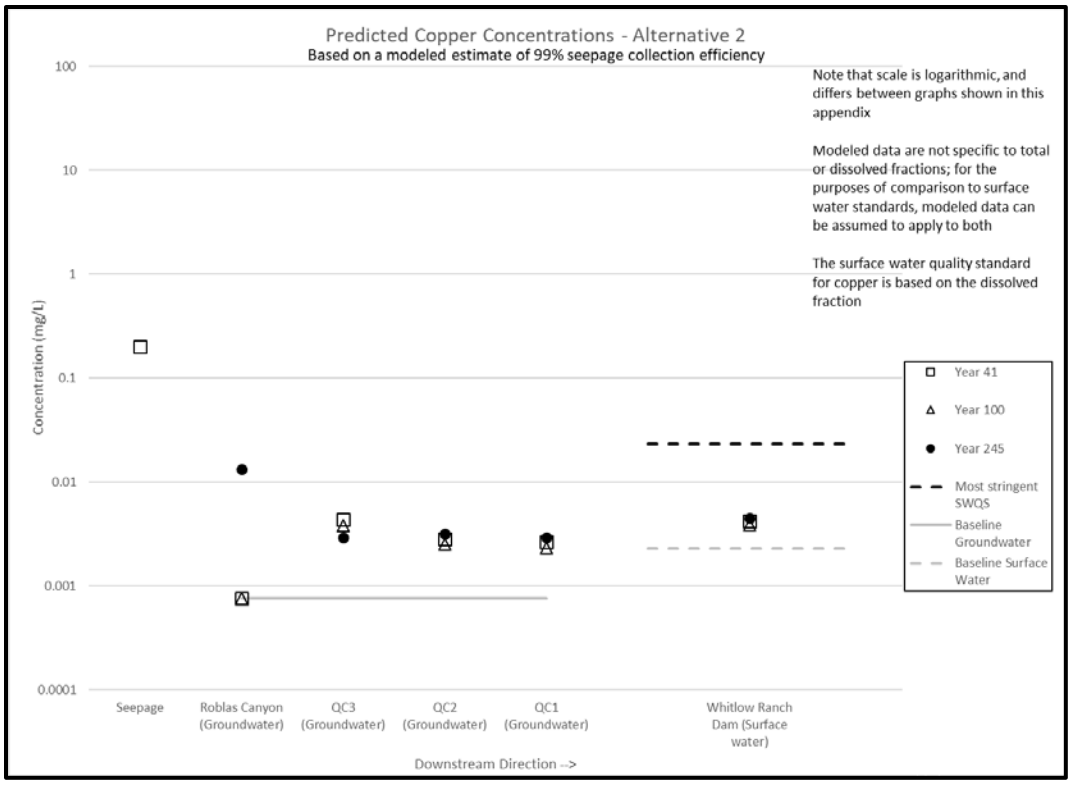

Figure M-7. Predicted copper concentrations, Alternative 2

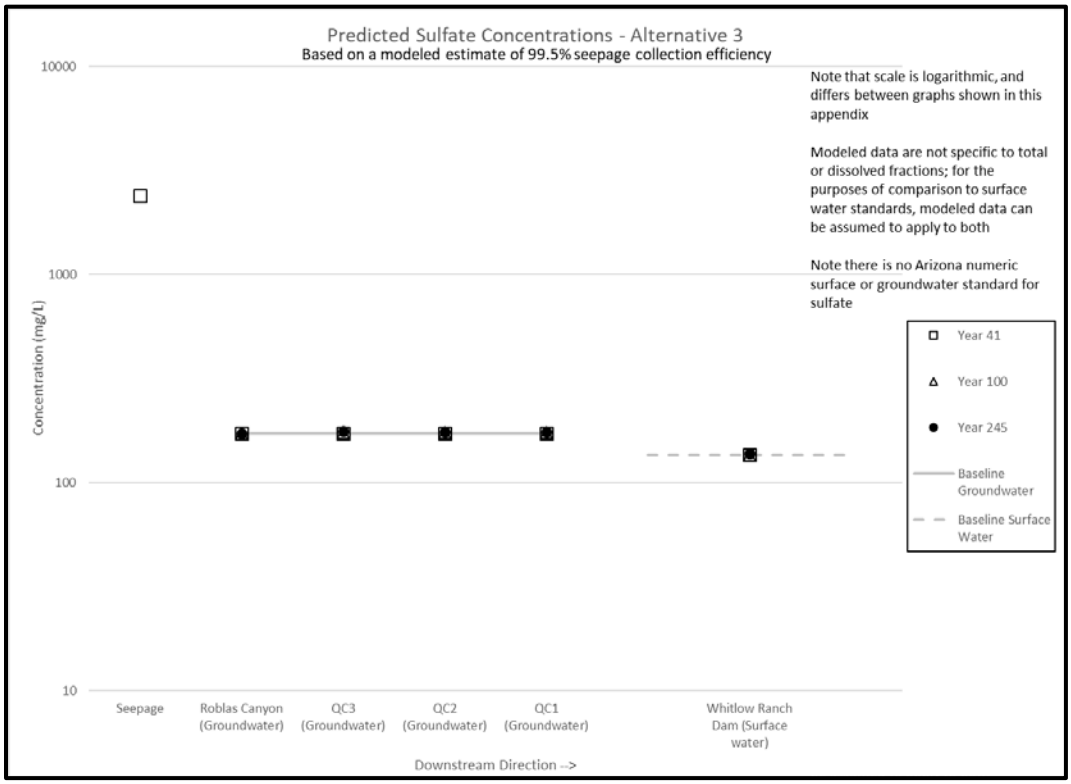

Figure M-8. Predicted sulfate concentrations, Alternative 3

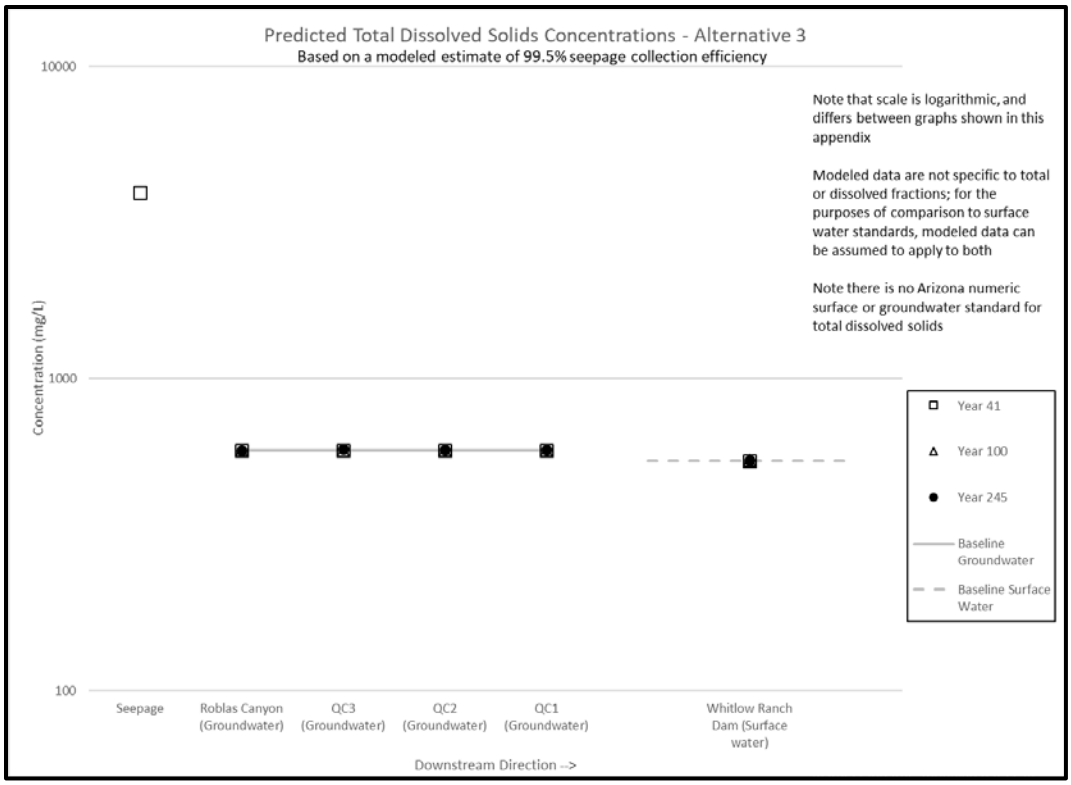

Figure M-9. Predicted total dissolved solids concentrations, Alternative 3

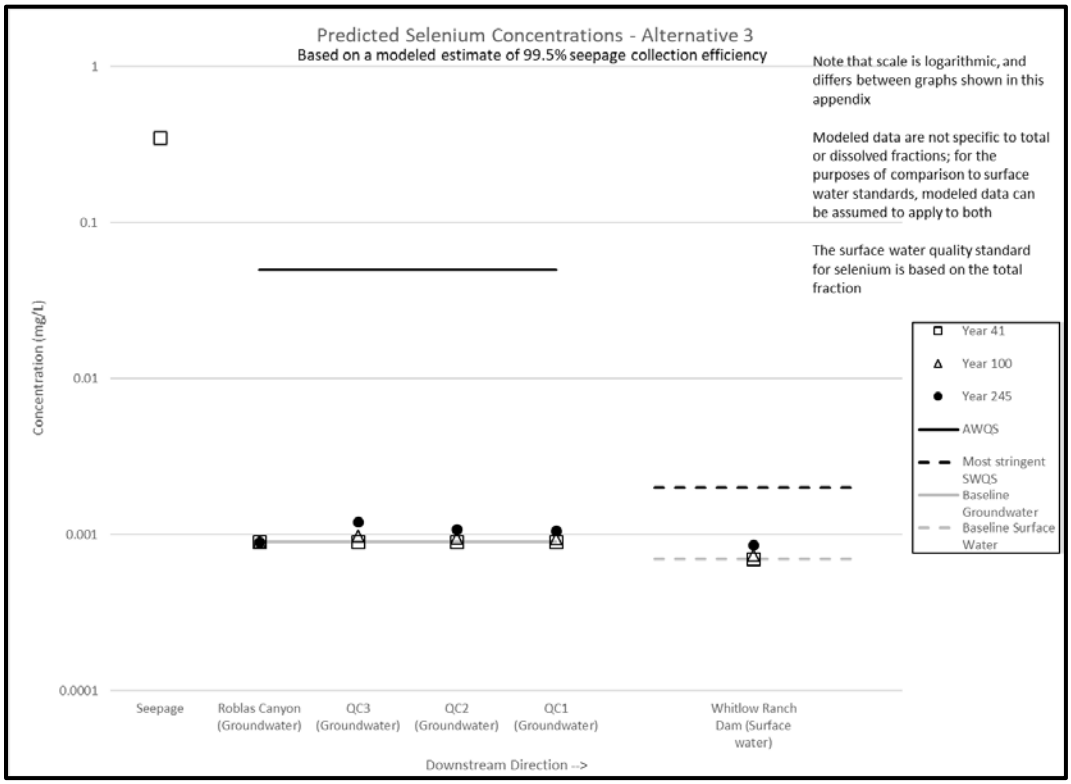

Figure M-10. Predicted selenium concentrations, Alternative 3

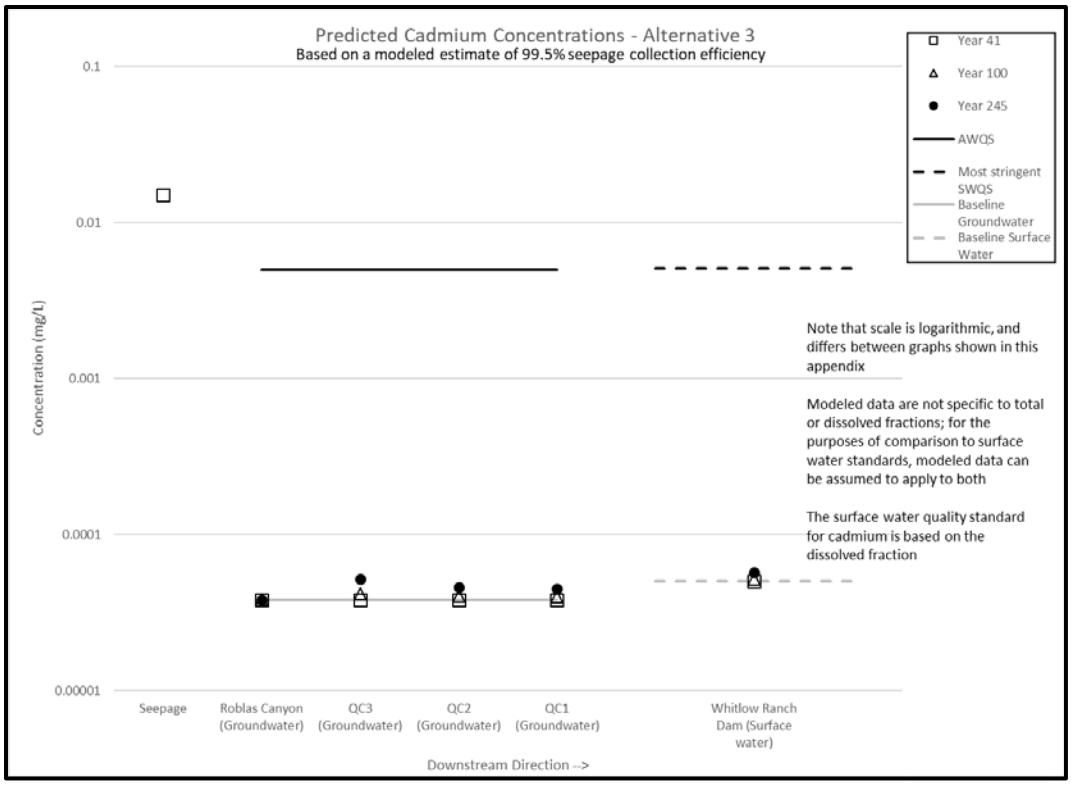

Figure M-11. Predicted cadmium concentrations, Alternative 3

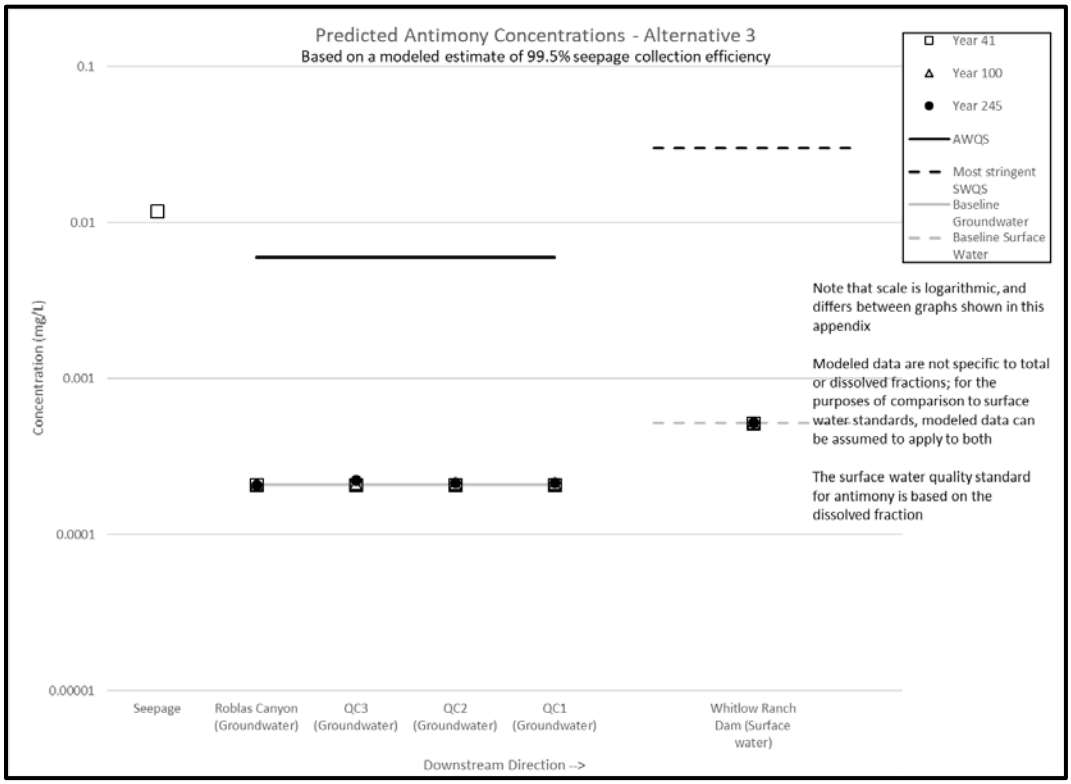

Figure M-12. Predicted antimony concentrations, Alternative 3

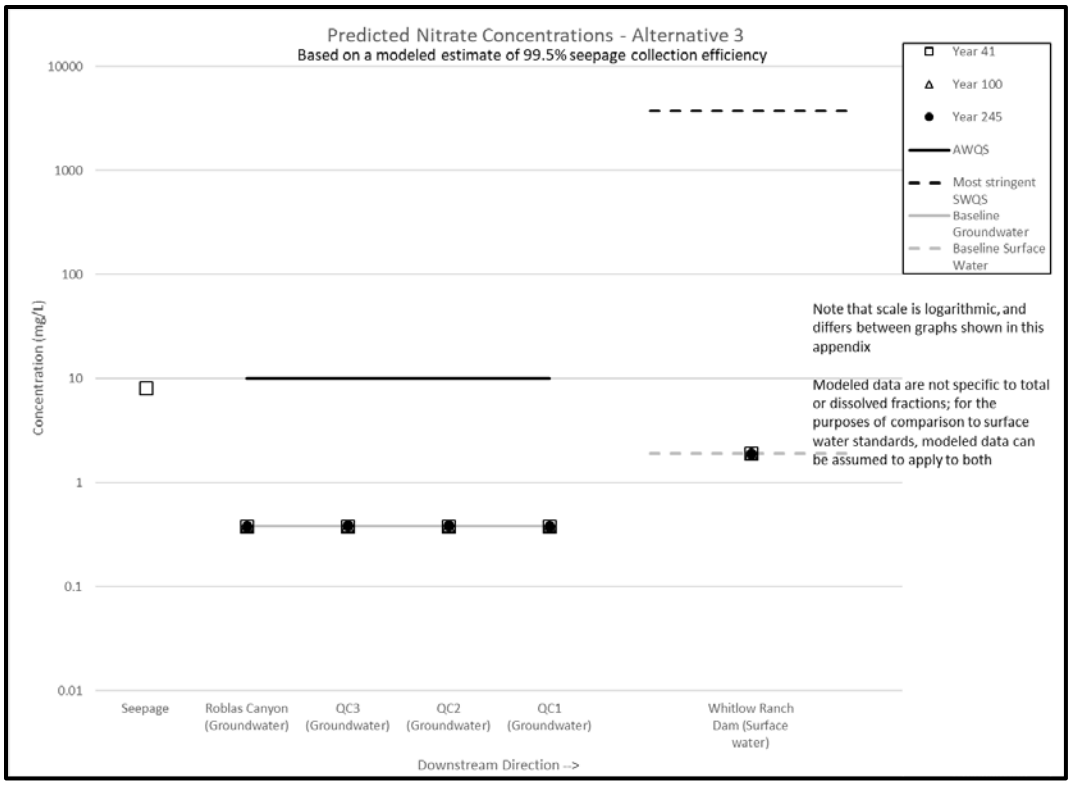

Figure M-13. Predicted nitrate concentrations, Alternative 3

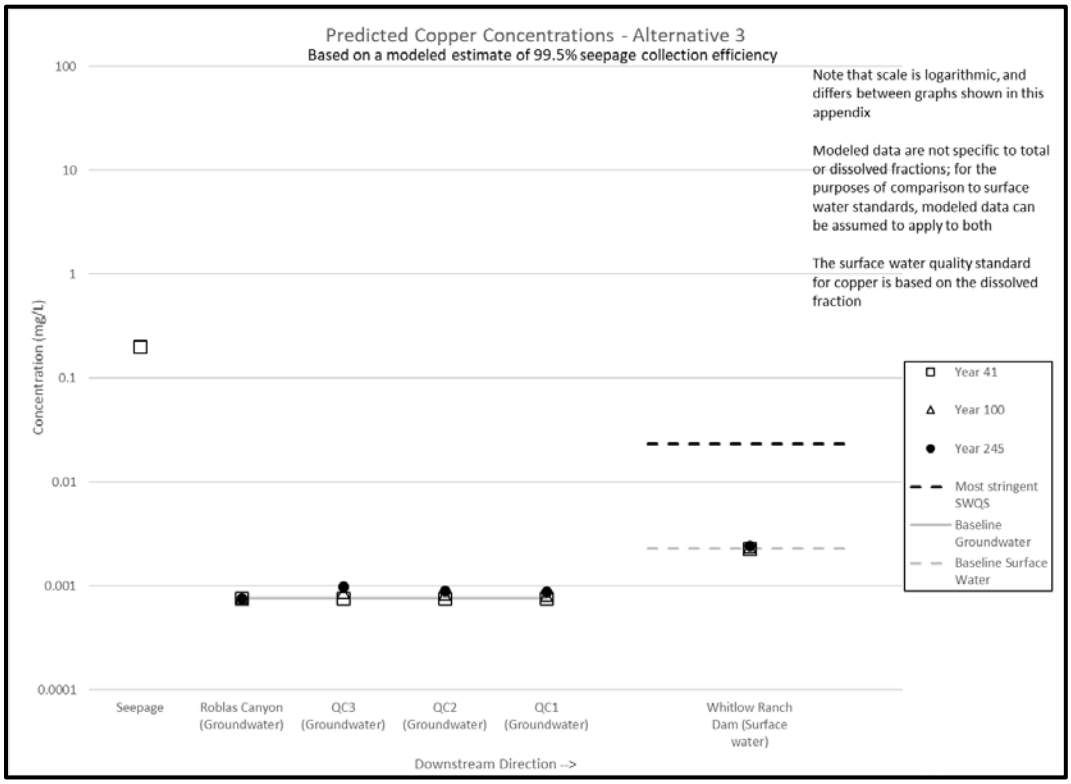

Figure M-14. Predicted copper concentrations, Alternative 3

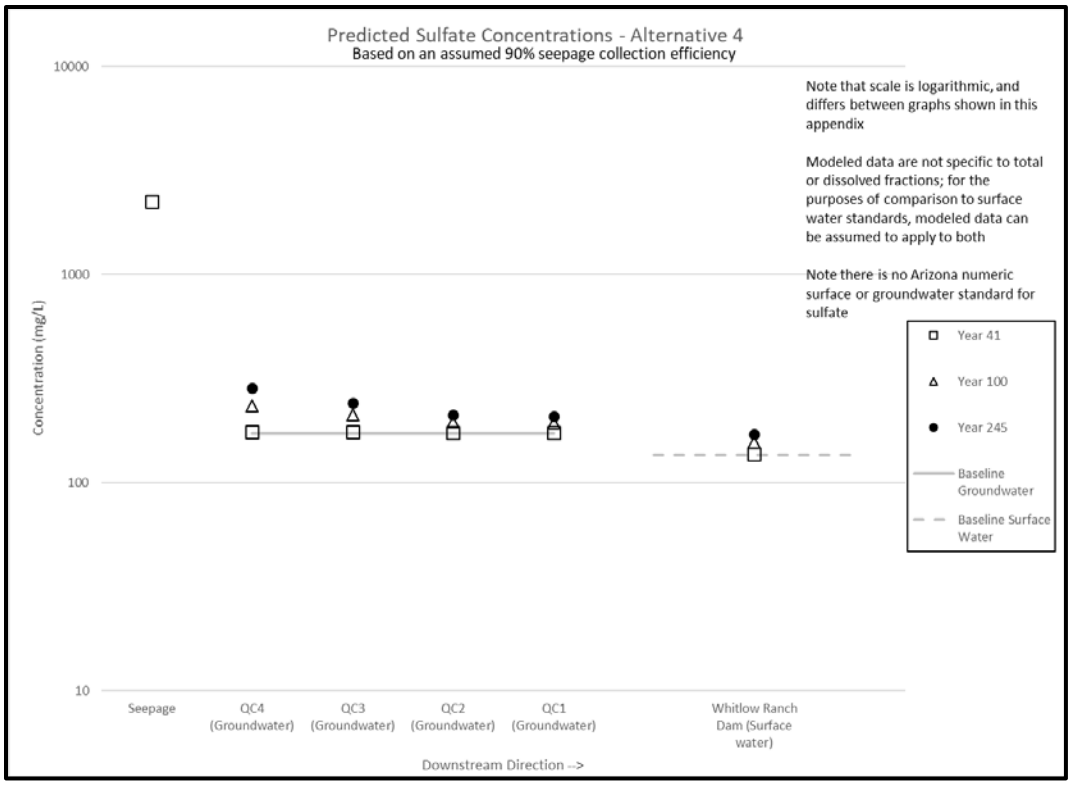

Figure M-15. Predicted sulfate concentrations, Alternative 4

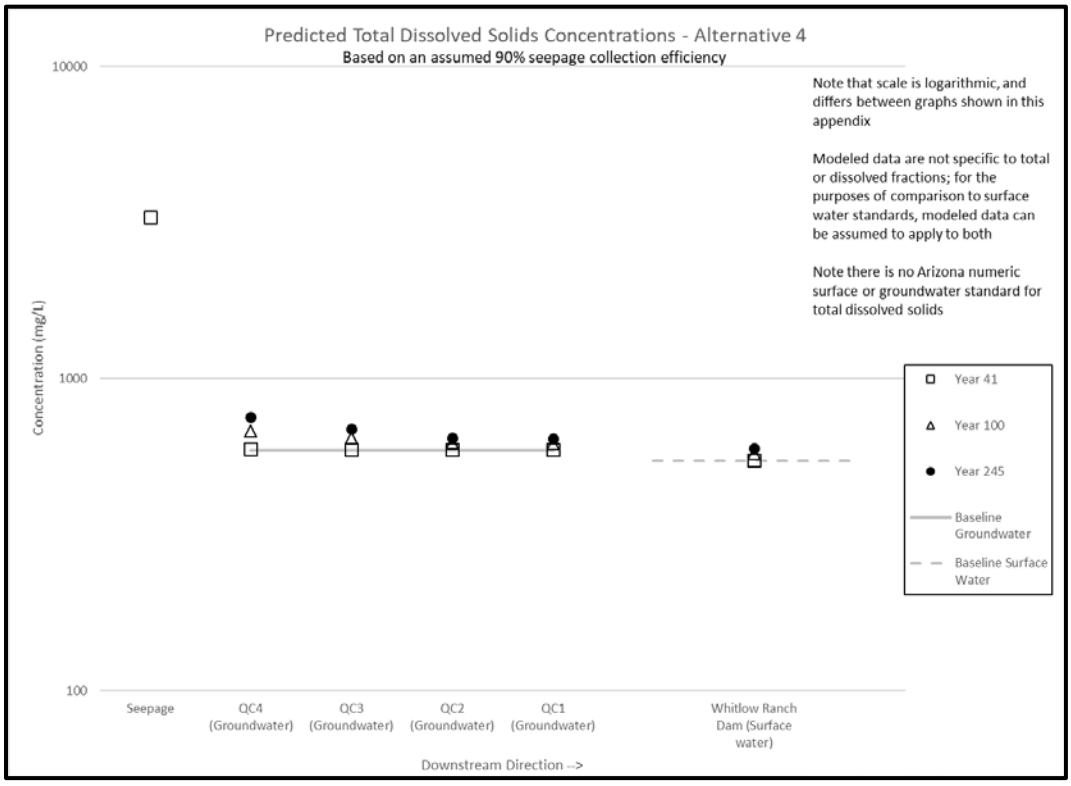

Figure M-16. Predicted total dissolved solids concentrations, Alternative 4

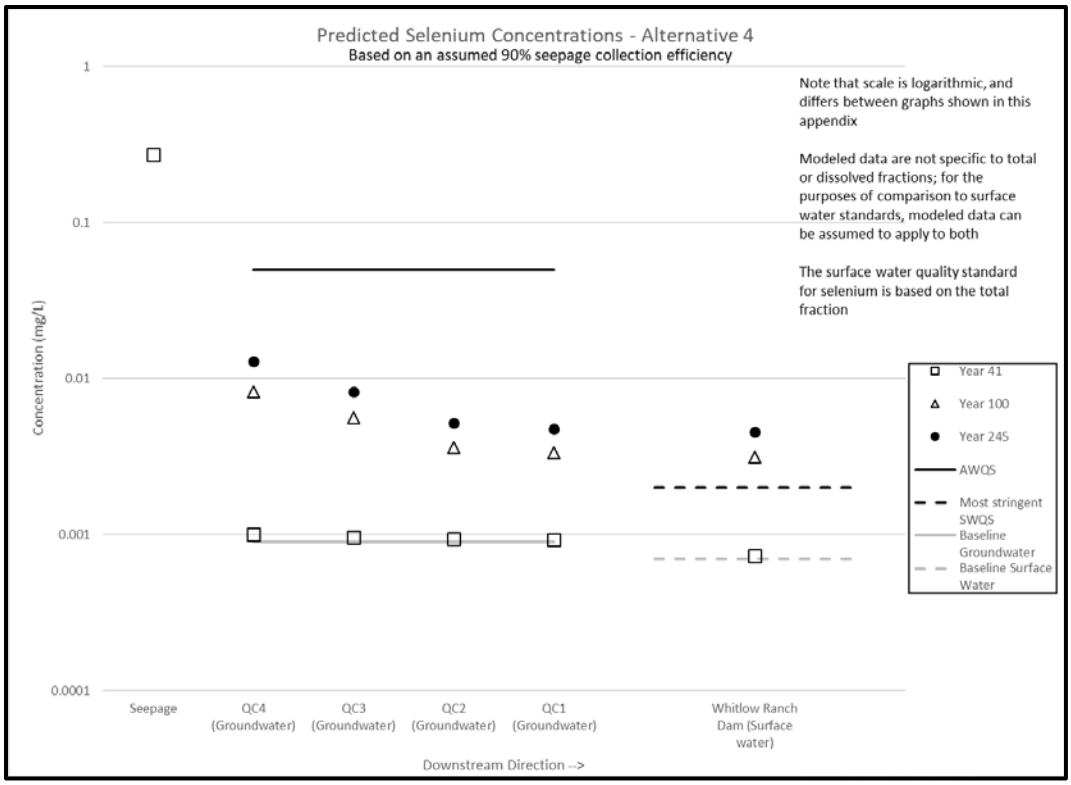

Figure M-17. Predicted selenium concentrations, Alternative 4

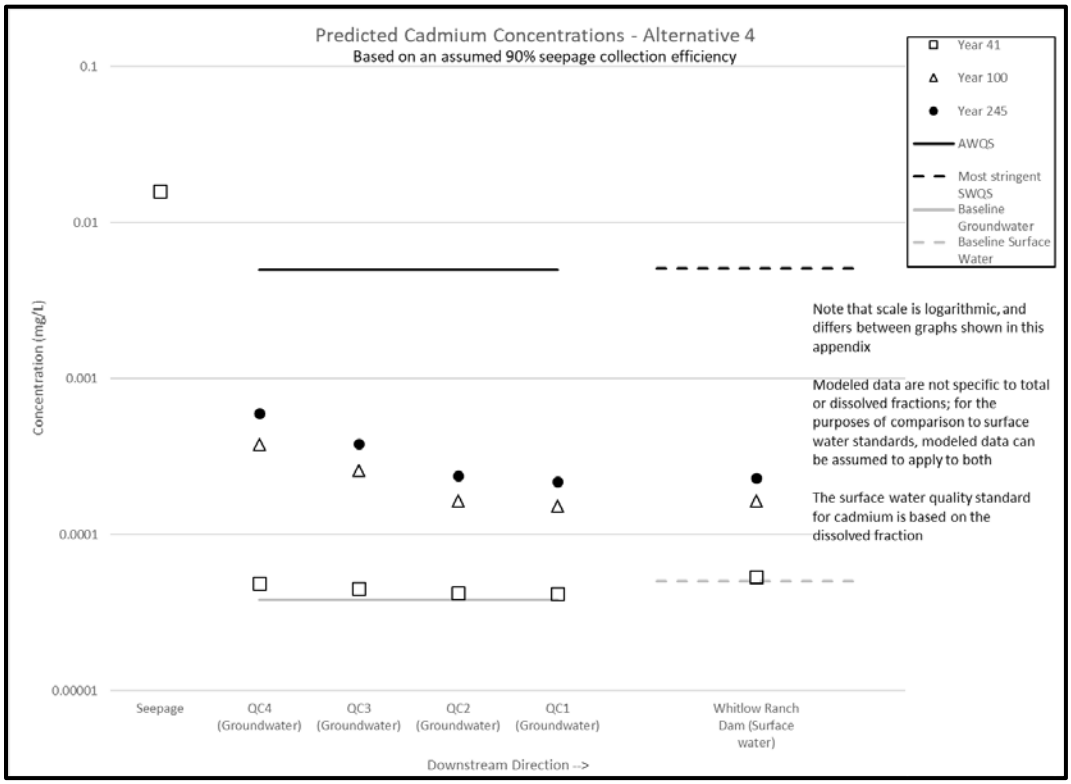

Figure M-18. Predicted cadmium concentrations, Alternative 4

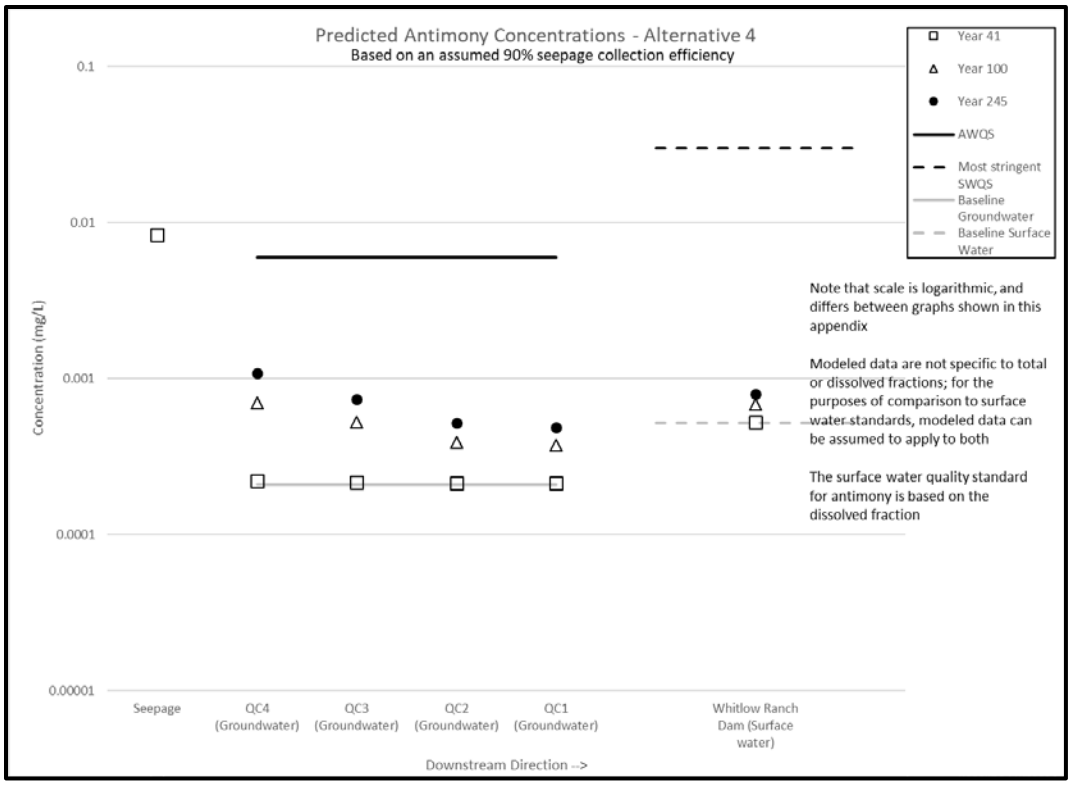

Figure M-19. Predicted antimony concentrations, Alternative 4

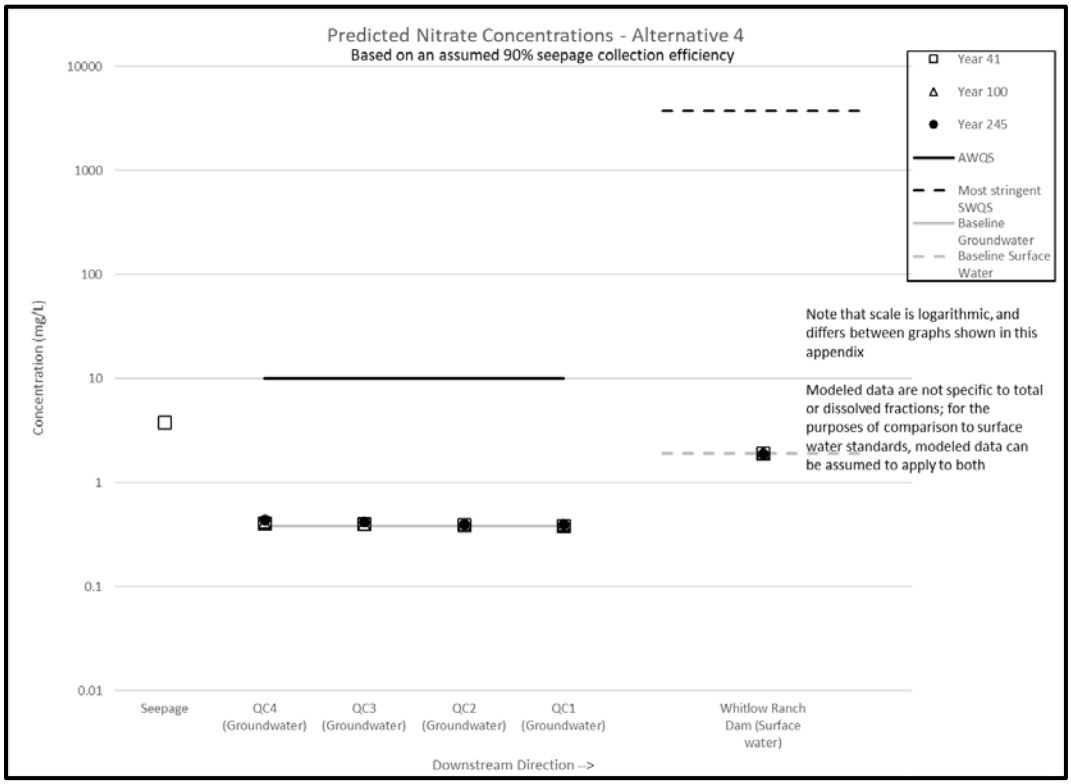

Figure M-20. Predicted nitrate concentrations, Alternative 4

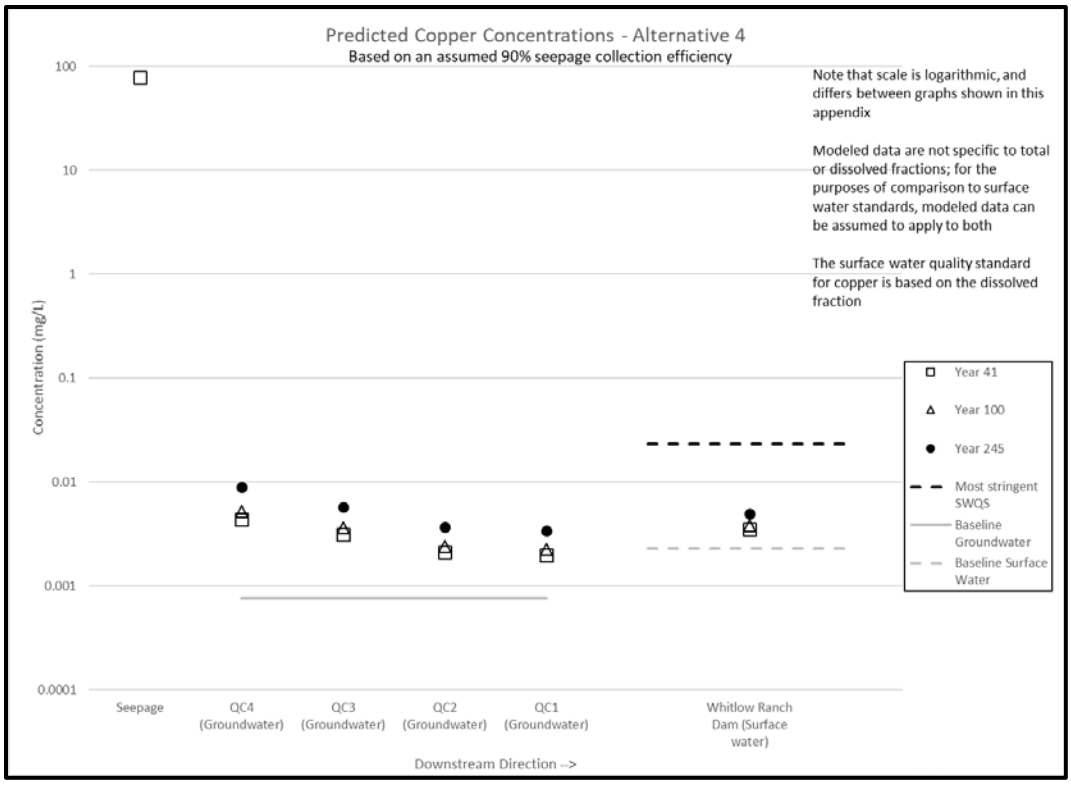

Figure M-21. Predicted copper concentrations, Alternative 4

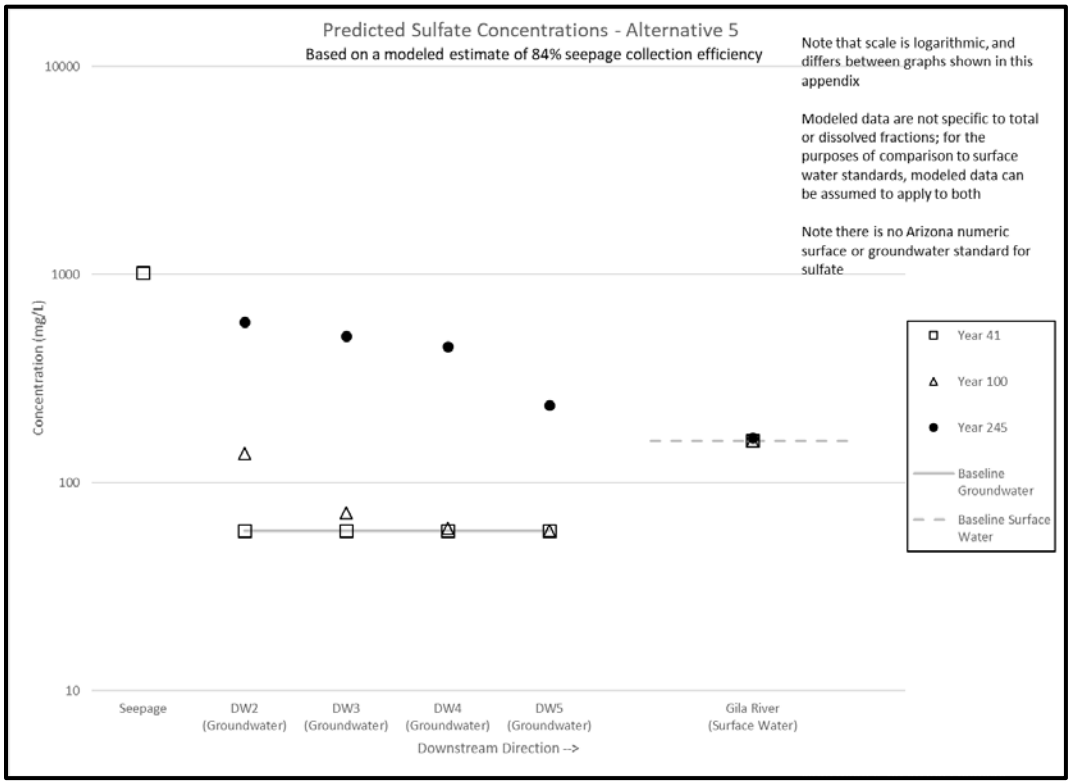

Figure M-22. Predicted sulfate concentrations, Alternative 5

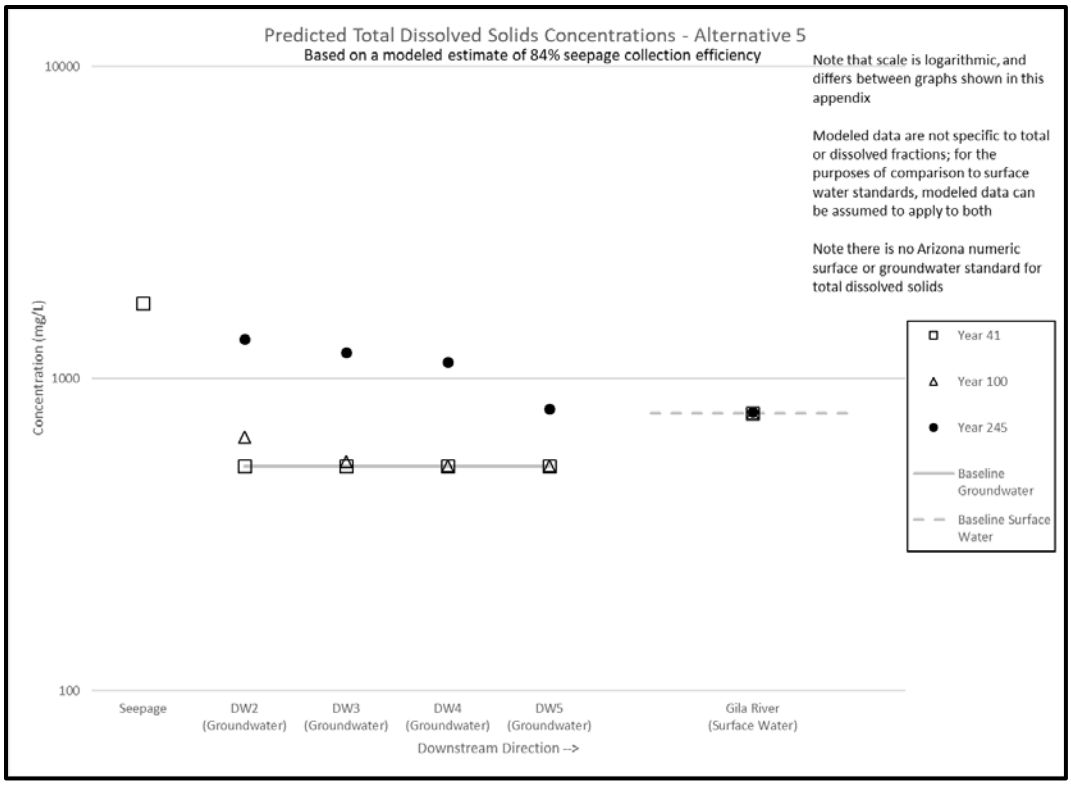

Figure M-23. Predicted total dissolved solids concentrations, Alternative 5

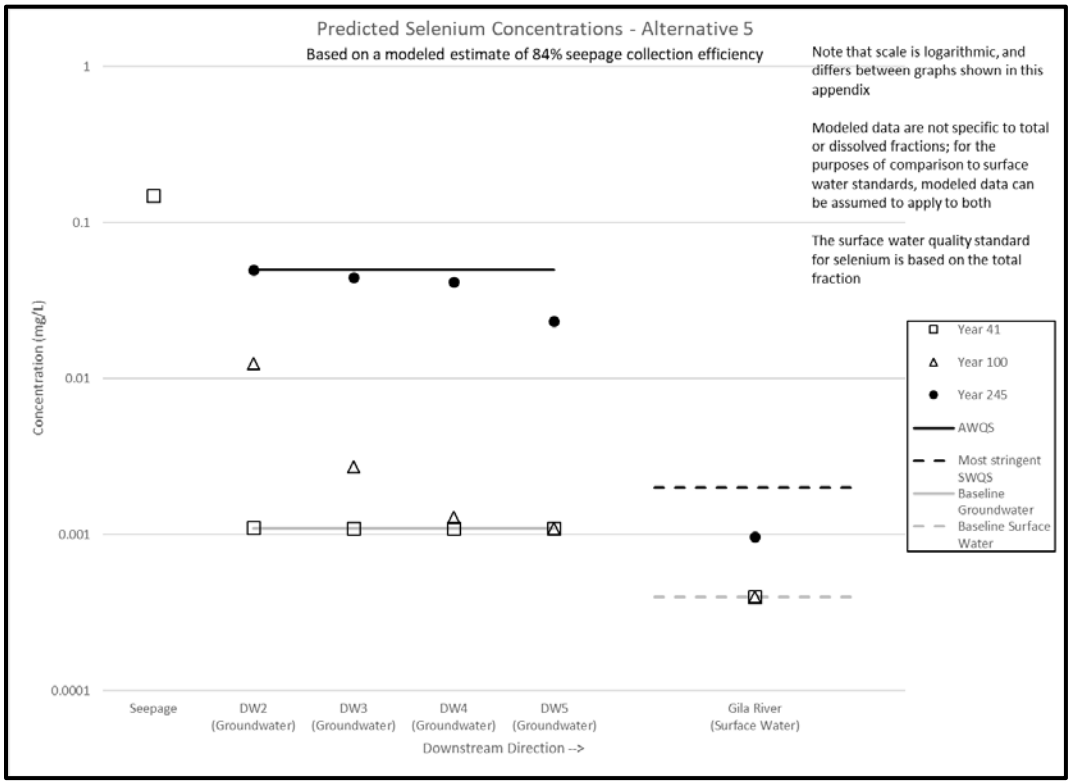

Figure M-24. Predicted selenium concentrations, Alternative 5

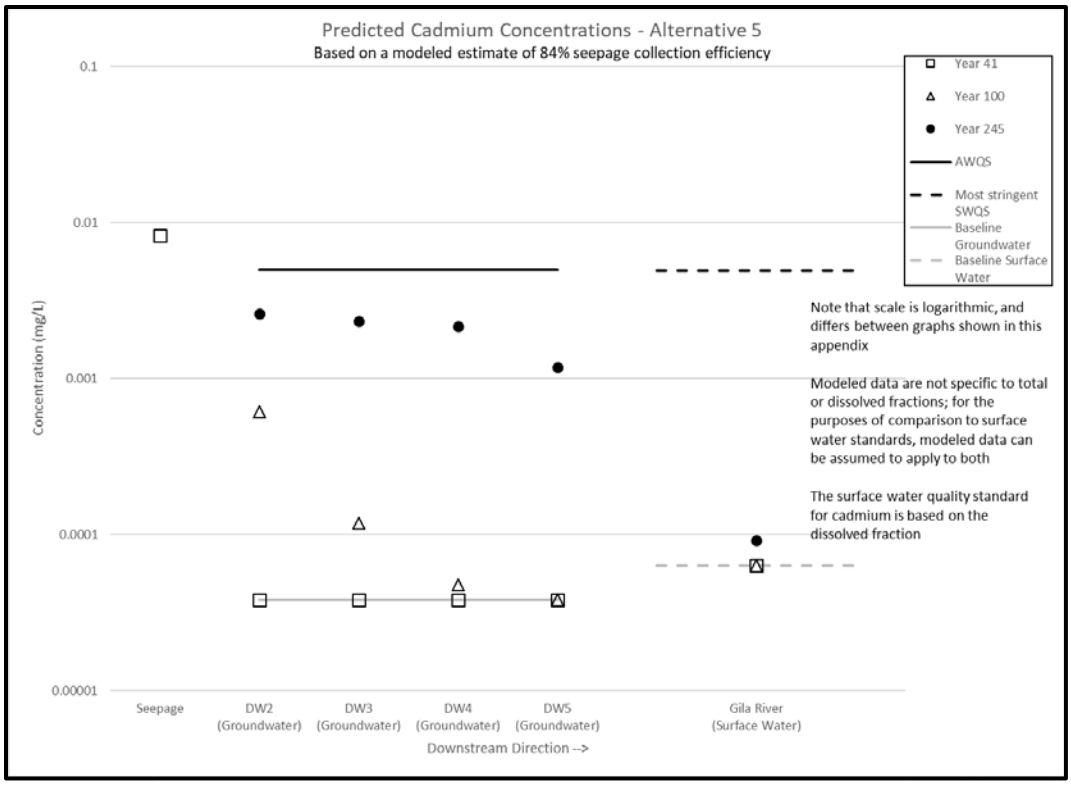

Figure M-25. Predicted cadmium concentrations, Alternative 5

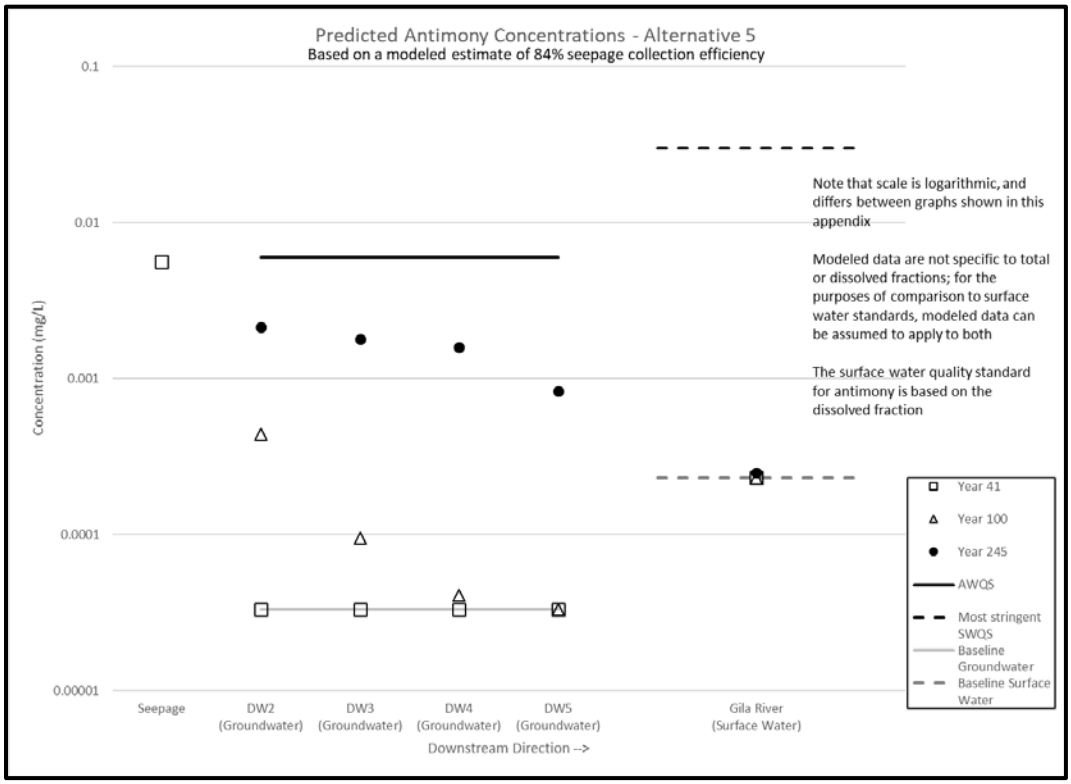

Figure M-26. Predicted antimony concentrations, Alternative 5

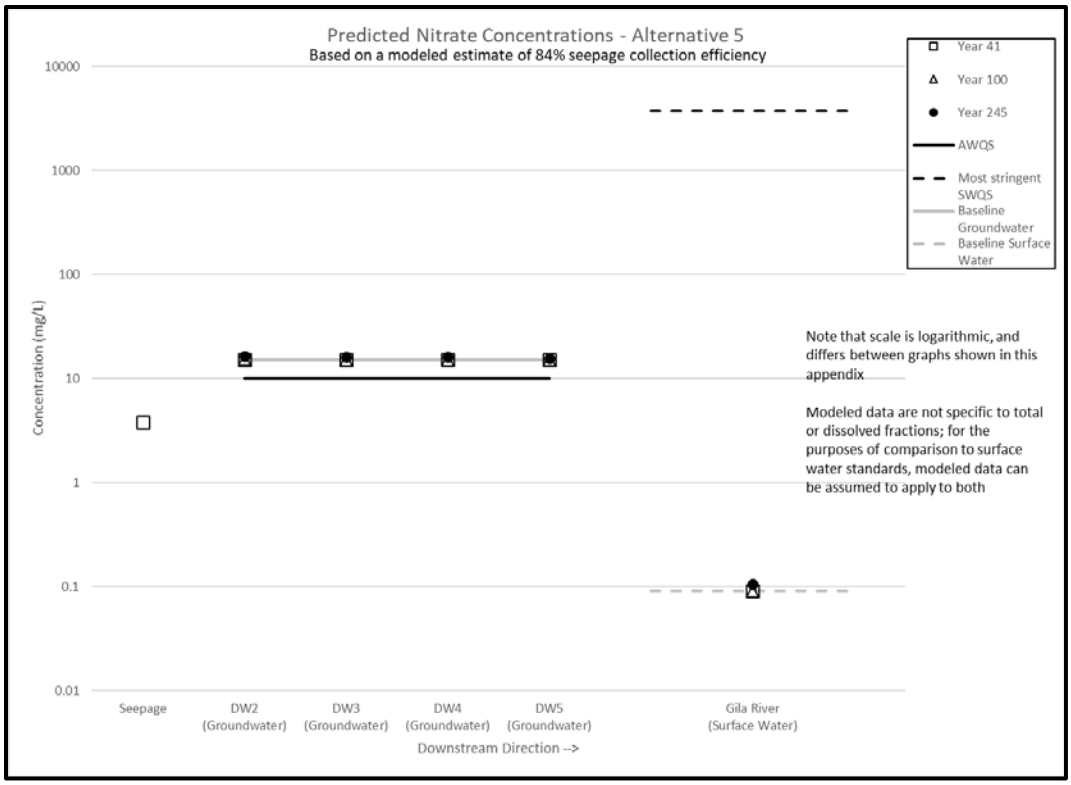

Figure M-27. Predicted nitrate concentrations, Alternative 5

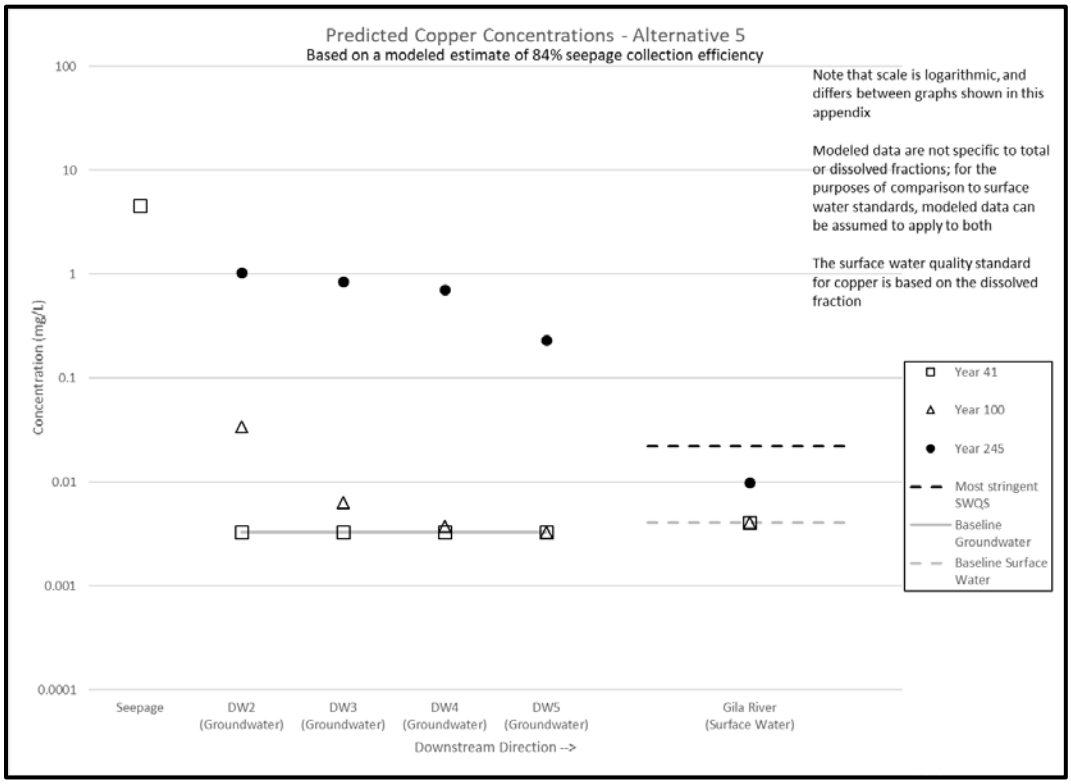

Figure M-28. Predicted copper concentrations, Alternative 5

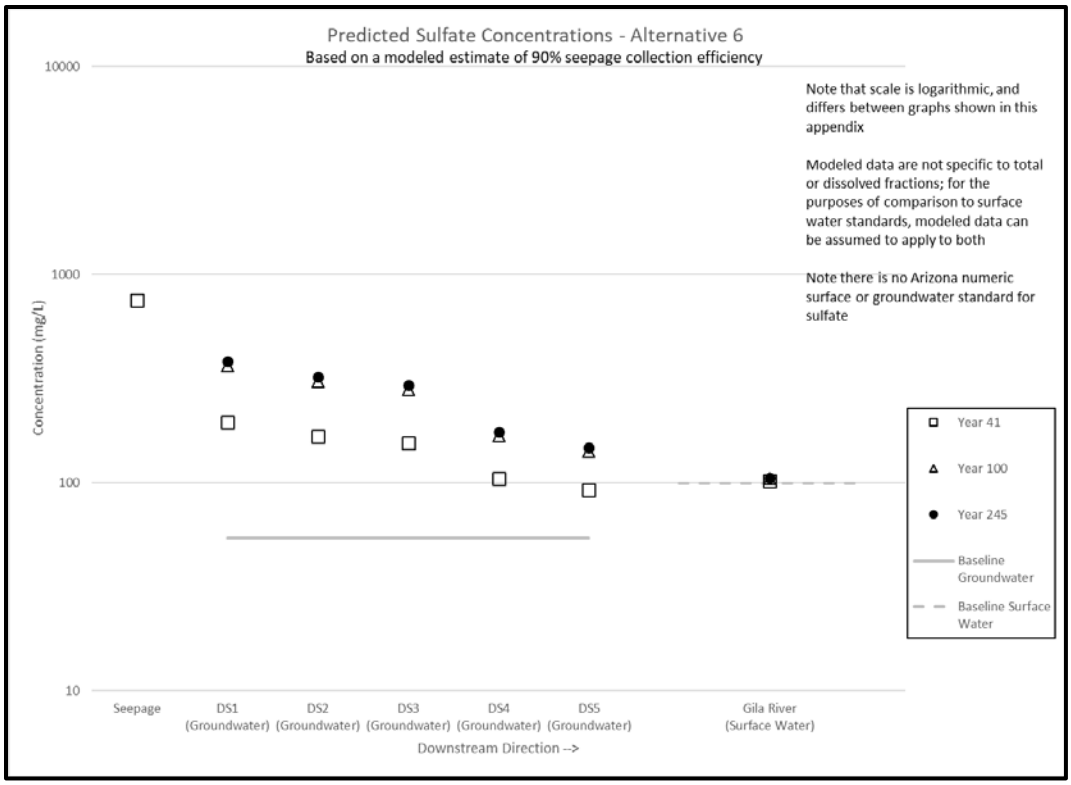

Figure M-29. Predicted sulfate concentrations, Alternative 6

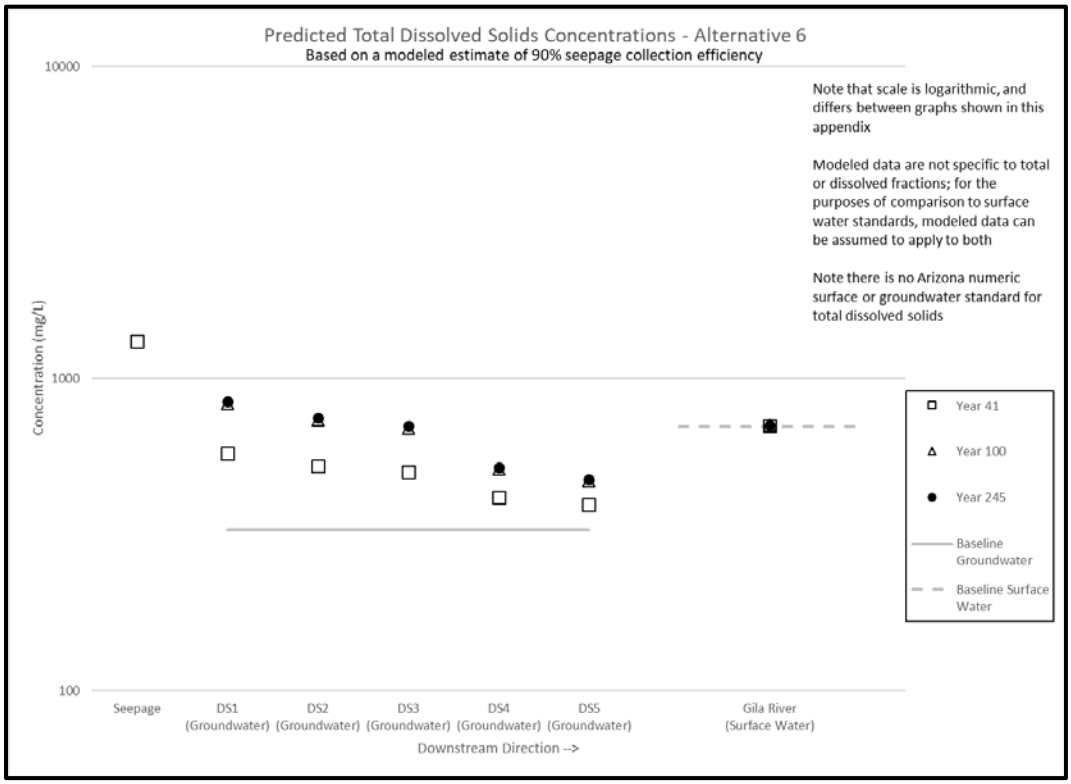

Figure M-30. Predicted total dissolved solids concentrations, Alternative 6

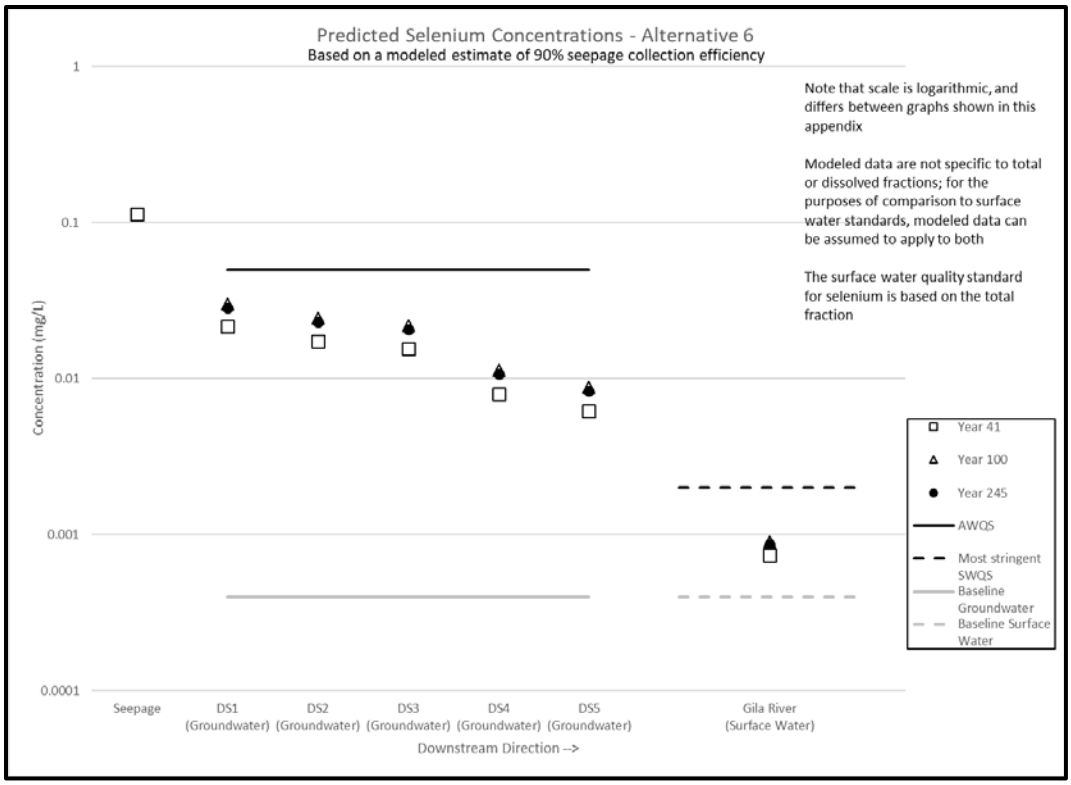

Figure M-31. Predicted selenium concentrations, Alternative 6

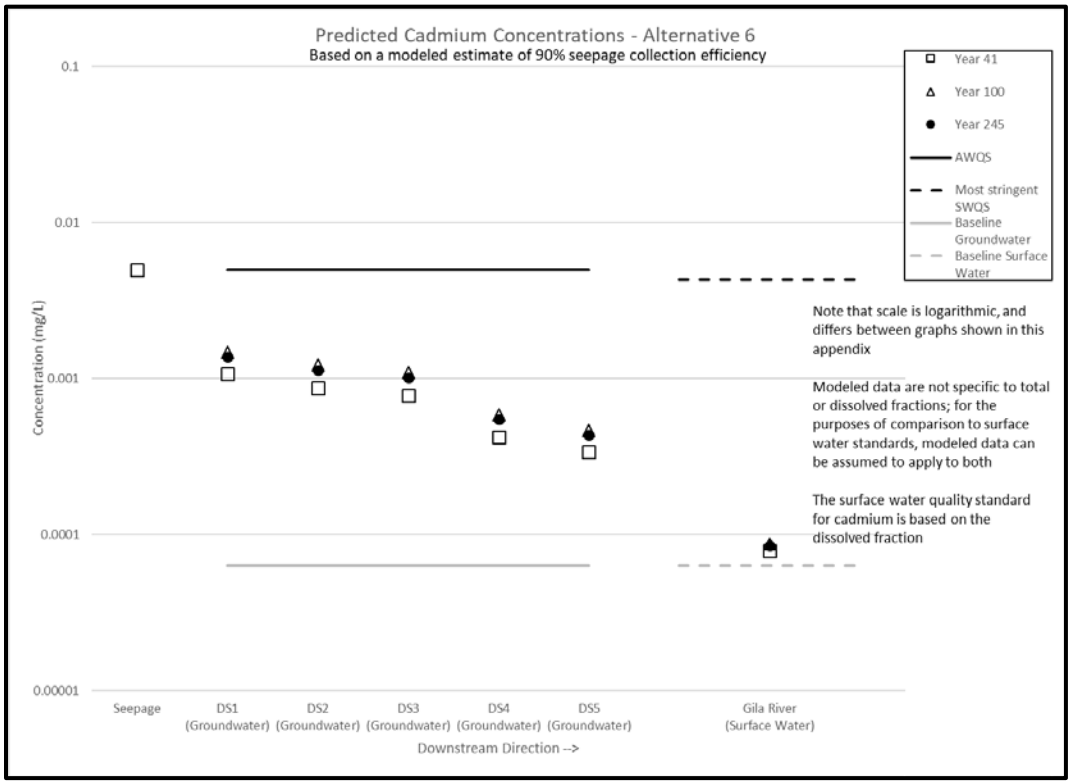

Figure M-32. Predicted cadmium concentrations, Alternative 6

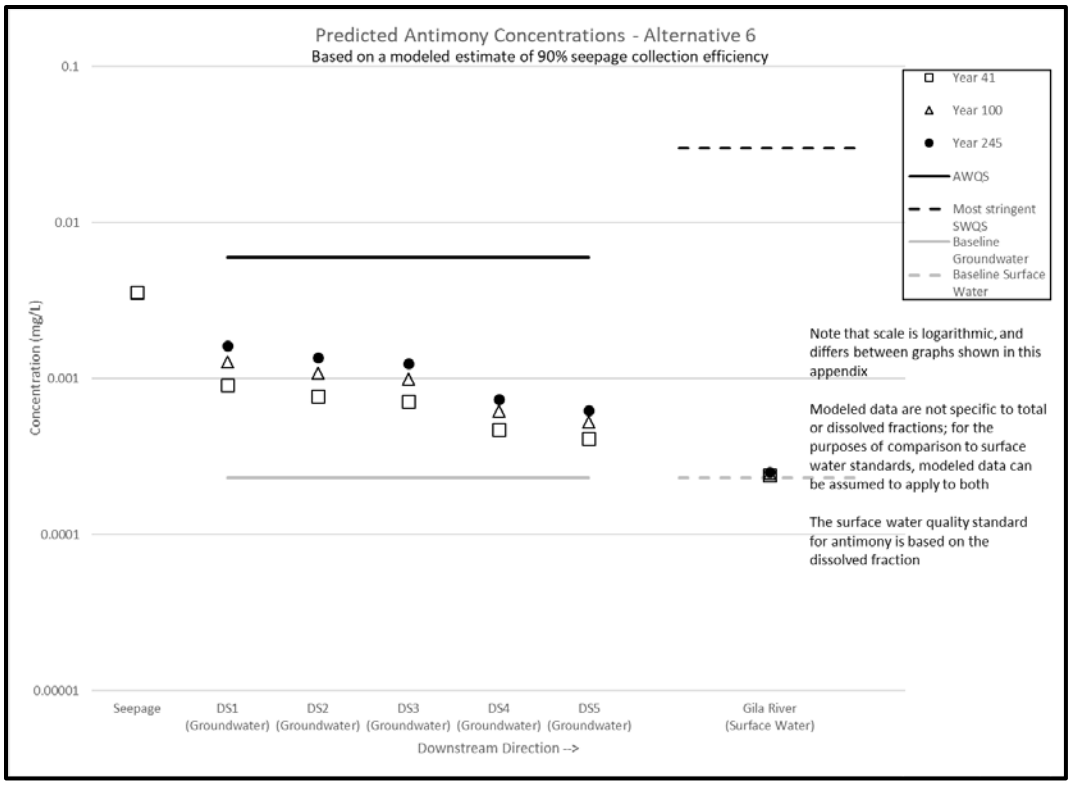

Figure M-33. Predicted antimony concentrations, Alternative 6

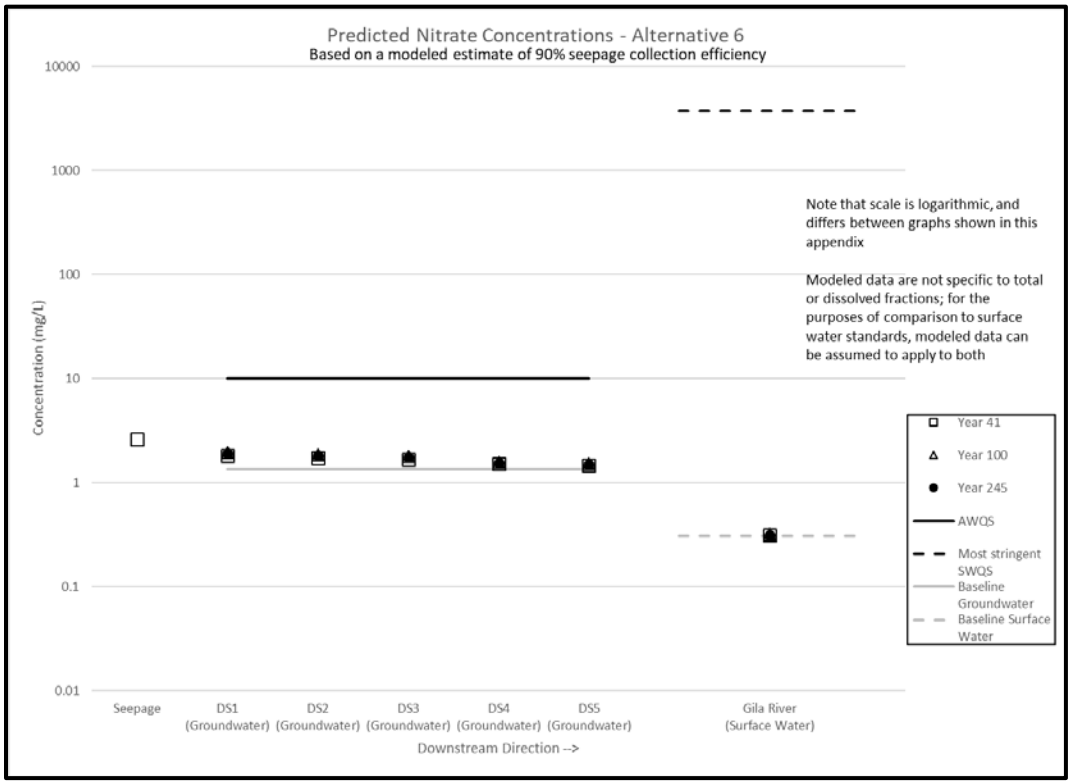

Figure M-34. Predicted nitrate concentrations, Alternative 6

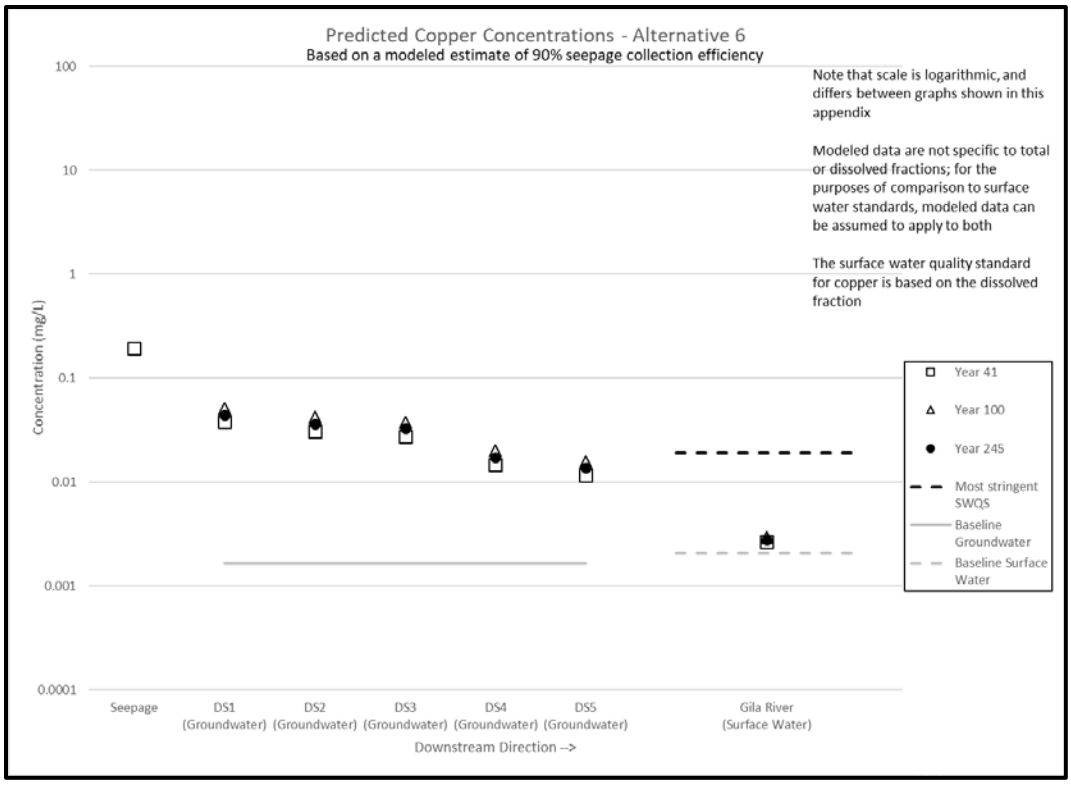

Figure M-35. Predicted copper concentrations, Alternative 6

APPENDIX N. SUMMARY OF EXISTING GROUNDWATER AND SURFACE WATER QUALITY

Overview of Existing Water Quality Sampling

While some water quality samples have been collected in the area as early as 1986, water quality sampling conducted by Resolution Copper Mining, LLC (Resolution Copper) began in earnest in 2003 (Garrett 2017a; Rietz 2016a). Groundwater and surface water quality samples have been analyzed for a wide suite of field parameters, general hydrochemistry, metals, isotopes, and radionuclides. Samples used for the environmental impact statement (EIS) analysis extend through the end of 2015.

Groundwater sampling has focused on wells installed in the Apache Leap Tuff aquifer, the deeper groundwater system, and wells associated solely with shallow alluvium, fracture systems, or perched aquifers (see Garrett 2018b). A separate groundwater investigation associated with voluntary closure and reclamation activities at the West Plant Site also has resulted in a number of water quality samples. In addition to wells, a number of springs have also been sampled; flowing springs are by definition associated with groundwater of some type, though it could be localized or regional in nature.

Surface water sampling has focused on stream systems, notably Devil's Canyon, Arnett Creek, Mineral Creek, and Queen Creek, as well as certain tributaries to these systems (Iron Creek, Hackberry Creek, Oak Flat Wash, Number 9 Wash, Rancho Rio Canyon).

The tables included in this appendix are not a comprehensive database of water quality results, but rather a statistical summary intended to provide an overview of existing groundwater and surface water quality, which forms a baseline for analysis of potential effects.

Summary of Existing Groundwater Quality

Existing groundwater quality data are summarized in Table N-1, for the shallow alluvial or perched groundwater, Apache Leap Tuff aquifer, and deep groundwater system. These data were used as one basis for determining the likely water source for various groundwater-dependent ecosystems (Garrett 2018d).

Summary of Existing Surface Water Quality

The following tables summarize the existing surface water quality data:

- Table N-2. Summary of filtered surface water quality samples for major stream systems in the analysis area. Filtered samples represent dissolved concentrations of constituents.
- Table N-3. Summary of unfiltered surface water quality samples for major stream systems in the analysis area. Unfiltered samples represent total concentrations of constituents.
- Table N-4. Summary of exceedances of Arizona surface water quality standards by existing surface water quality

Table N-1. Summary of existing groundwater quality for shallow alluvial or perched groundwater, Apache Leap Tuff aquifer, and deep groundwater system

		Shallow Groundwater (alluvium or shallow bedrock)					Apache Leap Tuff Aquifer					Deep Groundwater System				
	Units	**Number of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**Number of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**Number of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**
Electrical Conductivity (Field)	uS/cm	5	208.80	880.00	543.76	525.00	5	479.40	931.00	648.76	560.00	2	513.40	536.10	524.75	524.75
Flow Rate	gpm	1	5.80	5.80	5.80	5.80	1	0.45	0.45	0.45	0.45					
Oxidation-Reduction Potential (Field)	mV											2	65.00	115.00	90.00	90.00
pH (Field)	S.U.	27	5.49	8.21	6.41	6.43	105	6.51	10.17	7.34	7.27	27	6.59	9.75	7.39	7.30
Specific Conductance (Field)	uS/cm	22	199.00	1,020.00	493.54	399.00	100	232.00	736.20	322.84	274.80	25	285.10	4,196.00	1,671.32	1,922.00
Temperature (Field)	C	27	11.11	22.17	17.28	17.10	106	15.00	28.40	24.07	24.20	27	28.80	68.70	43.92	42.70
Turbidity (Field)	NTU						1	4.82	4.82	4.82	4.82					
Carbon 14	PMC	15	85.70	108.50	98.89	97.00	76	55.30	106.29	71.16	67.10	20	0.60	82.45	28.12	24.50
Delta Carbon-13 of DIC	Per mil	15	−20.90	−6.30	−16.75	−18.80	76	−20.10	−7.70	−15.87	−15.80	20	−19.30	−7.30	−13.23	−13.40
Delta Deuterium	Per mil	25	−73.00	−43.00	−60.68	−63.00	92	−79.00	−55.20	−68.80	−69.85	20	−86.00	−67.60	−79.41	−83.05
Delta Oxygen-18 of Sulfate	Per mil	19	−0.70	32.30	8.12	5.60	70	−5.90	23.80	6.24	6.40	16	−1.00	7.60	3.71	3.35
Delta Oxygen-18	Per mil	25	−10.50	−4.61	−8.56	−9.30	92	−11.40	−8.44	−9.92	−9.95	20	−11.96	−9.17	−11.03	−11.51
Delta Sulfur-34	Per mil	20	−5.40	4.60	−0.56	−1.10	70	−3.60	10.00	4.79	4.90	17	−1.20	14.80	5.74	7.70
Strontium 87/86	Ratio	15	0.71	0.72	0.71	0.71	69	0.71	0.73	0.71	0.71	19	0.71	0.72	0.71	0.71
Tritium	T.U.	22	1.22	6.20	3.50	3.25	81	0.30	3.40	1.13	1.00	19	1.00	1.50	1.05	1.00
Alkalinity (as CaCO3)	mg/L	26	11.00	289.00	81.57	66.00	107	73.00	299.00	146.92	140.00	20	110.00	337.00	225.85	245.00
Alkalinity, Phenolphthalein	mg/L	3	6.00	6.00	6.00	6.00	44	6.00	6.00	6.00	6.00	18	6.00	33.00	7.50	6.00
Anions (Laboratory)	meq/L						8	2.82	3.76	3.16	3.04	1	11.46	11.46	11.46	11.46
Bicarbonate (calculated by M&A)	mg/L	26	13.00	353.00	99.40	80.50	107	73.80	365.00	177.44	170.00	20	59.00	411.00	271.10	299.00
Bicarbonate Alkalinity (as CaCO3)	mg/L	26	11.00	289.00	81.57	66.00	107	60.50	299.00	145.42	139.00	20	48.00	337.00	222.25	245.00
Bicarbonate Ion	mg/L	1	117.00	117.00	117.00	117.00										
Carbonate (calculated by M&A)	mg/L	26	0.00	0.00	0.00	0.00	107	0.00	36.50	0.87	0.00	20	0.00	39.00	2.17	0.00
Carbonate Alkalinity (as CaCO3)	mg/L	26	1.00	6.00	5.04	6.00	107	1.00	60.90	6.60	6.00	20	1.00	65.00	8.76	6.00
Cations (Laboratory)	meq/L						8	2.49	3.76	3.01	2.98	1	11.52	11.52	11.52	11.52
Chloride	mg/L	27	3.52	66.70	28.39	27.00	107	4.20	39.90	7.63	5.90	20	5.80	27.00	15.62	17.00
Dissolved oxygen	mg/L	4	1.12	10.61	5.53	5.20	4	1.00	4.60	2.89	2.97					
Fluoride	mg/L	27	0.09	0.48	0.37	0.40	107	0.22	1.05	0.44	0.40	20	0.40	6.26	1.91	0.81
Hardness (as CaCO3)	mg/L	17	76.50	431.00	203.15	170.00	81	63.00	444.00	125.99	92.00	20	6.00	700.00	335.10	255.00
Hydroxide Alkalinity (as CaCO3)	mg/L	21	2.00	6.00	5.81	6.00	87	2.00	6.00	5.82	6.00	19	6.00	6.00	6.00	6.00
Ion Balance (Laboratory)	%						8	−6.21	0.00	−2.58	−2.12	1	0.26	0.26	0.26	0.26
Nitrate as N	mg/L	22	0.20	16.00	2.04	0.20	65	0.20	1.60	0.52	0.51	10	0.20	1.40	0.53	0.28

		Shallow Groundwater (alluvium or shallow bedrock)					Apache Leap Tuff Aquifer					Deep Groundwater System				
	Units	**Number of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**Number of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**	**Number of Samples**	**Minimum**	**Maximum**	**Mean**	**Median**
Nitrate+Nitrite as N (calculated by M&A)	mg/L	22	0.00	16.00	1.93	0.00	65	0.00	1.60	0.52	0.51	10	0.00	1.40	0.43	0.18
Nitrate+Nitrite as N	mg/L	9	0.03	3.63	0.59	0.30	53	0.02	3.46	1.37	2.00	12	0.02	2.00	1.29	2.00
Nitrite as N	mg/L	22	0.10	0.20	0.16	0.20	64	0.10	0.20	0.17	0.20	10	0.03	0.20	0.16	0.20
Ortho-Phosphate	mg/L											1	0.12	0.12	0.12	0.12
pH (Laboratory)	S.U.	24	5.54	8.20	6.82	6.86	98	7.01	9.79	7.74	7.65	19	7.00	9.38	7.63	7.39
Silica	mg/L	25	30.00	52.60	37.19	37.00	106	6.98	88.00	59.34	62.50	20	5.80	87.00	33.31	25.00
Specific Conductance (Laboratory)	uS/cm	24	218.00	1,170.00	519.21	440.00	98	220.00	933.00	332.51	275.00	19	260.00	1,800.00	882.63	570.00
Sulfate	mg/L	27	10.90	547.00	141.63	100.00	107	1.40	228.00	18.07	4.70	20	2.00	840.00	252.28	28.50
Sulfide	mg/L	26	0.04	0.41	0.11	0.04	96	0.04	0.73	0.08	0.05	20	0.02	12.00	0.73	0.05
Temperature (Laboratory)	C	20	17.80	22.20	19.73	19.55	86	17.70	23.00	19.55	19.50	19	17.30	24.10	19.89	19.70
Total Dissolved Solids (calculated by laboratory)	mg/L						8	154.00	275.00	225.25	226.50	1	760.00	760.00	760.00	760.00
Total Dissolved Solids (Laboratory)	mg/L	27	135.00	823.00	364.52	290.00	107	140.00	663.00	247.97	217.00	20	92.00	1,400.00	637.55	410.00
Total Suspended Solids	mg/L	3	10.00	18.00	12.67	10.00	7	10.00	12.00	10.29	10.00	3	5.00	10.00	8.33	10.00
Aluminum	mg/L	26	0.04	1.01	0.21	0.20	107	0.02	0.50	0.21	0.20	20	0.03	4.50	0.40	0.20
Antimony	mg/L	26	0.00	0.00	0.00	0.00	107	0.00	0.02	0.00	0.00	20	0.00	0.06	0.01	0.00
Arsenic	mg/L	26	0.00	0.00	0.00	0.00	107	0.00	0.01	0.00	0.00	20	0.00	0.13	0.01	0.01
Barium	mg/L	26	0.01	0.22	0.08	0.09	107	0.00	0.06	0.02	0.02	20	0.01	0.48	0.08	0.03
Beryllium	mg/L	26	0.00	0.00	0.00	0.00	107	0.00	0.00	0.00	0.00	20	0.00	0.00	0.00	0.00
Boron	mg/L	23	0.04	0.20	0.17	0.20	100	0.03	0.50	0.20	0.20	19	0.07	1.50	0.26	0.20
Bromide	mg/L	26	0.05	0.91	0.48	0.50	97	0.07	1.00	0.49	0.50	20	0.07	0.50	0.42	0.50
Cadmium	mg/L	26	0.00	0.00	0.00	0.00	107	0.00	0.01	0.00	0.00	20	0.00	0.02	0.00	0.00
Calcium	mg/L	27	22.10	130.00	58.33	43.00	107	1.16	130.00	35.22	28.00	20	2.00	270.00	103.16	58.00
Chromium	mg/L	26	0.00	0.01	0.01	0.01	107	0.00	0.01	0.00	0.00	20	0.00	0.61	0.03	0.00
Cobalt	mg/L	23	0.00	0.04	0.01	0.00	100	0.00	0.05	0.00	0.00	19	0.00	0.06	0.00	0.00
Copper	mg/L	26	0.00	0.19	0.02	0.01	107	0.00	0.06	0.01	0.00	20	0.00	1.80	0.10	0.00
Cyanide, Amenable	mg/L	22	0.02	0.05	0.03	0.03	91	0.01	0.05	0.03	0.03	11	0.01	0.05	0.02	0.01
Cyanide, Free	mg/L											1	0.10	0.10	0.10	0.10
Cyanide, Total	mg/L	4	0.00	0.00	0.00	0.00	5	0.00	0.01	0.01	0.00	8	0.00	0.05	0.02	0.01
Cyanide, weak acid dissociable	mg/L											1	0.01	0.01	0.01	0.01
Iron	mg/L	26	0.05	30.00	4.53	0.39	107	0.02	10.00	0.65	0.13	20	0.05	1,100.00	59.07	2.05
Lead	mg/L	26	0.00	0.02	0.00	0.00	107	0.00	0.01	0.00	0.00	20	0.00	0.43	0.02	0.00
Lithium	mg/L											1	0.10	0.10	0.10	0.10
Magnesium	mg/L	27	2.60	38.10	11.88	9.90	107	0.04	28.80	6.39	4.70	20	0.25	43.00	19.33	20.00
Manganese	mg/L	23	0.00	2.06	0.42	0.30	100	0.00	1.30	0.11	0.03	20	0.01	15.00	0.94	0.16
Mercury	mg/L	25	0.00	0.00	0.00	0.00	105	0.00	0.00	0.00	0.00	20	0.00	0.00	0.00	0.00

		Shallow Groundwater (alluvium or shallow bedrock)					Apache Leap Tuff Aquifer					Deep Groundwater System				
	Units	Number of Samples	Minimum	Maximum	Mean	Median	Number of Samples	Minimum	Maximum	Mean	Median	Number of Samples	Minimum	Maximum	Mean	Median
Molybdenum	mg/L	26	0.00	0.02	0.01	0.01	107	0.00	0.05	0.01	0.00	20	0.00	0.27	0.03	0.02
Nickel	mg/L	26	0.00	0.02	0.01	0.01	107	0.00	0.14	0.01	0.00	20	0.00	0.22	0.02	0.00
Potassium	mg/L	27	0.76	4.37	2.34	2.00	107	0.95	5.80	1.97	2.00	20	2.00	39.00	14.36	6.10
Selenium	mg/L	26	0.00	0.02	0.00	0.00	107	0.00	0.02	0.00	0.00	20	0.00	0.04	0.00	0.00
Silicon	mg/L	1	40.00	40.00	40.00	40.00	1	59.00	59.00	59.00	59.00					
Silver	mg/L	26	0.00	0.00	0.00	0.00	107	0.00	0.01	0.00	0.00	20	0.00	0.02	0.00	0.00
Sodium	mg/L	27	7.00	131.00	29.73	22.00	107	16.00	69.30	28.29	25.00	20	13.00	160.00	72.10	33.00
Strontium (by isotope dilution)	mg/L	15	0.17	1.25	0.44	0.29	69	0.09	0.52	0.18	0.15	19	0.03	41.83	5.16	0.61
Strontium	mg/L											1	0.76	0.76	0.76	0.76
Thallium	mg/L	26	0.00	0.00	0.00	0.00	107	0.00	0.01	0.00	0.00	20	0.00	0.02	0.00	0.00
Uranium	mg/L	12	0.00	0.00	0.00	0.00	62	0.00	0.02	0.00	0.00	20	0.00	0.01	0.00	0.00
Zinc	mg/L	26	0.01	1.04	0.15	0.06	107	0.01	1.97	0.26	0.08	20	0.01	1.70	0.16	0.05
Gross Alpha, Adjusted	pCi/L						34	−10.70	7.00	−0.55	−0.11	17	−13.70	49.00	5.24	0.01
Gross Alpha	pCi/L	14	1.00	18.00	4.58	2.10	64	1.00	10.00	2.66	2.00	20	1.80	49.00	13.73	3.20
Gross Beta	pCi/L	14	2.00	14.00	4.62	2.80	64	2.00	9.70	3.68	3.80	20	2.60	56.00	20.17	9.40
Radium 226 + Radium 228	pCi/L	14	0.00	3.39	1.03	0.45	64	0.00	2.70	0.44	0.00	20	0.00	16.00	4.56	1.07
Radium 226	pCi/L	14	0.10	0.60	0.28	0.23	64	0.08	0.69	0.22	0.19	20	0.20	11.00	3.53	0.65
Radium 228	pCi/L	14	0.85	2.80	1.53	1.20	64	0.54	2.70	1.33	1.20	20	0.57	5.30	1.57	1.00
Radon 222	pCi/L						5	130.00	530.00	360.00	470.00	4	24.00	2,400.00	1,781.00	2,350.00
U-234/U-238	Ratio						28	0.40	8.70	2.73	2.25	5	0.60	14.00	6.26	2.80
Uranium 234	pCi/L	12	0.20	0.20	0.20	0.20	63	0.20	7.30	1.62	1.20	19	0.20	46.00	6.41	1.10
Uranium 235	pCi/L	12	0.20	0.20	0.20	0.20	63	0.10	1.30	0.67	0.97	19	0.10	5.00	1.22	0.99
Uranium 238	pCi/L	12	0.20	0.20	0.20	0.20	63	0.20	5.32	1.04	1.00	19	0.10	6.29	1.76	1.10
Uranium Activity (Calc 200_8)	pCi/L						2	0.20	6.10	3.15	3.15					
Uranium Activity (Calc 907_0)	pCi/L	12	0.20	0.20	0.20	0.20	29	0.20	6.40	1.50	1.10	2	0.20	0.30	0.25	0.25

Notes: M&A = Montgomery & Associates

Units: C = degrees Celsius; gpm = gallons per minute; mg/L = milligrams per liter; meq/L = milliequivalents per liter; mV = millivolts; NTU = Nephelometric Turbidity Units; pCi/L = picocuries per liter; per mil = parts per thousand PMC = percent modern carbon; ratio = mathematical comparison of two strontium isotopes; S.U. = standard units; T.U. = tritium units; uS/cm = microSiemens per centimeter

The database of groundwater quality results is extensive; this table is meant to be a summary and necessarily requires assumptions about processing and using reported data. The following assumptions were used when compiling and assessing the data:

1) For any samples reported as less than the detection limit, concentrations were set to the detection limit. While other methods could be used (such as setting these values to zero), this method specifically avoids underreporting concentrations.
2) For any samples reported as simply “non-detect,” without a quantified detection limit, concentrations were set to zero.
3) Samples reported with certain data qualifiers were not used. These include samples reported with insufficient sample amount, data not usable, or lost samples.
4) The database used to compile this table utilized all available data, regardless of whether the sample had been filtered or not. Therefore this table includes reported results for total, total recoverable, and dissolved concentrations. This method was deemed appropriate because Arizona aquifer water quality standards are not specific to total or dissolved concentrations, unlike Arizona surface water quality standards.

Table N-2. Summary of filtered surface water quality samples for major stream systems in the analysis area

		Upper Devil's Canyon				Middle Devil's Canyon				Lower Devil's Canyon				Upper Queen Creek				Lower Queen Creek				Mineral Creek			
Parameter	**Units**	**Max**	**Range**	**Avg**	**Median**	**Max**	**Range**	**Avg**	**Median**	**Max**	**Range**	**Avg**	**Median**	**Max**	**Range**	**Avg**	**Median**	**Max**	**Range**	**Avg**	**Median**	**Max**	**Range**	**Avg**	**Median**
Alkalinity (as CaCO3)	mg/L	50.3	38.8	26.1	16.4	135.0	20.0	125.0	125.0					262.0	153.0	182.3	176.0	137.0	0.0	137.0	137.0				
Bicarbonate Alkalinity (as CaCO3)	mg/L	50.3	38.8	26.1	16.4	135.0	21.0	124.5	124.5					262.0	153.0	182.3	176.0	137.0	0.0	137.0	137.0				
Carbonate Alkalinity (as CaCO3)	mg/L	1.0	0.0	1.0	1.0	1.6	0.6	1.3	1.3					1.0	0.0	1.0	1.0	1.0	0.0	1.0	1.0				
Chloride	mg/L	14.6	11.7	7.6	5.4	9.5	2.5	8.3	8.3					33.6	24.8	17.9	11.3	12.6	0.0	12.6	12.6				
Dissolved Organic Carbon	mg/L	8.1	1.9	7.1	7.0	2.0	0.0	2.0	2.0					10.4	5.7	8.0	8.5					7.1	5.4	3.3	2.8
Fluoride	mg/L	0.18	0.08	0.13	0.10	0.42	0.21	0.29	0.23					0.13	0.01	0.12	0.12								
Hardness (as CaCO3)	mg/L	47.8	36.0	26.8	19.3	87.9	69.6	65.3	85.0					311.0	251.4	195.1	187.0	69.4	20.4	59.2	59.2	363.0	173.0	250.6	196.0
Silica	mg/L	54.8	36.6	33.3	32.1	73.2	51.9	46.9	43.7	47.4	16.8	36.9	32.7	51.2	51.0	25.2	25.4	39.3	32.1	26.2	23.8	64.0	34.5	47.5	42.9
Sulfate	mg/L	8.6	7.9	3.3	0.7	3.5	0.8	3.1	3.1					29.6	15.7	19.9	16.2	56.9	0.0	56.9	56.9				
Aluminum	mg/L	2.200	2.186	0.192	0.080	0.165	0.151	0.072	0.080	0.080	0.040	0.067	0.080	0.200	0.178	0.076	0.080	0.790	0.776	0.177	0.080	0.200	0.186	0.066	0.080
Antimony	mg/L	0.006	0.006	0.003	0.003	0.006	0.006	0.003	0.003	0.003	0.003	0.003	0.003	0.015	0.014	0.003	0.003	0.003	0.002	0.002	0.002	0.003	0.003	0.002	0.003
Arsenic	mg/L	0.025	0.024	0.012	0.007	0.025	0.024	0.012	0.007	0.025	0.022	0.008	0.004	0.051	0.047	0.023	0.025	0.027	0.025	0.017	0.024	0.037	0.036	0.020	0.025
Barium	mg/L	0.054	0.052	0.015	0.012	0.043	0.032	0.022	0.023	0.054	0.041	0.028	0.025	0.075	0.064	0.039	0.036	0.044	0.031	0.028	0.034	0.054	0.025	0.039	0.037
Beryllium	mg/L	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.002	0.002	0.001	0.001
Boron	mg/L	0.040	0.025	0.032	0.040	0.040	0.031	0.021	0.014	0.009	0.000	0.009	0.009	0.200	0.180	0.087	0.040	0.068	0.051	0.049	0.061	0.200	0.187	0.064	0.021
Bromide	mg/L	0.350	0.250	0.176	0.120	0.150	0.050	0.123	0.120					0.240	0.100	0.190	0.190								
Cadmium	mg/L	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.005	0.000	0.000	0.001	0.001	0.000	0.000	0.001	0.001	0.000	0.000
Calcium	mg/L	13.0	9.2	7.6	6.2	26.6	2.7	25.3	25.3					89.0	46.0	64.7	63.5	57.0	40.0	37.0	37.0	54.0	0.0	54.0	54.0
Chromium	mg/L	0.006	0.006	0.005	0.006	0.006	0.006	0.005	0.006	0.006	0.006	0.005	0.006	0.006	0.006	0.005	0.006	0.010	0.009	0.002	0.001	0.001	0.000	0.001	0.001
Cobalt	mg/L	0.006	0.005	0.005	0.006	0.006	0.005	0.004	0.006	0.006	0.004	0.005	0.006	0.006	0.005	0.005	0.006	0.010	0.009	0.004	0.004	0.006	0.005	0.004	0.006
Copper	mg/L	0.028	0.027	0.007	0.005	0.013	0.012	0.004	0.002	0.010	0.009	0.005	0.003	0.051	0.050	0.009	0.007	0.062	0.060	0.020	0.020	0.013	0.012	0.002	0.001
Iron	mg/L	3.640	3.580	0.400	0.128	0.115	0.095	0.057	0.060	0.060	0.012	0.056	0.060	0.180	0.160	0.060	0.060	0.560	0.540	0.114	0.060	0.230	0.212	0.059	0.060
Lead	mg/L	0.003	0.003	0.002	0.003	0.003	0.003	0.001	0.000	0.003	0.003	0.002	0.003	0.005	0.005	0.001	0.000	0.005	0.005	0.001	0.000	0.003	0.003	0.000	0.000
Magnesium	mg/L	3.4	2.2	2.0	1.6	5.6	0.2	5.5	5.5					18.0	9.5	14.3	15.4	12.4	10.3	7.2	7.2	15.0	0.0	15.0	15.0
Manganese	mg/L	0.824	0.820	0.113	0.019	0.032	0.031	0.010	0.008	0.252	0.250	0.086	0.004	2.600	2.598	0.184	0.030	0.500	0.496	0.077	0.010	0.136	0.134	0.029	0.010
Mercury, Low Level	ng/l	12.0	11.3	4.0	1.6	1.0	0.5	0.6	0.5					2.5	1.8	1.4	1.1	0.9	0.0	0.9	0.9	0.5	0.0	0.5	0.5
Mercury	mg/L	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001	0.0000	0.0002	0.0002	0.0001	0.0001
Molybdenum	mg/L	0.008	0.008	0.006	0.008	0.028	0.026	0.007	0.008	0.008	0.003	0.007	0.008	0.049	0.047	0.011	0.008	0.020	0.019	0.007	0.007	0.012	0.010	0.007	0.008
Nickel	mg/L	0.010	0.009	0.006	0.010	0.010	0.009	0.005	0.004	0.010	0.009	0.007	0.010	0.010	0.009	0.005	0.003	0.010	0.009	0.002	0.002	0.010	0.009	0.003	0.002
Potassium	mg/L	2.5	0.6	2.2	2.3	2.4	0.8	1.9	1.9					7.6	4.5	4.6	3.8	4.2	0.0	4.2	4.2	2.0	0.0	2.0	2.0
Selenium	mg/L	0.001	0.000	0.001	0.001	0.001	0.000	0.000	0.001	0.001	0.000	0.001	0.001	0.010	0.009	0.003	0.001	0.002	0.002	0.001	0.001	0.002	0.001	0.001	0.001
Silver	mg/L	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.005	0.000	0.000	0.001	0.001	0.000	0.000	0.001	0.001	0.000	0.000
Sodium	mg/L	9.0	4.9	5.8	4.3	21.9	4.9	19.4	19.4					27.0	18.3	17.6	17.3	14.5	0.0	14.5	14.5	24.0	0.0	24.0	24.0
Strontium	mg/L	0.143	0.122	0.056	0.040	0.190	0.159	0.123	0.140					0.364	0.314	0.182	0.175	0.200	0.131	0.135	0.135	0.349	0.169	0.275	0.272
Thallium	mg/L	0.002	0.002	0.001	0.001	0.002	0.002	0.001	0.001	0.002	0.002	0.001	0.002	0.005	0.005	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

		Upper Devil's Canyon				Middle Devil's Canyon				Lower Devil's Canyon				Upper Queen Creek				Lower Queen Creek				Mineral Creek			
Parameter	**Units**	**Max**	**Range**	**Avg**	**Median**	**Max**	**Range**	**Avg**	**Median**	**Max**	**Range**	**Avg**	**Median**	**Max**	**Range**	**Avg**	**Median**	**Max**	**Range**	**Avg**	**Median**	**Max**	**Range**	**Avg**	**Median**
Zinc	mg/L	0.024	0.023	0.008	0.010	0.010	0.010	0.007	0.010	0.010	0.010	0.008	0.010	0.050	0.050	0.009	0.010	0.050	0.048	0.010	0.010	2.600	2.598	0.073	0.010

Units: mg/L = milligrams per liter; ng//L = nanograms per liter

The database of groundwater quality results is extensive; this table is meant to be a summary and necessarily requires assumptions about processing and using reported data. The following assumptions were used when compiling and assessing the data:

1) For any samples reported as less than the detection limit, concentrations were set to the detection limit. While other methods could be used (such as setting these values to zero), this method specifically avoids underreporting concentrations.
2) For any samples reported as simply "non-detect," without a quantified detection limit, concentrations were set to zero.
3) Samples reported with certain data qualifiers were not used. These include samples reported with insufficient sample amount, data not usable, or lost samples.

Table N-3. Summary of unfiltered surface water quality samples for major stream systems in the analysis area

		Upper Devil's Canyon				Middle Devil's Canyon				Lower Devil's Canyon				Upper Queen Creek				Lower Queen Creek				Mineral Creek			
Parameter	**Units**	**Max**	**Range**	**Avg**	**Median**	**Max**	**Range**	**Avg**	**Median**	**Max**	**Range**	**Avg**	**Median**	**Max**	**Range**	**Avg**	**Median**	**Max**	**Range**	**Avg**	**Median**	**Max**	**Range**	**Avg**	**Median**
E. coli	MPN/100ml	1,600	1,598	234	3	900	898	65	5	50	48	9	3	900	898	106	2	99		99	99				
Total Coliforms	MPN/100ml	1,600	1,592	682	170	1,600	1,579	457	185	1,600	1,589	315	130	1,600	1,588	766	300	2,420		2,420	2,420				
Alkalinity (as CaCO3)	mg/L	81.5	77.4	23.7	17.0	177.0	167.3	109.7	116.5	225.0	206.9	124.9	129.0	333.0	280.5	175.8	170.0	287.0	249.5	132.5	84.0	364.0	222.0	245.2	206.0
Bicarbonate Alkalinity (as CaCO3)	mg/L	81.5	77.4	23.7	17.0	177.0	167.3	109.5	116.0	225.0	206.9	124.9	129.0	381.0	328.5	177.1	170.0	287.0	249.5	132.1	84.0	364.0	222.0	244.1	203.5
Carbonate Alkalinity (as CaCO3)	mg/L	6.0	5.0	1.1	1.0	8.3	7.3	1.2	1.0	1.0	0.0	1.0	1.0	27.5	26.5	2.2	1.0	6.0	5.0	2.7	1.0	8.4	7.4	1.9	1.0
Chloride	mg/L	27.3	25.4	8.3	6.4	12.4	9.6	7.6	7.4	11.4	8.0	8.4	8.7	43.0	39.7	13.7	12.4	28.8	26.8	12.6	7.5	20.5	14.5	13.7	12.5
Fluoride	mg/L	0.57	0.49	0.14	0.10	0.56	0.46	0.24	0.23	0.24	0.14	0.17	0.17	0.40	0.30	0.17	0.14	0.50	0.40	0.25	0.18	0.53	0.36	0.32	0.31
Hardness (as CaCO3)	mg/L	92.0	91.9	18.1	0.5	46.0	45.9	7.5	0.3	37.0	36.8	8.5	5.0	74.0	73.9	6.8	0.2	0.5	0.4	0.3	0.2	0.5	0.4	0.3	0.3
Nitrate as N	mg/L	2.5	2.4	0.4	0.2	1.0	0.9	0.2	0.1	0.2	0.1	0.1	0.1	5.6	5.5	0.7	0.2	4.6	3.9	2.4	1.9	0.4	0.2	0.3	0.3
Nitrite as N	mg/L	1.0	0.9	0.1	0.1	1.0	0.9	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.2	0.0	0.2	0.2
Nitrate+Nitrite as N	mg/L	2.5	2.4	0.4	0.2	2.0	2.0	0.3	0.2	0.2	0.1	0.2	0.2	2.1	2.0	0.7	0.3	1.9	1.2	1.5	1.8	2.0	1.9	0.6	0.4
Ortho-Phosphate	mg/L	5.0	4.5	0.7	0.5	0.5	0.0	0.5	0.5	0.5	0.0	0.5	0.5	0.5	0.0	0.5	0.5								
pH (Laboratory)	S.U.	7.0	0.1	7.0	7.0	8.1	0.3	7.9	7.9	8.1	0.0	8.1	8.1	8.0	0.2	7.9	7.9	8.4	0.7	8.0	7.9	8.4	0.8	8.0	8.0
Silica	mg/L	53.6	40.7	30.5	31.0	82.3	57.3	52.1	50.7	53.8	26.4	41.4	43.1	69.7	42.6	40.4	40.0	120.0	96.0	51.5	45.1	62.9	23.6	51.8	52.5
Specific Conductance (Laboratory)	uS/cm	133	52	107	107	333	60	309	316	300	0	300	300	650	288	506	506	860	720	554	789	704	315	514	481
Sulfate	mg/L	58.0	57.7	13.0	10.6	71.1	70.6	9.3	6.6	41.6	30.7	19.7	15.6	70.7	62.4	31.1	27.9	150.0	143.0	60.4	35.4	103.0	86.1	51.5	49.7
Sulfide	mg/L	1.00	0.61	0.97	1.00	1.00	0.61	0.89	1.00	1.00	0.61	0.93	1.00	1.00	0.95	0.90	1.00	0.39	0.00	0.39	0.39	1.10	1.05	0.69	0.81
Total Dissolved Solids (Laboratory)	mg/L	224	194	101	96	320	247	177	182	321	232	202	200	473	353	270	250	580	458	296	207	498	247	368	344
Total Suspended Solids	mg/L	171	166	16	5	11	6	6	5	5	0	5	5	173	168	18	5	10	5	7	6	2,630	2,625	78	5
Gross Alpha	pCi/L	20.8	19.8	4.4	1.6	3.9	2.4	2.4	2.3	2.0	0.0	2.0	2.0	4.7	2.8	2.8	2.5	5.9	1.6	5.1	5.1	7.5	5.8	3.5	3.0
Gross Beta	pCi/L	18.4	15.8	5.7	4.0	4.3	1.6	3.7	3.7	4.1	0.0	4.1	4.1	6.2	3.3	4.0	3.4	14.0	9.8	9.1	9.1	8.1	6.5	4.1	4.0
Aluminum	mg/L	2.5	2.5	0.5	0.2	0.9	0.9	0.1	0.0	0.7	0.6	0.1	0.0	9.3	9.3	0.7	0.0	67.0	66.8	11.1	1.2	0.2	0.1	0.1	0.1
Antimony	mg/L	0.006	0.006	0.003	0.003	0.006	0.006	0.003	0.003	0.003	0.003	0.002	0.003	0.015	0.015	0.003	0.003	0.004	0.004	0.002	0.002	0.015	0.015	0.002	0.003
Arsenic	mg/L	0.038	0.037	0.012	0.006	0.025	0.024	0.011	0.005	0.025	0.022	0.008	0.005	0.045	0.041	0.024	0.025	0.072	0.071	0.021	0.025	0.043	0.042	0.017	0.025
Barium	mg/L	0.036	0.031	0.014	0.012	0.041	0.033	0.024	0.023	0.054	0.037	0.033	0.026	0.078	0.076	0.036	0.028	0.380	0.364	0.061	0.028	0.857	0.828	0.072	0.040
Beryllium	mg/L	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.004	0.003	0.001	0.001	0.005	0.005	0.002	0.002

		Upper Devil's Canyon				Middle Devil's Canyon				Lower Devil's Canyon				Upper Queen Creek				Lower Queen Creek				Mineral Creek			
Parameter	**Units**	**Max**	**Range**	**Avg**	**Median**	**Max**	**Range**	**Avg**	**Median**	**Max**	**Range**	**Avg**	**Median**	**Max**	**Range**	**Avg**	**Median**	**Max**	**Range**	**Avg**	**Median**	**Max**	**Range**	**Avg**	**Median**
Boron	mg/L	0.040	0.033	0.035	0.040	0.040	0.033	0.033	0.040	0.040	0.033	0.034	0.040	0.200	0.193	0.044	0.040	0.082	0.059	0.050	0.040	0.200	0.186	0.041	0.040
Bromide	mg/L	0.470	0.387	0.136	0.100	0.573	0.503	0.118	0.100	0.190	0.130	0.117	0.100	1.110	1.040	0.215	0.160	0.500	0.449	0.158	0.106	0.500	0.420	0.141	0.115
Cadmium	mg/L	0.002	0.002	0.001	0.000	0.005	0.005	0.001	0.000	0.002	0.002	0.000	0.000	0.005	0.005	0.001	0.002	0.004	0.004	0.001	0.001	0.005	0.005	0.002	0.002
Calcium	mg/L	22.3	19.2	9.3	7.3	41.4	36.3	24.2	25.9	55.9	48.1	32.0	30.2	112.0	93.6	58.3	56.1	210.0	191.9	65.4	35.9	95.1	51.1	68.8	60.9
Chromium	mg/L	0.006	0.006	0.005	0.006	0.006	0.006	0.005	0.006	0.006	0.006	0.005	0.006	0.006	0.006	0.005	0.006	0.071	0.071	0.009	0.006	0.058	0.058	0.006	0.006
Cobalt	mg/L	0.006	0.005	0.005	0.006	0.006	0.005	0.005	0.006	0.006	0.005	0.005	0.006	0.006	0.005	0.005	0.006	0.028	0.028	0.005	0.001	0.005	0.004	0.002	0.001
Copper	mg/L	0.088	0.087	0.012	0.010	0.015	0.014	0.007	0.010	0.011	0.009	0.007	0.010	0.144	0.141	0.015	0.010	0.680	0.677	0.074	0.023	0.702	0.701	0.025	0.010
Cyanide, Amenable	mg/L													0.008	0.000	0.008	0.008					0.008	0.000	0.008	0.008
Cyanide, Free	mg/L	0.100	0.000	0.100	0.100	0.100	0.000	0.100	0.100					0.100	0.000	0.100	0.100								
Cyanide, Total	mg/L	0.010	0.005	0.009	0.010	0.010	0.006	0.007	0.005	0.010	0.006	0.007	0.007	0.010	0.005	0.008	0.010	0.005	0.000	0.005	0.005	0.004	0.000	0.004	0.004
Iron	mg/L	8.260	8.200	1.299	0.436	0.454	0.430	0.128	0.094	0.328	0.304	0.090	0.060	5.110	5.097	0.418	0.048	56.000	55.730	9.374	1.210	0.337	0.283	0.157	0.119
Lead	mg/L	0.010	0.010	0.003	0.003	0.005	0.005	0.003	0.003	0.005	0.005	0.003	0.003	0.022	0.021	0.003	0.003	0.380	0.380	0.031	0.003	0.222	0.222	0.008	0.003
Magnesium	mg/L	6.3	5.3	2.6	2.0	8.8	7.5	5.1	5.3	11.4	9.6	6.6	6.3	23.7	20.4	11.7	11.5	29.0	25.6	13.6	8.7	36.1	26.0	21.0	16.5
Manganese	mg/L	1.060	1.056	0.147	0.064	0.137	0.133	0.023	0.014	0.276	0.275	0.043	0.013	2.700	2.696	0.212	0.086	3.900	3.896	0.384	0.016	8.230	8.226	0.259	0.017
Mercury	mg/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Molybdenum	mg/L	0.008	0.008	0.007	0.008	0.008	0.005	0.007	0.008	0.009	0.007	0.007	0.008	0.014	0.011	0.009	0.009	0.010	0.009	0.003	0.003	0.005	0.002	0.003	0.003
Nickel	mg/L	0.010	0.009	0.008	0.010	0.010	0.008	0.008	0.010	0.010	0.009	0.008	0.010	0.010	0.009	0.009	0.010	0.047	0.046	0.009	0.006	0.114	0.113	0.010	0.010
Potassium	mg/L	8.8	7.7	2.3	2.0	3.1	2.1	1.7	1.5	3.7	2.2	2.2	2.1	7.6	6.2	3.8	3.3	17.0	15.5	3.9	3.0	19.9	19.2	1.8	1.4
Selenium	mg/L	0.005	0.005	0.002	0.003	0.006	0.006	0.002	0.001	0.003	0.003	0.002	0.003	0.010	0.010	0.002	0.001	0.004	0.004	0.001	0.001	0.010	0.010	0.001	0.001
Silver	mg/L	0.005	0.005	0.002	0.000	0.005	0.005	0.002	0.000	0.005	0.005	0.001	0.000	0.005	0.005	0.003	0.005	0.005	0.005	0.003	0.002	0.005	0.005	0.003	0.005
Sodium	mg/L	13.2	10.0	6.7	6.0	30.9	26.4	19.8	19.1	32.2	26.5	19.9	19.3	28.0	23.6	13.1	14.6	46.3	44.1	18.4	11.1	36.5	22.9	27.8	26.9
Strontium (by isotope dilution)	ppm	0.100	0.075	0.048	0.045	0.161	0.070	0.127	0.120					0.310	0.174	0.210	0.205	0.204	0.000	0.204	0.204	0.369	0.183	0.274	0.266
Thallium	mg/L	0.002	0.002	0.001	0.001	0.002	0.002	0.001	0.001	0.002	0.002	0.001	0.002	0.005	0.005	0.001	0.001	0.002	0.002	0.001	0.001	0.005	0.005	0.001	0.001
Uranium	mg/L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.001	0.001	0.001	0.005	0.005	0.003	0.003	0.004	0.004	0.002	0.002
Zinc	mg/L	0.020	0.018	0.008	0.010	0.016	0.015	0.007	0.010	0.020	0.018	0.008	0.010	0.090	0.089	0.012	0.010	1.300	1.297	0.105	0.010	0.784	0.783	0.028	0.010
Radium 226 + Radium 228	pCi/L	1.40	1.40	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10	1.10	0.33	0.00	0.00	0.00	0.00	0.00	1.30	1.30	0.15	0.00
Radium 226	pCi/L	1.00	0.81	0.43	0.35	1.10	0.90	0.44	0.35	0.30	0.00	0.30	0.30	0.90	0.70	0.50	0.41	0.26	0.05	0.23	0.23	0.26	0.20	0.18	0.20
Radium 228	pCi/L	1.50	0.30	1.38	1.40	1.50	0.30	1.37	1.40	1.40	0.00	1.40	1.40	1.50	0.40	1.28	1.20	1.40	0.20	1.30	1.30	1.50	0.92	1.11	1.10

* mg/L = milligrams per liter; MPN/100ml = most probable number per 100 milliliters; pCi/L = picocuries per liter; ppm = parts per million; S.U. = standard unit; uS/cm = microSiemens per centimeter

The database of groundwater quality results is extensive; this table is meant to be a summary and necessarily requires assumptions about processing and using reported data. The following assumptions were used when compiling and assessing the data:

1) For any samples reported as less than the detection limit, concentrations were set to the detection limit. While other methods could be used (such as setting these values to zero), this method specifically avoids underreporting concentrations.
2) For any samples reported as simply "non-detect," without a quantified detection limit, concentrations were set to zero.
3) Samples reported with certain data qualifiers were not used. These include samples reported with insufficient sample amount, data not usable, or lost samples.

Table N-4 summarizes the number of samples that were identified as exceeding Arizona surface water quality standards. Grayed areas indicate that no standard exists, for either that chemical constituent or for the specific water use (Arizona Administrative Code, R18-11 Article 1). Cited standards for constituents that are not based on the hardness of the water are shown in bold at the head of each constituent section. Where no standard is listed, the applicable standard is based upon the hardness of the water (the amount of calcium and magnesium in the water) and is variable.

Table N-4. Summary of exceedances of Arizona surface water quality standards by existing surface water quality

		Number of Exceedances by Major Stream System, for Arizona Surface Water Quality Standards									
PARAMETER	**Stream System**	**DWS**	**FC**	**PBC**	**FBC**	**A&Ww Acute**	**A&Ww Chronic**	**A&We Acute**	**A&W edw Acute**	**A&W edw Chronic**	**AgL**
		mg/L	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Gross Alpha pCi/L		**15**									
	Upper Devil's Canyon	1									
	Middle Devil's Canyon	0									
	Lower Devil's Canyon	0									
	Upper Queen Creek	0									
	Lower Queen Creek	0									
	Mineral Creek	0									
Antimony		**0.006 T**	**0.640 T**	**0.747 T**		**0.088 D**	**0.030 D**				
	Upper Devil's Canyon	3	0	0		0	0				
	Middle Devil's Canyon	2	0	0		0	0				
	Lower Devil's Canyon	0	0	0		0	0				
	Upper Queen Creek	2		0		0	0				
	Lower Queen Creek	0	0	0	0	0	0				
	Mineral Creek	1	0		0	0	0				
Arsenic		**0.010 T**	**0.0080 T**	**0.280 T**		**0.340 D**	**0.150 D**	**0.440 D**			**0.200 T**
	Upper Devil's Canyon	20	21	0		0	0	0			0
	Middle Devil's Canyon	16	18	0		0	0	0			0
	Lower Devil's Canyon	2	2	0		0	0	0			0
	Upper Queen Creek	38	38	0		0	0	0			0
	Lower Queen Creek	10	10	0		0	0	0			0
	Mineral Creek	25	25	0		0	0	0			0
Barium		**2.0 T**		**98.0 T**							
	Upper Devil's Canyon	0		0							
	Middle Devil's Canyon	0		0							
	Lower Devil's Canyon	0		0							
	Upper Queen Creek	0		0							
	Lower Queen Creek	0		0							
	Mineral Creek	0		0							
Beryllium		**0.004 T**	**0.084 T**	**1.867 T**							
	Upper Devil's Canyon	0	0	0							
	Middle Devil's Canyon	0	0	0							
	Lower Devil's Canyon	0	0	0							
	Upper Queen Creek	0	0	0							
	Lower Queen Creek	0	0	0							
	Mineral Creek	1	0	0							

		Number of Exceedances by Major Stream System, for Arizona Surface Water Quality Standards									
PARAMETER	**Stream System**	**DWS**	**FC**	**PBC**	**FBC**	**A&Ww Acute**	**A&Ww Chronic**	**A&We Acute**	**A&W edw Acute**	**A&W edw Chronic**	**AgL**
		mg/L	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Boron		**1.400 T**		**186.667 T**							**1.000 T**
	Upper Devil's Canyon	0		0							0
	Middle Devil's Canyon	0		0							0
	Lower Devil's Canyon	0		0							0
	Upper Queen Creek	0		0							0
	Lower Queen Creek	0		0							0
	Mineral Creek	0		0							0
Cadmium		**0.005 T**	**0.084 T**	**0.700 T**	**0.700 T**						**50 T**
	Upper Devil's Canyon	0	0	0	0	9	24				0
	Middle Devil's Canyon	0	0	0	0	0	2				0
	Lower Devil's Canyon	0	0	0	0	3	21				0
	Upper Queen Creek	0	0	0	0	0	1				0
	Lower Queen Creek	0	0	0	0	1	2		1	2	0
	Mineral Creek	0	0	0	0	0	1				0
Chromium III			**75.000 T**	**1,400 T**	**1,400 T**						
	Upper Devil's Canyon		ND	ND	ND	ND	ND				
	Middle Devil's Canyon		ND	ND	ND	ND	ND				
	Lower Devil's Canyon		ND	ND	ND	ND	ND				
	Upper Queen Creek		ND	ND	ND	ND	ND				
	Lower Queen Creek		ND	ND	ND	ND	ND		ND	ND	
	Mineral Creek		ND	ND	ND	ND	ND				
Chromium VI		**0.021 T**	**0.150 T**	**2.800 T**	**2.800 T**	**0.016 D**	**0.011 D**	**0.034 D**			
	Upper Devil's Canyon	ND	ND	ND	ND	ND	ND	ND			
	Middle Devil's Canyon	ND	ND	ND	ND	ND	ND	ND			
	Lower Devil's Canyon	ND	ND	ND	ND	ND	ND	ND			
	Upper Queen Creek	ND	ND	ND	ND	ND	ND	ND			
	Lower Queen Creek	ND	ND	ND	ND	ND	ND	ND			
	Mineral Creek	ND	ND	ND	ND	ND	ND	ND			
Chromium (Total)		**0.100 T**									**1 T**
	Upper Devil's Canyon	0									0
	Middle Devil's Canyon	0									0
	Lower Devil's Canyon	0									0
	Upper Queen Creek	0									0
	Lower Queen Creek	0									0
	Mineral Creek	0									0
Copper		**1.300 T**		**1.300 T**	**1.300 T**						**0.500 T**

		Number of Exceedances by Major Stream System, for Arizona Surface Water Quality Standards									
PARAMETER	**Stream System**	**DWS**	**FC**	**PBC**	**FBC**	**A&Ww Acute**	**A&Ww Chronic**	**A&We Acute**	**A&W edw Acute**	**A&W edw Chronic**	**AgL**
		mg/L	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
	Upper Devil's Canyon	0		0		29	33				0
	Middle Devil's Canyon	0		0		7	10				0
	Lower Devil's Canyon	0		0		31	40				0
	Upper Queen Creek	0		0		4	8		4	8	0
	Lower Queen Creek	0		0	0	13	18				1
	Mineral Creek	0			0	0	0				1
Cyanide (as free cyanide)		**0.200 T**	**16.000 T**	**18.667 T**	**18.667 T**	**0.041 T**	**0.0097 T**	**0.084 T**			**0.200 T**
	Upper Devil's Canyon	0	0	0		3	3	3			0
	Middle Devil's Canyon	0	0	0		2	2	2			0
	Lower Devil's Canyon	0	0	0		0	0	0			0
	Upper Queen Creek	0	0	0		1	1	1			0
	Lower Queen Creek	0	0	0	0	0	0	0			0
	Mineral Creek	0	0		0	0	0	0			0
Fluoride		**4 T**		**140 T**	**140 T**						
	Upper Devil's Canyon	0		0							
	Middle Devil's Canyon	0		0							
	Lower Devil's Canyon	0		0							
	Upper Queen Creek	0		0							
	Lower Queen Creek	0		0	0						
	Mineral Creek	0			0						
Iron							**1 D**				
	Upper Devil's Canyon						2				
	Middle Devil's Canyon						0				
	Lower Devil's Canyon						0				
	Upper Queen Creek						0				
	Lower Queen Creek						0				
	Mineral Creek						0				
Lead		**0.015 T**		**0.015 T**	**0.015 T**						**0.100 T**
	Upper Devil's Canyon	0		0		0	36				0
	Middle Devil's Canyon	0		0		0	21				0
	Lower Devil's Canyon	0		0		0	57				0
	Upper Queen Creek	1		1		0	3		0	3	0
	Lower Queen Creek	2		2	2	0	4				1
	Mineral Creek	1			1	0	0				1
Manganese*		**0.98**		**130.667**							
	Upper Devil's Canyon	2		0							

		Number of Exceedances by Major Stream System, for Arizona Surface Water Quality Standards									
PARAMETER	**Stream System**	**DWS**	**FC**	**PBC**	**FBC**	**A&Ww Acute**	**A&Ww Chronic**	**A&We Acute**	**A&W edw Acute**	**A&W edw Chronic**	**AgL**
		mg/L	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
	Middle Devil's Canyon	0		0							
	Lower Devil's Canyon	0		0							
	Upper Queen Creek	1		0							
	Lower Queen Creek	1		0							
	Mineral Creek	1		0							
Mercury		**0.002 T**		**0.280 T**	**0.280 T**	**0.0024 D**	**0.00001 D**	**0.005 D**			**0.010 T**
	Upper Devil's Canyon	0		0		0	29	0			0
	Middle Devil's Canyon	0		0		0	27	0			0
	Lower Devil's Canyon	0		0		0	9	0			0
	Upper Queen Creek	0		0		0	20	0			0
	Lower Queen Creek	0		0	0	0	6	0			0
	Mineral Creek	0		0	0	0	6	0			0
Nickel		**0.210 T**	**0.511 T**	**28.000 T**	**28.000 T**						
	Upper Devil's Canyon	0	0	0		0	5				
	Middle Devil's Canyon	0	0	0		0	0				
	Lower Devil's Canyon	0	0	0		0	2				
	Upper Queen Creek	0	0	0		0	0		0	0	
	Lower Queen Creek	0	0	0	0	0	1				
	Mineral Creek	0	0	0	0	0	0				
Nitrate*		**10 T**		**3,733.333**							
	Upper Devil's Canyon	0		0							
	Middle Devil's Canyon	0		0							
	Lower Devil's Canyon	0		0							
	Upper Queen Creek	0		0							
	Lower Queen Creek	0		0							
	Mineral Creek	0		0							
Nitrite*		**1 T**		**233.333**							
	Upper Devil's Canyon	1		0							
	Middle Devil's Canyon	1		0							
	Lower Devil's Canyon	0		0							
	Upper Queen Creek	0		0							
	Lower Queen Creek	0		0							
	Mineral Creek	0		0							
Nitrate + Nitrite		**10 T**									
	Upper Devil's Canyon	0									
	Middle Devil's Canyon	0									

		Number of Exceedances by Major Stream System, for Arizona Surface Water Quality Standards									
PARAMETER	**Stream System**	**DWS**	**FC**	**PBC**	**FBC**	**A&Ww Acute**	**A&Ww Chronic**	**A&We Acute**	**A&W edw Acute**	**A&W edw Chronic**	**AgL**
		mg/L	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
	Lower Devil's Canyon	0									
	Upper Queen Creek	0									
	Lower Queen Creek	0									
	Mineral Creek	0									
Radium 226 + Radium 228		**5 pCi/L**									
	Upper Devil's Canyon	0									
	Middle Devil's Canyon	0									
	Lower Devil's Canyon	0									
	Upper Queen Creek	0									
	Lower Queen Creek	0									
	Mineral Creek	0									
Selenium		**0.050 T**	**0.667 T**	**4.667 T**	**4.667 T**		**0.002 T**	**0.033 T**			**0.050 T**
	Upper Devil's Canyon	0	0	0	0		26	0			0
	Middle Devil's Canyon	0	0	0	0		21	0			0
	Lower Devil's Canyon	0	0	0	0		7	0			0
	Upper Queen Creek	0	0	0	0		17	0			0
	Lower Queen Creek	0	0	0	0		1	0			0
	Mineral Creek	0	0	0	0		4	0			0
Silver		**0.035 T**	**8.000 T**	**4.667 T**	**4.667 T**						
	Upper Devil's Canyon	0	0	0	0	18					
	Middle Devil's Canyon	0	0	0	0	1					
	Lower Devil's Canyon	0	0	0	0	13					
	Upper Queen Creek	0	0	0	0	0					
	Lower Queen Creek	0	0	0	0	1					
	Mineral Creek	0	0	0	0	0					
Thallium		**0.002 T**	**0.001 T**	**0.075 T**	**0.075 T**	**0.700 D**	**0.150 D**		**0.700 D**	**0.150 D**	
	Upper Devil's Canyon	21	38	0	0	0	0		0	0	
	Middle Devil's Canyon	17	34	0	0	0	0		0	0	
	Lower Devil's Canyon	7	9	0	0	0	0		0	0	
	Upper Queen Creek	12	34	0	0	0	0		0	0	
	Lower Queen Creek	1	7	0	0	0	0		0	0	
	Mineral Creek	1	27	0	0	0	0		0	0	
Uranium		**0.030 D**		**2.8 T**	**2.8 T**						
	Upper Devil's Canyon	0		0	0						
	Middle Devil's Canyon	0		0	0						
	Lower Devil's Canyon	0		0	0						

		Number of Exceedances by Major Stream System, for Arizona Surface Water Quality Standards									
PARAMETER	**Stream System**	**DWS**	**FC**	**PBC**	**FBC**	**A&Ww Acute**	**A&Ww Chronic**	**A&We Acute**	**A&W edw Acute**	**A&W edw Chronic**	**AgL**
		mg/L	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
	Upper Queen Creek	0		0	0						
	Lower Queen Creek	0		0	0						
	Mineral Creek	0		0	0						
Zinc		**2.100 T**	**5.106 T**	**28.0000 T**	**28.0000 T**						**25.000 T**
	Upper Devil's Canyon	0	0	0	0	0	0				0
	Middle Devil's Canyon	0	0	0	0	0	0				0
	Lower Devil's Canyon	0	0	0	0	0	0				0
	Upper Queen Creek	0	0	0	0	0	0		0	0	0
	Lower Queen Creek	0	0	0	0	0	0				0
	Mineral Creek	0	0	0	0	0	0				0
E. coli[†]			**235 cfu/100 ml**	**575 cfu/100 ml**							
	Upper Devil's Canyon		3	3							
	Middle Devil's Canyon		1	1							
	Lower Devil's Canyon		0	0							
	Upper Queen Creek		1	1							
	Lower Queen Creek		0	0							
	Mineral Creek		0	0							

Note: A&We = aquatic and wildlife ephemeral warm water; A&W edw = aquatic and wildlife (effluent-dependent waters); A&Ww = aquatic and wildlife warm water resource; AgL = agricultural livestock watering; DWS = drinking water standard; FBC = full body contact; FC = fish consumption; ND = no data; PBC = partial body contact;
Units: cfu/100 ml = colony-forming units per 100 milliliters; D = dissolved; mg/L = milligrams per liter; pCi/l = picocuries per liter; T = total

* Water quality standards based on dissolved concentrations, but nitrate, nitrite, and manganese exceedances determined based on total concentrations as that was all that was available.

[†] E. coli data as reported are in units inconsistent with standards

The analyses in section 3.7.2 rely on Arizona surface water and aquifer water quality standards as a comparison to provide context to modeled water quality results. Standards vary by use and in some cases, by hardness. For reference, table N-5 summarizes all numeric surface water and groundwater quality standards (Arizona Administrative Code, R18-11 Article 1), and which standards are applicable to the water bodies of interest.

Table N-5. Summary of numeric Arizona surface water and aquifer quality standards

	A&Ww Chronic	**A&Ww Acute**	**A&We**	**FBC**	**PBC**	**FC**	**AgI**	**AgL**	**Surface Water Standard for Most Restrictive Use (Queen Creek)**	**Surface Water Standard for Most Restrictive Use (Gila River at Donnelly Wash)**	**Surface Water Standard for Most Restrictive Use (Gila River at Dripping Spring Wash)**	**Surface Water Standard for Most Restrictive Use (Ephemeral Tributaries)**	**Aquifer Water Quality Standard**
Gila River	X	X		X		X	X	X					
Queen Creek	X	X		X		X		X					
Donnelly Wash, Potts Canyon, Roblas Canyon, Silver King Wash, Dripping Spring Wash			X		X								
Constituents with Numeric Standards													
Antimony	0.030	0.088	-	0.747	0.747	0.640	-	-	0.030	0.030	0.030	0.747	0.006

	A&Ww Chronic	A&Ww Acute	A&We	FBC	PBC	FC	AgI	AgL	Surface Water Standard for Most Restrictive Use (Queen Creek)	Surface Water Standard for Most Restrictive Use (Gila River at Donnelly Wash)	Surface Water Standard for Most Restrictive Use (Gila River at Dripping Spring Wash)	Surface Water Standard for Most Restrictive Use (Ephemeral Tributaries)	Aquifer Water Quality Standard
Arsenic	0.150	0.340	0.440	0.030	0.280	0.080	2	0.2	0.030	0.030	0.030	0.280	0.05
Barium	-	-	-	98	98	-	-	-	98	98	98	98	2
Beryllium	0.0053	0.065	-	1.867	1.867	0.084	-	-	0.0053	0.0053	00053	1.867	0.004
Boron	-	-	-	186.667	186.667	-	1	-	1	1	1	186.667	-
Cadmium*	-	-	-	0.7	0.7	0.084	0.05	0.05	0.0051	0.0049	0.0043	0.2175	0.005
- At hardness = 242 mg/L	0.0043	0.0111	0.1681	-	-	-	-	-	-	-	-	-	-
- At hardness = 290 mg/L	0.0049	0.0135	0.2045	-	-	-	-	-	-	-	-	-	-
- At hardness = 307 mg/L	0.0051	0.0144	0.2175	-	-	-	-	-	-	-	-	-	-
- At hardness = 400 mg/L	0.0062	0.0191	0.2895	-	-	-	-	-	-	-	-	-	-
Chromium, Total	-	-	-	-	-	-	1	1	1	1	1	-	0.1
Copper*	-	-	-	1.3	1.3	-	5	0.5	0.0234	0.0222	0.0191	0.0669	-
- At hardness = 242 mg/L	0.0191	0.0308	0.0535	-	-	-	-	-	-	-	-	-	-
- At hardness = 290 mg/L	0.0222	0.0366	0.0634	-	-	-	-	-	-	-	-	-	-
- At hardness = 307 mg/L	0.0234	0.0386	0.0669	-	-	-	-	-	-	-	-	-	-
- At hardness = 400 mg/L	0.0293	0.0495	0.0859	-	-	-	-	-	-	-	-	-	-
Fluoride	-	-	-	140	140	-	-	-	140	140	140	140	4
Iron	1	-	-	-	-	-	-	-	1	1	1	-	-
Lead*	-	-	-	0.015	0.015	-	10	0.1	0.0083	0.0078	0.0065	0.015	0.05
- At hardness = 242 mg/L	0.0065	0.1665	0.3514	-	-	-	-	-	-	-	-	-	-
- At hardness = 290 mg/L	0.0078	0.2013	0.4248	-	-	-	-	-	-	-	-	-	-
- At hardness = 307 mg/L	0.0083	0.2136	0.4508	-	-	-	-	-	-	-	-	-	-
- At hardness = 400 mg/L	0.0109	0.2808	0.5926	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	130.667	130.667	-	10	-	10	10	10	130.667	-
Mercury	0.0024	0.00001	0.005	0.28	0.28	-	-	0.010	0.00001	0.00001	0.00001	0.005	0.002
Nickel*	-	-	-	28	28	4.6	-	-	0.1343	0.1280	0.1098	10.7379	0.1
- At hardness = 242 mg/L	0.1098	0.9887	8.7803	-	-	-	-	-	-	-	-	-	-
- At hardness = 290 mg/L	0.1280	1.1523	10.2327	-	-	-	-	-	-	-	-	-	-
- At hardness = 307 mg/L	0.1343	1.2092	10.7379	-	-	-	-	-	-	-	-	-	-
- At hardness = 400 mg/L	0.1680	1.5126	13.4319	-	-	-	-	-	-	-	-	-	-
Nitrate	-	-	-	3,733.333	3,733.333	-	-	-	3,733.333	3,733.333	3,733.333	3,733.333	10
Nitrite	-	-	-	233.333	233.333	-	-	-	233.333	233.333	233.333	233.333	1
Selenium	0.002	-	0.033	4.667	4.667	0.667	0.020	0.050	0.002	0.002	0.002	0.033	0.05
Silver*	-	-	-	4.667	4.667	8	-	-	0.0221	0.0201	0.0147	0.0221	-
- At hardness = 242 mg/L	-	0.0147	0.0147	-	-	-	-	-	-	-	-	-	-
- At hardness = 290 mg/L	-	0.0201	0.0201	-	-	-	-	-	-	-	-	-	-
- At hardness = 307 mg/L	-	0.0221	0.0221	-	-	-	-	-	-	-	-	-	-
- At hardness = 400 mg/L	-	0.0349	0.0349	-	-	-	-	-	-	-	-	-	-

	A&Ww Chronic	A&Ww Acute	A&We	FBC	PBC	FC	AgI	AgL	Surface Water Standard for Most Restrictive Use (Queen Creek)	Surface Water Standard for Most Restrictive Use (Gila River at Donnelly Wash)	Surface Water Standard for Most Restrictive Use (Gila River at Dripping Spring Wash)	Surface Water Standard for Most Restrictive Use (Ephemeral Tributaries)	Aquifer Water Quality Standard
Thallium	0.15	0.7	-	0.075	0.075	0.0072	-	-	0.0072	0.0072	0.0072	0.075	0.002
Uranium	-	-	-	2.8	2.8	-	-	-	2.8	2.8	2.8	2.8	-
Zinc*	-	-	-	280	280	5.106	10	25	0.3031	0.2888	0.2477	2.8758	-
- At hardness = 242 mg/L	0.2477	0.2477	2.3508	-	-	-	-	-	-	-	-	-	-
- At hardness = 290 mg/L	0.2888	0.2888	2.7403	-	-	-	-	-	-	-	-	-	-
- At hardness = 307 mg/L	0.3031	0.3031	2.8758	-	-	-	-	-	-	-	-	-	-
- At hardness = 400 mg/L	0.3792	0.3792	3.5985	-	-	-	-	-	-	-	-	-	-
pH	6.5–9.0	6.5–9.0	6.5–9.0	6.5–9.0	6.5–9.0	-	4.5–9.0	6.5–9.0	6.5–9.0	6.5–9.0	6.5–9.0	6.5–9.0	-
Constituents without Numeric Standards													
Sulfate	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Dissolved Solids	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Notes: A&Ww = Aquatic and Wildlife-Warmwater; A&We = Aquatic & Wildlife-Ephemeral; FBC = Full Body Contact; PBC = Partial Body Contact; FC = Fish Consumption; AgI = Agricultural-Irrigation; AgL = Agricultural-Livestock Watering

Standards for A&Ww and A&We are for dissolved concentrations, except for selenium which is for total concentrations. All other standards are for total concentrations.

All values shown in milligrams per liter.

* These constituents have surface water standards that vary depending on hardness, with a maximum hardness of 400 mg/L. The four hardness values shown were chosen as follows:

- 242 mg/L represents the hardness for the Gila River at Dripping Spring Wash, based on a sample collected November 19, 2018, calculated from a calcium concentration of 64.8 mg/L and a magnesium concentration of 19.4 mg/L. This hardness was used for ephemeral tributaries as well.
- 290 mg/L represents the hardness for the Gila River at Donnelly Wash, based on a sample collected November 13, 2018, calculated from a calcium concentration of 77.7 mg/L and a magnesium concentration of 23.4 mg/L
- 307 mg/L represents the hardness for Queen Creek at Whitlow Ranch Dam, based on the lowest calculated hardness from five samples (August 25, 2017), calculated from a calcium concentration of 87.5 mg/L and a magnesium concentration of 21.4 mg/L
- 400 mg/L represents the maximum hardness that can be used to calculate surface water standards. Many of the geochemical samples (synthetic precipitate leaching procedure [SPLP] results, for instance) exceed this hardness.

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APPENDIX O. DRAFT PROGRAMMATIC AGREEMENT REGARDING COMPLIANCE WITH THE NHPA ON THE RESOLUTION COPPER PROJECT AND SOUTHEAST ARIZONA LAND EXCHANGE

PROGRAMMATIC AGREEMENT
AMONG THE
USDA FOREST SERVICE TONTO NATIONAL FOREST,
ARIZONA STATE HISTORIC PRESERVATION OFFICER,
THE ADVISORY COUNCIL ON HISTORIC PRESERVATION,
REGARDING
COMPLIANCE WITH THE NATIONAL HISTORIC PRESERVATION ACT
ON THE RESOLUTION COPPER PROJECT
AND SOUTHEAST ARIZONA LAND EXCHANGE
NEAR SUPERIOR, ARIZONA

1. WHEREAS, Resolution Copper Mining, LLC (Resolution Copper), proposes to conduct mining operations on land administered by the U.S. Department of Agriculture (USDA) Forest Service (Forest Service) Tonto National Forest (TNF), land administered by the Arizona State Land Department (ASLD), and private land near Superior, Pinal County, Arizona, based on a General Plan of Operations (GPO); and

2. WHEREAS, the GPO details Resolution Copper's proposed mining operations as consisting of five locations: East Plant Site, West Plant Site, Tailings Facility and Tailings Corridor, Magma Arizona Railroad Company (MARRCO) corridor, and Filter Plant and Loadout Facility, with the five locations presented in the GPO estimated to disturb a total of 6,951 acres of TNF, ASLD, and private land within a 13,713-acre project area; and

3. WHEREAS, the GPO includes the mining and processing (concentrator and filter plant/rail loadout) operations, transportation corridors for conveying concentrate and tailings, utility corridors, and a tailings facility; and

4. WHEREAS, TNF and Resolution Copper have developed alternatives for comparative analysis and compliance with the National Environmental Policy Act (NEPA, 42 United States Code [U.S.C.] 4321 et seq.) that may include transportation and utility corridors, tailings storage facilities, and a Filter Plant and Loadout Facility on U.S. Department of the Interior Bureau of Land Management (BLM) Tucson Field Office, TNF, ASLD, and private lands; and

5. WHEREAS, on December 12, 2014, Congress passed the Southeast Arizona Land Exchange and Conservation Act (Section 3003 of Public Law 113-291), which authorizes a land exchange between the U.S. government (U.S. Department of Agriculture and U.S. Department of the Interior) and Resolution Copper. Under the exchange, Resolution Copper will receive 2,422 acres of land known as the Oak Flat Federal Parcel (Selected Lands) managed by the Forest Service in exchange for 5,376 acres of private land (Offered Lands) owned by Resolution Copper consisting of eight parcels: Apache Leap South End Parcel (142 acres) near Superior in Pinal County; Tangle Creek Parcel (148 acres) in Yavapai County; Turkey Creek Parcel (147 acres) in Gila County; Cave Creek parcel (149 acres) near Cave Creek in Maricopa County; East Clear Creek Parcel (640 acres) near Payson in Coconino County; Lower San Pedro River Parcel (3,050 acres) near Mammoth in Pinal County; Appleton Ranch Parcel (940 acres) near Elgin in Santa Cruz County; and Dripping Springs Parcel (160 acres) near Kearny in Gila and Pinal Counties; and

6. WHEREAS, both the land exchange mandated by the Southeast Arizona Land Exchange and Conservation Act and the approval of the GPO submitted by Resolution Copper constitute a Federal undertaking (Undertaking) as defined by 36 Code of Federal Regulations (CFR) 800.16(y) which requires compliance with Section 106 of the National Historic Preservation Act (NHPA); and

7. WHEREAS, the TNF is the lead agency for the Section 106 compliance process; and

8. WHEREAS, the TNF has consulted with the Arizona State Historic Preservation Officer (SHPO) pursuant to 36 CFR 800.6 regarding the resolution of adverse effects and SHPO is a Signatory to this Programmatic Agreement (Agreement); and

9. WHEREAS, the BLM Tucson Field Office is considering issuing Federal authorizations related to the mitigation, construction, operation, maintenance, and reclamation of portions of the proposed Undertaking that must comply with Section 106 of the NHPA and applicable portions of the Archaeological Resources Protection Act (ARPA; 16 U.S.C. 470aa–470mm), the American Indian Religious Freedom Act (42 U.S.C. 1996), and the Native American Graves Protection and Repatriation Act (NAGPRA; 25 U.S.C. 3001 et seq.), and the BLM is participating as an Invited Signatory to this Agreement; and

10. WHEREAS, the Arizona State Museum (ASM) has been invited to participate because it has mandated authority and responsibilities under the Arizona Antiquities Act, Arizona Revised Statutes (ARS) 41-841 et seq., that apply to that portion of the Undertaking on State land, and mandated authority and responsibilities under ARS 41-865 that apply to that portion of the Undertaking on private land; and

11. WHEREAS, any testing and data recovery necessitated by the Undertaking, located on State land, must be permitted by the ASM pursuant to ARS 41-842, and ASM is an Invited Signatory to this Agreement; and

12. WHEREAS, the U.S. Army Corps of Engineers (USACE) may be responsible for issuing a Clean Water Act Section 404 permit for the Undertaking, and recognizes the TNF as the lead Federal agency, and is an Invited Signatory to this Agreement under 36 CFR 8002(a)(2) to act on its behalf under Section 106, and

13. WHEREAS, the Undertaking includes State Trust land administered by the ASLD, and the ASLD may use provisions of this Agreement to address the applicable requirements of the Arizona State Historic Preservation Act (ARS 41-861 et seq.) on State land in Arizona, and the ASLD is an Invited Signatory to this Agreement; and

14. WHEREAS, Resolution Copper, as an applicant and consulting party, is entitled to participate in the Section 106 consultation process under 36 CFR 800.2(c)(4) and in the development of this Agreement per 36 CFR 800.6(a)(2), because of its obligations and duties to implement the mitigation measures as required under both the Southeast Arizona Land Exchange Act (Sec. 3003) and the Agreement, and is an Invited Signatory under 36 CFR 800.6(c)(2)(iii); and

15. WHEREAS, the TNF has assumed the lead Federal agency status for government-to-government consultation with Indian Tribes, and has the delegated authority of the Secretary of Agriculture to implement the Southeast Arizona Land Exchange including the mandate to "*consult with Resolution Copper and seek to find mutually acceptable measures to—(i) address the concerns of the affected Indian tribes; and (ii) minimize the adverse effects on the affected Indian tribes resulting from mining and related activities on the Federal land conveyed to Resolution Copper under this section.* (Sec. 3003(c)(3))"; and

16. WHEREAS, during project initiation in 2008, the Forest Service initiated consultation with the Tribes they regularly consult—the Fort McDowell Yavapai Nation, the Gila River Indian Community, the Hopi Tribe, the Mescalero Apache Tribe, the Pueblo of Zuni, the Salt River Pima-Maricopa Indian

Community, the San Carlos Apache Tribe, the Tonto Apache Tribe, the White Mountain Apache Tribe, the Yavapai-Apache Nation, and the Yavapai Prescott Indian Tribe; and

17. WHEREAS, additional locations have been proposed for the permanent disposal and management of the mine tailings, including the alternative on BLM land, and BLM routinely consults with four additional Tribes—the Ak-Chin Indian Community, the Fort Sill Apache Tribe, the Pascua Yaqui Tribe, and the Tohono O′odham Nation—that may also have traditional and/or cultural interests within the expanded environmental impact statement (EIS) analysis area; and

18. WHEREAS, the TNF has invited all 15 Tribes to participate as concurring parties in this Agreement, and additional Tribes may be added and/or removed at their request as the consultation progresses and as the project scope and area of potential effects (APE) are finalized; and

19. WHEREAS, TNF has determined due to the scale and complexity of the Undertaking that it will develop a Programmatic Agreement, pursuant to 36 CFR 800.14(b)(1), to address further identification requirements and resolution of adverse effects; and

20. WHEREAS, in accordance with 36 CFR 800.6(a)(1), the TNF notified the Advisory Council on Historic Preservation (ACHP) of its adverse effect finding, provided the specified documentation, and invited the ACHP to participate in consultation (using the ACHP's e-file notification system on December 7, 2017), and the ACHP has chosen to participate in this Agreement (letter dated December 21, 2017); and

21. WHEREAS, the proposed action and all alternatives encompasses 40,988 acres and multiple land jurisdictions as shown on figure 1 in Appendix A, and consists of the Selected Lands leaving the jurisdiction of the Federal Government (2,422 acres) per Section 3003 of Public Law 113-291, and the project components and all alternatives associated with the Resolution Copper GPO (38,566 acres not including those also within the land exchange); and

22. WHEREAS, the direct APE for ground disturbance will consist of the Oak Flat Federal Parcel and the GPO with the selected tailings alternative; and

23. WHEREAS, the indirect APE consists of a 2-mile buffer around the direct APE and its alternatives with multiple land jurisdictions as shown on figure A.1 in Appendix A; and

24. WHEREAS, the atmospheric APE including visual and auditory effects and the cumulative APE together consist of a 6-mile buffer around the direct APE and its alternatives with multiple land jurisdictions as shown on figure A.1 in Appendix A; and

25. WHEREAS, this project is located within the adjudicated territory of the Salt and Gila River Tribes; however, this landscape is important to many tribes and has been for many generations. It continues to this day to be utilized for cultural and spiritual purposes.

26. WHEREAS, the Forest has consulted regularly with eleven federally-recognized tribes that are culturally affiliated with the lands that stand to be affected. Tribes have had the opportunity to be active in the consultation, review and comment processes of the project. No tribe supports the desecration/destruction of ancestral sites. Places where ancestors have lived are considered alive and sacred. It is a tribal cultural imperative that these places should not be disturbed for any reason. Continued access to the land and all its resources is necessary and should be accommodated for present and future generations. Participation in the design of this destructive activity has caused considerable emotional stress and brings direct harm to the traditional way of life to tribes; however, it is still deemed necessary

to ensure ancestral homes and ancestors receive the most thoughtful and respectful treatment possible. These eleven tribes represent four cultural groups with ties to the traditional homelands: Akimel O'Odham (Gila River Indian Community, Salt River Pima-Maricopa Indian Community), Puebloan (Hopi Tribe, Pueblo of Zuni), Apache (Mescalero Apache Tribe, San Carlos Apache Tribe, Tonto Apache Tribe, White Mountain Apache Tribe, Yavapai-Apache Nation), and Yavapai (Fort McDowell Yavapai Nation, Yavapai Apache Nation, Yavapai Prescott Indian Tribe. Consultation has identified two distinct culturally-affiliated treatments of Native American human remains and cultural items, based on whether they are prehistoric or protohistoric/historic in age. These two distinctions will determine specific treatment protocols for ancestral sites and remains.

27. WHEREAS, 721 archaeological sites (both prehistoric and historic), one traditional cultural property (TCPs), and 11 places of traditional religious and cultural significance have been identified to date within the direct APE, with surveys ongoing (see figures in Appendix B for identified historic properties and previous survey report references); and

28. WHEREAS, the TNF, in consultation with the SHPO, has determined that 523 archaeological sites are eligible for the National Register of Historic Places (NRHP) under Criterion D, as well as one TCP that has been listed in the NRHP under Criteria A, B, C, and/or D; and

29. WHEREAS, additional inventory efforts needed to completely identify cultural resources within the direct, atmospheric, and indirect APEs will likely add additional NRHP-eligible historic properties, and TNF will continue to seek concurrence on its determinations of eligibility and effect from the SHPO as further cultural resource inventories are completed for the remainder of the project; and

30. WHEREAS, for portions of the direct APE that have not already been surveyed for cultural resources, the TNF proposes to phase any remaining identification and evaluation needs, pursuant to 36 CFR 188.4(b)(2), I, and complete all inventory in the summer of 2019; and

31. WHEREAS, because 118 archaeological sites in the APE shown in Appendix B are currently unevaluated for listing on the NRHP, and additional cultural resources may be identified as surveys continue; and

32. WHEREAS, the TNF has determined that the Undertaking will result in adverse effects to historic properties including TCPs that have been determined eligible for the NRHP under Criteria A, B, C, and/or D, and has consulted with the SHPO, pursuant to 36 CFR 800, regarding the regulations implementing Section 106 of the NHPA. Adverse effects include, but are not limited to, transfer of historic properties out of federal ownership, physical destruction and/or damage due to ground disturbance, and changes to setting; and

33. WHEREAS, the SHPO is authorized to enter into this Agreement in its role of advising and assisting Federal agencies in carrying out their Federal responsibilities under Sections 101 and 106 of the NHPA, at 36 CFR 800.2(c)(l)(i) and 36 CFR 800.6(b), and to fulfill its state historic preservation responsibilities under ARS 41-511.04(D)(4); and

34. WHEREAS, the TNF is committed to respecting the sensitive and private nature of tribal traditional knowledge; and,

35. WHEREAS, a comprehensive ethnographic and ethnohistoric study regarding places of traditional or cultural importance to Indian Tribes was completed (Hopkins et al. 2015) and the Forest Service has implanted a tribal monitoring program to identify historic properties in the APE; and

36. WHEREAS, the Tribes have stated that the APE is within a landscape important to many Tribes and has been for many generations, and continues to this day to be utilized for cultural and spiritual purposes; no Tribe supports the desecration/destruction of ancestral sites because places where ancestors have lived are considered alive and sacred, it is a tribal cultural imperative that these places should not be disturbed for any reason, and continued access to the land and all its resources is necessary and should be accommodated for present and future generations; participation in the design of this destructive activity has caused considerable emotional stress and brings direct harm to the traditional way of life to Tribes; however, it is still deemed necessary to ensure ancestral homes and ancestors receive the most thoughtful and respectful treatment possible; and

37. WHEREAS, the Tribes have declared that they consider adverse effects from the Undertaking to be unmitigable and, even if they sign this Agreement, they consider the mitigation in the document as being insufficient; and

38. WHEREAS, the TNF has used and coordinated the NEPA public participation requirements to assist the Federal agencies in satisfying the public involvement requirements under Section 106 pursuant to 36 CFR 800.2(d)(3) through involving interested parties in the NEPA process, providing project information to the public, giving them opportunities to comment on the project through public scoping and alternatives meetings, and will continue to disseminate information through public meetings and will afford the public opportunities to comment on the EIS throughout the drafting process; and

39. WHEREAS, the Signatories, Invited Signatories, and concurring parties of this Agreement will be referred to as Consulting Parties in this Agreement; and

40. WHEREAS, the TNF, in consultation with all Consulting Parties, will explore both traditional and alternative mitigation measures that are in the public interest and provide the best use of available funding and resources as it seeks to resolve adverse effects to historic properties; and

41. WHEREAS, definitions used in this Agreement are outlined in Appendix C of this document; and

NOW THEREFORE, the TNF, SHPO, and the ACHP agree that this Agreement shall be implemented in accordance with the following stipulations to address the effects of the Undertaking on historic properties.

STIPULATIONS

The TNF shall ensure that the following stipulations are carried out:

I. ROLES AND RESPONSIBILITIES

A. TONTO NATIONAL FOREST

1. The signatories agree that the TNF is the lead Federal agency for administering and implementing this Agreement with responsibilities that include:
    - consulting and coordinating with the Consulting Parties;
    - carrying out their responsibilities in accordance with applicable laws and authorities ensuring that all Signatories and Invited Signatories fulfill their obligations;
    - making Determinations of NRHP eligibility and Determinations of Effect for cultural resources on TNF land;
    - overseeing all cultural resource management work in coordination with appropriate land-managing agencies including any additional historic properties inventory, and drafting and/or assembling all submissions to the Consulting Parties, including the additional historic properties inventory reports (if needed), historic property treatment plans (HPTPs), and the preliminary and final data recovery reports;
    - seeking SHPO concurrence with agency decisions as required by 36 CFR 800 relating to the treatment of historic properties; and
    - implementing the HPTP(s).
2. The TNF will use the principles in the Forest Service policy, *Consultation with Indian Tribes and Alaska Native Corporations* (Forest Service Manual 1563.1) to guide its tribal consultation procedures and relationships. The TNF shall, in compliance with Section 3003(c)(3) of the Southeast Arizona Land Exchange Act, engage as the lead agency for the following:
    a. government-to-government consultation with affected Indian Tribes concerning issues of concern to the affected Indian Tribes related to the land exchange.
    b. consultations with Resolution Copper to find mutually acceptable measures that: (i) address the concerns of the affected Indian Tribes; and (ii) minimize the adverse effects on properties significant to Indian Tribes resulting from mining and related activities on the Federal land conveyed to Resolution Copper.

B. RESOLUTION COPPER MINING, LLC

1. Per the Carl Levin and Howard P. 'Buck' McKeon National Defense Authorization Act for Fiscal Year 2015 (NDAA 2015) § 3003, the signatories agree that Resolution Copper "shall agree to pay, without compensation, all costs that are associated with the land exchange and any environmental review document." As part of the environmental review process, Resolution Copper is financially responsible for all work that is associated with complying with the NHPA and Arizona State Historic Preservation Act (ARS 41-861 et seq. and ARS 41-865).
    a. This includes, but is not limited to: inventories of archaeological sites, historic buildings and structures, and TCPs within the APE; evaluation of all cultural resources for inclusion in the NRHP; determination of the effects of the Undertaking on historic properties in consultation with the SHPO and Consulting Parties; and creation and implementation of the HPTPs and any mitigation measures (i.e., data recovery) for the

historic properties within the APE as agreed to by the signatories to this Agreement through the consultation process.

C. BUREAU OF LAND MANAGEMENT

1. For the purposes of the Undertaking, the BLM shall work in coordination with TNF for both agencies to comply with Section 106 of the NHPA. The BLM retains authority for the management of all resources and historic properties on BLM lands (Alternative 5). The BLM will participate only in those activities related to its jurisdiction or decision-making authorities, unless otherwise invited by the TNF. The BLM's status as a Cooperating Agency and Invited Signatory to this Agreement does not affect its independent responsibilities under applicable Federal statutes and regulations that may pertain to the agency's special expertise and/or jurisdictional authorities.

2. If an alternative that does not involve BLM-administered land becomes the selected alternative, the BLM's responsibilities and involvement in this Agreement shall cease.

D. U.S. ARMY CORPS OF ENGINEERS

1. For purposes of this undertaking, USACE shall work in coordination with TNF to comply with Section 106 of the NHPA. USACE will only participate in those activities within their defined permit area related to Clean Water Act Section 404 permitting per 33 CFR Part 325 Appendix C (1)(g). This also extends to compensatory mitigation activities, yet to be specifically defined, that may be required of the Permittee, Resolution Copper.

2. If an alternative that does not require a Section 404 permit becomes the selected alternative, USACE's responsibilities and involvement in this Agreement shall cease.

E. ARIZONA STATE LAND DEPARTMENT

1. ASLD, in coordination with the TNF and the SHPO, will be responsible for reviewing all cultural resources work completed on State Trust land, including inventories, determinations of eligibility and effect, HPTPs, and the preliminary and final data recovery reports. ASLD shall work in close coordination with TNF to complete the Section 106 process and ensure compliance with the Arizona State Historic Preservation Act (ARS 41-861 et seq.). The ASLD shall retain responsibility for the management of cultural resources that are located on ASLD land. ASLD will participate only in those activities in those areas related to its jurisdiction or decision-making authorities, unless otherwise invited by the TNF.

F. ARIZONA STATE MUSEUM

1. ASM will be responsible for reviewing proposed and completed archaeological work in accordance with ARS 41-841 et seq., Rules Implementing ARS 15-1631 and 41-841 et seq., ARS 41-865, Rules Implementing ARS 41-865, and ASM policy and procedures.

II. PROFESSIONAL QUALIFICATIONS AND PERMITS

A. For all cultural resource-related activities, Resolution Copper shall ensure that its cultural resources contractors use qualified historic preservation professionals that meet the Secretary of the Interior's standards (48 Federal Register 44716), as per Section 112(a)(1)(A) of the NHPA and 36 CFR 800.2(a)(1).

B. For cultural resource-related activities on Federal land, Forest Service and/or BLM shall ensure that all agency personnel responsible for historic properties shall meet Professional Qualification Standards as defined by the Office of Personnel Management: Heritage Program Professionals (GS-170 historian, GS-190 anthropologist, and GS-193 archaeologist; see definition in Appendix C). For work on Forest Service land, only Heritage Program Professionals may make management recommendations and review and recommend approval of heritage work done by Forest Service employees, contractors, and volunteers. For work on BLM land, only BLM-designated Heritage Program Specialists make recommendations and review and recommend approval of heritage work done by BLM employees, contractors, and volunteers.

C. For cultural resource-related activities on Federal land, the Forest Service and/or the BLM shall ensure that all necessary permits and permissions are obtained from the appropriate land-managing agency prior to any fieldwork, including ARPA permits for any ground-disturbing work.

D. For all cultural resource-related activities occurring on State land, Resolution Copper shall ensure that its cultural resources contractors obtain an Arizona Antiquities Act Permit from the ASM prior to conducting archaeological activities on State land pursuant to ARS 41-841 et seq. Resolution Copper shall also ensure that its cultural resources contractors obtain a burial agreement from the ASM prior to all ground-disturbing activity on State and private lands pursuant to Rules Implementing ARS 41-844 and 41-865.

E. In recognition of the special expertise of tribal experts concerning properties of traditional religious and/or cultural significance, the standards of 36 CFR 61 will not apply to tribally designated representatives carrying out identification and evaluation efforts for such properties of tribal interest.

III. COORDINATION WITH OTHER FEDERAL REVIEWS

A. Any Federal agency that will provide approvals or assistance for the Undertaking may comply with the agency's Section 106 responsibilities by agreeing to the terms of this Agreement in writing and sending copies of such written agreement to all the parties of this Agreement.

B. In the event that another Federal agency not initially a party to or subject to this Agreement receives an application for funding/license/permit for the Undertaking as described in this Agreement, that agency may fulfill its Section 106 responsibilities by stating in writing it concurs with the terms of this Agreement and notifying TNF, the SHPO, and the ACHP that it intends to do so. In the event that an above Federal agency's application for funding/license/permit does not match the undertaking as described in this Agreement, that agency may complete a separate review to fulfill its Section 106 responsibilities or request of the signatories that the Agreement be amended to account for those changes in the undertaking.

IV. AREA OF POTENTIAL EFFECTS

A. **Direct effects**: The APE for direct effects will include the Selected Lands leaving Federal management under the land exchange and the project areas associated with the GPO. The APE for direct effects during construction, operations, and reclamation and will include all areas likely to be affected by such activities, as well as the Selected Lands (see Appendix A). The direct effects APE associated with the GPO will be modified as necessary to allow for adjustments in construction, operations, and access road placement to avoid, when possible, natural, cultural, or modern features such as outcrops, historic properties, petroglyph sites, and structures. The final acreage and layout of the APE will be dependent on which alternative is selected (see Appendix A).

Indirect effects: The APE for indirect effects shall be areas within 2 miles from any project component (including any access routes, facilities, and relocated facilities) or where consultation identifies a need to expand this APE in certain locations (see Appendix A).

Atmospheric effects: The APE for atmospheric effects (including visual and auditory) shall be areas within 6 miles from any project component (including any access routes, facilities, and relocated facilities) or the visual horizon, whichever is closer, or where consultation identifies a need to expand this APE in certain locations (see Appendix A).

The APEs may extend beyond the above definitions to encompass properties that have traditional religious and cultural importance, including TCPs or other geographically extensive historic properties such as trails, when effects have been determined through consultation with the SHPO and Consulting Parties to extend beyond this distance.

B. **Cumulative effects**: The APE for cumulative effects shall be the same as that for the direct, atmospheric, and indirect effects combined.

C. The Forest Service shall ensure that any modification of the APE will be done through consultation conducted among the Consulting Parties. The Forest Service shall notify the Signatories to the Agreement of any proposed modifications. Signatories, Invited Signatories, and Consulting Parties shall have 14 calendar days to respond to the proposed changes; if no response is received, the Forest Service will make a good-faith effort to contact the Signatories and, if no response is received, will proceed with the modifications. Modifications to the APE will not require an amendment to the Agreement.

V. TRIBAL CONSULTATION

A. Through government-to-government consultation with Indian Tribes, pursuant to 36 CFR 800.2(c)(2), TNF and other Federal land-managing agencies, as appropriate, have made and will continue to make a good-faith effort to identify properties that have traditional religious and cultural significance to one or more Indian Tribes and to determine whether they are NRHP-eligible historic properties. Tribal comments and concerns will be consolidated for consideration by the respective land-managing agency. All parties to this Agreement will respect any sites of traditional religious and cultural importance (NHPA 101(d)(6)(A)) and confidentiality concerns expressed by Indian Tribes to the extent allowed by law (see Stipulation XIV). The Signatories shall follow the regulations outlined in 36 CFR 800 Subpart B.

B. In compliance with Chapter 10, Consultation with Indian Tribes and Alaska Native Corporations of the Forest Service Handbook titled *American Indian and Alaska Native Relations Handbook* (FSH 1509.13), the TNF will continue to engage Indian Tribes in government-to-government consultation throughout the duration of the Undertaking through in-person meetings, telephone calls, and on-site field visits. Information and documents will be provided via mail, email, or in person.

C. In general, the TNF Forest Supervisor and Tribal Liaison at a minimum, often accompanied by Forest Service subject experts, offer to travel at least once per year to each Tribe culturally affiliated with TNF land to provide updates on ongoing or proposed projects within the TNF. Additional meetings with the associated cultural groups (Apache, Akimel O'odham, Puebloan, and Yavapai) are scheduled. At least once per year the Forest Service hosts an All Tribes Meeting to discuss the larger actions in this project (for example the Tribal Monitor Program, the HPTP, and this Agreement). The Forest Service consistently consults with Tribes while documents are in draft form and before they are finalized. Consultation with Tribes has repeatedly resulted in activities design (and redesign), document design (and redesign), field visits, and the creation of projects and programs. Examples of actions include sensitive plant monitoring for the magnetotelluric study at Oak Flat, Oak Flat listing to the NRHP, the Superior Area Ethnographic Study, activity component relocation to protect TCPs in the GPO, custom design of the Apache Leap Special Management Area, the identification of alternate mine tailings locations away from TCPs, the creation of the Tribal Monitor Program, archaeological site restoration with Tribes at Oak Flat, and the Emory Oak Restoration Program. Consultation will continue as needed throughout the lifetime of this project.

VI. IDENTIFICATION OF HISTORIC PROPERTIES

A. TNF shall ensure all of the Selected Lands, GPO project areas, and alternatives are surveyed for cultural resources prior to the Record of Decision as directed by Section 3003 of Public Law 113-291. Cultural resources inventory surveys conducted to date are shown in Appendix B. Separate inventories are being conducted with tribal monitors and/or tribal elder consultation to identify cultural resources significant to tribal peoples and TCPs within the Selected Lands, GPO project areas, and alternatives, in addition to the archaeological and historic building/structure inventory.

B. Surveys to date cover the portions of the APE that include the Oak Flat Federal Parcel, GPO project components (East Plant Site, West Plant Site, MARRCO Corridor, and Filter and Loadout Facility), and the proposed tailings locations for Alternatives 2, 3, 4, and 5. Additional survey is in progress for the Alternative 6 tailings location, pipeline routes for Alternatives 5 and 6, main 230-kilovolt power lines for the GPO and power line route for Alternative 6, and any remaining areas not covered in earlier surveys due to project adjustments, and is scheduled to be completed in the summer of 2019.

C. Identification of cultural resources has yet to be completed for the Skunk Camp Tailings location (Alternative 6), pipeline routes for Alternatives 5 and 6, main 230-kilovolt power lines for the GPO and power line route for Alternative 6, and any remaining areas not covered in earlier surveys due to project adjustments. Surveys of Alternative 6 and the pipeline/access routes to Alternatives 5 and 6 will be overseen by the Forest Service and will be completed in the summer of 2019.

D. If additional areas are identified that need cultural resources inventories due to necessary changes in the GPO after the signing of this Agreement, the TNF shall ensure that all inventories will be carried out in conformance with current professional standards and will consist of a 100% survey strategy.

E. The completed historic property inventories have included inventories for TCPs and places of traditional or cultural significance to Indian Tribes through a tribal monitoring program. Trained tribal monitors have worked both with the archaeological survey crews and independently to record places of traditional or cultural significance and identify those that would qualify as TCPs under Section 106 of the NHPA. Additional inventories, such as that for Skunk Camp, will include tribal monitor surveys for TCPs and places of traditional or cultural significance and will be supervised by the Forest Service. Due to the sensitive nature of these surveys, they will be reported on separately from the archaeological findings.

F. Per Federal and State guidelines, the draft inventory report(s) generated through this identification effort will be reviewed and revised in three steps:

1. The draft inventory report(s) will be first reviewed by both the TNF and the other appropriate land-managing agency (BLM or ASLD) for a 30-day comment and review period. Comments will then be incorporated into a revised draft report.
2. Once accepted by the agency's cultural resource specialist, the revised draft inventory reports and associated documentation will be submitted to all Consulting Parties for a 30-day review and comment period. The TNF will also submit the TNF's determinations of eligibility and effects to the SHPO along with revised draft report for a 30-day review and comment period.
3. The TNF will consider all comments received during this period, and a draft final inventory report will be produced that will be submitted to the Consulting Parties for a 30-day review period.

If the TNF does not receive a response from a Consulting Party during these review periods, the TNF will make a good-faith effort to contact the party by email and telephone. If, after a reasonable and good-faith effort to reach an unresponsive party, there is no response, the TNF will proceed to the next step prescribed by this Agreement (Stipulation VIII).

G. A Class I literature review of the 6-mile atmospheric APE for historic properties listed in or eligible for the NRHP under Criteria A, B, and/or C (properties where impacts to setting could alter the characteristics that make the property eligible for the NRHP) was completed in October 2018. No ground disturbance is planned outside the direct APE; therefore, properties eligible under Criterion D were not included. The search included records at the Forest Service, BLM, and on the AZSITE online database and identified 14 historic buildings, structures, or districts listed in the NRHP and 37 archaeological sites eligible for the NRHP.

H. A Class I literature review for the indirect APE will be conducted to identify historic properties which may be indirectly affected by the Undertaking. The Class I review will include archaeological sites, historic buildings and structures, historic districts, and TCPs. Information will be sought through records searches and consultation.

I. The Forest Service shall ensure that a single report will be prepared, detailing the results of both the Class I for the atmospheric APE and the Class I for the indirect APE. The report shall include contextual information, property types, and an overview of the effects of the Undertaking. The draft Class I report will be reviewed as set forth in the above Stipulation VI.F.

VII. TRIBAL MONITOR PROGRAM

In consultation with Indian Tribes, the request was heard by the Forest to employ "Tribal Monitors," to conduct pedestrian survey alongside archaeologists. Tribal Monitors function as traditional cultural specialists who have the ability to identify important resources on the landscape that are both archaeological and non-archaeological. Incorporating tribal members into data-gathering processes maximizes transparency and cooperation between the Forest Service and participating Tribes. In their own words, the Tribal Monitors consider themselves the "eyes and ears" of their communities. The TNF Tribal Monitor Program places an emphasis on providing the opportunity for tribal elders, traditional practitioners, and tribal leaders to visit locations identified by the monitors. Monitors working directly with traditional practitioners helps to ensure sites are being identified correctly and concerns are being discussed and recorded for the report. The Tribal Monitor reports will be reviewed by the agency decision maker to ensure tribal concerns are being considered. The program currently consists of 30 monitors; in response to tribal requests, a third training is scheduled for the summer of 2019.

VIII. EVALUATION OF HISTORIC PROPERTIES

A. The historic properties identified as of June 6, 2019, are listed in Appendix B. In total, 721 archeological sites have been recorded within the Oak Flat Federal Parcel, GPO project components, and the proposed tailings location for Alternatives 2, 3, 4, and 5. Of these, 523 sites have been determined eligible for the NRHP, and 86 sites have been determined not eligible for the NRHP. Another 118 sites are unevaluated against NRHP significance criteria. Two sites are exempt from Section 106 consultation because they are in-use gas pipelines, per the ACHP's *Exemption Regarding Historic Preservation Review Process for Projects Involving Natural Gas Pipelines* (Federal Register, Vol. 67, No. 66, April 5, 2002).

B. TNF shall ensure all cultural resources identified during additional Class III inventory and through tribal consultation will be evaluated by the TNF for their eligibility for the NRHP and for project effects in accordance with 36 CFR 800.4(b) and in consultation with the appropriate Consulting Parties. The TNF shall make determinations of eligibility and effect upon completion of all inventory reports in coordination with land-managing agencies when appropriate; the SHPO shall be afforded the opportunity to review and concur on the determinations (see Stipulation VI).

C. If the NRHP eligibility of cultural resources cannot be determined at the time of initial inventory, the TNF will either (a) ensure that an eligibility testing program is conducted according to the provisions outlined in Stipulation IX below, or (b) treat unevaluated cultural resources as eligible for the NRHP. The TNF's subsequent NRHP determinations in concurrence with the land-managing agency when appropriate will then be submitted to the SHPO for concurrence in accordance with 36 CFR 800.4(b)(2).

D. Should the SHPO disagree with these determinations, the TNF will try to resolve the disagreement informally. If after a reasonable and good-faith effort a resolution cannot be achieved, the TNF shall request a formal determination from the Keeper of the National Register if it is an issue of determination of eligibility, per 36 CFR 63. For disputes regarding determinations of effects, mitigation, or other parts of the Section 106 process other than NRHP-eligibility determinations, the TNF shall request that the ACHP resolve the dispute, per 36 CFR 800.2(b)(2).

E. The TNF has determined that the Undertaking will have an adverse effect on historic properties; however, the TNF, in consultation with the appropriate land-managing agency, will determine on a property-by-property basis if the Undertaking will have an adverse effect on specific historic properties in the GPO with the exception of those in the Oak Flat Federal Parcel. Because the Oak Flat Federal Parcel will be leaving Federal ownership, the Undertaking will have an adverse effect on all historic properties within the parcel.

F. Visual effects to historic properties in the atmospheric APE, and the potential impacts to setting for qualifying historic properties, will be assessed using viewshed modeling of the visibility of project components and factoring qualities such as distance from the project component, intervening landforms and/or human-made constructions, and overall modifications to the visual landscape.

G. If the TNF does not receive a response from a Consulting Party during these review periods, the TNF will make a good-faith effort to contact the party by email and telephone. If, after a reasonable and good-faith effort to reach an unresponsive party, there is no response, the TNF will proceed to the next step prescribed by this Agreement as described in Stipulation IX.

IX. MITIGATION AND TREATMENT PLANS

A. Because of the size and complexity of the Undertaking, mitigation resolution of adverse effects to historic properties will be outlined in several documents.

1. The TNF will prepare an archaeological HPTP with support from Resolution Copper for the Oak Flat Federal Parcel (Selected Lands) prior to the land exchange and the execution of the Agreement. Implementation of this HPTP will begin prior to the land exchange and may still be ongoing after the formal transfer of the Oak Flat Federal Parcel.

2. Separate from the Oak Flat Federal Parcel HPTP, the TNF will prepare, with support from Resolution Copper, an overall archaeological Research Design for the GPO, including the selected tailings alternative in place of a GPO HPTP prior to the execution of the Agreement. Detailed Data Recovery Plans for each GPO component will then be prepared under the GPO Research Design after the Agreement is executed. It is anticipated that treatments and mitigations for the GPO will be implemented after the formal transfer of the Oak Flat Federal Parcel.

3. The TNF will prepare a separate and confidential Mitigation Plan describing the steps needed for the mitigation of the adverse effects to TCPs affected by the Undertaking. Mitigation negotiations are ongoing and because of the sensitive and sacred nature of the resources to Tribes, these negotiations are confidential.

4. If needed, the TNF will prepare additional mitigation plan(s) that describe mitigation measures to address atmospheric (including visual), indirect, and cumulative effects to historic properties, TCPs, and the cultural and natural resources important to the Tribes.

B. Preparation of the Oak Flat HPTP and GPO Research Design with Data Recovery Plans:

1. The Research Design for the GPO will consist of a context and research design that will apply to all areas of the GPO and alternatives. Data Recovery Plans for detailing the plan of work for each GPO project component area will be prepared under the umbrella document of the GPO Research Design.

2. If Alternative 5 (Peg Leg) is selected, the Data Recovery Plan for the tailings alternative area and associated infrastructure will be prepared in direct coordination with the BLM and submitted to SHPO and the Tribes for review and comment.

3. Mitigation in the Oak Flat Federal Parcel HPTP and GPO Data Recovery Plans will include, but is not limited to, data recovery for historic properties that are eligible for the NRHP under Criterion D.

4. The data recovery strategy specified in the Oak Flat Federal Parcel HPTP and the GPO Research Design in conjunction with the Data Recovery Plans will be consistent with the *Secretary of the Interior's Standards and Guidelines* (48 Federal Register 44716-44742), the ACHP's *Recommended Approach for Consultation on Recovery of Significant Information from Archeological Sites* (64 Federal Register 95:27085–27087), and guidance from the TNF and SHPO.

5. The archaeological strategies specified in the HPTP and the GPO Research Design will be consistent with ARS 41-841 et seq. and ARS 41-865 for work conducted on State and private lands, respectively.

6. The Oak Flat Federal Parcel HPTP and the GPO Research Design in conjunction with the Data Recovery Plans will specify at a minimum:

a. The results of previous research and a research design that discusses the questions to be addressed through data recovery, archival research, analysis and interpretation, with an explanation of their relevance and importance;

b. The process for interfacing the results of eligibility testing and the resultant determinations of eligibility with the relevant data recovery methodology;

c. The results of tribal consultation regarding the incorporation of tribal perspectives into the culture history, research design, data recovery methods, analysis, and interpretation;

d. The properties or portions of properties where data recovery is to be carried out, and any property or portion of property that would be affected by the Undertaking without treatment, and a rationale for dealing with affected properties or portions (e.g., discussion of the sampling strategy, avoidance, etc.);

e. If the data recovery is to be phased (i.e., additional data recovery is required), a discussion of the transition between Phase I and Phase II including time frames for review of preliminary reports and field visits/consultations;

f. The archival, field, and laboratory methods to be used, with an explanation of their relevance to the research questions;

g. Specification of the methods and level of effort to be expended on the treatment of each historic property;

h. The methods to be used in the management and dissemination of the resultant data to the professional community and the public as outlined below in Stipulation IXF, including a proposed schedule for tasks outlined in the GPO, and a schedule for the submittal of draft and final reports (Summary Treatment Report(s) and Full Treatment Report(s)) to Consulting Parties for review and comment;

i. A discussion of permits and personnel qualifications for archaeological crews;

j. A provision for cultural and archaeological sensitivity training for construction personnel, and an outline of topics to be covered in sensitivity trainings, including tribal participation, if possible, in leading the trainings;

k. The proposed disposition and curation of recovered materials and records in accordance with relevant state and Federal laws (36 CFR 79).

C. The Forest Service shall develop a TCP Redress Plan which shall include at a minimum:

1. Tribal perspectives of the Undertaking footprint and the surrounding vicinity;

2. The tribal consultation steps taken by the TNF and results of that consultation including the types of TCPs located in the Undertaking footprint;

3. A discussion of the tribal monitoring program, field methods, and results;

4. A discussion of and commitment to the sensitivity and privacy regarding tribal knowledge, including how sensitive information will not be released to the public, how all public documents will be redacted or written so that sensitive information will not be needed; and how all exchanges of sensitive information to and from the Forest Service will be kept internally;

5. A description of the TCPs in the APE for direct, atmospheric, and indirect effects; however, the TNF will be sensitive to the private nature of tribal knowledge for this section;

6. A description of all mitigation to be conducted to resolve adverse effects to TCPs. Please note that negotiations between the Tribes, the TNF, and Resolution Copper are ongoing. Because the adverse effects of the Undertaking are to a sacred resource, all parties involved in the negotiations have agreed to keep the details confidential;

7. A description of tribal monitoring to be conducted during the construction of mining facilities on Federal, State, and private lands.

D. The Forest Service shall implement a burial plan that corresponds to the requirements of each landholding jurisdiction: a NAGPRA Plan of Action for Federal lands; and an ASM Burial Agreement for state and private lands in accordance with Stipulation XI, and included as an appendix in all documents discussing Section 106 compliance.

E. The Forest Service shall prepare a separate Monitoring and Discovery Plan prior to the land exchange and the issuance of a Notice to Proceed from the Forest Service for the GPO with procedures for monitoring, evaluating, and treating discoveries of unexpected or newly identified nonhuman remains and cultural resources during implementation of the Undertaking, including the consultation process and timelines with appropriate Consulting Parties.

1. If historic properties will be avoided by activities associated with the Undertaking on Federal or State land, but could be threatened after construction by operations, maintenance, and/or decommissioning of the Undertaking, the Monitoring and Discovery Plan will include a program for long-term monitoring of these historic properties on Federal or State land.

2. The Monitoring and Discovery Plan will also include tribal monitoring during construction of mining facilities on private, State, and Federal lands. All discussion of tribal monitoring and resources shall be in a form suitable for public viewing (i.e., for construction and mining personnel).

F. The Forest Service shall develop a strategy for a public education program per ACHP guidelines presented in *Recommended Approach for Consultation on Recovery of Significant Information from Archeological Sites* (June 17, 1999) with the goal of disseminating information to the general public about the results (either ongoing or post-data recovery) of the historic properties investigations, completed in coordination with the Tribes and Consulting Parties. This program shall include at a minimum: presentation of data recovery results at a local archaeological conference and a display for Arizona Archaeology Awareness Month activities.

G. Section 106 Mitigation Documents Review

1. Upon receipt of a draft of the documents, the TNF will submit the draft to the SHPO and simultaneously afford all Consulting Parties to this Agreement the opportunity to review and comment. All parties will have 30 calendar days from receipt to review and provide comments to the TNF.

2. If revisions to the documents are needed, all Consulting Parties to this Agreement will have 30 calendar days from receipt to review and comment on the revisions.

3. The TNF will ensure that an in-person meeting is scheduled with the Tribes to discuss their comments, if requested.

4. If the TNF does not receive a response from a Consulting Party during these review periods, the TNF will make a good-faith effort to contact the party by email and telephone. If, after a reasonable and good-faith effort to reach an unresponsive party, there is no response, the TNF assumes there are no comments.

5. Copies of the final documents in electronic and hard copy format will be provided by the TNF to all Consulting Parties to this Agreement.

H. HPTP and GPO Data Recovery Plans Implementation

1. The land-managing agencies will only authorize the proposed archaeological fieldwork or other mitigation strategies after the TNF has approved the HPTP and GPO Data Recovery Plans and the SHPO has concurred.
2. If in-field modifications of the HPTP or GPO Data Recovery Plans are necessary, the TNF shall consult with the appropriate land-managing agency and the SHPO prior to approving the modification. Once the TNF has notified the SHPO of the changes, the SHPO shall have 14 days to comment. Comments will then be addressed by the TNF; if no comments are received within 14 days, the TNF will move forward. Modifications will be discussed and justified in the report(s) of the work.

I. Summary Treatment Report(s)

1. The TNF shall ensure that Summary Treatment Reports summarizing the implementation of the Oak Flat Federal Parcel HPTP and GPO Data Recovery Plans or other treatments are prepared within 30 calendar days after fieldwork or other mitigation strategies are completed. Separate reports may be prepared for archaeological work and non-archaeological mitigation.
2. The Summary Treatment Report for archaeological work will contain at a minimum:
    a. Descriptions and justifications of any changes in field methods from those presented in the HPTP or Data Recovery Plans.
    b. A map of each treated site showing excavated areas, feature locations, areas monitored, and other data as appropriate.
    c. A list of features identified at each site, brief descriptions, extent of investigation, and assessment of function and age.
    d. A summary of the data recovery results, including summary descriptions of recovered artifacts and samples, by class.
    e. A discussion of any suggested changes or refinements to the research questions or analyses identified in the research design that might be warranted based on the preliminary findings and the character of the recovered assemblages.
    f. A schedule for the completion of all analyses and submission of the Full Treatment Report.
3. Summary Treatment Reports for all other mitigation strategies (non-archaeological) will include:
    a. A description of the work conducted in accordance with the treatment plans.
    b. Any deviations from the plans with justifications.
    c. Results of work conducted.
4. The TNF shall submit the draft Summary Treatment Report to the SHPO and simultaneously afford all Consulting Parties to this Agreement the opportunity to review and comment on the report(s) within 20 calendar days of receipt of the report. The TNF will consult with the SHPO and other Consulting Parties to this Agreement to ensure, to the extent the TNF agrees, that any comments are addressed in the final Summary Treatment Report. If any party fails to respond in writing, by telephone, or by email within 20 calendar days, it is assumed that there are no comments.

J. Full Treatment Report(s)

1. Draft Full Treatment Reports will be prepared for each treated project component.

2. The TNF shall ensure that Draft Full Treatment Reports are completed within 1 year of completion of applicable fieldwork, and Final Reports within 2 years of completion of applicable fieldwork or mitigation tasks.
3. The Draft and Full Treatment Report(s) will contain at a minimum:
    a. Discussion of the methods and treatments applied to the historic properties with an assessment of the degree to which these methods and treatments followed the direction provided by the plans and comments to the Summary Treatment Report.
    b. Discussion of any changes in methods from those proposed in the plans.
    c. A topographic plan view map for each treated historic property investigated, depicting all features, treatment areas, and other data as appropriate.
    d. Final descriptions, drawings, and/or photographs for each feature.
    e. Final descriptions and analyses of all recovered data classes.
    f. Final interpretation of each site according to the research contexts identified in the plans.
    g. Overall synthesis of the data recovery and analysis results with an interpretation of perceived patterns.
    h. Interpretation of the project results in a regional context.
    i. If a burial agreement with the ASM has been acquired, all information relevant to compliance with the reporting requirements under the burial agreement.
    j. A schedule for the completion of all curation and repatriation requirements.
4. The TNF will provide the Draft Full Treatment Reports to the SHPO and simultaneously afford all Consulting Parties to this Agreement the opportunity to review and comment on the report(s). SHPO and the other Consulting Parties to this Agreement will have 30 calendar days from receipt of the Draft Full Treatment Report to review and comment.
5. If the TNF does not receive a response from a Consulting Party during these review periods, the TNF will make a good-faith effort to contact the party by email and telephone. If, after a reasonable and good-faith effort to reach an unresponsive party, there is no response, it is assumed there are no comments.
6. TNF will direct Resolution Copper in the completion of the Full Treatment Report to address all comments. Electronic and hard copies of the Full Treatment Report will be provided to TNF and in turn to the SHPO, land-management agencies, and other Consulting Parties to this Agreement. Land-management agencies are responsible for filing this documentation with the curation repository for their collections.

K. Because the treatments may be long term, progress on treatments to mitigate adverse effects will be reported on during the annual report required by this Agreement per Stipulation XVII. A separate stand-alone treatment report for TCPs will not be prepared.

X. OTHER COMPENSATIONS

If during the life of the mine, other compensations not discussed in Stipulation IX are needed to address adverse effects to cultural resources, the Forest Service shall ensure that those compensations are developed and implemented in consultation with the Tribes. The Forest Service shall ensure that tribal concerns are addressed and redressed throughout the life of the project.

XI. TREATMENT OF HUMAN REMAINS AND FUNERARY OBJECTS

Human remains, associated funerary objects, sacred objects, objects of cultural patrimony, objects of tribal patrimony, or formal non-human burials discovered on Federal land will be treated in compliance with NAGPRA, ARPA, and the Forest Service Region 3 policy for the treatment and disposition of Native American human remains and associated funerary objects recovered from Forest Service Southwestern Region lands (Region 3 Supplement 2300-99-3 to Forest Service Manual, Chapter 2360 – Special Interest Areas, Section 2361.29–Recovery, Curation and Public Use, 08/12/1999).

A NAGPRA Plan of Action regarding the treatment and disposition of any human remains, funerary objects, sacred objects, objects of cultural patrimony, objects of tribal patrimony, or formal non-human burials discovered on Federal land will be developed by the TNF or the BLM, according to each agency's jurisdictional authority (see Appendix D).

Human remains, funerary objects, sacred objects, objects of cultural patrimony, objects of tribal patrimony, or formal non-human burials discovered on State land will be treated in compliance with ARS 41-844, and human remains and funerary objects discovered on private land will be treated in compliance with ARS 41-865 under the jurisdictional authority of the Director of the ASM. For cultural resources work on State or private land, a burial agreement for the treatment and disposition of human remains, funerary objects, sacred objects, objects of cultural patrimony, objects of tribal patrimony, or formal non-human burials must be developed in coordination with ASM.

XII. AUTHORIZATION OF PROJECT ACTIVITY IMPLEMENTATION

A. For activities on Forest Service land, ground-disturbing/GPO activities may be authorized once the TNF, in consultation with the SHPO pursuant to Stipulations VI through VIII, determines that:

    1. No historic properties are present within the Undertaking APE at the location of the proposed activity; or

    2. Historic properties that are present within the APE at the location of the proposed activity will not be adversely affected; or

    3. The HPTP has been implemented for historic properties that are present within the APE at the location of a proposed activity that will be adversely affected, and the Summary Treatment Report documenting compliance with the HPTP has been accepted by the TNF with the understanding that a full report is in preparation. TNF may only authorize activities if such authorization will not preclude the ability to redesign or relocate project activities to avoid adverse effects on historic properties, or to resolve those adverse effects in accordance with the terms of this Agreement.

B. For activities on BLM land, ground-disturbing/GPO activities may be authorized once the TNF and BLM, in consultation with the SHPO, pursuant to Stipulations VI through VIII, determine that:

    1. No historic properties are present within the Undertaking APE at the location of the proposed activity; or

    2. Historic properties that are present within the APE at the location of the proposed activity will not be adversely affected; or

    3. The HPTP has been implemented for historic properties that are present within the APE at the location of a proposed activity that will be adversely affected, and the Summary Treatment Report documenting compliance with the HPTP has been accepted by the TNF and the BLM with the understanding that a full report is in preparation.

C. For activities on ASLD land, ground-disturbing/GPO activities may be authorized once the TNF and ASLD, in consultation with the SHPO pursuant to Stipulations VI through VIII, determine that:

1. No historic properties are present within the Undertaking APE at the location of the proposed activity; or
2. Historic properties that are present within the APE at the location of the proposed activity will not be adversely affected; or
3. The HPTP has been implemented for historic properties that are present within the APE at the location of a proposed activity and will be adversely affected, and the Summary Treatment Report documenting compliance with the HPTP has been accepted by the TNF and the ASLD with the understanding that a full report is in preparation.

D. For activities located on non-federal lands within the USACE's permit area associated with a Section 404 permit, ground-disturbing/GPO activities may be authorized once the TNF, in consultation with the SHPO pursuant to Stipulations VI through VIII, determines that:

1. No historic properties are present within the Undertaking APE at the location of the proposed activity; or
2. Historic properties that are present within the APE at the location of the proposed activity will not be adversely affected; or
3. The HPTP has been implemented for historic properties that are present within the APE at the location of a proposed activity that will be adversely affected, and the Summary Treatment Report documenting compliance with the HPTP has been accepted by the TNF with the understanding that a full report is in preparation.

XIII. COMMUNICATION AMONG PARTIES TO THE PROGRAMMATIC AGREEMENT

Electronic mail (email) will serve as the preferred official correspondence for all communications regarding this Agreement and its provisions. See Appendix E for a list of contacts and email addresses. Contact information in Appendix E may be updated as needed without an amendment to this Agreement. It is the responsibility of each Consulting Party to immediately inform the TNF of any change in name, email address, or telephone number for any point-of-contact. The TNF will forward this information to all Consulting Parties by email.

XIV. CONFIDENTIALITY

To the maximum extent allowed by Federal and state law, the TNF will maintain confidentiality of sensitive information regarding historic properties that could be damaged through looting or disturbance, and/or to help protect a historic property to which a Tribe attaches religious or cultural significance. However, any documents or records the TNF has in its possession are subject to the Freedom of Information Act (FOIA) (5 U.S.C. 552 et seq.) and its exemptions, as applicable. The TNF shall evaluate whether a FOIA request for records or documents would involve a sensitive historic property, or a historic property to which a Tribe attaches religious or cultural significance, and if such documents contain information that the TNF is authorized to withhold from disclosure by other statutes including Section 304 of the NHPA, and the provisions of the ARPA. If this is the case, TNF will consult with the Keeper of the Register and the ACHP regarding withholding the sensitive information per 36 CFR 800.11(c). If a tribally sensitive property is involved, the TNF will also consult with the relevant Tribe prior to making a determination in response to a FOIA request.

XV. EMERGENCIES

Should an emergency situation occur that represents an immediate threat to life or property, the TNF shall immediately notify the SHPO, Tribes, and land managers (as applicable) as to the situation and the measures taken to respond to the emergency or hazardous condition. Should land managers or Tribes desire to provide technical assistance to the TNF, they shall submit comments within 7 calendar days from notification, if the nature of the emergency or hazardous condition allows for such coordination.

XVI. CURATION

The TNF shall ensure that all records and materials resulting from compliance with Section 106 for the Undertaking are curated at a repository approved by the TNF or participating land-managing agency, and that the facility meets the standards set forth in the 1980 ACHP Handbook and the 1990 Guidelines for 36 CFR 79. In compliance with the Arizona Antiquities Act, the TNF will ensure that all materials recovered from State land and the associated reports will be curated at ASM or another approved repository. Curation costs will be the responsibility of Resolution Copper.

XVII. ANNUAL REVIEW OF PROGRAMMATIC AGREEMENT AND ANNUAL REPORT

A. The Consulting Parties shall evaluate the implementation and operation of this Agreement on an annual basis. There shall be an annual meeting among the Consulting Parties on or near the anniversary date of the execution of this Agreement to review the progress and effectiveness of this Agreement. The TNF is responsible for setting up this meeting, in coordination with all the Consulting Parties.

B. Prior to the annual meeting, the TNF will provide Consulting Parties with an annual report (Annual Report) to review the progress under this Agreement and under the approved HPTP(s). The Annual Report will include:

    1. acreage of new historic property/cultural resources surveys and results;
    2. status of mitigation activities;
    3. monitoring efforts;
    4. unanticipated discoveries,
    5. ongoing and completed public education activities;
    6. any issues that are affecting or may affect the ability of the Federal agencies to continue to meet the terms of this Agreement;
    7. any disputes and objections received, and how they were resolved;
    8. any additional parties who have become signatories or concurring parties to this Agreement in the past year; and
    9. proposed plans for next year's activities.

C. Consulting Parties will have 30 calendar days to review the Annual Report and provide comments to the TNF, which will then consolidate the comments to develop the agenda for the annual meeting.

D. Within 14 calendar days after the annual meeting, the TNF will summarize the meeting, including proposed action items and how they are to be addressed, in a letter to Consulting Parties. After the meeting, Consulting Parties will have 20 calendar days to review and comment on the meeting notes and, if necessary, provide the TNF with any edits to the meeting notes. If changes are needed, the TNF will produce revised meeting notes within 30 calendar days of receipt of comments and will provide the final notes to the Consulting Parties.

E. Evaluation of the implementation of this Agreement may also include in-person meetings or conference calls among Consulting Parties, and suggestions for possible modifications or amendments to this Agreement. If the TNF does not receive a response from a Consulting Party, the TNF will make a good-faith effort to contact the party by email and telephone. If, after a reasonable and good-faith effort to reach an unresponsive party, there is no response, the TNF will proceed to the next step.

XVIII. POST-REVIEW DISCOVERIES OF CULTURAL RESOURCES

A. The TNF will ensure that procedures regarding post-review discoveries are included as provisions of Resolution Copper's GPO. The protocol to be followed will also be identified in the Monitoring and Discovery Plan.

B. The TNF will ensure that Resolution Copper immediately halts ground-disturbing activities within a 100-foot-radius of any new discovery of cultural resources, clearly marks the area of discovery, takes steps to ensure that the area is protected and secured, implements additional measures, as appropriate, to protect the discovery from looting and vandalism, and has a professional archaeologist inspect the area and vicinity to determine the extent of the discovery and provide recommendations to TNF regarding NRHP eligibility, effect, and mitigation treatment.

C. The TNF will notify the SHPO, affiliated Tribes, and applicable land managers, within 48 hours of the discovery, and will provide its assessment of the NRHP eligibility of the discovery and measures proposed to resolve adverse effects. The TNF will take into account the SHPO's, Tribes', and applicable land manager's recommendations on eligibility and treatment of the discovery, as tiered off of the Oak Flat Federal Parcel HPTP or the GPO Research Design, and will notify Resolution Copper of any appropriate actions required to resolve adverse effects.

D. If the post-review discovery consists of human remains or funerary objects, the TNF shall follow the procedures outlined in the NAGPRA Plan of Action for discoveries on Federal land or those outlined in the burial plan for discoveries on State or private land per ARS 41-844 and ARS 41-865 (see Stipulation XI). In addition, humans remains and funerary objects shall be treated in accordance with Stipulation XI.

E. The TNF, in coordination with any applicable land manager, may allow construction activities to proceed in the area of discovery after the TNF has determined that implementation of the actions taken to address the discovery pursuant to this Stipulation have been completed.

XIX. AMENDMENTS

A. This Agreement may be amended when such an amendment is agreed to in writing by all Signatories and Invited Signatories. Any Signatory or Invited Signatory may propose an amendment in writing to the TNF. The amendment will be effective on the date a copy signed by all of the Signatories is filed with the ACHP.

B. Copies of the amendment will be provided by the TNF to all parties to this Agreement.

XX. DISPUTE RESOLUTION

Should any signatory or concurring party to this Agreement object at any time to any actions proposed or the manner in which the terms of this Agreement are implemented, the TNF shall consult with such party to resolve the objection and shall notify the SHPO and Consulting Parties of the objection. If the TNF determines that such objection cannot be resolved, the TNF will:

A. Forward all documentation relevant to the dispute, including the TNF's proposed resolution, to the ACHP. The ACHP shall provide the TNF with its opinion on the resolution of the objection within 30 calendar days of receiving adequate documentation. Prior to reaching a final decision on the dispute, the TNF shall prepare a written response that takes into account any timely opinion or comments regarding the dispute from the ACHP, signatories, and concurring parties, and provide them with a copy of this written response. The TNF will then proceed according to its final decision.

B. If the ACHP does not provide comments regarding the dispute within the 30-day time period, the TNF may make a final decision on the dispute and proceed accordingly. Prior to reaching a final decision, the TNF shall prepare a written response that takes into account any timely comments regarding the dispute from the signatories and concurring parties to the Agreement and provide them and the ACHP with a copy of such written response.

C. The responsibilities of the TNF to carry out all other actions subject to the terms of this Agreement that are not the subject of the dispute remain unchanged.

XXI. TERMINATION

A. If any signatory to this Agreement determines that its terms will not or cannot be carried out, the TNF shall immediately consult with the other signatories to attempt to develop an amendment per Stipulation XIX. If, within 30 calendar days (or another time period agreed to by all signatories), an amendment cannot be reached, any signatory may terminate this Agreement upon written notification to the other signatories.

B. Once this Agreement is terminated, and prior to work continuing on the Undertaking, the TNF must either (a) execute an Agreement pursuant to 36 CFR 800.6, or (b) request, take into account, and respond to the comments of the ACHP under 36 CFR 800.7. The TNF shall notify the signatories as to the course of action it will pursue.

C. At any point after the execution of this Agreement, and after providing written notice to the Signatories and Invited Signatories, the BLM or the USACE may (a) determine that it no longer has Section 106 responsibilities associated with the Undertaking; or (b) decide to continue complying with its Section 106 responsibilities independently through a separate Agreement per 36 CFR 800.14(b) or, failing that, (c) through its request, consideration, and response to the formal comments of the ACHP per 36 CFR 800.7(c), determine that it will no longer participate in this Agreement. Such a decision by the BLM or USACE will not affect this Agreement with regard to other land managers and/or permitting entities who are Signatories and/or Invited Signatories and will not require an amendment to this Agreement.

D. If the project is suspended or terminated for any reason, in-process mitigation will be completed according to the appropriate plan to the extent applicable. This includes data recovery and mitigation of adverse effects to TCPs. Resolution Copper will be responsible for the costs associated with completion of the mitigation. For data recovery, the Forest Service shall ensure that any in-process data recovery fieldwork is completed and that all analysis, interpretation, reporting, curation of artifacts, and repatriation of remains be completed within 1 year of project suspension or termination. For other mitigation, the Forest Service shall, in consultation with the land-managing agencies, SHPO, and Tribes, develop steps for completion of the mitigation within 1 year of the suspension or termination.

XXII. TRANSFER OF PERMITS TO SUCCESSOR

Any transfer or assignment of the Agreement for the Undertaking to another party will require the assignee or successor to assume all responsibilities of Resolution Copper under this Agreement for mitigation of adverse effects, and any successor or assignee of Resolution Copper is bound to the terms of this Agreement. Any transfer or assignment of the permits for the Undertaking to another party will require the assignee or successor to sign an amendment to this Agreement to become an Invited Signatory at the time of transfer or assignment. All Consulting Parties will be notified if an amendment to reassign the duties of Resolution Copper is proposed.

XXIII. DURATION OF PROGRAMMATIC AGREEMENT

This Agreement shall be in effect for 10 years with the understanding that it will be extended after 10 years. The Forest Service will ensure that an agreement is in place for the duration of the mine.

XXIV. ANTI-DEFICIENCY ACT

The TNF's obligations under this Agreement are subject to availability of appropriated funds, and the stipulations of this Agreement are subject to the provisions of the Anti-Deficiency Act. The TNF shall make reasonable and good-faith efforts to secure the necessary funds to implement this Agreement in its entirety. If compliance with the Anti-Deficiency Act alters or impairs the TNF's ability to implement the stipulations of this agreement, the TNF shall consult in accordance with the amendment and termination procedures found at Stipulations XIX and XXI of this Agreement.

XXV. NON-ENDORSEMENT CLAUSE

Nothing in this Agreement should be interpreted to imply that any party endorses the Undertaking. Consulting Parties will not take any action or make any statement that suggests or implies such an endorsement based on signing this Agreement. Per 36 CFR 800.6(c)(2)(iv), the refusal of any party invited to become a signatory or concurring party will not invalidate this Agreement.

XXVI. AUTHORIZING SIGNATURES

In witness hereof, the following authorized representatives of the parties have signed their names on the dates indicated, thereby executing this Agreement. This Agreement may be signed by the Signatories and Invited Signatories using photocopy, facsimile, or counterpart signature pages. TNF will distribute copies of all signed pages to the Signatories, Invited Signatories, and Consulting Parties, once the Agreement is executed. Execution of this Agreement by the TNF, the SHPO, and the ACHP, and implementation of its terms, evidence that the TNF has taken into account the effects of this undertaking on historic properties and has afforded the ACHP an opportunity to comment.

APPENDICES

A. Area of Potential Effects
B. Maps
C. Definitions
D. NAGPRA Plan
E. Key Staff Contact Information
F. Programmatic Agreement Process

SIGNATORY PAGE

PROGRAMMATIC AGREEMENT
AMONG THE
USDA FOREST SERVICE TONTO NATIONAL FOREST,
ARIZONA STATE HISTORIC PRESERVATION OFFICER,
THE ADVISORY COUNCIL ON HISTORIC PRESERVATION,
REGARDING
COMPLIANCE WITH THE NATIONAL HISTORIC PRESERVATION ACT
ON THE RESOLUTION COPPER PROJECT
AND SOUTHEAST ARIZONA LAND EXCHANGE
NEAR SUPERIOR, ARIZONA

USDA Forest Service, Tonto National Forest

By: _____

Printed Name: _____

Title: _____

Date: _____

SIGNATORY PAGE

PROGRAMMATIC AGREEMENT
AMONG THE
USDA FOREST SERVICE TONTO NATIONAL FOREST,
ARIZONA STATE HISTORIC PRESERVATION OFFICER,
THE ADVISORY COUNCIL ON HISTORIC PRESERVATION,
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COMPLIANCE WITH THE NATIONAL HISTORIC PRESERVATION ACT
ON THE RESOLUTION COPPER PROJECT
AND SOUTHEAST ARIZONA LAND EXCHANGE
NEAR SUPERIOR, ARIZONA

Arizona State Historic Preservation Officer

By: _____

Printed Name: _____

Title: _____

Date: _____

SIGNATORY PAGE

PROGRAMMATIC AGREEMENT
AMONG THE
USDA FOREST SERVICE TONTO NATIONAL FOREST,
ARIZONA STATE HISTORIC PRESERVATION OFFICER,
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COMPLIANCE WITH THE NATIONAL HISTORIC PRESERVATION ACT
ON THE RESOLUTION COPPER PROJECT
AND SOUTHEAST ARIZONA LAND EXCHANGE
NEAR SUPERIOR, ARIZONA

The Advisory Council on Historic Preservation

By: _____

Printed Name: _____

Title: _____

Date: _____

INVITED SIGNATORY PAGE

PROGRAMMATIC AGREEMENT
AMONG THE
USDA FOREST SERVICE TONTO NATIONAL FOREST,
ARIZONA STATE HISTORIC PRESERVATION OFFICER,
THE ADVISORY COUNCIL ON HISTORIC PRESERVATION,
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COMPLIANCE WITH THE NATIONAL HISTORIC PRESERVATION ACT
ON THE RESOLUTION COPPER PROJECT
AND SOUTHEAST ARIZONA LAND EXCHANGE
NEAR SUPERIOR, ARIZONA

Resolution Copper Mining, LLC

By: _____

Date: _____

INVITED By: _____

Printed Name: _____

Title: _____

Date: _____

INVITED SIGNATORY PAGE

PROGRAMMATIC AGREEMENT
AMONG THE
USDA FOREST SERVICE TONTO NATIONAL FOREST,
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COMPLIANCE WITH THE NATIONAL HISTORIC PRESERVATION ACT
ON THE RESOLUTION COPPER PROJECT
AND SOUTHEAST ARIZONA LAND EXCHANGE
NEAR SUPERIOR, ARIZONA

Arizona State Land Department

By: _____

Date: _____

INVITED By: _____

Printed Name: _____

Title: _____

Date: _____

INVITED SIGNATORY PAGE

PROGRAMMATIC AGREEMENT
AMONG THE
USDA FOREST SERVICE TONTO NATIONAL FOREST,
ARIZONA STATE HISTORIC PRESERVATION OFFICER,
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COMPLIANCE WITH THE NATIONAL HISTORIC PRESERVATION ACT
ON THE RESOLUTION COPPER PROJECT
AND SOUTHEAST ARIZONA LAND EXCHANGE
NEAR SUPERIOR, ARIZONA

U.S. Department of the Interior, Bureau of Land Management

By: _____

Date: _____

INVITED By: _____

Printed Name: _____

Title: _____

Date: _____

INVITED SIGNATORY PAGE

PROGRAMMATIC AGREEMENT
AMONG THE
USDA FOREST SERVICE TONTO NATIONAL FOREST,
ARIZONA STATE HISTORIC PRESERVATION OFFICER,
THE ADVISORY COUNCIL ON HISTORIC PRESERVATION,
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ON THE RESOLUTION COPPER PROJECT
AND SOUTHEAST ARIZONA LAND EXCHANGE
NEAR SUPERIOR, ARIZONA

United States Army Corps of Engineers, Los Angeles District

By: _____

Date: _____

INVITED By: _____

Printed Name: _____

Title: _____

Date: _____

INVITED SIGNATORY PAGE

PROGRAMMATIC AGREEMENT
AMONG THE
USDA FOREST SERVICE TONTO NATIONAL FOREST,
ARIZONA STATE HISTORIC PRESERVATION OFFICER,
THE ADVISORY COUNCIL ON HISTORIC PRESERVATION,
REGARDING
COMPLIANCE WITH THE NATIONAL HISTORIC PRESERVATION ACT
ON THE RESOLUTION COPPER PROJECT
AND SOUTHEAST ARIZONA LAND EXCHANGE
NEAR SUPERIOR, ARIZONA

Arizona State Museum

By: _____

Date: _____

INVITED By: _____

Printed Name: _____

Title: _____

Date: _____