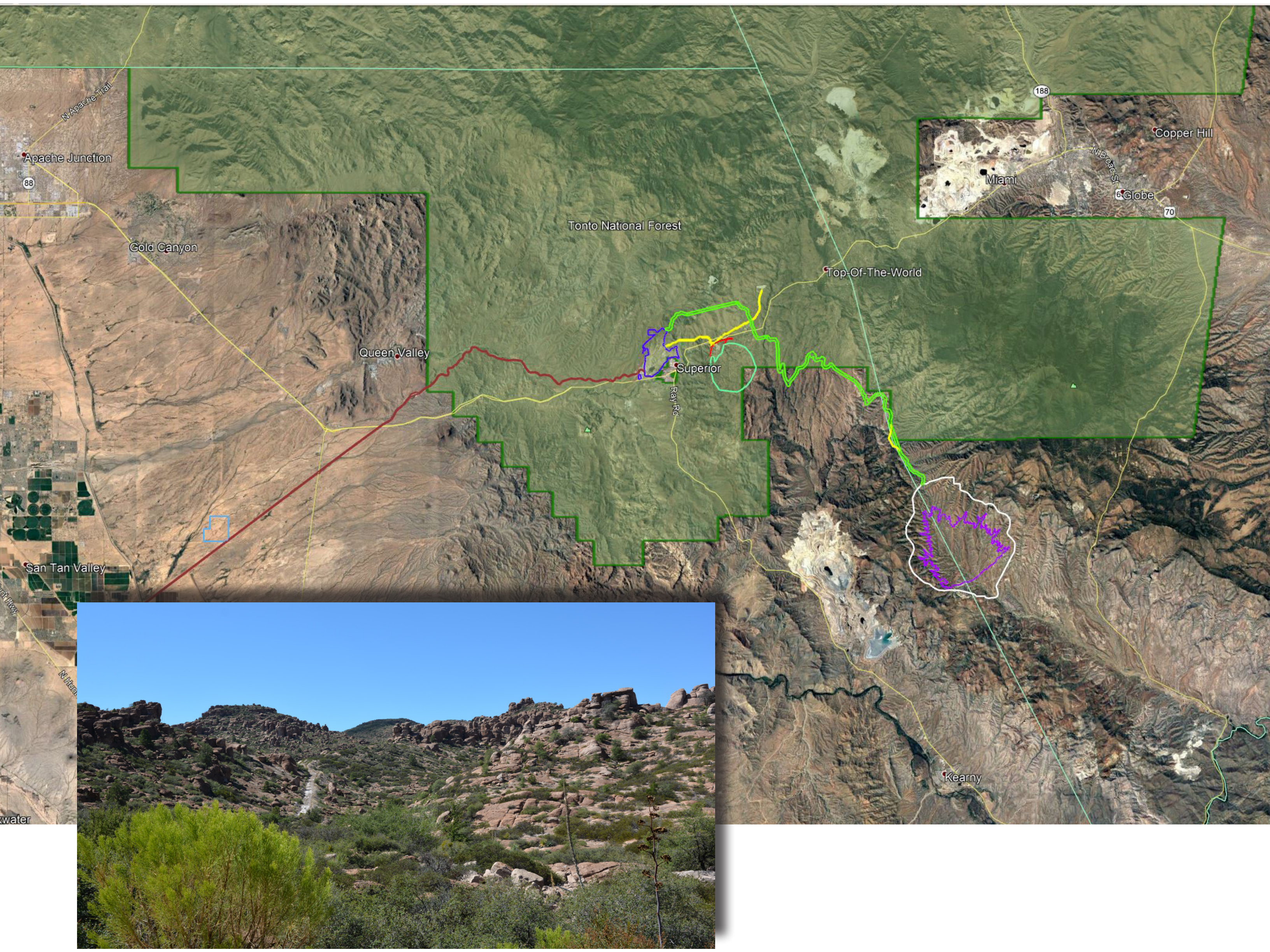
Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Tonto National Forest | MB-R3-12-10 | June 2025

FINAL Environmental Impact Statement

Resolution Copper Project and Land Exchange

Coconino, Gila, Maricopa, Pinal, Santa Cruz, and Yavapai Counties, Arizona



Volume 5

Front Cover photo captions:

Top: Map of the Preferred Alternative Project location and the Tonto National Forest

Bottom Left: Oak Flat Federal Parcel

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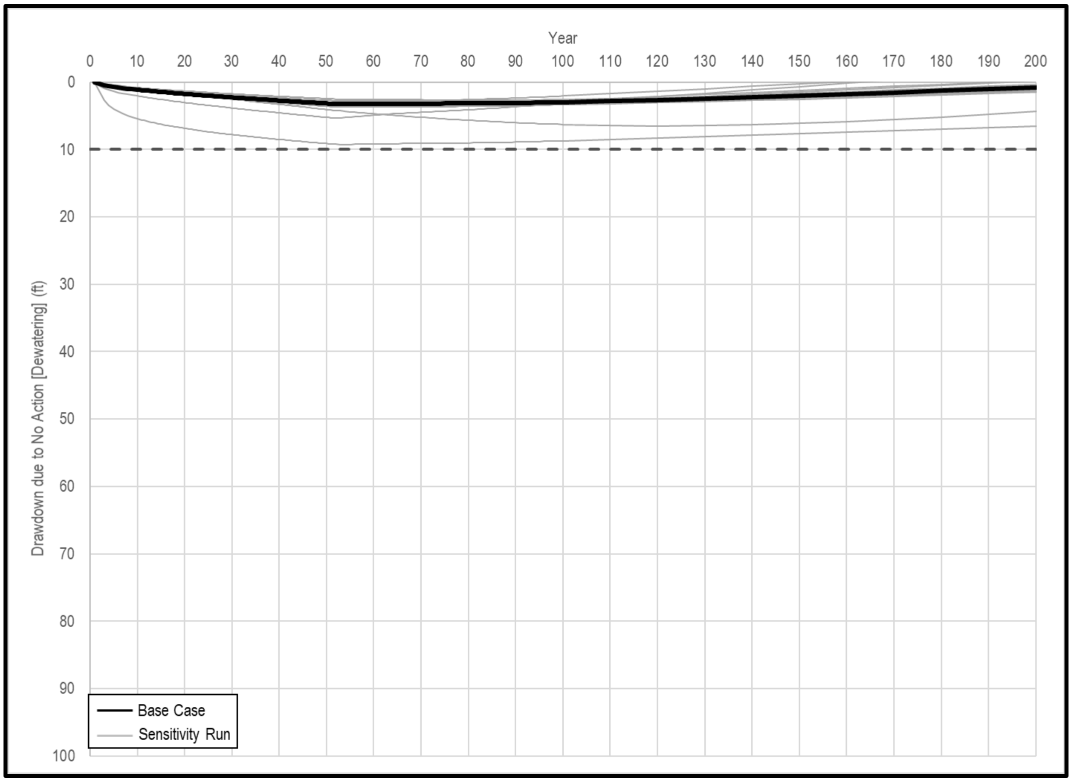
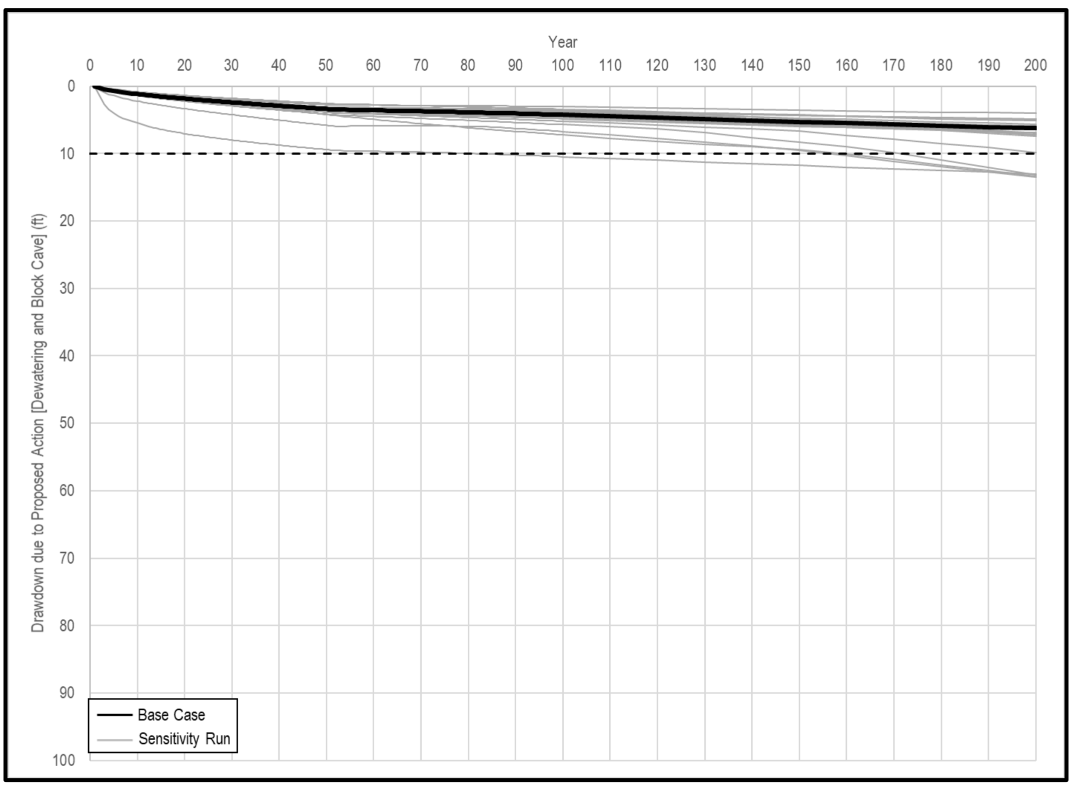
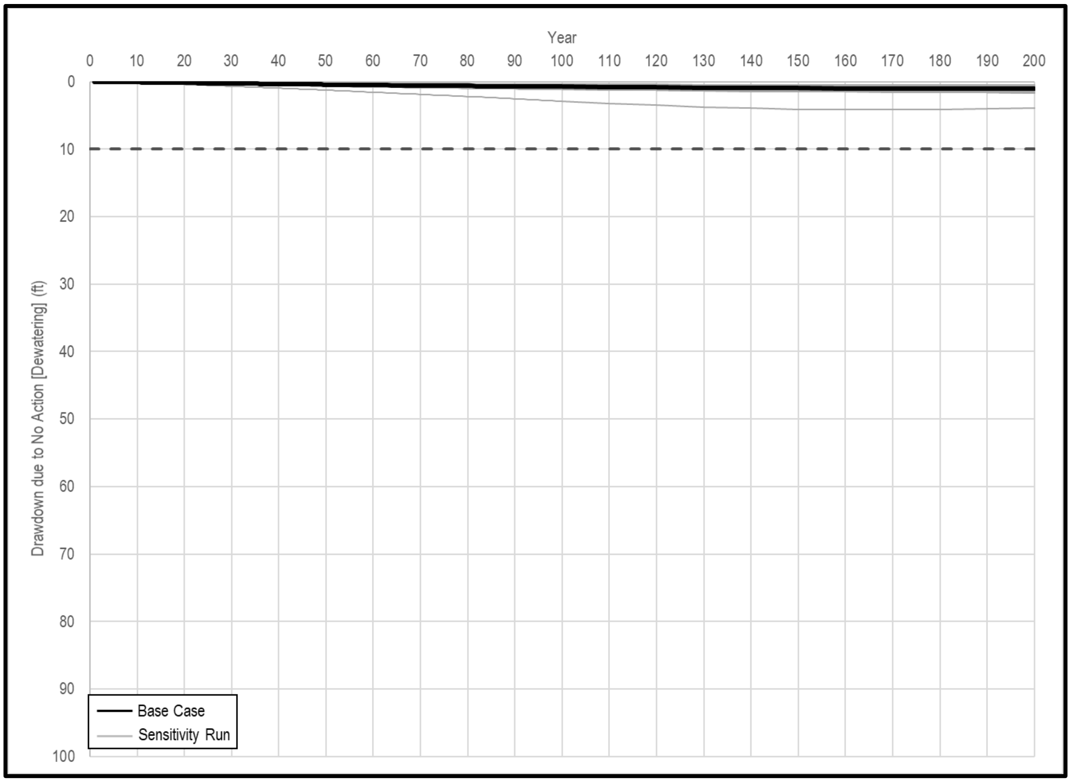
Appendix L. Detailed Hydrographs Describing Impacts on Groundwater-Dependent Ecosystems



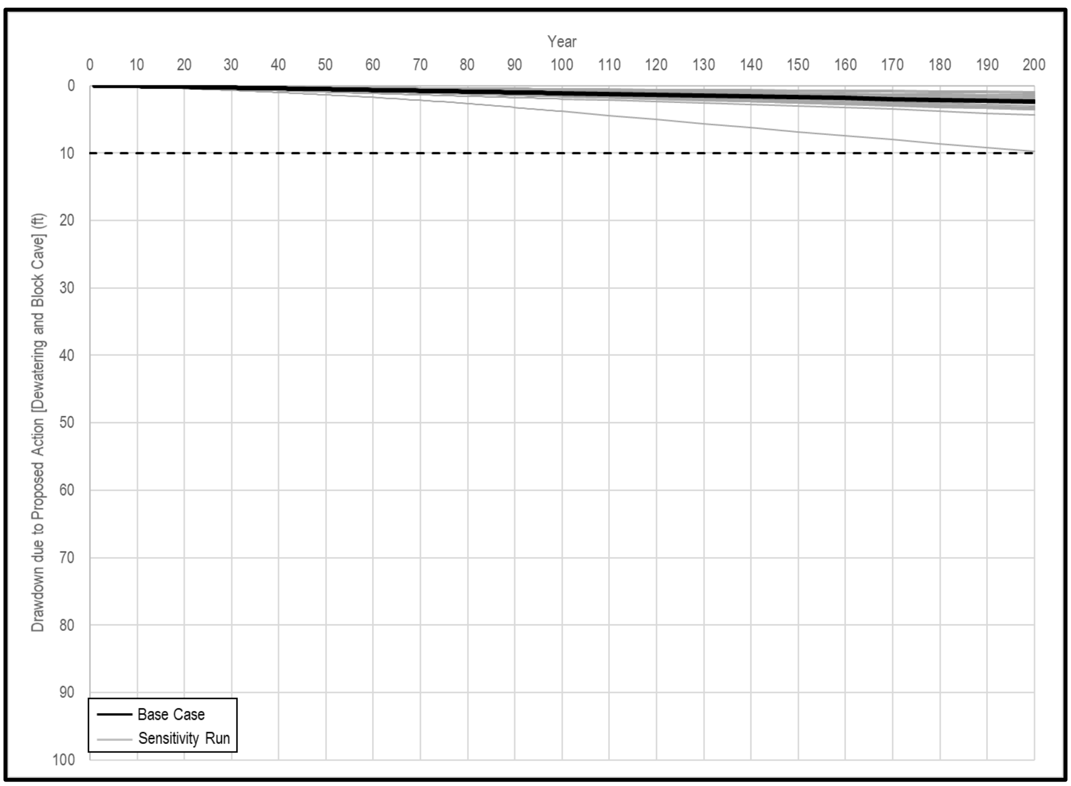
Queen Creek – Flowing reach from 17.39 to 15.55 km—no action



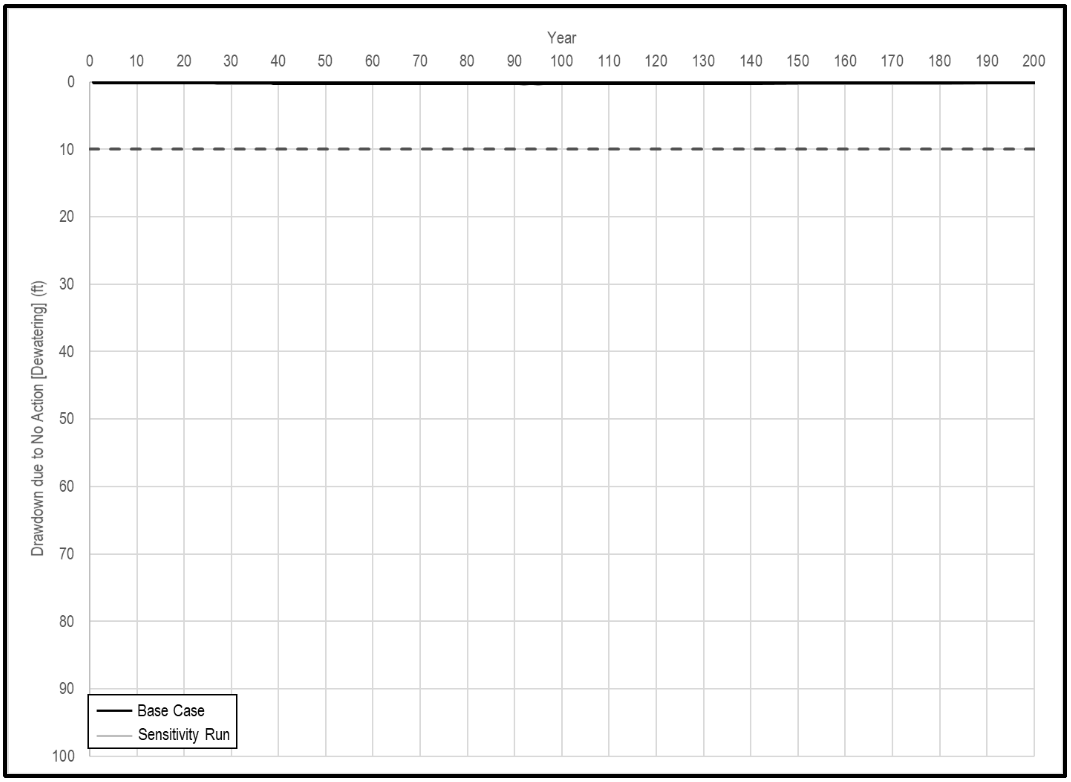
Queen Creek – Flowing reach from 17.39 to 15.55 km—proposed action



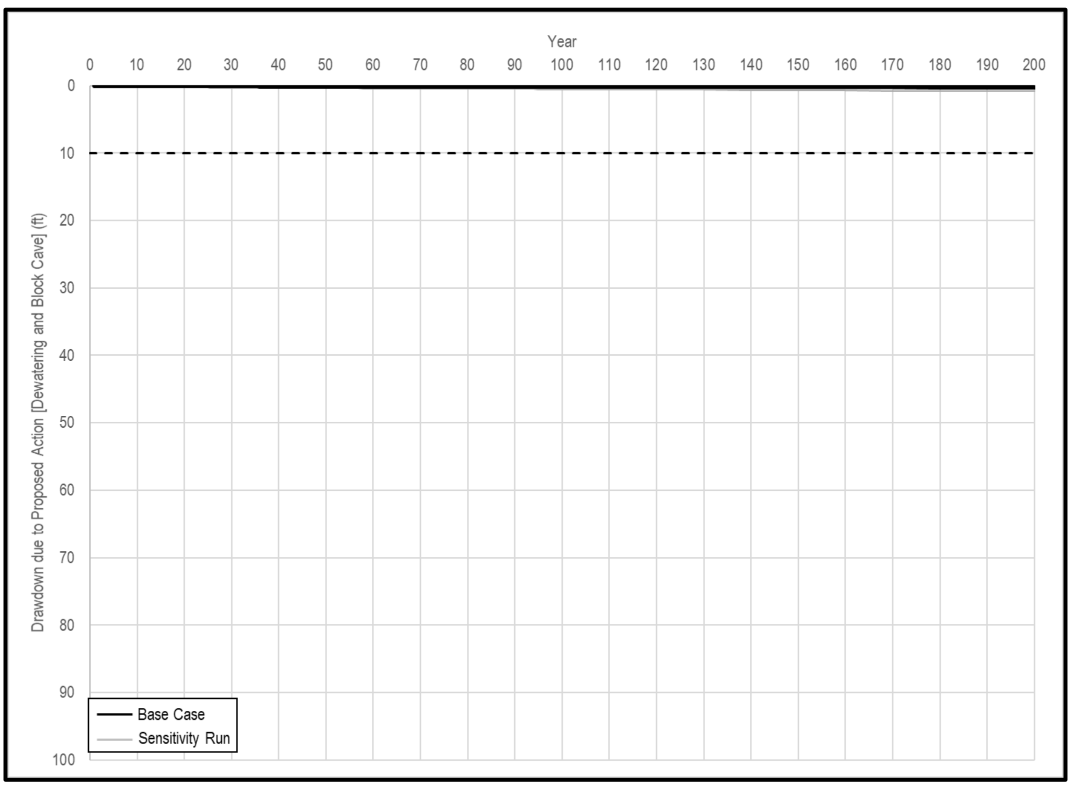
Arnett Creek (from Blue Spring to confluence with Queen Creek). Specific location: AC-12.49—no action.



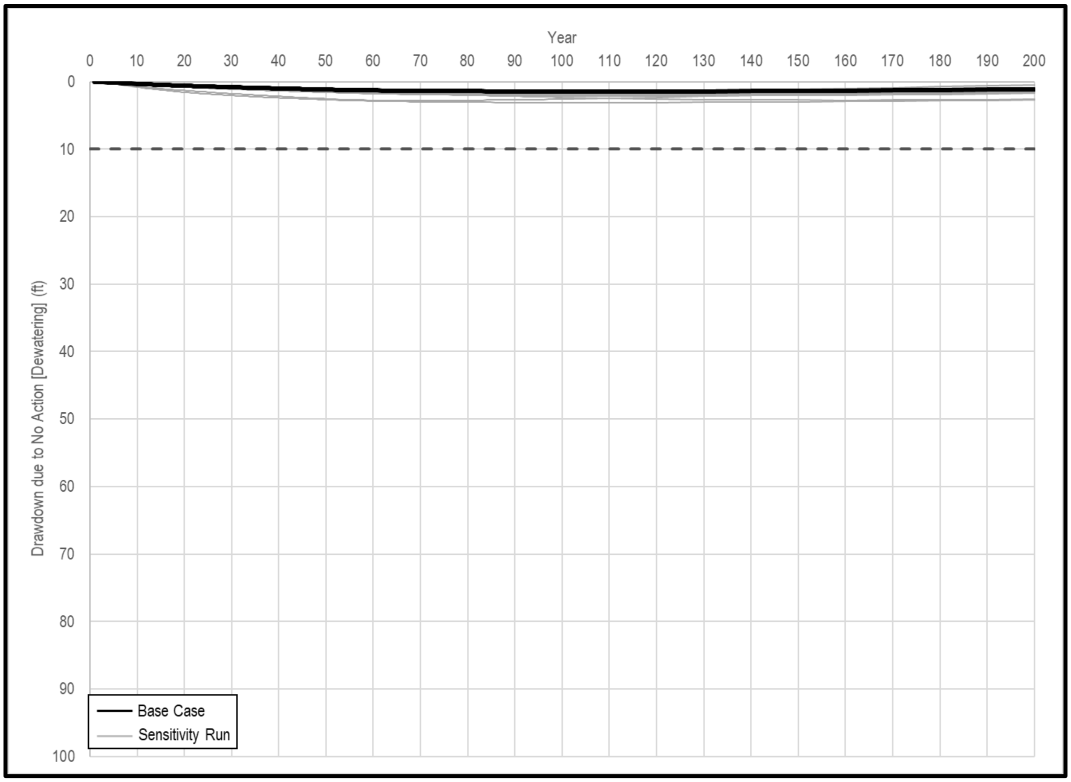
Arnett Creek (from Blue Spring to confluence with Queen Creek). Specific location: AC-12.49—proposed action.



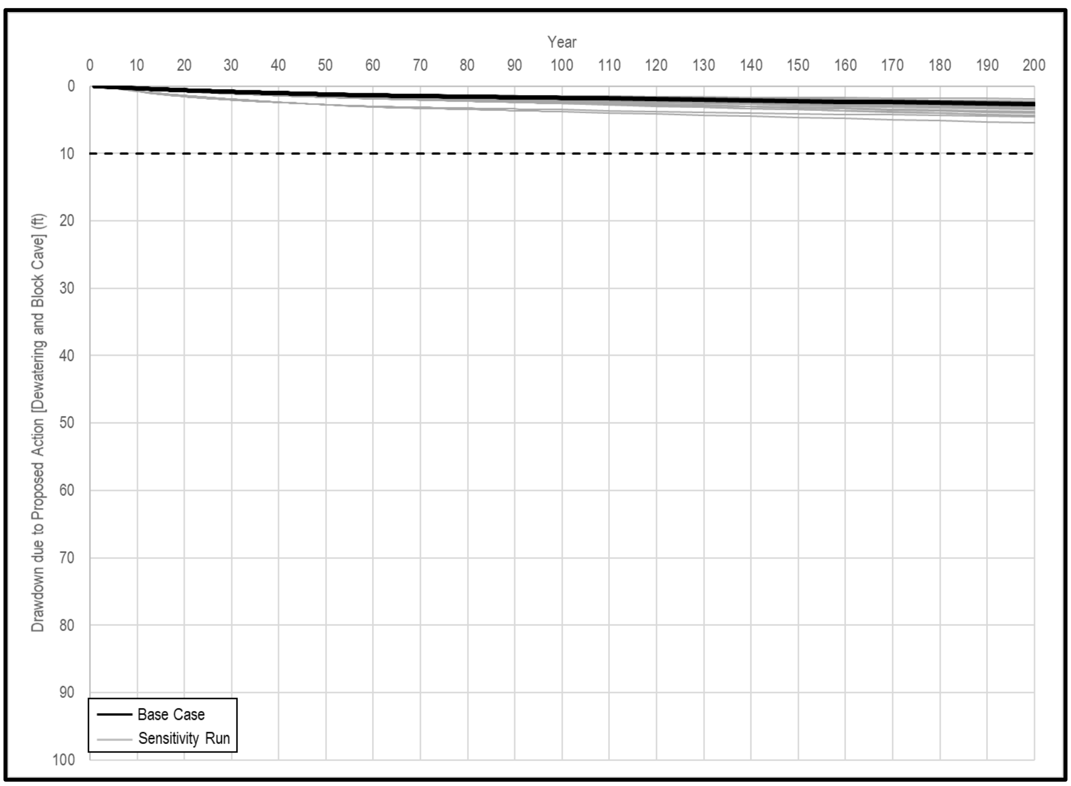
Arnett Creek (from Blue Spring to confluence with Queen Creek). Specific location: AC-4.54—no action.



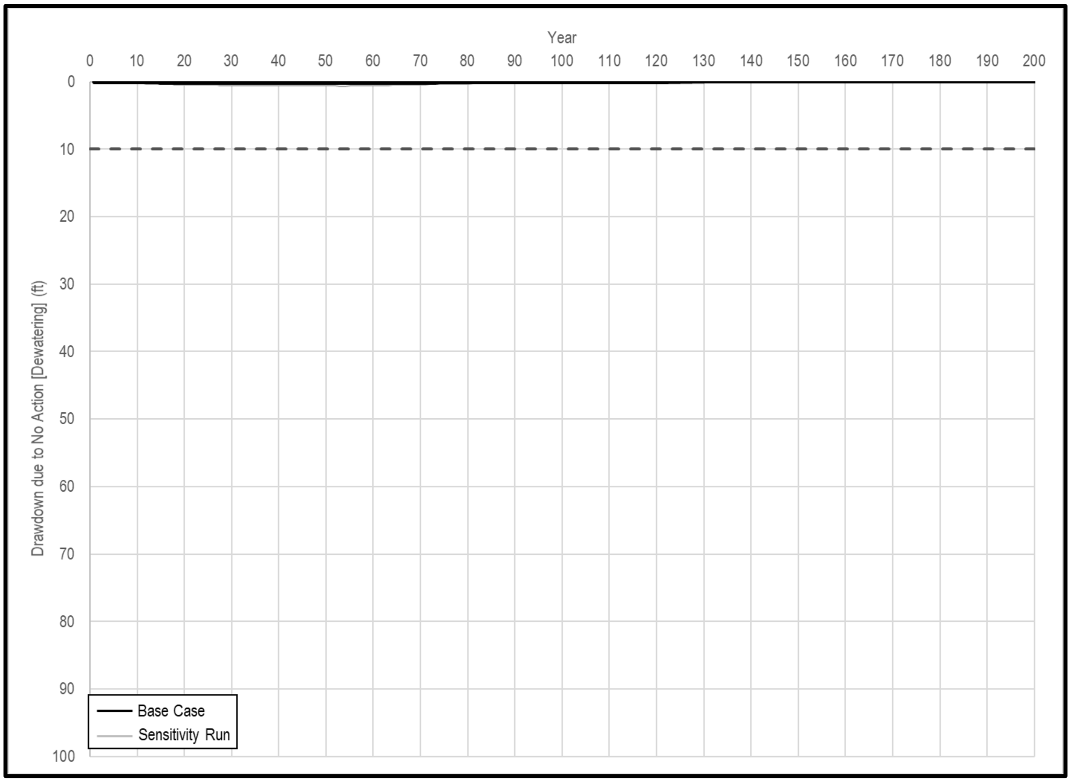
Arnett Creek (from Blue Spring to confluence with Queen Creek). Specific location: AC-4.54—proposed action.



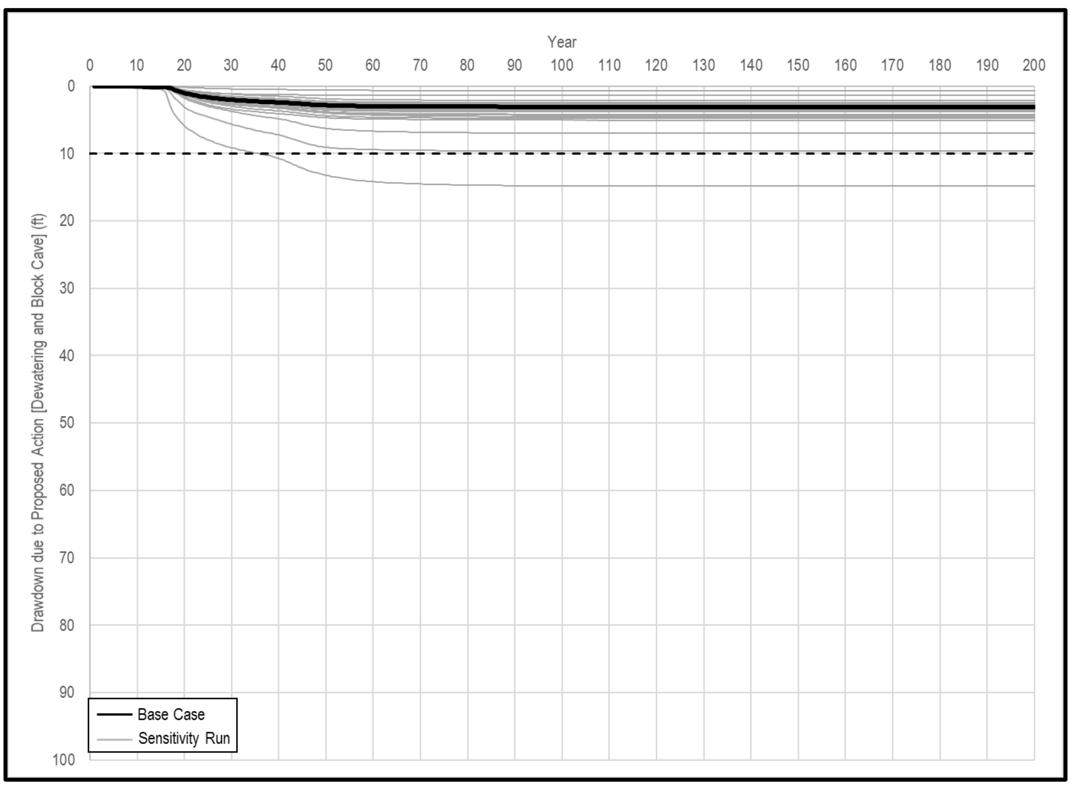
Telegraph Canyon (near confluence with Arnett Creek)—no action



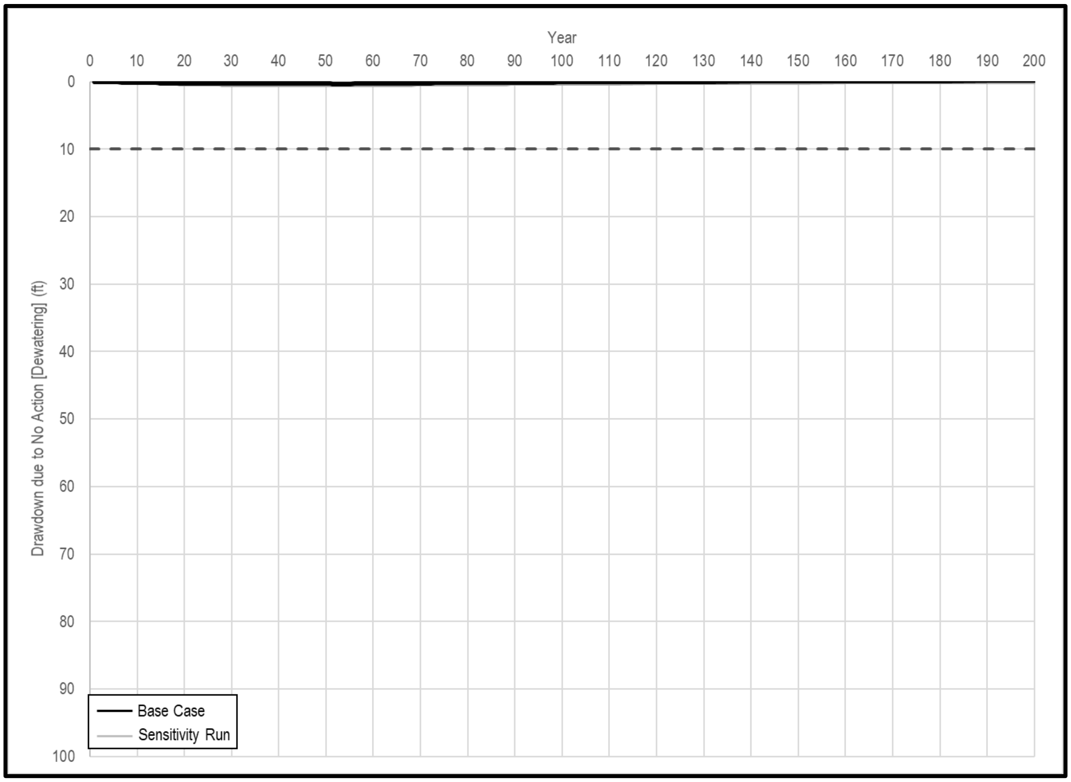
Telegraph Canyon (near confluence with Arnett Creek)—proposed action



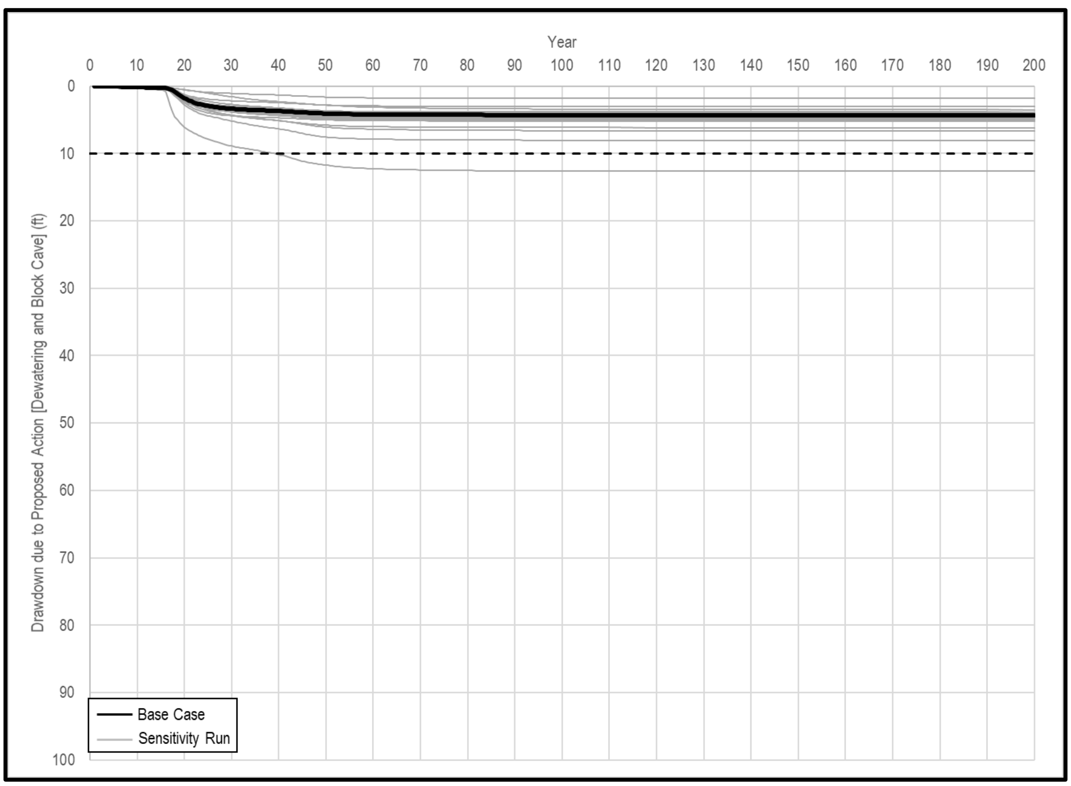
Middle Devil's Canyon (from km 9.3 to km 6.1). Specific location: DC-8.8C—no action.



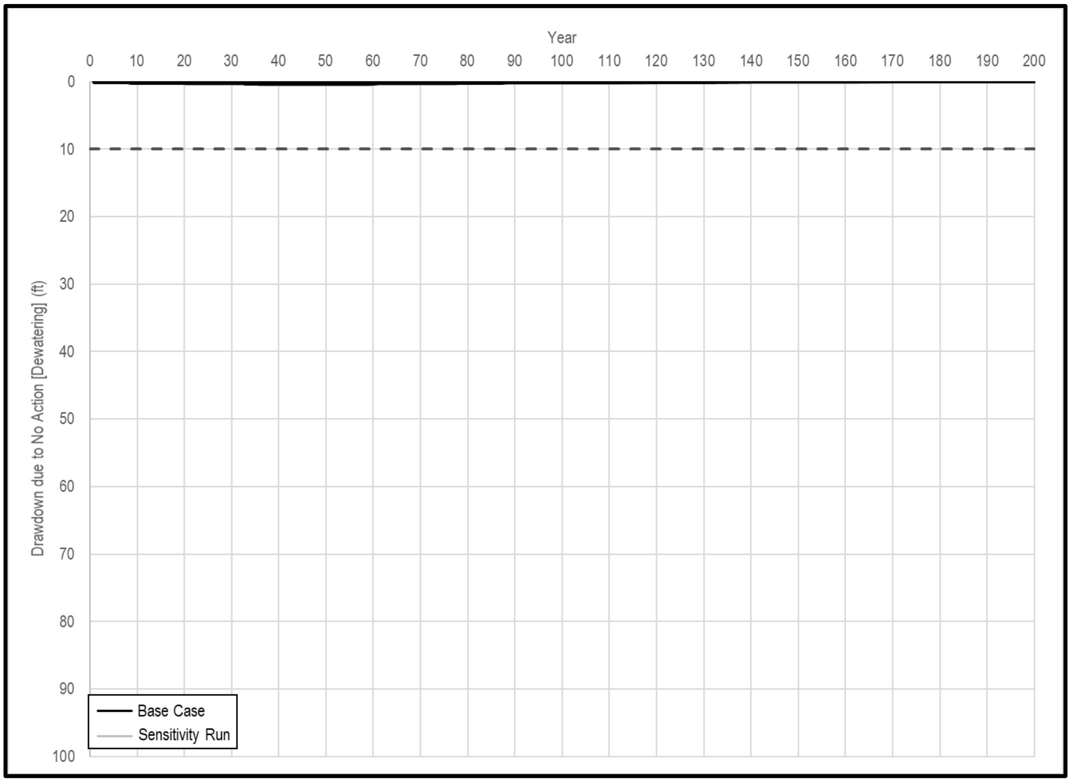
Middle Devil's Canyon (from km 9.3 to km 6.1). Specific location: DC-8.8C—proposed action.



Middle Devil's Canyon (from km 9.3 to km 6.1). Specific location: DC-8.2W—no action.



Middle Devil's Canyon (from km 9.3 to km 6.1). Specific location: DC-8.2W—proposed action.



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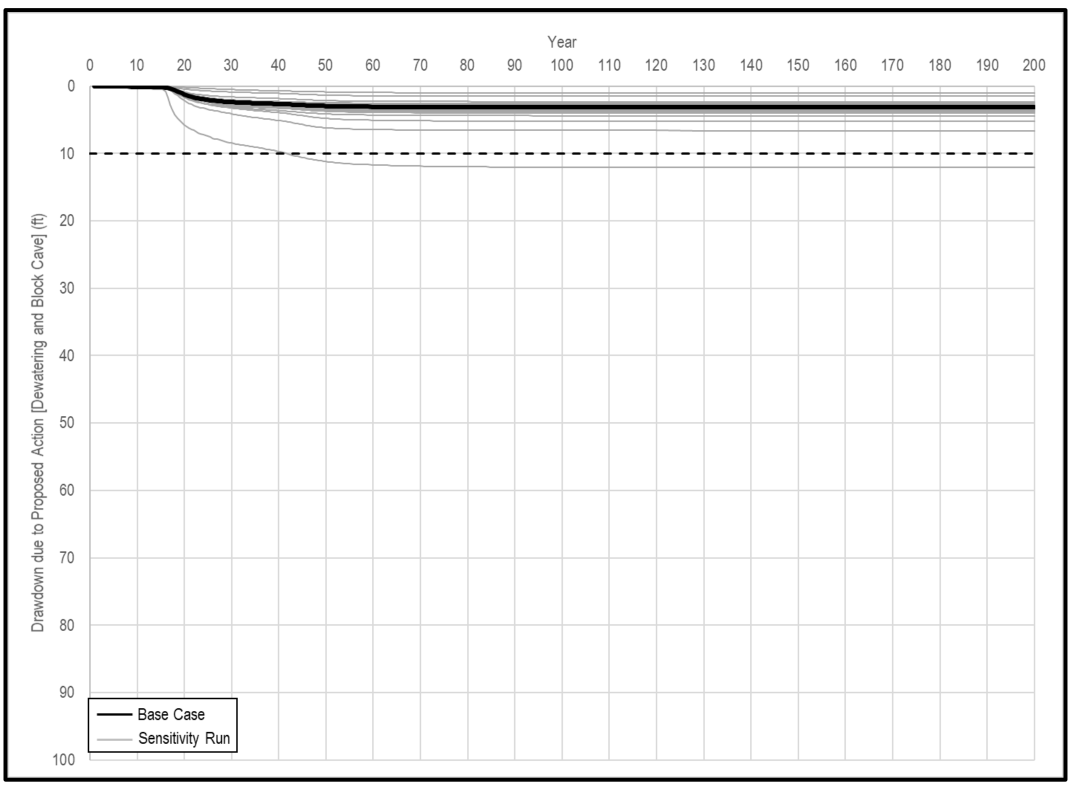
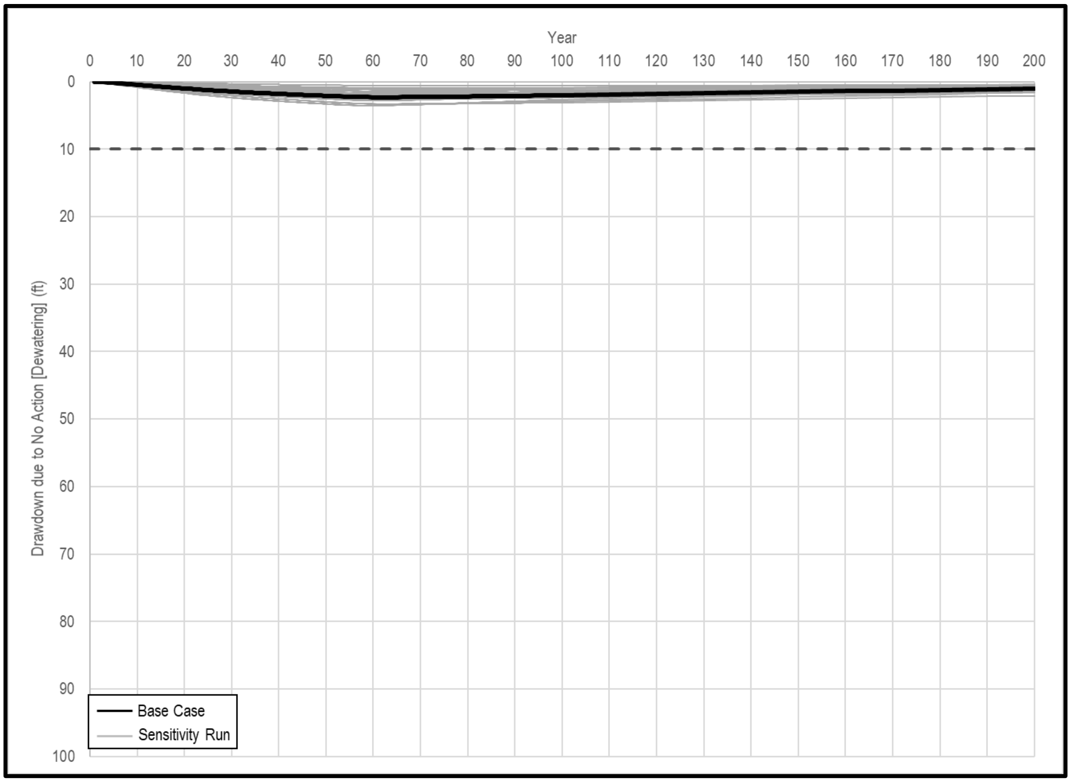
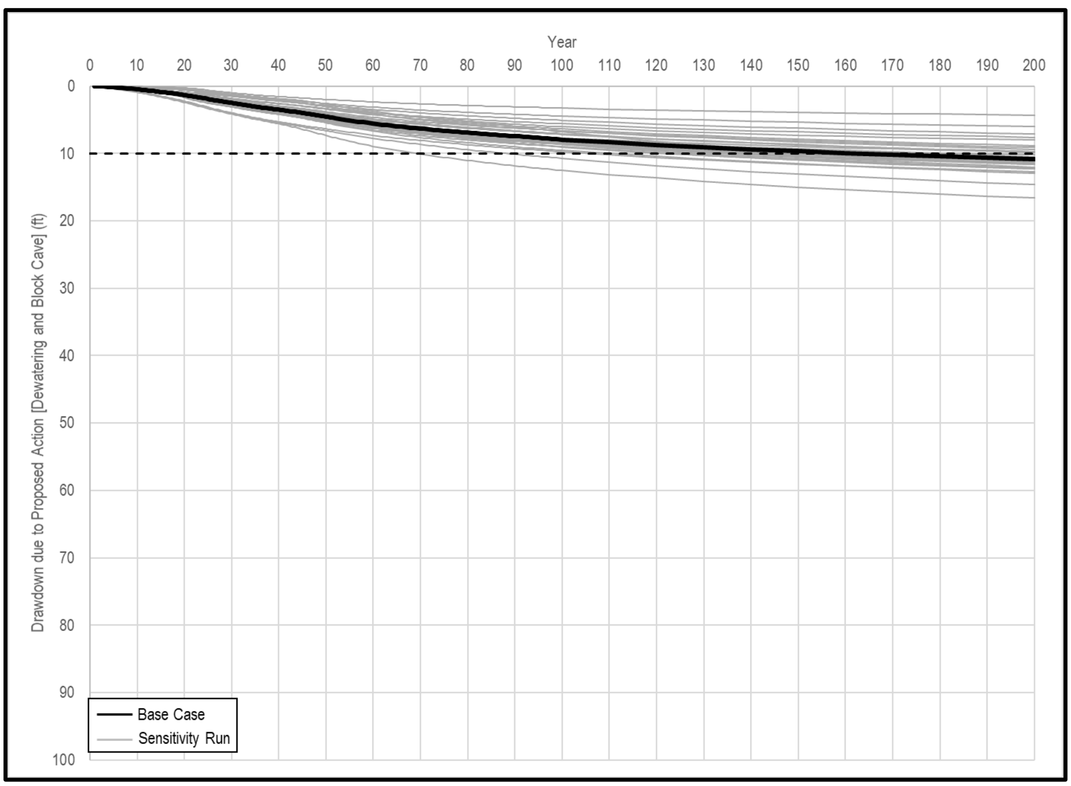


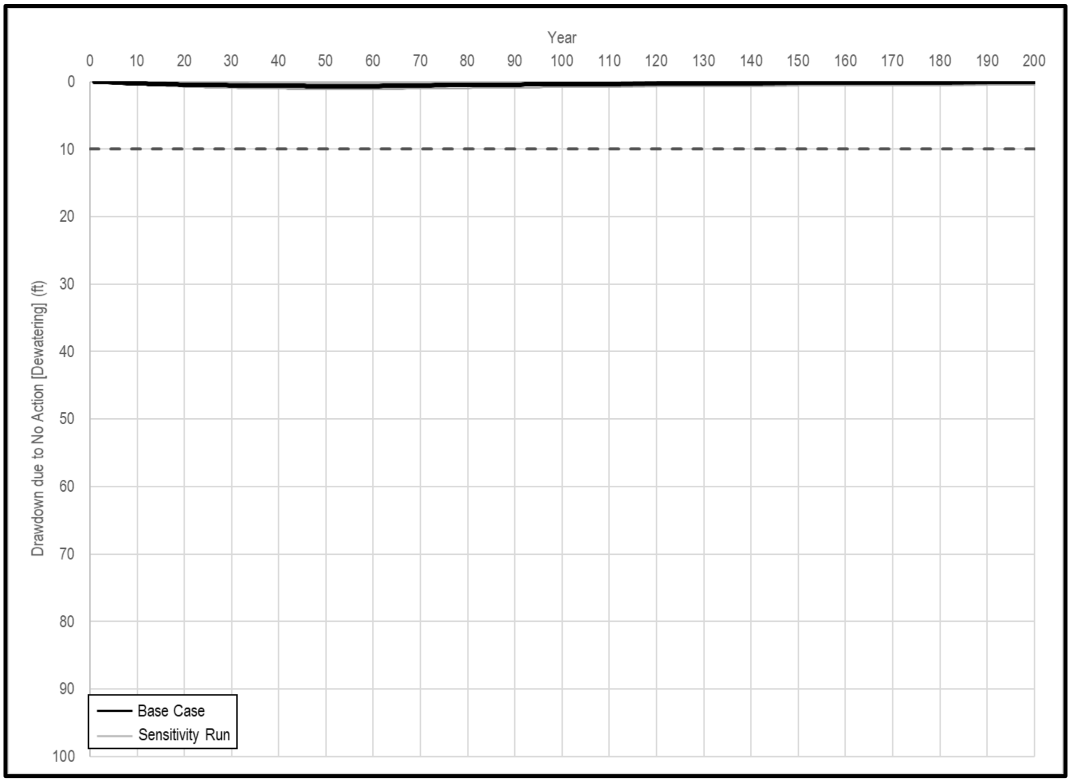
Middle Devil's Canyon (from km 9.3 to km 6.1). Specific location: DC-8.1C—proposed action.



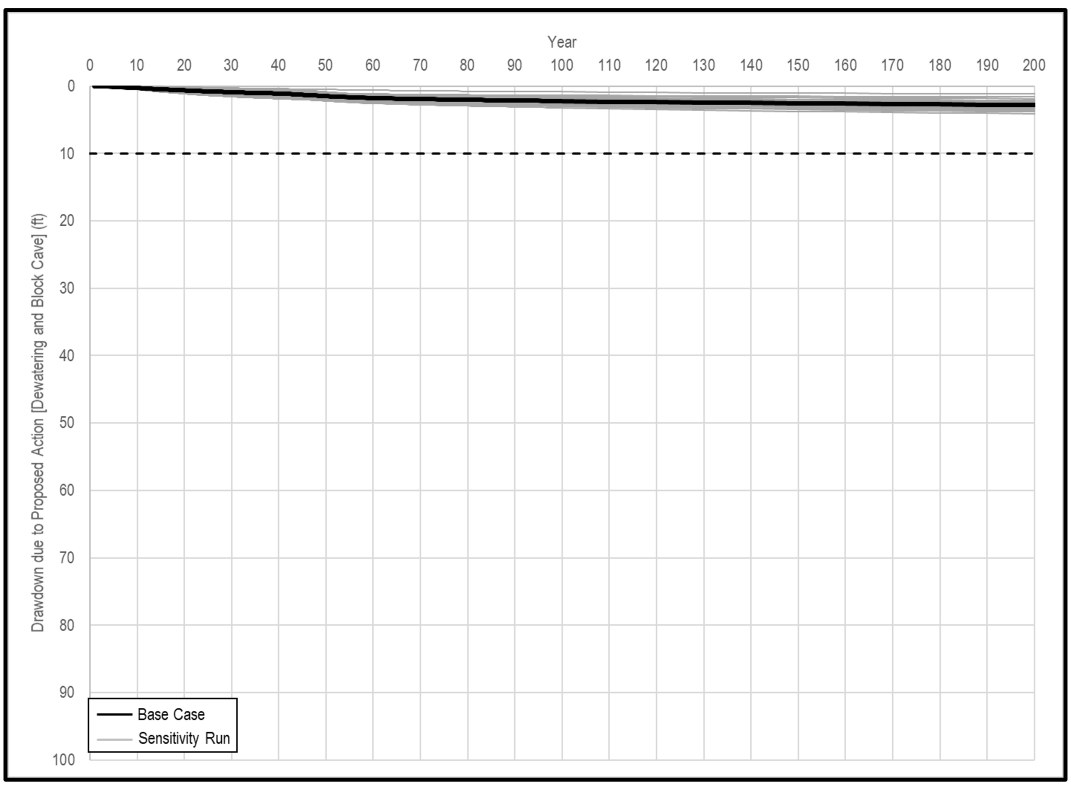
Middle Devil's Canyon (from km 9.3 to km 6.1). Specific location: DC-6.6W—no action.



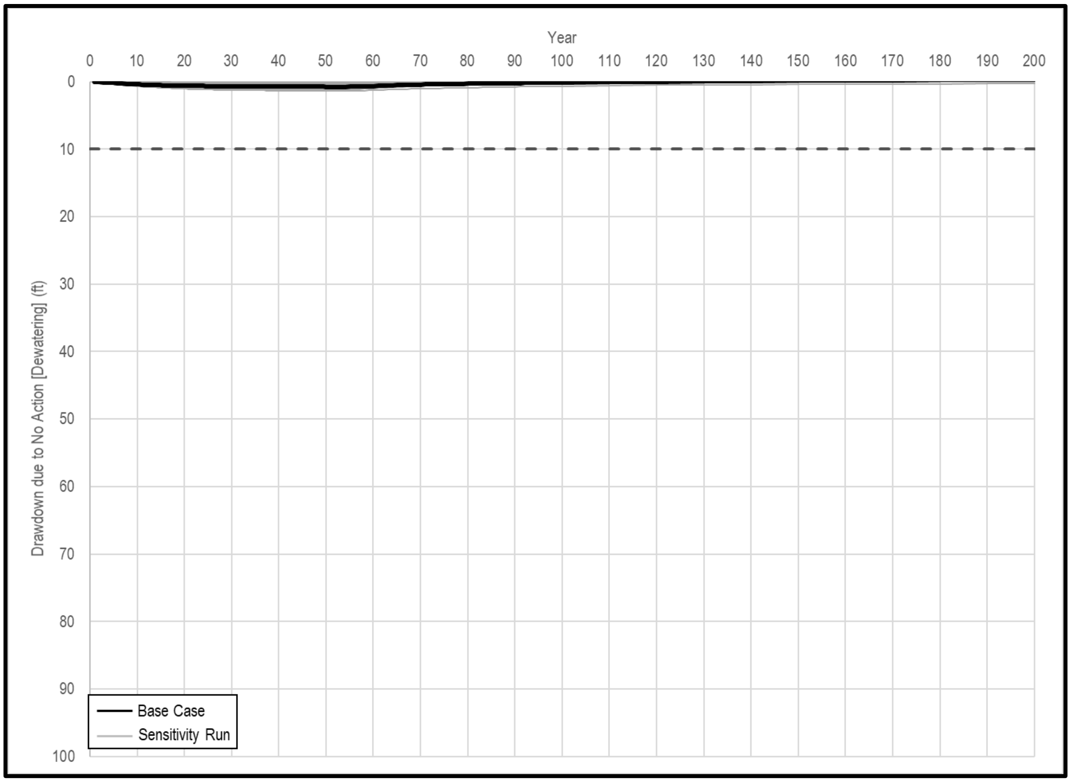
Middle Devil's Canyon (from km 9.3 to km 6.1). Specific location: DC-6.6W—proposed action.



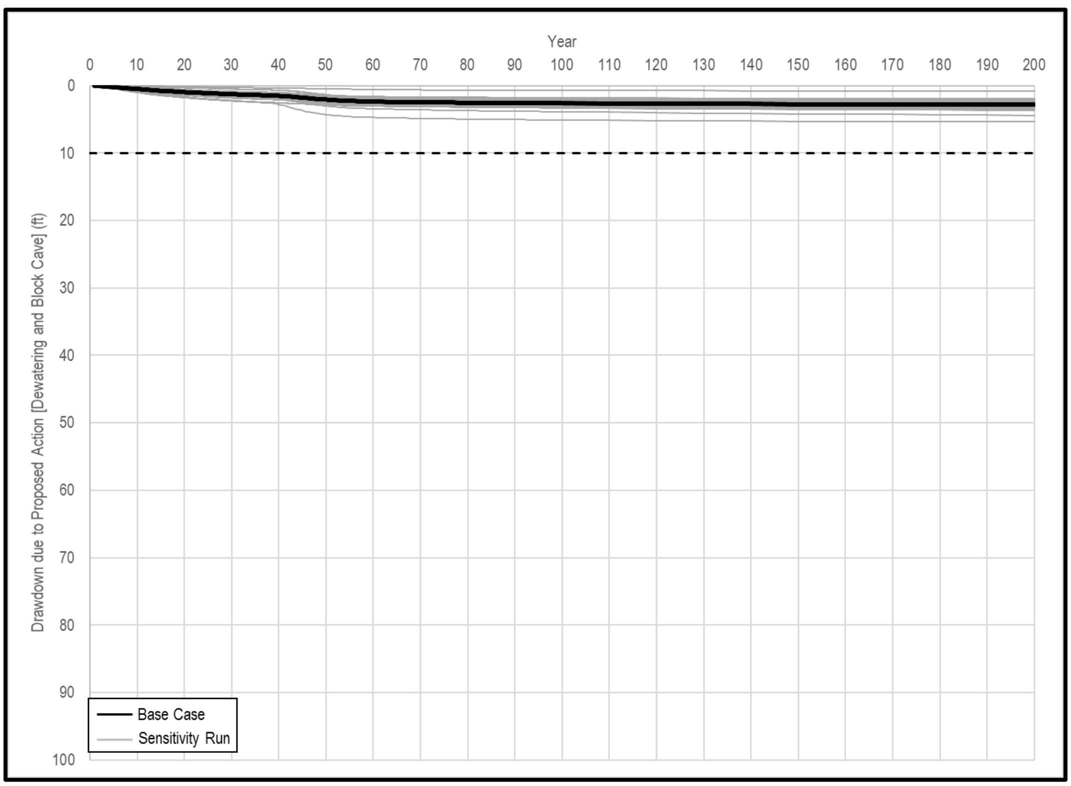
Middle Devil's Canyon (from km 9.3 to km 6.1). Specific location: DC-6.1E—no action.



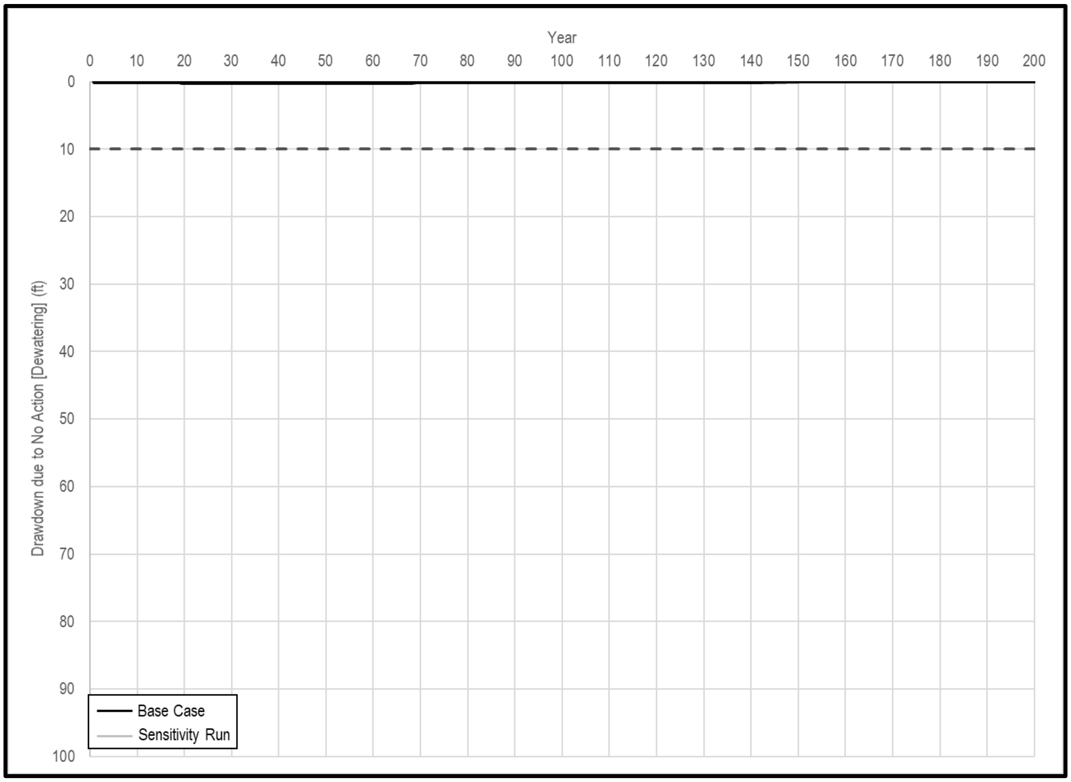
Middle Devil's Canyon (from km 9.3 to km 6.1). Specific location: DC-6.1E—proposed action.



Lower Devil's Canyon (from km 6.1 to confluence with Mineral Creek). Specific location: DC-5.5C—no action.



Lower Devil's Canyon (from km 6.1 to confluence with Mineral Creek). Specific location: DC-5.5C—proposed action.



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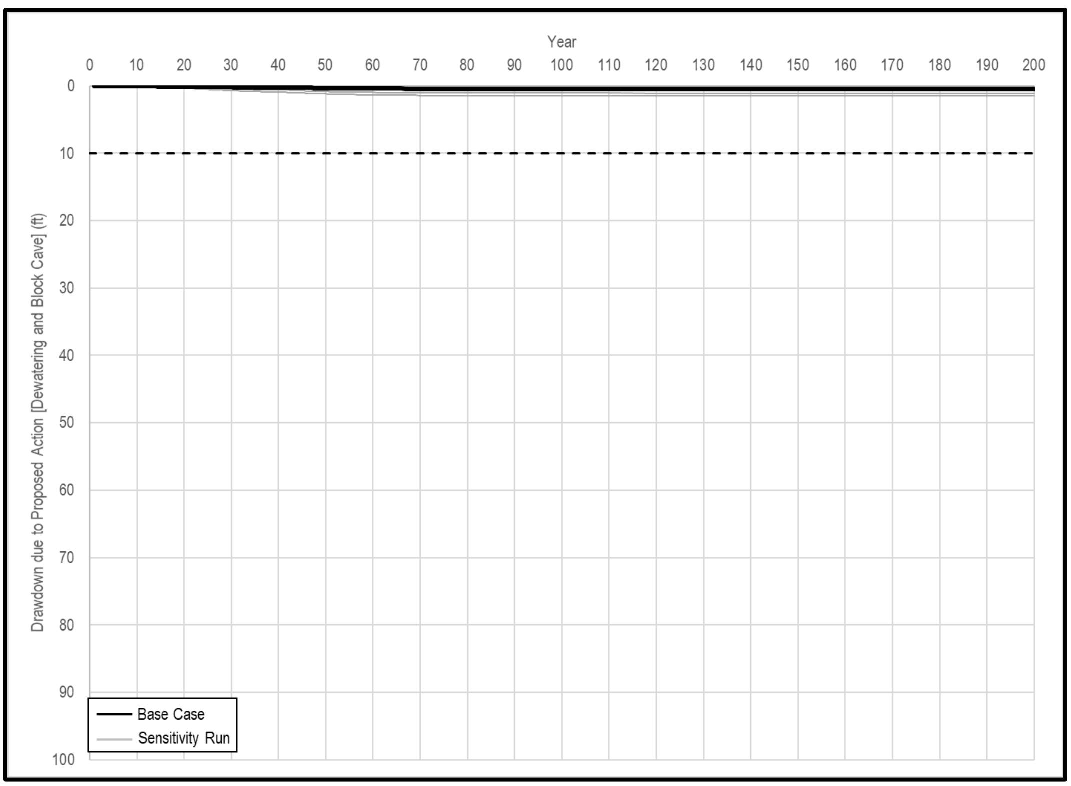
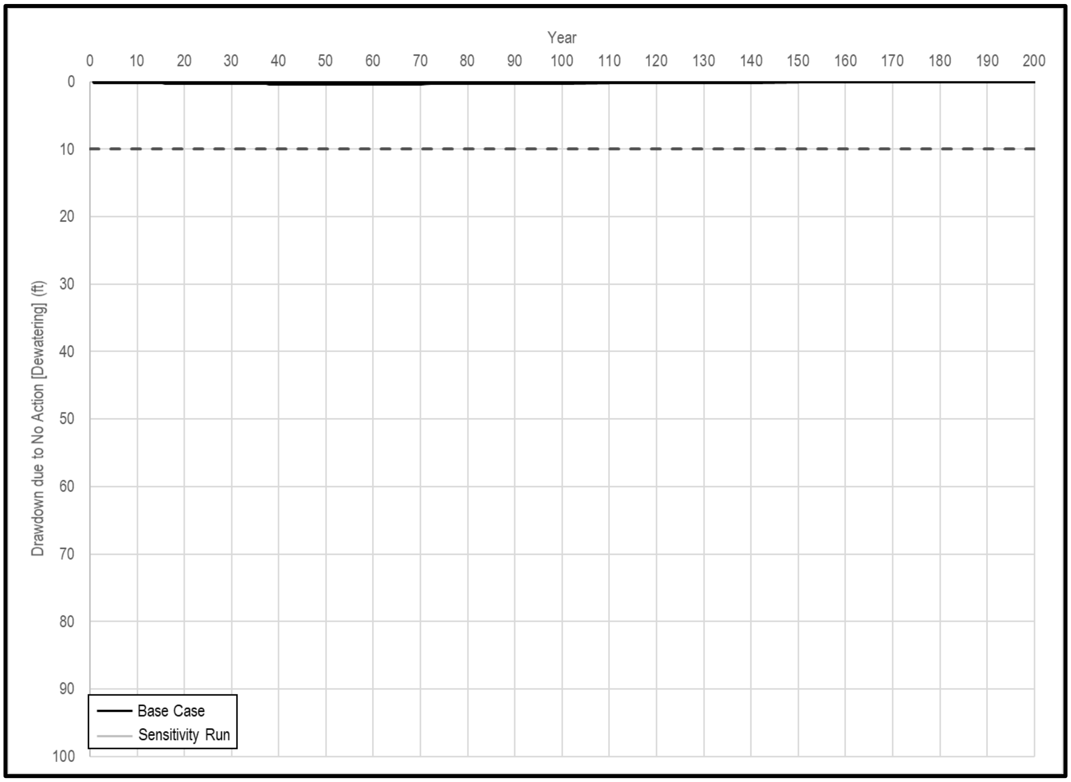
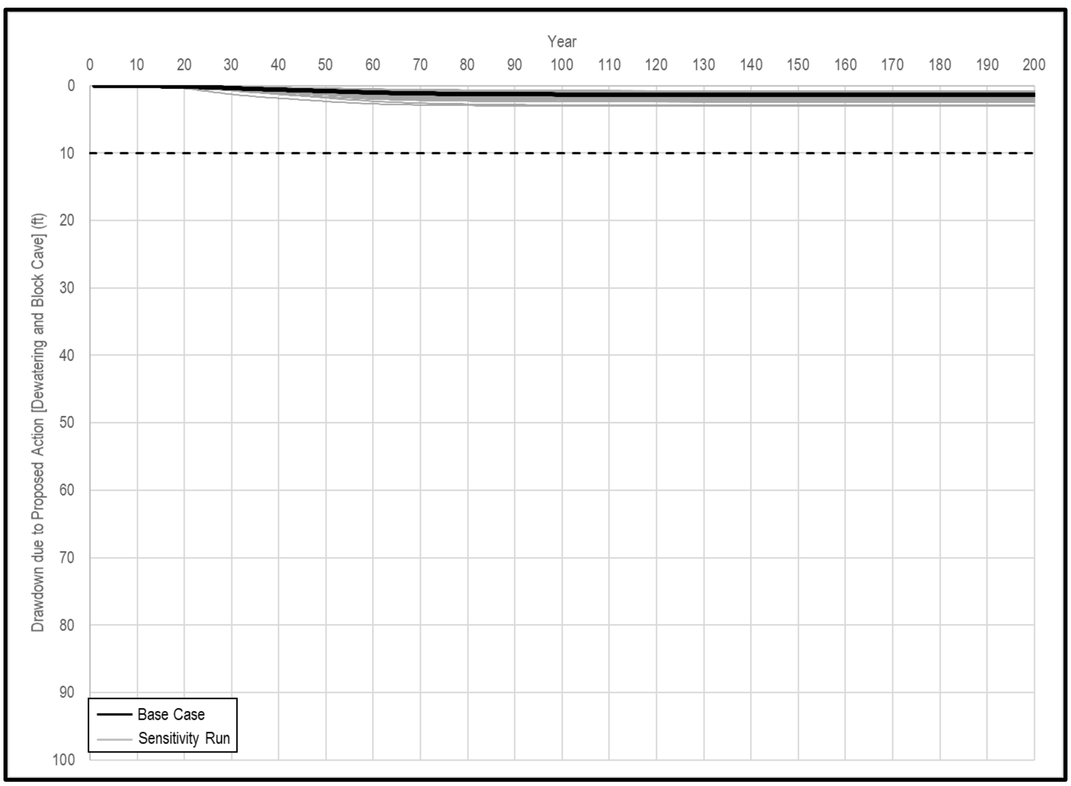


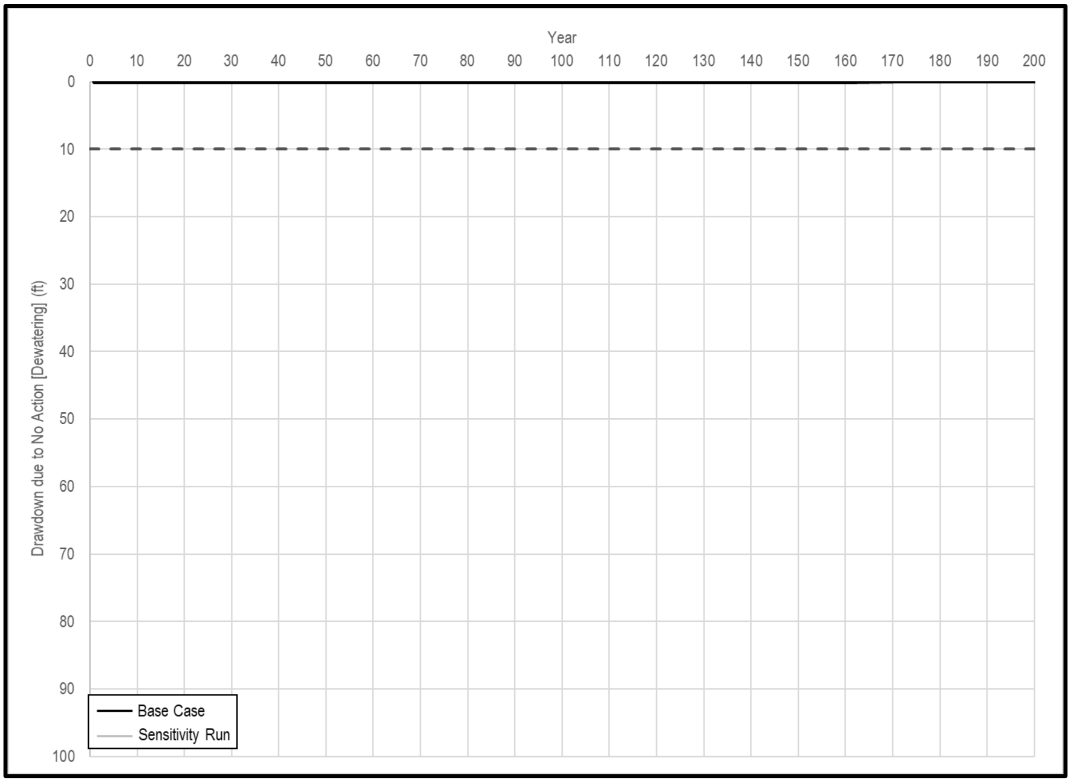
Lower Devil's Canyon (from km 6.1 to confluence with Mineral Creek). Specific location: DC-4.1E—proposed action.



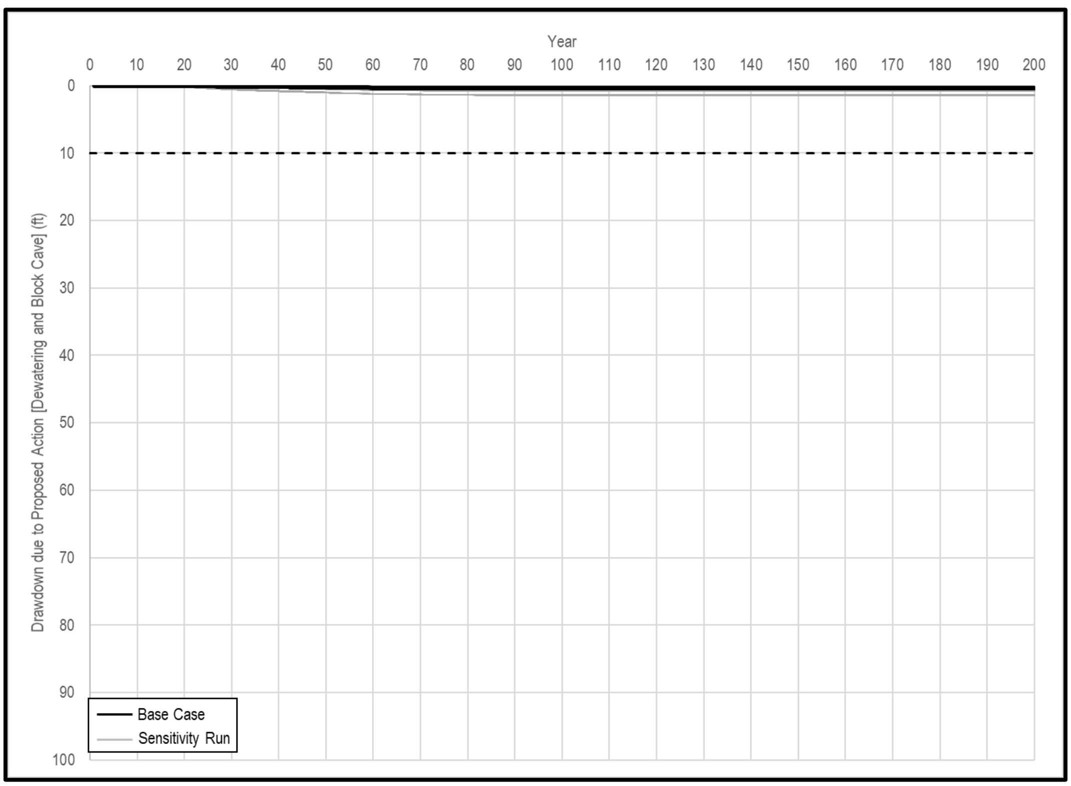
Mineral Creek (from Government Springs [km 8.7] to confluence with Devil's Canyon). Specific location: MC-6.9—no action.



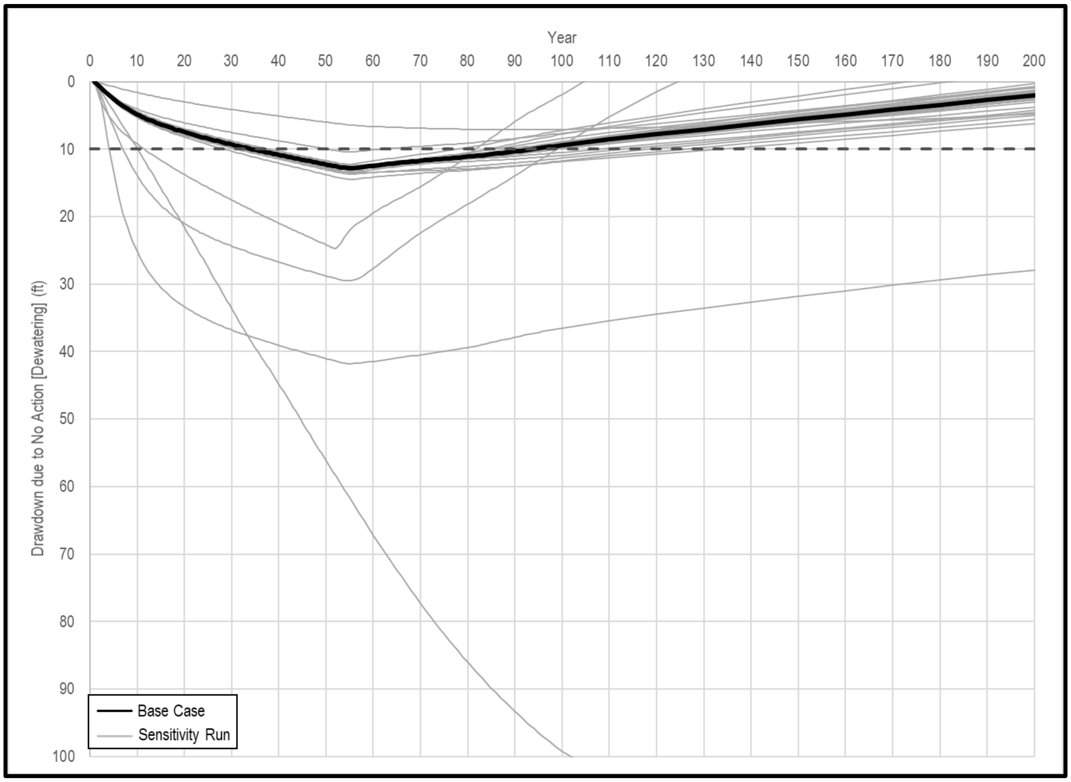
Mineral Creek (from Government Springs [km 8.7] to confluence with Devil's Canyon). Specific location: MC-6.9—proposed action.



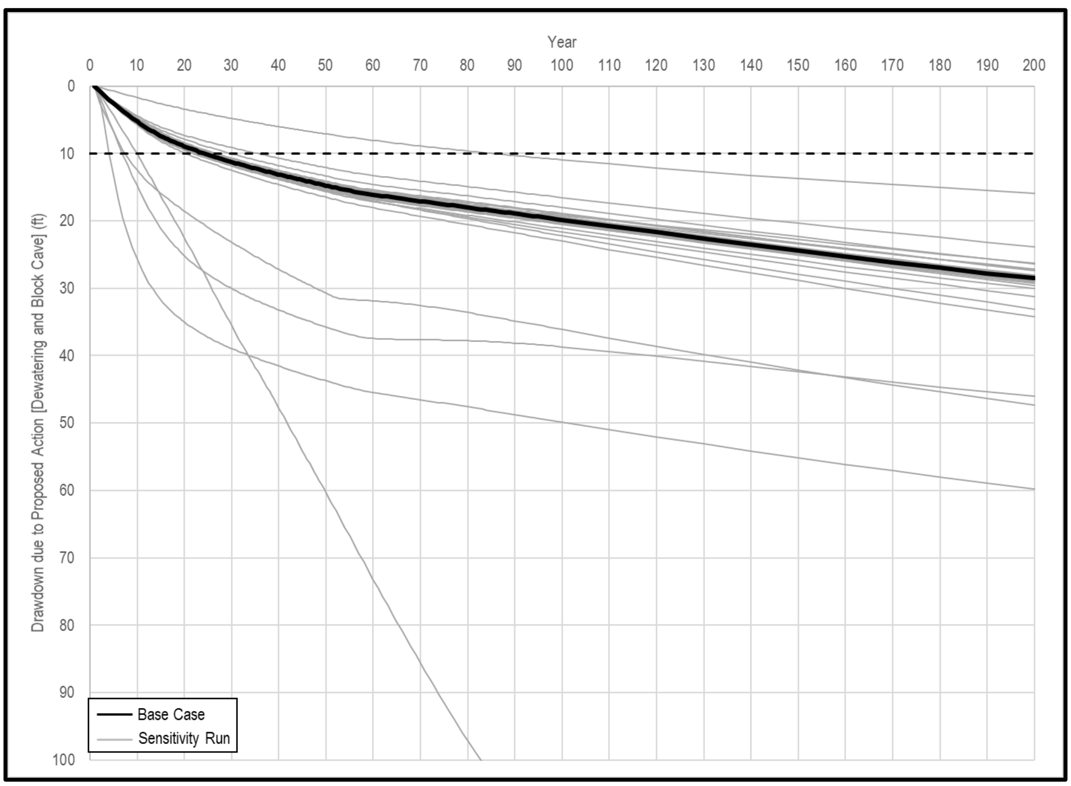
Mineral Creek (from Government Springs [km 8.7] to confluence with Devil's Canyon). Specific location: Lower Mineral Creek—no action.



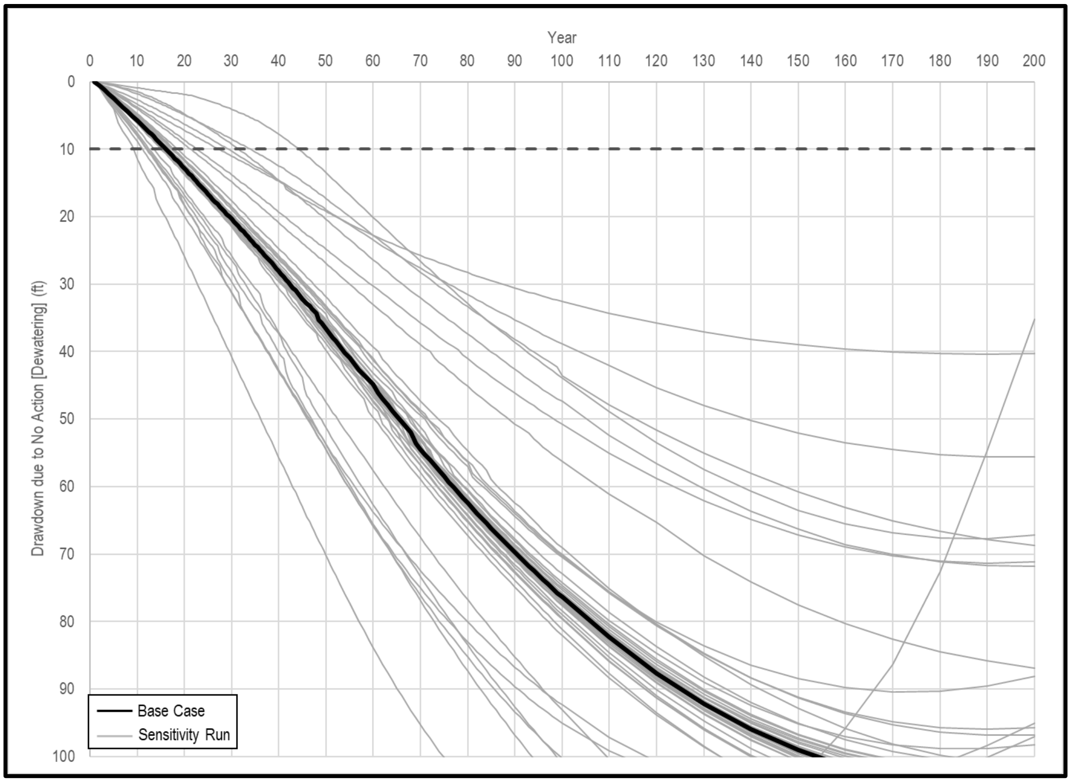
Mineral Creek (from Government Springs [km 8.7] to confluence with Devil's Canyon). Specific location: Lower Mineral Creek—proposed action.



Bitter Spring—no action



Bitter Spring—proposed action



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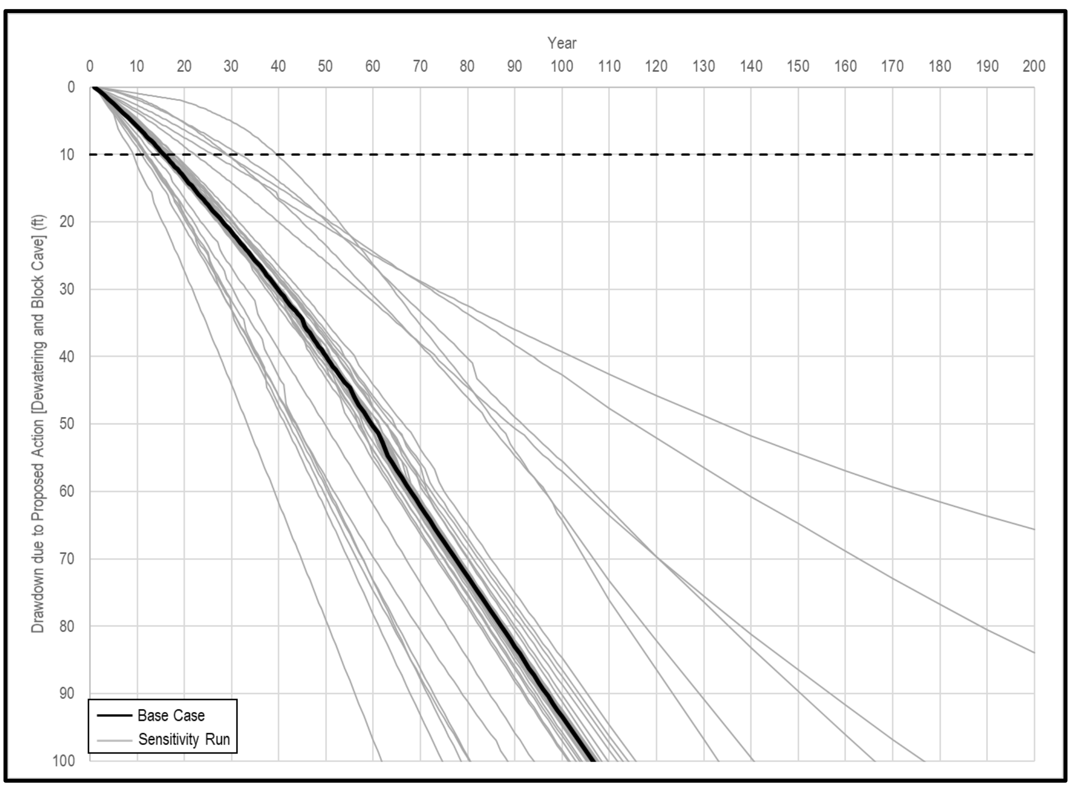

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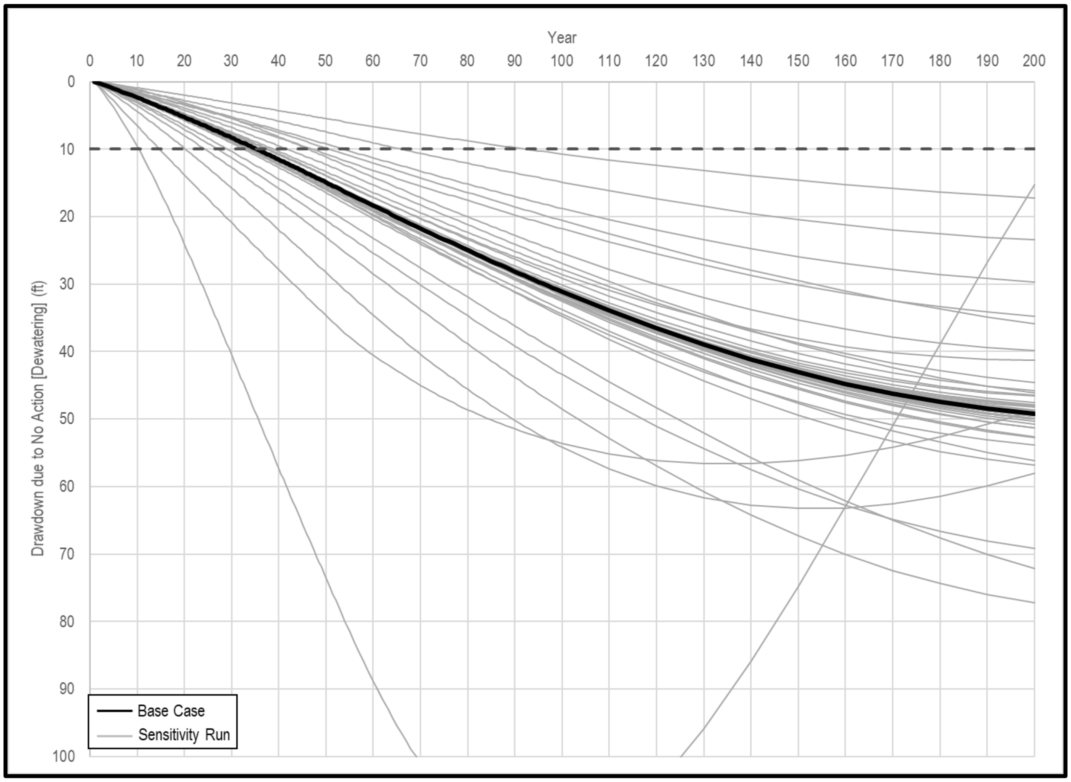
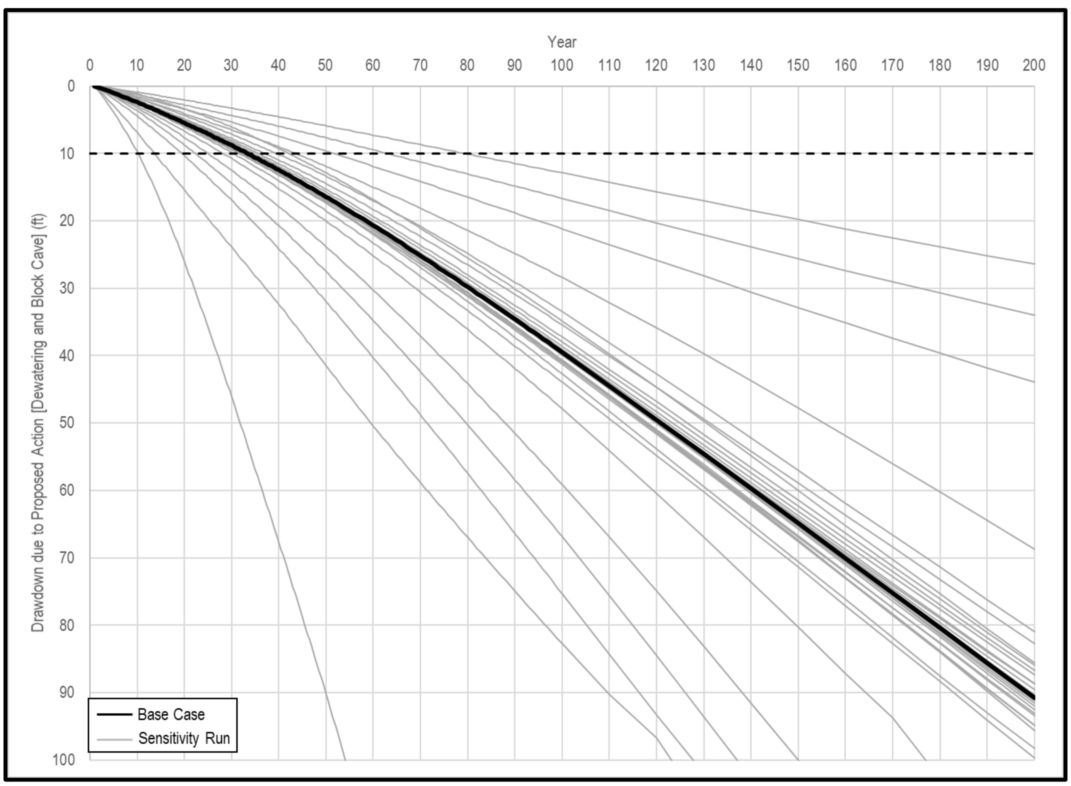
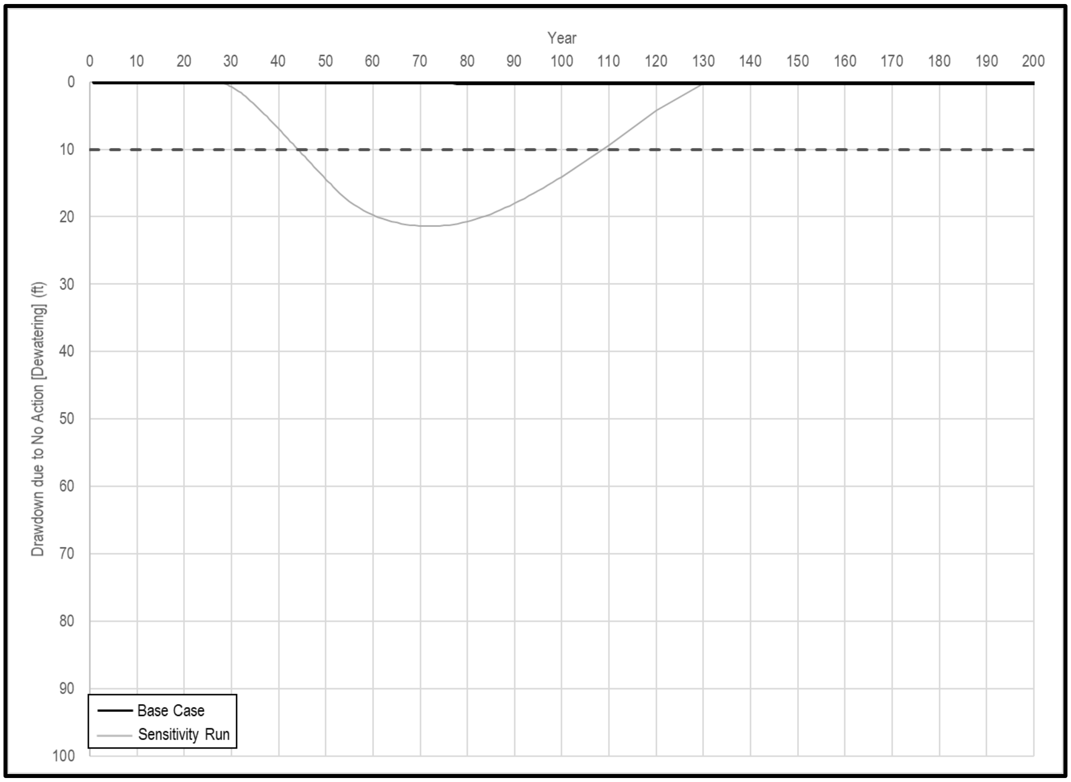


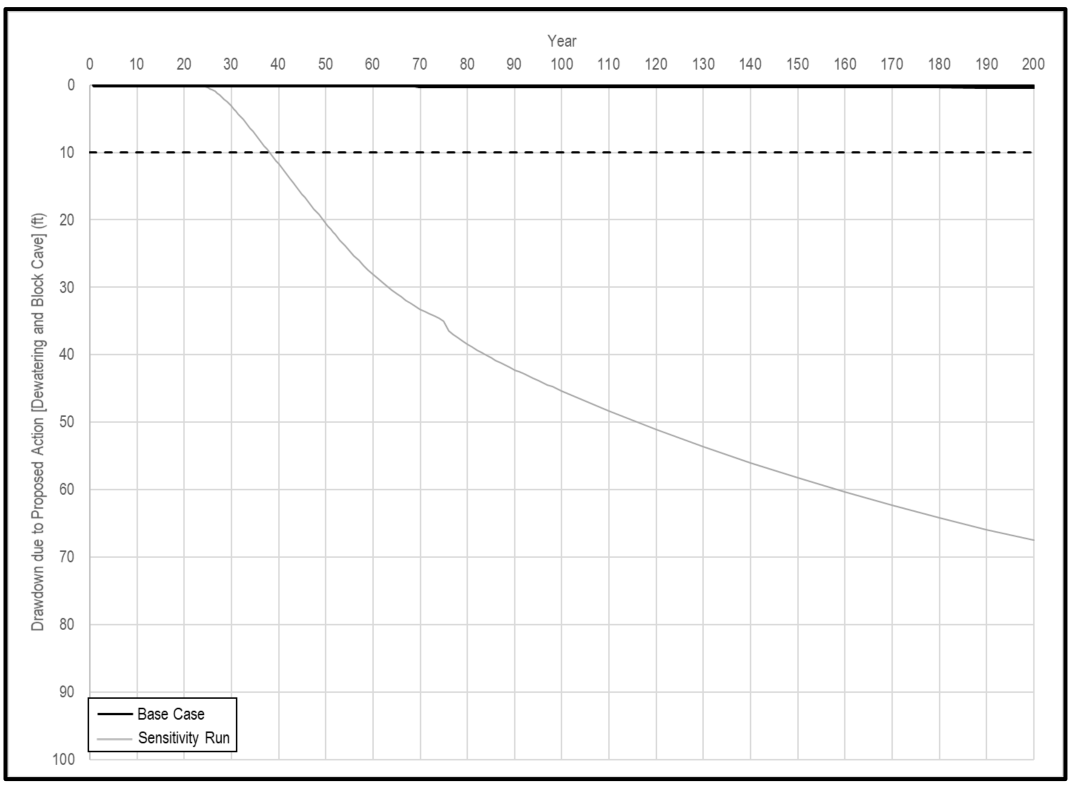
Hidden Spring—no action



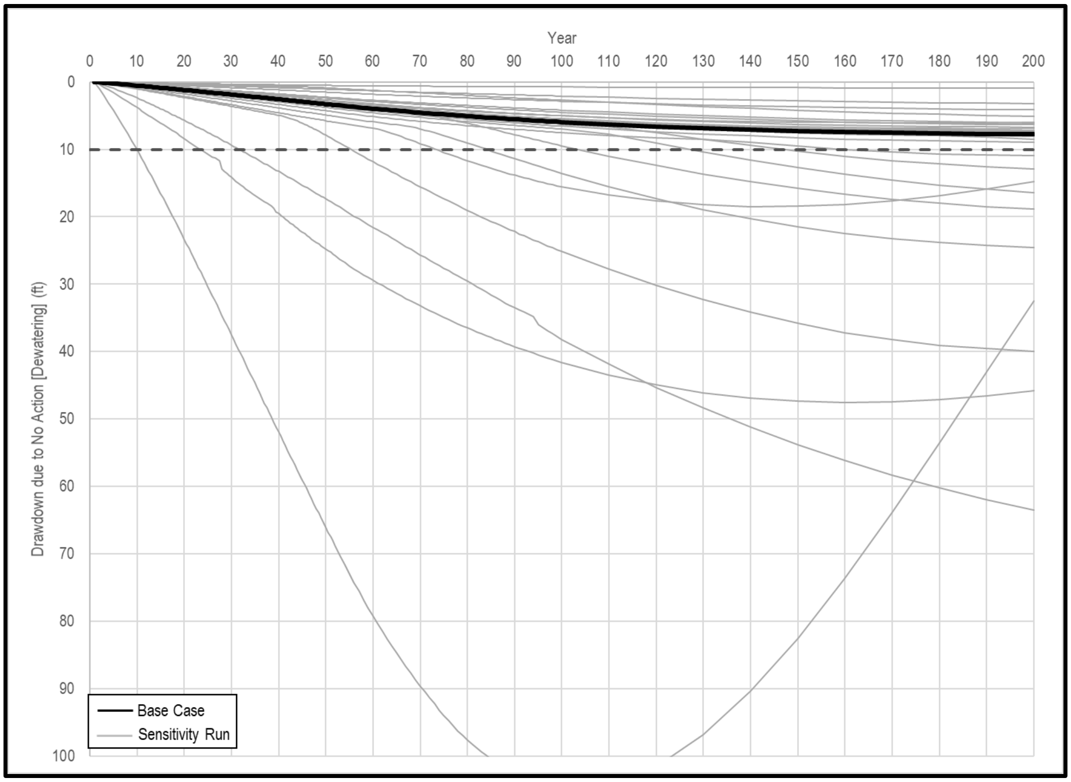
Hidden Spring—proposed action



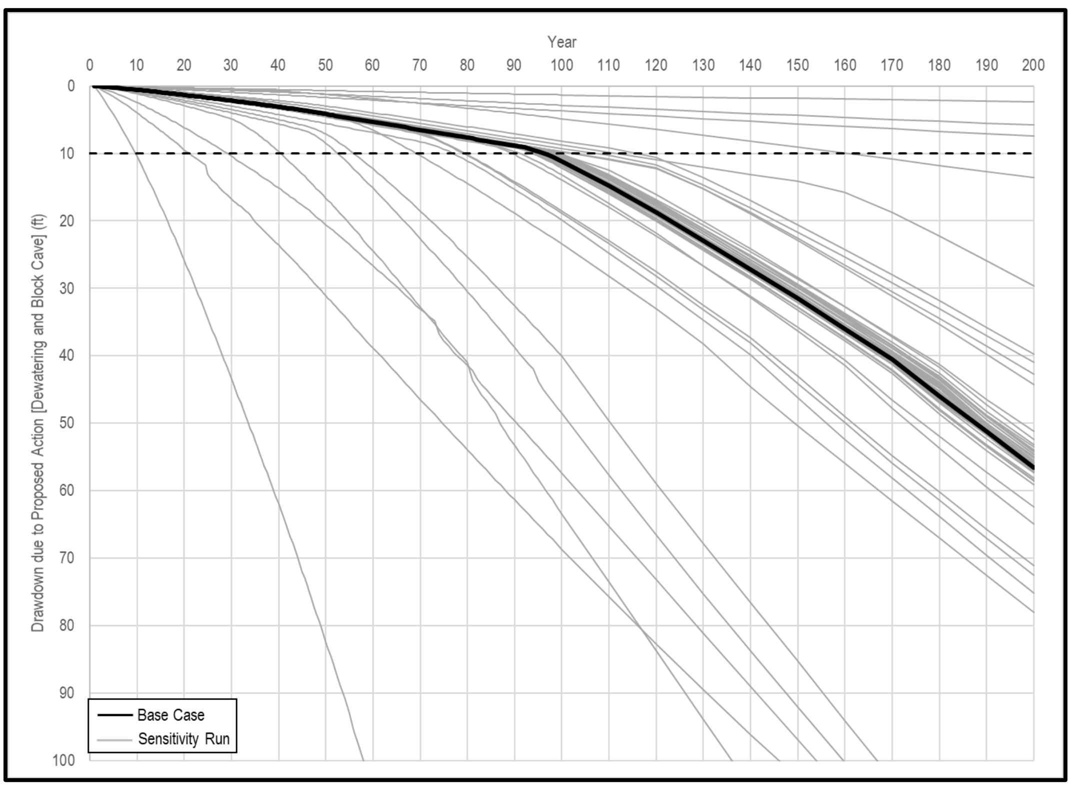
Iberri Spring—no action



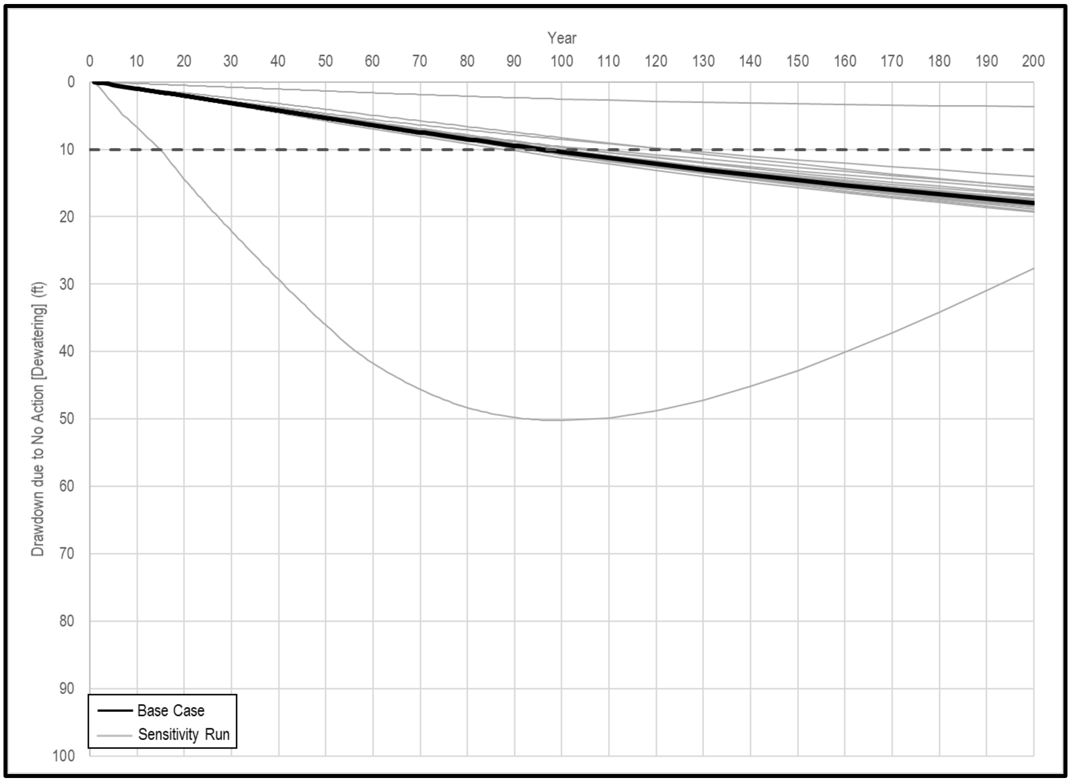
Iberri Spring—proposed action



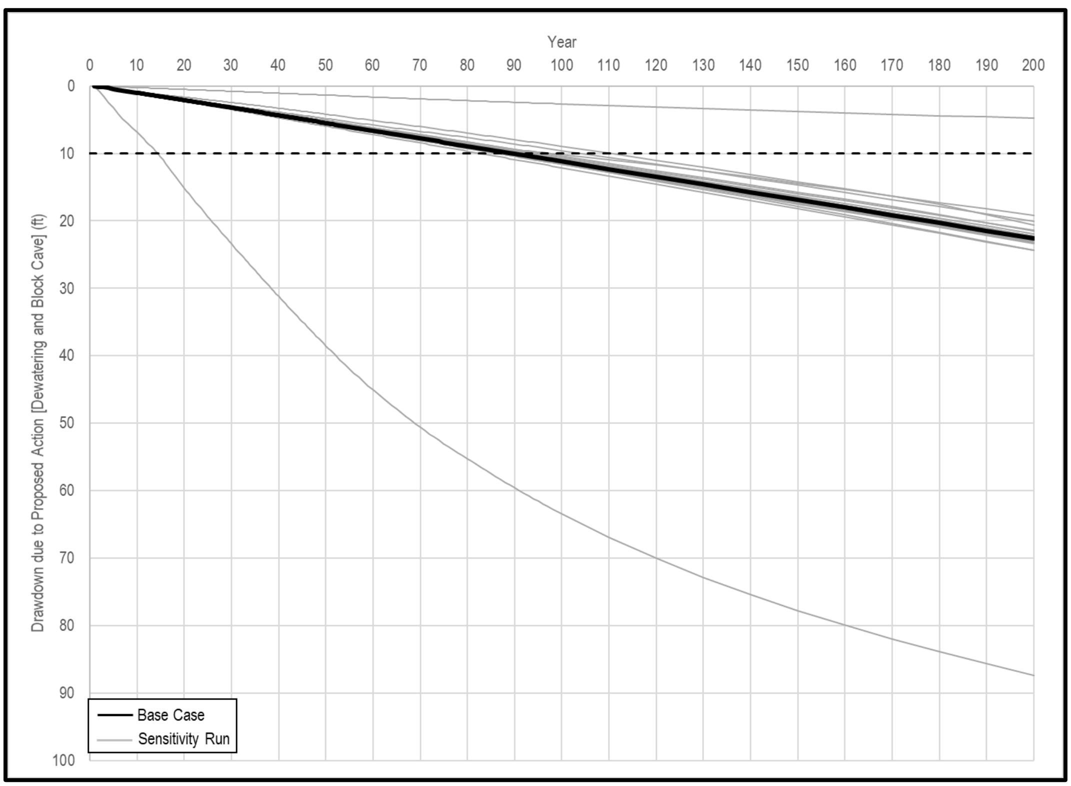
Kane Spring—no action



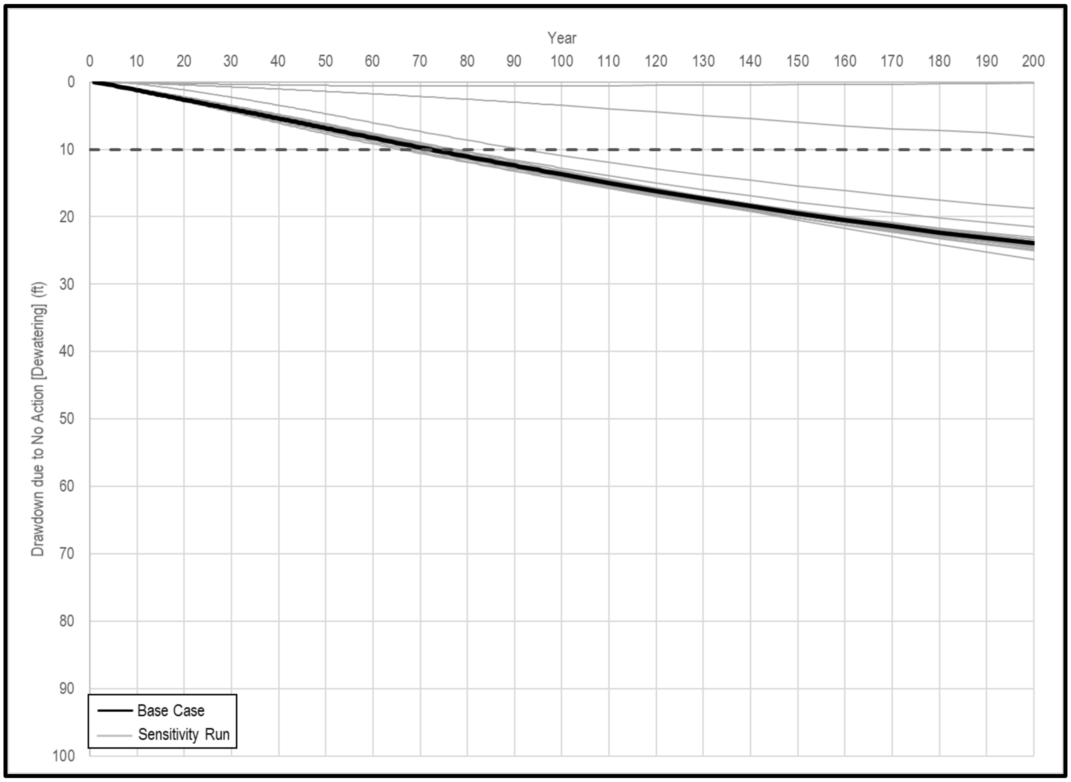
Kane Spring—proposed action



McGinnel Mine Spring—no action



McGinnel Mine Spring—proposed action



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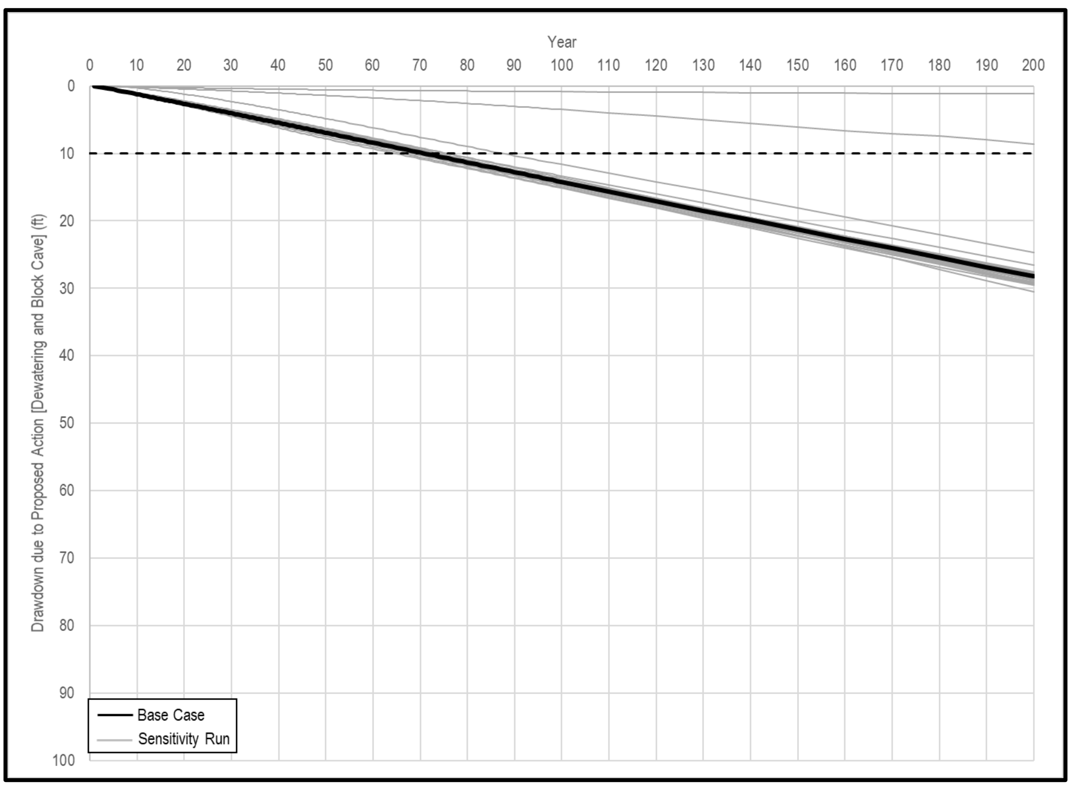
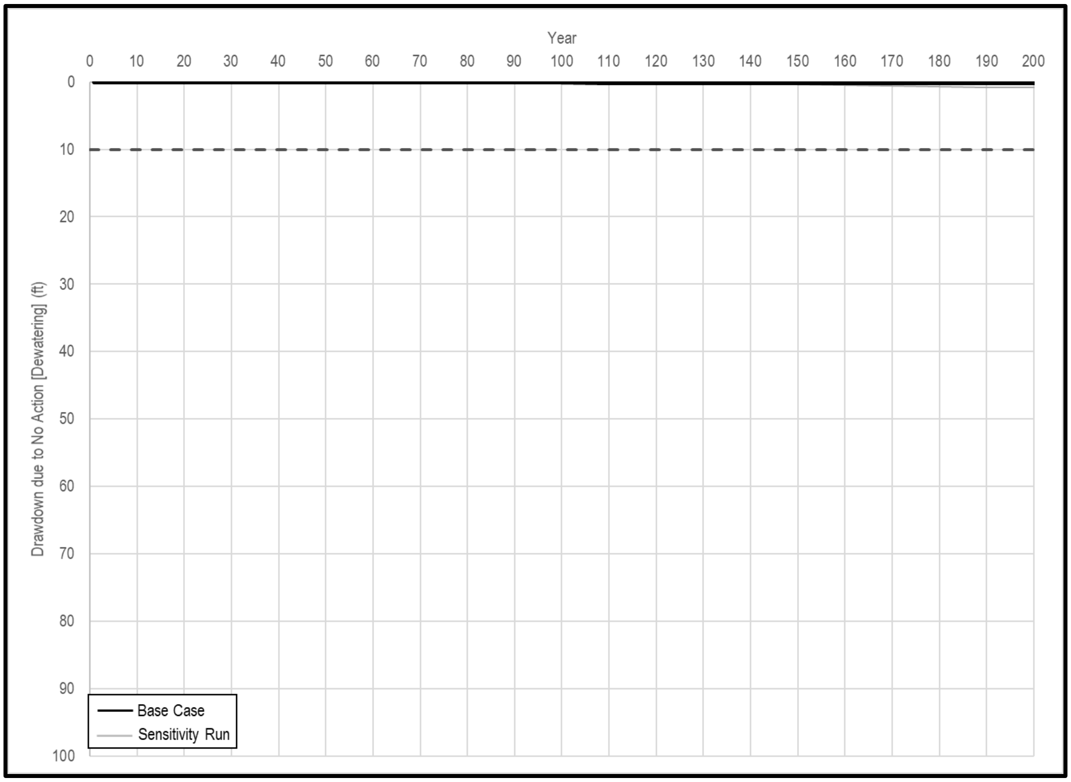


McGinnel Spring—proposed action



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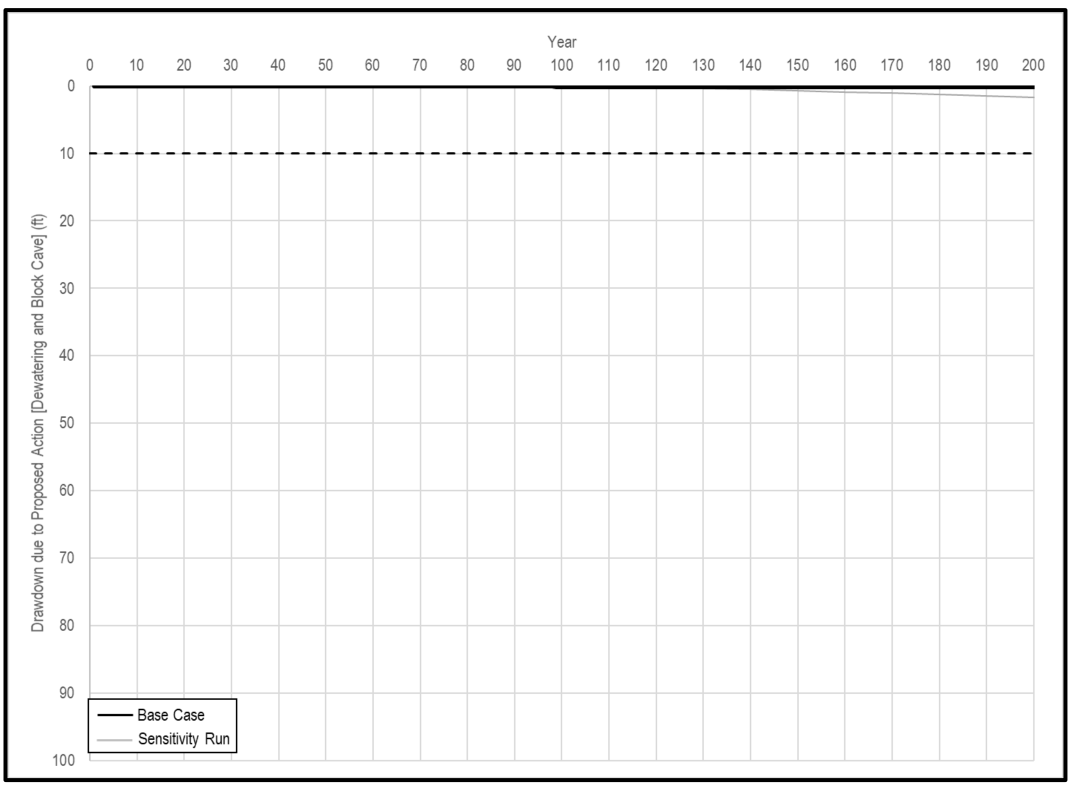
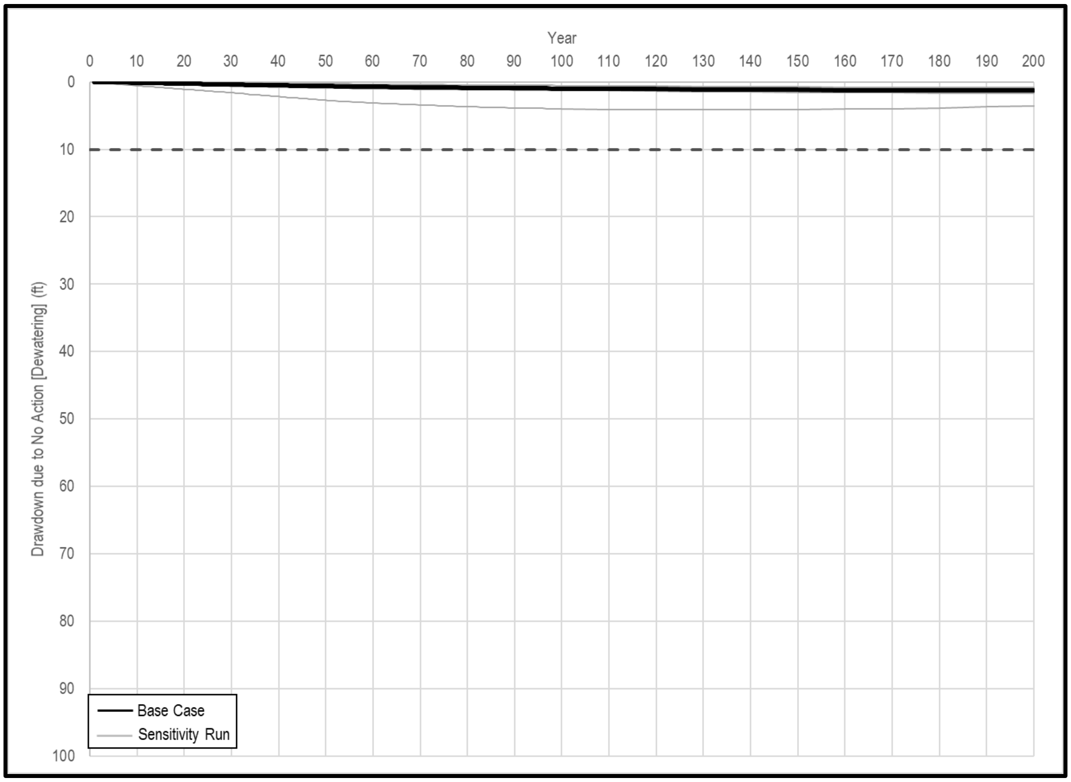
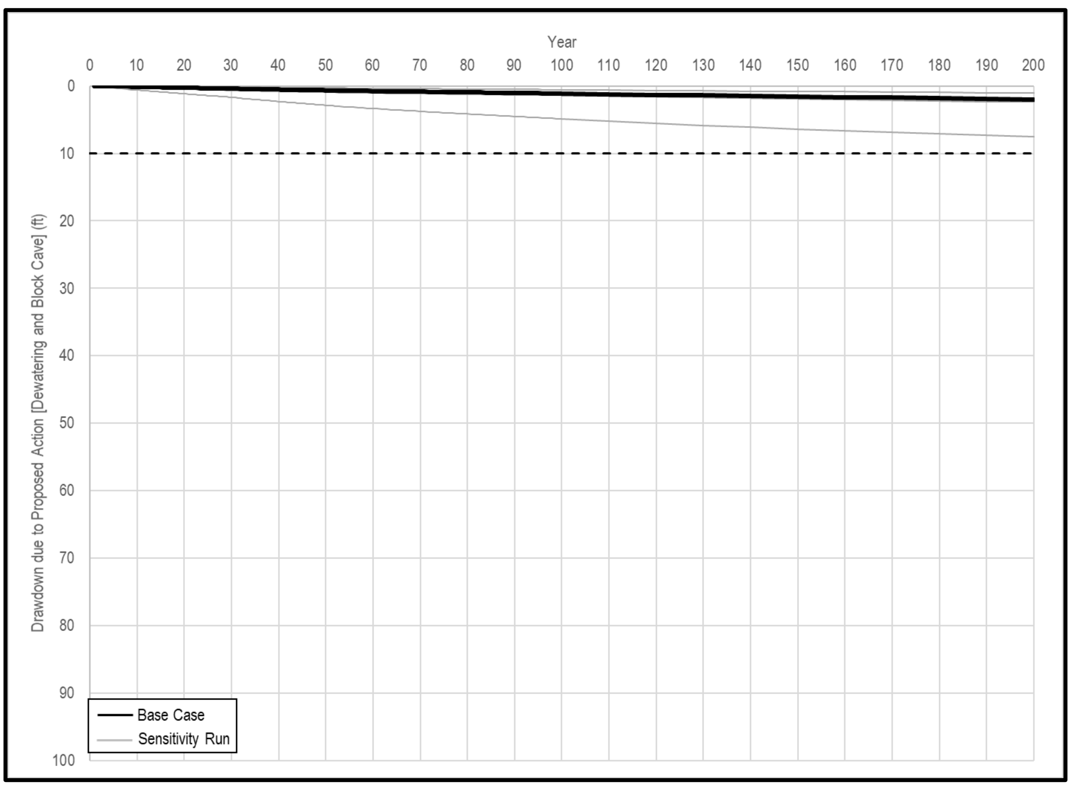


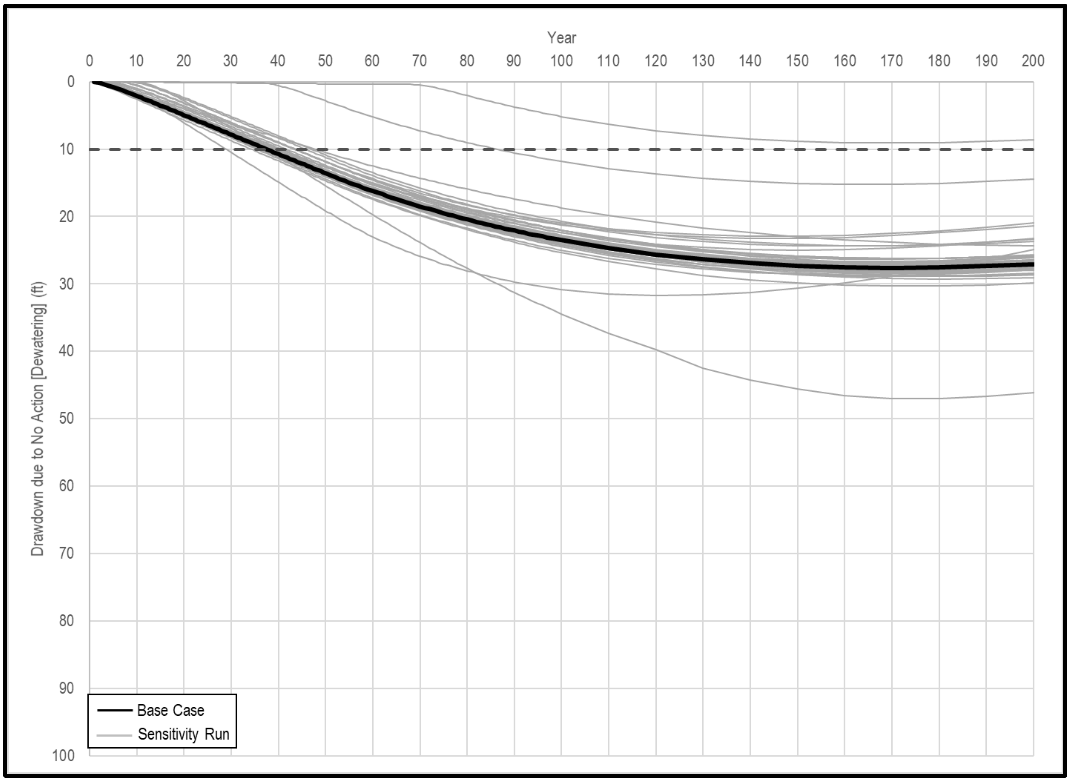
No Name Spring—proposed action



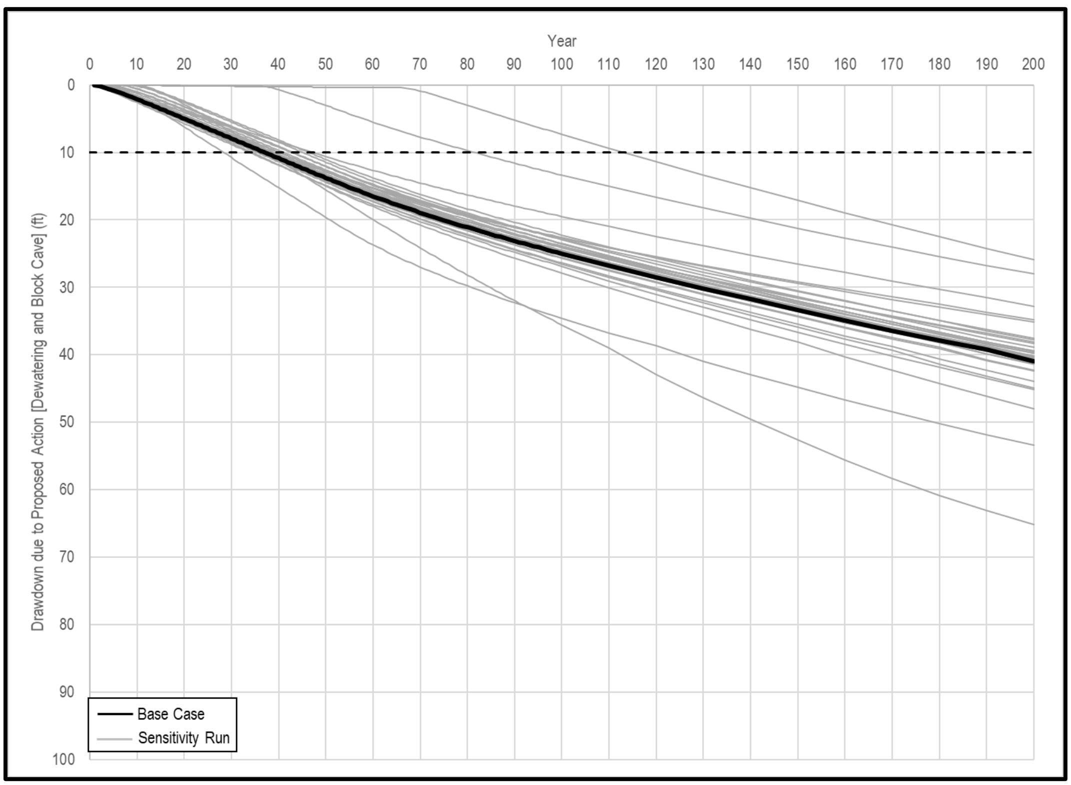
Rock Horizontal Spring—no action



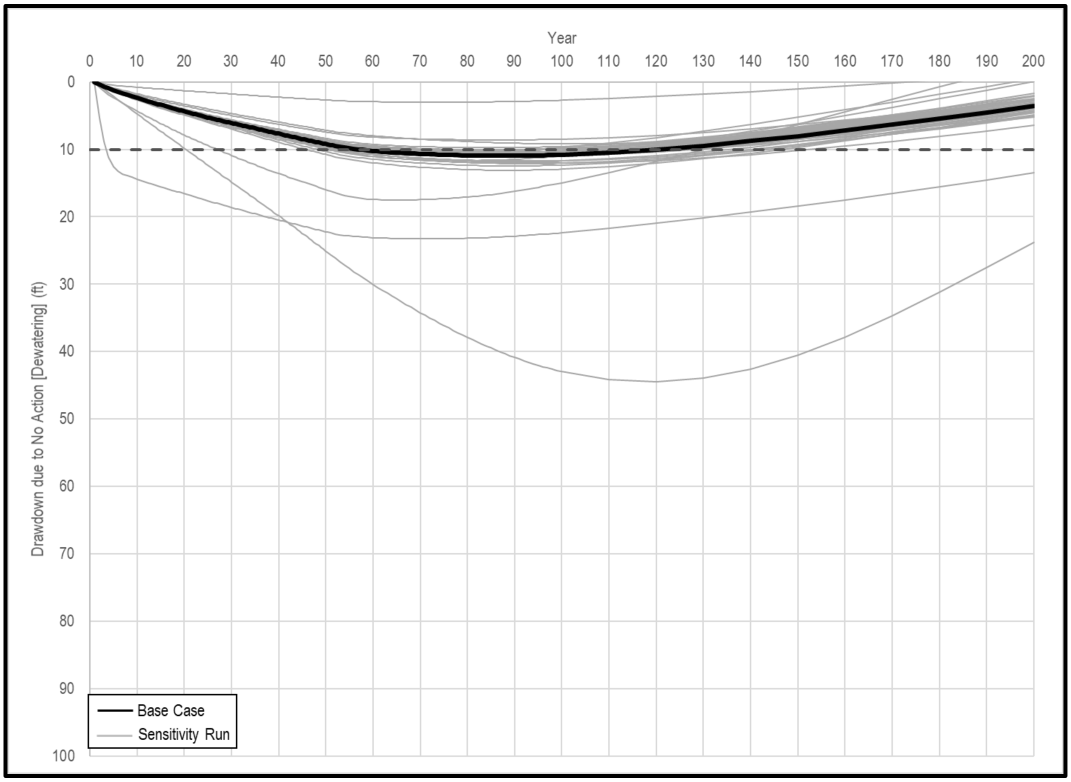
Rock Horizontal Spring—proposed action



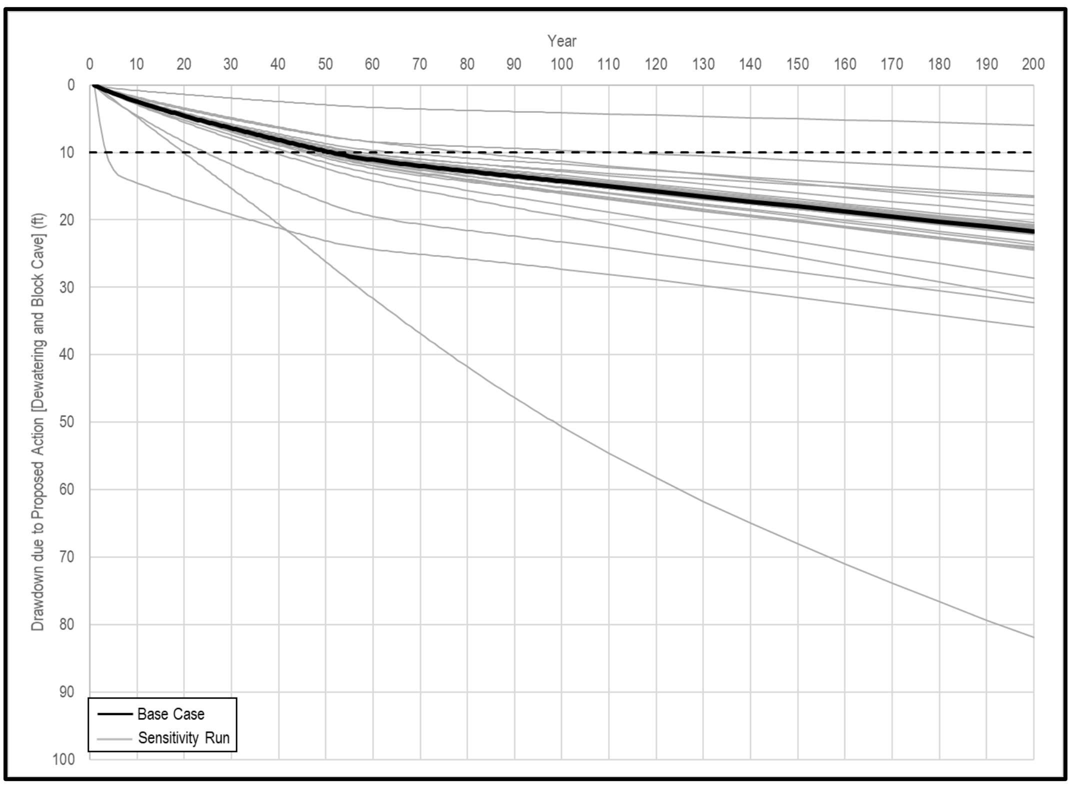
Walker Spring—no action



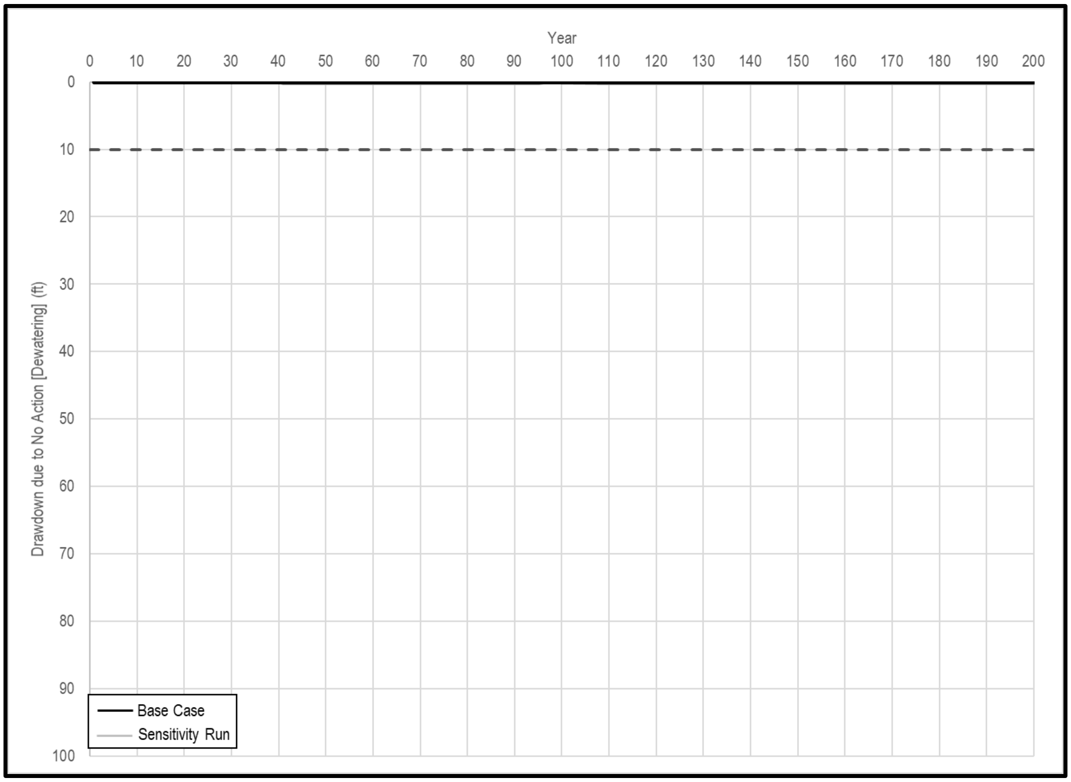
Walker Spring—proposed action



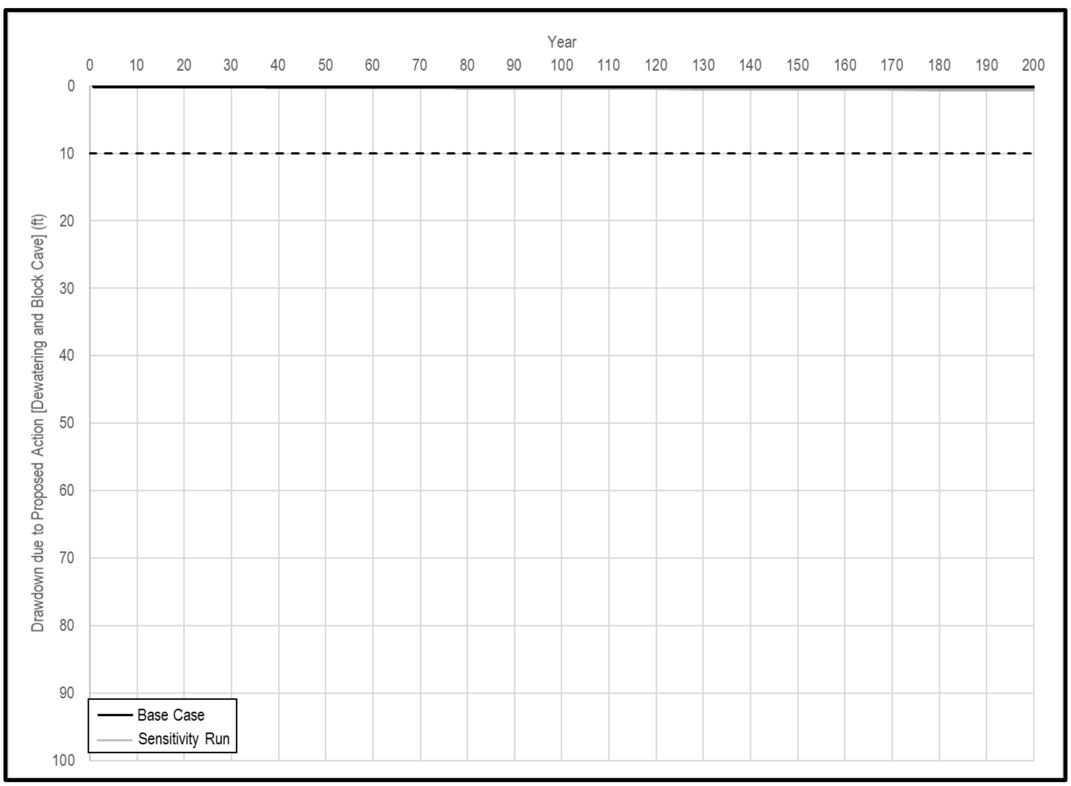
DHRES-16_743 (Superior)—no action



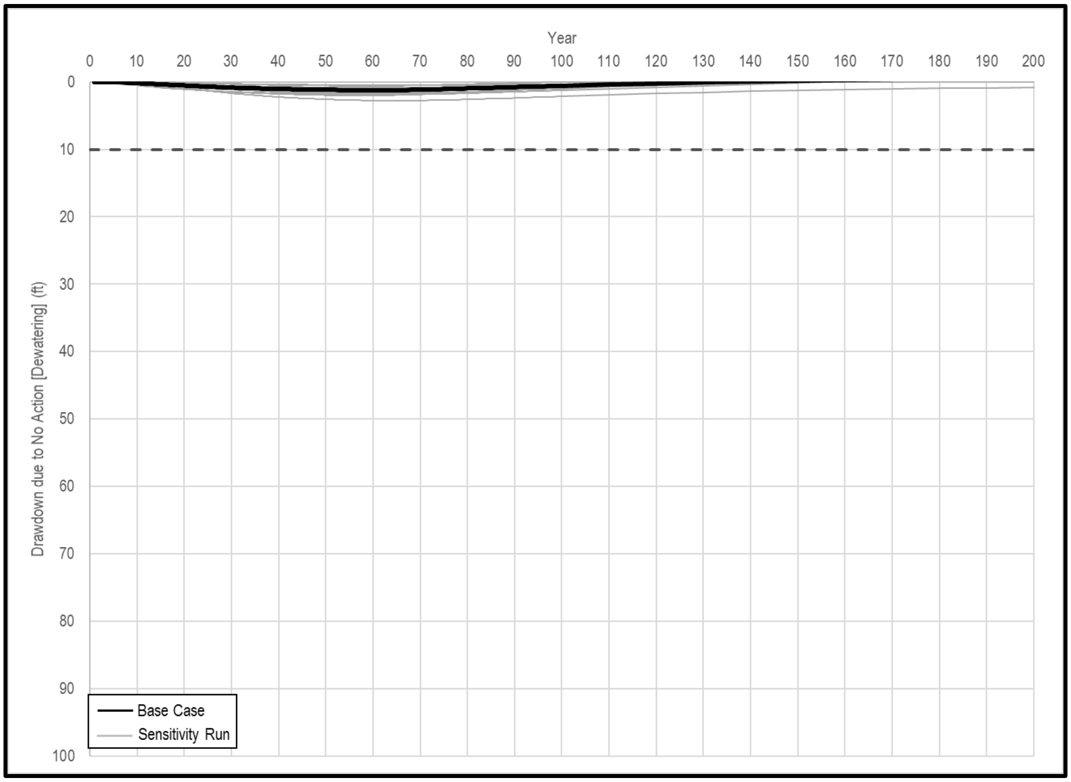
DHRES-16_743 (Superior)—proposed action



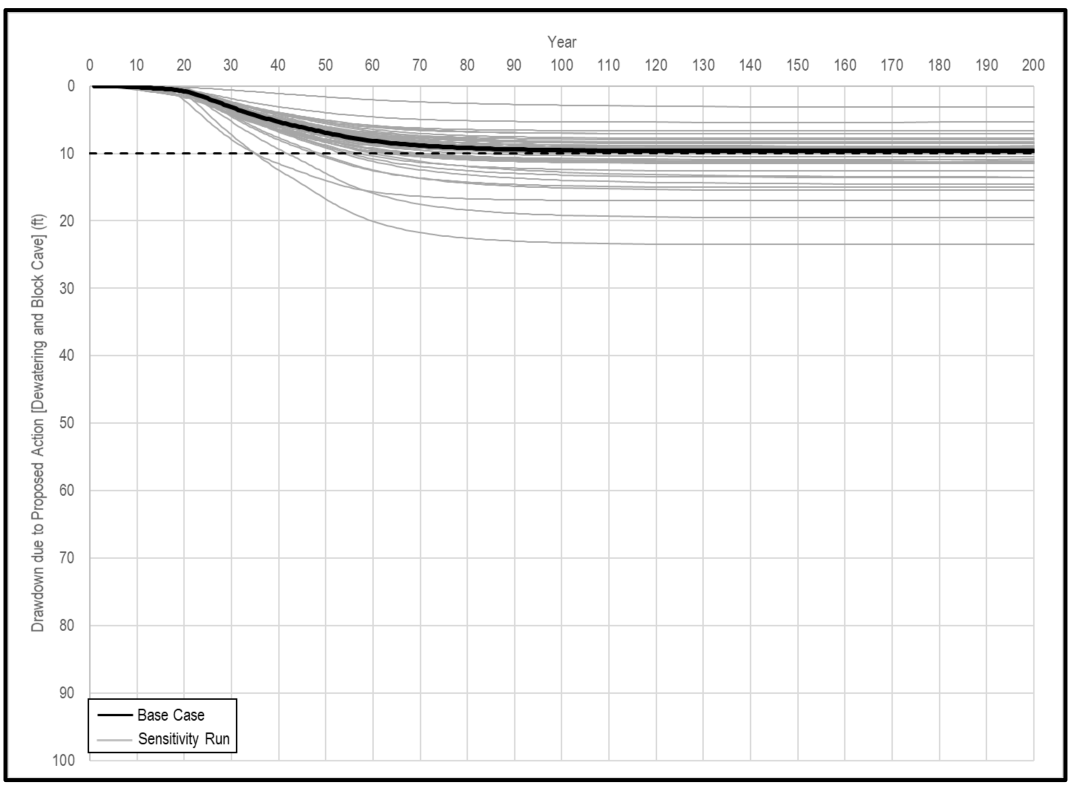
Gallery Well (Boyce Thompson Arboretum)—no action



Gallery Well (Boyce Thompson Arboretum)—proposed action



HRES-06 (Top-of-the-World)—no action



HRES-06 (Top-of-the-World)—proposed action

Appendix M. Water Quality Modeling Results for Constituents of Concern

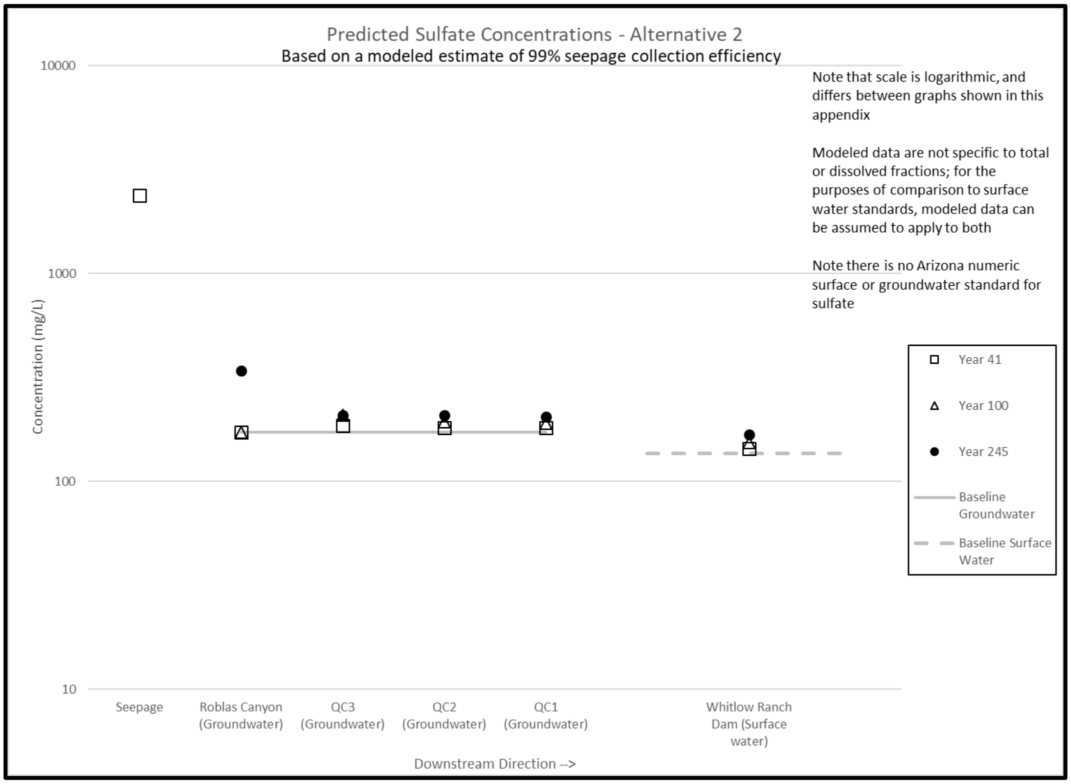


Figure M-1. Predicted sulfate concentrations, Alternative 2

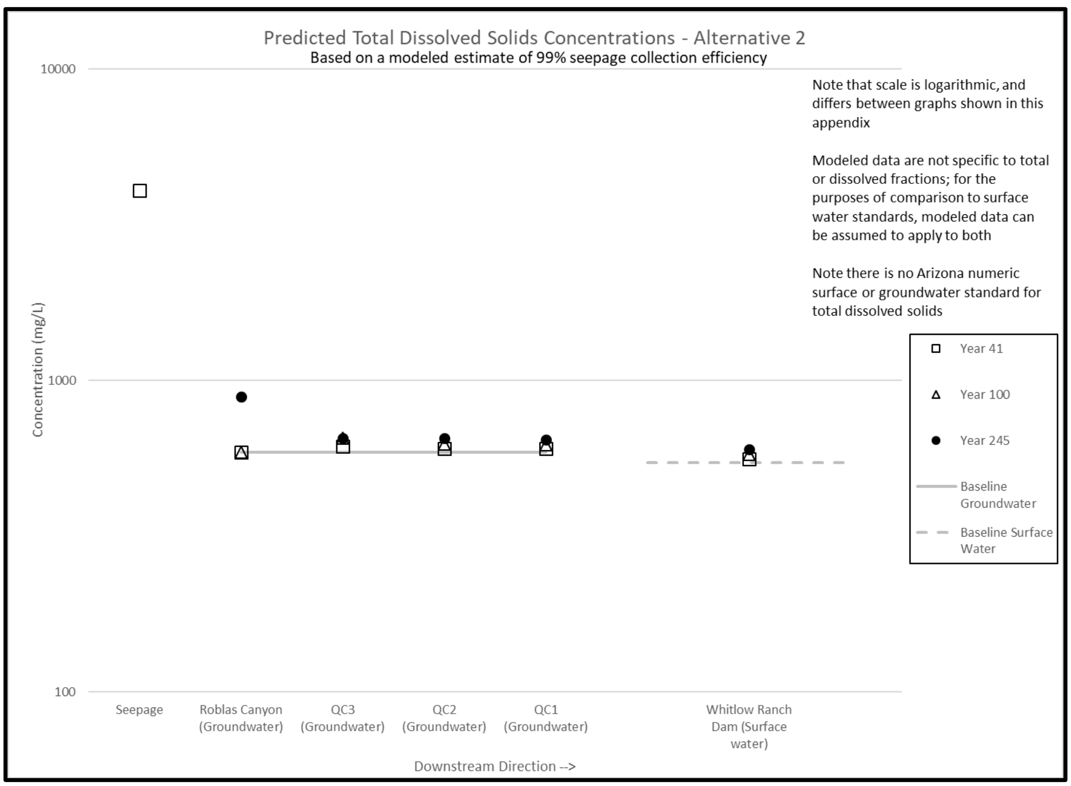


Figure M-2. Predicted total dissolved solids concentrations, Alternative 2

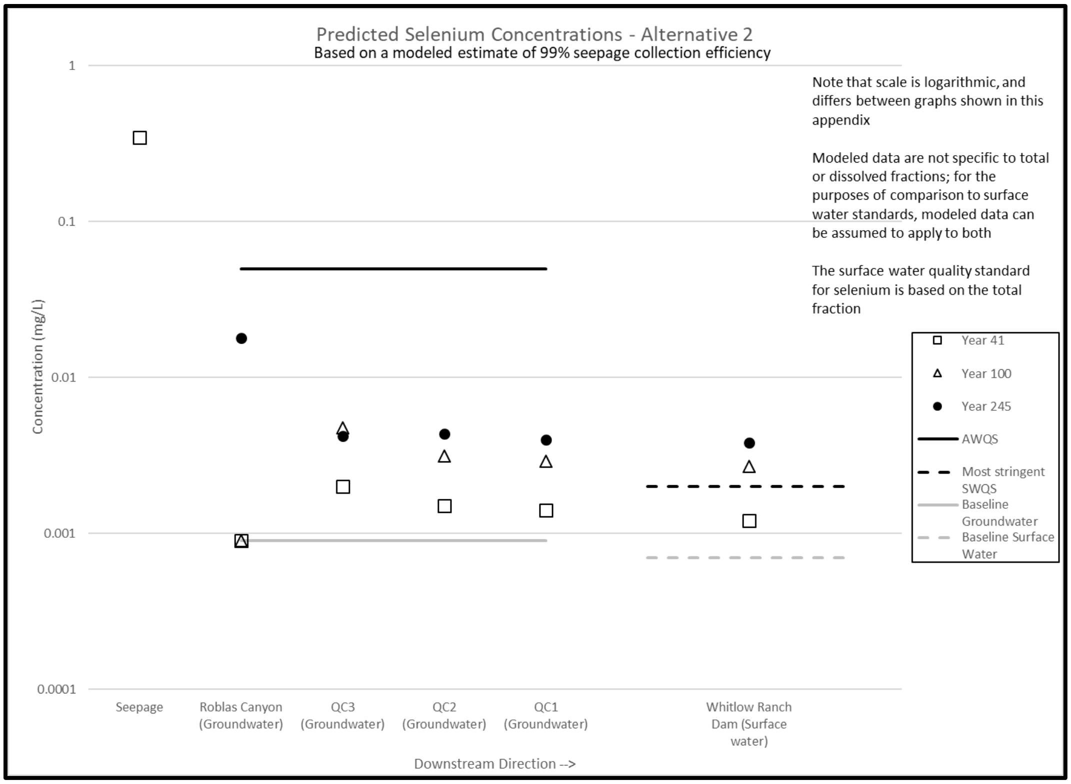


Figure M-3. Predicted selenium concentrations, Alternative 2

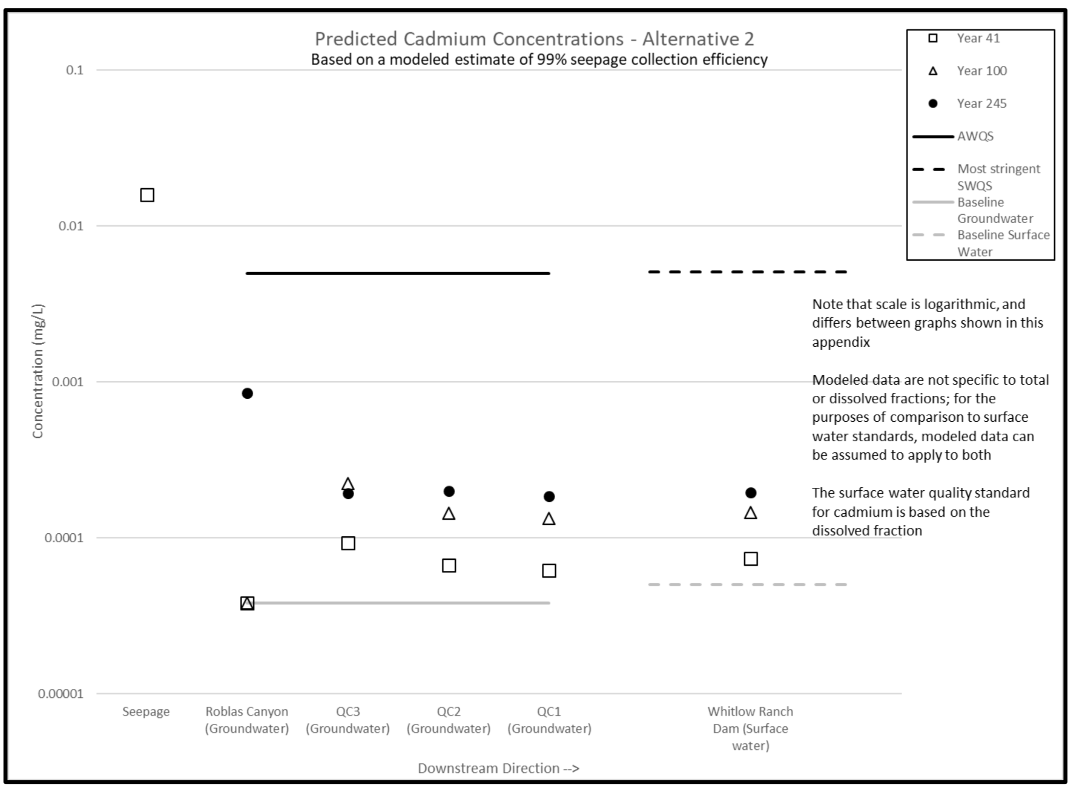


Figure M-4. Predicted cadmium concentrations, Alternative 2

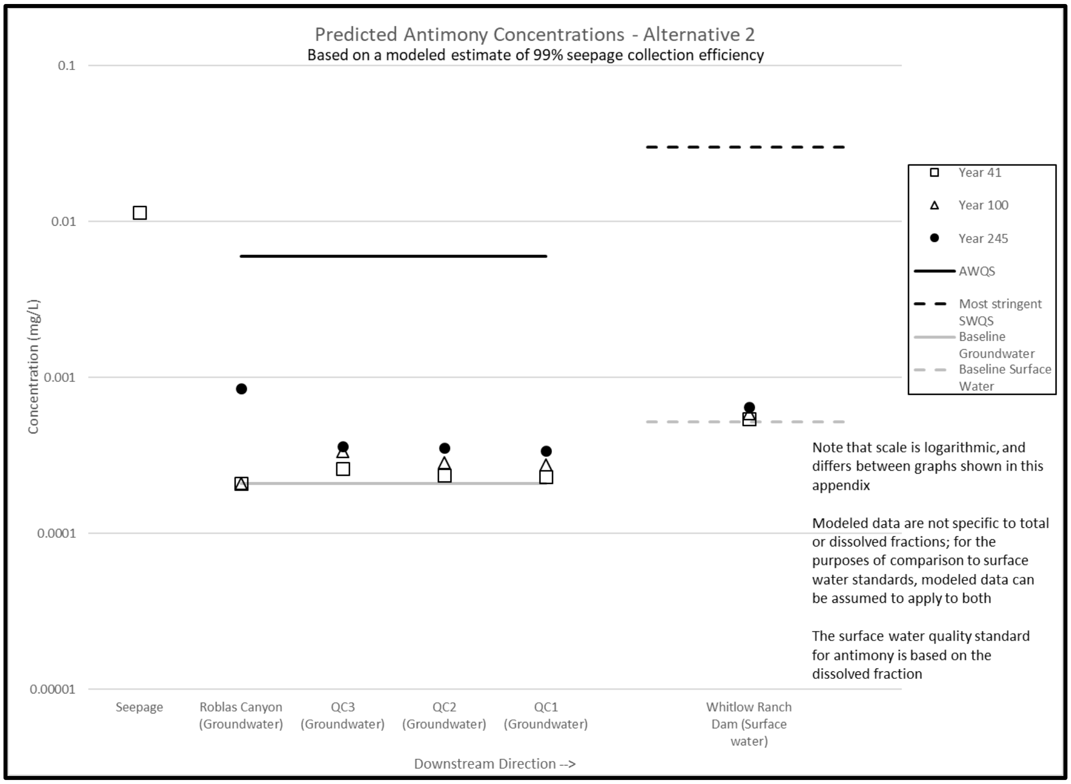


Figure M-5. Predicted antimony concentrations, Alternative 2

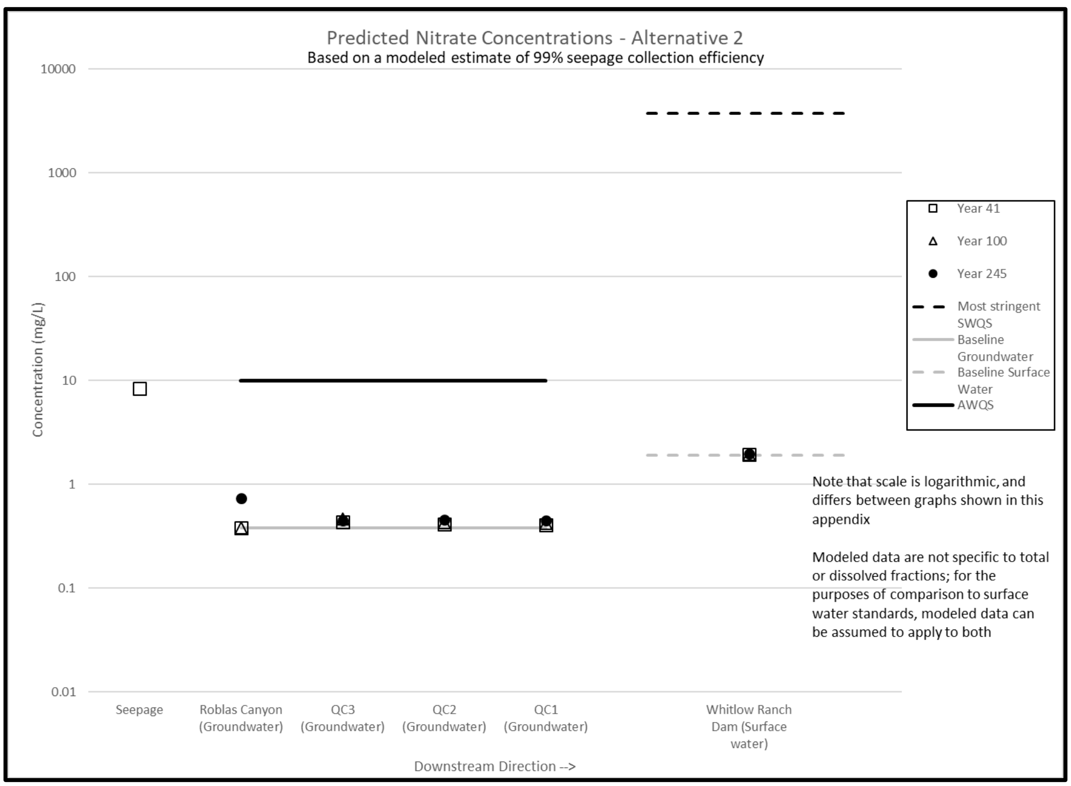


Figure M-6. Predicted nitrate concentrations, Alternative 2

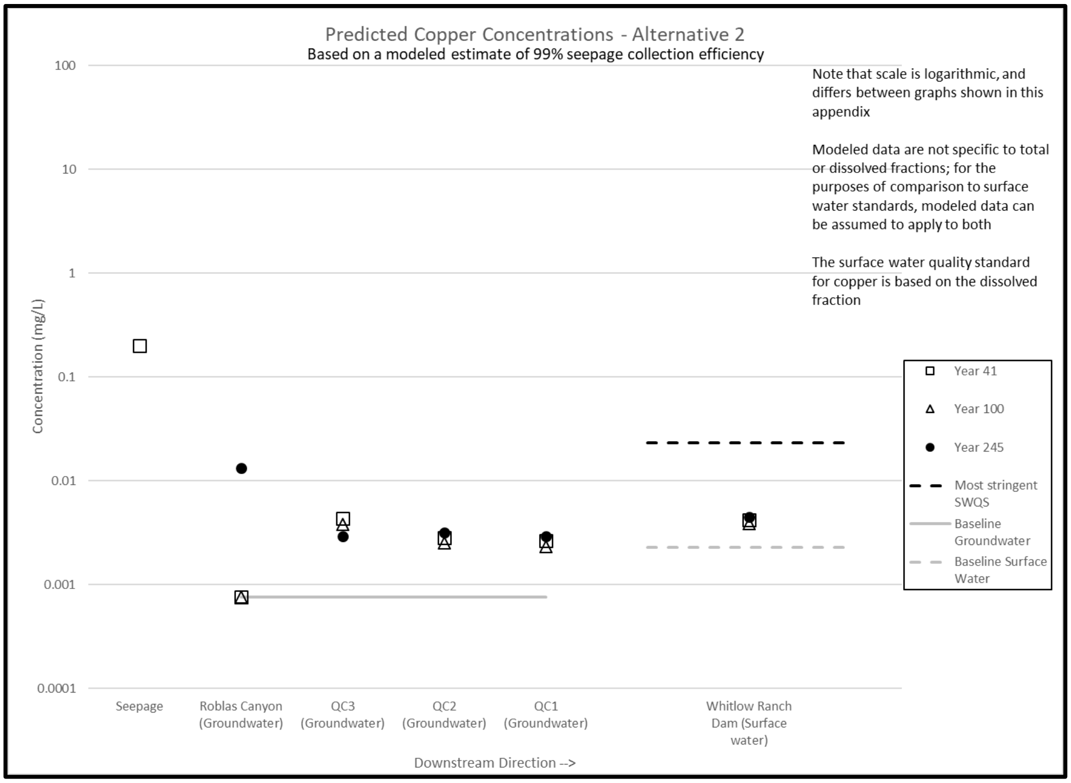


Figure M-7. Predicted copper concentrations, Alternative 2

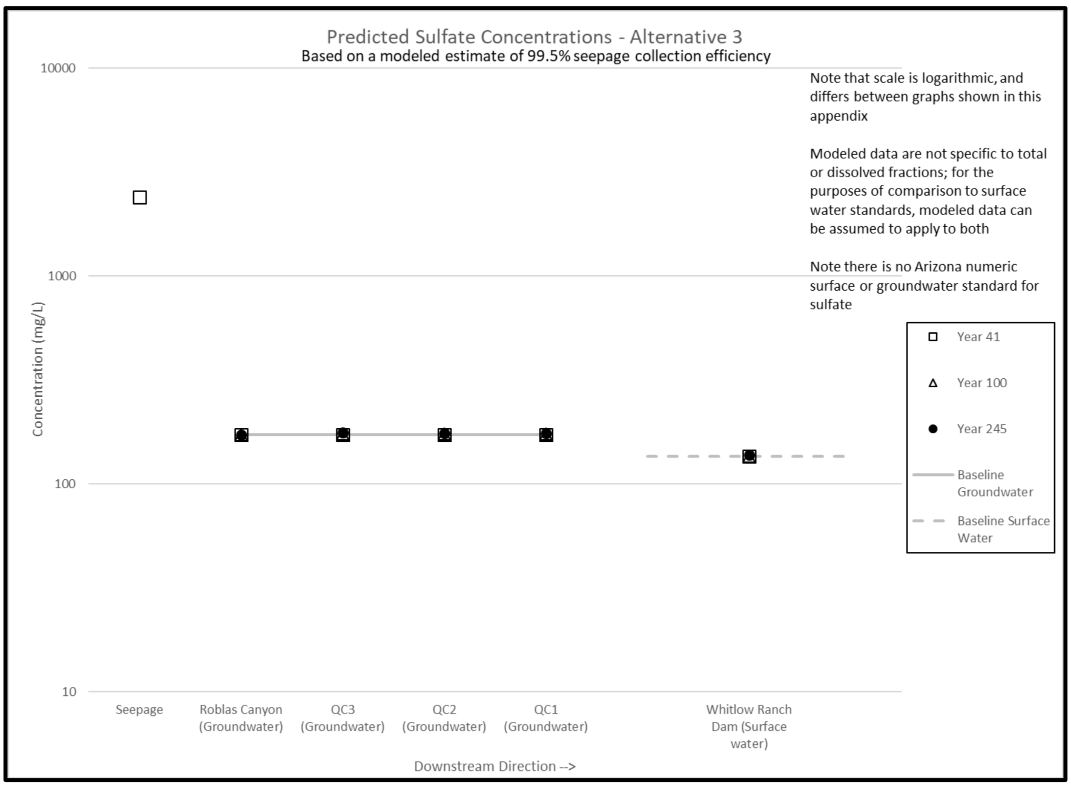


Figure M-8. Predicted sulfate concentrations, Alternative 3

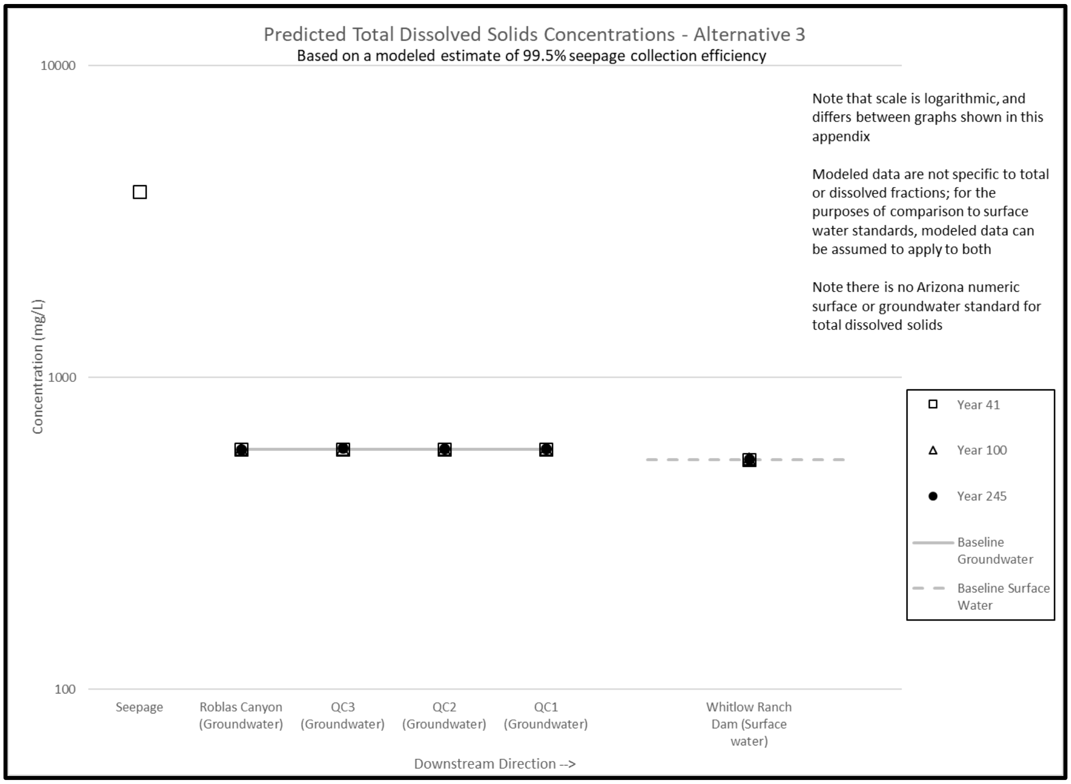


Figure M-9. Predicted total dissolved solids concentrations, Alternative 3

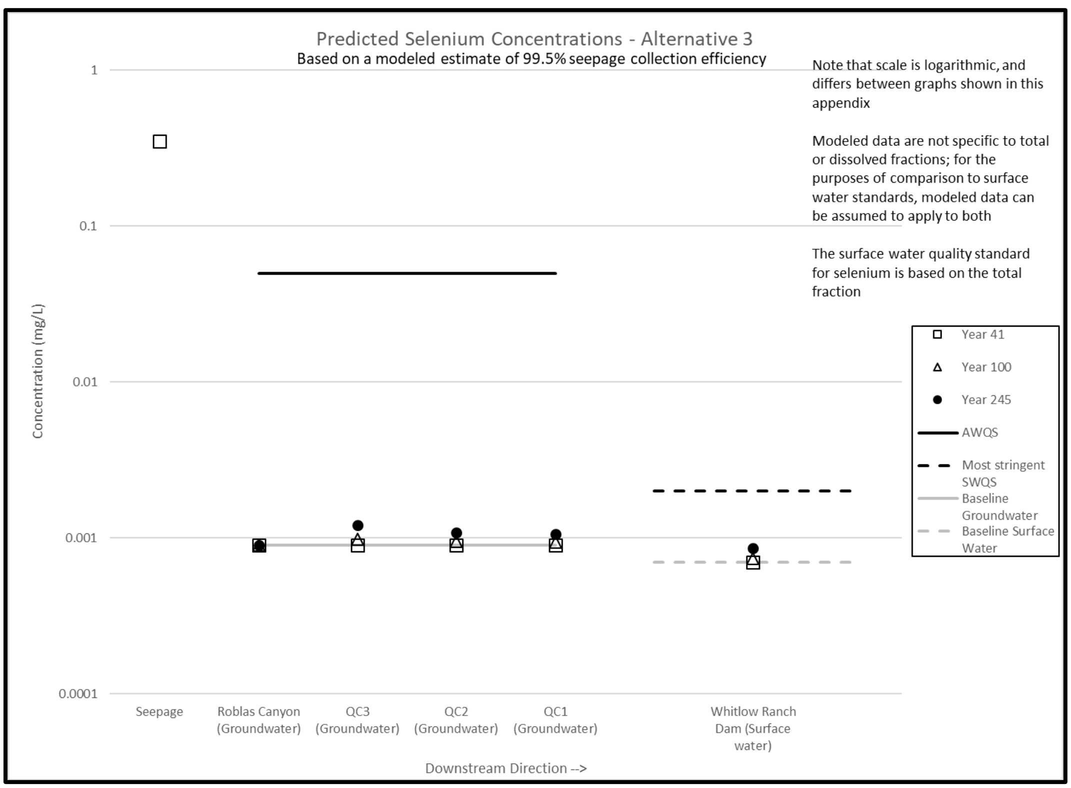


Figure M-10. Predicted selenium concentrations, Alternative 3

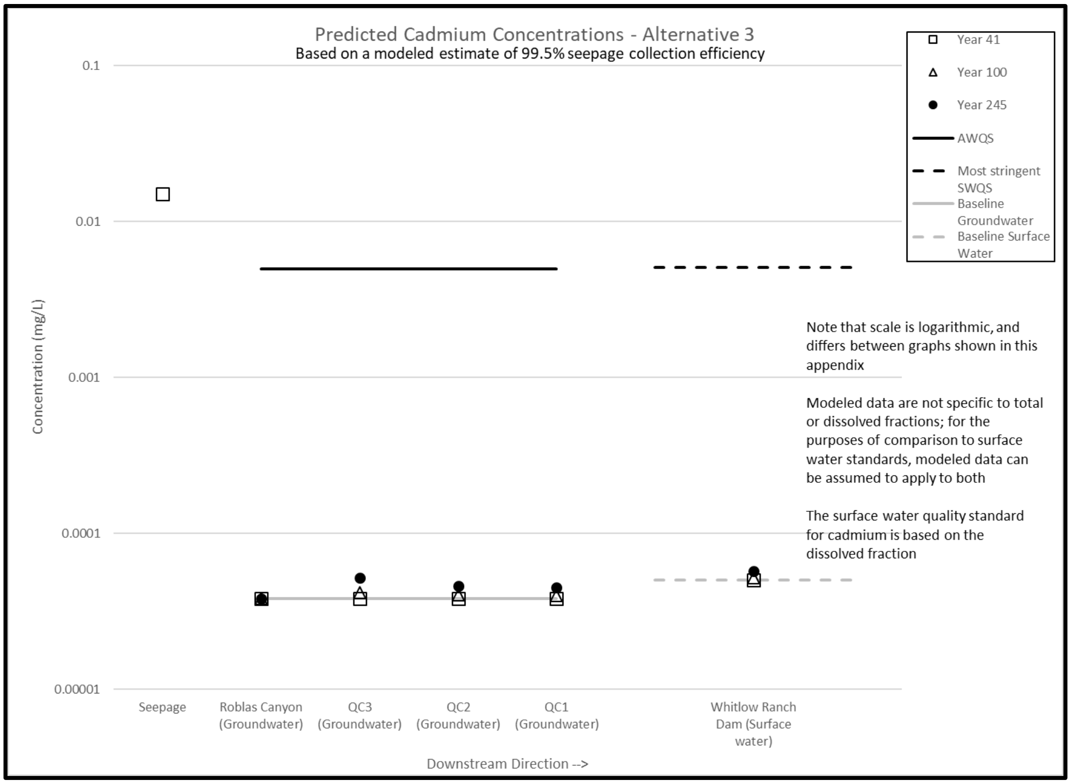


Figure M-11. Predicted cadmium concentrations, Alternative 3

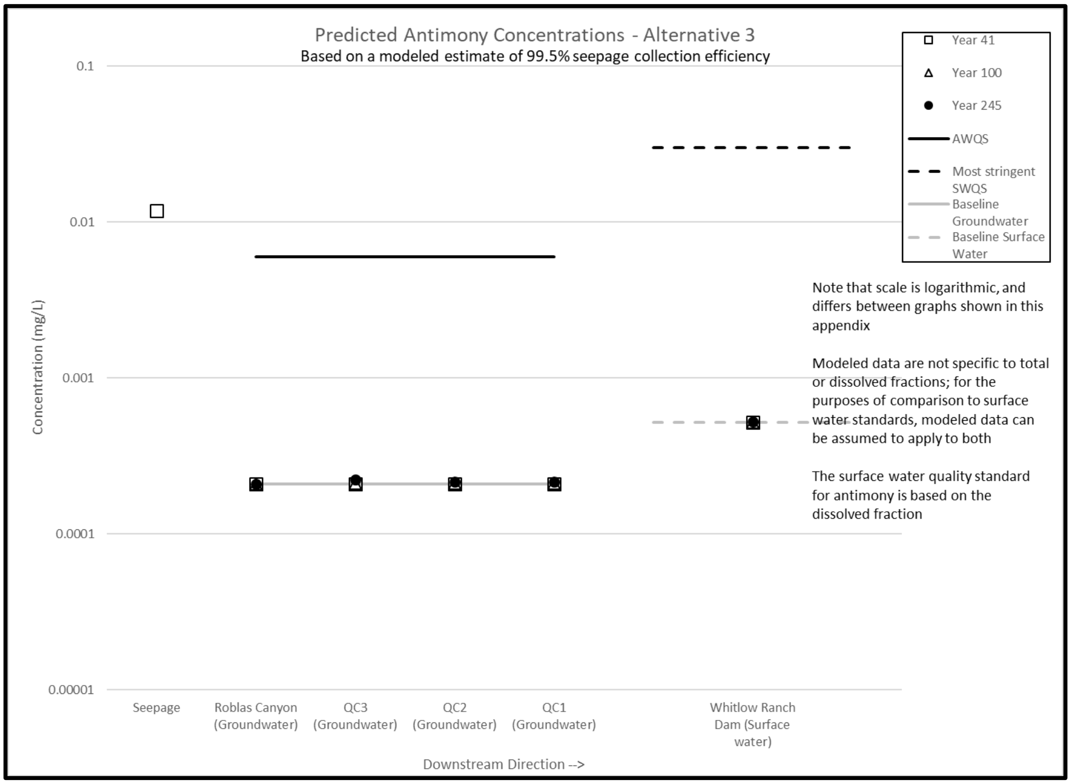


Figure M-12. Predicted antimony concentrations, Alternative 3

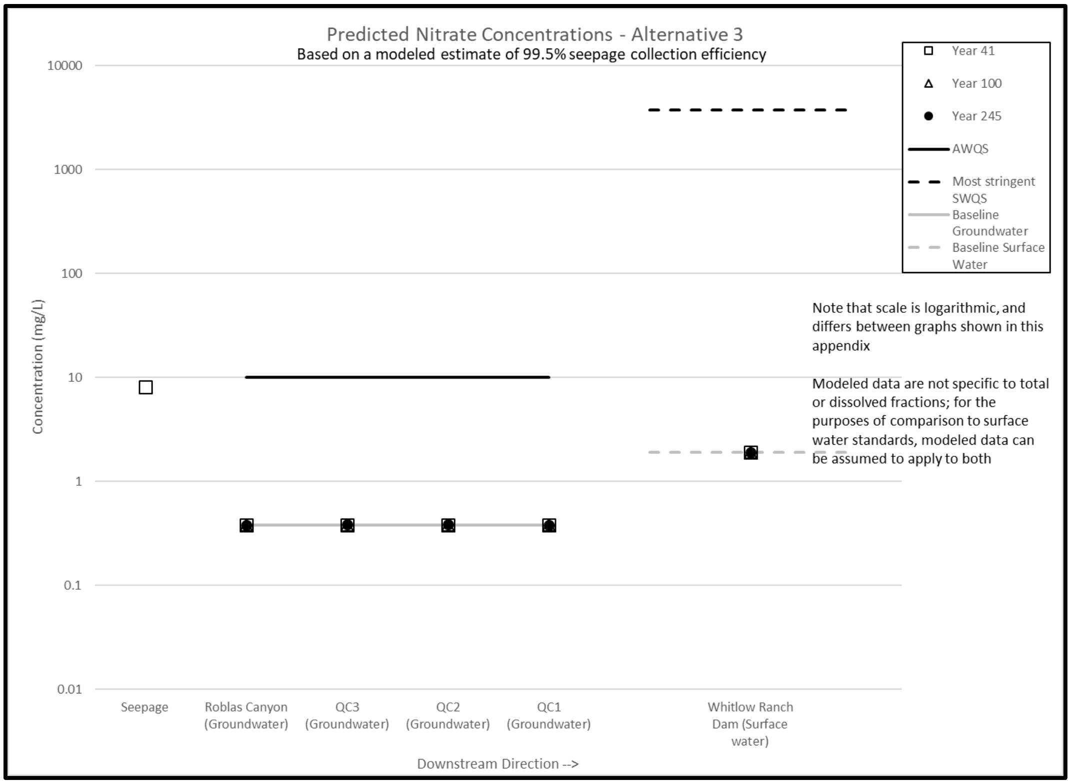


Figure M-13. Predicted nitrate concentrations, Alternative 3

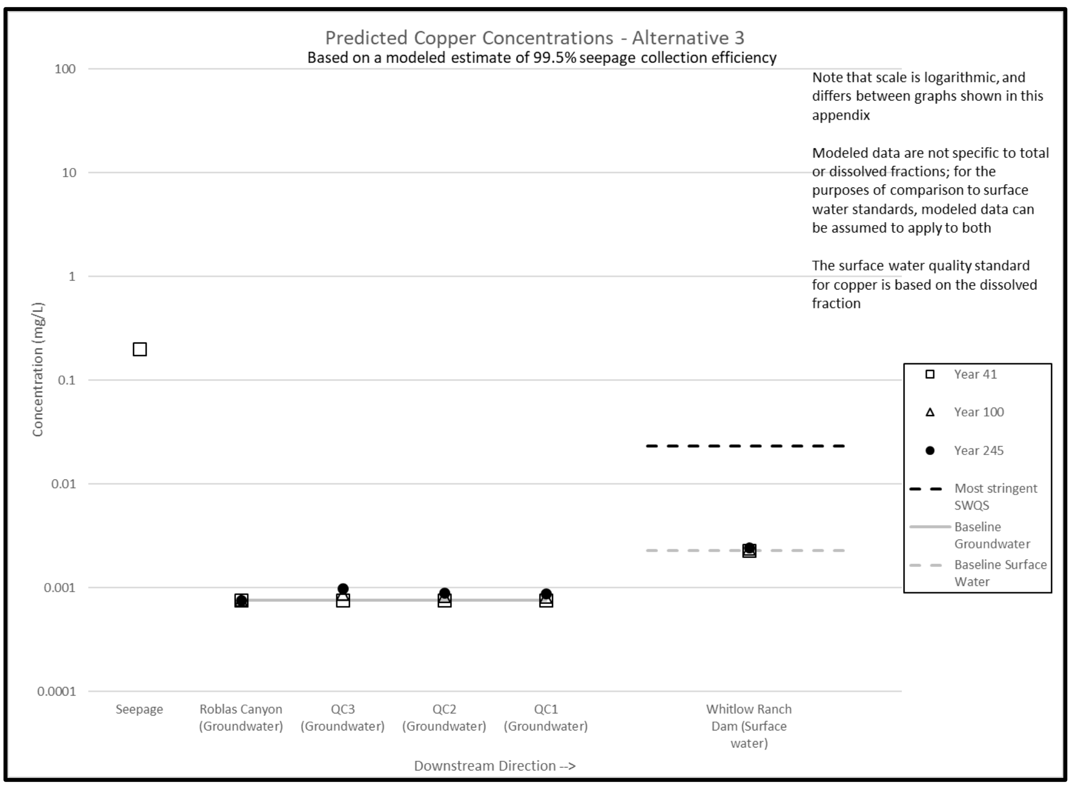


Figure M-14. Predicted copper concentrations, Alternative 3

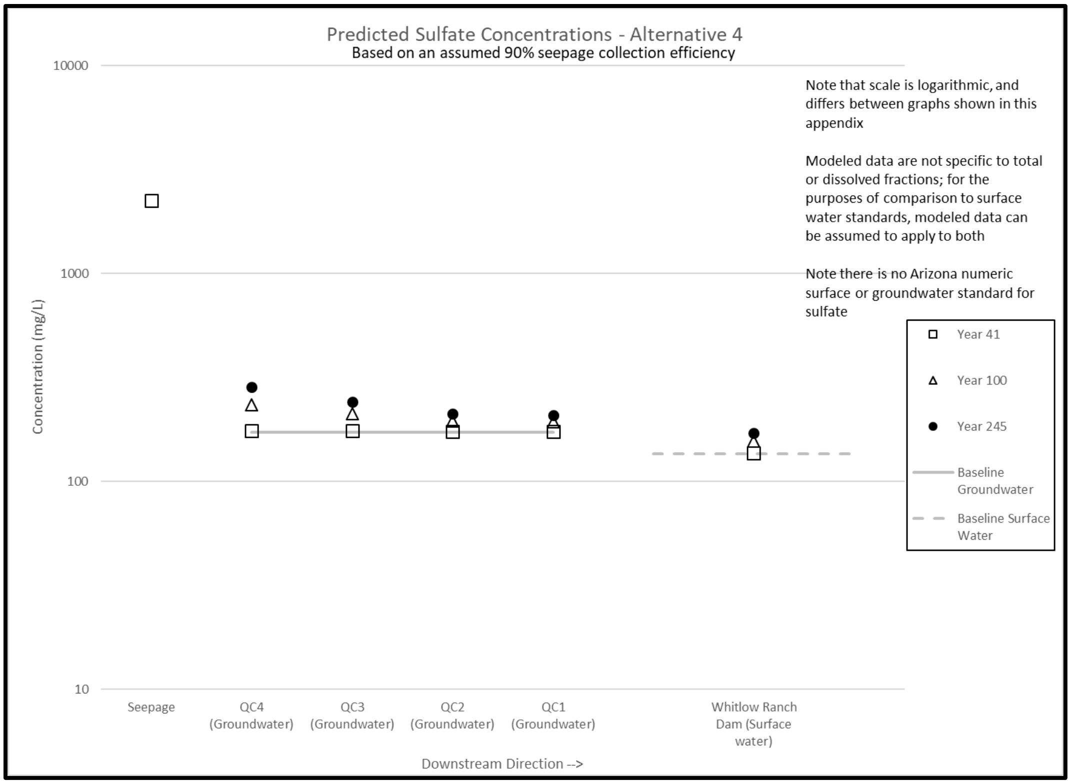


Figure M-15. Predicted sulfate concentrations, Alternative 4

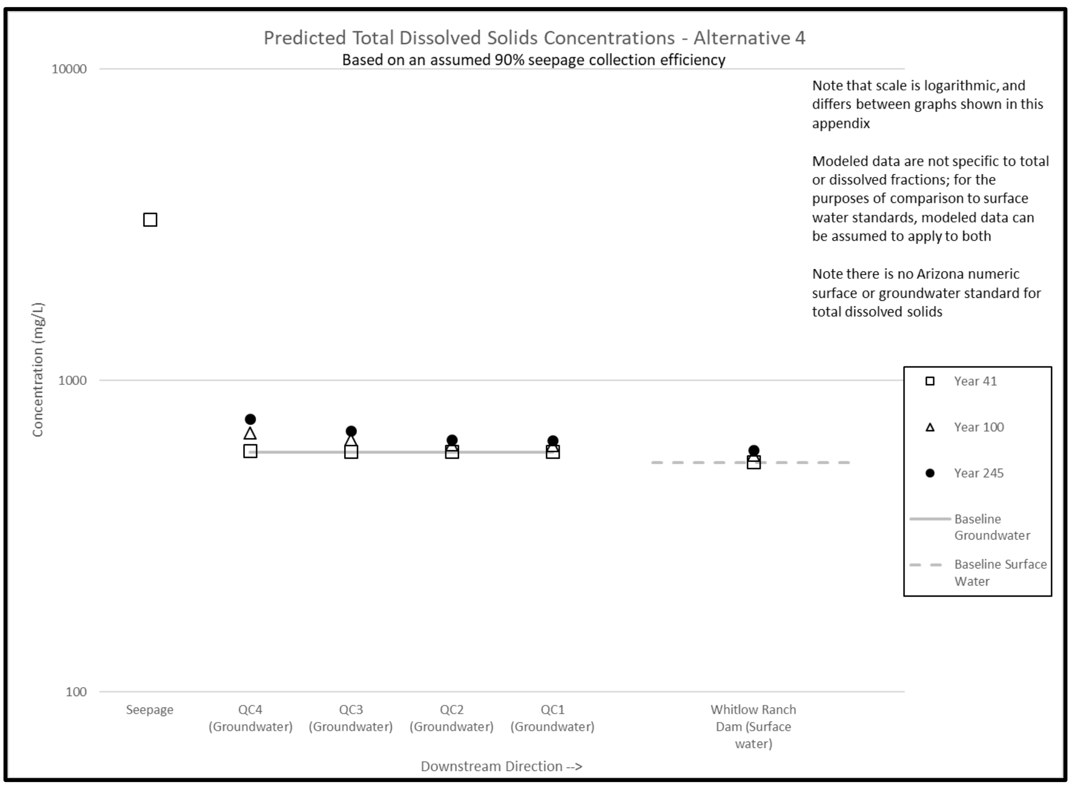


Figure M-16. Predicted total dissolved solids concentrations, Alternative 4

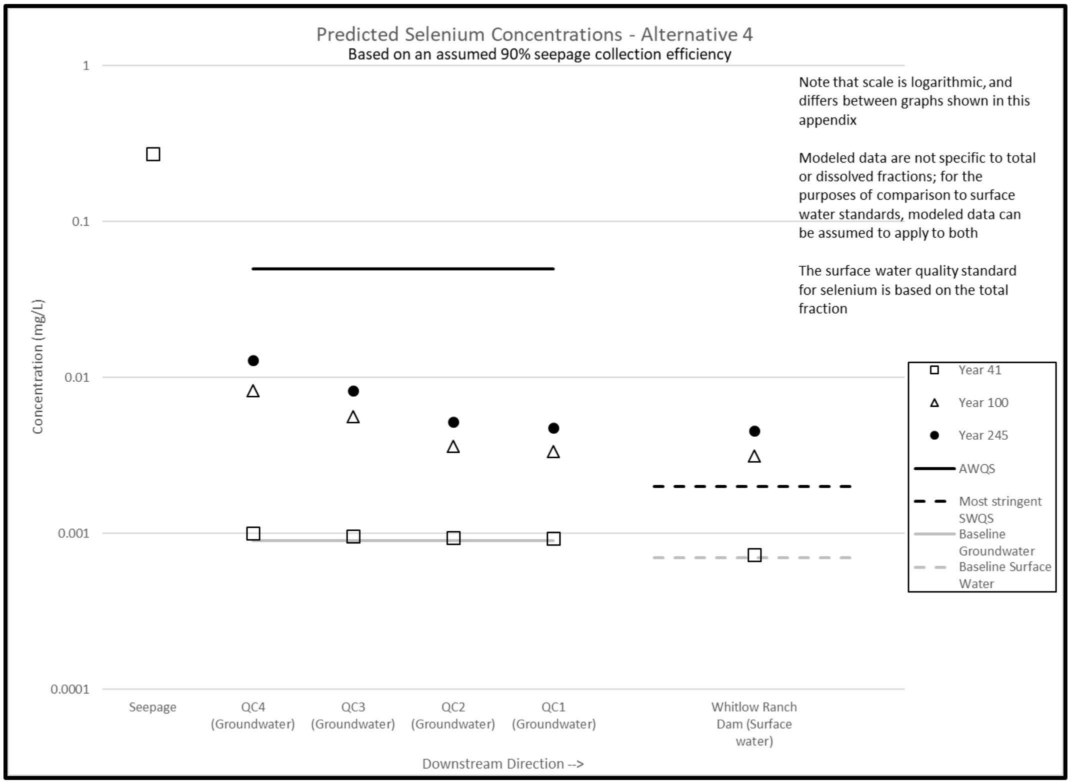


Figure M-17. Predicted selenium concentrations, Alternative 4

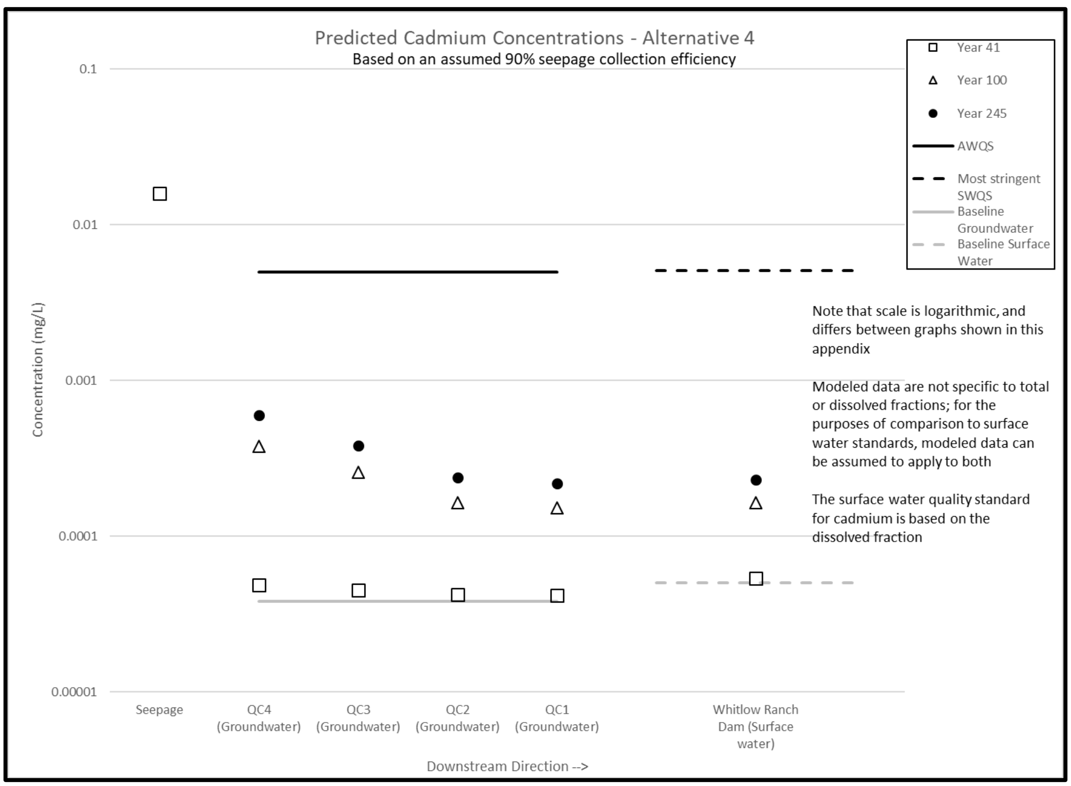


Figure M-18. Predicted cadmium concentrations, Alternative 4

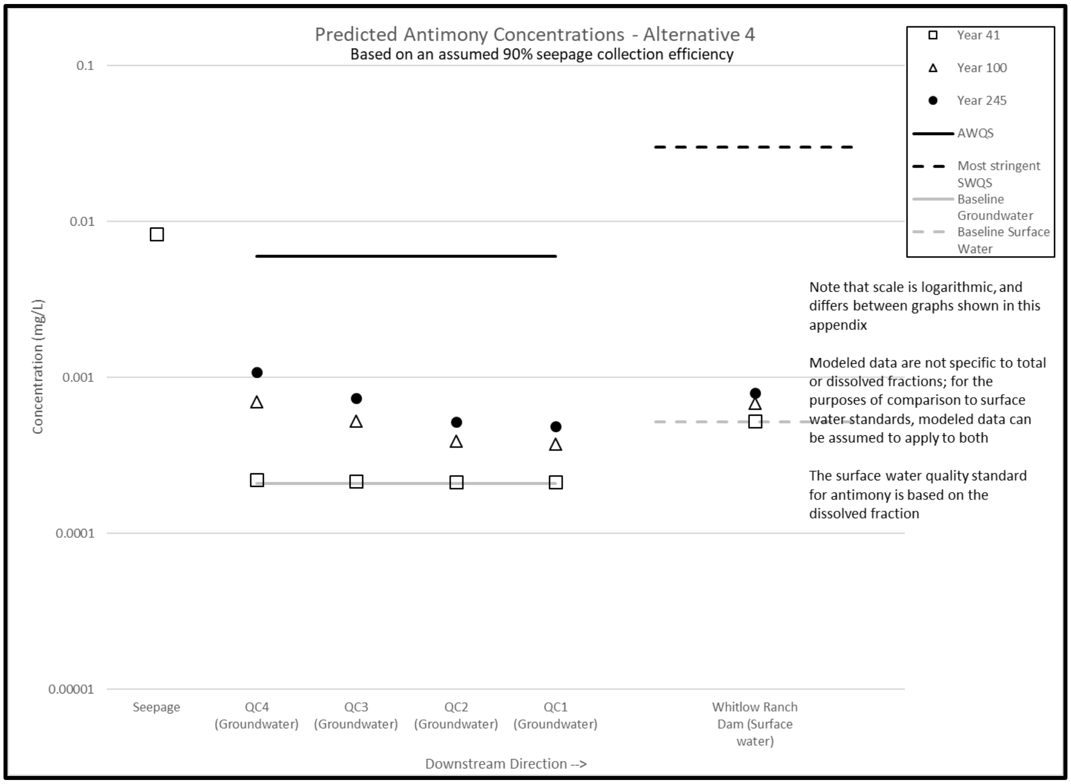


Figure M-19. Predicted antimony concentrations, Alternative 4

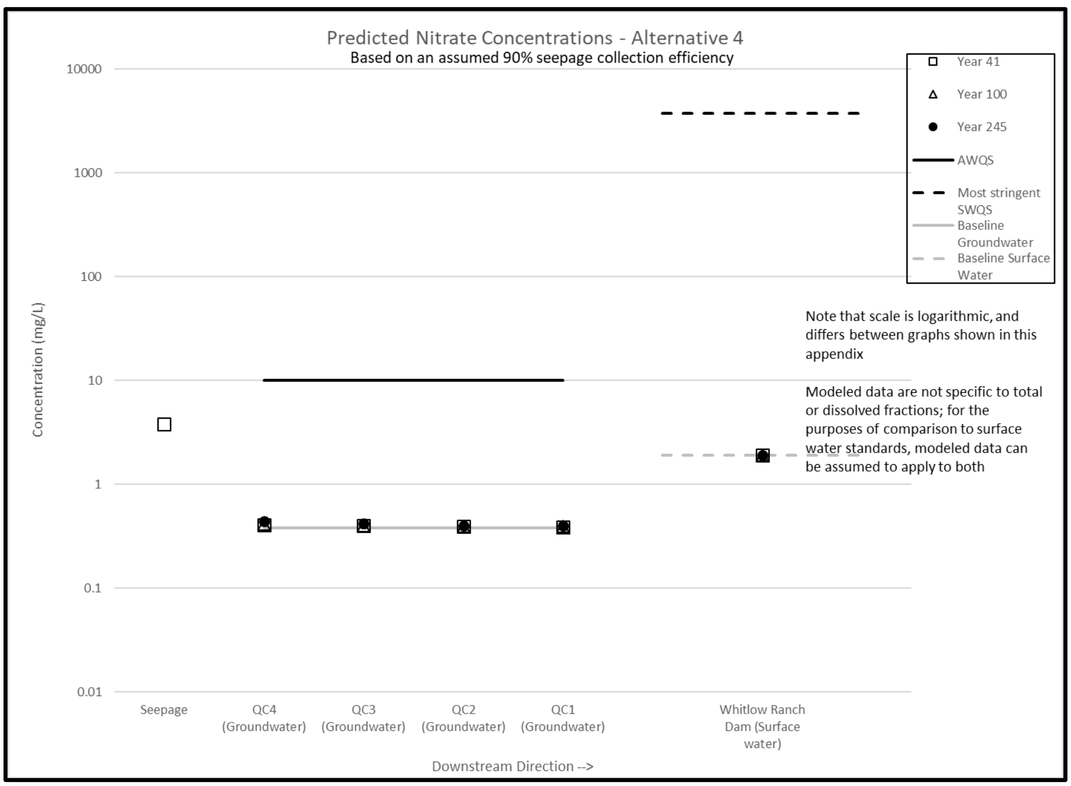


Figure M-20. Predicted nitrate concentrations, Alternative 4

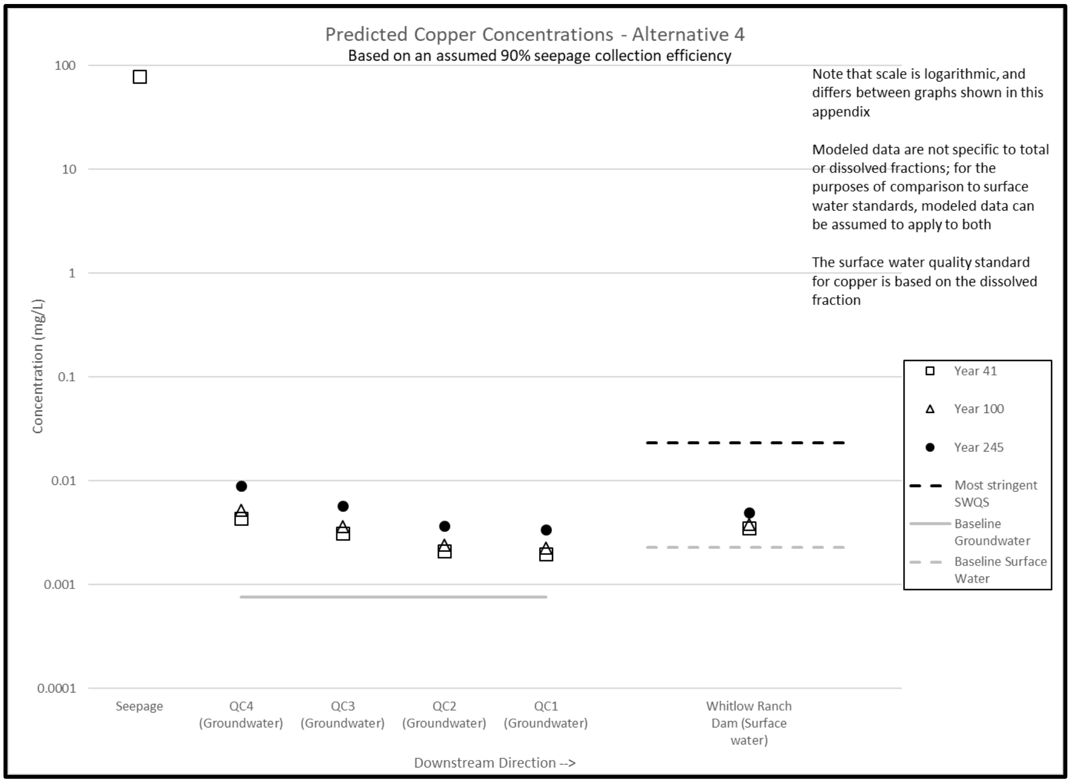


Figure M-21. Predicted copper concentrations, Alternative 4

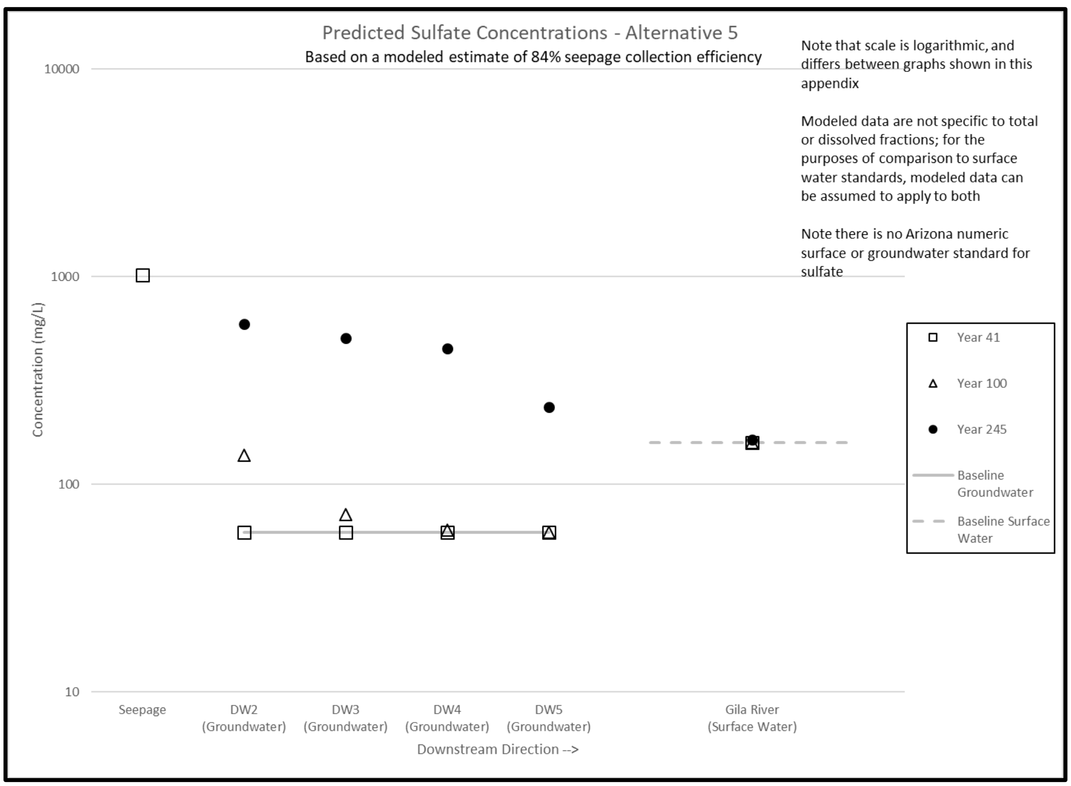


Figure M-22. Predicted sulfate concentrations, Alternative 5

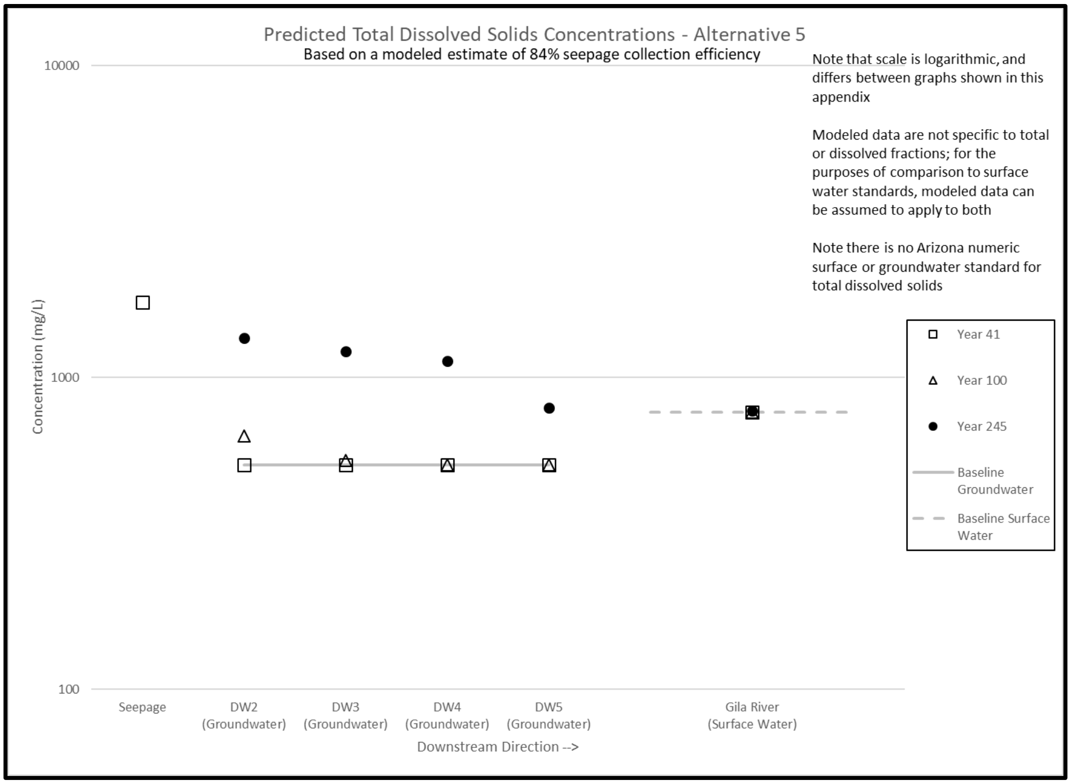


Figure M-23. Predicted total dissolved solids concentrations, Alternative 5

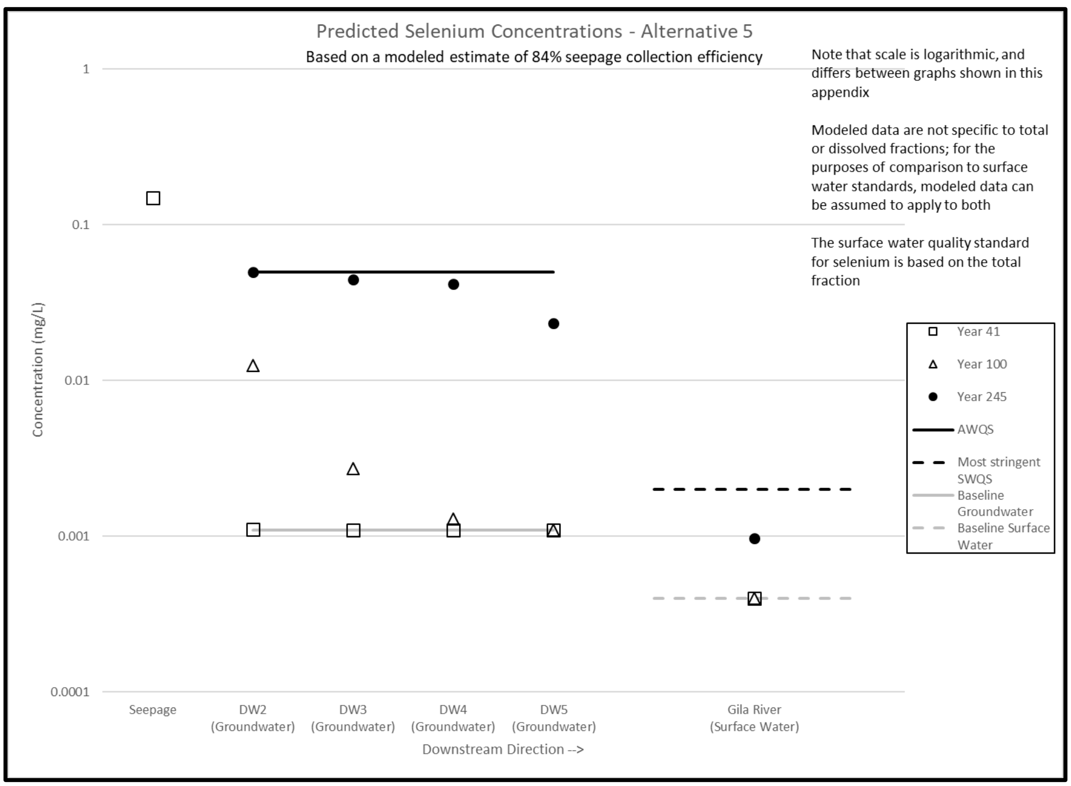


Figure M-24. Predicted selenium concentrations, Alternative 5

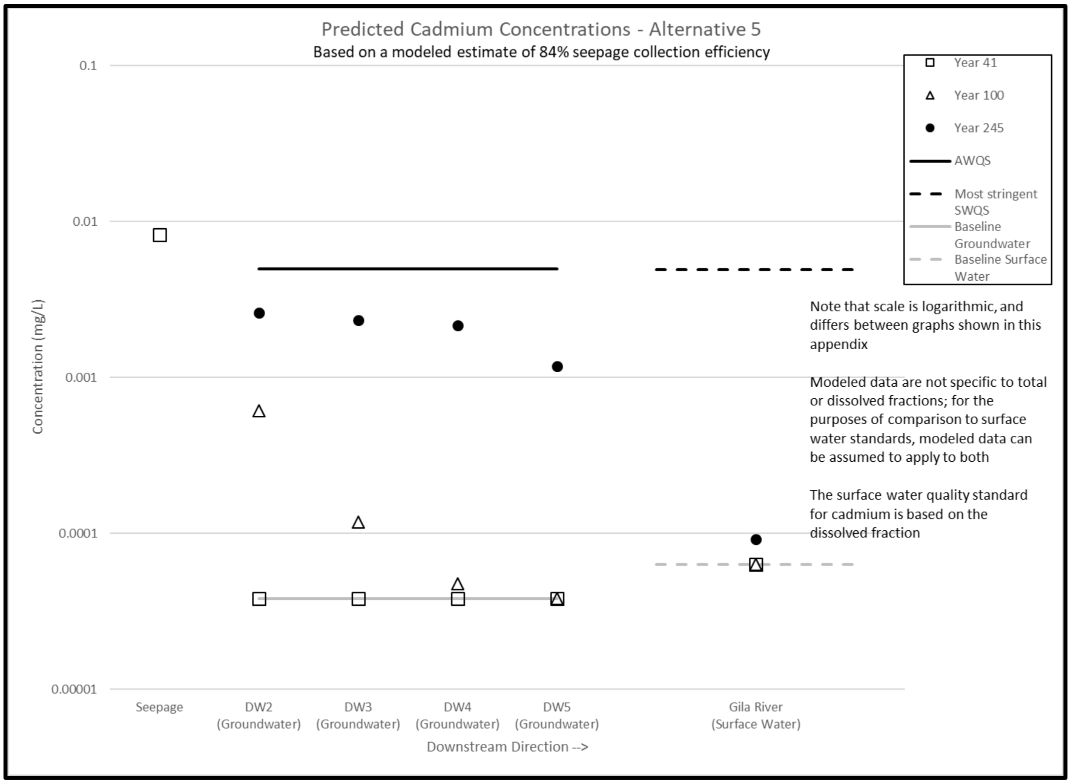


Figure M-25. Predicted cadmium concentrations, Alternative 5

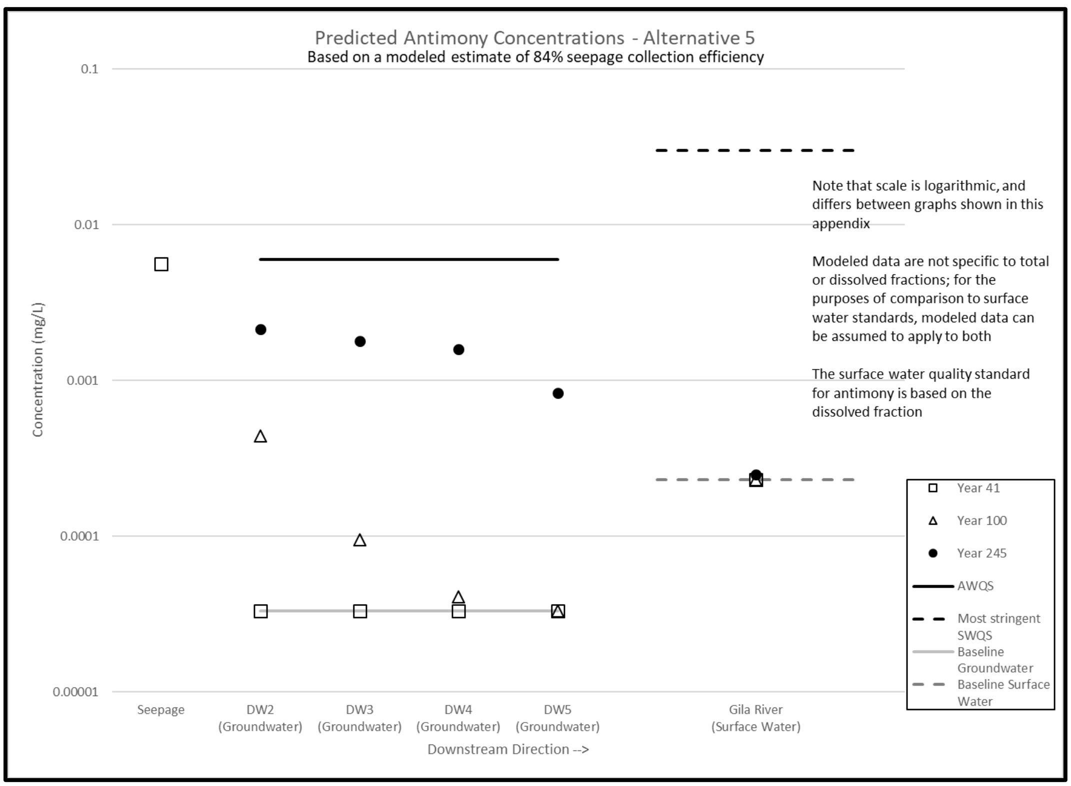


Figure M-26. Predicted antimony concentrations, Alternative 5

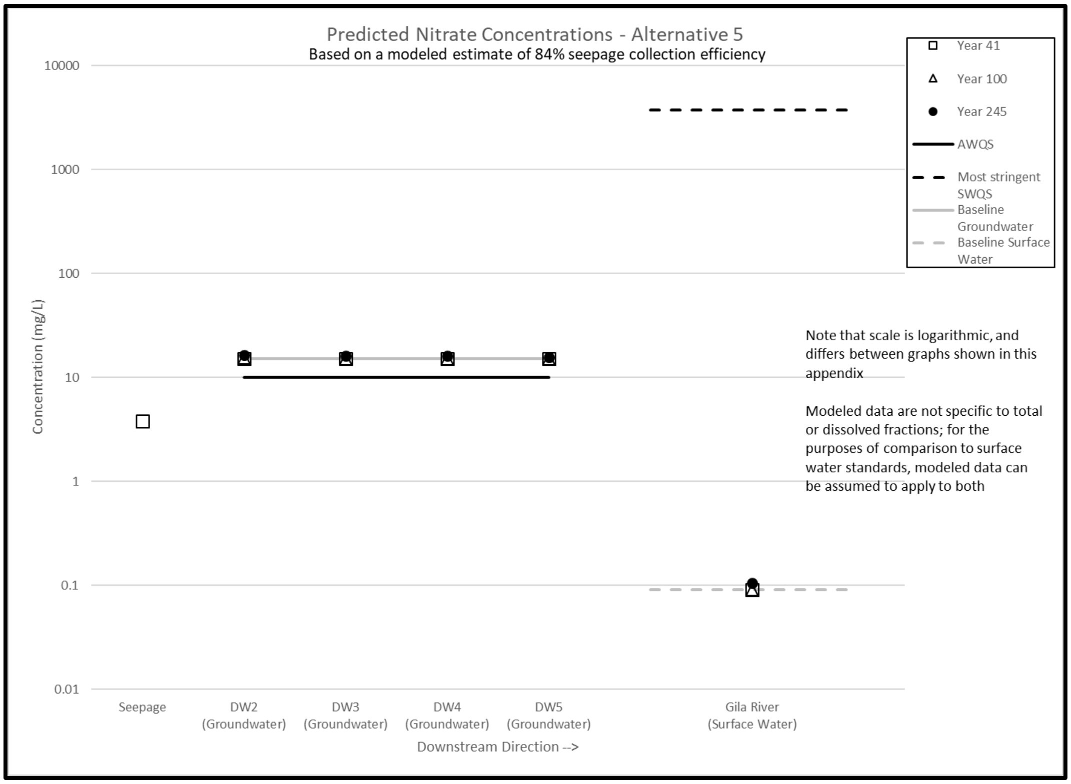


Figure M-27. Predicted nitrate concentrations, Alternative 5

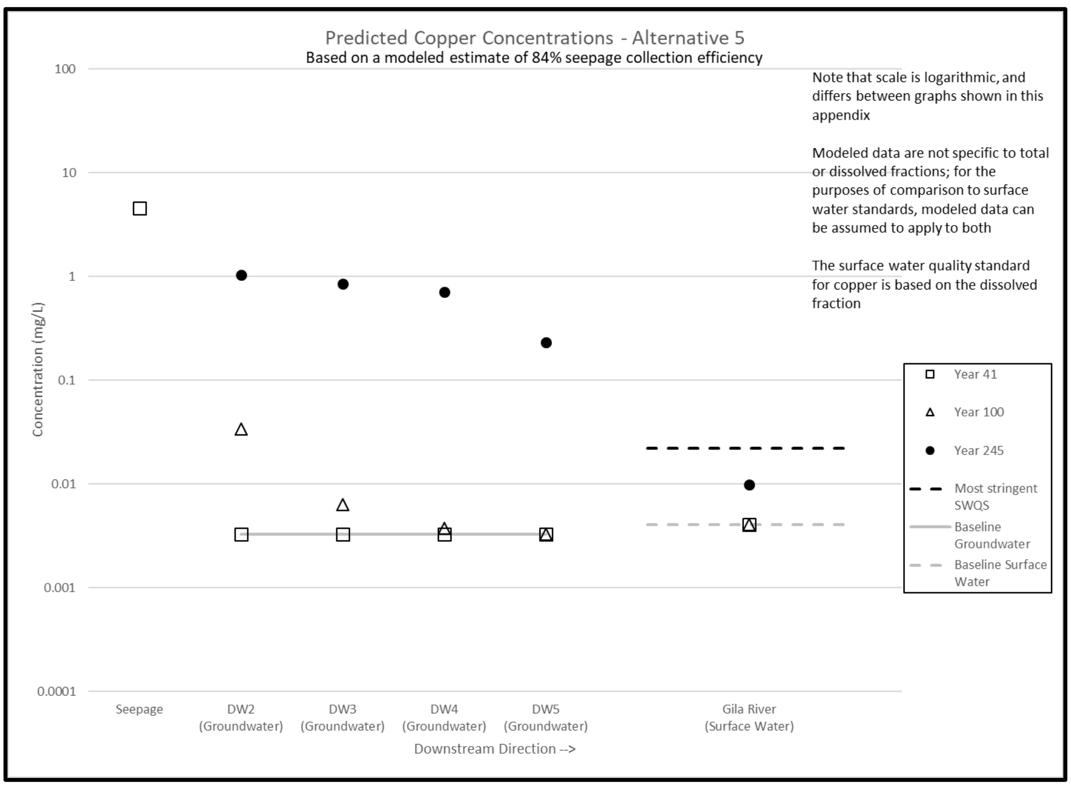


Figure M-28. Predicted copper concentrations, Alternative 5

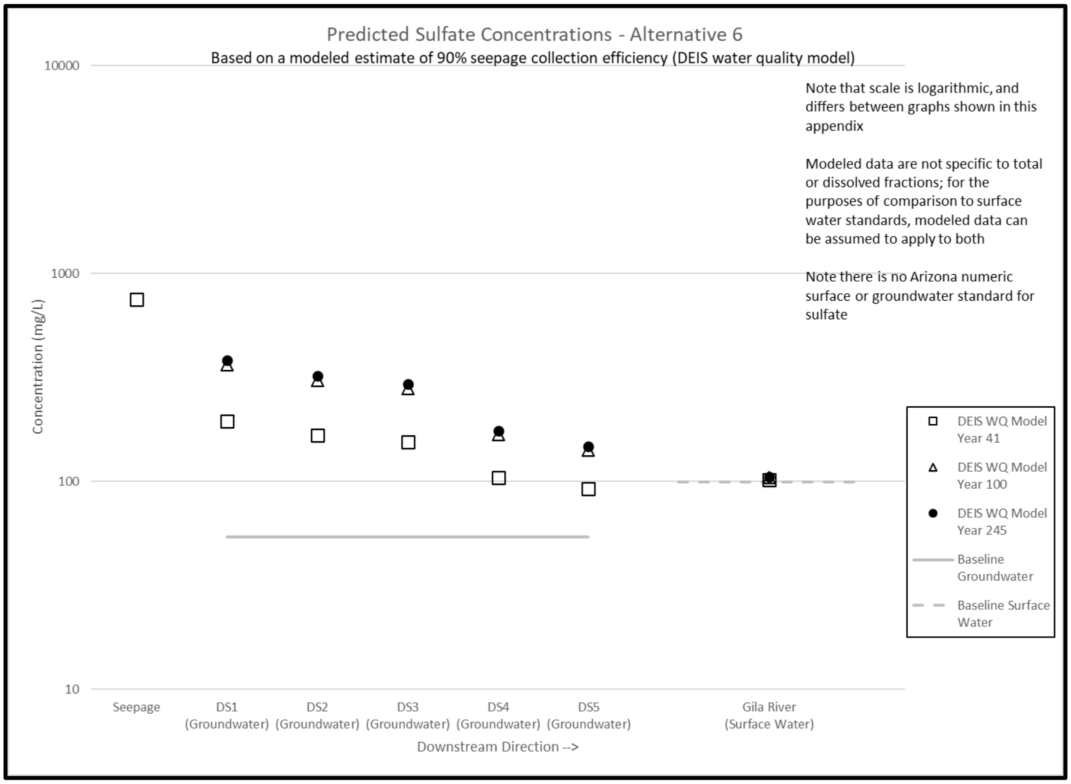


Figure M-29. Predicted sulfate concentrations, Alternative 6, draft environmental impact statement (DEIS) water quality model

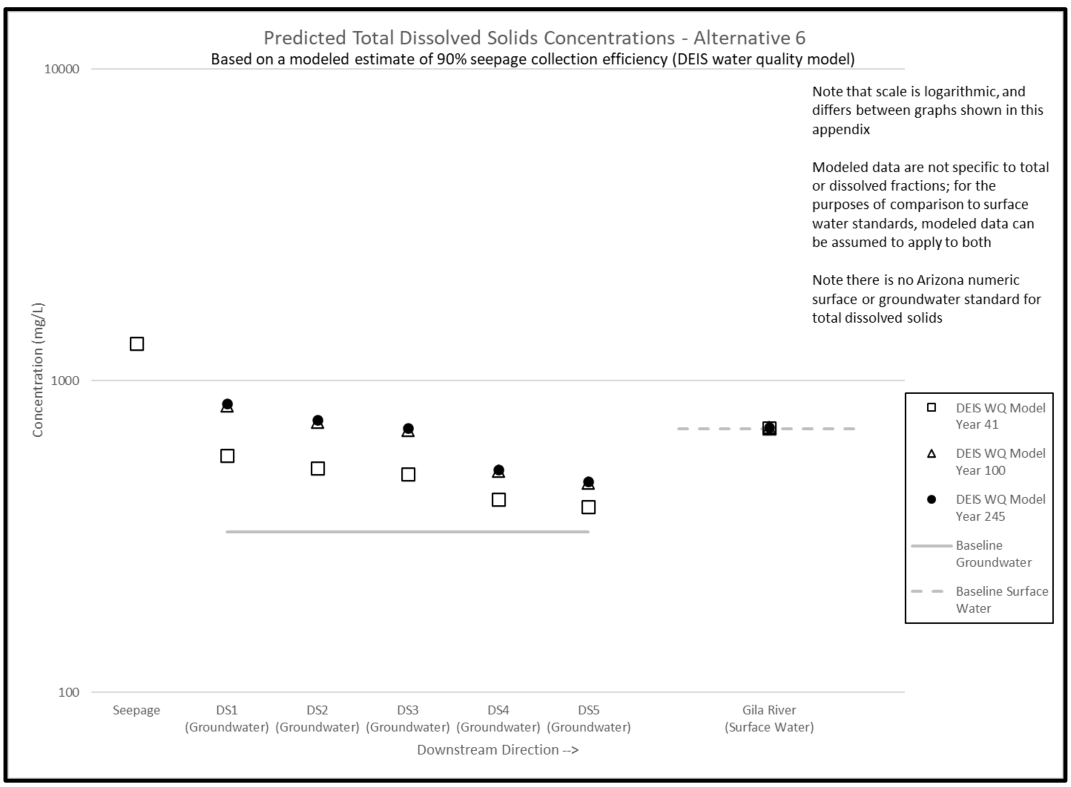


Figure M-30. Predicted total dissolved solids concentrations, Alternative 6, DEIS water quality model

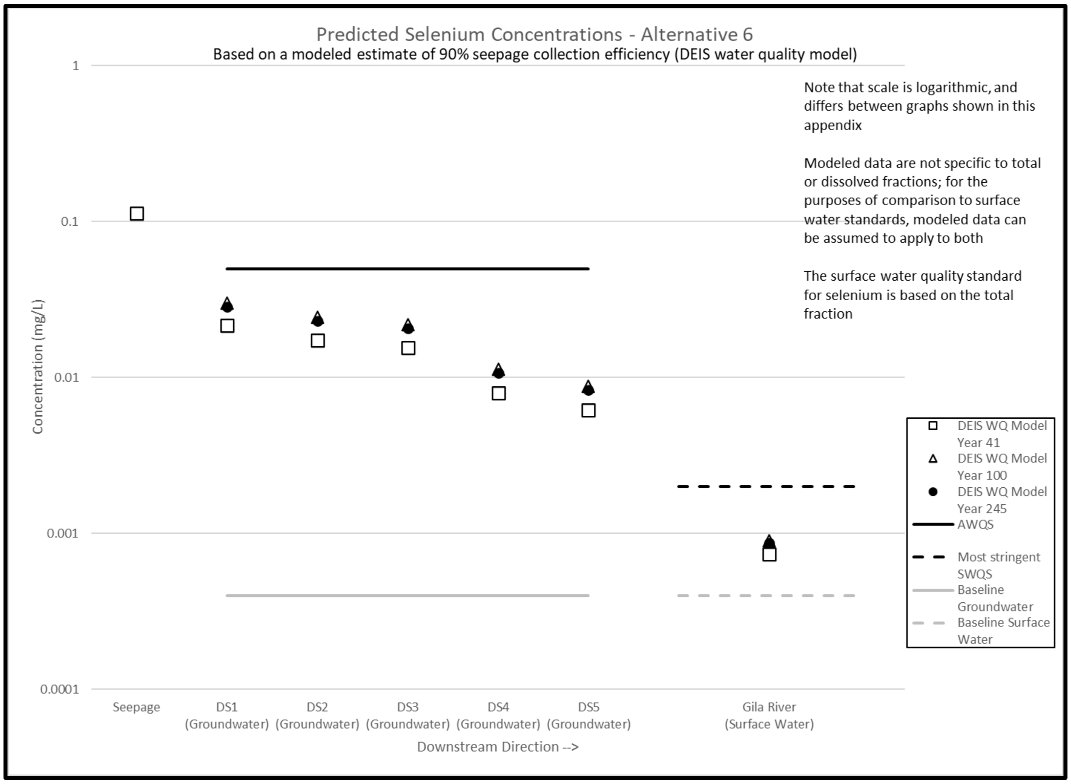


Figure M-31. Predicted selenium concentrations, Alternative 6, DEIS water quality model

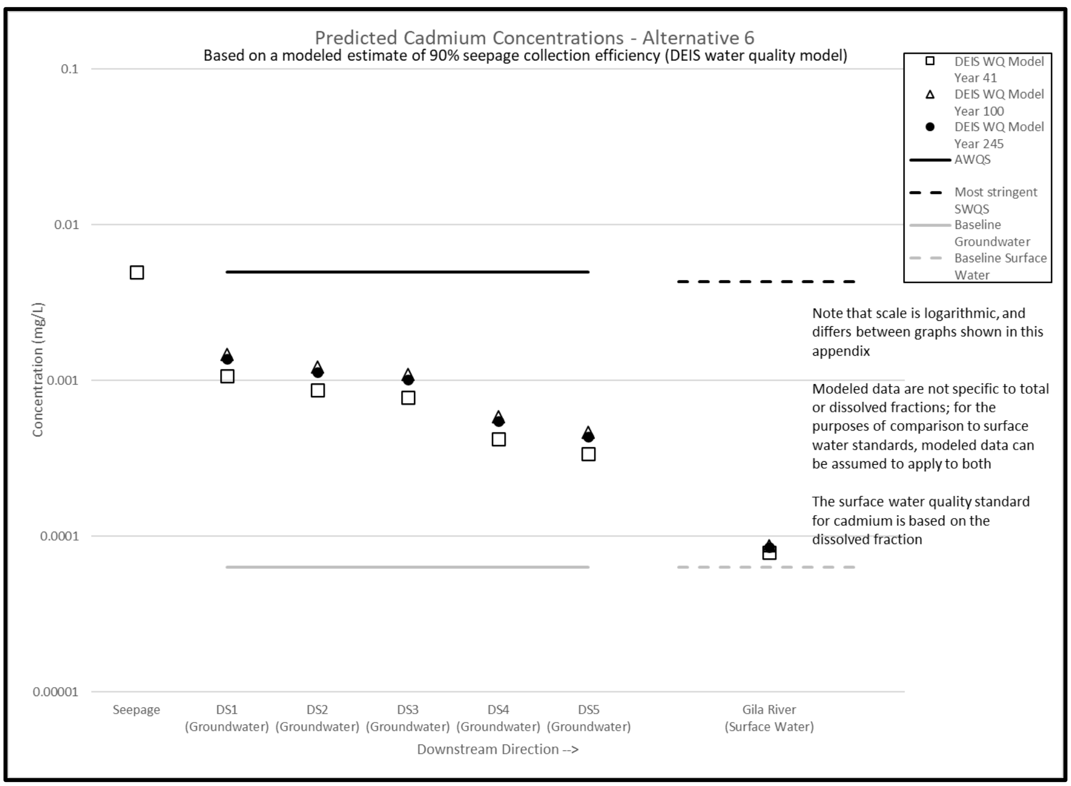


Figure M-32. Predicted cadmium concentrations, Alternative 6, DEIS water quality model

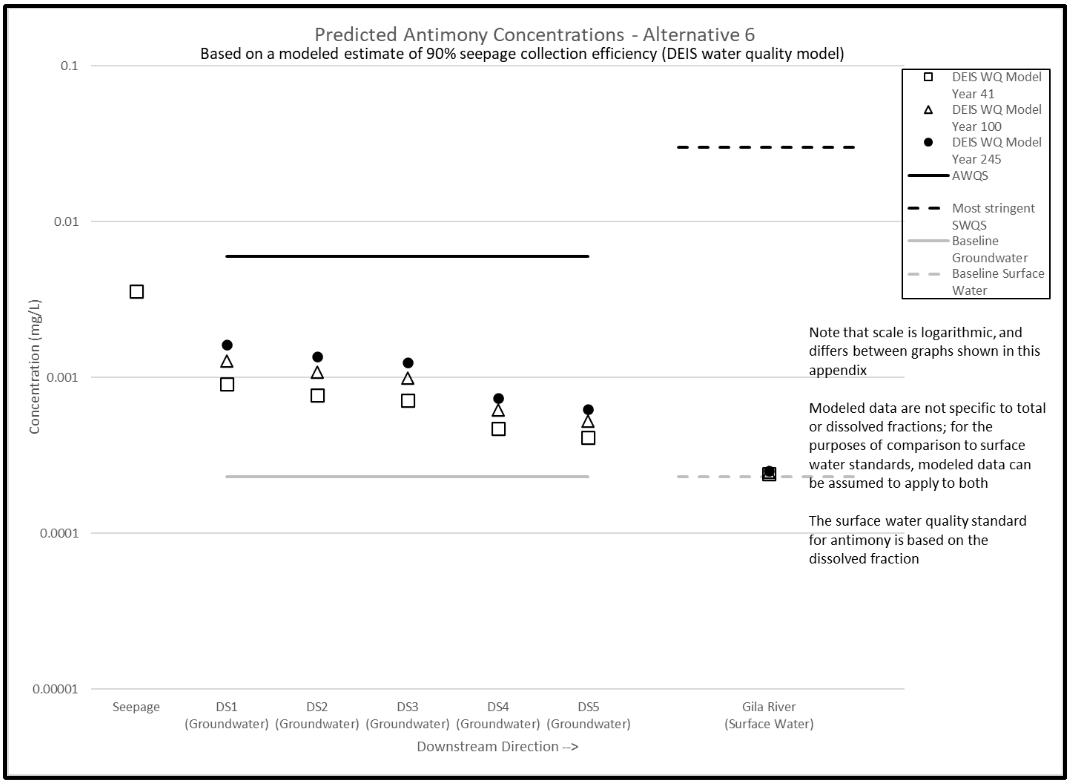


Figure M-33. Predicted antimony concentrations, Alternative 6, DEIS water quality model

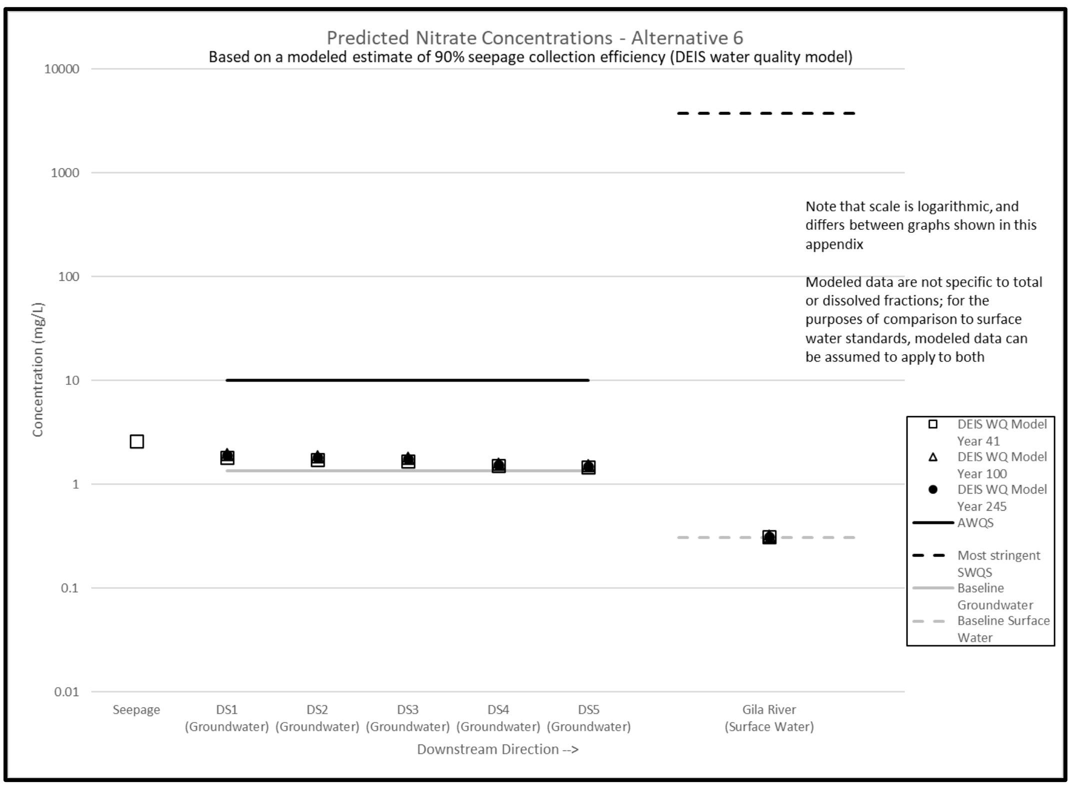


Figure M-34. Predicted nitrate concentrations, Alternative 6, DEIS water quality model

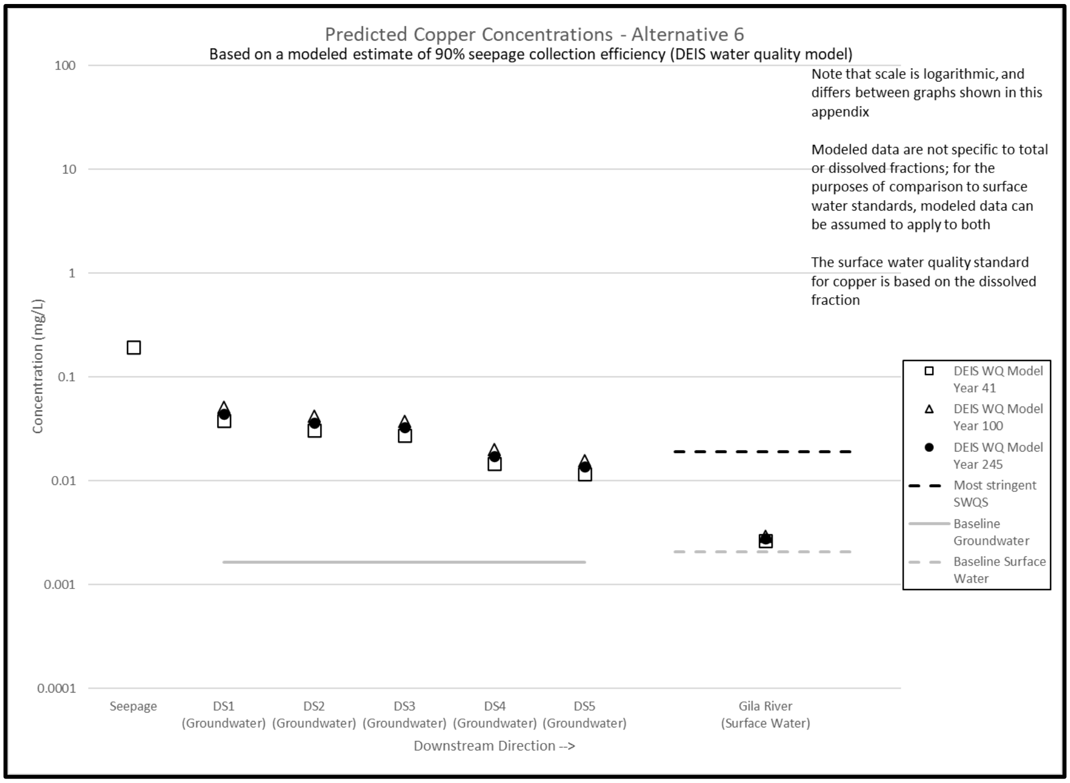


Figure M-35. Predicted copper concentrations, Alternative 6, DEIS water quality model

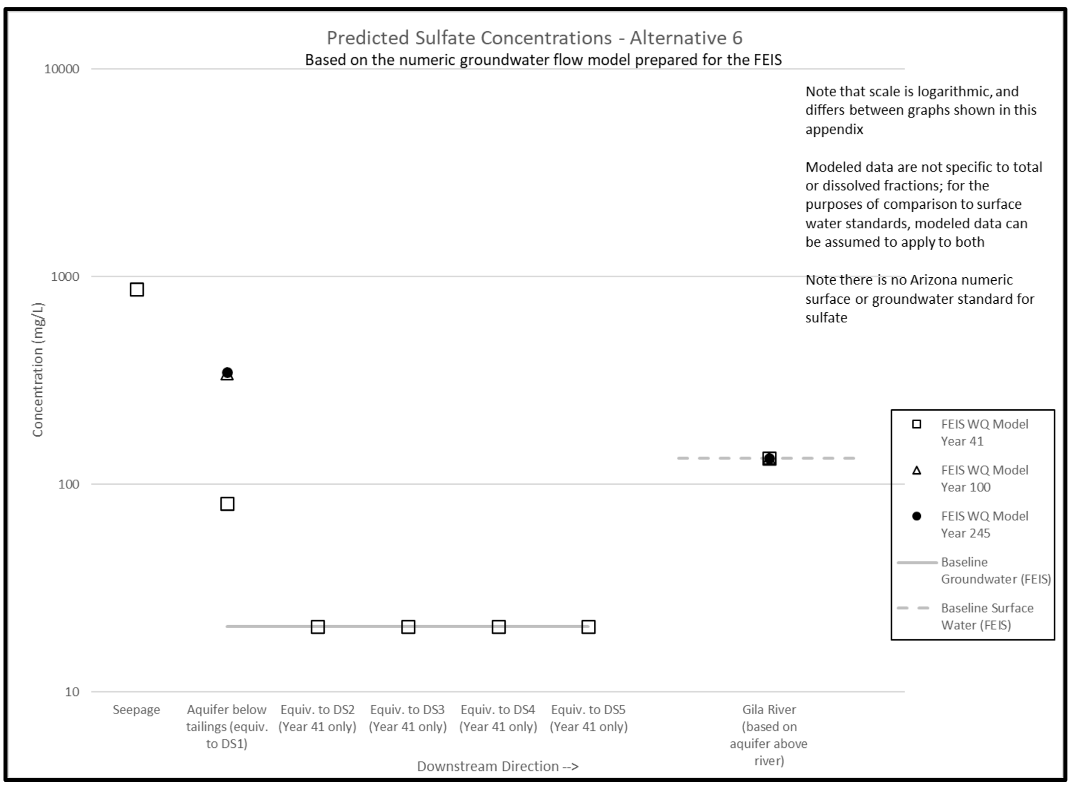


Figure M-36. Predicted sulfate concentrations, Alternative 6, final environmental impact statement (FEIS) water quality model

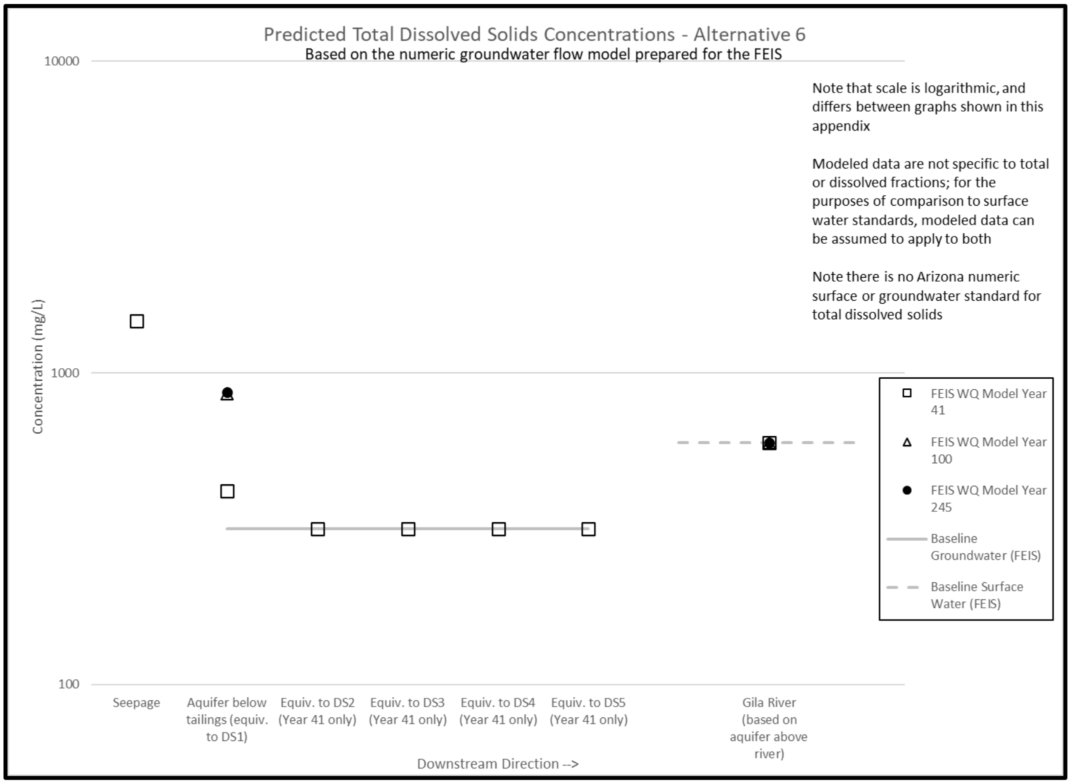


Figure M-37. Predicted total dissolved solids concentrations, Alternative 6, FEIS water quality model

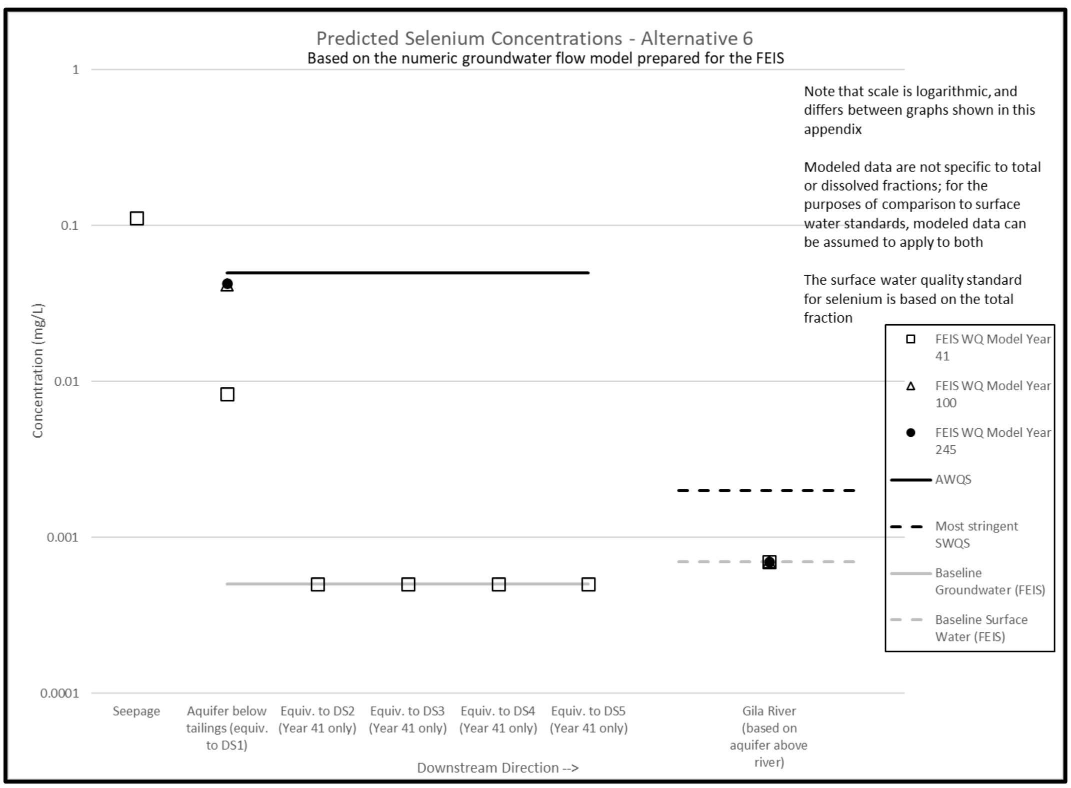


Figure M-38. Predicted selenium concentrations, Alternative 6, FEIS water quality model

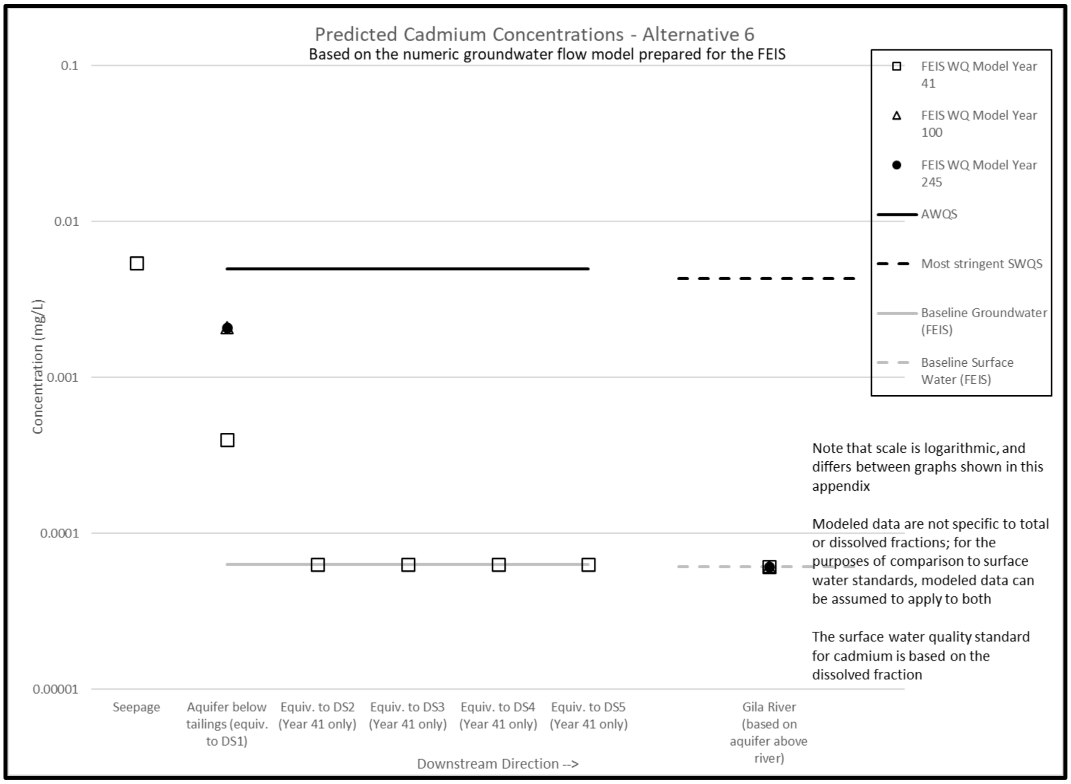


Figure M-39. Predicted cadmium concentrations, Alternative 6, FEIS water quality model

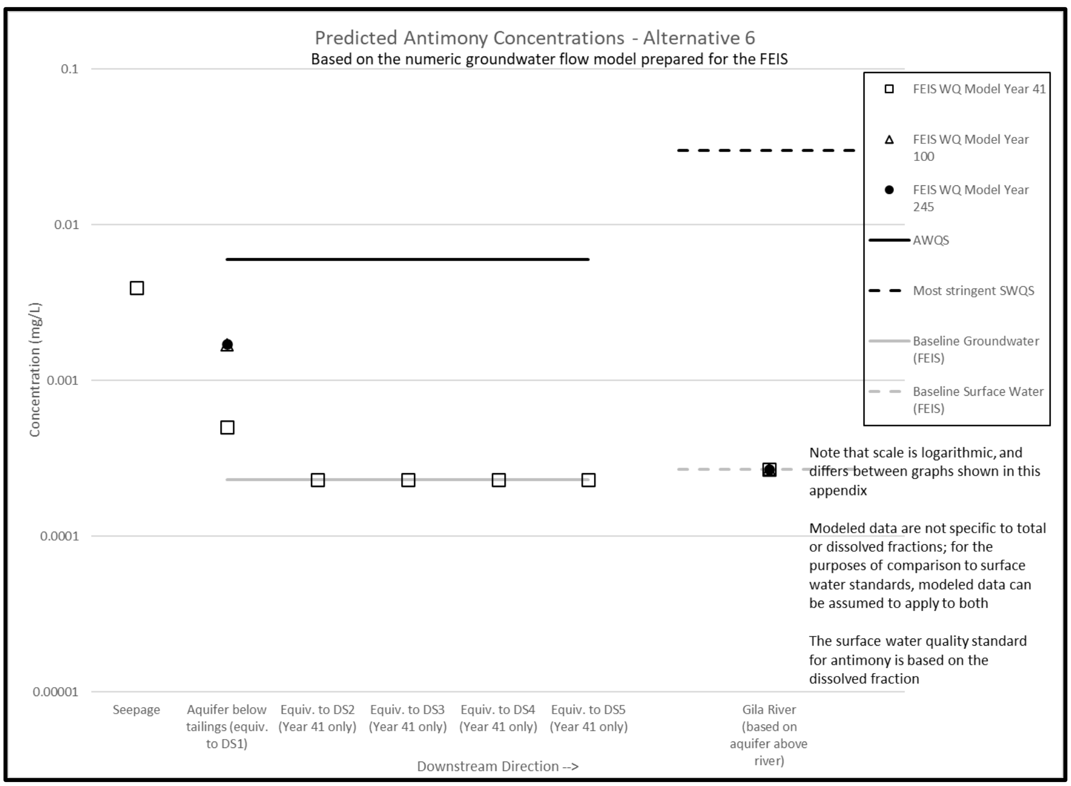


Figure M-40. Predicted antimony concentrations, Alternative 6, FEIS water quality model

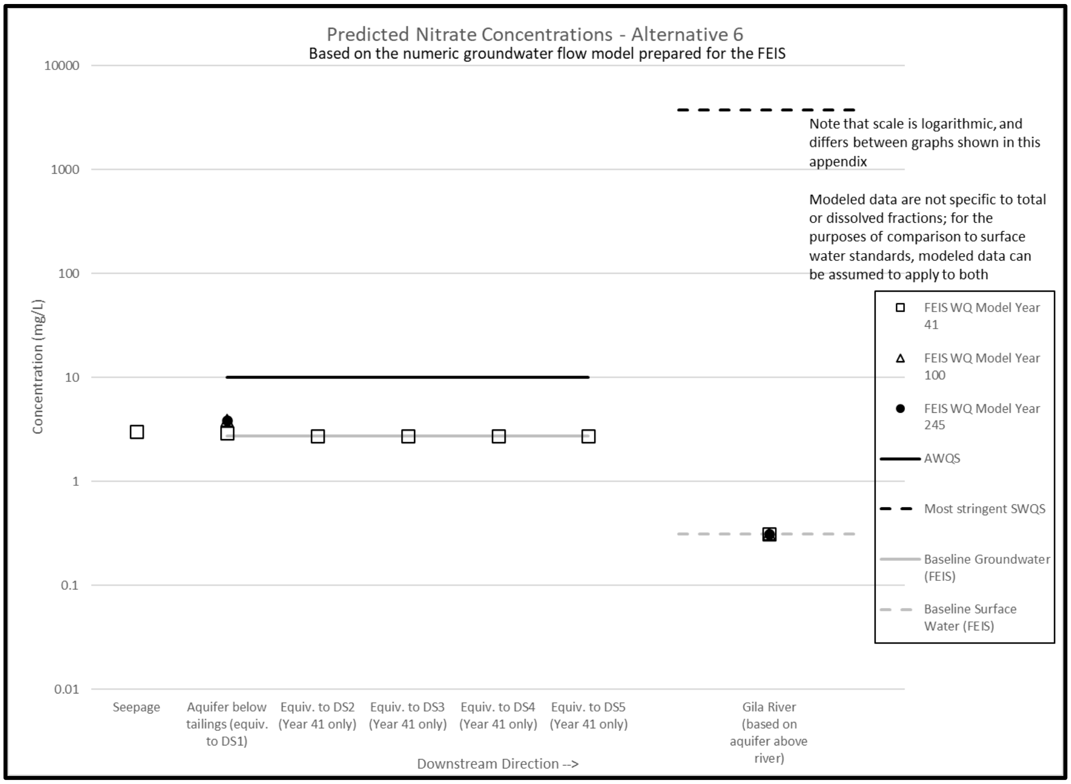


Figure M-41. Predicted nitrate concentrations, Alternative 6, FEIS water quality model

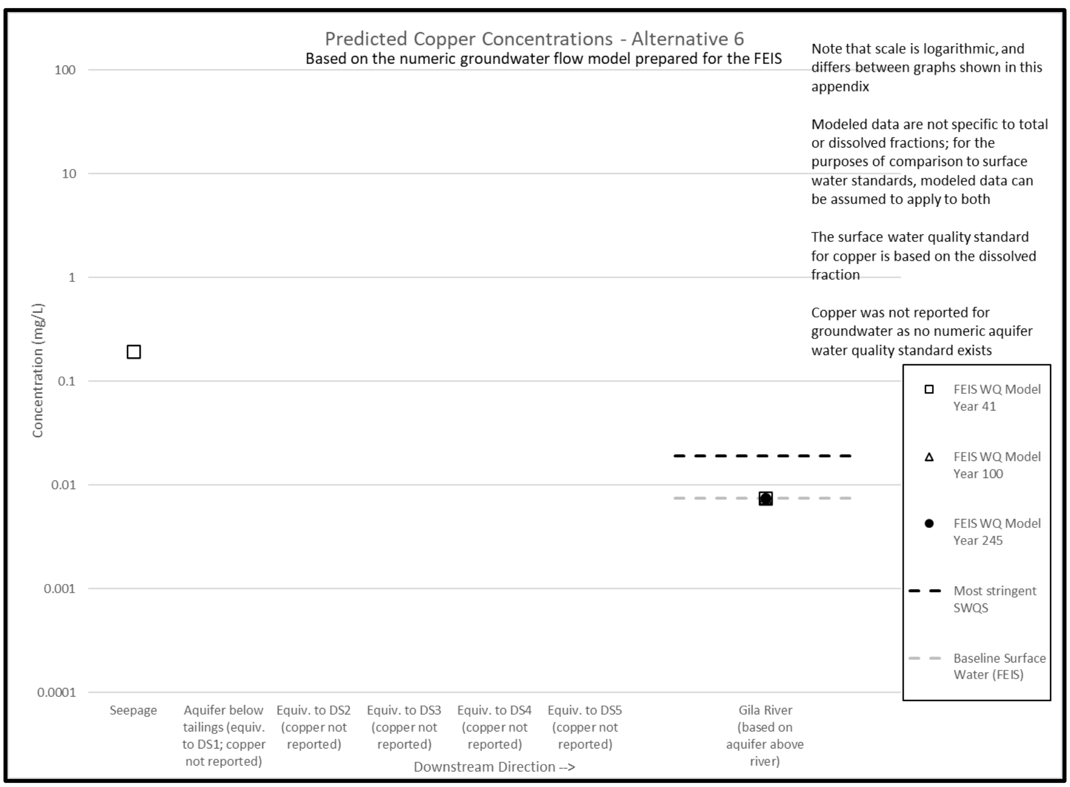


Figure M-42. Predicted copper concentrations, Alternative 6, FEIS water quality model

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Appendix N. Summary of Existing Groundwater and Surface Water Quality

Overview of Existing Water Quality Sampling

While some water quality samples were being collected in the area as early as 1986, water quality sampling conducted by Resolution Copper Mining LLC (Resolution Copper) began in earnest in 2003 (Agner 2020; 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. Water quality samples used for the final environmental impact statement (FEIS) analysis extend through the end of 2016.

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 2018e).

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

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

	Units	Shallow Groundwater (alluvium or shallow bedrock)					Apache Leap Tuff Aquifer					Deep Groundwater System				
		Number of Samples	Minimum	Maximum	Mean	Median	Number of Samples	Minimum	Maximum	Mean	Median	Number of Samples	Minimum	Maximum	Mean	Median
pH (Field)	S.U.	29	5.49	7.42	6.26	6.40	105	6.51	10.17	7.34	7.27	30	6.59	9.75	7.44	7.25
Specific Conductance (Field)	μS/cm	22	199.00	1,020.00	493.54	399.00	99	233.00	736.20	323.76	275.00	25	285.10	4,196.00	1,671.32	1,922.00
Temperature (Field)	C	28	13.60	20.70	17.12	17.05	105	15.00	28.40	24.03	24.20	30	28.50	68.70	42.55	42.15
Carbon 14	PMC	13	89.96	108.50	99.70	97.00	78	55.30	106.29	72.29	67.21	22	0.60	84.85	31.29	24.50
Delta Carbon-13 of DIC	Per mil	13	−20.90	−10.50	−17.82	−18.90	78	−20.10	−7.70	−15.84	−15.60	22	−19.30	−7.30	−13.04	−13.25
Delta Deuterium	Per mil	23	−73.00	−43.00	−61.45	−64.00	92	−79.00	−54.00	−68.64	−69.50	20	−86.00	−67.60	−79.69	−83.05
Delta Oxygen-18 of Sulfate	Per mil	19	−0.70	32.30	8.12	5.60	69	−5.90	18.70	5.99	6.30	15	−1.00	7.60	3.45	2.30
Delta Oxygen-18	Per mil	23	−10.50	−5.60	−8.75	−9.32	92	−11.40	−7.97	−9.90	−9.90	20	−11.96	−9.17	−11.05	−11.51
Delta Sulfur-34	Per mil	20	−5.40	4.60	−0.56	−1.10	69	−3.60	10.00	4.78	4.90	16	−1.20	9.40	5.17	6.45
Strontium 87/86	Ratio	14	0.71	0.71	0.71	0.71	72	0.71	0.73	0.71	0.71	22	0.71	0.72	0.71	0.71
Tritium	T.U.	20	2.30	6.20	3.70	3.55	81	0.30	3.42	1.17	1.00	21	0.43	1.50	1.02	1.00
Alkalinity (as CaCO3)	mg/L	28	11.00	289.00	72.45	61.00	106	73.00	335.00	148.13	140.00	22	110.00	320.00	220.18	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
Bicarbonate (calculated by M&A)	mg/L	28	13.00	353.00	88.29	74.00	106	73.80	409.00	179.23	170.50	22	59.00	390.00	263.09	299.00
Bicarbonate Alkalinity (as CaCO3)	mg/L	28	11.00	289.00	72.45	61.00	106	60.50	335.00	146.89	139.50	22	48.00	320.00	215.67	245.00
Carbonate (calculated by M&A)	mg/L	28	0.00	0.00	0.00	0.00	106	0.00	36.50	0.75	0.00	22	0.00	39.00	2.70	0.00
Carbonate Alkalinity (as CaCO3)	mg/L	28	1.00	6.00	4.75	6.00	106	1.00	60.90	6.40	6.00	22	1.00	65.00	9.23	6.00
Chloride	mg/L	29	3.52	57.00	26.43	27.00	106	4.20	24.70	7.39	5.90	22	5.80	26.00	15.75	17.00
Dissolved oxygen	mg/L	6	1.12	4.42	2.71	2.90	5	1.00	5.75	2.75	2.97	3	1.25	1.52	1.34	1.25
Fluoride	mg/L	29	0.04	0.45	0.33	0.40	106	0.20	1.05	0.44	0.40	22	0.12	4.10	1.52	0.68
Hardness (as CaCO3)	mg/L	19	74.60	370.00	164.79	120.00	81	63.00	345.00	125.31	94.00	22	2.82	700.00	338.22	270.00
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
Nitrate as N	mg/L	22	0.20	16.00	2.04	0.20	63	0.20	1.60	0.50	0.49	10	0.20	1.40	0.53	0.28
Nitrate+Nitrite as N (calculated by M&A)	mg/L	22	0.00	16.00	1.93	0.00	63	0.00	1.60	0.50	0.49	10	0.00	1.40	0.43	0.18
Nitrate+Nitrite as N	mg/L	11	0.03	2.22	0.82	0.40	53	0.02	2.57	1.34	2.00	14	0.16	2.00	1.31	1.71
Nitrite as N	mg/L	22	0.10	0.20	0.16	0.20	63	0.10	0.20	0.17	0.20	10	0.03	0.20	0.16	0.20
pH (Laboratory)	S.U.	26	5.54	8.20	6.74	6.82	98	7.01	9.79	7.72	7.65	22	7.00	9.38	7.72	7.45
Silica	mg/L	28	30.00	43.60	36.87	37.60	106	6.98	75.00	58.81	62.00	22	5.80	87.00	30.45	24.00
Specific Conductance (Laboratory)	μS/cm	22	218.00	1,100.00	470.00	420.00	96	220.00	843.00	326.91	275.00	19	260.00	1,800.00	882.63	570.00
Sulfate	mg/L	29	10.90	450.00	113.92	53.40	106	1.40	163.00	18.07	4.70	22	2.00	840.00	245.24	39.85
Sulfide	mg/L	28	0.04	0.45	0.12	0.04	96	0.04	0.77	0.08	0.05	22	0.02	12.00	0.68	0.05
Temperature (Laboratory)	C	20	17.80	22.20	19.73	19.55	85	17.70	22.50	19.50	19.50	19	17.30	24.10	19.89	19.70

	Units	Shallow Groundwater (alluvium or shallow bedrock)					Apache Leap Tuff Aquifer					Deep Groundwater System				
		Number of Samples	Minimum	Maximum	Mean	Median	Number of Samples	Minimum	Maximum	Mean	Median	Number of Samples	Minimum	Maximum	Mean	Median
Total Dissolved Solids (Laboratory)	mg/L	29	135.00	750.00	316.90	240.00	106	140.00	579.00	247.58	218.50	22	92.00	1,400.00	609.23	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	2	10.00	10.00	10.00	10.00
Aluminum	mg/L	28	0.05	1.01	0.22	0.20	106	0.02	0.50	0.21	0.20	22	0.03	4.50	0.37	0.20
Antimony	mg/L	27	0.00	0.00	0.00	0.00	100	0.00	0.02	0.00	0.00	22	0.00	0.06	0.00	0.00
Arsenic	mg/L	27	0.00	0.00	0.00	0.00	100	0.00	0.01	0.00	0.00	22	0.00	0.13	0.01	0.00
Barium	mg/L	28	0.03	0.22	0.10	0.10	106	0.00	0.06	0.02	0.02	22	0.00	0.48	0.06	0.03
Beryllium	mg/L	28	0.00	0.00	0.00	0.00	106	0.00	0.00	0.00	0.00	22	0.00	0.00	0.00	0.00
Boron	mg/L	25	0.02	0.20	0.15	0.20	99	0.02	0.50	0.19	0.20	21	0.06	1.50	0.25	0.20
Bromide	mg/L	28	0.05	0.50	0.41	0.50	97	0.07	1.00	0.48	0.50	22	0.07	0.50	0.40	0.50
Cadmium	mg/L	27	0.00	0.00	0.00	0.00	101	0.00	0.01	0.00	0.00	22	0.00	0.02	0.00	0.00
Calcium	mg/L	29	21.40	130.00	50.63	37.00	106	1.16	91.10	35.05	28.00	22	1.13	270.00	101.19	58.00
Chromium	mg/L	28	0.00	0.01	0.01	0.00	106	0.00	0.01	0.00	0.00	22	0.00	0.61	0.03	0.00
Cobalt	mg/L	25	0.00	0.04	0.01	0.00	99	0.00	0.05	0.00	0.00	21	0.00	0.06	0.00	0.00
Copper	mg/L	28	0.00	0.19	0.01	0.01	106	0.00	0.06	0.01	0.00	22	0.00	1.80	0.09	0.00
Cyanide, Amenable	mg/L	22	0.02	0.05	0.03	0.03	90	0.01	0.05	0.03	0.03	11	0.01	0.05	0.02	0.01
Cyanide, Total	mg/L	5	0.00	0.00	0.00	0.00	6	0.00	0.01	0.01	0.00	10	0.00	0.05	0.02	0.01
Iron	mg/L	28	0.05	30.00	6.03	3.40	106	0.02	10.00	0.70	0.14	22	0.05	1,100.00	53.19	1.90
Lead	mg/L	27	0.00	0.02	0.00	0.00	100	0.00	0.01	0.00	0.00	22	0.00	0.43	0.02	0.00
Magnesium	mg/L	29	5.13	26.00	10.58	7.80	106	0.04	28.50	6.45	4.70	22	0.04	43.50	21.25	24.00
Manganese	mg/L	25	0.02	2.06	0.44	0.35	99	0.00	1.30	0.11	0.03	22	0.00	15.00	0.84	0.14
Mercury	mg/L	27	0.00	0.00	0.00	0.00	104	0.00	0.00	0.00	0.00	22	0.00	0.00	0.00	0.00
Molybdenum	mg/L	28	0.00	0.02	0.01	0.01	106	0.00	0.05	0.01	0.00	22	0.00	0.27	0.03	0.01
Nickel	mg/L	28	0.00	0.02	0.01	0.01	106	0.00	0.05	0.01	0.00	22	0.00	0.22	0.02	0.00
Potassium	mg/L	29	0.60	4.37	2.18	2.00	106	0.85	5.80	1.92	2.00	22	0.53	39.00	12.66	5.10
Selenium	mg/L	27	0.00	0.02	0.00	0.00	100	0.00	0.02	0.00	0.00	22	0.00	0.04	0.00	0.00
Silver	mg/L	27	0.00	0.00	0.00	0.00	101	0.00	0.01	0.00	0.00	22	0.00	0.02	0.00	0.00
Sodium	mg/L	29	7.00	55.00	23.96	18.20	106	16.00	69.30	28.49	25.00	22	13.00	160.00	64.99	33.35
Strontium (by isotope dilution)	mg/L	14	0.17	1.00	0.39	0.28	72	0.09	0.52	0.19	0.16	22	0.00	41.83	4.51	0.61
Thallium	mg/L	27	0.00	0.00	0.00	0.00	100	0.00	0.01	0.00	0.00	22	0.00	0.02	0.00	0.00
Uranium	mg/L	12	0.00	0.00	0.00	0.00	63	0.00	0.02	0.00	0.00	22	0.00	0.01	0.00	0.00
Zinc	mg/L	28	0.01	0.60	0.09	0.05	106	0.01	1.97	0.26	0.09	20	0.00	1.70	0.16	0.05
Gross Alpha, Adjusted	pCi/L	0	–	–	–	–	36	−10.70	7.00	−0.77	−0.36	20	−13.70	49.00	3.72	-0.79
Gross Alpha	pCi/L	12	1.00	8.60	2.68	1.55	64	1.00	10.00	2.66	2.00	22	1.80	49.00	15.42	4.45
Gross Beta	pCi/L	12	2.00	6.00	3.31	2.70	64	2.00	9.70	3.75	3.85	22	2.60	56.00	18.88	9.70
Radium 226 + Radium 228	pCi/L	12	0.00	3.05	0.77	0.15	64	0.00	2.50	0.39	0.00	22	0.00	16.00	3.67	0.64
Radium 226	pCi/L	12	0.10	0.60	0.27	0.23	64	0.08	0.69	0.21	0.19	22	0.08	11.00	2.82	0.60
Radium 228	pCi/L	12	0.85	2.80	1.40	1.20	64	0.47	2.60	1.28	1.20	22	0.57	5.30	1.39	0.98

	Units	Shallow Groundwater (alluvium or shallow bedrock)					Apache Leap Tuff Aquifer					Deep Groundwater System				
		Number of Samples	Minimum	Maximum	Mean	Median	Number of Samples	Minimum	Maximum	Mean	Median	Number of Samples	Minimum	Maximum	Mean	Median
Radon 222	pCi/L	0	–	–	–	–	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	0	–	–	–	–	30	0.40	8.70	2.61	1.90	7	0.60	15.00	7.61	7.00
Uranium 234	pCi/L	12	0.20	0.20	0.20	0.20	64	0.20	7.50	1.73	1.25	22	0.20	46.00	9.44	1.10
Uranium 235	pCi/L	12	0.20	0.20	0.20	0.20	64	0.10	1.30	0.69	0.97	22	0.10	5.00	1.25	1.00
Uranium 238	pCi/L	12	0.20	0.20	0.20	0.20	64	0.20	6.05	1.14	1.00	22	0.10	6.29	1.95	1.10
Uranium Activity (Calc 907_0)	pCi/L	12	0.20	0.20	0.20	0.20	28	0.20	6.40	1.55	1.15	2	0.20	0.30	0.25	0.25

Notes: M&A = Montgomery & Associates; Dash indicates no analysis available for this parameter

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; μS/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 used 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

Parameter	Units	Upper Devil's Canyon				Middle Devil's Canyon				Lower Devil's Canyon				Upper Queen Creek				Lower Queen Creek				Mineral Creek			
		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

Parameter	Units	Upper Devil's Canyon				Middle Devil's Canyon				Lower Devil's Canyon				Upper Queen Creek				Lower Queen Creek				Mineral Creek			
		Max	Range	Avg	Median	Max	Range	Avg	Median	Max	Range	Avg	Median	Max	Range	Avg	Median	Max	Range	Avg	Median	Max	Range	Avg	Median
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
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

Dash indicates no analysis available for this parameter

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

Parameter	Units	Upper Devil's Canyon				Middle Devil's Canyon				Lower Devil's Canyon				Upper Queen Creek				Lower Queen Creek				Mineral Creek			
		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

Parameter	Units	Upper Devil's Canyon				Middle Devil's Canyon				Lower Devil's Canyon				Upper Queen Creek				Lower Queen Creek				Mineral Creek			
		Max	Range	Avg	Median	Max	Range	Avg	Median	Max	Range	Avg	Median	Max	Range	Avg	Median	Max	Range	Avg	Median	Max	Range	Avg	Median
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)	μS/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
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

Parameter	Units	Upper Devil's Canyon				Middle Devil's Canyon				Lower Devil's Canyon				Upper Queen Creek				Lower Queen Creek				Mineral Creek			
		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	0.020	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

Notes: 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; µS/cm = microSiemens per centimeter

Dash indicates no analysis available for this parameter

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

PARAMETER	Stream System	Number of Exceedances by Major Stream System, for Arizona Surface Water Quality Standards									
		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

PARAMETER	Stream System	Number of Exceedances by Major Stream System, for Arizona Surface Water Quality Standards									
		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**
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							
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				

PARAMETER	Stream System	Number of Exceedances by Major Stream System, for Arizona Surface Water Quality Standards									
		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
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
	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						

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
		Number of Exceedances by Major Stream System, for Arizona Surface Water Quality Standards									
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
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							
	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				

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
		Number of Exceedances by Major Stream System, for Arizona Surface Water Quality Standards									
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
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									
	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

PARAMETER	Stream System	Number of Exceedances by Major Stream System, for Arizona Surface Water Quality Standards									
		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
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						
	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
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
Chromium III*	–	–	–	1,400	1,400	75	–	–	0.1856	0.1772	0.1528	3.9385	–
At hardness = 242 mg/L	0.1528	1.1740	3.9385	–	–	–	–	–	–	–	–	–	–
At hardness = 290 mg/L	0.1772	1.3615	4.5675	–	–	–	–	–	–	–	–	–	–
At hardness = 307 mg/L	0.1856	1.4265	4.7856	–	–	–	–	–	–	–	–	–	–
At hardness = 400 mg/L	0.2305	1.7717	5.9436	–	–	–	–	–	–	–	–	–	–
Chromium VI	0.011	0.016	0.034	2.8	2.8	0.15	–	–	0.011	0.011	0.011	0.011	–
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	–	–	–	–	–	–	–	–	–	–

	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
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	–	–	–	–	–	–	–	–	–	–
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. Programmatic Agreement [Removed]

As described in chapter 1, the draft Programmatic Agreement that was included in the January 2021 Rescinded FEIS has been removed from the republished FEIS.

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Appendix P. Final Biological Opinion Completing Consultation under Section 7 of the Endangered Species Act

United States Department of the Interior

Fish and Wildlife Service
Arizona Ecological Services Office
9828 North 31st Avenue, Suite C3
Phoenix, Arizona 85051
Telephone: (602) 242-0210 Fax: (602) 242-2513

In Reply refer to:
02EAAZ00-2020-F-0822

December 31, 2020

Tom Torres
Acting Forest Supervisor, Tonto National Forest
2324 East McDowell Road
Phoenix, Arizona 85006

Dear Mr. Torres:

Thank you for your request for formal consultation with the U.S Fish and Wildlife Service (FWS) pursuant to section 7 of the Endangered Species Act of 1973 (16 U.S.C. § 1531-1544), as amended (ESA). We received your request and revised Biological Assessment (BA) dated June 26, 2020, the same day. At issue are effects that may result from the proposed Resolution Copper Mine located in Gila and Pinal counties, Arizona. The proposed action may affect the endangered Arizona hedgehog cactus (*Echinocereus triglochidiatus* var. *arizonicus*).

In your letter, you requested our concurrence that the proposed action is not likely to adversely affect the endangered Gila chub (*Gila intermedia*) and southwestern willow flycatcher (*Empidonax traillii extimus*) and their designated critical habitat; the threatened northern Mexican gartersnake (*Thamnophis eques megalops*); and the threatened yellow-billed cuckoo (*Coccyzus americanus*) and its proposed critical habitat. We concur with your determinations and include our rationales in Appendix A.

You also determined that this action will have "no effect" on the Acuña cactus (*Echinomastus erectocentrus* var. *acunensis*), desert pupfish (*Cyprinodon macularius*), Little Colorado spinedace (*Lepidomeda vittata*), loach minnow (*Tiaroga cobitis*), spikedace (*Meda fulgida*), Colorado pikeminnow (Ptychocheilus lucius), Chiricahua leopard frog (*Rana chiricahuensis*), razorback sucker (*Xyrauchen texanus*), woundfin (*Plagopterus argentissimus*), Mexican spotted owl (*Strix occidentalis lucida*) and their critical habitat, and Nichol's turk's head cactus (*Echinocactus horizonthalonius* var. *nicholii*), Apache trout (*Oncorhynchus apache*), gila trout (*Oncorhynchus gilae*), gila topminnow (*Poeciliopsis occidentalis*), Sonoran pronghorn (*Antilocapra americana sonoriensis*), Mexican wolf (*Canis lupus baileyi*), and ocelot (*Leopardus pardalis*). "No effect" determinations do not require our review and we will not address them further in this biological opinion.

On August 3, 2020, we reached a settlement agreement with WildEarth Guardians and Western Watershed Project to add the Sonoran desert tortoise (*Gopherus morafkai*) to the candidate species list under the Act. We provide our technical assistance for the tortoise in Appendix B.

This biological opinion is based on information provided in the revised June 26, 2020, BA (SWCA 2020), the August 9, 2019, draft National Environmental Policy Act (NEPA) Environmental Impact Statement (DEIS) (USFS 2019), technical memo project updates (SWCA 2020a, 2020b), baseline reports associated with the DEIS, meetings, telephone conversations, and other sources of information. Literature cited in this biological opinion is not a complete bibliography of all literature available on the species of concern, mining activities, ground clearing activities, invasive weed control, habitat restoration and its effects, or on other subjects considered in this opinion. A complete administrative record of this consultation is on file at the Arizona Ecological Services Field Office.

Consultation History

March 18, 2016:	We received notice from the Tonto National Forest (TNF) of their intent to prepare a DEIS for the Resolution Copper Mine Project.
August 19, 2016:	We responded to the TNF's invitation to participate as a cooperating agency in the development of the DEIS.
November 22, 2016:	We attended the Cooperating Agency meeting.
February 24, 2017:	We provided general comments on biological resources in the Scoping Issues Report.
March 1, 2017:	We decided not to accept the cooperating agency invitation. We would continue to provide species information as requested.
January 5, 2018:	We received notice of the TNF's Final Decision Notice for the Apache Leap Special Management Area Management Plan Environmental Assessment and Finding of No Significant Impact.
August 1, 2019:	TNF publishes DEIS for Resolution Copper Mine.
December 18, 2019:	We received the TNF's letter designating SWCA Environmental Consultants (SWCA) as their non-federal agency representatives.
January 24, 2020:	We met with the TNF, SWCA, and U.S. Army Corps of Engineers (USACE) to discuss the initial Resolution Copper Mine project, the BA's development, and section 7 consultation.
Jan. to May 2020:	We participated in early coordination with SWCA regarding aspects of the consultation.
May 8, 2020:	We received a BA from the TNF for the Resolution Copper Mine.

May 20, 2020:	We met with the TNF and SWCA to discuss the proposed action, project timelines, and the scheduling of the BA.
June 1, 2020:	We submitted comments to the TNF and SWCA on the BA's analyses of the Arizona hedgehog cactus and Gila chub.
June 2, 2020:	We met with the TNF and SWCA to discuss our comments on the Gila chub, next steps, and consultation timelines.
June 4, 2020:	We provided technical information to SWCA regarding conservation measures for the Sonoran desert tortoise.
June 5, 2020:	We submitted comments to the TNF and SWCA on the BA's analyses of the Northern Mexican garter snake.
June 8, 2020:	We sent a letter to the TNF that there is insufficient information in the BA to initiate consultation. We also received correspondence by the TNF granting applicant status to Resolution Copper Mining, LLC.
June 10, 2020:	We met with the TNF, SWCA, Resolution Copper Mining, LLC, WestLand Resources, Inc. (applicant's consultants), and USACE to discuss species information regarding compensatory mitigation parcels under Section 404 of the Clean Water Act. WestLand Resources, Inc. also presented changes to the pipeline corridor alignment.
June 19, 2020:	We met with the TNF and SWCA to discuss and review our comments on the Arizona hedgehog cactus.
June 26, 2020:	We received the revised BA.
July 9, 2020:	We sent a letter to the TNF accepting the BA.
July thru Oct., 2020:	We received clarifications on the proposed action from the TNF, SWCA, and Resolution Copper Mining, LLC.
September 1, 2020:	We received information from SWCA (2020a) regarding Resolution Copper's addition of a conservation easement for the Arizona hedgehog cactus.
September 9, 2020:	We provided the TNF and SWCA an informal draft of the description of the proposed action to be included in the BO for review.
September 16, 2020:	We received comments from TNF and SWCA on the proposed action.
October 2, 2020:	We received information from SWCA (2020b) regarding Salt River Project's (SRP) proposed transmission line maintenance, vegetation maintenance underneath those lines, and associated conservation measures, recreation and USACE CWA 404 mitigation, and various clarifications.

November 2, 2020: We sent the draft BO to the TNF.

December 2, 2020: We received comments on the draft BO.

December 2020: We collaborated with the TNF and SWCA on addressing BO comments.

December 30, 2020: We received a letter from TNF describing that we have received a thorough and accurate description of the proposed action from the DEIS, BAs, technical memos, and communication between our offices, and all the information to be included in the Final EIS relevant to this biological opinion, has been provided for our consideration.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

Regulations implementing the Act (50 CFR 402.02) define “action” as “all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies of the United States or upon the high seas.”

Background

In 2014, Resolution Copper proposed developing an underground copper mine on unpatented mining claims on National Forest System (NFS) lands near Superior, Arizona. To consolidate land ownership above the copper deposit, located primarily on NFS lands, Resolution Copper pursued a land exchange with the United States of America Federal Government. In December 2014, Congress authorized a land exchange pending completion of an Environmental Impact Statement (EIS), as outlined in Section 3003, Southeast Arizona land exchange and conservation, of the Carl Levin and Howard P. ‘Buck’ McKeon National Defense Authorization Act for Fiscal Year 2015 (PL 113-291; NDAA 2015). The exchange parcel conveyed to Resolution Copper includes the NFS surface lands above the copper deposit and the lands of the Oak Flat Withdrawal Area. This collective 2,422-acre tract of land is the “Oak Flat Federal Parcel.” Resolution Copper will, in turn, exchange eight parcels located throughout Arizona (approximately 5,460 acres per the legal description of private land currently owned by Resolution Copper) to the Federal Government. The Forest Service and Bureau of Land Management will administer private lands transferred into Federal ownership from the land exchange under existing resource management plans. Congress dictated that conveyance of all right, title, and interest for the Oak Flat Federal Parcel will occur no more than 60 days after publication of the Final EIS. Therefore, the land exchange itself is not an action considered in the TNF’s BA or in this BO.

On behalf of the Secretary of Agriculture, the TNF is responsible for preparing a single EIS to address: the use Forest Service lands for the Resolution Copper Mine Project and any other decisions by federal agencies related to the mine, and to facilitate the land exchange of the Oak Flat Federal Parcel for the eight private parcels located throughout Arizona as directed by Section 3003 of the PL 113-291.

The TNF’s preferred NEPA alternative is Alternative 6, Skunk Camp North Tailings Facility. The federal action associated with Alternative 6 consists of three main components: (1) the Southeast Arizona Land Exchange, a congressionally mandated exchange of land between Resolution Copper and the United States; (2) TNF authorization of special use/road permits for Resolution Copper Mine operations on NFS land; and (3) USACE authorization of impacts to waters of the U.S. from mine activities.

The discretionary federal proposed actions taken by the TNF and USACE addressed under Section 7 of the Act for the life of the estimated overall 60-year project include: the TNF’s authorization of special use/road permits for Resolution Copper Mine Project operations on NFS land and the USACE’s permitting under the Section 404 of the Clean Water Act (CWA). Based upon these discretionary federal actions associated with Resolution Copper Mine (*e.g.,* special use/road permits for road use, pipeline construction/operation, transmission line construction/operation), the subsequent analysis addresses consequences that would not occur “but for” the proposed action and are reasonably certain to occur (*e.g.,* all related mine development, operations, closure, and reclamation).

Resolution Copper Mine Project proposed actions occur on non-federal lands and current TNF lands. We anticipate the current TNF land where the mine will be located will become non-federal land once the land exchange occurs. The proposed location of the Alternative 6 tailings storage facility occurs on private land and Arizona state trust lands southeast of the mine site (which Resolution Copper is expected to acquire).

The TNF's proposed special use/road permits for Resolution Copper Mine operations on NFS lands are for roads (improvement, development, maintenance, and use) and new power transmission lines and tailings pipeline corridors that cross NFS lands. Resolution Copper will implement road management and construct and maintain tailings pipelines. SRP is the electrical service provider for the project and will update existing powerline capability and construct new power line corridors to provide service to the new tailings storage facility. SRP plans a new 115 kilovolt (kV) line to power Skunk Camp co-located with tailings pipelines, and also a new 115kV/230kV line from the West Plant Site to a SRP Substation. A separate special use permit for the SRP powerlines is necessary because while the pipeline and powerlines are colocated, they follow different routes in some areas, reflect different uses (as per 36 CFR 251/FSH 2709.11, use code 761 for slurry pipelines, and use code 643 for powerlines), and involve separate responsible parties. Though the TNF will issue a separate permit, SRP's actions to upgrade, construct, operate and maintain electrical facilities are solely mine related and considered in this consultation.

Since the proposed project will discharge fill materials into potentially jurisdictional waters of the U.S. at the tailings storage facility and along the transmission and tailings pipeline corridor, Resolution Copper has requested authorization from the USACE under Section 404 of the Clean Water Act (CWA). The USACE's CWA Section 404 permitted activities include compensatory mitigation actions at parcels located outside of the mining project footprint (see definition below). The federal permitting and mitigation actions by the USACE under Section 404 of the CWA require Section 7 ESA evaluation.

The proposed action analyzed in the BA and our BO includes the following aspects of the project:

1. The construction or expansion of the mine's main facilities (existing and new).
2. The mining processes and associated activities (*e.g.,* transmission and pipeline construction/operation) occurring during operations of the mine.
3. The closure and reclamation processes.
4. The CWA Section 404 permit activities and off-site compensatory mitigation lands.
5. The disturbance of land as part of mitigation measures associated with the project.

Much of Resolution Copper's General Plan of Operation (GPO) describes the TNF's proposed action; however, the TNF analyzed a number of changes in the GPO during the NEPA alternatives development (*e.g*., recreation mitigation). Resolution Copper Mine's GPO describes the collection of mining actions, including the construction or expansion of the mine's main facilities (existing and new), mining processes and activities occurring during operation, as well as closure and reclamation processes. The proposed action analyzed in the TNF's BA reflects the anticipated activities that would take place under the preferred alternative described in the DEIS (USFS 2019), not the original GPO. Similarly, the effects in the TNF's BA reflect the entire body of analysis conducted to support the NEPA process (2016–present), not solely the effects disclosed in the GPO

(2015). In addition to changes in the GPO that occurred during the NEPA alternatives development process, the TNF and SWCA have incorporated certain other post–Draft EIS changes into the proposed action for this BA. These include:

- Relocation of a process water pond to fit within the boundaries of the West Plant Site, instead of on TNF land. This relocation was identified in the Draft EIS as an option, but not part of the preferred alternative;
- Post–Draft EIS changes in the alignment of the pipeline corridor to further avoid sensitive resources;
- Post–Draft EIS changes in the alignment of the power line corridor to further avoid sensitive resources;
- Post–Draft EIS changes in the closure plans for the Skunk Camp tailings storage facility; and,
- Impacts or disturbance associated with lands used for off-site mitigation activities brought forth during the NEPA process and compensatory mitigation required by the CWA Section 404 permitting process.

The TNF will not retain jurisdiction over any lands transferred to Resolution Copper's private ownership once the land exchange is completed. The Forest Service will retain limited future discretion for the proposed action's approximate 60-year duration under section 7 of the ESA due to the administrative oversight responsibilities required of the special use/road permits. Also, the USACE will retain limited future discretion for the specified duration of the Clean Water Act permit, under section 7 of the ESA due to the administrative oversight responsibilities required of the Clean Water Act permit.

The following is a summary describing relevant portions of the proposed action for inclusion in this biological opinion. A detailed description of the proposed action is found in the revised June 2020, BA (included herein by reference) (SWCA 2020) and the August 9, 2019, DEIS (USFS 2109).

Mine Phases: Construction, Operation, and Closure and Reclamation Time Frames

Mining components and activities will occur at new mining facilities, existing mining facilities, and existing facilities proposed for expansion. The main project facilities are the East Plant Site, West Plant Site, Skunk Camp North Tailings Facility, the Transmission Line and Tailings Pipeline Corridor, the existing Magma Arizona Railroad Company (MARRCO) corridor, and the Filter Plant and Loadout Facility (Figures 1-6, Appendix C).

The proposed Resolution Copper Mine project consists of approximately 14,950 acres of land, of which 2,467 acres are TNF lands, Arizona State Land Department (ASLD) manages 8,218 acres, and 4,265 acres is private land. An additional 725 acres are associated with Clean Water Act mitigation for the project (described below). An additional 92 acres are associated with required recreation mitigations to offset impacts of the project.

The TNF and SWCA calculated the project component vegetation disturbance acreage by using the project footprint (*i.e.*, 14,950 acres). However, several components will not involve ground disturbance, including Pipeline North Tunnel (122.0 acres), Pipeline Devils Canyon Span (5.4 acres), Pipeline Queen Creek Span (3.2 acres), and Pipeline Underground Boring (60.9 acres). Thus, approximately 191.5 acres of mapped vegetation disturbance will not occur because the TNF does not anticipate construction of these components will include ground disturbance.

The estimated overall life of the mine will be 51 to 56 years. Resolution Copper estimates that the mine will take approximately 9 years to construct (mine years 1 to 9), an operational life of approximately 41 years (mine years 6 to 46), followed by 5 to 10 years (mine years 46 to 51 or 56) of reclamation activities. Mining operations will occur 24 hours a day, 365 days a year.

Construction

- Mine years 1 through 9
- Specific activities will include:
    - Construction of new facilities at the East Plant Site, including new shafts, new roads, new substations, the refrigeration plant, and underground workings. Underground construction will be ongoing throughout the mine life.
    - Construction of new facilities at the West Plant Site, including the concentrator complex, process water pond, water treatment plant, substations, and new or rerouted Forest Service and private access roads. Ore processing facilities will be complete by mine year 6 and will begin processing ore from construction of the shaft and tunnels at the East Plant Site.
    - Construction of the Filter Plant and Loadout Facility by mine year 2.
    - Construction of power lines and tailings/copper concentrate/water pipelines within the various utility corridors, including new infrastructure within the MARRCO corridor.
    - Construction at the Skunk Camp tailings storage facility, including new roads, administrative facilities, stormwater controls and soil or growth media stockpiling. Resolution Copper expects the tailings storage facility construction to be ongoing throughout the mine life, as the facility will continually increase in both height and area.

Operators will construct a 20-foot-wide gravel access road generally adjacent to the tailings storage pipelines, located within a 500-foot wide right-of-way corridor. The access road will run almost the full length of the pipeline at the same grade and will be designed to allow all-weather access and to prevent scouring and erosion. Except in limited areas, road access will use existing roads only. These exceptions include where the pipeline is located in a tunnel north of U.S. 60, where the pipeline crosses underneath U.S. 60, where the pipeline bridges/spans the drainages of Queen Creek and Devil's Canyon, and where the pipeline is bored underneath Mineral/Mill Creek (activities occur at the intermittent/ephemeral Mill Creek and upper Mineral Creek confluence).

Crews will construct overhead power lines in the same vicinity generally parallel to the pipeline corridor. Construction of a few spur roads will occur outside of the corridor to allow SRP access to transmission towers. Catenary cable bridges will occur where required for the pipeline to span across major drainages or washes. Slope stabilization measures will mitigate unstable slope hazards, including horizontal drains and/or toe buttressing. In addition, erosion protection measures will occur, particularly at toe areas of watercourse crossings.

Constructed channels and culverts, designed to 100-year discharge rates, will allow passage of stormwater to maintain existing upland runoff and major drainage paths that cross the corridor. Where it is not practical to install a culvert along the alignment of an existing stream (e.g., where the corridor is in a cut), or where the discharges are small, runoff will be collected in the up gradient diversion channel and conveyed parallel to the corridor for conveyance through culverts placed at desired locations.

Operations and Maintenance

- Mine years 6 through 46
- Specific activities will include:
    - Production of 132,000 to 165,000 tons per day of ore from the East Plant Site. Ore partially crushed underground will travel underground to the West Plant Site for processing.
    - Ore will be processed into copper and molybdenum concentrate at the West Plant Site. A pipeline will pump copper concentrate in the MARRCO corridor to the Filter Plant and Loadout Facility. Trucks will take molybdenum concentrate directly from the West Plant Site.
    - Further dewatering of the copper concentrate occurs at the Filter Plant and Loadout Facility, then operators will load and transport copper concentrate by rail to market. The final smelter destination is unknown at this time. A pipeline will transport recycled water back to West Plant Site for use in the mining circuit.
    - Processing will create approximately 1.4 billion tons of tailings as waste material. Tailings will travel by pipeline to the Skunk Camp tailings storage facility. The tailings storage facility will continually expand over time and tailings would remain in the storage facility in perpetuity.

Closure and Reclamation

- Mine years 46 through 51 to 56. Some reclamation activities will occur during construction and operation phases. Examples include revegetation and stabilization along utility corridors and temporary construction areas, and concurrent reclamation on portions of the tailings storage facility embankment once the final embankment face is complete.
- Specific activities include:
    - Decommissioning, removing, and closing facilities.
    - Recontouring and regrading disturbed surfaces.
    - Replacing growth media, which could be stockpiled soils or other material such as Gila conglomerate.
    - Revegetating surfaces with native vegetation.
    - Closure of the tailings storage facility. The sequence and timing of closure of the tailings storage facility depends primarily on water management. Closure activities regarding seepage will continue beyond the end of mining operations and consist of monitoring seepage and activities associated with water quality concerns.

The closure and reclamation phase will occur after the approximate 40-year operations phase and will have a duration of approximately 5 to 10 years, longer for the tailings storage facility (estimated seepage rates suggest that additional closure activities including monitoring and possible water treatment would be required up to 80 years after the end of operations). Crews may complete reclamation concurrent with operations on the outer slopes of the tailings storage facility, where practicable.

Underground Mining and Subsidence

The GPO, submitted by Resolution Copper, proposes to conduct underground mining of a copper-molybdenum deposit located between approximately 4,500 to 7,000 feet below the area known as Oak Flat (Table 1, Appendix C). To obtain the ore, Resolution Copper will use a technique known as panel caving, which divides the ore into large sections or panels and depends on gravity and internal geological stresses to extract ore from underneath the ore body. Resolution Copper will construct a network of shafts and tunnels below the ore body using standard underground mining techniques including drilling, blasting, and removing the blasted rock. Access to the tunnels from vertical shafts will occur from the East Plant Site. Once crews build the tunnels below the copper deposit, explosives fracture the ore above and gravity moves the ore downward for removal and crushing. Primary crushing occurs underground. Operations will then convey the ore to a production shaft and hoist the ore approximately halfway to the surface (approximately 3,500 feet below surface). Operations will send the ore to the West Plant Site via an inclined underground-to-surface conveyor system. All of these steps occur underground.

The continued process of collapsing and excavating the ore repeatedly occurs until the copper deposit is exhausted or the grade of the collapsed ore is no longer economically viable. Over the 40-year operations phase, this process will occur at six panels adjacent to one another. Under the proposed action, mining will not occur within some sections of the one percent copper deposit shell nearest Apache Leap to minimize risk of subsidence at Apache Leap.

As the panel caving process is repeated, the volume of ore extracted from the underground mine is expected to cause the ground surface above the ore body to collapse or subside. Resolution Copper predicts the potential area that will subside will begin to show at the surface in about the sixth year of active mining. The overall subsidence will consist of the crater limit, the fracture limit, and the continuous subsidence limit, resulting in a 1,751-acre crater with maximum width of 1.8 miles and maximum depth of 800-1,115 feet at the end of mine life.

Dewatering of the deep groundwater system below the East Plant Site has taken place on private land with the appropriate permits since 2009, in order to allow for building of underground infrastructure (see Environmental Baseline). Currently, a thick sequence of poorly permeable Tertiary basin-fill sediments (the Whitetail Conglomerate) separates the Apache Leap Tuff aquifer from the deep groundwater system. Once mining proceeds, panel caving will create a hydraulic connection from the ground surface to the deep groundwater system and eliminate any intervening layers like the Whitetail Conglomerate that formerly were able to prevent or slow vertical groundwater flow. As the fractured zone of rock above the ore body extends to the surface, the fractures intersecting the overlying Apache Leap Tuff aquifer will partially dewater along with the deep groundwater system which can change the Apache Leap Tuff aquifer supply to springs and perennial streams. This dewatering will continue throughout the life of the mine.

East Plant Site

The East Plant Site is the location of the existing Magma Mine #9 and #10 shafts. Resolution Copper will enhance the East Plant Site adjacent to the Oak Flat Federal parcel by expanding its current size of 39 acres to 188.8 acres. The East Plant Site will include surface support facilities for the underground mining activities, such as access to vertical shafts and tunnels, refrigeration, ventilation, and surface support buildings. The Magma Mine Road provides access to the East Plant Site. Resolution Copper will eventually reroute the Magma Mine Road due to anticipated subsidence impacts. At present, four acres of the existing East Plant Site and 80 acres of the proposed East Plant Site are on Forest Service lands; following the land exchange, all of the East Plant Site will be private. The four acres of the existing East Plant Site has been previously disturbed.

Closure and reclamation at the East Plant site will consist of salvaging and demolishing all buildings, except for the headframes and hoists, which operators will use for post-closure groundwater monitoring. All salvageable and non-salvageable building materials will be disposed of off-site. All disturbed surfaces except those needed for long-term monitoring, including paved and graveled areas, will be regraded and reseeded with appropriate local seed mixes. Operators will close contact water basins in accordance with Aquifer Protection Permit (APP) requirements, and permanently seal shaft collars and subcollars by an engineered seal.

Reclamation activities will not occur within the subsidence area. There will be a berm and/or fence constructed around the perimeter of the continuous subsidence area to protect public safety from the unstable ground surface. To the extent practicable, operators will construct surface water diversions to divert stormwater away from the subsidence area and into natural drainages.

After closure, groundwater levels in the vicinity of the mine site will begin to recover; a process that will take centuries (USFS 2019, SWCA 2020). There is a remote and speculative possibility that eventually groundwater levels may rise high enough to encounter the subsidence crater, raising the possibility of a lake forming. The DEIS analysis modeled a range of groundwater recovery scenarios; and even with the fastest recovery, the models do not anticipate recovery to take place within 800-900 years after closure of the mine.

West Plant Site

The 940-acre West Plant Site, formerly the location of the old Magma Mine processing and smelter facilities, will process crushed ore arriving from the East Plant Site. The West Plant Site consists of three main facilities: (1) the stockpile, which includes the development rock and intermediate rock stockpiles (the rock stockpiles generally only persist during construction and startup of the facility); (2) the concentrator complex, which includes the process water pond, ore stockpile facility, tailings thickeners, copper molybdenum and copper concentrator thickeners, and the molybdenum plant; and (3) the auxiliary facilities, which include the administration building, contractor and warehouse laydown yards, and parking areas. The footprint of the West Plant Site will be on private lands owned by Resolution Copper. The Silver King Mine Road (Forest Service Road (FS) 229), which is on both private and Forest Service lands provides access to the West Plant Site. Resolution Copper will reconstruct and maintain portions of FS 229 across private land to Mine Safety and Health Administration specifications. The mine will use this as an alternate road to transport mine personnel, equipment, supplies, and molybdenum and other mine products to and/or from the West Plant Site without needing to enter the Town of Superior proper. Employees would primarily enter the West Plant Site from Lone Tree/Smelter Town Road.

At the end of the project, Resolution Copper will decommission the West Plant Site facilities, and contour, grade, and reseed (with local species seed mixes) the land surface as necessary to blend into the surrounding topography and terrain. A diversion channel, stormwater channel, and an on-site channel will remain in place to route flow through a new diversion channel to the Apex Tunnel to existing drainages (e.g., Silver King Wash). Operators will grade non-contact water basins to drain, and close, in accordance with Aquifer Protection Permit requirements, the process water pond and contact water basins.

Roads needed to support the reclamation and closure efforts will remain to provide access to monitoring stations and remediation areas. Resolution Copper will reclaim all other roads. Operators will salvage or demolish all buildings, with the exception of the historical cooling tower, and properly dispose all materials off-site. Operators will decommission, cap, and reclaim at the surface all portals, ventilation shafts, and tunnel entrances.

Skunk Camp Tailings Storage Facility

The Skunk Camp tailings storage facility is located on a mixture of land administered by the ASLD and private land approximately two miles east of the existing ASARCO Ray Mine (Table 2, Appendix C). There will be approximately 14,950 acres of disturbance, of which 2,467 acres is Forest Service land, 8,218 acres is ASLD, and 4,265 acres is private land. Resolution Copper will eventually purchase the State trust land at auction. Additional project activities would occur on 92 acres for recreational mitigations and 725 acres of USACE CWA 404 permitting compensatory mitigation. This acreage includes the area of the tailings storage facility as well as the tailings conveyance pipeline and powerline corridor.

Mining operations will create and pipe approximately 1.4 billion tons of tailings waste material to the Skunk Camp tailings storage facility. The tailings storage facility will continually expand over the mine's life. The approximate size at fence line of the tailing storage facility will be 9,611 acres, with about 4,002 acres of disturbance within its footprint. The approximate embankment height will be 490 feet. The tailings will remain in the storage facility in perpetuity. Operators will create a pipeline and power line to convey tailings and power to the storage facility.

Ore processing at the West Plant Site will result in two separate streams of tailings: potentially acid generating (PAG) tailings representing about 16 percent of the tailings, and non-potentially acid generating (NPAG) tailings representing 84 percent of the tailings. Once at the tailings storage facility, operations will handle the two tailings streams differently, but independent pipelines will pump both as slurry to the tailings storage facility. Once delivered as a slurry, the NPAG tailings will be cycloned to separate the coarser particles for use as embankment fill, with the finer particles thickened at the site before discharge into the impoundment. Operations will deposit PAG tailings sub aqueously into two separate cells to the north (upstream) end of the facility. At mine closure, Resolution Copper will encapsulate the two PAG cells by the NPAG tailings. Pumped recycled water will return to West Plant Site for use in the operations.

Separate cross-valley starter embankments will impound PAG and NPAG cells. The impoundments will initially be constructed with borrow material from within the ultimate tailings facility footprint. Periodically, the impoundments will rise in elevation during operations with compacted cycloned sand fill. Resolution Copper has designed the two PAG embankments as downstream-type dams lined with a non-permeable layer to reduce seepage.

The NPAG cross-valley, centerline embankment will contain an underdrain system to maintain a low saturated surface in the tailings embankment and to intercept and direct seepage from the impoundment to the downstream seepage collection system ponds. Operators will place additional seepage controls (grout cutoff wall, seepage collection pond, pumpback wells) downstream of the tailings storage facility to collect seepage entering the environment. At full buildout, the embankment containing the NPAG tailings will be approximately 490 feet in height.

Operators will construct 5 diversion dams, 5 diversion channels, and 2 non-contact water surface-water pipelines along the east and west sides of the tailings storage facility. Collection ditches will occur along the embankment toe and at underdrain discharges to convey contact water to the seepage collection pond. Resolution Copper will construct additional auxiliary facilities at the Skunk Camp site such as the cyclone processing system, an electrical substation and electrical distribution lines, and administration facilities. Traffic will access the tailings storage facility along the existing Dripping Springs Road.

At the end of mining operations, operators will salvage or demolish all buildings and their foundations at the tailings storage facility, and all materials and debris will be properly disposed of off-site. Roads that will not be required for closure and reclamation activities will be decommissioned, recontoured, and revegetated.

Operators will cover the remaining area of PAG tailings with a minimum 10-foot layer of NPAG tailings. The surfaces of both the NPAG and PAG facilities will be shaped to prevent standing water and divert runoff into channels leading to the downstream collection pond, and both NPAG and PAG areas will be covered by a 1- to 2-foot layer of low-permeability, erosion-resistant growth medium (e.g., Gila conglomerate or equivalent soil, sand, and gravel mix) and revegetated. The timing of reclamation is dependent of the surface being dry enough to allow equipment access for reclamation.

Crews will construct a perimeter fence or berm around the tailings storage facility to prevent access. Revegetation of some surface water diversion structures will occur to control water and wind erosion, and operators will reconfigure others to carry water along topography through and off the site. The diversion structures will stay in perpetuity and reinforced with riprap to minimize erosion.

Estimated seepage rates suggest active closure will be required from 10 to 80 years after the end of all mining operations and passive treatment of seepage may occur up to 250 years after the end of all mining operations. Resolution Copper estimates closure of the tailings recycled water pond to take up to 10 years after closure. Specifically, up to 10 years after closure, Resolution Copper will pump back excess seepage in seepage ponds to the recycled water pond, and reclamation will take place on the embankment and tailings beaches. After 10 years when the recycled water pond is closed and no longer present, Resolution Copper will use seepage ponds to evaporate seepage, and the remaining reclamation of the tailings surface would occur. The mine operators will expand seepage collection ponds to maximize evaporation in order to passively evaporate all incoming seepage (estimated from 10 to 80 years). If necessary, Resolution Copper may need to implement other active water control measures such as spray evaporators or active treatment and release downstream. The seepage ponds will close only after seepage is determined to meet standards acceptable for release downstream. Once closed, the sludge containing concentrated metals and salts from evaporation will likely require cleanup and handling as a solid or hazardous waste.

Tailings Pipeline Corridor

Operators will transport the tailings within a corridor that includes four pipelines of varying sizes, access roads, and power and communication lines. The tailings corridor will follow existing roads or previously disturbed areas where possible. As mentioned above, operators will handle the tailings in separate split streams (PAG and NPAG) based on the ore processing at the West Plant Site. The pipelines will match the flow characteristics of materials and velocity and vary between 10-inch, 22-inch, or 34-inch diameter. Recycled water will travel back to the West Plant Site from the tailings storage facility via a 16-inch pipeline.

Pipeline installation, spill containment necessary based on pipeline installation method, and access roads would vary by topography. The pipeline designs will include being buried to the extent possible, horizontal directional drilling (underneath U.S. 60, cable-stay bridges (across Queen Creek and Devil's Canyon), tunnels (Silver King-Kings Crown Peak area), or underground boring (Mineral/Mill Creek). Installation design would vary based on topography throughout each corridor segment.

Throughout the life of the project, regular patrols will assess all areas of the tailings pipeline route. The patrol route would be conducted at least 26 times each calendar year at intervals not exceeding three weeks and serve to inspect the surface conditions on or adjacent to each pipeline right-of-way and the condition of crossings under navigable waterways. Methods of patrol would include walking, driving, or flying a drone. Pipelines have pressure indicators and flow indicators incorporated that allow instantaneous detection of leaks. A leak detection system would connect via fiber-optic cable to the control room at the West Plant Site and the control room at the tailings facility.

The right-of-way (ROW) for the tailings corridor will likely be 150-feet wide upon final approval. Where the pipeline runs parallel with the 115-kV transmission line, the right-of-way will be 225 to 280-feet wide upon final approval (i.e., SWCA used a width of 500-feet for their analysis while the corridor design was being finalized). The colocated corridor from the tailings pipeline north of U.S. 60 to the Skunk Camp tailings storage facility fence lines will result in 831.9 acres of disturbance. Disturbance will consist of excavation, stockpiles, laydown areas, vegetation clearing, and structures. Permanent disturbance will primarily be associated with an access road that overlaps these ROWs and infrastructure like tower footings. Operators will reclaim and revegetate other disturbed areas after construction.

The tailings pipeline will cross Queen Creek and Devil's Canyon and pass under Mill Creek. The Queen Creek and Devil's Canyon crossings will take place at locations that do not have perennial flow and will use a Catenary cable bridge for the pipelines to span these streams. No disturbance will take place to the streambed or habitat along the streams in these locations. The Mill Creek crossing will take place upstream of Government Springs Ranch. Specific design measures implemented to minimize potential effects at these crossings include:

- Using an underground boring method to install the pipelines at a minimum depth of 30-feet below the ground surface of Mill Creek.
- All power poles colocated with the tailings pipeline corridor will be located outside of the ordinary high-water mark of Mineral Creek and the transmission lines will pass overhead.
- Construction crews will use the existing Dripping Springs Road; no new access roads will occur at the Mineral and Mill creek crossing locations. Crews will deliver construction

materials to sites via helicopter, crane, or by foot, and access power pole locations on foot during construction and for general vegetation management to avoid effects to proposed yellow-billed cuckoo and designated Gila chub critical habitat.

The locations where the tailings pipeline will span Queen Creek and Devil's Canyon and cross under Mill Creek will have no additional ground disturbance, but the acres are included as part of the estimated amount of disturbance within the action area because of potential effects (such as noise, maintenance, dust, shading, etc). We describe these acreages below:

- 3.2 acres within the pipeline corridor with no ground disturbance where the pipeline will span Queen Creek.
- 5.4 acres within the pipeline corridor with no ground disturbance where the pipeline will span Devil's Canyon.
- 60.9 acres for the underground boring with no surface ground disturbance within the ordinary high-water mark of Mill Creek or within designated Gila chub and proposed yellow-billed cuckoo critical habitat.

Facilities associated with fresh water supply and distribution, such as pipelines, pump stations, and water tanks, may have a post-mining use and transferred to a third-party utility. These facilities are associated with the MARRCO corridor. Resolution Copper does not anticipate third-party uses within the tailings pipeline corridor at this time. No closure or reclamation activities would occur at these facilities if transferred to a third party.

Facilities that will not have a post-mining use include the tailings slurry lines, concentrate pipelines, and associated pump station with electrical power. Operators will decommission and remove these facilities and remove and scrap or salvage buried or aboveground pipelines. All disturbed areas will be recontoured and reseeded.

Electricity Supply and Transmission Lines

SRP currently supplies electricity to the East Plant Site by an existing 115-kilovolt (kV) transmission line, and to existing facility substations at the West Plant Site by an existing 115-kV and 230-kV transmission line.

Construction and operation of the proposed mine requires new transmission lines between these main facilities to accommodate greater power needs, as well as new transmission lines to power the tailings storage facility, water pumps within the MARRCO corridor, and the Filter Plant and Loadout facility (Table 3, Figure 5 - Appendix C). Operators will upgrade substations and/or construct new 230-kV substations to accommodate electricity from the upgraded lines and to distribute electricity throughout the site.

Easements for the transmission lines will vary between 75 to 160 feet, depending on the size of the line and the requirements for construction, maintenance, and electrical clearances. Transmission lines corridors colocated (e.g., line would run parallel to the other) with the tailings pipeline will be from 225 to 280-feet wide upon final approval. Tower designs will be either lattice steel towers or tubular steel poles with footings up to 50 feet square. The foundations for the transmission line structures are auger-drilled reinforced concrete piers. A lattice tower typically has four legs, each attached to a concrete foundation set into the ground.

Wherever possible, operators will use existing roads to construct the transmission facilities. In some areas, crews will clear access roads on an as-required basis to ensure adequate access for construction and maintenance activities. Construction of a permanent access road will occur along the colocated transmission line and tailings pipelines but within the proposed corridor in drivable terrain. Staging areas immediately surrounding line structures will also occur within the proposed corridor. Spur access roads constructed for SRP to reach tower facilities would be 20-feet wide and use existing roads and trails where possible. Along Mineral Creek, SRP will deliver materials by hand, helicopter, or crane from existing roads to construct the 115-kV transmission line and stay within previously disturbed areas.

SWCA's (2020) analysis considered a 500-foot wide corridor to estimate total ground disturbance for section 7 purposes. Based on initial conceptual designs, the transmission line right-of-ways will vary from 75 to 160 feet wide (Table 4, Appendix C) with only a portion disturbed during construction. Disturbance will consist of excavation, stockpiles, laydown areas, vegetation clearing, and structures. Permanent disturbance would primarily be associated with an access road that overlaps these ROWs and infrastructure like tower footings. Operators will reclaim and revegetate disturbed areas after construction.

Amount of disturbance anticipated for the transmission lines include:

- Transmission line 115-kV only: 3.0 acres within the corridor
- Transmission line 115-kV/tailings pipeline colocated corridor: 294.9 acres within the 500-foot corridor
- Transmission line 115-kV/230-kV colocated: 57.3 acres within the 500-foot corridor

Unless operators identify a post-mining use, they may remove power transmission facilities, which include electrical substations, transmission lines, and power centers, as part of the reclamation program. SRP would continue to own the power lines and may have a post-mining use for ongoing power transmission in the area.

Vegetation Management and Line Maintenance at Transmission and Distribution Lines

SRP will be responsible for vegetation management and repairs/maintenance at and along power transmission and distribution lines that supply Resolution Copper Mine (Table 6 & 7, Appendix C).

Line Inspection and Maintenance

SRP will inspect overhead and underground lines, poles, and towers by helicopter and with a truck, utility vehicle, and by foot (Table 6, Appendix C). The variety of structures and lines will be evaluated at intervals ranging from every 6 months to every 10 years. The duration of these activities will typically last hours to weeks.

Routine aerial inspections of the transmission line will occur by helicopter flight just above conductor height (50 to 150 feet above ground level), except where terrain or trees require a higher observation elevation. The low-level flights are a reconnaissance of the power line, structures, and associated equipment, and identify areas that may require repair. Helicopter flight patterns may include hovering or circling, or occasional landing. During the flights, SRP will identify and record line maintenance issues, and follow up with scheduled treatments.

In addition to routine helicopter flights, SRP may conduct additional flights by helicopter and/or small fixed-wing aircraft to collect light detection and ranging (LIDAR) data along the length of the lines between elevations of about 300 feet to 7,000 feet. LIDAR-related flights could occur during any time of year based on conditions within the right-of-way and maintenance needs. Prior to these flights, SRP may place and remove (when flights are complete) temporary ground control and/or weather stations (5-6 feet tall) along the line.

Should temporary helicopter refueling be required, SRP will conduct these in an open and previously disturbed area, following standard protocols to prevent spills, and at least 0.25 mile from protected or environmentally sensitive areas.

Routine ground inspection of the transmission line typically includes one or two utility employees driving a pickup truck, UTV, or traveling on foot to document problem areas for future repair. These employees could occasionally conduct minor repairs during the patrol.

Crews will maintain lines and structures by conducting repairs as needed (every 1-10 years) and structural replacement every 10-60 years (Table 5, Appendix C). These single location repairs or repair/replacement of line sections may last days or weeks. SRP estimates unscheduled and infrequent emergency inspections and repairs about 10 times per year. The repairs and replacement will involve various heavy equipment and air support, including backhoes; boom, bucket, cable puller, hole digger, and pickup trucks; D4 and D5 caterpillars; utility vehicles; and helicopters.

When SRP identifies maintenance issues with the line, poles, or other related structures, SRP prioritizes work to address non-hazardous issues in accordance with their priority schedule. SRP may need to replace the line or related structures at any time within the line's lifespan, making maintenance frequency difficult to predict. However, should pole replacement be required it will involve a large hole digger truck to drive in the right-of-way and dig a hole 20 to 36 inches wide and 5 to 15 feet deep near the existing pole. Crews will cut the old poles at ground level and take them off-site. The new pole is set with a hole digger truck or a boom truck. If access does not allow for the vehicle to enter the right-of-way, crews will walk in with a hand rock drill and air compressor to dig the hole. Pole replacement may involve a single pole or small group of poles, or multiple poles along a longer section of the line.

Line maintenance also may include erosion control and prevention work around pole bases if erosion has occurred. This work would involve a bulldozer or backhoe entering the area and fixing the eroded area. If a bulldozer or backhoe cannot access the area, crews will conduct work by hand.

SRP crews will conduct unscheduled emergency inspections by either helicopter or by ground inspection and follow procedures described above for those tasks. Unscheduled emergency inspections will differ from routine inspections in that they could occur at any time on a year-round basis.

When SRP identifies emergency hazardous issues with the line, poles, or other related structures, SRP will immediately addresses these issues as a priority. Emergency maintenance work involves the same types of work as the routine line maintenance tasks described above, but along a tighter timeframe and with a higher urgency. Additionally, hazardous line problems require immediate repair; therefore, SRP may not be able to reasonably implement all mitigation measures.

Vegetation Maintenance
SRP will inspect vegetation condition at transmission and distribution lines from the air (twice a year) and from the ground (every 1-5 years) to evaluate routine vegetation maintenance needs and hazards (Table 7, Appendix C).

SRP will perform routine vegetation management every 1-5 years across the entire circuit and conduct hazard vegetation treatment infrequently, estimated at about a single instance a year (Table 7, Appendix C). The equipment and methods will involve bucket and pickup trucks, utility vehicles, mechanical mowers as needed, and chippers.

The methodologies for routine vegetation management include: 1) vegetation aerial inspection, 2) vegetation ground inspection, routine vegetation maintenance, and hazard vegetation treatment (Table 7, Appendix C).

SRP will conduct aerial inspections of transmission line right-of-way by helicopter flight just above conductor height (50 to 150 feet above ground level), except where terrain or trees require a higher observation elevation. The low-level flights are a reconnaissance of general vegetation conditions within the right-of-way, identify hazard vegetation, and help plan the next routine maintenance cycle. SRP may use information from inspections to plan access routes, collect data, refine the number of crews needed, and develop the vegetation treatment method and plan of work.

Crews in trucks, UTVs, or on foot (as dictated by site condition) will inspect the transmission line right-of-way. Ground inspection is a reconnaissance of the right-of-way that can occur in conjunction with aerial inspection or when/where aerial inspection is not practical. Ground inspection will record general vegetation conditions within the right-of-way, identify hazard vegetation, and plan the next routine maintenance cycle. SRP may use information from inspections to plan access routes, collect data, refine the number of crews needed, and develop the vegetation treatment method and plan of work.

Routine vegetation maintenance is the process of pruning or removing vegetation within the right-of-way to maintain safety and access. Pruning is typically limited to the edges of the right-of-way corridor. Pruning is also limited to where protected resources or where threatened and endangered species exist, and pruning is required rather than removal of a tree or vegetation. SRP separates routine vegetation maintenance into 1) lines cleared to the recommended clearance standards that require only routine follow-up maintenance, and 2) lines not cleared to the clearance standards and require extensive clearing. SRP plans the schedule of routine vegetation maintenance projects through the results of aerial and ground inspections. Crews clear power lines on a cyclical basis every 1 to 5 years depending on factors such as vegetation type and the clearance standards for the line type. Routine vegetation maintenance can involve mechanical (mowing) and manual (hand crew) treatments; mowing is unlikely to be used along the Resolution Copper powerline. Hand crew removal and pruning of trees generally involves the use of chainsaw felling and pruning techniques.

Hand crews and power cutting tools will conduct hazard vegetation operations to remove and/or prune vegetation that poses an immediate threat to a utility line or associated structure. Because hazard vegetation requires immediate treatment to maintain the line in a safe operating condition, SRP may not be able to reasonably implement all species conservation measures to minimize and/or avoid effects. Therefore, SRP may remove or prune hazard vegetation at any time of year, and at any location within the right-of-way.

MARRCO Corridor

The 30-mile-long MARRCO corridor is an existing 685-acre railroad and utility corridor right-of-way running roughly east-west from Superior to Magma Junction (Figure 3, Appendix C). Hewitt Canyon Road (FS 357) provides access to the MARRCO corridor, which crosses private lands as well as lands administered by the TNF and the ASLD. Resolution Copper currently owns the MARRCO corridor ROW. The corridor is 200-feet wide, and private parcels along the MARRCO corridor have been developed, particularly east of Queen Station and near Magma Junction.

The corridor currently contains multiple utility lines and water pipelines and infrastructure, including an overhead transmission line and telephone line, buried natural gas pipelines, Arizona Water Supply Company pipelines and infrastructure providing water supply to the town of Superior, and an 18-inch dewatering line transporting water being dewatered from the East Plant Site to the New Magma Irrigation and Drainage District (NMIDD). New corridor facilities will include additional water pipelines, water pumps and recovery wells, and copper concentrate pipelines to transport ore concentrate to the Filter Plant and Loadout facility. Operators will upgrade the rail lines to allow use of freight car transport of concentrate from the Filter Plant and Loadout Facility to the main Union Pacific line to market. Resolution Copper anticipates the existing historic rail lines will stay in place between the West Plant Site and the Filter Plant and Loadout Facility.

The closure and reclamation of the MARRCO line is undetermined because Resolution Copper is not certain of the intended post-closure use of the railroad and utility lines. Resolution Copper does not foresee a use of the railroad or utility lines for project reclamation or post-closure use, but another entity might buy the facilities and continue use. However, Resolution Copper will remove the concentrate lines from the MARRCO corridor, and recontour and revegetate direct surface disturbance areas to the extent possible with adjacent utilities. Bridge structures will be assessed and either removed or upgraded.

Filter Plant and Loadout Facility

The Filter Plant and Loadout Facility is located on 553 acres of private lands controlled by Resolution Copper. A pipeline within the MARRCO corridor will transport copper concentrate slurry from the concentrator complex at the West Plant Site 22 miles to the Filter Plant and Loadout Facility near San Tan Valley. The Filter Plant's primary function will be to filter the copper concentrate for transportation. The Loadout Facility's primary function will be to remove water from the copper concentrate to prepare the concentrate for delivery to an off-site smelter and recycle water for use in the concentrator.

After completion of the project, Resolution Copper will salvage or demolish all buildings at the Filter Plant and Loadout Facility, including building foundations, and all material and debris will be disposed of properly off-site. Resolution Copper will close and reclaim all tanks and ponds in accordance with Aquifer Protection Permits (APP) and Arizona Pollutant Discharge Elimination System (AZPDES) permit requirements. Crews will regrade all disturbed areas, with the exception of the diversion channel on the north side of the facility that routes surface water flows around the site to existing drainages.

Recreation Mitigation Parcels
Resolution Copper is proposing to mitigate for the loss of public recreational opportunities (world-recognized rock-climbing areas, Oak Flat campground, nearby trails and Forest Service access to trails) on the Oak Flat Federal Parcel by proposed replacement areas (Figure 10, Appendix C). The total disturbance to these recreational areas is 92 acres. Recreation-related mitigation includes: 1) Arnett trailhead, 2) a comprehensive recreation mitigation package that includes motorized trails (9.3 miles) and non-motorized trails (11.5 miles), 3) a road extension to provide access to the Inconceivables Climbing Area, and 4) a replacement campground along Queen Creek named the Castleberry Campground, and associated infrastructure such as a water line to support the campground.

USACE Clean Water Act Section 404

All effects to potential jurisdictional waters of the U.S. are solely associated with the Skunk Camp tailings storage facility or the pipeline/power line corridor between the West Plant Site and the tailings storage facility. Resolution Copper anticipates the direct fill and permanent loss of approximately 129.2 acres of ephemeral drainages, including Dripping Spring Wash, Skunk Camp Wash, Stone Cabin Wash and a number of unnamed drainages that are located within the tailings storage facility footprint. In addition, Resolution Copper anticipates 15.7 acres of temporary impacts to ephemeral drainages from the tailings pipeline/powerline corridor. The proposed project will also result in a total of 43.4 acres of indirect impact caused by dewatering of downstream drainages. In total,188.3 acres of direct and indirect effects by discharges of dredged or fill material into potential jurisdictional waters of the U.S, primarily from levelling of existing topography through cut and fill of the ground surface. No wetlands or other special aquatic sites, springs, seeps, intermittent waters, or perennial waters that the USACE would consider to be potentially jurisdictional under the Clean Water Act are present in the proposed footprint of the tailings storage facility and related features.

Conservation Measures

The following conservation measures (placed under specific subheadings) include Resolution Copper's actions to reduce, minimize, or eliminate effects to listed species, measures to minimize the effects of the action on the broader environment (and listed species) through Best Management Practices (BMP), CWA Section 404 mitigation actions for effects to waters of the U.S, and SRP's measures to conserve Arizona hedgehog cactus during transmission line maintenance.

<u>USACE Clean Water Act Section 404 Permit Mitigation Measures</u> (addressed in *Effects of the Action* and *Concurrences*)

USACE permitting under Section 404 of the CWA will require compensatory mitigation to offset direct and indirect effects to waters of the U.S. Resolution Copper and USACE have developed a final compensatory mitigation plan with specific actions as part of the USACE permitting process. Resolution Copper will implement the following suite of off-site mitigation measures along the Gila River, Queen Creek, and the San Pedro River (Figures 6-9, Appendix C). Resolution Copper's compensatory mitigation actions for effects to waters of the U.S. at the Skunk Camp tailings facility and pipeline/transmission line corridor may result in future habitat improvements for listed species. We address any effects to listed species from issuing the permit for impacts to waters of the U.S. and implementing associated mitigation actions in the Effects of the Action and Concurrences (Appendix A).

MAR-5 Discharge Area/Olberg Road Vegetation Management Site
Resolution Copper CWA Section 404 mitigation activities at the 23-acre Olberg Road Restoration Site (ORRS) will contribute to the Gila River Indian Community's broader strategy of using a portion of its Central Arizona Project (CAP) water allocation to recharge the Gila River at the MAR-5 Discharge Area to improve river and vegetation quality (Figure 6 & 7, Appendix C). The Gila River Indian Community, on behalf of Resolution Copper, will implement ORRS mitigation consisting of tamarisk (*Tamarix* spp.) removal and control, followed by seeding of native plant species. Exotic tree species removal and control, combined with seeding of native plant species, may allow for the establishment and maintenance of a riparian habitat dominated by native tree species and eliminate a large, local source of exotic tree species seed from that section of the Gila River.

Queen Creek
A 1.8-mile segment of Queen Creek is a CWA Section 404 mitigation site (Figure 6 & 8, Appendix C). The overall site is composed of Resolution Copper and BHP Mineral Resources, Inc. parcels and is approximately 79 acres. The ephemeral reach of Queen Creek on the parcel is a medium to large, well-defined, single to multi-threaded, low-gradient drainage system. The entire Queen Creek site will be subject to a conservation easement and active vegetation management will take place on 33 acres of the property.

Resolution Copper's proposed mitigation activities for the Queen Creek site have been planned for three separate areas (Areas A, B, and C) (Figure 6 & 8, Appendix C) and would include ecological improvements to the riparian habitat totaling approximately 33 acres. Within the xeroriparian corridor (Area A), limited removal of sparsely populated tamarisk and other exotic plant species would occur, followed by planting and seeding of native plant species. In portions of the site where there are anthropogenic disturbances (Area B), crews would selectively remove debris while avoiding disturbance to existing mature woody vegetation; seeding of native plant species would follow. The remaining portions of the mitigation site (Area C) would be preserved, providing protection to riparian and wildlife habitat. Exotic plant species and debris removal in any area would occur outside of the yellow-billed cuckoo (May 15-September 30) and southwestern willow flycatcher breeding seasons (May 1 through September 15).

H&E Farm
The H&E Farm is a 500-acre property owned by The Nature Conservancy and used for agriculture and cattle since at least the 1950s (Figure 6 & 9, Appendix C). The parcel contains an intermittent reach of the San Pedro River. The drainage system is large, well-defined, low- gradient, and braided within a broad, comparatively level floodplain.

H&E Farm has been separated into three areas with specific planned CWA Section 404 mitigation activities (Area A, B, and C) (Figure 6 & 9, Appendix C). Resolution Copper's proposed mitigation activities for Area A include earthwork to reconnect historic tributaries.

The proposed earthwork is to reestablish the San Pedro River's access to its floodplain and terrace and enhance the wetland features present in the area. The soils across the site on the terraces are compacted and causing earth fissures and sinkholes on the parcel, which will continue if no intervention occurs. Grading in some areas would reestablish the natural alluvial fan and floodplain terrace structure. Planting and seeding native species is to restore a more native vegetation community along the bank of the river. Resolution Copper intends to mirror previous mitigation strategies implemented by The Nature Conservancy as well as ongoing mitigation at the

Arizona Game and Fish Department Lower San Pedro Wildlife Area that is contiguous to the western and northern boundaries of the H&E Farm parcel. The terrace area to be reestablished encompasses 300 acres, and the wetland area to be reestablished encompasses 15 acres. The Nature Conservancy will conserve the remainder of the property in its current condition.

Groundwater Dependent Ecosystems

Resolution Copper intends to replace any lost water that mine dewatering may have on groundwater-dependent ecosystems (GDEs). GDEs include seeps and springs, as well as perennial or intermittent streams like Devil's Canyon, Mineral Creek, Queen Creek, Arnett Creek, the Gila River, and Telegraph Canyon.

Resolution Copper has developed a Monitoring and Mitigation Plan for Groundwater Dependent Ecosystems and Water Wells, revised in 2020 for the TNF (Montgomery and Associates Inc. 2020). This document outlines a monitoring plan to assess potential impacts on each GDE, identifies triggers and associated actions to be taken by Resolution Copper to ensure that GDEs are preserved, and suggests mitigation measures for each GDE if it is shown to be impacted by future mine dewatering. 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 does not contain a specified duration over which monitoring and mitigation will take place, however, the TNF intends to specify the timeline in the FEIS and Draft ROD to include all of the operations and closure phases, with GDEs then being dropped from monitoring only upon approval of TNF, based upon accumulated monitoring results (C. Garrett, SWCA, pers. comm. 2020).

The Monitoring and Mitigation Plan identifies 16 springs that will be monitored, as well as surface water flows in 10 locations along Queen Creek, Arnett Creek, Telegraph Canyon, Devil's Canyon, and Mineral Creek. A variety of potential actions are identified that could be used to replace water sources if monitoring reaches a specified trigger. These include drilling new wells to supply water, installing spring boxes, installing guzzlers, or installing surface water capture systems such as check dams, alluvial capture, recharge wells, or surface water diversions. These methods can supplement diminished groundwater flow at GDEs by retaining precipitation in the form of runoff or snowmelt, making it available for ecosystem requirements. One further method for replacing flow would be to provide alternative water supplies from a nearby source (such as groundwater from the Desert Wellfield or Arizona Water Company, that deliver water to the town of Superior, both located in the same Active Management Area, as regulated by Arizona Department of Water Resources).

The effectiveness of these GDE mitigation measures will be verified by annual monitoring of areas, type of phreatophyte, and depend on the specific approach used to replace water. Engineered replacements like pipelines, guzzlers, or spring boxes would be effective at maintaining a water source and maintaining a riparian ecosystem, but the exact type, location, and extent of riparian vegetation could change to adapt to the new discharge location and frequency of the new water source. Changes in water quality are unlikely to be an issue, since new water sources would likely derive from the same source as natural spring flow (i.e., the Apache Leap Tuff aquifer, or stored precipitation).

Best Management Practices (BMPs) and Other Conservation Measures

Resolution Copper commits to environmental protection BMPs to reduce potential impacts on habitat, air, water, non-listed wildlife, and other resources (including listed species in some instances). These measures are part of the proposed action and detailed information is available in Volume1: Chapter 3, Volume 2: Chapter 3, Volume 4: Appendix J of the DEIS (USFWS 2019), and the BA (SWCA 2020). Resolution Copper will be responsible for ensuring implementation of these measures during construction, operation, and maintenance, including along the tailings pipeline corridor.

Soils and Vegetation
BMPs for soil and vegetation, specifically stabilization of slopes and implementing noxious weed management and control can minimize effects to Arizona hedgehog cactus adjacent to the project footprint by protecting the plants from rockslides, erosion, exotic plant encroachment, wildfire, and fugitive dust.

1. Road embankment slopes will be graded and stabilized with vegetation or rock as practicable to prevent erosion.
2. During construction and operations, crews will construct diversions around the affected areas to minimize erosion. Resolution Copper will also implement a number of best management practices, including check dams, dispersion terraces, and filter fences.
3. Resolution Copper will monitor newly reclaimed areas on the TNF for weeds and invasive plants for the first five years after reclamation. Crews will treat invasive species after identification as soon as possible, or as soon as weather conditions are appropriate for treatment.
4. Resolution Copper stipulates that on NFS lands, seed mixes used in reclamation will be certified free of seeds listed on the Forest Service's noxious weed list and contain only species native to the action area. Resolution Copper will develop seed mixes from a native species seed list approved by the Forest Service.
5. Resolution Copper has prepared a Noxious Weed and Invasive Species Management Plan on National Forest System Lands (Resolution Copper 2019). Resolution Copper will submit reports two years after construction begins and every five years during operation to provide an update on surveys, control, and activities related the noxious and invasive weed management to the TNF and FWS.

Noise
1. Mining activities, primary crushing and conveying, will take place underground, and exhaust fans will be equipped with silencers for noise reduction. Milling will take place within a fully enclosed building.

Transportation
1. Best management practices for road construction and maintenance include:
    a. To the extent practicable, crews will not remove vegetation except from those areas directly affected by road reconstruction activities.
    b. Road construction designs for cut-and-fill slopes will prevent soil erosion.
    c. Crews will construct drainage ditches with cross drains where necessary. Resolution Copper will revegetate, mulch, or otherwise stabilize disturbed slopes to minimize erosion as soon as practicable following construction.
    d. Road embankment slopes will be graded and stabilized with vegetation or rock as

practicable to prevent erosion.

e. Resolution Copper will address road runoff through best management practices, including sediment traps, settling ponds, berms, sediment filter fabric, wattles, etc. They will design of these features based on an analysis of local hydrologic conditions.
f. Crews will generally avoid off-road vehicle travel.
g. Construction and operation crews will construct diversions around affected areas to minimize erosion. Crews will implement a number of best management practices, including check dams, dispersion terraces, and filter fences during construction and operations.

Air Quality
BMPs for air quality can help to reduce fugitive dust from affecting Arizona hedgehog cactus within the action area.

1. Dust control on roads will include regular watering, road base maintenance and dust suppression, paving of select access roads to the East Plant Site and West Plant Site with asphalt, and setting of reasonable speed limits on access roads within the operational footprint.
2. Dust control at the tailings storage facility will include delivering tailings to the storage facility via distribution pipelines and continuously wetting the tailings during active deposition. During non-active periods, dust emissions will be managed by wetting inactive beaches and embankment surfaces with sprinkler systems, and treatment with chemical or polymer dust suppressants, if necessary, as well as progressive reclamation on the outer embankment.
3. Dust control at the East Plant Site will include periodic water and/or chemical dust suppressant, normal mining controls such as wet drilling and the wetting of broken rock, application of water suppression spray to control dust ore conveyance, dedicated exhaust ventilation systems and/or enclosures for crushers and transfer points underground, performing primary crushing and conveying underground, and saturating underground exhaust ventilation.
4. Dust control at the West Plant Site will include housing main active ore stockpiles in fully covered buildings, applying water suppression spray to control dust ore conveyance, processing ore in a new enclosed building, and enclosing conveyor transfer points within the concentrator building.
5. Dust control during shipping will include bagging molybdenum concentrate at the concentrator facility before shipping and enclosing the loadout building and storage shed.

Groundwater and Surface Water Quality
1. At no point during normal construction, operation, closure, or post-closure will Resolution Copper allow stormwater, or any other liquid such as seepage, water used for dust control, or chemical suppressants used for dust control, that has come into contact with tailings, ore, or processing areas to discharge downstream. After closure, precipitation falling on the tailings facilities will interact with the soil cover, not tailings. The seepage collection ponds represent a long-term commitment for managing seepage and stormwater. Eventually the collection ponds will become passive systems, fully evaporating collected water, or operators will remove them after demonstrating that collected water is of adequate quality to discharge.

Surface Water Quantity

1. To the extent practicable, Resolution Copper will divert stormwater flows that are upgradient of the facilities around disturbed areas and to the natural drainage system.
2. As much water as possible will be recycled for reuse in the mining circuit.
3. Resolution Copper will design permanent diversion channels for operations and closure.
4. Resolution Copper will implement best management practices to address runoff from roads, buildings, and other structures, including sediment traps, settling ponds, berms, sediment filter fabric, wattles, etc.

Wildlife

Wildlife management at ponds such as bird hazing and vegetation management reduces the risk of attracting listed bird species to ponds and coming in contact with contaminants. Transmission lines development in accordance with standards and use of line markers can reduce the likelihood of bird collision, including listed species.

1. In order to minimize the potential risk for bird collisions with transmission lines, operators will design the lines and structures in accordance with Reducing Avian Collision with Power Lines (Avian Power Line Interaction Committee 2012). Crews will place line marking devices (i.e., flight diverters) at the proposed crossings of Queen Creek, Devil's Canyon, and Mineral Creek, especially in areas where there is suitable habitat for the yellow-billed cuckoo.
2. Additional hazing devices to deter and disperse wildlife from the PAG tailings, non-contact and contact stormwater catchment basins, and process water ponds may also be considered and could include the following:
   a. Plastic ball covers, vehicle lights and horns, motion-sensor lights, flags, perch deterrents, shell crackers, bird bangers, screamers, distress cries/electronic noise systems, bird scare balloons, propane cannons, and mylar scare tape.
   b. Resolution Copper will develop a bird hazing protocol for its employees that will include a combination of harassment techniques, with the opportunity for additional or adjusted techniques based on field observations and ongoing research efforts. The protocol will include an inspection schedule, acceptable harassment techniques, a field log procedure, and incident reporting procedures. Resolution Copper will train its staff responsible for implementing the bird hazing program on the protocol prior to its initiation.
3. Resolution Copper will manage and periodically remove vegetation growth within the contact and non-contact stormwater catchment basins and process water ponds, as often as necessary, to further discourage the presence of wading birds.
4. Resolution Copper will implement a comprehensive wildlife management plan, as included in Appendix X of the GPO. A draft revised wildlife management plan was prepared in collaboration with AGFD (Resolution Copper 2020).

Sonoran Desert Tortoise

1. Resolution Copper will conduct pre-construction surveys for Sonoran desert tortoise (*Gopherus morafkai*) and Gila monster (*Heloderma suspectum*) before surface ground-disturbing activities start in areas containing their suitable habitat. A biological monitor will monitor for Sonoran desert tortoise and Gila monster during construction activities. The monitor will flag Sonoran desert tortoise and Gila monster shelter sites/burrows. Biological monitors will inspect these flagged areas, and monitors will relocate any Gila monsters and tortoises discovered outside project activity areas.

2. Resolution Copper will inform project crews of the potential to encounter Sonoran desert tortoise and Gila monster within the surface action area and project footprint. Resolution Copper will instruct work crews to check below equipment prior to moving, and to cover and/or backfill holes that could potentially entrap these species. If work crews observe these species, they will stop work until the biological monitor has relocated these species out of harm's way.
3. Resolution Copper will establish tortoise crossings, as needed and applicable, for concentrate and tailings pipeline corridors, as well as the railroad tracks within the MARCCO corridor within areas containing suitable habitat.

Public Health and Safety

1. Pipelines will be buried where feasible, given the geological setting, and where buried they would be externally coated.
2. Any vegetation cleared from the site will be temporarily stored on-site at a location with minimal fire risk, well within a cleared area away from ignition sources. Handheld and large equipment (e.g., saws, tractors) used for vegetation clearing will be equipped with working spark arresters. Resolution Copper will take additional precautions if work occurs during the critical dry season, which may include larger amounts of extinguishing agents, shovels, and possibly a fire watch.
3. Resolution Copper will prohibit parking on vegetated areas outside the designated construction footprint and proper disposal of smoking materials will be required. All surface mine vehicles will be equipped with, at a minimum, fire extinguishers and first aid kits.
4. Resolution Copper will incorporate a number of environmental protection measures into the project design to reduce potential effects of hazardous materials. These are non-discretionary measures outlined in a variety of protection plans (listed below and included in the GPO).
   a. Spill Prevention Control and Countermeasures Plan (Appendix O of the GPO)
   b. Emergency Response and Contingency Plan (Appendix L of the GPO)
   c. Stormwater Pollution Prevention Plan (Appendix W of the GPO)
   d. Fire Prevention and Response Plan (Appendix M of the GPO)
   e. Environmental Materials Management Plan (Appendix V of the GPO)
   f. Explosives Management Plan (Appendix P of the GPO)
   g. Hydrocarbon Management Plan (Appendix U of the GPO)
   h. Tailings Pipeline Management Plan (AMEC Foster Wheeler Americas Limited 2019)
   i. Concentrate Pipeline Management Plan (M3 Engineering and Technology Corporation 2019b)

Scenic Resources

1. Resolution Copper will implement an outdoor lighting plan that will reduce potential impacts from artificial night lighting (M3 Engineering, July 2018).
2. Resolution Copper will reduce illumination levels where appropriate while still meeting Mine Safety and Health Administration (MSHA) requirements for lighting sufficient to provide safe working conditions.
3. Resolution Copper will adhere to the Pinal County Outdoor Lighting Code.
4. Resolution Copper will use control systems that can turn off lights at particular times of night or activated by detecting motion while still meeting MSHA requirements for lighting sufficient to provide safe working conditions.

Additional Environmental Protection Measures

1. Resolution Copper will bury concentrate pipelines to the extent practicable. Concentrate pipelines will have approximately 3.3 feet of cover over buried sections.
2. Resolution Copper will bury tailings and other pipelines to the extent practicable.
3. Resolution Copper will perform concurrent reclamation of tailings embankment beginning at approximate year 10 of tailings operations.
4. Resolution Copper will use a reclamation seed mix of weed-free native species consistent with surrounding vegetation.

SRP Transmission Line and Vegetation Maintenance Conservation Measures for Arizona Hedgehog Cactus

SRP will be responsible for construction, operation, and maintenance of the powerlines, including the powerline to the tailings storage facility. SRP will adhere to the following BMPs and conservation measures related to powerline vegetation maintenance to conserve the Arizona hedgehog cactus through identification and avoidance.

1. Work crews will be educated on the avoidance of Arizona hedgehog cactus prior to scheduled work in potential habitat. The training for work crews will include one or more members of the crew and the supervisor or utility employee overseeing work. The training will include education on the appearance of the Arizona hedgehog cactus; reference materials to assist in avoidance in the field; field visit, if needed, for refinement of search image; and procedures on identifying and avoiding any Arizona hedgehog cactus or similar looking cacti not found during pre-work inventory.
2. Do not use a mechanical mower for routine vegetation maintenance within Arizona hedgehog cactus occupied habitat to avoid trampling and damaging cactus.
3. To avoid trampling and damaging Arizona hedgehog cactus, vegetation management workers will drive vehicles only on existing roads and utility access routes to access the ROW. Do not drive vehicles off-road within the ROW.
4. Prior to each vegetation management cycle, a qualified biologist or other experienced professional in the identification of this plant will survey for Arizona hedgehog cactus. They will record and report Global Positioning System (GPS) coordinates of found plants to the Forest Service.
5. For manual cutting of vegetation, surveyors will flag all Arizona hedgehog cacti within and immediately adjacent to the work area for avoidance.
6. In an effort to be conservative, all Arizona hedgehog cacti and those similar to it, may be included in the flagging for avoidance.
7. During vegetation management work, crews will check for any Arizona hedgehog cactus under target plants prior to treatment. If crews find a cactus, they will implement appropriate conservation measures to avoid the cactus.
8. During manual vegetation maintenance work, if an Arizona hedgehog cactus occurs underneath and shaded by a shrub, crews will leave the target shrub untreated. In very rare circumstances, crews may selectively trim the nurse plant in a manner to maintain the same shading protection for the Arizona hedgehog cactus. Crews will trim no more than 30% of the nurse plant.
9. Prior to ground disturbing line maintenance activities, a qualified botanist or other professional experienced in the identification of this plant will identify all Arizona hedgehog cacti within and immediately adjacent to the work area. SRP will flag plants for avoidance. In an effort to be conservative, SRP will flag and avoid all Arizona hedgehog cacti and those

similar to them.

10. For line maintenance, drive vehicles only on existing roads and utility access routes to access the ROW to avoid damaging cactus. If driving off road in the ROW is necessary for line maintenance repairs, inventory, flag, and avoid Arizona hedgehog cactus prior to the work.

Resolution Copper Conservation Measures for Listed Species

Resolution Copper will implement the following conservation measures for the Arizona hedgehog cactus, Gila chub, southwestern willow flycatcher, and yellow-billed cuckoo to avoid, reduce, or minimize effects. There is no northern Mexican gartersnake habitat within the mining footprint or action area portion of the project, and therefore no conservation measures are proposed (see *Concurrences* associated with CWA mitigation activities).

Arizona Hedgehog Cactus

1. Prior to any ground-disturbing activities, biologists will survey suitable habitat within the project footprint for Arizona hedgehog cactus to identify cactus for salvage and transplant, or avoidance.
2. Before construction begins within the Arizona hedgehog cactus known range, a biological monitor shall establish and clearly flag Arizona hedgehog cactus avoidance areas based on preconstruction surveys and leave individual cacti in place. Flagging will extend out a minimum of 20 feet from the nearest Arizona hedgehog cactus within the project footprint but outside the area of ground disturbance.

   Flagging is an effective and typical method to avoid the Arizona hedgehog cactus and other smaller cacti growing in Arizona desert habitats. Arizona hedgehog cactus habitat is typically open, with low stature shrubs. Crews are able to more easily see flags in these open areas. In locations where vegetation may be dense, crews will place flags at the top of shrubs or use tape to block an area.
3. Construction contractors shall stay outside of flagged Arizona hedgehog cactus avoidance areas to prevent effects to cactus from construction activities.
4. Prior to any ground-disturbing activities, a Forest Service–approved biological monitor with appropriate FWS permits, shall salvage Arizona hedgehog cacti that are inside the construction footprint in areas where ground disturbance will occur following the Waldron and Durham (2016) protocol as revised by the Forest Service (USFS 2020) and as required by the TNF biologist.
5. Biologists will replant healthy Arizona hedgehog cacti, salvaged from areas that will be disturbed, outside the construction footprint, but within the action area on Federal lands. At the time of salvage, if it is determined that individual Arizona hedgehog cactus are not healthy enough for transplanting, other measures such as transplanting individual healthy stems from otherwise dying individuals or collection of seed will be conducted. This could include having a Forest Service and FWS approved nursery hold plants that need additional time to increase root mass, such as with individual healthy stems before replanting into the action area on Federal lands. Resolution Copper will further develop these measures in an Arizona Hedgehog Cactus Relocation, Salvage, and Monitoring Plan (see Conservation Measure 11 below). Salvage activities will take place between October and May, whenever possible. If salvage activities must occur between May and October, biologists will provide additional water for salvaged plants when replanted.

6. Before construction begins, the biological monitor shall identify individual cactus that are growing downslope of construction areas that are at risk from rockfall and shifting material from above. Monitors and crews will use fencing or barriers or other forms of protection to prevent effects from rockfall and shifting material. A monitor will be present during work upslope of cactus known to be in areas where shifting materials occur.
7. Prior to the start of each phase of construction, operations and maintenance, or closure and reclamation activities, the biological monitor shall conduct a training for all crew members regarding identification and avoidance of Arizona hedgehog cactus and inform crews of the presence and location of all known Arizona hedgehog cacti proximate to the new, proposed construction activities and measures required to avoid adverse impacts. This training will include identification of Arizona hedgehog cactus locations and avoidance areas and the conservation measures provided in this biological opinion.
8. If crews find a previously undocumented Arizona hedgehog cactus during construction, operations and maintenance, or closure and reclamation activities, they will report it to the biological monitor. Crews will avoid or protect the cactus in place, or a qualified biologist will salvage and replant the cactus within the action area on Federal lands, if possible.
9. During construction, qualified biologists shall immediately replant any salvaged Arizona hedgehog cacti, when possible, within the action area on Federal lands and outside the area to be disturbed using the protocol in Waldron and Durham (2016) as modified (USFS 2020).
10. Biologists shall monitor any transplanted cacti yearly during the plant flowering period for the first 10 years following transplanting, and again every 5th year after that throughout the life of the project. Resolution Copper will provide monitoring results to the TNF and FWS by the end of the calendar year in which the monitoring occurs.
11. Prior to relocation and salvage efforts, Resolution Copper will work with the FWS and the TNF to develop an Arizona Hedgehog Cactus Relocation, Salvage, and Monitoring Plan. The plan will provide criteria for determining which cacti are suitable for immediate relocation, as well as measures to collect seed or salvage healthy stems from individuals that otherwise monitors could not salvage. The TNF and FWS will approve relocation areas.
12. Biologists will salvage and transplant the two known Arizona hedgehog cacti on private property in the project footprint near the East Plant Site in the 230-kV corridor outside the disturbance area and onto TNF lands. The TNF and FWS will approve relocation areas.
13. Resolution Copper will record a new conservation easement on portions of the JI Ranch, or a comparable location with suitable Arizona hedgehog cactus habitat, after the publication of a Record of Decision (by both the TNF and the USACE) and receipt of all requisite permits and approvals from the USACE (under CWA Section 404) and the Forest Service, and before construction of tailings pipeline and powerline infrastructure for the final selected alternative. The conservation easement's purpose shall be for the protection of the Arizona hedgehog cactus and will be at least 100 acres, comprised of one or multiple parcels, excluding roads and trails. The duration of the conservation easement will be for the life of the project or until the release of the reclamation bond from the Forest Service.

Gila Chub (addressed in *Concurrences*)

1. Resolution Copper will develop a site-specific wildlife mitigation plan in coordination with

AGFD, FWS, and TNF biologists to address construction-related actions to avoid, minimize, and mitigate impacts on special status species (e.g., timing of construction, species relocations, etc.).

2. All ground disturbing activities associated with tailings pipeline and power line work near Mineral Creek and Gila chub designated critical habitat will occur outside the ordinary high-water mark and Gila chub designated critical habitat to minimize and avoid effects to the stream and the chub.
3. In areas where project facilities intersect Mineral Creek trenchless/non-surface impact methods (i.e., horizontal drilling, micro-tunneling, etc.) will be used to avoid surface disturbance within the ordinary high-water mark and Gila chub designated critical habitat to minimize and avoid effects to the stream and the chub.
4. The contractor shall clearly delineate the perimeter of the construction footprint with flagging or other appropriate markers to restrict heavy equipment use and other surface-disturbing activities to areas within the construction footprint. The biological monitor will be present at all times during construction and will help ensure that construction activities and equipment remain within designated limits and outside the ordinary high-water mark and Gila chub designated critical habitat to minimize and avoid effects to the stream and chub.
5. Resolution Copper will develop and implement a stormwater pollution prevention plan (SWPPP) to reduce potential project related increases in sedimentation to Mineral Creek to avoid or minimize effects to Gila chub and its designated critical habitat.

Southwestern Willow Flycatcher and Yellow-Billed Cuckoo (addressed in *Concurrences*)

1. In project areas along Mineral/Mill Creek within the action area where FWS protocol surveys have detected the presence of the yellow-billed cuckoo, crews will not conduct construction or closure and reclamation activities within 500 feet of the ordinary high-water mark of Mineral/Mill Creek from May 15 through September 30 to remain outside the species breeding season, avoiding any disturbance to breeding cuckoos.
2. Between May and September each year, a qualified biological monitor will be present in work areas that contain southwestern willow flycatcher and yellow-billed cuckoo suitable habitat along Mineral Creek during all surface-disturbing activities and will monitor for the presence of the species.
3. Annual yellow-billed cuckoo surveys will be conducted in potentially suitable habitat of Devil's Canyon and Mineral Creek immediately upstream and downstream of disturbance areas and crossings, starting two years prior to surface-disturbing activities and continue until pipeline construction has been completed, including reclamation of temporary construction disturbance.
4. In areas where surveys show presence of yellow-billed cuckoo and to prevent effects on cuckoos (injuries or fatalities to adults, eggs, or young), vegetation clearing and ground disturbing activities associated with pipeline construction within 500 feet of the ordinary high water mark of Mineral Creek will occur outside of the May 15 to September 30 breeding season.
5. Large trees (greater than 12 inches in diameter), including Fremont cottonwood (*Populus fremontii*) and willow species (*Salix* spp.), as well as dense stands of vegetation, will be

avoided when possible.

6. Most ground-disturbing activities take place outside of the riparian corridor along Mineral Creek, and Resolution Copper anticipates they will not remove riparian trees unless required for safety. Riparian trees that are removed will be cut to ground level, but when possible, root masses will be left intact to help to stabilize soils and provide opportunities for regrowth through adventitious shoots (e.g., in the case of willows).
7. The contractor shall clearly delineate the perimeter of the construction footprint with flagging or other appropriate markers to restrict heavy equipment use and other surface-disturbing activities to areas within the construction footprint. The biological monitor will be present at all times during construction and will help ensure that construction activities and equipment remain within designated limits and outside the ordinary high-water mark to avoid effects to proposed yellow billed cuckoo critical habitat.
8. During mine operations, biologists will conduct yellow-billed cuckoo surveys every five years in potentially suitable habitat of Devil's Canyon and Mineral Creek immediately upstream and downstream of action area crossings to continue to monitor cuckoo presence in the area and prevent/minimize effects on cuckoos.
9. In areas where surveys show presence of possible, probable, or confirmed breeding yellow-billed cuckoos, large-scale, major noise-producing activities within 500 feet of the ordinary high-water mark of Mineral Creek will be avoided to the extent possible to prevent disturbance to cuckoos (e.g., maintenance activities associated with pipeline replacement and cleaning that may affect cuckoo habitat during the May 15 to September 30 breeding season, annually).
10. In order to minimize the potential risk for bird collisions with transmission lines, the lines and structures will be designed in accordance with Reducing Avian Collision with Power Lines (Avian Power Line Interaction Committee [APLIC] 2012) and line marking devices, (i.e., flight diverters) will be placed at the proposed crossings of Queen Creek, Devil's Canyon, and Mineral Creek, especially where suitable yellow-billed cuckoo habitat exists.

Action Area

The action area is defined as all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR § 402.02). In delineating the action area, we evaluated the farthest-reaching physical, chemical, and biotic effects of the action on the environment.

The action area for this project is the entire proposed Resolution Copper Mine project footprint (see definition below) plus a 1-mile buffer (Figure 6, Appendix C). The 1-mile buffer keeps the same distance analyzed and determined by the TNF during the NEPA process (USFS 2019) to account for any consequences to listed species and their respective habitats that the mining project may affect by ground disturbance, noise, light, modeled changes in groundwater and surface water quality and quantity, changes in air quality (fugitive dust), temporal parameters, etc. The buffer for the USACE CWA compensatory and recreation mitigation parcels is 0.25 mile to account for any impacts from the proposed activities to any listed species in those areas and there is no buffer for the JI Ranch Conservation Easement. The size of the action area is approximately 99,648.7 acres.

The proposed Resolution Copper Project is located on a combination of federal, state, and private lands primarily in northeast Pinal County, with a portion of a project component in southwest Gila

County in central Arizona. The proposed mining project is within portions of the TNF's Mesa and Globe Ranger Districts near the town of Superior, about 60 miles east of Phoenix. Information describing the action area is in the June 2020 BA and summarized below (SWCA 2020).

The action area's regional climate is semiarid, including long periods with little or no precipitation. Precipitation falls in a bimodal pattern. Most of the annual rainfall within the region occurs during the winter and summer months, with dry periods mainly in the spring and fall. In general, the total average annual precipitation varies between 15.7 inches and 18.8 inches, with 52 percent of the precipitation falling between November and April. However, climate variables may change based on the elevation of specific areas. For example, the average total annual precipitation in a lower elevation location near to the MARRCO Corridor (Station Florence, Arizona, for 1981–2010) is 9.72 inches, whereas the average total precipitation in a higher elevation location is 23.91 inches (Station Superior 2 ENE, Arizona, 1981–2010) (SWCA 2020). Precipitation usually occurs with steady, longer-duration frontal storm events during the winter months (December through March). Rain events during the summer months (July to early September) are typically of shorter duration with more intensity associated with thunderstorms.

The action area has both bedrock-controlled soils (alluvium and colluvium up to five feet in thickness) and deeper soils formed in alluvial fans (more than 60 inches deep) (SWCA 2020). These soils have low organic matter (approximately 1 percent) and slightly acidic to slightly alkaline pH conditions that support annual rangeland productivity.

Basin and Range geomorphology characterizes the project area with mining occurring within the Transition Zone or Central Highlands province. The Basin and Range aquifers generally consist of unconsolidated gravel, sand, silt, and clay, or partly consolidated sedimentary or volcanic materials. These materials have filled deep fault-block valleys formed by large vertical displacement across faults. Mountain ranges that generally consist of impermeable rocks separate adjacent valleys leading to compartmentalized groundwater systems.

The semiarid climate in the region limits the amount of surface water available for infiltration, resulting in slow recharge of the groundwater with an average annual infiltration of 0.2 to 0.4 inch per year (SWCA 2020). Much of this recharge occurs as mountain-front recharge, where runoff concentrates along ephemeral channels.

Twelve vegetation communities and land cover types occur within the action area, including human dominated, interior chaparral, open pit-mine, pinyon-juniper, Ponderosa pine-evergreen oak, riparian, rock, semidesert grassland, Sonoran desertscrub, wash, water, and xeric riparian. The dominant vegetation communities represented by the highest acreage are Sonoran desertscrub, semidesert grassland, and interior chaparral. The Sonoran desertscrub vegetation community generally dominates in broad valleys, lower bajadas, plains, and low hills of lower elevations. Trees are sparse and the understory is bare ground or sparse grass and shrubs, typically whitethorn, creosote, and bursage. Cacti are also present, such as saguaro, prickly pear, and cholla. Common trees are paloverde, catclaw acacia, mesquite, and ironwood. This community occurs on a total of approximately 52,639 acres in the action area. Semidesert grassland typically occurs from 3,000 to 5,000 feet in elevation with diverse perennial grasses and an established shrub layer consisting of mesquite, snakeweed, wait-a-minute bush, turpentine bush, and catclaw acacia. This community occurs on about 20,420 acres in the action area. The interior chaparral community typically occurs from 3,000 to 7,000 feet in elevation on side slopes that transition into pinyon-juniper woodlands.

Interior chaparral has an open canopy and open space either bare or covered with grasses and forbs. This community occurs on about 15,693 acres in the action area.

Project Footprint

Similar to the BA, we use the term *project or construction footprint* to primarily represent areas within the action area where Resolution Copper is planning construction activities with permanent and temporary surface disturbance from mining and associated activities (tailings facilities, mine facilities, roads, transmission and pipeline corridors, etc.). The project footprint also includes conservation and mitigation areas within the action area.

The primary Resolution Copper Mine facilities and properties, and other areas that comprise the project footprint include locations such as the Oak Flat Federal Parcel and subsidence area, East and West Plant sites, Filter Plant/Loadout Facility, MAARCO corridor, pipeline and transmission line corridors, Skunk Camp Tailings facility, access roads and realignments, JI Ranch easement, recreation mitigation lands, and USACE CWA 404 permit off-site mitigation areas (SWCA 2020, Table 2) (Figure 1-3, Appendix C).

The primary mining facilities that are part of the project or construction footprint occur near the Town of Superior. These primary mining sites are the Oak Flat Federal Parcel and subsidence area, and East and West Plant sites. The MAARCO corridor connects these facilities to the Filter Plant/Load Out Facility, which is west of the mine facilities near the San Tan Valley (Figure 2, Appendix C). SRP transmission lines and pipeline corridors help to connect mining and tailings facilities (Figure 5, Appendix C).

The Skunk Camp tailings facility footprint will occupy the upper portion of Dripping Spring Valley, the northeastern slopes and foothills of the Dripping Spring Mountains, and the southwestern foothills of the Pinal Mountains, including a 4-mile reach of Dripping Spring Wash, a 3.5-mile reach of Stone Cabin Wash, and a 4.8-mile reach of Skunk Camp Wash. The proposed site lies approximately two miles due east of the existing ASARCO Ray Mine and approximately 13 miles north of the point where Dripping Spring Wash drains into the Gila River (Figure 2, Appendix C).

USACE CWA compensatory mitigation parcels at the Gila River Indian Community (Gila River), The Nature Conservancy's H&E Farm (San Pedro River), and Resolution Copper and BHP Mineral's Queen Creek site will occur in areas of Pinal and Gila counties (addressed in *Effects of the Action* and *Concurrences*) (Figures 7-9, Appendix C).

Resolution Copper recreation mitigation lands occur near Queen Creek, Inconceivables Climbing Area, and Arnett Creek and associated motorized and non-motorized trails near the Town of Superior (Figure 10, Appendix C).

The 100-acre JI Ranch conservation easement is located on the overall 272-acre ranch owned by Resolution Copper. The JI Ranch is approximately five miles northwest of the Oak Creek Federal Parcel in Pinal County, near the Pinal/Gila County Line (Figure 13 & 14, Appendix C).

STATUS OF THE SPECIES

The information in this section summarizes the Arizona hedgehog cactus' rangewide status considered in this BO. Further information on the status of the species is in the administrative record for this project, documents on our web page (ECOS Environmental Conservation Online System), and in other references cited in each summary below.

Arizona hedgehog cactus

The FWS listed the Arizona hedgehog cactus rangewide as an endangered variety (*Echinocereus triglochidiatus* var. *arizonicus*) on October 25, 1979 (USFWS 1979). We cited the potential loss of habitat through mining activities, significant insect damage, and collection of wild plants as threats to the cactus' survival (USFWS 1979). We determined that designating critical habitat was not prudent because it would increase threats to the plant from illegal collection.

At the time of listing, accurate identification was difficult and multiple varieties of *Echinocereus triglochidiatus* were taxonomically difficult to separate. Subsequent to the listing rule, cytological (i.e., study of chromosome numbers for classification) and morphological studies within *E. triglochidiatus* led to separations of taxa based on ploidy levels (i.e., the number of copies of the complete genetic information) (Parfitt and Christy 1992; Cota and Philbrick 1994; Baker 2006). The diploids (two homologous copies of each chromosome (2n)) are now recognized as *E. triglochidiatus* or *E. arizonicus* Rose ex Orcutt (Blum et al. 1998; Zimmerman and Parfitt 2003). Parfitt and Christy (1992) found that *E. arizonicus* is geographically separated from varieties of *E. triglochidiatus* by its distribution and is restricted to areas between the town of Superior and the vicinity of the Globe/Miami communities.

Blum et al. (1998) classified *E. arizonicus* as an independent species with several subspecies including *E. arizonicus* subspecies *arizonicus* (Arizona hedgehog cactus) from central Arizona. The Flora of North America (Zimmerman and Parfitt 2003) and Integrated Taxonomic Information System (ITIS 2020) also follow this taxonomic treatment. We are currently working on a technical name change revision and will refer to the taxon by the scientific name, *Echinocereus arizonicus* subsp. a*rizonicus*.

The Arizona hedgehog cactus is a dark-green perennial succulent in the Cactaceae family. Individual plants have large robust stems that distinguish it from other species of *Echinocereus*. Stems range in size from 2.5 to 16 inches height and 6 to 10 inches in diameter. Immature plants occur as a solitary stem while mature plants are multi-branched (caespitose) with stems forming at the base, most often occurring in loose clusters of 4 to 20 stems, occasionally exceeding 50 to 100 stems (Arizona Rare Plant Committee 2000; Cedar Creek Associates, Inc., 1996). Individual stems have 7 to 11 tuberculate ribs (Cedar Creek Associates, Inc., 1996, Baker 2006). There are 1 to 3 central spines gray or pinkish in color, largest deflexed, gradually tapering with minute striations; and 5 to 11 radial spines often slightly curved, pinkish-tan in color and shorter than central spine (Phillips et al. 1979).

Arizona hedgehog cactus flowers are a brilliant red to crimson red in color and claret-cup shaped with red or purple colored anthers and green stigma lobes (Blum et al. 1998; Zimmerman and Parfitt 2003). Floral buds burst through the epidermis from the upper one-third of the stem (Phillips et al. 1979; Sanchez et al. 2017) leaving a scar on the stem above the spine (AZGFD 2003). The flowers are perfect (i.e., flowers have both male (stamens) and female (carpel) reproductive structures) and bloom from late-April to mid-May (AZGFD 2003). Fruiting occurs from May to July with germination in midsummer (Zimmerman and Parfitt 2003; Arizona Rare Plant Society 2000). Fruits are red in color, globose, and spiny taking three months to mature (AZGFD 2003). At maturity, the side of the fruit splits open (*e.g*., dehiscence) releasing on average 424 (Aslan 2015) to 1466 (Siegwarth 2014) small black seeds. The mechanism of seed dispersal is unknown. Its pollinators include native bees (*Halictidae*), honeybees (*Apis mellifera*), and hummingbirds (Anna's hummingbird (*Calypte anna*), broad-billed hummingbird *Cynanthus latirostris*), and black-chinned hummingbird (*Archilochus alexandri*) (Aslan 2015).

The Arizona hedgehog cactus is endemic to central Arizona between the towns of Superior and Globe/Miami. Individual plants occur from 3,300 to 5,700 feet in elevation within the transition zone of the Mogollon Rim where the upland Sonoran Desert, montane woodlands, and interior chaparral communities converge. Its preferred habitat is exposed and stable bedrock or boulders exhibiting sufficient fracturing or rock fields. The cactus' roots invade cracks, fissures, or interstices within exposed rock or narrow pockets between boulders where the microclimate provides the necessary periodic moisture, moist soils, and shelter from high temperatures (Crosswhite 1992; Cedar Creek Associates, Inc., 1996). Parent materials of preferred habitat are Schultze granite and Apache Leap tuff (dacite), both igneous in origin (Crosswhite 1992). To a lesser degree, Pinal Schist and the Pioneer Formation also provide habitat to the Arizona hedgehog cactus, but only where these formations expressed themselves as exposed bedrock (Cedar Creek Associates, Inc., 1996). The majority of cacti occur scattered on open, rocky slopes of 20 to 90 degrees, and steep fissured cliffs (Philips et al. 1979; Crosswhite 1992). Some plants may be found on level ground within eroded areas and in the understory of shrubs, but moderate to high shrub densities and associated deeper soils tend to preclude the cactus (Cedar Creek Associates, Inc., 1996).

Surveys and other studies have defined and expanded the taxon's range beyond its type locality. Its current known range extends from Superstition Wilderness area south to Devils Canyon, east along US 60 Highway to Top of the World and south to the Mescal and Pinal Mountains (Arizona Rare Plant Committee 2000; AGFD 2003, Fehlberg et al. 2013). The range also includes two small populations, the El Capitan population south of Globe and the Apache Peak population north of the city of Globe, which merits further taxonomic verification (Cedar Creek Associates, Inc., 1996), Based on its distribution and potential habitat, its estimated range is approximately 54,734 acres. More than 90 percent of occupied Arizona hedgehog cactus is on the Globe Ranger District of the TNF. Remaining occupied habitat occurs on land managed by the Bureau of Land Management and ASLD, or is privately owned.

Fehlberg et al. (2013) studied population genetics of the Arizona hedgehog cactus, reaching the preliminary conclusion that the population maintains a high level of genetic diversity. They visited 14 sites across its range, Superior to Miami, and collected spine samples for DNA analyses from about 172 individual Arizona hedgehog cacti. They found that high levels of genetic diversity likely reflect healthy levels of cross-pollination, large effective population sizes, and an absence of inbreeding, isolation, and genetic drift. Fehlberg et al. (2013) also found that populations appear connected by high levels of gene flow and/or dispersal. That is, even though there is some genetic differences in the population, they concluded that there is good gene flow or connectivity and dispersal within the Arizona hedgehog cactus population, which occurs across several mountain ranges, and that is encouraging from a conservation perspective.

We have limited knowledge about Arizona hedgehog cactus abundance because of the difficulty accessing and surveying rugged areas, and correct species identification. Direct access to a large portion of the species range is limited due to the rugged topography and remoteness of its habitat making surveys difficult to conduct. In addition, this cactus variety can be difficult to distinguish from other red flowered hedgehog cactus, especially the *Echinocereus santaritensis* that grows near the Arizona hedgehog cactus. Federal agencies report most of the Arizona hedgehog cactus count information when implementing projects requiring section 7 consultations. According to the AZGFD Arizona Heritage Management Database (HDMS), surveyors observed approximately 1,302 cacti between 1922 and 2009 on the TNF (S. Schwartz, AZGFD, personal communication, 2009). Some of those records are anecdotal and some records are for red flowered hedgehog cacti in eastern Arizona identified through morphology, chromosome counts, or genetics as either *E. santaritensis* or *E. coccineus*.

The majority of Arizona hedgehog cactus occurrence data was reported by WestLand Resources, Inc. (WestLand Resources). From 2010 to 2012, WestLand Resources (2013) conducted surveys of the Arizona hedgehog cactus in conjunction with Resolution Copper's prefeasibility study for the proposed Resolution Copper Mine. Surveys took place along roadways, drill pads, and corridors within occupied and/or suitable Arizona hedgehog cactus habitat. This effort documented 4,035 individuals on TNF lands from east of Superior to the Gila/Pinal county boundary. However, WestLand Resources acknowledged that genetic analysis did not occur, and taxonomic status of the individual plants counted was not certain. Additional surveys and genetic studies identified some Arizona hedgehog cacti observed by WestLand Resources are actually the *Echinocereus santaritensis* (M. Baker, personal communication 2013; Fehlberg and Allen 2013).

In 2012, we estimated the current rangewide abundance of the Arizona hedgehog cactus at about 6,010 individuals based on georeferenced (GPS) data submitted supporting a section 6 grant (Baker 2013). Other various entities have also reported GPS data to the Arizona HDMS (J. Kuzek, AZGFD personal communication 2016).

As of October 2017, there were 6,679 or 6,769 Arizona hedgehog cactus records (numbers were likely transposed), depending on which source is relied upon (USFS 2018, Thomas et al. 2019, S. Tonn, AZGFD HDMS, personal communication, 2020). Thomas et al. (2019) stated that records submitted to the AZGFD's HDMS is voluntary and do not all include the date of observation nor the name of the observer. These records may also include hybrid plants, not fully quantified (USFS 2018). It is also unknown whether some records report on the same individual Arizona hedgehog cactus or if the total number of records includes Arizona hedgehog cacti that were removed, salvaged and/or planted during federally funded projects. Location information may also be inaccurate. The AZGFD HDMS has not received any new Arizona hedgehog cactus records since 2018 (S. Tonn, AZGFD HDMS, personal communication, 2020). WestLand (2019) found about 870 cacti in 2019 that may be in addition to AZGFD's HDMS tally, but not yet received or entered into their database. SWCA and the TNF (2020) estimated an overall abundance of 7,302 Arizona hedgehog cactus in the Resolution Copper Mine action area (2,087 cactus were actually counted). The approximate 6,700 number of Arizona hedgehog cactus by AZGFD's HDMS is an estimate and not an absolute number reflecting actual total abundance across its range. Trend information characterizing the rangewide population is not available.

Based upon the variety of current estimates and databases (Baker 2013, USFS 2018, Thomas et al. 2019, S.Tonn, AZGFD HDMS, pers. comm, 2020, and USFS 2020), cumulation of past effects authorized, combined with conservation measures, and other reporting and tracking challenges in establishing a running tally, the approximate 6,010 to 6,700 Arizona hedgehog cactus records from 2012 to 2018 is our best and conservative estimate of the rangewide abundance.

Arizona hedgehog cactus conservation actions associated with recent biological opinions are helping to minimize the effects of projects and improve the success of future recovery actions. Waldron and Durham (2016) developed standardized transplant methodologies for the US 60 highway widening and improvement project (02EAAZ00-2012-F-0334). After three years of monitoring (i.e., repeat observations of the status of the cactus), no plant deaths have occurred from 24 Arizona hedgehog cactus being salvaged and transplanted to new locations. More long-term monitoring (>15 years) will help to better understand the effectiveness of Arizona hedgehog cactus salvage and transplant methods. Similarly, the Desert Botanical Garden salvaged 33 Arizona hedgehog cacti, 68 stems, and collected thousands of seeds prior to construction (S. Blackwell, Desert Botanical Garden, pers. comm. 2020) for the Pinto Bridge replacement project, which is currently in progress. The Desert Botanical Garden has completed controlled pollination of the plants to produce additional seeds for germination. Qualified biologists will replant all of these Arizona hedgehog cacti as part of the reclamation process following construction.

Previous Related Consultations

Between 1983 and 2020, we completed 16 formal section 7 consultation for the Arizona hedgehog cactus. Recent section 7 consultations addressing the Arizona hedgehog cactus have included Resolution Copper's pre-feasibility study (22410-2009- F-0229), Frio Fire suppression activities (22410-2011-FE-0477), US 60 highway widening and improvements (02EAAZ00-2012-F-0334), Pinto Bridge replacement (02EAAZ00-2016-F-0450), and Pinto Valley Mine (02EAAZ00-2020-F-0490).

Because of the clarifications to species identification over time, different strategies in evaluating effects, and the implementation of conservation measures (such as salvage and transplant), the actual effects to individual Arizona hedgehog cactus through federal projects over its 40-year listed history may be less than the tabulation of numbers from individual biological opinions. For example, the estimated effect from the Phoenix Resource Management Plan consultation in the late 1980s (22410-88-F-167) addressing construction of US 60 and its realignment was that 2,348 cacti were lost from within approximately 67 acres of presumed occupied habitat is questionable. That estimated effect is questionable because nobody counted individual cacti affected by the project; rather, consultants estimated the number based upon habitat characteristics, topography, geologic material, and Arizona hedgehog cactus densities in similar habitats.

We have evaluated federal projects and authorized effects and loss of an estimated 3,382 individual cacti and adverse effects to approximately 948 acres of occupied and/or suitable Arizona hedgehog cactus habitat since the Arizona hedgehog cactus' listing (USFWS 1979). The 6,010 to 6,700 rangewide Arizona hedgehog cactus estimate takes into account previous authorized effects from section 7 consultations.

ENVIRONMENTAL BASELINE

Regulations implementing the Act (50 CFR 402.02) define the environmental baseline as the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

Mine Facilities

The Resolution Copper Mine project footprint will occur on a collection of partially developed, undeveloped, and developed federal, state, and private lands (SWCA 2020). The Oak Flat underground mining area, Skunk Camp Tailings area, and new transmission lines and corridors will occur in largely undeveloped desert areas, where the East and West Plant sites and MAARCO corridor are disturbed and developed areas with a history of active mining (USFS 2019, Appendix G). The East Plant Site contains existing mining facilities associated with Magma Mine (which ceased operations in the mid-1990s), including buildings, cooling towers, and wastewater facilities, etc. The West Plant Site consists of existing mine facilities constructed during historic mining operations that include tailings ponds, houses and offices in the upper basin, and a smelter complex. The MARRCO corridor is a historic mining railroad corridor originally built in the 1920s that ceased operations in the mid-1990s after the closure of the Magma Mine. Several utilities are currently colocated within the MARRCO corridor, including a buried fiber-optic line, an overhead transmission line and telephone line, buried natural gas pipelines, and water pipelines. The Filter Plant/Loadout Facility is currently undeveloped cleared creosote habitat.

USACE Compensatory Mitigation Lands

The compensatory mitigation lands associated with USACE CWA 404 permitting are undeveloped riverine tribal and private lands. The Mar-5 and ORRS river management site, along the regulated Gila River on Gila River Indian Community land, is primarily composed of cattails (*Typha* spp.), Goodding's willow (*Salix gooddingii*) and tamarisk (*Tamarix* spp.) (SWCA 2020). The Queen Creek site, owned by Resolution Copper and BHP Mineral Resources, is an ephemeral single to multi-threaded, low-gradient drainage. Dense acacia-mesquite shrublands occur along Queen Creek, with mature, medium-stature catclaw acacia and velvet mesquite (*Prosopis velutina*) dominating the vegetation community (SWCA 2020). H&E Farm, owned by The Nature Conservancy, includes an intermittent reach of the San Pedro River. The San Pedro River is large, well-defined, low-gradient, and braided within a broad, comparatively level floodplain. The active San Pedro River channel within the parcel consists of narrow dense stands of trees and shrubs, including large-statured mesquite and tamarisk, along with a few individual cottonwoods and patches of single whorl burro brush (SWCA 2020). The San Pedro river floodplain terraces contain moderately dense medium to large statured mesquite and tamarisk.

JI Ranch

Resolution Copper owns the 272.4-acre JI Ranch, located on both sides of US 60 near Top of the World and the Pinal/Gila county line (SWCA 2020a). Resolution Copper is proposing a 100-acre conservation easement on the ranch for the Arizona hedgehog cactus. The TNF borders the Ranch to the north, west, and south, and private property to the east. The ranch is primarily undeveloped with similar amounts of acreage on both sides of US 60 and is comprised of plant species such as scrub live oak (*Quercus turbinella*) and pointleaf manzanita (*Arctostaphylos pungens*). The JI

Ranch property has been an active cattle ranch in the uplands east of Superior for over 60 years (Buckles 2010). JI Ranch was built sometime between 1931 and 1948, and the property has been used for ranching and cattle grazing since that time. Historic and modern development on the property includes a ranch house, windmill, access road from U.S. Highway 60 in Iron Canyon, ranch road system south of the ranch, livestock watering tanks, corrals, pump houses, and barns (Buckles 2010). Integrity Land and Cattle, LLC, maintains a USFS grazing permit for the Devil's Canyon allotment, a portion of which is located within the JI Ranch property. Once Resolution Copper's records the conservation easement, they will prohibit future development and grazing activities within the conservation easement portion of the allotment for the duration of the Project. Limited roads and trails occur at the Ranch and ongoing operations include ranching and grazing.

Arizona hedgehog cactus occur throughout the ranch on both sides of US 60. The JI Ranch is home to hundreds of Arizona hedgehog cactus. In addition to the existing species detected, Resolution began propagating Arizona hedgehog cactus at JI Ranch in 2011. Resolution Copper selected two primary propagation techniques. The first approach involved planting seed by hand and by naturally pollinated fruits in the field, and the second approach involved collecting and planting vegetative offsets in pots, both approaches taking place onsite at JI Ranch. By 2020, Resolution Copper transplanted approximately 300 live potted Arizona hedgehog cacti into suitable habitat at JI Ranch.

<u>Streams, Springs and Groundwater Dependent Ecosystem Monitoring</u>

Perennial and intermittent streams occur in the action area, such as Queen Creek, Devil's Canyon, and Mineral Creek, as well as various springs and washes. For the most part, surface waters in the area consist of dry washes or ephemeral channels that flow only in response to moderate- to high-intensity rainfall events. Queen Creek drains the western part of the action area, which arises in the highlands around the Pinal Mountains and flows past Oak Flat and through the town of Superior. Queen Creek from its headwaters to Whitlow Dam is ephemeral in nature, with possibly some intermittent areas above the Town of Superior. Devil's Canyon is located on the east side of Oak Flat, and drains southward to join Mineral Creek, near the reservoir of Big Box Dam. Portions of Devil's Canyon are perennial or intermittent. The tailings pipeline corridor will span Queen Creek and Devil's Canyon where the streams are not perennial. Mineral Creek is similar in nature to lower Devil's Canyon, supported in part by near-surface storage of seasonal precipitation, and partially from the Apache Leap Tuff aquifer and regional sources. Dripping Spring Wash is located in the eastern part of the action area where the tailings storage facility is located. Dripping Spring Wash flows to the southeast for approximately 18 miles before discharging into the Gila River downstream of the Coolidge Dam. The main stem channel of Dripping Spring Wash is entirely ephemeral, with no known perennial reaches. Springs that occur include Bitter Spring, Bored Spring, Hidden Spring, McGinnel Mine Spring, McGinnel Spring, and Walker Spring.

Resolution Copper has been drilling, sampling, and monitoring wells at the project site since 2009, including wells in the deep groundwater system, the Apache Leap Tuff aquifer, and the shallow perched/fractured system. Resolution Copper's monitoring results associated with water levels, flow observations, water chemistry, and isotope sampling, has allowed detailed characterization of the groundwater in these three aquifer systems. Resolution Copper's dewatering of the deep groundwater system is anticipated to take place regardless of the construction of the proposed mine, as Resolution Copper has the legal right to continue to pump to protect the existing mine infrastructure on private land.

Over the same time period, Resolution Copper has been monitoring and sampling springs and streams in the project area. By comparing the various chemical characteristics of spring discharges or baseflow in perennial streams to the different types of groundwater, the TNF was able to ascertain the most likely source of groundwater feeding the springs and streams in the project area.

We note that Arizona hedgehog cactus is not groundwater dependent and these perennial and intermittent waters are outside the cactus' known range. The discussion of these waters has been included primarily to support the evaluation of other listed species in Appendix A (see *Concurrences*).

Concentrator Fault and Apache Leap Tuff Aquifer
The East Plant Site is located on Oak Flat, east of the Concentrator Fault. Three different types of groundwater occur in the East Plant Site located on Oak Flat, east of the Concentrator fault: shallow, perched groundwater systems; the regional Apache Leap Tuff aquifer; and a regional deep groundwater system.

The Concentrator Fault is a barrier to flow in the deep groundwater systems on either side of the fault. The shallow groundwater system consists of several shallow, perched aquifers of limited areal extent hosted in alluvial deposits and the uppermost weathered part of the Apache Leap Tuff aquifer. The primary shallow aquifers in this area are located near Top-of-the-World and JI Ranch, and to a lesser degree along some of the major drainages such as Hackberry Canyon and Rancho Rio Canyon.

The Apache Leap Tuff aquifer is a fractured-rock aquifer that extends throughout much of the Upper Queen Creek and Devil's Canyon watersheds, and the western part of the Upper Mineral Creek watershed. A thick sequence of poorly permeable Tertiary basin-fill sediments (the Whitetail Conglomerate) separates the Apache Leap Tuff aquifer from the deep groundwater system. In general, the direction of groundwater movement in the Apache Leap Tuff aquifer follows surface drainage patterns, with groundwater moving from areas of recharge at higher elevations to natural discharge areas in Devil's Canyon and in Mineral Creek.

The deep groundwater system east of the Concentrator Fault is compartmentalized, and faults separate individual sections of the groundwater system from each other. Depending on their character, faults can either inhibit or enhance groundwater flow. Based on available evidence, the faults in the project area tend to restrict groundwater flow between individual sections. The ore body and future block-cave zone lie within a geological structure called the Resolution Graben. A series of regional faults bounds the Resolution Graben geologic structure. A hydraulic connection connects the deep groundwater system in the Resolution Graben to existing mine workings, and Resolution Copper has observed a clear decrease in water levels in response to ongoing dewatering of the mine workings.

Devil's Canyon Monitoring
The upper reach of Devil's Canyon includes a reach of perennial flow. The geohydrology suggests that this section of Devil's Canyon lies above the water table in the Apache Leap Tuff aquifer and is most likely supported by snowmelt or precipitation stored in near-surface fractures, and/or floodwaters that have been stored in shallow alluvium along the stream, before slowly draining into the main channel. Further evaluation of hydrochemistry and flow data support this conclusion (Garrett 2018). The TNF does not consider there to be a connection between the Upper Devil's Canyon streamflow and the regional Apache Leap Tuff aquifer (SWCA 2020).

Moving downstream in Devil's Canyon, persistent streamflow arises again at about km 9.3. From this point downstream, Devil's Canyon contains stretches of perennial flow, aquatic habitat, and riparian galleries. Flow arises both from discrete springs along the walls of the canyon (four total: DC-8.2W, DC-6.6W, DC-6.1E, DC-4.1E), as well as groundwater inflow along the channel bottom. Near-surface storage of seasonal precipitation partially supports these reaches of Devil's Canyon. The available evidence indicates that these waters arise primarily from the regional Apache Leap Tuff aquifer. The TNF considers there to be connection between the middle and lower Devil's Canyon streamflow and the regional Apache Leap Tuff aquifer. Resolution Copper's block cave mining, dewatering, and groundwater drawdown can potentially affect the Devil's Canyon streamflow (SWCA 2020). These reaches of Devil's Canyon also receive runoff from the area where the subsidence area would occur and therefore may also lose flow during runoff events.

Resolution Copper has analyzed 14 separate sampling points along Devil's Canyon, extending from the headwaters to the confluence with Mineral Creek (USFS 2019, SWCA 2020). Four of these locations are discrete springs discharging along the banks or close to Devil's Canyon and the remaining 10 locations represented surface water in the channel itself. Resolution Copper, SWCA and the TNF used a "weight-of-evidence" approach to assess the water source for each of these locations, which included diagnostic lines of evidence that can clearly show water sources (carbon-14, tritium, and Piper plots), physical constraints like the elevation of the spring compared to known aquifer water levels, and analysis of other less- diagnostic water quality characteristics (USFS 2019, SWCA 2020).

The upper reaches of Devil's Canyon, from the headwaters (roughly kilometer 15.5) downstream to roughly kilometer 9.0, were determined to be disconnected from the regional aquifer, based on multiple and consistent lines of evidence. The lower part of this reach has persistent flow, but the various lines of evidence suggest that snowmelt and/or floodwaters that have entered streambank storage before slowly draining into the main channel, not regional groundwater, supports this persistent flow.

We note that Arizona hedgehog cactus does not occur along the stream in Devil's Canyon and the discussion of this stream has been included primarily to support the evaluation of other listed species in Appendix A (see *Concurrences*).

Mineral Creek Monitoring

As with Devil's Canyon, Resolution Copper studied a number of surface water and spring locations along Mineral Creek, and the likely groundwater sources supporting these locations were determined through multiple lines of evidence (USFS 2019, SWCA 2020).

Resolution Copper analyzed six separate sampling points along Mineral Creek in this way, extending from the headwaters to the confluence with Devil's Canyon (USFS 2019, SWCA 2020). Three of these locations were discrete springs discharging along the banks or close to Mineral Creek (Government Springs, MC-8.4C, and MC-3.4W [also known as Wet Leg Spring]), and the remaining three locations represented surface water in the channel itself.

All samples along Mineral Creek have strong or mixed evidence that they are at least partially supported by groundwater associated with the Apache Leap Tuff aquifer. This includes a 2.9-mile long reach with persistent water (from kilometer 6.4 to 1.7) as well as at least three distinct riparian galleries.

We note that Arizona hedgehog cactus does not occur along Mineral Creek and the discussion of this stream has been included primarily to support the evaluation of other listed species in Appendix A (see *Concurrences*).

Status of the Species within the Action Area

The Arizona hedgehog cactus occurs within the project or construction footprint and in adjacent areas that are within the broader action area (Figure 11, Appendix C). Multiple surveys conducted in portions of the East Plant Site, Oak Flat Federal parcel, and portions of the 230-kV transmission line corridor and the colocated 115-kV transmission line and tailings pipeline corridor occurred in 2004, 2007, 2008, 2010, 2012, 2014, 2015, 2017, 2019. A total of 165 Arizona hedgehog cacti were documented (Table 5, Appendix C) and briefly described below.

Surveyors found no Arizona hedgehog cactus in the western portions of the action area that includes the MARRCO corridor, Filter Plant and Loadout Facility, Skunk Camp tailings storage facility, and the West Plant Site. These areas do not contain suitable habitat for the cactus and are outside the cactus' known range. Similarly, the Recreation Mitigation Lands near the town of Superior and USACE CWA compensatory mitigation areas along Queen Creek, and the Gila and San Pedro rivers are also areas outside the Arizona hedgehog cactus' range.

Surveys conducted by WestLand Resources, Inc., (WestLand) since 2004 to document the Arizona hedgehog cactus occurred on about 745.4 acres of suitable habitat within the project footprint and on 2,662.7 acres within the action area. WestLand resurveyed Arizona hedgehog cactus habitat in more recent years (2015 to 2017) to confirm and re-assess the distribution and abundance of cacti found from 2004 to 2008. Overall, the surveys included about 80.8 percent of the total project footprint and about 28.6 percent of the total action area. Surveys did not cover about 167.7 acres within the project footprint and did not cover about 6,653.6 acres of the action area that contain suitable habitat for the cactus. The TNF estimates that the action area covers about 23.7 percent of the Arizona hedgehog cactus total known range (SWCA 2020). WestLand's surveys were conducted prior to determination of the final proposed action and for other efforts, and thus do not cover the entire project footprint and action area of this project. The TNF and SWCA estimated Arizona hedgehog cactus abundance in unsurveyed areas within the project footprint based upon the density of known Arizona hedgehog cacti in surveyed areas. The survey information documents the numbers of Arizona hedgehog cacti found within areas that are in or overlap with the action area.

WestLand conducted a survey for the Arizona hedgehog cactus on the 3,025-acre Oak Flat Federal Parcel in 2004. Nine individual Arizona hedgehog cacti were identified (SWCA 2020). Those surveyed areas overlap with portions of the East Plant Site, the subsidence area, and a portions of the 230-kV transmission line corridor and the colocated 115-kV transmission line and tailings pipeline corridor. WestLand re-surveyed these areas in 2015 and relocated these nine cacti (see below).

In 2007 and 2008, WestLand surveyed for the Arizona hedgehog cactus along areas proposed for their pre-feasibility activities. The survey area occurred on 738 acres and included portions of the East Plant Site, subsidence area, and the colocated 115-kV transmission line and tailings pipeline corridor (WestLand 2008). WestLand located 63 Arizona hedgehog cacti on the TNF and an additional 26 individuals outside of the pre-feasibility survey area or along several Forest Service roads. Westland re-surveyed these areas from 2015 to 2017, relocating these cacti (see below).

From 2010 to 2014, WestLand, conducted several Arizona hedgehog cactus surveys to comply with biannual monitoring requirements for the Resolution Copper Pre-feasibility Activities Plan of Operations (WestLand Resources 2014). The surveys covered 738 acres and included portions of the East Plant Site, subsidence area, the colocated 115-kV transmission line and tailings pipeline corridor. In 2010, WestLand surveyed the pre-feasibility activity area and documented a total of 346 Arizona hedgehog cacti (WestLand Resources2010). Their second survey of the area in 2012 identified 98 Arizona hedgehog cacti, in addition to the 346 individuals documented during 2010 survey (WestLand Resources 2012). Their third survey in 2014, WestLand documented an additional 44 Arizona hedgehog cacti (WestLand Resources 2014). WestLand did not find any Arizona hedgehog cacti growing west and south of Apache Leap (WestLand 2010, 2014).

From 2015 to 2017, WestLand conducted multiple surveys for the Arizona hedgehog cactus within the footprint of the proposed copper mine and associated mine facilities. In 2015, WestLand surveyed potential Arizona hedgehog cactus habitat within the project footprint that biologists had not surveyed since 2004, and revisited known occurrences at the Oak Flat Federal parcel with observed recruitment occurring around established Arizona hedgehog cacti. The surveyed area was approximately 300 acres within portions of the East Plant Site, West Plant Site, and the subsidence area. WestLand found one individual Arizona hedgehog cactus in previously unsurveyed potential habitat. They relocated 11 known cacti and found an additional five individual plants within a previously surveyed area (WestLand 2016). One relocated cactus found in 2012 was dead in 2015. In 2017, WestLand surveyed 360 acres of the East Plant Site. They detected 17 new individual Arizona hedgehog cacti in addition to the 11 individuals previously identified in this area (WestLand 2017a). Another survey of the East Plant Site in May 2020 relocated 31 Arizona hedgehog cacti and detected 9 new individual plants. Of the nine, only two were within the East Plant Site boundary. For the remaining 7 individual plants, 3 cacti were 25 feet or less outside of the East Plant Site boundary, and 4 newly detected cacti were approximately 250 feet outside the East Plant Site boundary. In total, WestLand detected 8 Arizona hedgehog cacti within the East Plant Site with another 5 individual plants outside, but within 25 feet of the East Plant Site (WestLand 2020a).

Surveys for the Arizona hedgehog cactus conducted in 2019 included surveys of portions of the 230-kV transmission line corridor, the Skunk Camp tailings 115-kV transmission line corridor, and the Skunk Camp tailings pipeline corridor (WestLand 2019). Overall, WestLand (2019) found about 870 cacti; approximately 280 Arizona hedgehog cacti occurred within the 230-kV transmission line corridor, 500 within Skunk Camp tailings 115- kV transmission line corridor, and 90 within the Skunk Camp pipeline corridor. The surveyed areas for both transmission line corridors were 1,000 feet wide. WestLand resurveyed these areas again in June 2020 and included the revised Skunk Camp corridor and subsidence area (WestLand 2020b). Some of these Arizona hedgehog cacti found were within the action area at the perimeter of these corridors, but outside of the corridor footprint and anticipated area of disturbance.

In summary, surveyors documented a total of 165 Arizona hedgehog cacti from project-related surveys within the proposed project footprint area. An additional 1,962 individuals were located outside the project footprint but within the action area. Specifically, surveyors identified 24 individual Arizona hedgehog cacti in the subsidence area, 13 in the East Plant site, 87 in the Skunk Camp tailings pipeline corridor, 2 in the 115-kV transmission line, and 39 in the colocated 230-kV/115-kV transmission lines. Surveys for Arizona hedgehog cactus were conducted in 2019 on approximately 203.1 acres (68.9 percent) of the 115-kV transmission line that is colocated with the

Skunk Camp pipeline corridor and no Arizona hedgehog cacti were identified within that portion of the project (Table 5, Appendix C).

SWCA (2020) concluded that the number of individual Arizona hedgehog cactus documented in the proposed project footprint area covers 80.8 percent of the total project footprint area. They also assumed that the Arizona hedgehog cactus is likely present on the remaining 19.2 percent of the Skunk Camp tailings pipeline corridor that overlaps with its range. Based upon the density of Arizona hedgehog cactus in the surveyed area, SWCA (2020) estimated that an additional 23 cacti occur in that area, bringing the estimated total to 186 individual Arizona hedgehog cacti in the project footprint area. We expect that because these Arizona hedgehog cacti are located within the core of its range, these plants are correctly identified and not confused with other similar looking cactus (*e.g.,* red-flowered hedgehog cactus, [*Echinocereus coccineus* var. *coccineus*]) occurring on the periphery of its range.

There are approximately 800 Arizona hedgehog cacti within the 100-acre JI Ranch conservation easement area. Resolution Copper planted approximately 300 cacti within the JI Ranch boundaries (SWCA 2020a).

EFFECTS OF THE ACTION

In accordance with 50 CFR § 402.02, effects of the action are all consequences to listed species or critical habitat caused by the proposed action, including the consequences of all other activities that are caused by the proposed action. "A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see §402.17)."

We have concluded that "but for" the TNF's permits for Resolution Copper Mine roads and pipelines and SRP's transmission lines on Forest Service land, the entire Resolution Copper Mine project would not occur and its consequences are reasonably certain to occur. The effects of the action may occur later in time and may include consequences occurring outside of the immediate area involved in the action.

Effects Overview

The proposed project will result in loss and degradation of approximately 822 acres of Arizona hedgehog cactus habitat and will lead to the removal and potential loss of up to 246 cacti. The conservation measures (*e.g.,* transplant) may minimize the loss of cactus and the JI Ranch conservation easement will conserve approximately 800 Arizona hedgehog cacti by protecting 100 acres of cactus habitat from threats on private land during the life of the project.

Consequences from Mine Components

<u>Mine Facilities Outside the Range of Arizona Hedgehog Cactus</u>

The western portions of the action area that includes the MARRCO corridor, Filter Plant and Loadout Facility, Skunk Camp tailings storage facility, and the West Plant Site, are outside the cactus' known range and do not contain suitable Arizona hedgehog cactus habitat or Arizona hedgehog cactus. As a result, we anticipate no effects to Arizona hedgehog cactus or its habitat from construction, mining activities, reclamation at these facilities, or USACE CWA permitting of effects to the waters of the U.S. at the Skunk Camp tailings storage facility.

Access Roads

The development of the access roads outside the transmission and pipeline corridors will lead to ground disturbance of about 1.6 acres within the known range of Arizona hedgehog cactus. Because surveyors did not identify individual cactus in the footprint of the access roads during surveys, it is unlikely that the species or the associated seed bank will be present and affected in these areas during construction. The potential effects on these 1.6 acres will include ground disturbance that could make these areas unsuitable for species re-establishment in the future after the project life span due to the changes to soils and geological formations from grading during construction.

Underground Mining and Subsidence

Surveys conducted in the subsidence area identified 10 individual Arizona hedgehog cacti. Because this parcel will be transferred to private property, Resolution Copper has proposed to transplant the cacti onto the TNF where Federal biologists continue to have access to the plants and the plants can remain federally protected under the Act (i.e., unless a federal nexus occurs on private lands, Endangered Species Act regulations for listed plants do not apply).

Approximately 387.1 acres of the underground mining area occur within the range of Arizona hedgehog cactus and will be degraded and likely permanently lost due to subsidence. The TNF and SWCA expect the ground surface dropping 800 to 1,115 feet will disrupt or overturn, to the point of death, most of the interior chaparral vegetation within the "crater limit." Some interior chaparral vegetation may survive in the "fracture limit" but the ground surface is expected to subside enough that stormwater runoff will change direction and flow towards the subsidence crater resulting in excess water. Therefore, while there may be a possibility for a small number of cacti to establish on the perimeter of the subsidence crater, we estimate that it is a low likelihood and more likely that Arizona hedgehog cactus habitat in the subsidence crater will be lost and unable, following the closure of the mine, to support Arizona hedgehog cactus.

We do not anticipate groundwater drawdowns to adversely affect Arizona hedgehog habitat or plants beyond the subsidence crater. We do not expect groundwater drawdowns caused by the dewatering of the Apache Leap Tuff aquifer to cause declines in the interior chaparral vegetation community beyond the subsidence crater. The interior chaparral vegetation, which provides Arizona hedgehog cactus habitat, relies on precipitation for obtaining water rather than groundwater. Therefore, we do not expect effects to this vegetation community and the cactus beyond the subsidence crater from groundwater drawdowns.

East Plant Site

We expect construction of surface support buildings, access shafts, and ventilation at the East Plant Site to affect 13 Arizona hedgehog cacti. We also anticipate effects to three additional cacti growing within or near the proposed re-alignment of Magma Mine Road. Loose soil or rocks rolling or sliding downslope from new road cuts and fill may adversely affect these plants. To prevent damage or direct losses to these plants, all 13 will be removed and planted in suitable habitat within the action area following the salvage and transplant protocol (USFS 2020). For any cacti downslope of the new road alignment that Resolution Copper can protect in place, they will implement conservation measures, such as fencing or barriers or other forms of protection to prevent damage to cacti from rolling or sliding debris during construction.

Ground disturbance associated with construction activities will alter about 22.1 acres of Arizona hedgehog cactus habitat. We expect that these areas will no longer be suitable for re-establishment of Arizona hedgehog cactus after the project is completed. Loss of suitable habitat will also result in a loss of any existing seeds stored in a soil seed bank that would otherwise enable future Arizona hedgehog cacti germination and establishment.

Tailings Pipeline Corridor

To assess project effects to the cactus, SWCA (2020) analyzed a 500-foot tailings pipeline corridor width and assumed all 56.7 acres could be disturbed. Our analysis is based upon this assumption. Upon final approval of the design, the TNF anticipates the final right-of-way will likely be 150 feet wide with the acreage of ground disturbance substantially less.

Ground disturbance associated with the tailings pipeline corridor includes the construction and installation of the 22-inch PAG pipeline, 34-inch NPAG pipeline, and 16-inch reclaimed water pipeline, and the 20-foot wide access road, grading, vegetation removal, and trenching. These construction activities will affect up to 89 individual Arizona hedgehog cacti and alter up to 56.7 acres of suitable cactus habitat. Prior to any ground disturbance, a qualified biologist will survey the corridor to identify any Arizona hedgehog cacti that may have been missed during previous surveys or new plants that have become established since the most recent 2019 survey. We anticipate that biologists will remove all 89 Arizona hedgehog cacti and any newly discovered individuals prior to ground disturbance and replant them into new areas outside the pipeline corridor, but within the action area.

Following the removal of plants, we do not anticipate that habitat within the pipeline corridor will become suitable for Arizona hedgehog cactus re-establishment in the future given routine maintenance of the pipeline during the life of the project and ground disturbance at mine closure to remove all of the pipelines within the corridor. We anticipate there will be no effects to the Arizona hedgehog cactus habitat from staging areas because these will be located within the newly constructed corridors during the project’s construction and closure phases.

Loss of Arizona hedgehog cactus suitable habitat will result in a loss of any seeds established in a soil seed bank across 56.7 acres. Loss of suitable habitat would likely reduce or eliminate the suitability of the cactus to re-establish after the project due to the removal of top soils, any seeds stored in a potential soil seed bank, and changes in geological formations from grading and trenching. Degradation of suitable habitat will increase habitat fragmentation between plants growing outside of the project footprint and inhibit future establishment of Arizona hedgehog cacti seedlings in the project footprint.

Resolution Copper development of the access road within the corridor (where existing access roads are not sufficient) could lead to road cuts and fill creating loose soil/rocks that could shift downslope and bury or crush individual Arizona hedgehog cacti outside the area to be disturbed. There are an estimated 11 Arizona hedgehog cacti within 100 feet of the project footprint that are downslope from project activities. To prevent damage and/or plant deaths, biologists will remove and transplant these cacti to new locations within the action area, following the TNF’s salvage and transplant protocols. If Resolution Copper can protect these plants in place, they will implement measures to protect those individuals**.**

Tailings Pipeline Corridor Colocated with the 115-kV Transmission Line

To assess effects to the cactus, SWCA (2020) analyzed a 500-feet corridor width for the 14.2-mile long tailings pipeline/115-kV transmission line. The 500-feet corridor includes 833.1 acres from the start of the colocated tailings pipeline/115-kV transmission line to the Skunk Camp tailings storage facility fence line. Upon final approval of the design, the TNF anticipates the final right-of-way will likely be from 225 to 280-feet wide for the tailings pipeline and the parallel transmission line. The acreage of ground disturbance could be substantially less.

No Arizona hedgehog cacti occur within the 500-foot wide colocated corridor. Some Arizona hedgehog cacti occur outside of the colocated corridor and outside of the action area. Therefore, we do not expect any construction-related effects to the cactus from this portion of the project. Prior to any ground disturbance, qualified biologists will survey this corridor again to ensure no individuals are present. Qualified biologists will transplant or protect in place any Arizona hedgehog cactus if construction activities will result in damage or death.

SWCA (2020) determined that the project will alter 294.9 acres of Arizona hedgehog cactus habitat within this 833.1-acre corridor (Table 5, Appendix C). Approximately 214 acres of habitat will be permanently altered (vegetation removal, grading, trenching) by the construction and installation of the 22-inch PAG, 34-inch NPAG, and 16-inch reclaimed water pipelines, the 50-feet by 50-feet transmission tower foundations, and staging areas. Another 4.2 acres of ground disturbance is associated with the construction of a 20-foot wide access road for SRP to gain access to the transmission towers. We anticipate that areas within the corridor will not become suitable Arizona hedgehog cactus habitat in the future due to construction habitat alteration; routine and hazardous vegetation management of the pipeline corridor and transmission line operation; and closure operations to remove the pipelines and potentially the transmission line.

Colocated 230-kV/115-kV Transmission Lines

To assess effects to the cactus, SWCA (2020) analyzed a 160-feet corridor width, consisting of 61 acres, for the new alignment of the colocated 230-kV/115-kV transmission lines. Upon final approval of the design, the TNF anticipates the final right-of-way will likely be from 110 to 160-feet wide for the colocated transmission lines and actual ground disturbance may be less.

SWCA (2020) estimated that 57.3 acres within the colocated 230-kV and 115-kV transmission lines is occupied and/or suitable Arizona hedgehog cactus habitat. Ground disturbance associated with construction of the corridor, 50-feet by 50-feet tower foundations, and staging areas will cause removal of 39 Arizona hedgehog cacti and loss of 57.3 acres of habitat. The acreage includes 1.2 acres of habitat loss to construct a 20-foot wide road for SRP to access to the transmission towers within the corridor.

Prior to any ground disturbance, a qualified biologist will survey the corridor to identify any Arizona hedgehog cacti and any plants established since the most recent survey. A qualified biologist will salvage any individual cacti that are suitable for transplant and plant it outside the area of disturbance prior to construction activities, following TNF's salvage and transplant protocols (USFS 2020).

The development of an access road within the corridor could lead to road cuts and fill creating loose soil/rocks that could shift and bury or crush individual Arizona hedgehog cactus growing downslope of construction. For those plants that qualified biologists cannot salvage but are downslope of a construction area, they will implement measures, such as fencing or barriers or other forms of protection to protect cacti from rolling or sliding debris.

<u>115 kV Transmission Line</u>

To assess effects to the cactus, SWCA (2020) analyzed a 160-feet corridor width for the new alignment of the 115-kV transmission line. Upon final approval of the design, the TNF anticipates the final right-of-way will likely be from 75 to 130-feet wide for the transmission line.

SWCA estimated that the new 115-kV transmission line alignment will occur within about 3.0 acres of occupied and/or suitable Arizona hedgehog cactus habitat. Ground disturbance associated with construction of the transmission line includes the construction of 50-feet by 50-feet tower foundations, SRP vegetation management, and staging areas.

Potential construction-related effects on the species from the 115-kV transmission lines, associated access roads, and staging areas will include the removal of two individual Arizona hedgehog cacti and any additional individuals established since surveys occurred in 2019. Prior to any ground disturbance, a qualified biologist will survey the corridor to identify any Arizona hedgehog cacti that may have been missed during previous surveys or new plants that have become established since the most recent survey. A qualified biologist will salvage any individuals of the species that are suitable for transplant and plant them into areas outside the area of disturbance prior to construction activities, following the TNF's salvage and transplant protocols (USFS 2020).

Ground disturbing activities will lead to a reduction or loss of the Arizona hedgehog cactus seed bank on up to 3.0 acres from construction of the 115-kV transmission line. These areas will no longer have Arizona hedgehog cactus contributing to the seed bank and ground disturbance can change conditions to make it less suitable for seed germination. Where disturbance occurs, this project corridor will reduce habitat suitability and the likelihood for the Arizona hedgehog cactus to re-establish after the life of the project.

Consequences from Mining Operations and Maintenance

We do not anticipate effects to the Arizona hedgehog cactus from continuous mine operations and subsidence on the Oak Flat parcel over the 40-year mining period due to the salvage and transplant of cactus from the Oak Flat parcel from conservation measure and BMP application prior to the development and implementation of mining facilities and activities.

Resolution Copper's implementation of BMPs will minimize and cause any effects to the Arizona hedgehog cactus growing downslope of the project footprint and its habitat to be insignificant. Specifically, Resolution Copper's *Noxious Weed and Invasive Species Management Plan on National Forest Systems Lands* provides strategies to treat and reduce the spread of weeds and invasive plants, stabilize embankment slopes, and implement various dust control and suppression measures to prevent fugitive dust from covering an Arizona hedgehog cactus.

Consequences from SRP Line Maintenance and Vegetation Management under Transmission Lines

We do not anticipate SRP transmission line maintenance/repairs/inspections and vegetation maintenance underneath lines will affect the Arizona hedgehog cactus because qualified biologists will transplant cactus prior to maintenance, repairs, and inspections or marked in a way that they will not be harmed. A qualified biologist will remove all 41 at-risk cacti that construction of the colocated 230kV-115kV and 115-kV may damage or kill. Helicopter flights are high above the ground and move quickly past this low growing cactus, preventing any effects associated with wind or dust. The likelihood of a helicopter landing where cacti occur, because of its rugged and rocky growing locations, is discountable. Line maintenance will be specific to a tower or a section on the circuit for purposes of minor or emergency hardware repair or replacement. In the rare event a structure needs replacing later in time, but during mine operations, we anticipate no effect to the Arizona hedgehog cacti because we do not expect any Arizona hedgehog cacti to remain in the corridor following the initial salvage and transplant prior to construction of the corridor. Similarly, because of cactus absence, we do not expect vegetation maintenance and hazard treatments within the transmission corridor and maintaining clearings around transmission towers to affect the Arizona hedgehog cactus. Because the transmission line occurs with low growing desert vegetation and the project will alter vegetation in the colocated corridors, we expect the need for extensive vegetation management will likely be minimal. Any necessary vegetation maintenance where qualified biologists have not removed Arizona hedgehog cactus will result in pre-project surveys to identify and protect cactus from any necessary vehicle access or vegetation removal.

Consequences from Closure and Reclamation Activities

During closure and reclamation activities in mine years 50 to 56, ground disturbing activities may affect any Arizona hedgehog cactus that germinates and grows during the 40-years of mine operations. Demolition of facilities, trenching to remove underground pipelines and pipeline bridges; contouring, and grading will result in the additional losses or degradation of soil. Resolution Copper will seed disturbed areas with native seed mixes and replace growth media to vegetate and stabilize embankments to reclaim disturbed areas. Demolition activities may damage or kill any new Arizona hedgehog cacti seedlings or plants originally protected in place in the project footprint, such as the East Plant site and tailing pipeline corridor. Qualified biologists will resurvey these areas for the cactus prior to demolition activities. While we do not anticipate any Arizona hedgehog cacti growing in these areas after the initial salvage and transplanting, it is possible that seedlings that either became established or individuals originally protected in place may now be at risk during this stage. Qualified biologists will remove any at-risk plants and replant them in the action area, following the TNF's salvage and transplant protocols. Grading and trenching activities will likely remove any potential seed remaining in the soil seed bank, eliminating the potential for future germination of Arizona hedgehog cactus in the area.

Consequences from CWA 404 and Recreation Mitigation Parcels

We do not anticipate any adverse effects to Arizona hedgehog cactus from ground disturbance associated with developing recreation mitigation activities for the Arnett Creek trailhead, motorized and non-motorized trails, Inconceivables Climbing Area road extension, and Queen Creek Castleberry Campground (and associated facilities) because these recreational improvement areas occur at lower elevations outside the known Arizona hedgehog cactus range. The total ground disturbance associated with these recreational areas is 92 acres.

The USACE CWA Section 404 compensatory mitigation parcels at Queen Creek, Gila River, and San Pedro River sites are outside of the cactus' known range and do not contain suitable Arizona hedgehog cactus habitat or Arizona hedgehog cactus. As a result, we anticipate no effects to Arizona hedgehog cactus or its habitat from CWA mitigation areas.

Summary of Consequences to the Arizona Hedgehog Cactus

Construction activities occurring over a nine-year period to build new facilities, create the transmission and pipeline corridors, access routes to transmission towers, and the subsidence crater will result in the loss of an estimated 165 individual Arizona hedgehog cacti. Closure activities to remove most of the mine components may result in additional adverse effects to cacti established during mine operations. The TNF estimates that an additional 21 individuals may occur across the entire project footprint for a total of 186 Arizona hedgehog cacti affected. Surveys before construction or any type of ground disturbance begins will help identify plants that monitors can protect in place. The TNF anticipates that monitors will relocate all 186 Arizona hedgehog cacti to a new location outside of the project footprint but within the action area.

Removal or transplant of at least 165 Arizona hedgehog cacti detected during project surveys will occur with a possibility that additional cacti may be found and transplanted. The TNF estimates that an additional 21 individuals may occur across the entire project footprint for a total of 186 Arizona hedgehog cacti affected. They estimated this number using densities of individuals in specific project features and extrapolating that density to areas not surveyed within the known species' range. However, surveyors can miss plants during pre-construction surveys, but discover them during the vegetation clearing activities. In this case, we estimate that an additional 60 individual Arizona hedgehog cacti could occur based on the large size of the project footprint that overlaps occupied habitat. We therefore estimate that project activities may adversely affect up to 246 individual Arizona hedgehog cacti. Because the corridor widths analyzed were conservative and broader than the likely footprint, the number of affected Arizona hedgehog cactus could be less, as could the loss of habitat.

Conservation measures proposed to salvage Arizona hedgehog cactus from areas of disturbance and replant them to new locations within the action area may minimize the loss of plants and effects to genetic variation. However, transplanting is not a guarantee for plant survival. A high mortality rate can occur if monitors do not plan carefully and persons approved to carry out the work are not experienced moving rare plants, particularly *Echinocereus* species. Timing of the removal, techniques used for removal (i.e., keeping much of the roots intact, preventing damage to stems, strategies for stem or plant removal within boulder crevices), suitability of new locations, an understanding of the species, and experience in transplanting native cactus species and other qualifications can improve survival.

The TNF and Resolution Copper proposed several conservation measures to reduce the number of Arizona hedgehog cacti adversely affected by this project. In particular, they will attempt to conduct transplanting activities between October and May, when the weather is cooler and winter rainfall may occur, to reduce heat stress on transplanted Arizona hedgehog cacti and improve their ability to re-establish. If transplanting activities must occur between May and October, the TNF or Resolution Copper will provide additional water to transplanted cactus to offset heat related stress to uprooted plants. They committed to conducting long-term monitoring of transplanted Arizona hedgehog cacti which will not only add insight to the status of transplanted individuals but will allow us to measure the effectiveness of the TNF's transplant techniques toward recovery. However, we are uncertain of who will conduct the transplanting, where qualified and appropriately permitted biologists will plant cactus in the action area, and other details. In the event that all estimated 246 Arizona hedgehog cacti do not survive transplantation; we expect the population to number around an estimated 5,760-6,450 plants. We expect these estimated 5,760-6,450 cacti to continue to contribute to Arizona hedgehog cactus survival and recovery because with the potential loss of 246 individuals, the population is likely to still maintain high levels of genetic diversity (Fehlberg et al. 2013) and be distributed across its range. The approximate 5,760-6,450 individual cactus remaining can provide seeds for propagation, as well as stems that qualified biologists can collect from genetically different individuals to grow in a greenhouse nursery and replanted back in its natural habitat for recovery purposes.

Resolution Copper has committed to developing an Arizona Hedgehog Cactus Relocation, Salvage, and Monitoring Plan with the TNF and our office that provides criteria for determining which cacti are suitable for immediate relocation as well as measures to collect seed or to salvage healthy stems from individuals when biologists cannot salvage the whole plant. This effort, in coordination with the FWS, is important to making decisions that can improve the chances of survivorship of translocated plants. However, Resolution Copper has not submitted this plan prior to consultation. Without specific information about this plan, who will implement the plan, and details, such as adaptive measures to prove its effectiveness over time, its conservation value toward minimizing adverse effects considered in the biological opinion is limited.

Construction, closure, and reclamation activities will result in the degradation and/or loss of up to approximately 822.8 acres of occupied and suitable Arizona hedgehog cactus habitat. We anticipate the project to cause permanent negative effects to about 375.3 acres from access roads, East Plant site construction/development, and the entire tailings pipeline, likely precluding future cactus re-establishment. We expect habitat degradation or loss at the subsidence area and, transmission lines will adversely affect about 447.5 acres, causing these areas to not likely be suitable for future cactus establishment. Additional transmission line habitat degradation may occur during closure activities if SRP does not use the powerlines for another purpose. Loss of occupied habitat will increase habitat fragmentation and reduce the taxon's ability to increase its population distribution between individual Arizona hedgehog cacti growing to the north and south of the project footprint.

We anticipate the conservation measures associated with transplanting Arizona hedgehog cacti and the conservation easement will help to reduce and minimize the effects of the action but will not completely offset the effects. Physically moving 186 to 246 cacti will alter the Arizona hedgehog cacti spatial distribution, create an artificial cluster of plants, and not all transplants will likely survive. Resolution Copper's new JI Ranch conservation easement of 100-acres for the life of the project will help conserve Arizona hedgehog cactus and its habitat for approximately 60 years. However, the conservation easement's duration for the life of the project and acreage does not fully offset the project's overall adverse effects to 822.8 acres of occupied and suitable Arizona hedgehog cactus habitat. When the JI Ranch conservation easement ends in about 60 years, it may return to private ownership. While we do not know the future circumstances surrounding the cactus' listing status, the environment, or plans for the ranch after the end of the project, Arizona hedgehog cactus were able to persist with previous ranching activities (see *Environmental Baseline*). Therefore, should the ranch return to current use following the end of the mine project, Arizona hedgehog cactus may still persist. Even without these conservation measures, the estimated abundance of remaining plants (5,760-6,450), distribution across its range, genetic diversity (Fehlberg et al. 2013), and amount of overall acreage within its range (approximately 54,000 acres), recovery of the plant is not precluded.

The proposed development of the Resolution Copper Mine is not likely to cause the endangered Arizona hedgehog cactus to reach a tipping point that precludes recovery, for the following reasons:

1) If all affected cacti from the project do not survive implementation of proposed conservation measures associated with tranplantation, the estimated rangewide Arizona hedgehog cactus population of 5,760-6,450 plants will remain large enough, be well distributed, and maintain a high level of genetic diversity (Fehlberg et al. 2013).
2) Conservation measures can minimize the effects to 186 and potentially up to 246 cacti through transplant techniques within the action area. While transplanting does not guarantee plant survival, we anticipate that some transplanted cacti will survive to reproduce.
3) The JI Ranch Arizona hedgehog cactus conservation easement minimizes some effects of the action by conserving about 100 acres of private land and approximately 800 Arizona hedgehog cacti from development, human access, and cattle grazing for the approximate 60-year life of the mine. Arizona hedgehog cactus may still persist at JI Ranch following termination of the easement if activities return to those currently occurring, based upon those actions persisting since the ranch's establishment in the 1930s/40s.
4) The degradation and/or loss of up to 822.8 acres of Arizona hedgehog cactus habitat caused by mining construction, closure and reclamation activities, represents only about 1.5% of the estimated 54,700 acres within its range. More than 90 percent of the Arizona hedgehog cactus' range occurs on the TNF, where it has greater long-term protection from the ESA, compared to non-Federal land.

CUMULATIVE EFFECTS

Cumulative effects are those "effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area" considered in this Opinion (50 CFR § 402.02).

We are not aware of any specific future state, tribal, local, or private actions that are reasonably certain to occur within the action area at this time; therefore, we are not able to currently anticipate any cumulative effects. Those actions that may be ongoing in the future include private land development and ranching. Because more than 90 percent of occupied Arizona hedgehog cactus is on the TNF's Globe Ranger District, and the remaining occupied habitat occurs on BLM, ASLD, or private lands, we anticipate that future activities within the action area that could have a substantial affect to the Arizona hedgehog cactus are likely to be subject to Section 7 consultation under the ESA.

JEOPARDY AND ADVERSE MODIFICATION ANALYSIS

Section 7(a)(2) of the ESA requires that federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat.

Jeopardy Analysis Framework

Our jeopardy analysis relies on the following:

"Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR § 402.02). The following analysis relies on four components:

1) Status of the Species, which evaluates the range-wide condition of the listed species, the factors responsible for that condition, and the species' survival and recovery needs;
2) Environmental Baseline, which evaluates the condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species;
3) Effects of the Action (including those from conservation measures), which determines the direct and indirect impacts of the proposed federal action and the effects of any interrelated or interdependent activities on the species; and
4) Cumulative Effects, which evaluates the effects of future, non-federal activities in the action area on the species.

The jeopardy analysis in this biological opinion emphasizes the range-wide survival and recovery needs of the listed species and the role of the action area in providing for those needs. We evaluate the significance of the proposed Federal action within this context, taken together with cumulative effects, for making the jeopardy determination.

CONCLUSION

After reviewing the current status of the Arizona hedgehog cactus, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is our biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the Arizona hedgehog cactus. We have not designated critical habitat for this taxon; therefore, none will be affected.

We base this conclusion on the following:

1. Regardless of the success of any conservation measures, the Arizona hedgehog cactus, following implementation of the project, will remain well distributed, large enough, and with a high level of genetic diversity throughout its range.
2. The proposed project may result in the loss of 186 and up to 246 Arizona hedgehog cacti. An entire loss of all 246 cacti would represent a small proportion of the current known population abundance (estimated at 6,010 to 6,700 plants and taking into account all effects from projects we previously analyzed pursuant to section 7 of ESA) and is not expected to hinder implementation of recovery actions for the taxon, such as, controlled propagation, seed collection, and continued translocations into suitable habitat within its range.
3. Resolution Copper, with input from TNF and FWS, will transplant any Arizona hedgehog cacti at risk of injury or death to new locations outside of the project footprint and within the action area to conserve the cactus. Transplants will possibly occur in cooler months to reduce additional stress on plants and improve survival. If transplantation occurs in warmer months, a biologist will provide supplemental water.

4. The loss and/or degradation or alteration of 822.8 acres of habitat represents only 1.5% of the estimated 54,700 acres within the Arizona hedgehog cactus' range. These effects are not likely to jeopardize the cactus because it occurs to the north, east, and south of the proposed project within the TNF in sites unaffected by the proposed action and maintains a high level of genetic diversity.
5. Resolution Copper will record a new conservation easement on 100-acres of private land that supports approximately 800 Arizona hedgehog cacti. This easement will conserve occupied Arizona hedgehog cactus habitat during the estimated 60-year life of the project. Because Arizona hedgehog cactus likely persisted with ongoing ranching activities since the 1930s/40s, they may also persist following completion of the easement should the ranch return to similar activities prior to the easement.
6. Groundwater drawdowns caused by the dewatering of the Apache Leap Tuff aquifer and changes in surface stormwater runoff will not cause a decline in the interior chaparral and related vegetation communities beyond the subsidence crater. The degradation or loss of 387.1 acres from subsidence is not likely to jeopardize the Arizona hedgehog cactus habitat because it represents only a 2% loss of the interior chapparal vegetation community within the action area. Interior chaparral and related vegetation communities and the Arizona hedgehog cactus rely on precipitation for obtaining water and therefore changes to groundwater and surface water will not affect the cactus or its habitat beyond the Oak Flat Federal parcel.

The conclusions of this biological opinion are based on full implementation of the project as described in the Description of the Proposed Action section of this document, including any conservation measures that were incorporated into the project design.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. "Take" is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct" (section 3(19)). "Harm" is further defined (50 CFR § 17.3) to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined (50 CFR § 17.3) as intentional or negligent actions or omissions that create the likelihood of injury to listed species by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

Sections 7(b)(4) and 7(o)(2) of the Act generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the Act prohibits the removal and reduction to possession of federally listed endangered plants from areas under Federal jurisdiction, or for any act that would remove, cut, dig up, or damage or destroy any such species on any other area in knowing violation of any regulation of any State or in the course of any violation of a State criminal trespass law.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. We recommend the TNF establish long-term Arizona hedgehog cactus demographic monitoring plots to record essential life history traits such as: germination rates, percent of population fruiting, seedling survival, and potential causes of mortality.
2. We recommend the TNF conduct a species distribution model with a climate vulnerability assessment that identifies areas of highly suitable habitat to inform the Arizona hedgehog cactus' status under changing climatic conditions, and potentially used for future translocations during federal projects.
3. We recommend Arizona hedgehog cactus surveys, especially in areas where Arizona hedgehog cactus have not been located in the past, to improve our understanding of its distribution and abundance.

For us to be informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, we request notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the Resolution Copper Mine project. As provided in 50 CFR § 402.16, reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this biological opinion or written concurrence; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Because there is no incidental take or numerical exceedance criteria for listed plants, consultation reinitiation for the Arizona hedgehog cactus for the Resolution Copper Mine project would rely on items such as changes in project location and/or acres of plants affected not considered in this biological opinion, where discretion is retained.

In keeping with our trust responsibilities to American Indian Tribes, we encourage you to continue to coordinate with the Bureau of Indian Affairs in the implementation of this consultation and, by copy of this biological opinion, are notifying the San Carlos, White Mountain, Mescalero, Tonto and Yavapai Apache Tribes; Gila River Indian Community; and the Hopi and Hualapai Tribes of its completion. We also encourage you to coordinate the review of this project with the Arizona Game and Fish Department.

We appreciate the TNF, USACE, SRP, SWCA, and Resolution Copper's collaborative efforts to identify and minimize effects to listed species from this project. Please refer to the consultation number, 02EAAZ00-2020-F-0822 in future correspondence concerning this project. Should you require further assistance or if you have any questions please contact Kathy Robertson, (602) 899-5957, or Greg Beatty, (602) 242-0210.

Sincerely,

Jeffrey A. Humphrey
Field Supervisor

cc (electronic):
- Chief, Habitat Branch, Arizona Game and Fish Department, Phoenix, AZ
- Regional Supervisor, Arizona Game and Fish Department, Mesa, AZ
- Fish and Wildlife Biologists, U.S. Fish and Wildlife Service, Phoenix and Tucson, AZ (Attn: Jeff Servoss, Ryan Gordon, Susan Sferra, Jason Douglas)
- District Ranger, Mesa Ranger District, Tonto National Forest, Mesa, AZ (Attn: Mark Taylor)
- District Biologist, Mesa Ranger District, Tonto National Forest, Mesa, AZ (Attn: Kelly Kessler)
- Tonto National Forest, Phoenix, AZ (Attn: Michael Martinez, Mary Rassmussen, Drew Ullberg)
- U.S. Army Corps of Engineers, Phoenix, AZ (Attn: Mike Langley)
- Biologist, Salt River Project, Phoenix, AZ (Attn: Lesly Swanson)
- SWCA Environmental Consultants, Tucson, AZ (Attn: C. Garrett, D. Morey, E. Gladding)
- Resolution Copper Mining, Superior, AZ (Attn: Vicky Peacey)

- Chairman, Hopi Tribe, Kykotsmovi, AZ
- Chairperson, Hualapai Tribe, Peach Springs, AZ
- Chairman, Mescalero Apache Tribe, Mescalero, NM
- Chairman, San Carlos Apache Tribe, San Carlos, AZ
- Chairperson, Tonto Apache Tribe, Payson, AZ
- Chairman, White Mountain Apache Tribe, Whiteriver, AZ
- Chairman, Yavapai Apache Nation, Camp Verde, AZ
- Director, Cultural Preservation Office, Hopi Tribe, Kykotsmovi, AZ
- Program Manager, Tribal Historic Preservation Office, Hualapai Tribe, Peach Springs, AZ
- Program Manager, Resource Management and Protection, Mescalero Apache Tribe, Mescalero, NM
- Director, Tribal Historic Preservation Office, San Carlos Apache Tribe, San Carlos, AZ
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- Director, Cultural Resources Department, Tonto Apache Tribe, Payson, AZ
- Director, Cultural Resources Department, White Mountain Apache Tribe, Whiteriver, AZ
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Appendix A: Concurrences

This appendix contains our concurrences with your "may affect, not likely to adversely affect" determinations for the endangered Gila chub (*Gila intermedia*) and southwestern willow flycatcher (*Empidonax traillii extimus*) and their designated critical habitat; the threatened northern Mexican gartersnake (*Thamnophis eques megalops*); and the threatened yellow-billed cuckoo (*Coccyzus americanus*) and its proposed critical habitat.

Gila Chub

We consider Mineral Creek occupied by a small, remnant population of Gila chub. Mill Creek at the confluence of upper Mineral Creek is intermittent/ephemeral and supports the Gila chub only during high flows. Both Mill Creek and upper Mineral Creek are designated critical habitat (Figure 12, Appendix C). The Arizona Game and Fish Department surveyed and found Gila chub in Mineral Creek in 2000; however, they found no Gila chub during surveys in 2002, 2006, 2007, 2008, 2009, and 2013 (Crowder et al. 2014). WestLand surveyed Mineral Creek in 2017, and Mineral and Mill Creek in 2020 and did not find any Gila chub (SWCA 2020). Although biologists did not detect Gila chub during these survey efforts, they would need to conduct additional thorough and expansive surveys with negative results within Mineral Creek to determine extirpation. If and when that is determined, we plan to repatriate Mineral Creek from another Gila chub population within the same recovery management unit (USFWS 2015). Gila chub, its habitat, and designated critical habitat do not occur in other streams within the proposed action area.

<u>Determination of Effects</u>

We concur with your determination that the proposed action may affect, but will not likely adversely affect the Gila chub and designated critical habitat. We based our concurrence on the following:

- Resolution Copper will install tailings pipelines (10-in. PAG, 22-in. PAG/NPAG, 34-in. NPAG, and 16-in. reclaimed water) underneath Mill Creek where the colocated corridor crosses the stream channel (also described as underground boring or trenchless crossing). Entry and exit points of the pipelines will occur outside of Mill Creek's ordinary high-water mark which is outside of stream channel and designated critical habitat. The tailings pipelines will be drilled at a minimum depth of 30-feet to avoid effects to the stream channel and riparian vegetation and occur where streamflow is ephemeral/intermittent (i.e., dry and lacks pool habitat). Therefore, construction of the tailings pipelines will have no effects to the Gila chub, its habitat or critical habitat primary constituent elements (PCEs), which are perennial pools, the necessary vegetation that provides cover, and adequate water quality. Because the pipeline's removal and reclamation will be similar to its installation by avoiding any riparian vegetation and also occurring outside the Mill Creek high water mark, stream channel, high water mark, and designated critical habitat boundary, we do not anticipate additional effects to Gila chub, its habitat or its critical habitat during the mine's closure activities.

- Construction and closure activities of the tailings pipelines will cause ground disturbance within the Mineral Creek watershed, and potentially result in sedimentation moving into Mineral and Mill Creeks during storm runoff events. Resolution Copper will minimize sedimentation and erosion by seeding disturbed areas with native vegetation, erosion control, other prevention measures, and implementing best management practices. Therefore, due to implementation of these conservation measures, we anticipate any effects to Gila chub critical habitat PCE 1 (stream habitat), 2 (temperature) and 3 (water quality) will be insignificant.

- The colocated 115-kV transmission line will pass overhead within upper Mineral Creek near its headwaters with Mill Creek. Construction and placement of the new power poles will be located outside of Mineral Creek's ordinary high-water mark which occurs outside of the stream channel and designated critical habitat boundary. Therefore, construction of the new transmission line will have no effect to the Gila chub or its critical habitat.

- Operators will use the existing Dripping Springs Road that crosses upper Mineral Creek during all phases of the proposed project. No road improvements or alterations to the road will occur. No new roads to access the power poles will be built (access would be by foot). Dripping Springs Road crosses Mineral Creek in a section that is primarily dry most of the year with only seasonal flows. During construction of the colocated 115-kV and tailings pipelines corridor, increased traffic crossing the creek is expected. When water is present, traffic may cause sedimentation to enter Mineral Creek. We anticipate the effect from sediment during seasonal flows will be local and short in duration, and as a result, likely result in an insignificant effect to Gila chub and its critical habitat downstream. We do not anticipate excess sedimentation to fill pools (PCE 1), increase turbidity that reduces water quality (PCEs 2 and 3), or effect primary productivity (PCE 4) because the streambed is dry surrounding the road crossing. Because Gila chub have not been found within Mineral Creek since 2000 and are considered nearly absent (see introduction summary above), and vehicles crossing the creek is anticipated to occur primarily during low flows in areas where fish are not likely to occur, and any sedimentation will be local, minimized, and of short duration, we anticipate any effects to the species and critical habitat by the use of Dripping Springs Road will be insignificant and discountable.

- We do not anticipate dewatering the deep groundwater system and partial dewatering of the Apache Leap Tuff aquifer due to block-caving will change Mineral Creek baseflow or adjacent spring or stream flow based upon surface water and spring monitoring and groundwater modeling studies and results (see *Environmental Baseline*). Resolution Copper will minimize any unanticipated effects to Mineral Creek through continued monitoring and conservation measures (see *Conservation Measures*). Therefore, based upon the studies and modeling results, continued monitoring, and conservation measure implementation (if necessary), we anticipate effects to Gila chub, its habitat, and its designated critical habitat PCEs (water quantity, stream pool habitat, stream flow, water temperature and quality, food, cover, water quality, or non-native fish abundance) will be insignificant.

Early in the NEPA process the Forest Service recognized the difficulties associated with modeling the complex hydrology and geology at the mine site, especially considering the extremely long time frames involved in the recovery of groundwater (hundreds or thousands of years), and the fact that the panel caving would fundamentally alter the hydrogeologic framework (USFS 2019, SWCA 2020). The TNF implemented five specific strategies to manage modeling uncertainties:

1. The Forest Service convened a Groundwater Modeling Workgroup, composed of experts from the Forest Service, the NEPA team, Resolution Copper and their subcontractors, and cooperating agencies and other stakeholders. The purpose of the workgroup was to review Resolution Copper's groundwater modeling, using a collaborative and iterative process. The workgroup met 11 times from September 2017 to September 2018; collaboration with the Geology and Subsidence workgroup also ensured that the geologic framework underlying the groundwater model was appropriate. The Draft EIS (USFS 2019) included a memorandum capturing the workgroup conclusions. Overall, the workgroup concluded: "...that the results of the predictive groundwater model appear reasonable and are based on best available science and understanding of the hydrogeology and project at the time the groundwater model was created."
2. As part of the analysis, the workgroup requested that Resolution Copper run a number of sensitivity analyses to evaluate how different assumptions for input parameters would change the modeling results. In total, Resolution Copper conducted 88 separate model runs. In order to deal with uncertainty, the Forest Service used all the sensitivity runs—not just the base case run—to assess impacts to GDEs.
3. The Forest Service recognized that the presentation of the modeling results would affect the public's perception of how certain they were. For instance, a result of "1.2 feet of drawdown" suggests that we can trust any model to accurately predict inches of change, which is not the case. Based on input from the modeling workgroup, the Forest Service decided to use 10 feet as a threshold for quantitatively using modeling results. The TNF did not consider results less than 10 feet reasonable to rely upon for quantitative impact analysis.
4. Similarly, the Forest Service recognized that presenting modeling predictions many hundreds of years in the future could lead the public to perceive that these were reliable results. Based on input from the modeling workgroup, the Forest Service decided to use 200 years as the limit of quantitative modeling results. However, the Forest Service still analyzed qualitative longer-term trends, as many of the peak impacts will not have occurred by 200 years.
5. Recognizing the inherent uncertainty in modeling, Resolution Copper proposed a monitoring plan to evaluate the real-world hydrologic changes, regardless of whether modeling predicted a GDE would be affected or not. Resolution Copper monitoring is tied to mitigation measures to replace lost water.

Resolution Copper, TNF, and SWCA conducted and analyzed studies evaluating Mineral Creek surface water and springs at six separate sampling points (USFS 2019, SWCA 2020). Because groundwater associated with the Apache Leap Tuff aquifer at least partially supports Mineral Creek, the TNF included it as part of the groundwater modeling process. SWCA and the TNF concluded there were, based upon the best-calibrated model run, as well as 87 sensitivity runs, no effects from mining to the Mineral Creek baseflow or to any of its discreet springs.

Regardless of anticipated effects, Resolution Copper intends to monitor the stream, and should any real-world loss begin to occur, replace any lost water. Resolution Copper has developed and submitted to the Forest Service a Monitoring and Mitigation Plan for Groundwater Dependent Ecosystems and Water Wells (Montgomery and Associates Inc. 2020). This document outlines a monitoring plan to assess potential effects on each GDE, identifies triggers and associated actions to be taken by Resolution Copper to ensure that

GDEs are preserved, and suggests mitigation measures for each GDE if it is shown to be affected by future mine dewatering. 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 does not contain a specified duration over which monitoring and mitigation will take place, however, the TNF intends to specify the timeline in the FEIS and Draft ROD to include all of the operations and closure phases, with GDEs then being dropped from monitoring only upon approval of TNF, based upon accumulated monitoring results (C. Garrett, SWCA, pers. comm. 2020).

The plan identifies 16 springs that would be monitored, as well as surface water flows in 10 locations, including Mineral Creek. A variety of potential actions are identified that could be used to replace water sources if monitoring reaches a specified trigger. These include drilling new wells to supply water, installing spring boxes, installing guzzlers, or installing surface water capture systems such as check dams, alluvial capture, recharge wells, or surface water diversions. Resolution Copper can use all of these to supplement diminished groundwater flow at GDEs by retaining precipitation in the form of runoff or snowmelt, making it available for ecosystem requirements. One further method for replacing flow would be to provide alternative water supplies from a nearby source (such as groundwater from the Desert Wellfield or Arizona Water Company that deliver water to the town of Superior, both located in the same Active Management Area, as regulated by Arizona Department of Water Resources).

The Draft EIS (USFS 2019) notes that for GDEs, the effectiveness of these mitigation measures would depend on the specific approach. Engineered replacements like pipelines, guzzlers, or spring boxes would be effective at maintaining a water source and maintaining a riparian ecosystem, but the exact type, location, and extent of riparian vegetation could change to adapt to the new discharge location and frequency of the new water source. Changes in water quality are unlikely to be an issue, since new water sources would likely derive from the same source as natural spring flow (i.e., the Apache Leap Tuff aquifer, or stored precipitation).

- We anticipate any precipitation that the subsidence area at Oak Flat captures will have no effect to Gila chub, its habitat, or its designated critical habitat on Mineral Creek (Garrett 2018). The subsidence area is not immediately connected through washes or drainages to Mineral Creek. Devil's Canyon, which is adjacent to the subsidence area (and will have a 5-10 percent reduction in precipitation runoff from subsidence), flows into Mineral Creek downstream of Gila chub designated critical habitat and where Gila chub would most likely occur (Figures 11&12, Appendix C). As a result, any precipitation captured by the subsidence area will not influence any Mineral Creek surface water where Gila chub, its habitat, or designated critical habitat occur. Therefore, we expect any stormwater precipitation captured by subsidence at the Oak Flat parcel due to mining will not affect Gila chub, its habitat, or designated critical habitat in Mineral Creek.

- Gila chub, its habitat or critical habitat do not occur and are not expected to occur in Devil's Canyon, Queen Creek, Arnett Creek or other springs that mining may affect from groundwater drawdowns. Therefore, we do not expect any groundwater effects that may occur in Devil's Canyon, Queen Creek, Arnett Creek or other springs will affect Gila chub, its habitat, or critical habitat.

- We do not anticipate effects to Gila chub as a result of construction at the following project components: Underground Mining and Subsidence, East Plant Site, Ore Conveyor/Infrastructure Corridor, West Plant Site, Skunk Camp Tailings Storage Facility, MARRCO Corridor, Filter Plant and Loadout Facility, and Electricity Supply and Transmission Lines (with the exception of the new 115-kV line colocated with the Tailings Pipeline Corridor, discussed above), because there is no Gila chub, Gila chub habitat, or designated critical habitat within these areas.

- Gila chub, its habitat or designated critical habitat do not occur within any of the Section 404, CWA compensatory mitigation parcels or recreation mitigation sites, and therefore, no effects to either will occur as a result of Resolution Copper's proposed mitigation activities for recreation and the CWA.

- We anticipate there will be no adverse effects to Gila chub or its designated critical habitat from affects to waters of the U.S. and USACE CWA 404 permitting at the Skunk Camp tailings facility. We have reached this conclusion because Gila chub, its habitat or designated critical habitat do not occur within the Skunk Camp tailings storage facility, or any of ephemeral drainages, including Dripping Spring Wash, Skunk Camp Wash, Stone Cabin Wash and a number of unnamed drainages that are located within the tailings storage facility footprint associated with potentially jurisdictional waters of the U.S. affected and permitted by the USACE.

- We anticipate any effects to Gila chub or its designated critical habitat from effects to ephemeral waters of the U.S., permitted by the USACE under section 404 of the CWA at the Skunk Camp tailings facility that may flow into Mineral Creek will be insignificant and discountable. We expect any sedimentation or change to stormwater flow to be temporary and minor due to the distance from Mineral Creek (approximately 5 miles), irregular flow, and implementation of a SWPPP. Therefore, we anticipate effects to Gila chub will be discountable due to unlikelihood of sedimentation effects reaching Mineral Creek and if it any increased sedimentation did occur, the insignificant effect it would have to any remnant small fish population or its habitat because it would be temporary, minor, a long distance to Gila chubs and its habitat, and minimized by implementing SWPP measures (SWCA 2020). We anticipate any effects to Gila chub critical habitat and its primary constituent elements associated with water quality, sedimentation, and quantity will be insignificant due to implementation of SWPPP and the small, temporary, and minor change to overall water flow that may reach Mineral Creek.

- We anticipate any effects to Gila chub or its designated critical habitat from effects to waters of the U.S. at Mineral Creek permitted by the USACE under section 404 of the CWA for the 115 kV colocated pipeline/power line construction, including use of the Mineral Creek crossing by vehicles during construction, will be insignificant and discountable. We reached this conclusion because we anticipate the implementation of BMPs and SWPPP will reduce, minimize, and possibly eliminate effects from sedimentation from construction within this localized portion of Mineral Creek. During construction of the colocated 115-kV and tailings pipelines corridor, increased traffic crossing the creek is expected. No road improvements or alterations to the road will occur. Dripping Springs Road crosses Mineral Creek in a section that is primarily dry most of year with only seasonal flows. When water is present, traffic may cause minor sedimentation to enter Mineral Creek. Increased sedimentation from vehicle crossing during construction will likely have a minor, localized, temporary, and insignificant impact on Gila chub critical habitat PCEs including water quality or availability of prey. Resolution Copper will use trenchless crossing (underground boring) to insert pipelines beneath Mineral Creek outside of the ordinary high-water mark and critical habitat and will not involve disturbance of the stream or nearby riparian vegetation. Power poles will be located outside of Mineral Creek and critical habitat, though the lines themselves will pass overhead. We do not anticipate construction of the colocated 115 kV line will fill pools (PCE 1), increase turbidity that reduces water quality (PCEs 2 and 3), or effect primary productivity (PCE 4) because the streambed is typically dry surrounding the road crossing. Because any vehicle caused sedimentation will be temporary, site-specific, and limited; trenchless crossing will avoid affecting stream habitat; power pole construction will occur outside of areas that may influence Mineral Creek stream habitat; and Gila chub have not been detected since 2000 in Mineral Creek; we anticipate any effects to Gila chub and critical habitat from USACE permitting for 115 kv colocated pipeline/power line construction will be insignificant and discountable.

Western Yellow-billed Cuckoo

As we described in the recent proposed critical habitat notice (USFWS 2020a), the western yellow-billed cuckoo (yellow-billed cuckoo or cuckoo) is a neotropical migratory species that travels between North, Central, and South America each spring and fall. As such, it needs movement corridors of linking habitats and stop-over sites along migration routes and between breeding areas. During movements between nesting attempts, biologists have found western yellow-billed cuckoos at riparian sites with small groves or strips of trees, sometimes less than 10 acres in extent. The habitat features at stop-over and foraging sites are typically similar to the features at breeding sites, but may be smaller in size, may be narrower in width, and may lack understory vegetation. We know much less about migration, stop-over, or dispersal habitat within the breeding range; however, western yellow-billed cuckoos do use a variety of habitats that may or may not be used for breeding. As a result, we do not think that migration, stop-over, or dispersal habitat is limiting.

Surveyors detected yellow-billed cuckoos in the project footprint and associated action area along Queen Creek upstream of the Whitlow Ranch Dam (Prager and Wise 2017), Arnett Creek (Prager and Wise 2017), Devil’s Canyon, and Mineral Creek (SWCA 2020). With the exception of Mineral Creek, multiple surveys of these areas did not include breeding pairs and resulted in detections presumed to be migrants or transient individuals (Halterman et al. 2016). Cuckoos detected infrequently upstream of Queen Creek near Whitlow Ranch Dam were likely migratory individuals (Prager and Wise 2017). Riparian habitat at Whitlow Ranch Dam is no longer considered suitable for the cuckoo because of an ongoing drought and a 2012 wildfire creating a mix of live and dead tree species (WestLand 2016). Surveyors did not detect yellow-billed cuckoos in Devil’s Canyon during five survey efforts between 2011 and 2019 (WestLand 2016, SWCA 2020). Surveyors detected a migratory cuckoo along Arnett Creek during two seasons of surveys (Prager and Wise 2015, 2017). Small patches of riparian habitat at Whitlow Ranch Dam, Rancho Rio Creek, and Devil’s Canyon may provide suitable stopover or foraging habitat for migratory yellow-billed cuckoos.

The cuckoo uses Mineral Creek during the breeding season (WestLand 2011, USFWS 2020a). Surveys in 2011 suggested that there were as many as six breeding pairs along the upper and middle portions of Mineral Creek (WestLand 2011). Mineral Creek also provides a movement corridor and migratory habitat for cuckoos. Proposed critical habitat occurs in Mineral Creek as

Unit AZ-28 and in the Lower San Pedro and Gila Rivers as Unit AZ-15 (USFWS 2020a) (Figure 12, Appendix C).

Determination of Effects

We concur with your determination that the proposed action may affect, but will not likely adversely affect, the yellow-billed cuckoo and proposed critical habitat. We based our concurrence on the following:

Early in the NEPA process the Forest Service recognized the difficulties associated with modeling the complex hydrology and geology at the mine site, especially considering the extremely long time frames involved in the recovery of groundwater (hundreds or thousands of years), and the fact that the panel caving would fundamentally alter the hydrogeologic framework (USFS 2019, SWCA 2020). The TNF implemented five specific strategies to manage modeling uncertainties:

1. The Forest Service convened a Groundwater Modeling Workgroup, composed of experts from the Forest Service, the NEPA team, Resolution Copper and their subcontractors, and cooperating agencies and other stakeholders. The purpose of the workgroup was to review Resolution Copper's groundwater modeling, using a collaborative and iterative process. The workgroup met 11 times from September 2017 to September 2018; collaboration with the Geology and Subsidence workgroup also ensured that the geologic framework underlying the groundwater model was appropriate. The Draft EIS (USFS 2019) included a memorandum capturing the workgroup conclusions. Overall the workgroup concluded: "...that the results of the predictive groundwater model appear reasonable and are based on best available science and understanding of the hydrogeology and project at the time the groundwater model was created.
2. As part of the analysis, the workgroup requested that Resolution Copper run a number of sensitivity analyses to evaluate how different assumptions for input parameters would change the modeling results. In total, Resolution Copper conducted 88 separate model runs. In order to deal with uncertainty, the Forest Service used all the sensitivity runs—not just the base case run—to assess impacts to GDEs.
3. The Forest Service recognized that the presentation of the modeling results would affect the public's perception of how certain they were. For instance, a result of "1.2 feet of drawdown" suggests that we can trust any model to accurately predict inches of change, which is not the case. Based on input from the modeling workgroup, the Forest Service decided to use 10 feet as a threshold for quantitatively using modeling results. The TNF did not consider results less than 10 feet reasonable to rely upon for quantitative impact analysis.
4. Similarly, the Forest Service recognized that presenting modeling predictions many hundreds of years in the future could lead the public to perceive that these were reliable results. Based on input from the modeling workgroup, the Forest Service decided to use 200 years as the limit of quantitative modeling results. However, the Forest Service still analyzed longer-term trends, as many of the peak impacts have not occurred by that time.
5. Recognizing the inherent uncertainty in modeling, Resolution Copper has proposed a monitoring plan to evaluate the real-world hydrologic changes, regardless of whether modeling predicted a GDE would be impacted or not. Resolution Copper monitoring is tied to mitigation measures to replace lost water.

Regardless of the anticipated effects, Resolution Copper intends to monitor streams, and should any real-world loss begin to occur, replace any lost water. Resolution Copper has developed and submitted to the Forest Service a Monitoring and Mitigation Plan for Groundwater Dependent Ecosystems and Water Wells (Montgomery and Associates Inc. 2020). This document outlines a monitoring plan to assess potential effects on each GDE, identifies triggers and associated actions to be taken by Resolution Copper to ensure that GDEs are preserved, and suggests mitigation measures for each GDE if it is shown to be affected by future mine dewatering. 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 does not contain a specified duration over which monitoring and mitigation will take place, however, the TNF intends to specify the timeline in the FEIS and Draft ROD to include all of the operations and closure phases, with GDEs then being dropped from monitoring only upon approval of TNF, based upon accumulated monitoring results (C. Garrett, SWCA, pers. comm. 2020).

The plan identifies 16 springs that would be monitored, as well as surface water flows in 10 locations along Queen Creek, Arnett Creek, Telegraph Canyon, Devil's Canyon, and Mineral Creek. A variety of potential actions are identified that could be used to replace water sources if monitoring reaches a specified trigger. These include drilling new wells to supply water, installing spring boxes, installing guzzlers, or installing surface water capture systems such as check dams, alluvial capture, recharge wells, or surface water diversions. Resolution Copper can use all of these to supplement diminished groundwater flow at GDEs by retaining precipitation in the form of runoff or snowmelt, making it available for ecosystem requirements. One further method for replacing flow would be to provide alternative water supplies from a nearby source (such as groundwater from the Desert Wellfield or Arizona Water Company that deliver water to the town of Superior, both located in the same Active Management Area, as regulated by Arizona Department of Water Resources).

The Draft EIS (USFS 2019) notes that for GDEs, the effectiveness of these mitigation measures would depend on the specific approach. Engineered replacements like pipelines, guzzlers, or spring boxes would be effective at maintaining a water source and maintaining a riparian ecosystem, but the exact type, location, and extent of riparian vegetation could change to adapt to the new discharge location and frequency of the new water source. Changes in water quality are unlikely to be an issue, since new water sources would likely derive from the same source as natural spring flow (i.e., the Apache Leap Tuff aquifer, or stored precipitation).

- We anticipate there will be insignificant effects to yellow-billed cuckoos from changes to water and vegetation quality within Devil's Canyon from the Resolution Copper Mine. Groundwater studies and modeling (USFS 2019, SWCA 2020) indicated that block-caving from underground mining was unlikely to lead to reductions in the main channel groundwater inflow in Middle Devil's Canyon and no changes to Lower Devil's Canyon. However, subsidence will result in reducing stormwater runoff, causing a reduction in the total volume of storm flows in the Devil's Canyon drainage (5.6 percent in middle Devil's Canyon to 3.5 percent at the mouth of Devil's Canyon) and dewatering will cause the permanent loss of a spring (DC6.6W). The Forest Service (2019) estimates a reduction in the lower Devil's Canyon mainstem flow by 5 to 10 percent, assuming no replacement of water occurs for spring DC6.6W. No yellow-billed cuckoo nesting habitat or proposed critical habitat occurs in Devil's Canyon, but the riparian habitat may provide migratory/stopover or foraging habitat. Up to 90 acres of dense riparian habitat within middle and lower Devil's Canyon will likely decline in quality from reduced surface flows and groundwater, but the Forest Service does not anticipate widespread vegetation loss as explained in the BA (SWCA 2020) and DEIS (USFS 2019). Because surveyors have not recorded breeding cuckoos in this area of Devil's Canyon and we expect migrant cuckoos (which can use a broader quality of habitat and for a temporary period of time) can still take advantage of the habitat's shelter and cover (USFWS 2020a), the effects to migrant cuckoos at Devil's Canyon from underground mining and subsidence to water within Devil's Canyon will be insignificant.

- We anticipate there will be insignificant effects to yellow-billed cuckoos from changes to water and vegetation quality within Queen Creek caused by mining. The TNF (USFS 2019) and SWCA (2020) anticipates, based upon studies and modeling, that Queen Creek groundwater drawdowns were possible but unlikely. More likely however, was that the subsidence area at Oak Flat would decrease the annual Queen Creek surface watershed volume, ranging from 19 percent (in Superior) to 3.5 percent (at Whitlow Ranch Dam). The Forest Service expects reduced groundwater and surface flows at Whitlow Dam and habitat disturbance from subsidence in Rancho Rio Creek to cause declines or modify the riparian vegetation at both areas. Biologists have not recorded breeding cuckoos along Queen Creek or near Whitlow Dam. Potential habitat changes include a reduction in the quality and extent of riparian habitat or conversion to a drier, xeroriparian habitat, altering cuckoo migratory/stopover or foraging habitat. We anticipate these potential effects will be insignificant because migrant cuckoo detections along Queen Creek near Whitlow Dam are infrequent or uncommon, and because migrant cuckoos can use wider varieties of habitat and locations temporarily (USFWS 2020a). Additionally, past fires at Whitlow Dam have burned riparian vegetation and it is unknown if the current baseline condition will allow previous habitat quality to recover.

  Similarly, there are no anticipated groundwater effects from drawdown to occur along Queen Creek at Boyce Thompson Arboretum based upon studies and modeling results (USFS 2019, SWCA 2020). We anticipate any reduction in flow due to the loss of watershed area from the subsidence crater to be minor, insignificantly affecting the current ephemeral stream supporting xeroriparian vegetation along Queen Creek at Boyce Thompson Arboretum. Similar to near Whitlow Dam, no breeding cuckoos or breeding cuckoo habitat (or proposed critical habitat) occurs along Queen Creek near Boyce Thompson Arboretum. We expect any migrant cuckoos that may occur along Queen Creek near Boyce Thompson Arboretum to be uncommon and can use wider varieties of habitat and locations temporarily (USFWS 2020a). Therefore, because we expect any minor loss of watershed area will not alter the existing ephemeral stream/xeroriparian habitat environmental baseline at Queen Creek near Boyce Thompson Arboretum and due to the migratory cuckoo's ability to still use the area, wider varieties of habitat, or move to other nearby locations, we anticipate the effect will be insignificant.

- We anticipate there will be no effects to yellow-billed cuckoos along Arnett Creek from groundwater effects because no breeding cuckoos are known to occur along Arnett Creek, no proposed cuckoo critical habitat occurs along the creek, and the TNF's groundwater studies and modeling (USFS 2019, SWCA 2020) indicate that no groundwater drawdowns will occur along Arnett Creek as a result of mine construction and operation activities.

- We anticipate there will be insignificant effects to yellow-billed cuckoos from mine caused groundwater drawdowns to springs within the action area. Bored Spring is the lone spring that supports any substantial riparian vegetation. Bored Spring has infrastructure improvements and consists of an approximately 65 × 25–foot depression with a cattle trough downstream (SWCA 2020). A cottonwood occurs at the site, and a string on scattered riparian vegetation occurs downstream for approximately 500 feet in the vicinity of Bored Spring, including Goodding's willow, velvet mesquite, tamarisk, and African sumac (SWCA 2020). TNF biologist Mark Taylor noted from past site visits that water is not always present at the site and the riparian vegetation in the spring vicinity is sparse and does not contain riparian vegetation density, or a multi-canopy structure that would indicate suitable breeding cuckoo habitat (SWCA 2020). In addition, Bored Spring is located directly adjacent to, and part of, a minerals material ADOT storage facility that is currently in use (SWCA 2020). Groundwater drawdown could lead to the death of a large Fremont cottonwood tree at the spring and other trees scattered over a 500-foot reach downstream of the spring. Because riparian habitat supported by the spring is small in extent and contains scattered, sparse riparian trees uncharacteristic of breeding cuckoo habitat, with existing human activity and infrastructure, we do not expect spring supported habitat this small in size to support breeding cuckoo habitat (USFWS 2020a). Therefore, we anticipate any effects to cuckoos associated with springs will be insignificant, because only one spring possesses substantial riparian vegetation, is a relatively small area, existing habitat quality is reduced, ongoing infrastructure/human activity occurs, and the ability for migrant cuckoos to use wide varieties of habitat and locations during migration (USFWS 2020a).

- We do not anticipate dewatering the deep groundwater system and partial dewatering of the Apache Leap Tuff aquifer due to block caving will change Mineral Creek baseflow or adjacent springs or stream flow, based upon surface water and spring monitoring and groundwater modeling results (see *Environmental Baseline*). Resolution Copper will minimize any unanticipated effects to Mineral Creek through continued monitoring and conservation measures (see *Conservation Measures*). Resolution Copper, TNF, and SWCA conducted and analyzed studies evaluating Mineral Creek surface water and springs at six separate sampling points (USFS 2019, SWCA 2020). Because Mineral Creek is at least partially supported by groundwater associated with the Apache Leap Tuff aquifer, it was included as part of the groundwater modeling process. SWCA and the TNF concluded, based upon the best-calibrated model run, as well as 87 sensitivity runs, that no effects from mining will occur to the Mineral Creek baseflow or to any of its discreet springs. Therefore, based upon the studies and modeling results, continued monitoring, and conservation measures, effects to yellow-billed cuckoo, its habitat, and its proposed critical habitat Physical or Biological Features (woodland floodplain habitat or immediate upland vegetation, prey base, and hydrologic processes) along Mineral Creek are expected to be insignificant.

- We anticipate any precipitation that the subsidence area at Oak Flat captures will have an insignificant effect to the yellow-billed cuckoo, its habitat, or proposed critical habitat at Mineral Creek, near the Mineral Creek/Devils Canyon confluence, and Big Box Dam reservoir. The Oak Flat subsidence area is not immediately connected through washes or drainages to Mineral Creek. Devil's Canyon, which is adjacent to the subsidence area (and will have minor 5-10 percent reduction in precipitation runoff from subsidence), flows downstream into Mineral Creek where Big Box Dam reservoir captures flow from both Mineral Creek and Devil's Canyon. Mineral Creek and yellow-billed cuckoo proposed critical habitat ends at Big Box Dam and reservoir immediately below the Devil's Canyon/Mineral Creek confluence (Figures 11&12, Appendix C) (USFWS 2020a). Any reduction in Devil's Canyon precipitation runoff will affect any Mineral Creek flow, because they are different drainages. We expect Big Box Dam water storage on Mineral

Creek will nearly eliminate any reduction in Devil's Canyon precipitation runoff below the Devils' Canyon/Mineral Creek confluence. A small reduction in precipitation stormwater flow will not affect any existing individual cuckoos, because cuckoos perch, forage, and seek cover in trees. We expect any existing cuckoo habitat will not be affected, because a small reduction in Devil's Canyon stormwater flow will not noticeably alter water storage and any existing vegetation at or surrounding the reservoir due to the amount of stormwater flow entering Big Box Dam reservoir from both the Devil's Canyon and Mineral Creek watersheds. SWCA determined that of the presence and extent of water behind Big Box Dam has remained consistent since the mid-1990s (C. Garrett, SWCA, pers. comm., 2020). We anticipate that existing water storage at Big Box Dam will prevent any reduction in stormwater flow from affecting proposed critical habitat physical and biological features such as riparian woodlands, insect prey, and hydrologic processes. Big Box Dam water storage will dominate stream function at the confluence and likely maintain and not noticeably alter existing baseline conditions for yellow-billed cuckoo proposed critical habitat physical and biological features (vegetation persistence, insect availability, and hydrologic processes). Therefore, because of the existing Big Box Dam and water storage, inflow from both Devil's Canyon and Mineral Creek watersheds, and its location at the Devil's Canyon/Mineral Creek confluence, we anticipate any effects to cuckoos, cuckoo habitat, or the physical or biological features of proposed cuckoo critical habitat (riparian woodlands, prey resources, or hydrologic processes) from a reduction in Devil's Canyon precipitation stormwater runoff at the Mineral Creek/Devil's Canyon confluence will be insignificant.

- We anticipate the construction of tailings pipelines will not affect yellow-billed cuckoos, its habitat, or its proposed critical habitat along Mineral Creek. Resolution Copper will install the tailings pipelines (10-inch PAG, 22-inch PAG/NPAG, 34-inch NPAG, and 16-inch reclaimed water) underneath Mill Creek where the colocated corridor crosses the stream channel. Entry and exit points of the pipelines will occur outside of proposed critical habitat and will be drilled at a minimum depth of 30-feet to avoid effects to the stream and riparian vegetation (trenchless crossing or underground boring). In order to prevent effects to cuckoos (injuries or fatalities to adults, eggs, or young) in areas where biologists may detect yellow-billed cuckoos during pre-project surveys, vegetation clearing and ground disturbing activities associated with pipeline construction within 500 feet of the ordinary high water mark of Mineral Creek will not be completed from May 15 through September 30 to remain outside the breeding season. Therefore, construction of the tailings pipelines will have no effects to the yellow-billed cuckoo or its proposed critical habitat.

- In order to reduce any likelihood for bird collisions with transmission lines, the lines and structures will be designed in accordance with "Reducing Avian Collision with Power Lines" (APLIC 2012), and line marking devices, (i.e., flight diverters) will be placed at the crossings of Devil's Canyon and Mineral Creek. The 115-kV transmission line will cross Devil's Canyon and upper Mineral Creek near its confluence with Mill Creek then parallel Mineral Creek for 0.5 mile. New power poles will be located outside of the ordinary high-water mark of upper Mineral Creek and proposed critical habitat. Construction crews will deliver materials by helicopter, crane, or by hand and use the existing Dripping Springs Road and access power poles by foot for any required maintenance. No new roads will occur. We described records of cuckoo collisions with towers, solar facilities, and wind turbines as a threat our listing rule (USFWS 2014c), but not collisions with power lines.

The transmission line locations occur in areas not known to be cuckoo migratory corridors. Therefore, we anticipate that effects from the construction and persistence of the transmission lines in upper Mineral Creek and Devil's Canyon will be insignificant and discountable to the yellow-billed cuckoo and proposed critical habitat.

- In areas where pre-project surveys show presence of possible, probable, or confirmed breeding yellow-billed cuckoos, large-scale, major noise-producing activities within 500 feet of the ordinary high water mark of Mineral Creek will be avoided to the extent possible (e.g., maintenance activities associated with pipeline replacement and cleaning) during the cuckoo breeding season (May 15 to September 30 annually). We therefore, do not anticipate effects to breeding cuckoos during maintenance activities.

- No ground disturbance within yellow-billed cuckoo habitat or proposed critical habitat along Mill and Mineral Creeks will occur during the removal of the colocated 115-kV transmission and tailings pipelines corridor. In areas where surveys have detected the presence of the yellow-billed cuckoo, closure and reclamation activities within 500 feet of the ordinary high-water mark of Mill and Mineral Creeks will occur from October 1 to May 14, which is outside of the cuckoo breeding season to avoid disturbance to nesting yellow-billed cuckoos.

- We anticipate there will be insignificant effects to yellow billed cuckoos from the specific construction, daily operational activity, and closure activities of mine facilities at the underground Oak Flat mining parcel, East and West Plant sites, Skunk Camp tailings facility, MAARCO corridor, and Filter Plant and Loadout facility (consequences associated with water drawdowns and transmission/pipeline line corridors are described separately within this concurrence). None of these locations contain yellow-billed cuckoo habitat or proposed critical habitat. However, because cuckoos are a migratory bird covering large areas, and some of these areas occur near locations where migratory cuckoos might visit, there is the possibility a cuckoo will occur at these facilities while in development, operation, or during closure. Because these facilities do not contain the riparian habitat cuckoos rely upon for cover, food, and shelter, we expect they will only occur briefly and continue to move to other areas. Should any cuckoo behavior alteration occur from mine-related activities (noise, human activity, vehicles, etc.), we anticipate these will be rare and short in duration, having an insignificant effect.

- We anticipate any effects to yellow-billed cuckoo from developing, maintaining, managing, and closing PAG tailings, non-contact and contact stormwater catchment basins, and process water ponds will be insignificant and discountable due to their location, lack of vegetated habitat, and management techniques. Resolution Copper will not place these ponds in locations (e.g., streams or proposed critical habitat) where we expect cuckoos will nest or rely upon. Resolution Copper will remove vegetation at these ponds to prevent these locations from attracting cuckoos and providing areas for perching, foraging, cover, and nesting. We expect additional hazing devices will deter and disperse any migrating cuckoos that might occur in these areas, but due to the ponds location and lack of habitat should be rare. We expect any effects to cuckoos or its habitat (or proposed critical habitat) will be insignificant and discountable because these ponds are located away from cuckoo habitat (and proposed critical habitat), will be managed to prevent vegetated habitat from developing, and any behavior alteration will be rare and temporary.

- The H&E Farm, included as part of Section 404, CWA compensatory mitigation parcels, encompasses 265 acres of yellow-billed cuckoo proposed critical habitat along the San Pedro River. Proposed mitigation efforts include drainage reconstruction to reconnect abandoned agricultural land on floodplain terraces to the active river channel. These abandoned agricultural lands are outside the proposed cuckoo critical habitat boundary. Mitigation efforts within proposed critical habitat includes planting and seeding of native species for habitat improvement along the eastern boundary of the property (Area B), and preservation efforts along the San Pedro River (Area C). No ground disturbing activities will occur within proposed critical habitat and therefore no effects to the physical or biological features are expected. The establishment of a conservation easement on the entire H&E Farm may benefit the species by protecting habitat in perpetuity.

- The Queen Creek and Mar5/Olberg Road Restoration CWA mitigation sites along the Gila River may currently provide migratory or stopover habitat for the yellow-billed cuckoos. Surveyors have not detected breeding or migratory cuckoos at these parcels. The proposed mitigation for both these sites is to remove tamarisk and plant native trees and shrubs. We anticipate that tamarisk removal will be insignificant to cuckoos and their habitat because of the small size of the sites, the lack of breeding cuckoos at these locations, and the ability for migrating cuckoos to take advantage of nearby habitat upstream and downstream of these mitigation sites. No proposed critical habitat occurs at either site and therefore, none is affected. There may be long term benefits to cuckoos from improved habitat quality at this site.

- We anticipate there will not be any adverse effects to yellow-billed cuckoo or its proposed critical habitat from USACE CWA 404 permitting at the Skunk Camp tailings facility. Yellow-billed cuckoo, its habitat or proposed critical habitat do not occur within the Skunk Camp tailings storage facility, or any of the ephemeral drainages, including Dripping Spring Wash, Skunk Camp Wash, Stone Cabin Wash and a number of unnamed drainages that are located within the tailings storage facility footprint and are associated with potentially jurisdictional waters of the U.S. affected and permitted by the USACE.

- We anticipate there will be no effects to yellow-billed cuckoos or its proposed critical habitat by USACE permitting effects to waters of the U.S. from construction of the 115 kV transmission line or installation of the tailings pipeline at Mineral and Mill Creek. The tailings pipeline will be bored 30 feet beneath the creek, and construction activity and pipeline entrance and exit points will occur outside of proposed critical habitat boundaries. Crews will place all power poles outside proposed critical habitat, and not create new access roads within proposed critical habitat. Implementation of BMP and SWPPP will minimize, reduce, or eliminate any potential sedimentation. Construction activities will avoid any breeding yellow-billed cuckoos, by conducting work outside of the May 15 to September 30 breeding season.
- The recreation mitigation sites at Queen Creek, Arnett Creek trailhead, Inconceivables Climbing area, and roads/trails do not contain or expect to have breeding yellow-billed cuckoo habitat because they are outside of suitable riparian woodlands. Migrant cuckoos can occur in a variety of habitats. Because these recreation sites are small and cuckoos can take advantage of nearby habitats, we expect any alteration to migrant cuckoo habitat is insignificant. Also, should migrant cuckoos occur at any of these recreation mitigation work sites, we expect birds will be able to move to nearby undisturbed habitat and any behavior alteration will be of short duration, temporary, and be an insignificant effect.

Northern Mexican Gartersnake

We listed the northern Mexican gartersnake as threatened under the Act on July 8, 2014 (USFWS 2014a) and revised proposed critical habitat on April 28, 2020 (USFWS 2020b). No detections of northern Mexican gartersnakes occur in the footprint of the project components and/or the associated action area. The only portion of the proposed action area where northern Mexican gartersnake has potential to occur is Area A at the H&E Farm, along the San Pedro River where CWA 404 mitigation activities are proposed. We believe the northern Mexican gartersnake could occur in low-density populations along the San Pedro River where populations of gartersnake prey, such as lowland leopard frogs (*Lithobates yavapaiensis*) and longfin dace (*Agosia chrysogaster*), exist (USFWS 2014b, 2020c). Although no recent occurrences have been detected along the lower San Pedro River (north of Interstate 10), this stretch of the San Pedro River has had limited search effort in extent since 1996. There is no proposed critical habitat within the action area.

Determination of Effects

We concur with your determination that the proposed action may affect, but will not likely adversely affect, northern Mexican gartersnake. We based our concurrence on the following:

- The northern Mexican gartersnake could occur on the San Pedro River, but in substantially low densities because many river sections have intermittent stream flow, reduced prey availability, and locally abundant occurrence of exotic aquatic predators. Gartersnakes and its habitat at H&E Farm likely do not occur due to the lack of a perennial stream and stable aquatic prey resources. As a result of the lack of suitable gartersnake foraging habitat and stable prey resources at H&E Farm, and therefore, the gartersnake's unlikely occurrence, we anticipate effects to gartersnakes at the H&E Farm are discountable.

- Areas proposed for active habitat improvement at the H&E Farm (Area A) do not contain suitable gartersnake habitat and will occur outside of the active San Pedro River channel (SWCA 2020). Area A is highly disturbed (e.g., soil compaction, fissures, and sink holes) and does not contain a perennial water source or stable food supply. Therefore, it is unlikely that a northern Mexican garternsnakes will be present and any effects to the gartersnake or its habitat from the proposed earthwork are insignificant and discountable.

- H&E Farm areas B and C will not have any substantial ground disturbing activities. Planting and seeding to improve native vegetation along the San Pedro River may benefit the northern Mexican gartersnake in the future. The establishment of a conservation easement on the entire H&E Farm may benefit the species by protecting habitat in perpetuity. Therefore, any effects to the northern Mexican gartersnake or its habitat will be insignificant and discountable from the proposed mitigation efforts.

- No proposed gartersnake critical habitat occurs on H&E Farm, and therefore, none is affected.

- Northern Mexican gartersnakes, its habitat, or proposed critical habitat do not occur within the mining or transmission/pipeline corridor project footprint, any of remaining Section 404, CWA compensatory mitigation parcels (Gila River or Queen Creek), USACE CWA permitted activities at Skunk Camp or 115 kV colocated pipeline corridor, or recreation mitigation sites. Therefore, we anticipate no effects to northern Mexican gartersnake, its habitat, or proposed critical habitat will occur from the remaining Resolution Copper mine activities and USACE CWA 404 permitted actions and compensatory mitigation actions.

Southwestern Willow Flycatcher

Southwestern willow flycatchers and the other willow flycatcher subspecies are neotropical migrants breeding in North America and wintering in Central and northern South America (Finch et al. 2000, USFWS 2002). Willow flycatchers use a greater variety and distribution of habitats, including non-riparian vegetation during migration, such as agricultural fields and desert grasslands (Finch et al. 2000, USFWS 2013). Flycatcher migration habitat can lack the key components necessary for breeding flycatchers, such as the presence of standing water or moist soils and suitable vegetation size and structure (Finch et al. 2000).

The collection of streams and habitat surrounding the Resolution Copper Mine Project primarily provide short-term opportunities for migratory southwestern willow flycatchers for cover, shelter, and food. The intermittent and ephemeral creeks, canyons, and springs surrounding Resolution Copper Mine (Arnett, Queen, and Mineral Creeks and Devil's Canyon) have riparian vegetation or drier xeroriparian vegetation, but do not have the broad, wide floodplains similar to the lower Colorado River, Verde River, Salt River/Tonto Creek confluence at Roosevelt Lake, or Rio Grande that contain the water and elevated groundwater to establish the abundant vegetation and conditions flycatchers typically rely on for successful nesting (USFWS 2002, 2013).

WestLand surveyors in 2017 and 2018 recorded a total of three migrant willow flycatchers of undetermined subspecies in the proposed project footprint (WestLand 2017, 2018). WestLand searched the Whitlow Ranch Dam area, Boyce Thompson Arboretum along Arnett Creek, Queen Creek upstream of Superior, and Mineral Creek on State Trust Lands. Two willow flycatchers occurred along Queen Creek near Boyce Thompson Arboretum, one in 2017 and one in 2018. Another willow flycatcher occurred near Whitlow Ranch Dam in 2018. WestLand concluded that these three flycatchers, detected early in the survey season, were migrant birds and did not persist into the breeding season (WestLand 2017, 2018). Based on the available survey data, the southwestern willow flycatcher is currently an occasional migrant in the action area (SWCA 2020). Flycatcher designated critical habitat only occurs in the action area along the San Pedro River where USACE CWA mitigation activities will occur (Figure 12, Appendix C) (USFWS 2013).

In 2005, a southwestern willow flycatcher territory occurred near Whitlow Ranch Dam, but no evidence of breeding was detected (English et al. 2006). Surveyors searched the Whitlow Dam site in 1994, 1996, 1998, and 2006, and did not detect flycatchers (Ellis et al. 2008). Subsequent fires at Whitlow Dam have affected habitat and there is uncertainty whether habitat quality can recover.

WestLand also conducted raptor and general avian surveys within the action area in 2008, 2009, 2012, and 2013 and did not detect any southwestern willow flycatchers (SWCA 2020).

Determination of Effects

We concur with your determination that the proposed action may affect, but will not likely adversely affect, the southwestern willow flycatcher and designated critical habitat. We based our concurrence on the following:

- No dense cottonwood-willow or tamarisk vegetation that is southwestern willow flycatcher nesting habitat occurs in the project footprint and CWA mitigation sites (Devil's Canyon, Queen Creek, Arnett Creek, Mineral Creek, Gila River, San Pedro River, or springs) and no breeding territories occur. Therefore, the proposed project will have no effect on breeding southwestern willow flycatchers.

- During mine operations, the estimated loss of annual volume of surface water in upper Queen Creek (Whitlow Ranch Dam) and Bored Spring will likely cause minor reductions in the quality and quantity of small patches or stringers of riparian vegetation that may provide migratory or stopover habitat for willow flycatchers. We anticipate the effect to migrant flycatchers from any reductions in riparian habitat along Queen Creek and Bored Spring will be insignificant because of the few migratory flycatchers found using these habitats, and the flycatcher's ability to move freely and take advantage of a wide diversity and quality of habitat (USFWS 2013).

  Similarly, there are no anticipated groundwater effects from drawdown to occur along Queen Creek at Boyce Thompson Arboretum based upon studies and modeling results (USFS 2019, SWCA 2020). We anticipate any reduction in flow due to the loss of watershed area from the subsidence crater will be minor, insignificantly affecting the current ephemeral stream supporting xeroriparian vegetation along Queen Creek at Boyce Thompson Arboretum. No breeding flycatchers or breeding flycatcher habitat (or critical habitat) occurs along Queen Creek near Boyce Thompson Arboretum because this stream does not have the water and wide, broad, and flat floodplains that are likely to develop habitat for breeding flycatchers (USFWS 2002) or essential for its conservation and recovery (USFWS 2002, 2013). Migrant flycatchers can move freely, taking advantage of wide varieties of habitat and locations for short periods (USFWS 2013). Therefore, because any minor loss of watershed area is not expected to alter the existing ephemeral stream/xeroriparian habitat environmental baseline at Queen Creek near Boyce Thompson Arboretum, and due to the few migratory flycatchers found using these habitats and their ability to still use the area, wide varieties of habitat, and move to other nearby locations, we anticipate the effect will be insignificant.

- We anticipate any groundwater drawdown related mine effects along Devil's Canyon, Mineral Creek, Arnett Creek, Queen Creek, and ephemeral drainages or springs or effects from reductions in precipitation runoff associated with subsidence will have an insignificant effect to migratory southwestern willow flycatchers and its habitat, and no effect to designated critical habitat. None of these streams possess the broad, flat, densely vegetated riparian areas we expect breeding flycatchers to rely upon for nesting. We did not designate these areas as flycatcher critical habitat (USFWS 2013), because these areas are not locations where the stream has the water and wide, broad, and flat floodplains that are likely to develop habitat for breeding flycatchers (USFWS 2002) or essential for its conservation and recovery (USFWS 2002, 2013). Additionally, the TNF does not expect mining to affect the groundwater at some of these streams, such as Mineral Creek and Arnett Creek, will occur based upon groundwater studies and modeling results (USFS 2019, SWCA 2020). We expect any anticipated reductions in precipitation runoff will result in minor changes to riparian habitat quality along Devil's Canyon and Queen Creek. We anticipate the effect to migrant flycatchers from any reductions in riparian habitat due to alteration of groundwater or surface water will be insignificant because of the few migratory flycatchers found using these habitats and the migratory flycatcher's ability to move freely and take advantage of a wider diversity and quality of habitat (USFWS 2013).

- In order to reduce any likelihood for flycatcher collisions with transmission lines, the lines and structures will be designed in accordance with "Reducing Avian Collision with Power Lines" (APLIC 2012), and line marking devices, (i.e., flight diverters) will be placed at the crossings of Devil's Canyon and Mineral Creek. The 115-kV transmission line will cross Devil's Canyon and upper Mineral Creek near its confluence with Mill Creek then parallel Mineral Creek for 0.5 mile. The areas surrounding these streams and transmission lines, unlike locations along the lower Colorado River or Rio Grande (Finch et al. 2000), are not known to be concentrated flycatcher migration corridors. Flycatcher collision with transmission lines was not identified as a threat in either the flycatcher listing rule (USFWS 1993) Recovery Plan (USFWS 2002), or most recent five-year review (USFWS 2017). Therefore, we anticipate that effects from the construction and persistence of the transmission line in upper Mineral Creek and Devil's Canyon will be insignificant and discountable to the flycatcher.

- We anticipate any effects to southwestern willow flycatchers from developing, maintaining, managing, and closing PAG tailings, non-contact and contact stormwater catchment basins, and process water ponds will be insignificant and discountable due to their location, lack of vegetated habitat, and management techniques. Resolution Copper will not place these ponds in locations (e.g., streams or designated critical habitat) where we expect flycatchers will nest or rely upon. Resolution Copper will remove vegetation at these ponds to prevent these locations from attracting flycatchers and providing areas for perching, foraging, cover, and nesting. We expect additional hazing devices will deter and disperse any migrating flycatchers that might occur in these areas, but due to the ponds location and lack of habitat should be rare. We expect any effects to flycatchers or its habitat (or designated critical habitat) will be insignificant and discountable because Resolution Copper will locate these ponds away from flycatcher habitat and designated critical habitat, and will manage them to prevent vegetated habitat from developing, and any bird behavior alteration will be rare and temporary.

- We anticipate there will be insignificant effects to southwestern willow flycatcher from the specific construction, daily operational activity, and closure activities of mine facilities at the underground Oak Flat mining parcel, East and West Plant sites, Skunk Camp tailings facility, MAARCO corridor, Filter Plant and Loadout facility, and transmission/pipeline line corridors (consequences associated with water drawdowns are described separately within this concurrence). None of these locations contain flycatcher breeding habitat or designated critical habitat. However, because flycatchers are a migratory bird covering large areas, and some of these areas occur near locations that migratory flycatchers might visit, there is the possibility a flycatcher will occur at these facilities while in development, operation, or during closure. Because these facilities do not contain the riparian habitat flycatchers rely upon for cover, food, and shelter, we expect they will only occur briefly and continue to move to other areas. Should any migratory flycatcher behavior alteration occur from mine-related activities (noise, human activity, vehicles, etc.), we anticipate these instances will be rare and short in duration, having an insignificant effect.

- We anticipate any USACE CWA 404 permitted activity for waters of the U.S. at the Skunk Camp tailings facility or from pipeline/power line corridors will have an insignificant effect to the southwestern willow flycatcher. The Skunk Camp tailings facility and associated ephemeral washes, and Queen and Mineral Creek corridors are not breeding flycatcher habitat or designated flycatcher critical habitat. However, because flycatchers are a migratory bird covering large areas, and some of these areas occur near locations where migratory flycatchers might visit, there is the possibility that migratory flycatchers have visited these areas or may visit them in the future. We anticipate the effect to migrant flycatchers from any reduction or change in riparian habitat or disturbance from construction activities will be insignificant because of the disturbance effect being short duration, and migratory flycatcher's ability to move freely and take advantage of a wide diversity and quality of habitat (USFWS 2013).

- The H&E Farm CWA mitigation site along the San Pedro River overlaps with southwestern willow flycatcher critical habitat (USFWS 2013) and encompasses approximately 16 acres of riparian habitat. No breeding flycatcher habitat occurs at this site and as a result, we do not anticipate any effects to breeding flycatchers. Proposed mitigation efforts to reconnect abandoned agricultural land on floodplain terraces to the active river channel will occur outside critical habitat boundaries. Resolution Copper proposed no other groundwork within critical habitat. Drainage reconstruction and subsequent planting of native species will reestablish natural runoff patterns and promote the establishment and maintenance of native riparian vegetation. The establishment of a conservation easement on the entire H&E Farm may benefit the species by protecting habitat in perpetuity. Because migratory flycatchers could occur during project implementation, we expect any alteration of their behavior that may occur will be of short duration and therefore, insignificant. Migratory flycatchers will be able to move a short distance away from activities to take advantage of similar habitat upstream or downstream of the project site. We expect any effects to southwestern willow flycatcher critical habitat from the proposed mitigation will be insignificant because the project will not remove or alter any substantial riparian habitat (PCE 1) or affect insect prey populations (PCE 2).

- The Gila River Mar5/Olberg Road and Queen Creek CWA habitat improvement mitigation sites may currently provide southwestern willow flycatcher migratory or stopover habitat. Surveyors have not detected flycatchers at these parcels. The proposed mitigation for both these sites is to remove tamarisk and plant native trees and shrubs. We anticipate that tamarisk removal will be insignificant to southwestern willow flycatchers because of the small size of the sites, the lack of breeding flycatchers at these locations, and the ability for migrating flycatchers to take advantage of a wider diversity and quality of habitat (USFWS 2013). No designated critical habitat occurs at either site; and therefore, none is affected.

- The recreation mitigation sites at Queen Creek, Arnett Creek trailhead, Inconceivables Climbing area, and roads/trails do not contain or expect to have breeding flycatcher habitat because they do not possess the broad wet floodplains with abundant riparian vegetation where nesting flycatchers occur. Because migrant flycatchers can occur in and take advantage of a variety of habitats and the relatively small size of each of these recreation sites, we expect any alteration of migrant flycatcher habitat will be insignificant. Also, should migrant flycatchers occur at any of these recreation mitigation work sites, we expect birds will be able to move to nearby undisturbed habitat and any behavior alteration will be of short duration, temporary, and an insignificant effect. No flycatcher critical habitat occurs at these recreation sites, and therefore it is not affected.

Appendix B: Technical Assistance

Sonoran Desert Tortoise

In 2020, the FWS reached a settlement agreement with WildEarth Guardians and Western Watersheds Project to review the status of the Sonoran desert tortoise (*Gopherus morafkai*). We agreed to publish a decision in 18 months and during this time, restore the tortoise as a candidate species while we complete our species status review.

Given the information provided in the BA and the nature of the project, we provide technical assistance for the Sonoran desert tortoise below. If plans for this project change, or if new information becomes available on the status, distribution, or abundance of the Sonoran desert tortoise in the action area, this technical assistance, and the need for section 7 consultation, may need to be reconsidered.

The Sonoran desert tortoise occurs in portions of the action area on Federal, State Trust, and private lands. The Cave Creek and Mesa Districts of the TNF joined and signed on to the "Sonoran Desert Tortoise Candidate Conservation Agreement (CCA)" that was finalized on May 27, 2015 (AIDTT 2015). For portions of the action area that fall under the TNF's administration, they will ensure that this project follows applicable measures in the CAA that are specific to the TNF.

Resolution Copper commits to implementing environmental protection measures to reduce impacts on wildlife for proposed actions occurring on private land. Several measures outlined in the CCA may help reduce effects to the Sonoran desert tortoise and we summarize them below:

1. Conduct pre-construction surveys for Sonoran desert tortoise before surface ground-disturbing activities start in its habitat. A biological monitor would monitor for Sonoran desert tortoise during construction activities. The monitor would flag Sonoran desert tortoise shelter sites/burrows. Monitors will inspect these flagged areas, and relocate any tortoises discovered outside project activity areas.

2. Inform project crews of the potential to encounter Sonoran desert tortoise within the action area and project footprint. Work crews will check below vehicles or equipment prior to moving, and cover and/or backfill holes or trenches that could potentially entrap the species. If crews observe a tortoise they will stop work until the biological monitor relocates it out of harm's way.

3. Project personnel would follow the AZGFD's *Guidelines for Handling Sonoran Desert Tortoises Encountered on Development Projects*, when handling a tortoise is necessary.

4. Establish tortoise crossings, as needed and applicable, for concentrate and tailings pipeline corridors, as well as the railroad tracks within the MARCCO corridor within areas containing suitable habitat.

5. We recommend Resolution Copper seek input from AZGFD and FWS for measures to conserve Sonoran desert tortoise and its habitat, including minimizing noxious weed establishment in all tortoise habitat and implementing tasks associated with detecting, relocating, handling, crossing designs, or any other applicable conservation measures.

Appendix C: Tables and Figures

Table 1: Characteristics and acreages of subsidence subareas.

Subsidence Subarea	Characteristics	Predicted Acreage of Each Area
Crater limit	Large, visible crater with cave angles of 70 to 78 degrees and with a depth between approximately 800 and 1,115 feet at the end of mine life	1,341.7
Fracture limit	Visible deformation in a conical form between the surface and cave zone; characterized by rotational failures, tension and dislocation cracks, benching, fractured surfaces, and toppling	256.4
Subsidence limit	Extremely small rock deformations that can only be detected by high-resolution monitoring equipment (would not be visible in the soil or on the ground)	159.0
Total Area of Subsidence		**1,757**

Table 2: Summary of Skunk Camp tailings storage facility.

Tailings Storage Facility	Description
Location	In Dripping Spring Wash approximately 13 miles north of confluence with the Gila River
Land ownership	ASLD, private
Distance from West Plant Site	15 miles
Tailings type and disposal	Thickened slurry tailings placed subaqueously for PAG tailings in one of two cells, NPAG placed hydraulically from perimeter. At disposal—PAG tailings would be 50% solids content; thickened cyclone overflow (NPAG) would be 60% solids content; and thickened NPAG stream sent directly from the mill would be 60% solids content.
Tailings embankment	Earthen starter dams raised with compacted cyclone sand. The NPAG facility would be a centerline construction approach with a 3H:1V slope and the PAG cells would be a downstream construction approach with a 2.5H:1V slope.
Lining and other seepage controls	Engineered, low-permeability layers will be installed on PAG cell foundation and the upstream slope of the embankment.
Approximate size at fence line of tailings storage facility	8,136 acres within fence line; 4,002 acres within footprint of disturbance
Approximate embankment height	490 feet
Pipelines/conveyance	Thickened slurry pumped in two streams (PAG and NPAG) to the tailings storage facility and recycled water pipeline to return water to processing loop at West Plant Site North Option: 22.20 miles of corridor from West Plant Site to tailings storage facility
Auxiliary facilities	Surface water diversions would be large due to the steep surrounding terrain and need to surround the tailings facility on northern, eastern, and western sides with extensive stormwater diversion structures.
Closure and reclamation	Reclamation of the NPAG tailings embankment face would begin as soon as the slope reaches its final extent starting at approximately mine year 10–15. The top of the tailings storage facility will not be reclaimed until after mining is complete. Closure of the tailings recycled water pond is estimated to take up to 5 years after closure. Until that time, excess seepage in seepage ponds will be pumped back to the recycled water pond, and reclamation would take place on the embankment and tailings beaches. After the recycled water pond is closed, seepage ponds will be used to evaporate seepage, and the remaining reclamation of the tailings surface would occur.

Table 3. Transmission line widths and activities occurring within the corridor.

Transmission Line	Description of Corridor	Analysis Width (feet)	Likely Final Approved Width (feet)
115-kV (Mineral Creek crossing)	Contains 50 feet by 50 feet tower foundations; vegetation management as required	130	75-130
115-kV and 230-kV colocated	Contains 50 feet by 50 feet tower foundations, 20 feet wide spur roads as needed to access towers; vegetation management as required	160	110-160
115-kV colocated with tailings pipelines	Pipelines for tailings conveyance and reclaim water for mine use; 20 feet wide access road; 50 feet by 50 feet tower foundations, 20 feet wide spur roads as needed to access towers; vegetation management as required	500	225-280

Table 4. Proposed new and upgraded transmission line summary.

Facility	Transmission Line Route	New Alignment or Upgrade	Approximate Length
East Plant Site	115-kV line colocated with the 230-kV line from Silver King substation to Oak Flat substation	New	3.2 miles
West Plant Site	115-kV line from West Plant Site substation to East Plant Site	New	3.3 miles
Skunk Camp tailings storage facility	115-kV line from the 115-kV /230-kV colocated line to the Skunk Camp tailings storage facility. It is colocated with the tailings pipeline corridor for a majority of this alignment.	New	14.2 miles

Table 5. Arizona hedgehog cactus survey summary

Proposed Action Component	Project Component (acreage)	Project Component Disturbance within Known Species' Range (acreage)	Percent of Project Component Surveyed within Known Species' Range	Individuals Observed during Surveys	Individuals Estimated for Project Component
Access Roads	4.2	1.6	75.3%	0	0
East Plant Site and Magma Road realignment	188.8	22.1	100%	13	13
Filter plant/Loadout Facility disturbance	552.5	–	–	–	–
MARRCO corridor	685.2	–	–	–	–
Silver King Road realignment	13.0	–	–	–	–
Subsidence area (excluding East Plant Site disturbance)	1,672.4	387.1	98.1%	24	24
Skunk Camp tailings storage facility fence line	4,644.5	–	–	–	–
Skunk Camp tailings pipeline	56.7	56.7	98.3%	87	89
Skunk Camp tailings storage facility disturbance	4,002.1	–	–	–	–
Transmission line 115-kV corridor	42.5	3.0	100%	2	2
Transmission line 115-kV/ Tailings pipeline colocated corridor	833.1	294.9	68.9%	0	0
Transmission lines colocated	61.0	57.3	100%	39	39
West Plant Site	940.1	–	–	–	–
Total Project Footprint	**14,739.5**	**822.8**	**88.7%**	**165**	**186**

Table 6. SRP Transmission and Distribution Line Maintenance Schedule Summary

Activity	Line Voltage	Frequency	Duration	Amount of Each Circuit	Equipment	Comments
Transmission and Distribution Line Maintenance						
Line Maintenance Aerial Inspection	Transmission	2 per year	Hours/Days	Entire Circuit	Helicopter	
Line Maintenance Ground Inspection	All Overhead	Every 5 years	Days/Weeks	Entire Circuit	Helicopter, Pickup truck UTV	Helicopter only used if area is inaccessible
Line Maintenance	All	Minor repairs every 1-10 years Structure replacement every 10-60 years (approximately)	Days/Weeks	Single or select locations on a circuit	Backhoe, Boom truck, Bucket truck, Cable puller truck, Caterpillar D4/D5 Crane, Helicopter, Hole digger truck, other repair trucks, Pickup truck UTV Trailer attachments	Line maintenance repairs are limited to a single structure or small numbers of structures and occurs infrequently. Minor repairs include replacing insulators, bolts, and other hardware. Helicopter used if area is inaccessible and/or in emergency situations.
Unscheduled Emergency Inspection	All	Infrequent – about 10 hazards per year	Hours/Days	1 span to entire circuit (entire circuit infrequent)	Helicopter, Pickup truck, UTV	Identified by helicopter, pickup truck or UTV first, then other vehicles used for repair work.
Emergency Line Maintenance	All	5-10 per year	Hours/Days	Single location or select locations along circuit	Backhoe, Boom truck Bucket truck, Cable puller truck, Caterpillar D4/D5 Crane, Helicopter, Hole digger truck, Other repair trucks, Pickup truck, UTV Trailer attachments	Repair vehicles and helicopter only used if hazard warrants use of these vehicles

Table 7. SRP Vegetation Management Schedule Summary

Activity	Line Voltage	Frequency	Duration	Amount of Each Circuit	Equipment	Comments
Vegetation Management						
Vegetation Aerial Inspection	Transmission	Annually	Hours/Days	Entire Circuit	Helicopter	
Vegetation Ground Inspection	All Overhead	Every 1-5 years	Hours/Weeks	Entire Circuit	Pickup truck, UTV, walk	
Routine Vegetation Maintenance	All Overhead	Every 1-5 years	Weeks/1-2 Months	Entire Circuit	Bucket truck (infrequent), Chipper trailer (infrequent), Pickup truck, UTV Mechanical mower (some lines)	Portions of power lines where line is high above vegetation or where incompatible vegetation does not occur or has not regrown will not be treated.
Hazard Vegetation Treatment	All Overhead	Infrequent - Less than 1 per year	Hours/Days	1 span to entire circuit (entire circuit infrequent)	Pickup truck, UTV, walk	

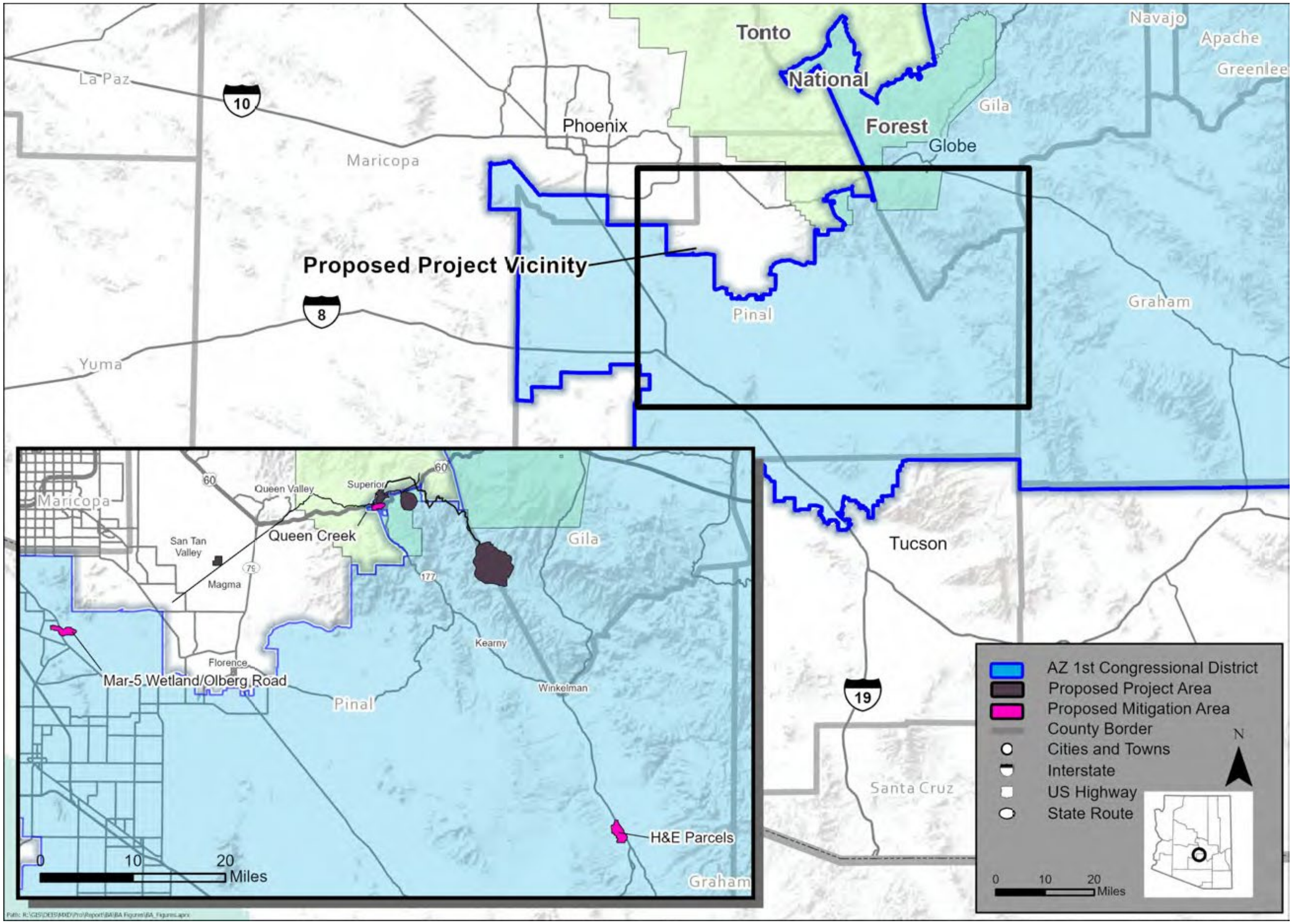

Figure 1. Resolution Copper Project vicinity map, Gila and Pinal counties, Arizona.

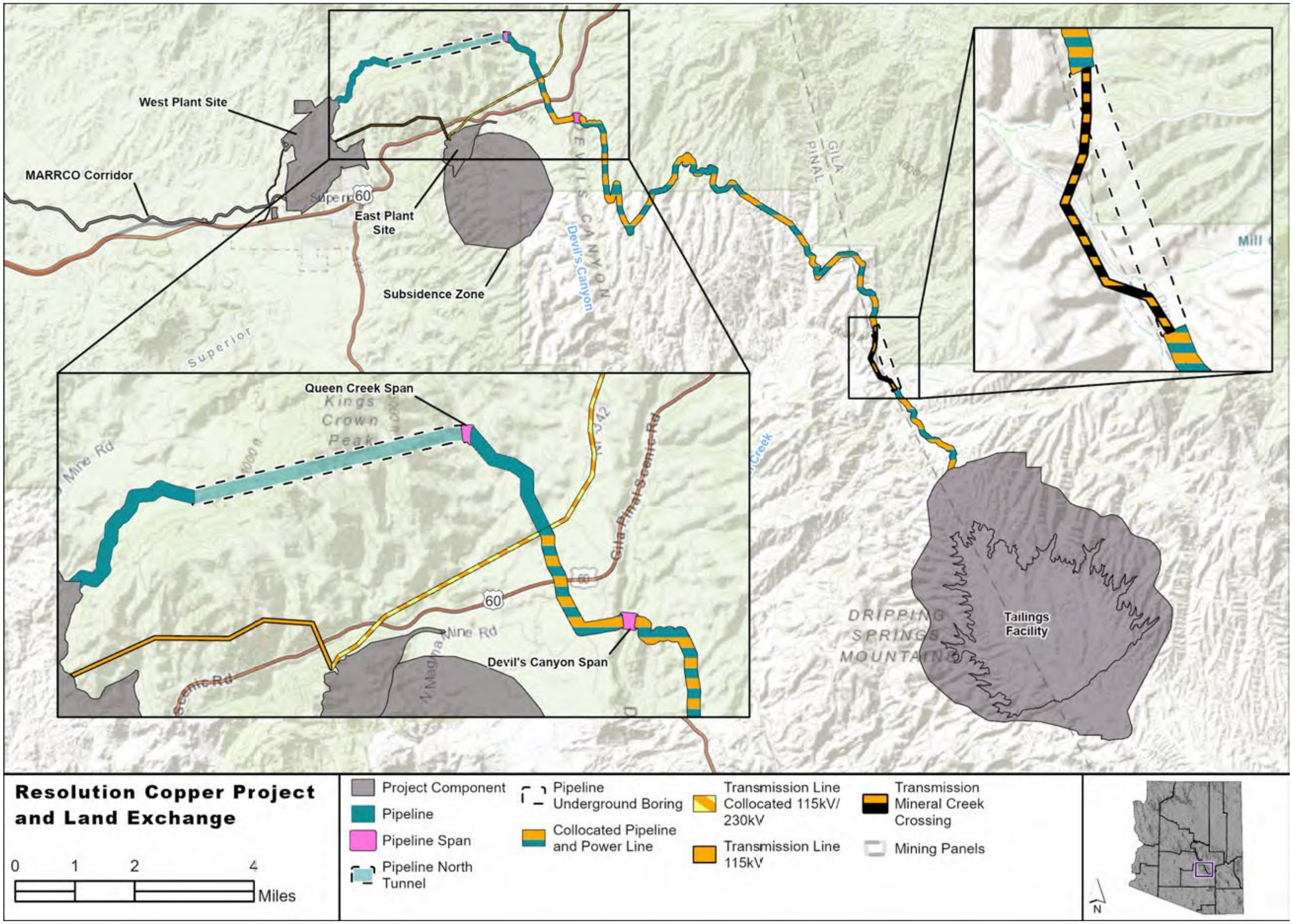

Figure 2. Resolution Copper Mine - proposed action components, Arizona.

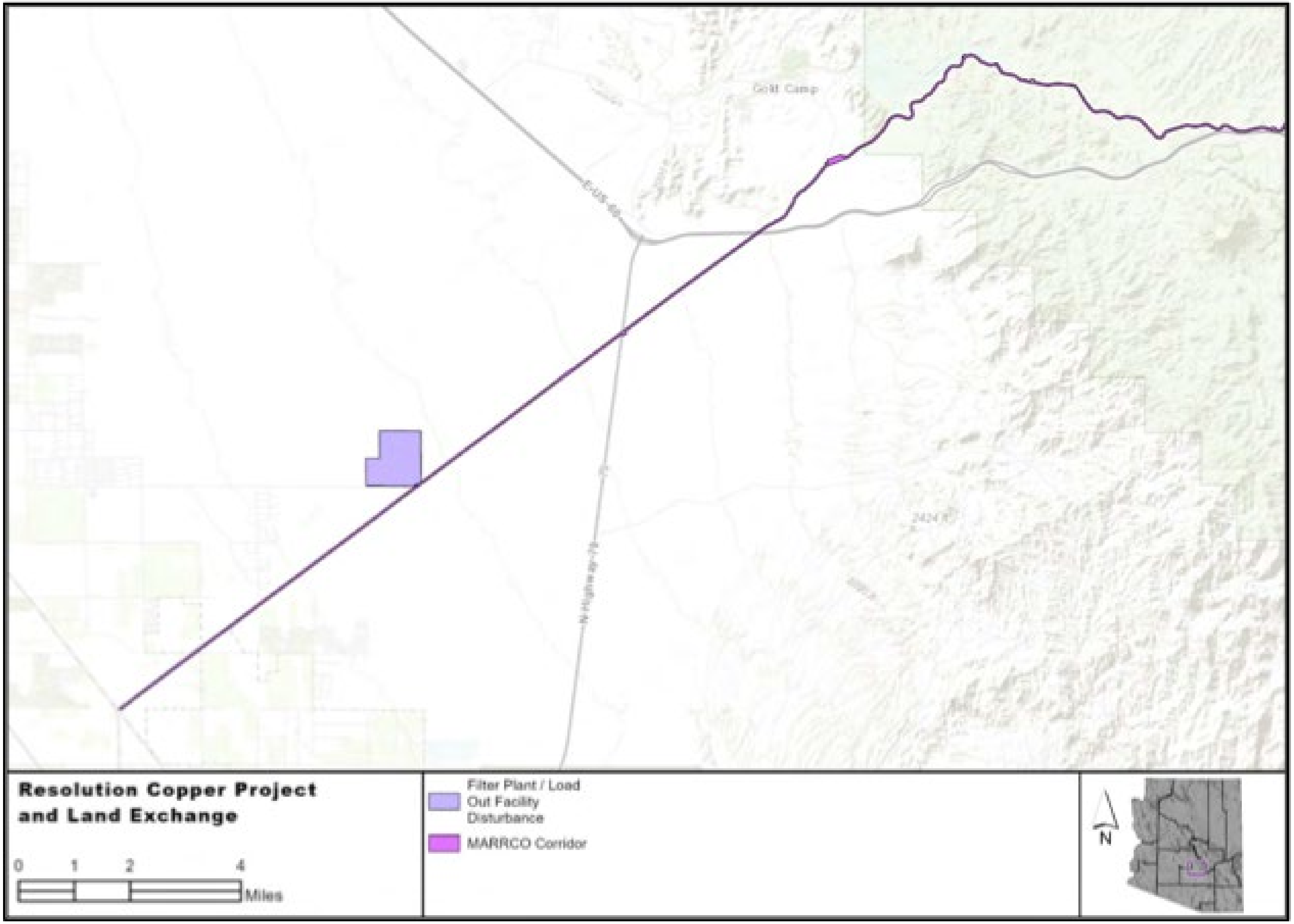

Figure 3. Resolution Copper Mine - proposed action components, Arizona.

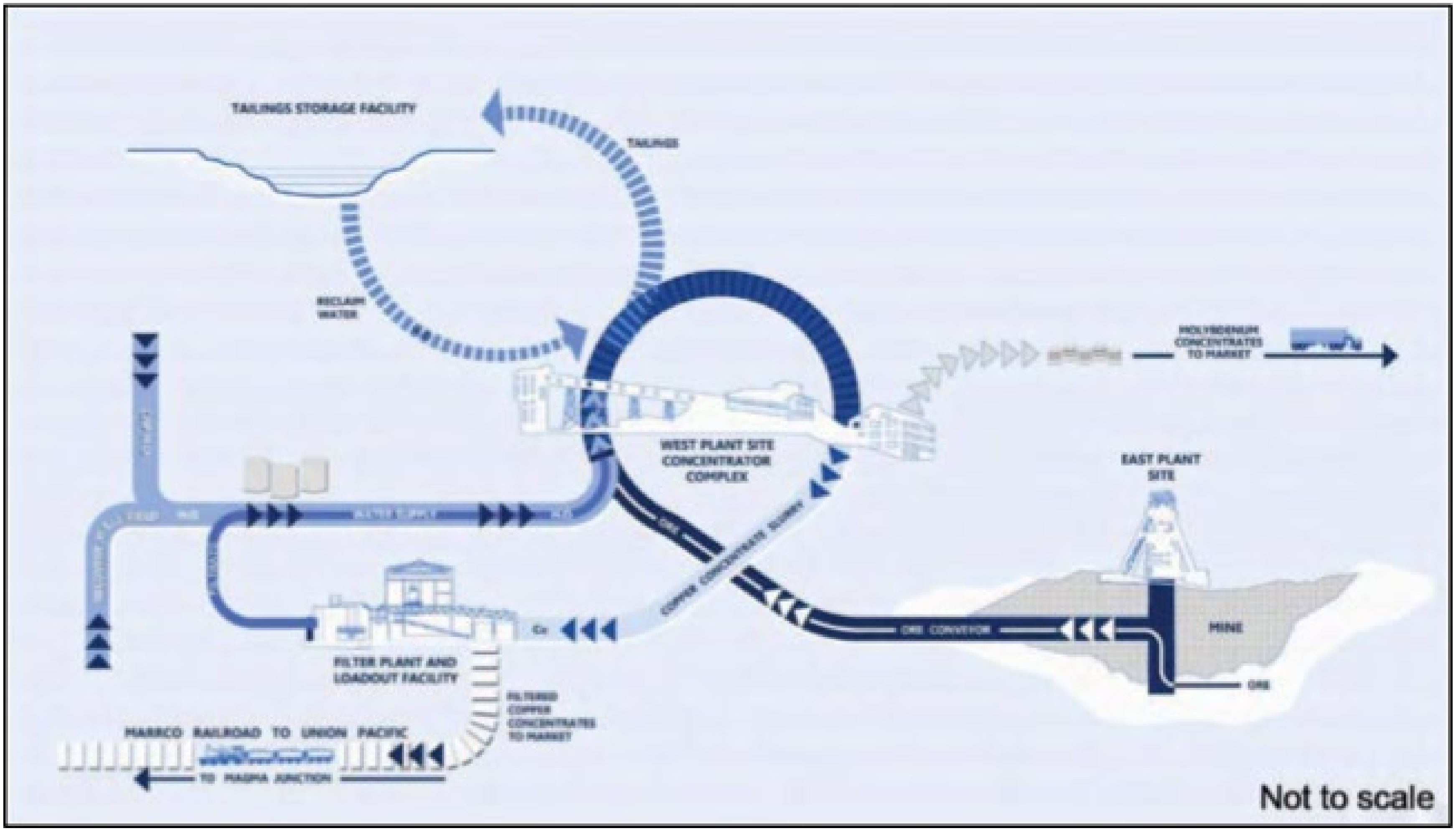

Figure 4. Resolution Copper Mine - overview of the mining process at full operation, Arizona.

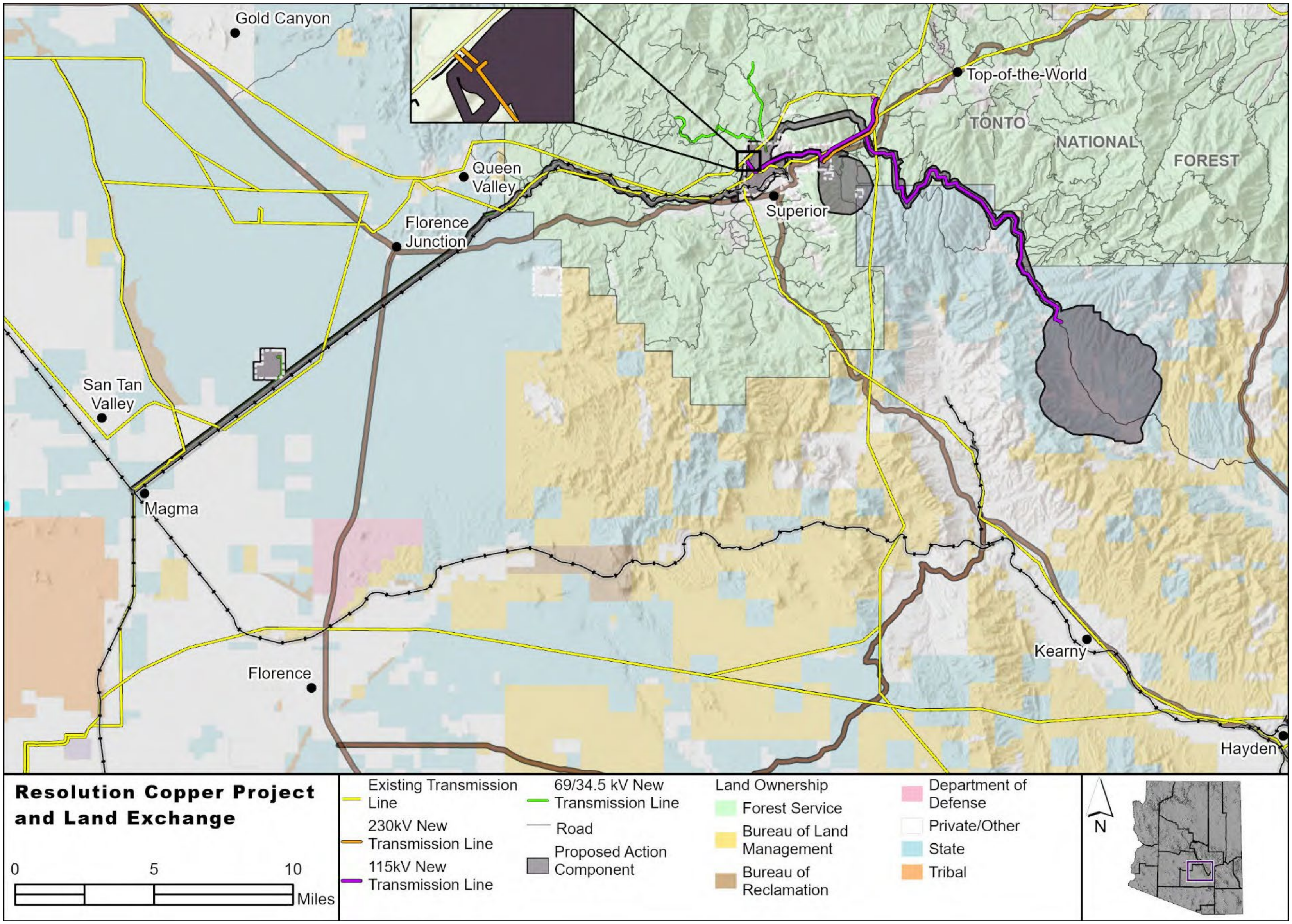

Figure 5. Resolution Copper Mine - proposed upgraded and new SRP transmission lines, Arizona.

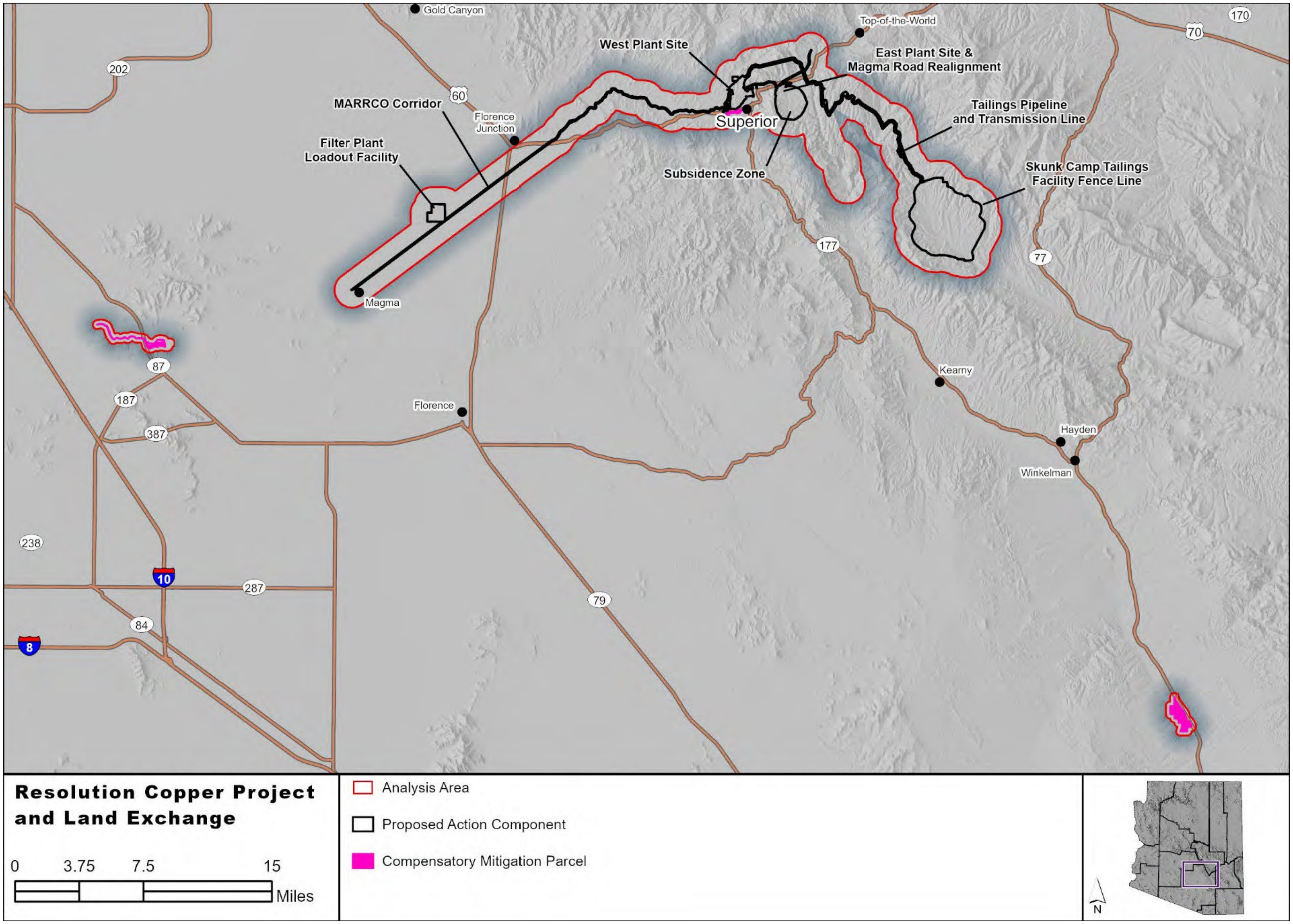

Figure 6. Resolution Copper Mine action area, including USACE Clean Water Act mitigation sites, Arizona.

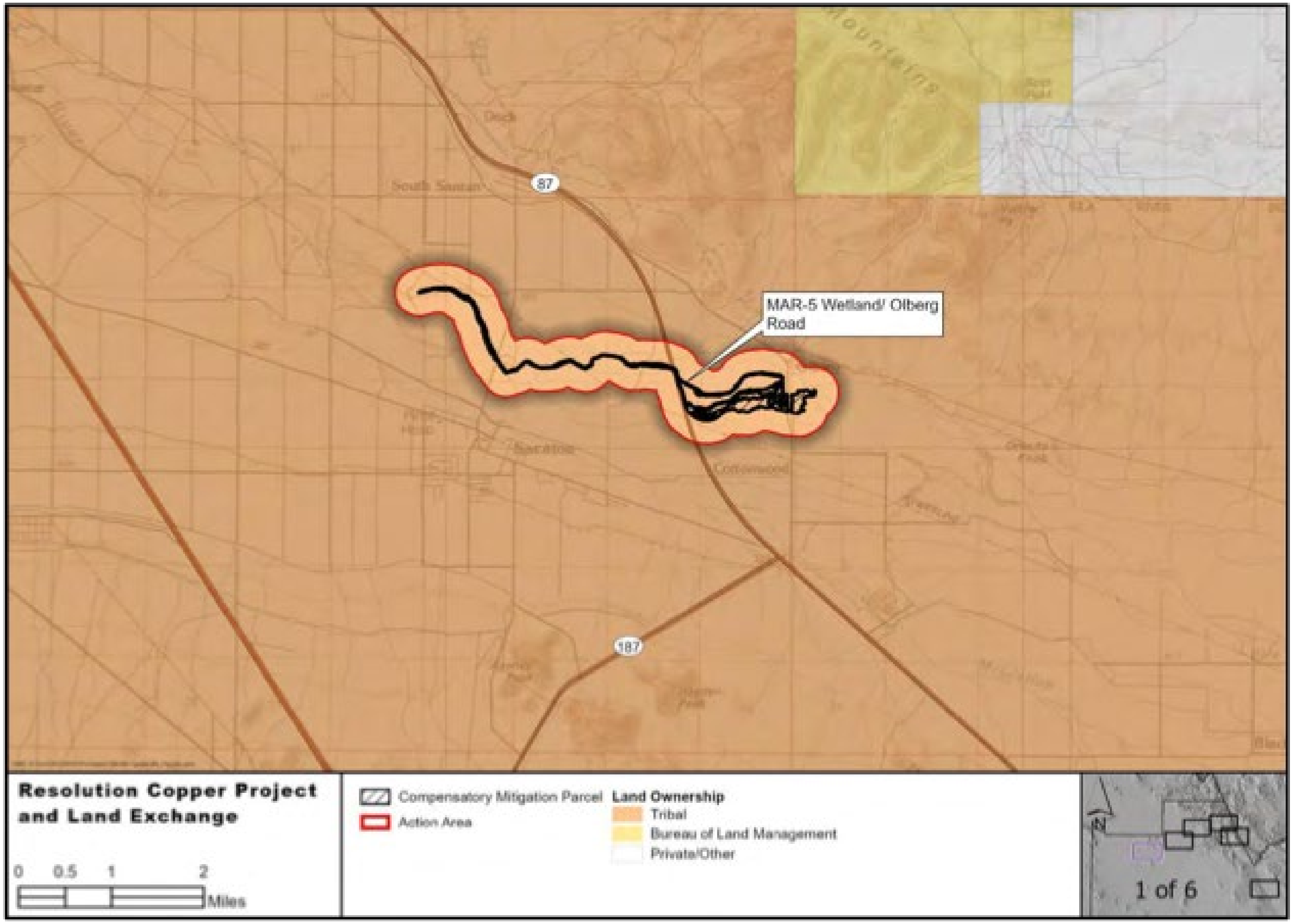

Figure 7. MAR-5/Olberg Road Restoration Site, USACE CWA mitigation site, Gila River, Arizona.

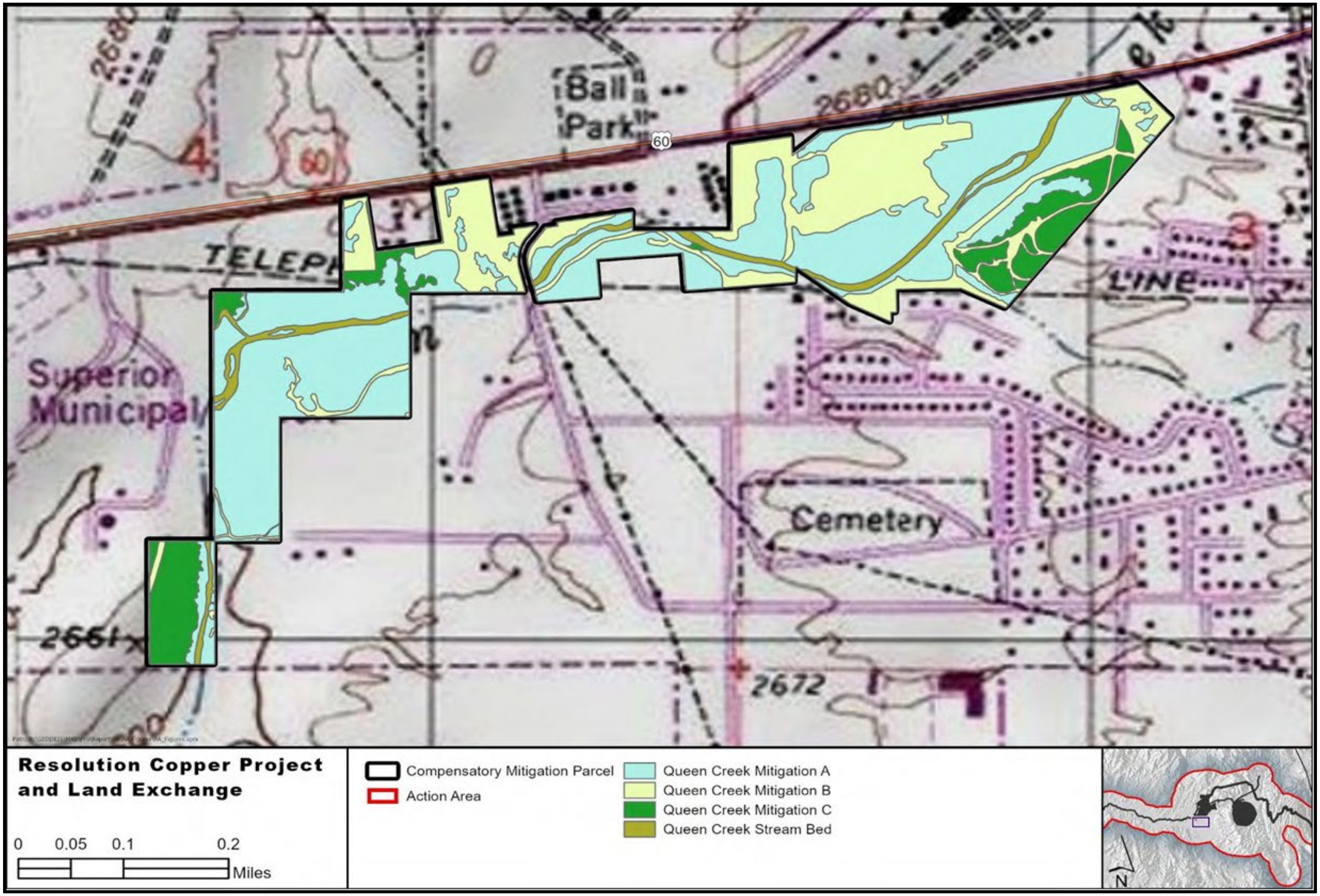

Figure 8. Queen Creek, USACE CWA mitigation site, Queen Creek, Arizona.

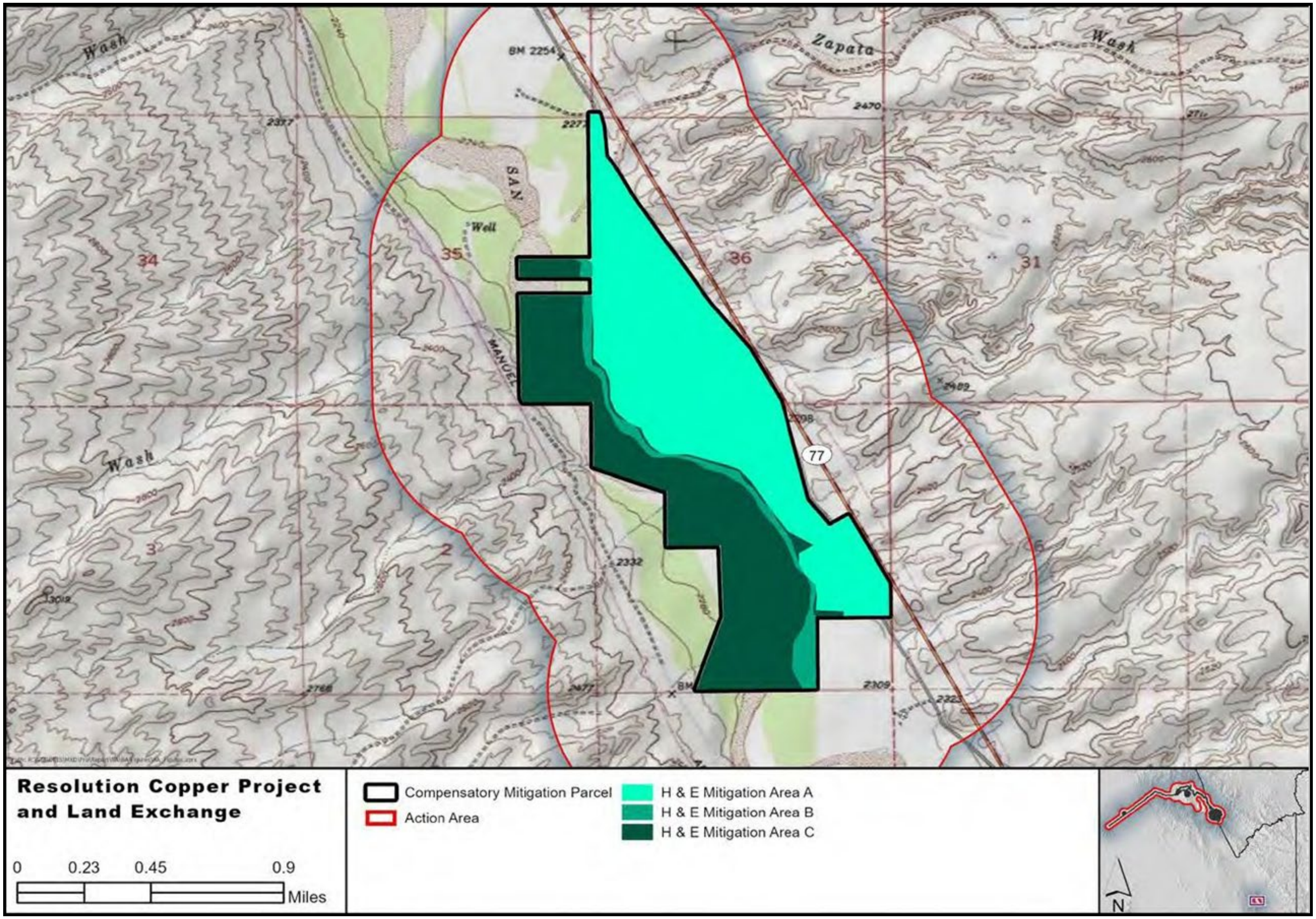

Figure 9. H&E Farm, USACE CWA mitigation site, San Pedro River, Arizona.

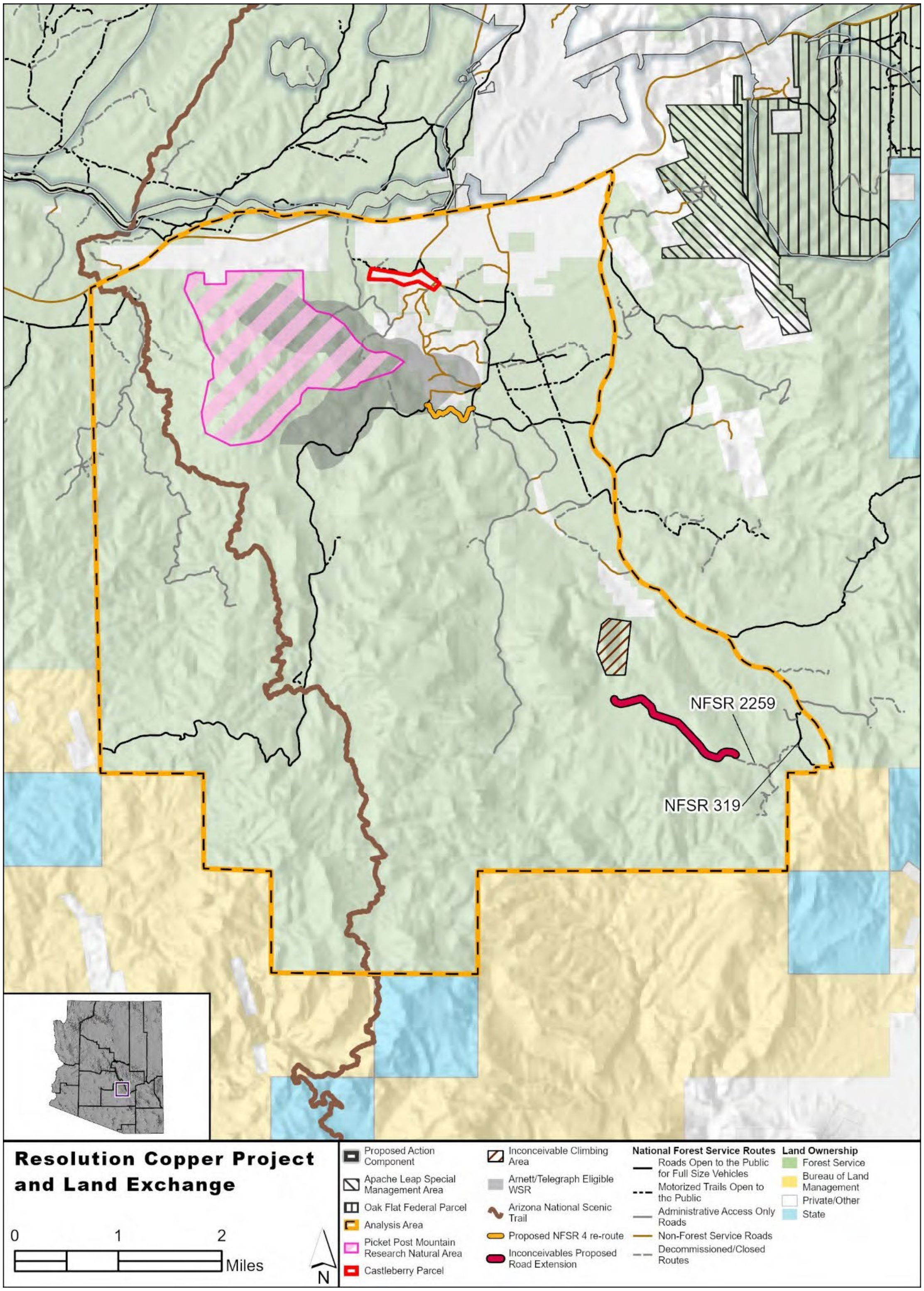

Figure 10. Recreation mitigation sites, Superior, Arizona.

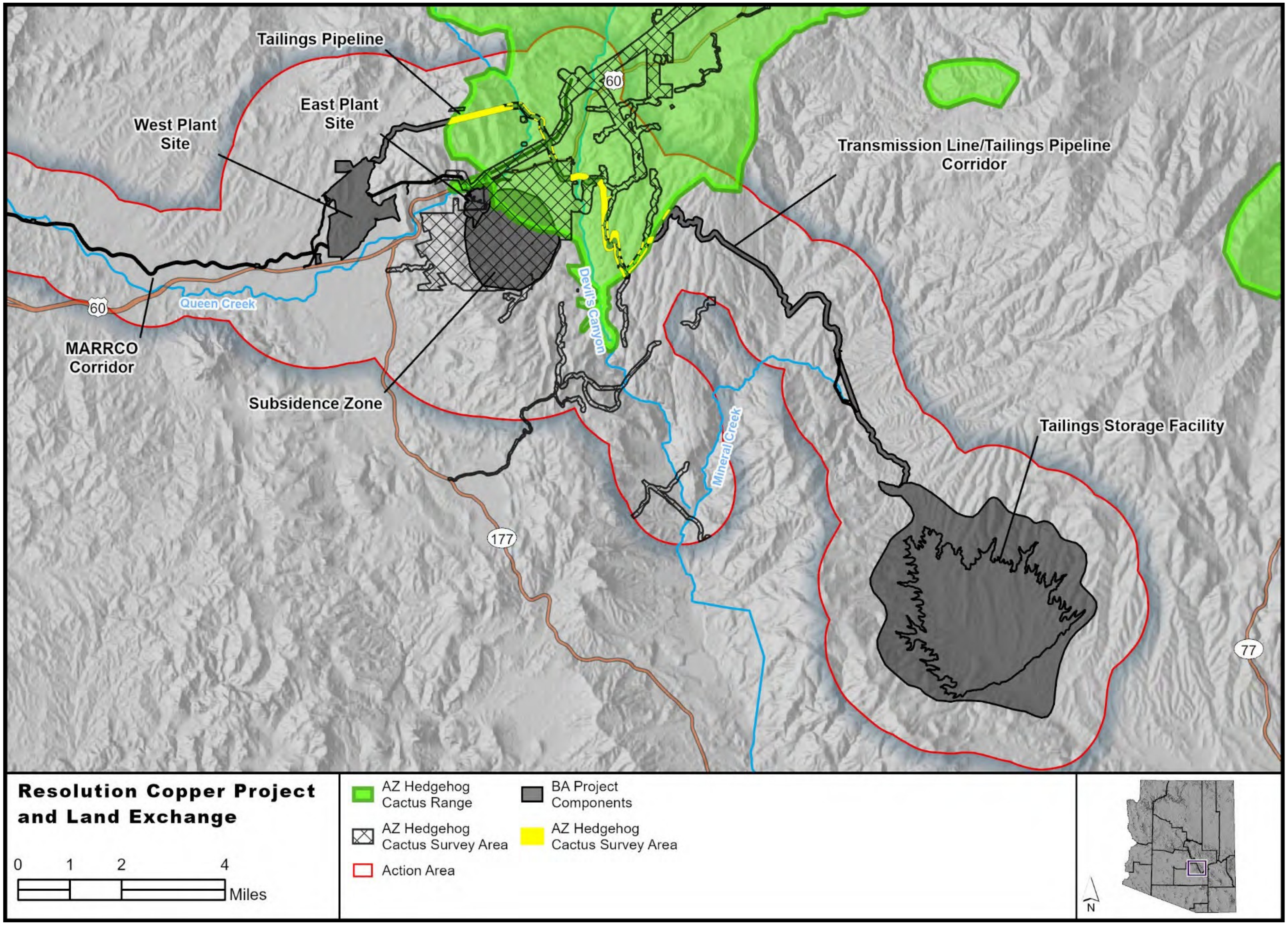

Figure 11. Arizona hedgehog cactus range overlapping proposed action area.

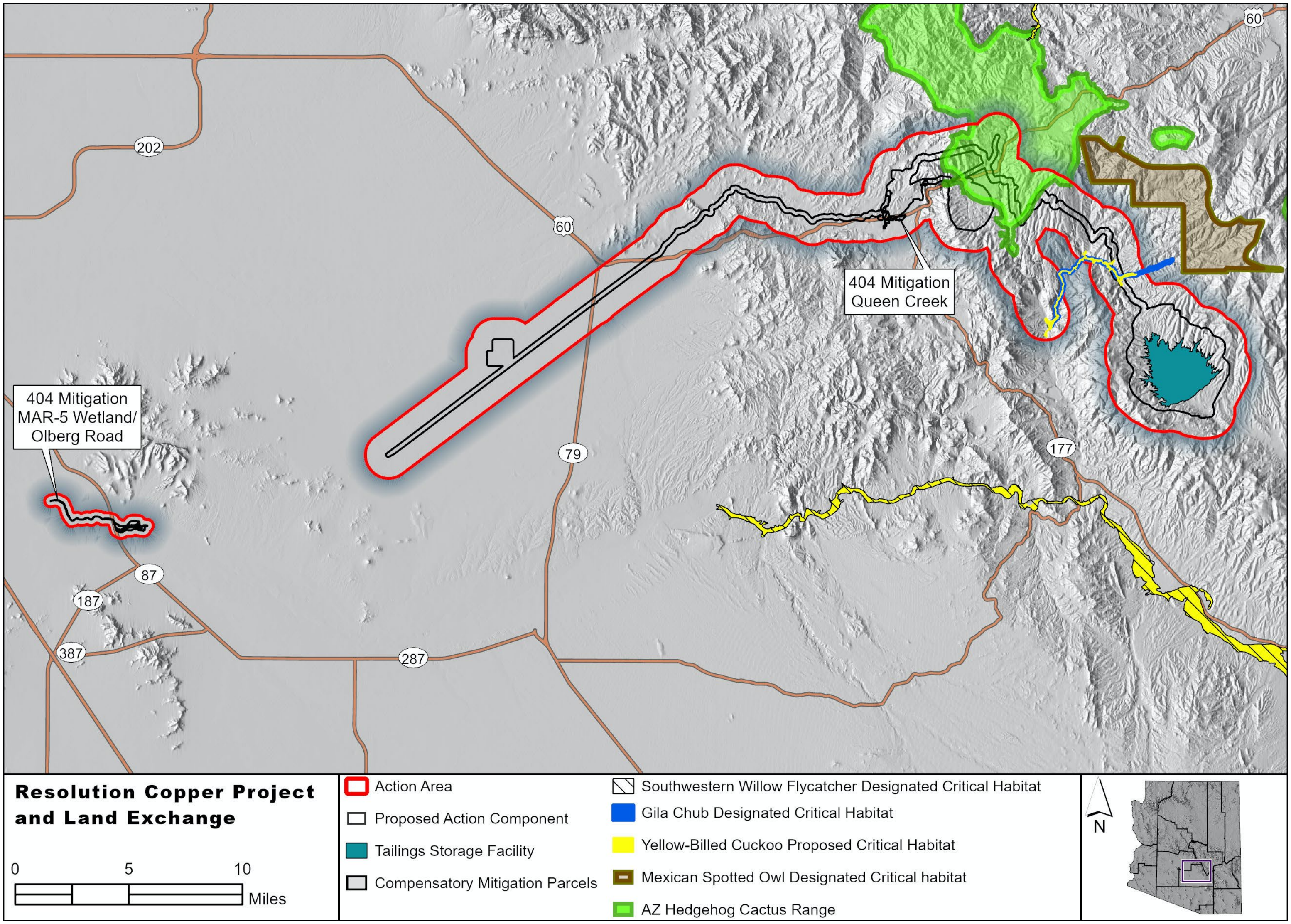

Figure 12. Designated critical habitat in Resolution Copper Mine project vicinity.

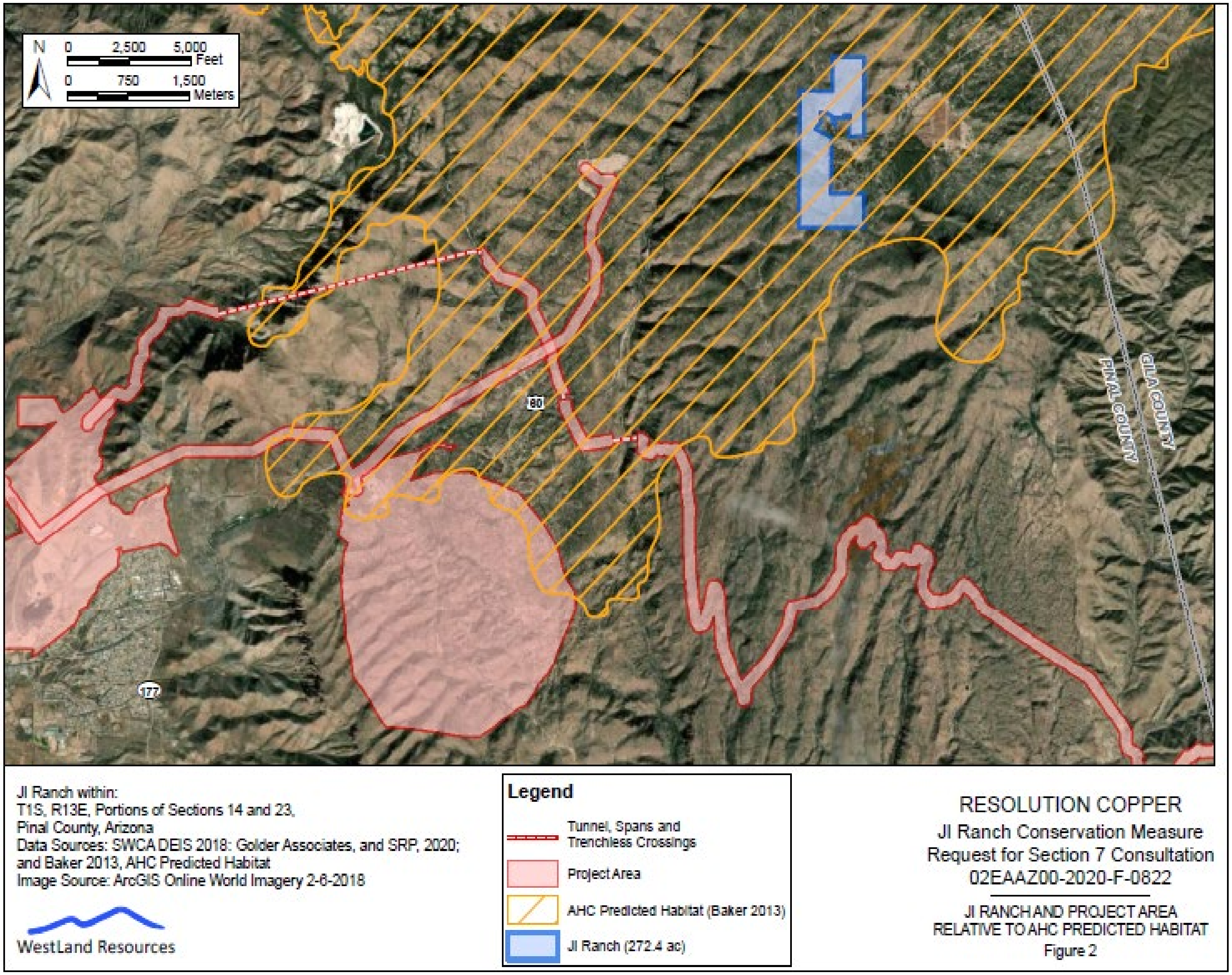

Figure 13. JI Ranch Conservation Easement and Resolution Copper Mine Project.

Appendix Q. Special Use Permit Applications

Introduction

As described in chapter 1, if the land exchange is completed as specified in Section 3003 of Public Law 113-291, and the preferred alternative is ultimately selected in the record of decision, the mineral extraction facilities, processing facilities, and tailings storage facility would be located on private land. Forest Service mining regulations at 36 Code of Federal Regulations (CFR) 228 Subpart A apply to operations conducted under the Mining Law (36 CFR 228.2). Mining operations that take place entirely on non-Federal lands are private mining operations, not operations under the Mining Law. Therefore, any associated uses of National Forest System (NFS) land such as roads, pipelines, and utilities are managed as special uses and regulated under 36 CFR 251.50.

Rather than submittal of a mine plan, authorization for a special use or occupancy of NFS lands requires submittal of a special use application (SF-299). This application process is designed to ensure that authorizations to use and occupy NFS lands are in the public interest (36 CFR 251, Subpart B).

The following applications have been submitted to the Tonto National Forest and are included in this appendix:

- Salt River Project (SRP) would be the owner and operator of the power line to the tailings storage facility, largely co-located with the tailings slurry pipelines. SRP would be responsible for construction, operation, and maintenance of the power line and would hold the special use permit. SRP submitted an SF-299 Special Use Permit application on November 11, 2020. Tonto National Forest staff carried out initial and secondary screenings and accepted the application on November 18, 2020.
- Under the likelihood that the land exchange would occur and the preferred alternative would be selected, Resolution Copper submitted an SF-299 Special Use Permit application on September 7, 2020. Tonto National Forest staff carried out initial and secondary screenings and accepted the application on September 28, 2020.

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USDA United States Department of Agriculture

Forest Service

Tonto National Forest

2324 East McDowell Road
Phoenix, AZ 85006
602-225-5200
TDD: 602-225-5395
Fax: 602-225-5295

File Code: 2720; 5430
Date: November 18, 2020

Jayson Carpenter
Lead Land Agent
PAB10W
P.O. Box 52025
Phoenix, AZ 85072-2025

Dear Mr. Carpenter;

I have reviewed your company's proposal to construct, maintain, and operate high voltage transmission lines within a 500 foot wide corridor defined in the Environmental Impact Statement (EIS) for the Resolution Copper Project and Land Exchange (August 2019) to provide additional electricity needed to meet the electric power demands of the expanding Resolution Copper Mine near Superior, Arizona. Based on the initial documents provided (i.e. cover letter, SF-299, and attachment dated 11/11/2020), the proposal passes the first and second level screening criteria as outlined in FSH 2709.11, Chapter 10 and is consistent with direction in PL 113-211 Section 3003(c)(9)(b). At this time, I accept your proposal as a formal application to be fully evaluated pursuant to the National Environmental Policy Act (NEPA), its implementing regulations, and agency NEPA procedures as outlined in FSM 1950 and FSH 1909.15.

It is understood that this proposal is preliminary and additional design, review, and other regulatory processes are required before an authorization will be issued. It is also understood that the need for this use is reliant on the proposed Resolution Copper Mine and will only be constructed if the need is confirmed. It is assumed that the proposed high voltage transmission line will be located within the 500 foot wide corridor defined and analyzed in the EIS. However, if the design and other regulatory processes have been completed and it is determined that the proposed high voltage transmission line cannot be located within the analyzed corridor, SRP shall submit a revised proposal and a complete review will be required.

An application number (#GLO479) has been assigned to this Power Line special use application/authorization. This project will remain in "Application Accepted" status until the above-mentioned design, review, and regulatory processes are complete. Please include this application number with all future correspondence.

If you have any questions about the environmental review process, project documents, or your Special Use Permit, please contact your Permit Administrator, Mark McEntarffer, at 602-225-5239 or Mark.McEntarffer@usda.gov.

Sincerely,

TOM TORRES
Acting Forest Supervisor

cc: Mary Rassmussen, Donna Morey

STANDARD FORM 299 (05/2009)
Prescribed by DOI/USDA/DOT
P.L. 96-487 and Federal
Register Notice 5-22-95

APPLICATION FOR TRANSPORTATION AND UTILITY SYSTEMS AND FACILITIES ON FEDERAL LANDS

FORM APPROVED
OMB Control Number: 0596-0082
Expiration Date: 1/31/2017

FOR AGENCY USE ONLY
Application Number

Date Filed

NOTE: Before completing and filing the application, the applicant should completely review this package and schedule a preapplication meeting with representatives of the agency responsible for processing the application. Each agency may have specific and unique requirements to be met in preparing and processing the application. Many times, with the help of the agency representative, the application can be completed at the preapplication meeting.

1. Name and address of applicant (*include zip code*)

Salt River Project Agricultural Improvement
and Power District
PO Box 52025
Phoenix, AZ 85072-2025

2. Name, title, and address of authorized agent if different from item 1 (*include zip code*)

3. Telephone (area code)
602-236-3490

Applicant
SRP

Authorized Agent
Jayson Carpenter

4. As applicant are you? *(check one)*

a. ☐ Individual
b. ☐ Corporation*
c. ☐ Partnership/Association*
d. ☒ State Government/State Agency
e. ☐ Local Government
f. ☐ Federal Agency

** If checked, complete supplemental page*

5. Specify what application is for: *(check one)*

a. ☒ New authorization
b. ☐ Renewing existing authorization No.
c. ☐ Amend existing authorization No.
d. ☐ Assign existing authorization No.
e. ☐ Existing use for which no authorization has been received *
f. ☐ Other*

** If checked, provide details under item 7*

6. If an individual, or partnership are you a citizen(s) of the United States? ☐ Yes ☐ No

7. Project description (describe in detail): (a) Type of system or facility, *(e.g., canal, pipeline, road);* (b) related structures and facilities; (c) physical specifications *(Length, width, grading, etc.*); (d) term of years needed: (e) time of year of use or operation; (f) Volume or amount of product to be transported; (g) duration and timing of construction; and (h) temporary work areas needed for construction *(Attach additional sheets, if additional space is needed.)*

See Attached.

8. Attach a map covering area and show location of project proposal

9. State or Local government approval: ☐ Attached ☐ Applied for ☐ Not Required

10. Nonreturnable application fee: ☐ Attached ☒ Not required

11. Does project cross international boundary or affect international waterways? ☐ Yes ☒ No *(if "yes," indicate on map)*

12. Give statement of your technical and financial capability to construct, operate, maintain, and terminate system for which authorization is being requested.

The Salt River Project Agricultural Improvement and Power District (The District) is an agricultural improvement district, organized under the laws of the State of Arizona, which provides electric service in a 2,900 square mile service territory in parts of Maricopa, Gila, and Pinal Counties in Arizona. The District provides electric service to mining customers in an additional area of 2,400 square miles in Pinal and Gila Counties.

In addition, the Salt River Valley Water Users Association cooperatively manages a 13,000 square mile watershed along the Salt and Verde Rivers. The Association delivers nearly 1 million acre-feet of water annually to a 240,000 acre service area in central Arizona.

13a. Describe other reasonable alternative routes and modes considered.
None considered, see EIS

b. Why were these alternatives not selected?
None considered, see EIS

c. Give explanation as t o why it is necessary to cross Federal Lands.
See EIS

14. List authorizations and pending applications filed for similar projects which may provide information to the authorizing agency. *(Specify number, date, code, or name)*

15. Provide statement of need for project, including the economic feasibility and items such as: (a) cost of proposal (construction, operation, and maintenance); (b) estimated cost of next best alternative; and (c) expected public benefits.
See EIS

16. Describe probable effects on the population in the area, including the social and economic aspects, and the rural lifestyles.
See EIS

17. Describe likely environmental effects that the proposed project will have on: (a) air quality; (b) visual impact; (c) surface and ground water quality and quantity; (d) the control or structural change on any stream or other body of water; (e) existing noise levels; and (f) the surface of the land, including vegetation, permafrost, soil, and soil stability.
See EIS

18. Describe the probable effects that the proposed project will have on (a) populations of fish, plantlife, wildlife, and marine life, including threatened and endangered species; and (b) marine mammals, including hunting, capturing, collecting, or killing these animals.
See EIS

19. State whether any hazardous material, as defined in this paragraph, will be used, produced, transported or stored on or within the right-of-way or any of the right-of-way facilities, or used in the construction, operation, maintenance or termination of the right-of-way or any of its facilities. "Hazardous material" means any substance, pollutant or contaminant that is listed as hazardous under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. 9601 et seq., and its regulations. The definition of hazardous substances under CERCLA includes any "hazardous waste" as defined in the Resource Conservation and Recovery Act of 1976 (RCRA), as amended, 42 U.S.C. 6901 et seq., and its regulations. The term hazardous materials also includes any nuclear or byproduct material as defined by the Atomic Energy Act of 1954, as amended, 42 U.S.C. 2011 et seq. The term does not include petroleum, including crude oil or any fraction thereof that is not otherwise specifically listed or designated as a hazardous substance under CERClA Section 101(14), 42 U.S.C. 9601(14), nor does the term include natural gas.
See EIS

20. Name all the Department(s)/Agency(ies) where this application is being filed.
Tonto National Forest, U.S. Forest Service

I HEREBY CERTIFY, That I am of legal age and authorized to do business in the State and that I have personally examined the information contained in the application and believe that the information submitted is correct to the best of my knowledge.

Signature of Applicant	Date
Carpenter Jayson B Digitally signed by Carpenter Jayson B Date: 2020.11.11 16:17:14 -07'00'	11/11/2020

Title 18, U.S.C. Section 1001, makes it a crime for any person knowingly and willfully to make to any department or agency of the United States any false, fictitious, or fraudulent statements or representations as to any matter within its jurisdiction.

GENERAL INFORMATION
ALASKA NATIONAL INTEREST LANDS

This application will be used when applying for a right-of-way, permit, license, lease, or certificate for the use of Federal lands which lie within conservation system units and National Recreation or Conservation Areas as defined in the Alaska National Interest lands Conservation Act. Conservation system units include the National Park System, National Wildlife Refuge System, National Wild and Scenic Rivers System, National Trails System, National Wilderness Preservation System, and National Forest Monuments.

Transportation and utility systems and facility uses for which the application may be used are:

1. Canals, ditches, flumes, laterals, pipes, pipelines, tunnels, and other systems for the transportation of water.

2. Pipelines and other systems for the transportation of liquids other than water, including oil, natural gas, synthetic liquid and gaseous fuels, and any refined product produced therefrom.

3. Pipelines, slurry and emulsion systems, and conveyor belts for transportation of solid materials.

4. Systems for the transmission and distribution of electric energy.

5. Systems for transmission or reception of radio, television, telephone, telegraph, and other electronic signals, and other means of communications.

6. Improved right-of-way for snow machines, air cushion vehicles, and all-terrain vehicles.

7. Roads, highways, railroads, tunnels, tramways, airports, landing strips, docks, and other systems of general transportation.

This application must be filed simultaneously with each Federal department or agency requiring authorization to establish and operate your proposal.

In Alaska, the following agencies will help the applicant file an application and identify the other agencies the applicant should contact and possibly file with:

Department of Agriculture
Regional Forester, Forest Service (USFS)
Federal Office Building,
P.O. Box 21628
Juneau, Alaska 99802-1628
Telephone: (907) 586-7847 *(or a local Forest Service Office)*

Department of the Interior
Bureau of Indian Affairs (BIA)
Juneau Area Office
Federal Building Annex
9109 Mendenhall Mall Road, Suite 5
Juneau, Alaska 99802
Telephone: (907) 586-7177

Department of the Interior
Bureau of Land Management
222 West 7th Avenue
P.O. Box 13
Anchorage, Alaska 99513-7599
Telephone: (907) 271-5477 (or a local BLM Office)

U.S. Fish & Wildlife Service (FWS)
Office of the Regional Director
1011 East Tudor Road
Anchorage, Alaska 99503
Telephone: (907) 786-3440

National Park Service (NPA)
Alaska Regional Office, 2225
Gambell St., Rm. 107
Anchorage, Alaska 99502-2892
Telephone: (907) 786-3440

Note - Filings with any Interior agency may be filed with any office noted above or with the Office of the Secretary of the Interior, Regional Environmental Office, P.O. Box 120, 1675 C Street, Anchorage, Alaska 9513.

Department of Transportation
Federal Aviation Administration
Alaska Region AAL-4, 222 West 7th Ave., Box 14
Anchorage, Alaska 99513-7587
Telephone: (907) 271-5285

NOTE - The Department of Transportation has established the above central filing point for agencies within that Department. Affected agencies are: Federal Aviation Administration (FAA), Coast Guard (USCG), Federal Highway Administration (FHWA), Federal Railroad Administration (FRA).

OTHER THAN ALASKA NATIONAL INTEREST LANDS

Use of this form is not limited to National Interest Conservation Lands of Alaska.

Individual department/agencies may authorize the use of this form by applicants for transportation and utility systems and facilities on other Federal lands outside those areas described above.

For proposals located outside of Alaska, applications will be filed at the local agency office or at a location specified by the responsible Federal agency.

SPECIFIC INSTRUCTIONS
(Items not listed are self-explanatory)

7 Attach preliminary site and facility construction plans. The responsible agency will provide instructions whenever specific plans are required.

8 Generally, the map must show the section(s), township(s), and range(s) within which the project is to be located. Show the proposed location of the project on the map as accurately as possible. Some agencies require detailed survey maps. The responsible agency will provide additional instructions.

9 , 10, and 12 The responsible agency will provide additional instructions.

13 Providing information on alternate routes and modes in as much detail as possible, discussing why certain routes or modes were rejected and why it is necessary to cross Federal lands will assist the agency(ies) in processing your application and reaching a final decision. Include only reasonable alternate routes and modes as related to current technology and economics.

14 The responsible agency will provide instructions.

15 Generally, a simple statement of the purpose of the proposal will be sufficient. However, major proposals located in critical or sensitive areas may require a full analysis with additional specific information. The responsible agency will provide additional instructions.

16 through 19 Providing this information is as much detail as possible will assist the Federal agency(ies) in processing the application and reaching a decision. When completing these items, you should use a sound judgment in furnishing relevant information. For example, if the project is not near a stream or other body of water, do not address this subject. The responsible agency will provide additional instructions.

Application must be signed by the applicant or applicant's authorized representative.

EFFECT OF NOT PROVIDING INFORMATION: Disclosure of the information is voluntary. If all the information is not provided, the application may be rejected.

DATA COLLECTION STATEMENT

The Federal agencies collect this information from applicants requesting right-of-way, permit, license, lease, or certification for the use of Federal lands. The Federal agencies use this information to evaluate the applicant's proposal. The public is obligated to submit this form if they wish to obtain permission to use Federal lands.

SUPPLEMENTAL		
NOTE: The responsible agency(ies) will provide instructions	CHECK APPROPRIATE BLOCK	
I - PRIVATE CORPORATIONS	ATTACHED	FILED*
a. Articles of Incorporation	☐	☐
b. Corporation Bylaws	☐	☐
c. A certification from the State showing the corporation is in good standing and is entitled to operate within the State	☐	☐
d Copy of resolution authorizing filing	☐	☐
e. The name and address of each shareholder owning 3 percent or more of the shares, together with the number and percentage of any class of voting shares of the entity which such shareholder is authorized to vote and the name and address of each affiliate of the entity together with, in the case of an affiliate controlled by the entity, the number of shares and the percentage of any class of voting stock of that affiliate owned, directly or indirectly, by that entity, and in the case of an affiliate which controls that entity, the number of shares and the percentage of any class of voting stock of that entity owned, directly or indirectly, by the affiliate.	☐	☐
f. If application is for an oil or gas pipeline, describe any related right- of-way or temporary use permit applications, and identify previous applications.	☐	☐
g. If application is for an oil and gas pipeline, identify all Federal lands by agency impacted by proposal.	☐	☐
II - PUBLIC CORPORATIONS		
a. Copy of law forming corporation	☐	☐
b. Proof of organization	☐	☐
c. Copy of Bylaws	☐	☐
d. Copy of resolution authorizing filing	☐	☐
e. If application is for an oil or gas pipeline, provide information required by item "I - f" and "I - g" above.	☐	☐
III - PARTNERSHIP OR OTHER UNINCORPORATED ENTITY		
a. Articles of association, if any	☐	☐
b. If one partner is authorized to sign, resolution authorizing action is	☐	☐
c. Name and address of each participant, partner, association, or other	☐	☐
d. If application is for an oil or gas pipeline, provide information required by item "I - f" and "I - g" above.	☐	☐

***If the required information is already filed with the agency processing this application and is current, check block entitled "Filed." Provide the file identification information *(e.g., number, date, code, name)*. If not on file or current, attach the requested information.

NOTICES

Note: This applies to the Department of Agriculture/Forest Service (FS)

This information is needed by the Forest Service to evaluate the requests to use National Forest System lands and manage those lands to protect natural resources, administer the use, and ensure public health and safety. This information is required to obtain or retain a benefit. The authority for that requirement is provided by the Organic Act of 1897 and the Federal Land Policy and Management Act of 1976, which authorize the secretary of Agriculture to promulgate rules and regulations for authorizing and managing National Forest System lands. These statutes, along with the Term Permit Act, National Forest Ski Area Permit Act, Granger-Thye Act, Mineral Leasing Act, Alaska Term Permit Act, Act of September 3, 1954, Wilderness Act, National Forest Roads and Trails Act, Act of November 16, 1973, Archeological Resources Protection Act, and Alaska National Interest Lands Conservation Act, authorize the Secretary of Agriculture to issue authorizations or the use and occupancy of National Forest System lands. The Secretary of Agriculture's regulations at 36 CFR Part 251, Subpart B, establish procedures for issuing those authorizations.

BURDEN AND NONDISCRIMINATION STATEMENTS

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0596-0082. The time required to complete this information collection is estimated to average 8 hours hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at 202-720- 2600 (voice and TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, 1400 Independence Avenue, SW, Washington, DC 20250-9410 or call toll free (866) 632-9992 (voice). TDD users can contact USDA through local relay or the Federal relay at (800) 877-8339 (TDD) or (866) 377-8642 (relay voice). USDA is an equal opportunity provider and employer.

The Privacy Act of 1974 (5 U.S.C. 552a) and the Freedom of Information Act (5 U.S.C. 552) govern the confidentiality to be provided for information received by the Forest Service.

7. Project Description

Salt River Project (SRP) plans to construct, operate, and maintain future 115kV & 230kV high voltage transmission lines to provide the additional electricity needed to meet the electric power demands of the expanding Resolution Copper Mine. The power lines will be constructed using pole structures and will occupy a 130-foot wide right-of-way upon completion. The U.S. Forest Service (USFS) has identified a 500-foot wide corridor where it would prefer the future high voltage line routes, access right-of-way, and construction disturbance will be co-located with the Resolution Copper owned and managed pipeline. This 500-foot wide corridor will be located upon USFS land administered by the Tonto National Forest (TNF), with the corridor crossing Sections 23, 24, and 26 of Township 1 South, Range 12 East, as well as portions of Sections 21, 27, 28, and 34-36, Township 1 South, Range 13 East of the Gila and Salt River Baseline and Meridian, Pinal and Gila counties. The TNF released an Environmental Impact Statement (EIS) for the Resolution Copper Project and Land Exchange on August 9, 2019 that provides detailed information on the Resolution Copper Project and related facilities, including the location of the 500-foot corridor wherein the USFS would like the power lines to be located.

SRP will attempt to construct the power lines within the TNF preferred corridor; however, SRP will not be able to finalize the location of the lines until design work and all regulatory requirements are met. SRP will submit updates to this application as the design and regulatory requirements are completed. In the event that design or regulatory constraints prevent SRP from constructing within the 500-foot corridor, additional environmental analysis may be required. Resolution Copper Mine will be financially responsible for the associated expenses correlated to this additional analysis.

SRP intends to complete the application process and commence a Special Use Permit or Electric Transmission Line Easement with the TNF when the Resolution Copper Mine has expanded and the construction of the high voltage lines are needed. As of the signature and submission date of this Standard Form 299, the estimated need date for Special Use Permit or Electric Transmission Line Easement will be in the next seven to twelve years, depending on the growth of the Resolution Copper Mine.

United States Department of Agriculture
Forest Service
Tonto National Forest
2324 East McDowell Road
Phoenix, AZ 85006
602-225-5200
TDD: 602-225-5395
Fax: 602-225-5295

File Code: 2720
Date: September 28, 2020

Ms. Vicky Peacey
Senior Manager, Environment and External Affairs
Resolution Copper Mining, LLC
102 Magma Heights
Superior, AZ 85173

Sent via email to: Victoria.Peacey@RioTinto.com

Dear Ms. Peacey:

I have reviewed your company's proposal to construct, operate, and reclaim a tailings pipeline infrastructure from Resolution Copper's West Plant Site (WPS) near Superior, Arizona across national forest system (NFS) lands administered by the Tonto National Forest, to the proposed Skunk Camp Tailings Storage Facility located on private and State trust lands in Gila County Arizona. Based on the initial documents provided (i.e. cover letter, SF-299, and attachment dated 9/07/2020), the proposal passes the first and second level screening criteria as outlined in FSH 2709.11, Chapter 10. At this time, we are prepared to accept your proposal as a formal application to be fully evaluated pursuant to the National Environmental Policy Act (NEPA), its implementing regulations, and agency NEPA procedures as outlined in FSM 1950 and FSH 1909.15.

An administrative tracking number (#GLO478) has been assigned to this tailings pipeline special use application/authorization. Please include this application/authorization number with all future correspondence.

Before I can approve the application to proceed with construction (comprising three tailings pipelines, a recycled water pipeline, access roads, and temporary construction laydown yards), an environmental review must be completed pursuant to NEPA to determine the effect(s) the proposed use may have on the natural and human environment. Consistent with direction in PL 113-211 Section 3003(c)(9)(b), this review will involve preparation of a single environmental impact statement (EIS) and will include evaluations for compliance with Section 7 of the Endangered Species Act, Section 404 of the Clean Water Act, and the National Historic Preservation Act as the basis for all decisions under federal law related to the proposed mine and activities identified in the Resolution Copper General Plan of Operations (GPO).

Approval of this project also requires Resolution Copper Mining, LLC to submit a final General Plan of Operations, based on the terms and conditions outlined in the final Record of Decision, to be reviewed and signed by the Forest Supervisor.

If you have any questions about the environmental review process, project documents, or your Special Use Permit, please contact your Permit Administrator, Mark McEntarffer, at 602-225-5239 or Mark.McEntarffer@usda.gov.

Sincerely,

X

NEIL BOSWORTH
Forest Supervisor

cc: mark.mcentarffer@usda.gov; mary.rasmussen@usda.gov; devin.quintana@usda.gov

STANDARD FORM 299 (05/09)
Prescribed by DOI/USDA/DOT
P.L. 96-487 and Federal
Register Notice 5-22-95

APPLICATION FOR TRANSPORTATION AND UTILITY SYSTEMS AND FACILITIES ON FEDERAL LANDS

FORM APPROVED
OMB NO. 0596-0082

FOR AGENCY USE ONLY

Application Number

Date Filed

NOTE: Before completing and filing the application, the applicant should completely review this package and schedule a preapplication meeting with representatives of the agency responsible for processing the application. Each agency may have specific and unique requirements to be met in preparing and processing the application. Many times, with the help of the agency representative, the application can be completed at the preapplication meeting.

1. Name and address of applicant (*include zip code*)

Resolution Copper Mining, LLC
102 Magma Heights
Superior, Arizona 85173

2. Name, title, and address of authorized agent if different from item 1 *(include zip code)*

3. Telephone (area code)

520-689-3313

Applicant

Authorized Agent

4. As applicant are you? *(check one)*
   - a. ☐ Individual
   - b. ☒ Corporation*
   - c. ☐ Partnership/Association*
   - d. ☐ State Government/State Agency
   - e. ☐ Local Government
   - f. ☐ Federal Agency

** If checked, complete supplemental page*

5. Specify what application is for: *(check one)*
   - a. ☒ New authorization
   - b. ☐ Renewing existing authorization No.
   - c. ☐ Amend existing authorization No.
   - d. ☐ Assign existing authorization No.
   - e. ☐ Existing use for which no authorization has been received *
   - f. ☐ Other*

** If checked, provide details under item 7*

6. If an individual, or partnership are you a citizen(s) of the United States? ☐ Yes ☐ No n/a

7. Project description (describe in detail): (a) Type of system or facility, *(e.g., canal, pipeline, road);* (b) related structures and facilities; (c) physical specifications *(Length, width, grading, etc.*); (d) term of years needed: (e) time of year of use or operation; (f) Volume or amount of product to be transported; (g) duration and timing of construction; and (h) temporary work areas needed for construction *(Attach additional sheets, if additional space is needed.)*

Please see Attachment 1.

8. Attach a map covering area and show location of project proposal See Figure 1

9. State or Local government approval: ☐ Attached ☐ Applied for ☒ Not Required

10. Nonreturnable application fee: ☐ Attached ☐ Not required Cost Recovery Agreement 19-CO-11031200-002

11. Does project cross international boundary or affect international waterways? ☐ Yes ☒ No *(if "yes," indicate on map)*

(Continued on page 2)

12. Give statement of your technical and financial capability to construct, operate, maintain, and terminate system for which authorization is being requested.

Please see Attachment 1.

13a. Describe other reasonable alternative routes and modes considered.

Please see Attachment 1.

b. Why were these alternatives not selected?

Please see Attachment 1.

c. Give explanation as to why it is necessary to cross Federal Lands.

Please see Attachment 1.

14. List authorizations and pending applications filed for similar projects which may provide information to the authorizing agency. *(Specify number, date, code, or name)*

Please see Attachment 1.

15. Provide statement of need for project, including the economic feasibility and items such as: (a) cost of proposal (construction, operation, and maintenance); (b) estimated cost of next best alternative; and (c) expected public benefits.

Please see Attachment 1.

16. Describe probable effects on the population in the area, including the social and economic aspects, and the rural lifestyles.

Please see Attachment 1.

17. Describe likely environmental effects that the proposed project will have on: (a) air quality; (b) visual impact; (c) surface and ground water quality and quantity; (d) the control or structural change on any stream or other body of water; (e) existing noise levels; and (f) the surface of the land, including vegetation, permafrost, soil, and soil stability.

Please see Attachment 1.

18. Describe the probable effects that the proposed project will have on (a) populations of fish, plantlife, wildlife, and marine life, including threatened and endangered species; and (b) marine mammals, including hunting, capturing, collecting, or killing these animals.

Please see Attachment 1.

19. State whether any hazardous material, as defined in this paragraph, will be used, produced, transported or stored on or within the right-of-way or any of the right-of-way facilities, or used in the construction, operation, maintenance or termination of the right-of-way or any of its facilities. "Hazardous material" means any substance, pollutant or contaminant that is listed as hazardous under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. 9601 et seq., and its regulations. The definition of hazardous substances under CERCLA includes any "hazardous waste" as defined in the Resource Conservation and Recovery Act of 1976 (RCRA), as amended, 42 U.S.C. 6901 et seq., and its regulations. The term hazardous materials also includes any nuclear

(Continued on page 3)

or byproduct material as defined by the Atomic Energy Act of 1954, as amended, 42 U.S.C. 2011 et seq. The term does not include petroleum, including crude oil or any fraction thereof that is not otherwise specifically listed or designated as a hazardous substance under CERClA Section 101(14), 42 U.S.C. 9601(14), nor does the term include natural gas.

Please see Attachment 1.

20. Name all the Department(s)/Agency(ies) where this application is being filed.

Please see Attachment 1.

I HEREBY CERTIFY, That I am of legal age and authorized to do business in the State and that I have personally examined the information contained in the application and believe that the information submitted is correct to the best of my knowledge.

Signature of Applicant	Date September 7, 2020

Title 18, U.S.C. Section 1001, makes it a crime for any person knowingly and willfully to make to any department or agency of the United States any false, fictitious, or fraudulent statements or representations as to any matter within its jurisdiction.

(Continued on page 3)

GENERAL INFORMATION

ALASKA NATIONAL INTEREST LANDS

This application will be used when applying for a right-of-way, permit, license, lease, or certificate for the use of Federal lands which lie within conservation system units and National Recreation or Conservation Areas as defined in the Alaska National Interest lands Conservation Act. Conservation system units include the National Park System, National Wildlife Refuge System, National Wild and Scenic Rivers System, National Trails System, National Wilderness Preservation System, and National Forest Monuments.

Transportation and utility systems and facility uses for which the application may be used are:

1. Canals, ditches, flumes, laterals, pipes, pipelines, tunnels, and other systems for the transportation of water.

2. Pipelines and other systems for the transportation of liquids other than water, including oil, natural gas, synthetic liquid and gaseous fuels, and any refined product produced therefrom.

3. Pipelines, slurry and emulsion systems, and conveyor belts for transportation of solid materials.

4. Systems for the transmission and distribution of electric energy.

5. Systems for transmission or reception of radio, television, telephone, telegraph, and other electronic signals, and other means of communications.

6. Improved right-of-way for snow machines, air cushion vehicles, and all-terrain vehicles.

7. Roads, highways, railroads, tunnels, tramways, airports, landing strips, docks, and other systems of general transportation.

This application must be filed simultaneously with each Federal department or agency requiring authorization to establish and operate your proposal.

In Alaska, the following agencies will help the applicant file an application and identify the other agencies the applicant should contact and possibly file with:

Department of Agriculture
Regional Forester, Forest Service (USFS)
Federal Office Building,
P.O. Box 21628
Juneau, Alaska 99802-1628
Telephone: (907) 586-7847 *(or a local Forest Service Office)*

Department of the Interior
Bureau of Indian Affairs (BIA)
Juneau Area Office
Federal Building Annex
9109 Mendenhall Mall Road, Suite 5
Juneau, Alaska 99802
Telephone: (907) 586-7177

Department of the Interior
Bureau of Land Management
222 West 7th Avenue
P.O. Box 13
Anchorage, Alaska 99513-7599
Telephone: (907) 271-5477 (or a local BLM Office)

U.S. Fish & Wildlife Service (FWS)
Office of the Regional Director
1011 East Tudor Road
Anchorage, Alaska 99503
Telephone: (907) 786-3440

National Park Service (NPA)
Alaska Regional Office,
2225 Gambell St., Rm. 107
Anchorage, Alaska 99502-2892
Telephone: (907) 786-3440

Note - Filings with any Interior agency may be filed with any office noted above or with the Office of the Secretary of the Interior, Regional Environmental Office,r P.O. Box 120, 1675 C Street, Anchorage, Alaska 9513.

Department of Transportation
Federal Aviation Administration
Alaska Region AAL-4, 222 West 7th Ave., Box 14
Anchorage, Alaska 99513-7587
Telephone: (907) 271-5285

NOTE - The Department of Transportation has established the above central filing point for agencies within that Department. Affected agencies are: Federal Aviation Administration (FAA), Coast Guard (USCG), Federal Highway Administration (FHWA), Federal Railroad Administration (FRA).

OTHER THAN ALASKA NATIONAL INTEREST LANDS

Use of this form is not limited to National Interest Conservation Lands of Alaska.

Individual department/agencies may authorize the use of this form by applicants for transportation and utility systems and facilities on other Federal lands outside those areas described above.

For proposals located outside of Alaska, applications will be filed at the local agency office or at a location specified by the responsible Federal agency.

SPECIFIC INSTRUCTIONS

(Items not listed are self-explanatory)

7 Attach preliminary site and facility construction plans. The responsible agency will provide instructions whenever specific plans are required.

8 Generally, the map must show the section(s), township(s), and range(s) within which the project is to be located. Show the proposed location of the project on the map as accurately as possible. Some agencies require detailed survey maps. The responsible agency will provide additional instructions.

9, 10, and 12 The responsible agency will provide additional instructions.

13 Providing information on alternate routes and modes in as much detail as possible, discussing why certain routes or modes were rejected and why it is necessary to cross Federal lands will assist the agency(ies) in processing your application and reaching a final decision. Include only reasonable alternate routes and modes as related to current technology and economics.

14 The responsible agency will provide instructions.

15 Generally, a simple statement of the purpose of the proposal will be sufficient. However, major proposals located in critical or sensitive areas may require a full analysis with additional specific information. The responsible agency will provide additional instructions.

16 through 19 Providing this information is as much detail as possible will assist the Federal agency(ies) in processing the application and reaching a decision. When completing these items, you should use a sound judgment in furnishing relevant information. Fore example, if the project is not near a stream or other body of water, do not address this subject. The responsible agency will provide additional instructions.

Application must be signed by the applicant or applicant's authorized representative.

EFFECT OF NOT PROVIDING INFORMATION: Disclosure of the information is voluntary. If all the information is not provided, the application may be rejected.

DATA COLLECTION STATEMENT

The Federal agencies collect this information from applicants requesting right-of-way, permit, license, lease, or certification for the use of Federal lands. The Federal agencies use this information to evaluate the applicant's proposal. The public is obligated to submit this form if they wish to obtain permission to use Federal lands.

(For supplemental, see page 4)

Resolution Copper Mining, LLC information is already on file with the U.S. Forest Service.

SUPPLEMENTAL		
NOTE: The responsible agency(ies) will provide instructions	CHECK APPROPRIATE BLOCK	
I - PRIVATE CORPORATIONS	ATTACHED	FILED*
a. Articles of Incorporation	☐	☐
b. Corporation Bylaws	☐	☐
c. A certification from the State showing the corporation is in good standing and is entitled to operate within the State	☐	☐
d. Copy of resolution authorizing filing	☐	☐
e. The name and address of each shareholder owning 3 percent or more of the shares, together with the number and percentage of any class of voting shares of the entity which such shareholder is authorized to vote and the name and address of each affiliate of the entity together with, in the case of an affiliate controlled by the entity, the number of shares and the percentage of any class of voting stock of that affiliate owned, directly or indirectly, by that entity, and in the case of an affiliate which controls that entity, the number of shares and the percentage of any class of voting stock of that entity owned, directly or indirectly, by the affiliate.	☐	☐
f. If application is for an oil or gas pipeline, describe any related right-of-way or temporary use permit applications, and identify previous applications.	☐	☐
g. If application is for an oil and gas pipeline, identify all Federal lands by agency impacted by proposal.	☐	☐
II - PUBLIC CORPORATIONS		
a. Copy of law forming corporation	☐	☐
b. Proof of organization	☐	☐
c. Copy of Bylaws	☐	☐
d. Copy of resolution authorizing filing	☐	☐
e. If application is for an oil or gas pipeline, provide information required by item "I-f" and "I-g" above.	☐	☐
III - PARTNERSHIP OR OTHER UNINCORPORATED ENTITY		
a. Articles of association, if any	☐	☐
b. If one partner is authorized to sign, resolution authorizing action is	☐	☐
c. Name and address of each participant, partner, association, or other	☐	☐
d. If application is for an oil or gas pipeline, provide information required by item "I-f" and "I-g" above.	☐	☐

***** If the required information is already filed with the agency processing this application and is current, check block entitled "Filed." Provide the file identification information *(e.g., number, date, code, name)*. If not on file or current, attach the requested information.

(Continued on page 5)

NOTICES

Note: This applies to the Department of Agriculture/Forest Service (FS)

This information is needed by the Forest Service to evaluate the requests to use National Forest System lands and manage those lands to protect natural resources, administer the use, and ensure public health and safety. This information is required to obtain or retain a benefit. The authority for that requirement is provided by the Organic Act of 1897 and the Federal Land Policy and Management Act of 1976, which authorize the secretary of Agriculture to promulgate rules and regulations for authorizing and managing National Forest System lands. These statutes, along with the Term Permit Act, National Forest Ski Area Permit Act, Granger-Thye Act, Mineral Leasing Act, Alaska Term Permit Act , Act of September 3, 1954, Wilderness Act, National Forest Roads and Trails Act, Act of November 16, 1973, Archeological Resources Protection Act, and Alaska National Interest Lands Conservation Act, authorize the Secretary of Agriculture to issue authorizations or the use and occupancy of National Forest System lands. The Secretary of Agriculture's regulations at 36 CFR Part 251, Subpart B, establish procedures for issuing those authorizations.

BURDEN AND NONDISCRIMINATION STATEMENTS

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0596-0082. The time required to complete this information collection is estimated to average 8 hours hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at 202-720-2600 (voice and TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, 1400 Independence Avenue, SW, Washington, DC 20250-9410 or call toll free (866) 632-9992 (voice). TDD users can contact USDA through local relay or the Federal relay at (800) 877-8339 (TDD) or (866) 377-8642 (relay voice). USDA is an equal opportunity provider and employer.

The Privacy Act of 1974 (5 U.S.C. 552a) and the Freedom of Information Act (5 U.S.C. 552) govern the confidentiality to be provided for information received by the Forest Service.

Block 7. Project Description (describe in detail): (a) Type of system or facility, (b) related structures and facilities; (c) physical specifications; (d) term of years needed; (e) time of year of use or operation; (f) volume or amount of product to be transported; (g) duration and timing of construction; and (h) temporary work areas needed for construction.

Resolution Copper Mining, LLC (Resolution), is proposing to construct a tailings pipeline corridor from the West Plant Site (WPS) near Superior, Arizona southeast to the Skunk Camp Tailings Storage Facility (TSF; pipeline Project; **Figure 1**). The pipeline Project area would cover approximately 419.4 acres from a 500-foot corridor over U.S. Forest Service (USFS) land administered by the Tonto National Forest (TNF). The estimated corridor construction disturbance would total approximately 167.8 acres based on a 200-foot pipeline and powerline construction disturbance width within the 500-foot corridor, within portions of Sections 23, 24 and 26, Township 1 South, Range 12 East; and portions of Sections 21, 27, 28 and 34-36, Township 1 South, Range 13 East of the Gila and Salt River Baseline and Meridian, Pinal and Gila counties.[1] The TNF released a Draft Environmental Impact Statement (DEIS) for the Resolution Copper Project and Land Exchange on August 9, 2019 that provides detailed information on the Resolution Copper Project and related facilities.

As a result of issues raised during the 120-day public scoping (March 2016 through July 2016) on the proposed Resolution Copper Plan of Operations and land exchange (the Project) regarding the TSF and associated pipeline corridor proposed on TNF lands, the TNF completed a comprehensive evaluation of dozens of alternative tailings locations and technologies within 200 miles of the Project. Five tailings alternatives with associated pipeline corridors were carried forward for detailed analysis including multiple pipeline alternatives within each tailings alternative. All of this information was disclosed in the DEIS which was published on August 9, 2019 for a 90-day public comment period (135 days for Tribes). In the DEIS, the TNF identified the Skunk Camp TSF and the associated north pipeline and powerline corridors as the preferred alternative; however, a south pipeline corridor was also analyzed and disclosed for public comment. The DEIS north option is approximately 21.6 miles long, whereas the DEIS south option is approximately 25 miles long (DEIS 2019, p. ES-20). In response to public and agency comments on the DEIS, the Skunk Camp TSF and North Pipeline and Powerline Alternative was refined and updated to collocate those facilities in the same corridor, resulting in reduced impacts to TNF lands and associated resources. This application for a Special Use Permit is for the collocated north pipeline (Revised Corridor).

The pipeline Project consists of three pipelines transporting tailings, a recycled water pipeline, access roads, and temporary construction laydown yards located within a 500-foot wide by approximately 7.2-miles long corridor on TNF lands (excluding spans over major drainages, tunnel in Silver King Canyon and boring under U.S. 60). This 500-foot-wide corridor allows for flexibility in locating or micro-siting

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1 Surface management acreage totals are post-land exchange. In December 2014, Congress authorized a land exchange pending completion of an Environmental Impact Statement, as outlined in Section 3003 of the National Defense Authorization Act (NDAA) for fiscal year 2015. The exchange parcel to be conveyed to Resolution includes a 2,422-acre tract of land is known as the "Oak Flat Federal Parcel.".

the pipeline and access roads along the route. Direct disturbance would include pipeline placement, access roads, and laydown yards for the pipeline construction, totaling 200 feet in width. Direct disturbance for the powerline within the pipeline corridor would be limited to tower footing placement with an approximate 0.5-acre footprint per tower. There are two stream crossings along the pipeline corridor at Queen Creek and Devils Canyon. These stream crossings are at locations that do not have perennial flow and would use a pipe bridge or similar structure to span Queen Creek and Devils Canyon, avoiding any disturbance of the streambed or riparian vegetation.

Pipelines would transport tailings as a solids/water mixture to the TSF and return water from the TSF. The slurry pipelines are designed for optimum performance and safety during each mine phase to match flow characteristics of materials and velocity. The components of the pipeline design on TNF lands are outlined below and described further in the Resolution Copper Skunk Camp Pipelines, Pipeline Protection and Integrity Plan (**Appendix A**).

- The design basis for the tailings corridor is a concentrator average daily throughput of 132,000 short tons per day.
- Scavenger tailings will be pumped from the tailings thickener to the TSF through a thick wall, high-grade carbon steel pipeline with the design criteria in **Appendix A**.
- The pyrite tailings will be pumped all the way to the TSF through a HDPE lined steel pipeline with the design criteria in **Appendix A**.
- Return water from the TSF will be pumped back to the process plant through a standard wall, carbon steel pipeline with the design criteria in **Appendix A**.
- The pipelines will be buried to the extent practicable (except the tunnel section, crossing over Queen creek, crossing under U.S. Highway 60 [US 60], and crossing over Devils Canyon).
- An access road will be constructed generally adjacent to the pipelines, running along the same corridor except those areas with limited access, such as the tunnel in Silver King, bridge and water crossing segments (Queen Creek and Devils Canyon) and the trenchless crossing beneath US 60.
- Associated channels and culverts would be designed to allow passage of storm water to maintain existing upland runoff and major drainage paths that cross the corridor.
- Pipe bridges will be constructed where required to cross major drainages or washes (Devils Canyon and Queen Creek).
- Overhead powerlines will be constructed in the same 500-foot-wide corridor and vicinity as the pipeline for shared access and reduced disturbance on TNF lands.

Pipeline pumps will be required and would be located on private land at the WPS and TSF. The pipelines will be buried and equipped with a modern control system permitting operation and monitoring of the entire system from a central control room and will include a leak detection system.

The leak detection system uses process data (pressure, flow, fluid density) collected from the operating system to monitor pipeline status.

Several intermediate pressure monitoring stations will be located along the pipeline at strategic locations to monitor intermediate conditions in the pipeline and support the leak detection system. These data supplement pressure, flow, and fluid density data available at the pump station and terminal station providing real-time information that supports the leak detection software system and pipeline operator decision-making.

Due to the varying topographic and geologic constraints along the pipeline corridor, multiple techniques would be used for installing the pipelines. It is anticipated that most of the pipeline would be installed buried using standard trenches and trench boxes. In portions of the corridor where underground construction is difficult due to the geology or topography, pipelines would be installed and secured at grade on pipe stands, approximately 1 foot above ground; however, these areas would be limited with the intent of avoiding above ground installation as much as practicable. Trenchless methods (horizontal directional drilling, micro tunneling and other boring methods) would be used to cross under roads, waterways, or for high-point mountain passes. On the TNF, this includes the trenchless crossing beneath US 60 and the tunnel section in Silver King Canyon (**Appendix A**). The proposed pipeline crossings for Queen Creek and Devils Canyon would be spanned using pipe bridges (**Appendix A**).

An access road that parallels the pipelines would be used for construction and maintenance during operations. Temporary laydown yards would be required during construction for material staging and would be located adjacent to access roads within the 500-foot corridor. Once approved, construction of the pipelines is expected to take approximately 2 years. The pipelines and access roads would be used year-round through the life of the mine, approximately 40 years. Over the life of the mine, the pipelines would transport approximately 1.37 billion tons of tailings (ground-up rock remaining after the copper and other economic minerals have been removed).

Block 12. Give statement of your technical and financial capability to construct, operate, maintain, and terminate system for which authorization is being requested.

Resolution is a limited liability company that is owned by Rio Tinto (55 percent) and BHP (45 percent); Rio Tinto is the managing member (DEIS 2019, p. ES-1). Rio Tinto has almost 150 years of pioneering exploration, expansion, diversification, and innovation, and is known as one of the world's largest producers of a range of essential materials (Rio Tinto 2019).[2] For the Resolution Copper Project, a General Plan of Operations (GPO; 2016)[3] was submitted to the USFS and includes technical

[2] Accessed online on November 13, 2019 at https://www.riotinto.com/aboutus/history-4705.aspx.
[3] Resolution Copper Mining. 2016. General Plan of Operations, Resolution Copper Mining. Initial Submittal November 15, 2013. Revised May 9, 2016. https://www.resolutionmineeis.us/documents/resolution-copper-gpo.

documents for the design and operation of the Resolution Copper Project. A final operating plan will be prepared and submitted to TNF following publication of a draft Record of Decision (ROD), objection period, and final ROD. Once the final operating plan is approved, the TNF Forest Supervisor would require Resolution to submit a reclamation bond or other financial assurance to ensure that National Forest System (NFS) lands and resources involved with the pipeline operation are reclaimed in accordance with the approved pipeline operating plan and special use permit per the requirements of 36 Code of Federal Regulations (CFR) 251.

Block 13a. Describe other reasonable alternative routes and modes of consideration.

As a result of issues raised during the 120-day public scoping on the proposed Resolution Copper GPO regarding the TSF and associated pipeline corridor proposed on TNF lands, the TNF completed a comprehensive evaluation of dozens of alternative tailings locations and technologies within 200 miles of the Project. Five tailings alternatives with associated pipeline corridors were carried forward for detailed analysis including multiple pipeline alternatives within each tailings alternative. All of this information was disclosed in the DEIS which was published on August 9, 2019 for a 90-day public comment period (135 days for Tribes). In the DEIS, the TNF identified the Skunk Camp TSF and the associated North Pipeline and Powerline alignments as the preferred alternative, however a south corridor was also analyzed and disclosed for public comment. The DEIS north option is approximately 21.6 miles long, whereas the DEIS south option is approximately 25 miles long (DEIS 2019, p. ES-20). In response to public and agency comments on the DEIS, the Skunk Camp TSF and North Pipeline and Powerline Alternative was refined and updated, to collocate those facilities in the same 500-foot right of way, resulting in reduced impacts to TNF lands and associated resources. This application for a Special Use Permit is for the collocated Revised Corridor.

Block 13b. Why were these alternatives not selected?

To minimize impacts to TNF lands, the north route (the pipeline Project) was selected as the preferred route. Overall, the Skunk Camp TSF with the north pipeline alternative has less disturbance to NFS Lands and associated resources. Additionally, in response to public and agency comments on the DEIS, the north pipeline alternative was updated and refined to collocate the pipeline and powerline in the same corridor (Revised Corridor), resulting in further reductions to disturbance of TNF lands and resources (see **Appendices B and C**; DEIS Alternatives Pipeline Disturbance Comparison and Skunk Camp Pipeline and Powerline Disturbance Comparison, respectively).

Block 13c. Give explanation as to why it is necessary to cross Federal Lands?

The USFS has identified the Skunk Camp TSF and north tailings pipeline (the pipeline Project) as the Lead Agency's preferred alternative (DEIS 2019, p. ES-20). The Skunk Camp TSF is located approximately 14 miles southeast from the WPS near Superior, Arizona and immediately adjacent (to the east) of the Asarco Ray open pit mining complex. The Skunk Camp TSF is on private and state land, removing approximately 4,000 acres of disturbance from TNF lands that would have resulted from the original TSF location called Near West on TNF lands as described in the GPO[3] and disclosed for public scoping. As a result of public and agency comments on the DEIS, the north pipeline alternative was updated and refined resulting in even further reductions to disturbance of TNF lands as described in **Appendix C** to collocate the pipeline and powerline. The estimated 200-foot disturbance within a 500-foot right of way for the Revised Corridor is 167.8 acres. The only way to provide access between the WPS and Skunk Camp TSF is through TNF lands (see **Figures 1 and 2**) and the collocated north route has the least impacts to TNF lands.

Block 14. List authorizations and pending applications filed for similar projects which may provide information to the authorizing agency.

The DEIS was published in August 2019 and provides detailed information on the Resolution Copper Project and related facilities. The TNF response to public comments, final EIS (FEIS) and project record contain additional information. The Salt River Project (SRP) will apply for construction of a 115-kV powerline to the Skunk Camp TSF that is within the Skunk Camp North Revised Corridor to minimize land disturbance. Other relevant agency information which has been submitted separately to the TNF as part of the EIS project record and pipelines includes:

- Clean Water Act (CWA) Section 401 certification application to the Arizona Department of Environmental Quality (ADEQ).
- Signed Preliminary Jurisdictional Determination (PJD) from the US Army Corps of Engineers (USACE).
- CWA Section 404 Permit Application and Public Notice.
- Draft Final CWA Section 404b1 alternatives analysis.
- Arizona Pollutant Discharge Elimination System (AZPDES) Notice of Intent (NOI) for construction general permit, which requires a stormwater pollution prevention plan (SWPPP).

Additional state and federal environmental permit and approval requirements prior to construction of the pipeline on TNF land include: CWA 401 certification; CWA 404 permit; AZPDES NOI and SWPPP; USFWS Biological Opinion; signed Programmatic Agreement; and final approved Historic Properties Treatment Plan.

Block 15. Provide statement of need for the project including the economic feasibility and items such as: (a) cost of proposal (construction, operation, and maintenance); (b) estimated cost of next best alternative; and (c) expected public benefits.

Resolution's overall need is to construct and operate a tailings pipeline corridor capable of transporting 1.37 billion tons of tailings produced through milling copper and molybdenum ore from the Resolution ore body to the Skunk Camp TSF; and recycled water from the TSF back to the WPS. Capacity to transport approximately 1.37 billion tons of tailings is required to allow for utilization of the Resolution ore body to the extent described in the GPO and FEIS.

The pipeline Project would allow the Resolution ore body to be developed, which would generate an average of $88 million to $113 million per year in state and local tax revenues and would also produce substantial revenues for the Federal Government, estimated at more than $200 million per year. On average, the mine is projected to directly employ 1,500 workers, pay about $134 million per year in total employee compensation, and purchase about $546 million per year in goods and services. Including direct and multiplier effects, the proposed mine is projected to increase average annual economic value added in Arizona by about $1 billion (DEIS 2019, p. ES-27).

Block 16. Describe probable effects on the population in the area, including the social and economic aspects, and the rural lifestyles.

The Resolution Copper Project effects are covered in the DEIS and FEIS analysis for the Skunk Camp preferred alternative and collocated Revised Corridor.

Block 17. Describe likely environmental effects the proposed project will have on: (a) air quality; (b) visual impact; (c) surface and ground water quality and quantity; (d) the control or structural change on any stream or other body of water; (e) existing noise levels; and (f) the surface of the land; including vegetation, permafrost, soil, and soil stability.

The Resolution Copper Project effects are covered in the DEIS and FEIS analysis for the Skunk Camp preferred alternative and collocated Revised Corridor. The impacts for the entire preferred alternative including the pipeline are summarized in the following:

Air Quality: During construction fugitive dust and vehicle emissions may be higher than normal. However, neither daily nor annual maximum impacts for fugitive dust would exceed established air quality thresholds (DEIS 2019, p. ES-23).

Visual Impacts: Visual impacts from pipeline Project construction activities would affect sensitive viewers on the Arizona Trail (Passage 18 Reavis Canyon) and NFS Off-Highway Vehicle (OHV) roads in the vicinity of the Revised Corridor (up to 2 miles). The Revised Corridor crosses, or will be accessed, using existing Forest Roads (FRs) between the TSF and WPS, including: FR 8, 229, 1010, 2445, 2458, 2459, 2466 and 3152 (see **Appendix D**, Road Use Plan). Scenery impacts on viewers from construction activities would be temporary over the 2-year duration of construction and would include fugitive dust from ground disturbance and construction equipment, including construction vehicles accessing the Revised Corridor. For forest users in the vicinity of the pipeline construction activities, temporary impacts on scenery would be strong; however, those impacts would be limited in duration to construction periods and would thus be temporary.

During operations, visual impacts would result from linear mine support facilities including access roads and powerlines in the pipeline corridor causing a change in contrast with the existing landscape. Except for bridge spans over Queen Creek and Devils Canyon, the pipeline across TNF lands will be buried. This includes the Silver King tunnel and subsurface passage beneath US 60. A strong contrast from vegetation removal in the corridor would be visible from two miles or more, depending on the vantage viewpoint. Long-term visual dominance from prominent changes in form and line would occur in areas where recreation facilities cross the corridor. Impacts on sensitive viewers using OHV roads in the vicinity of the pipeline corridor would occur in areas where the roads cross or are parallel to the corridor[4]. The updated Road Use Plan for the Revised Corridor describes the FRs in the vicinity of the pipeline corridor where roads cross or are parallel to the Revised Corridor (**Appendix D**).

During closure and reclamation, the pipeline Project and associated infrastructure would be removed, and the corridor area would be regraded to mimic the natural condition and planted with native vegetation. Longer-term impacts on scenery would be expected to persist because revegetation of disturbed landscapes in this type of desert ecosystem takes time. The pipeline Project would likely be visible and present a permanent linear corridor contrast across the background landscape. Initial scenery impacts would be strong and are anticipated to reduce to moderate as vegetation growth increases in the corridor over many years. Intensity and dominance of the corridor form and line in the scenic landscape would be reduced over time.[4]

<u>Surface and Groundwater Quality and Quantity:</u> Resolution would develop a SWPPP and secure an AZPDES Permit (stormwater multi-sector general permit) prior to construction of the pipeline Project. The State of Arizona has received jurisdiction (also known as “primacy”) to administer Sections 401 and 402 of the CWA, which is accomplished through the AZPDES program. Section 402/AZPDES regulates any discharges of pollutants to waters of the U.S. (WOTUS), including potential pollutants in stormwater runoff. An operating plan for the pipeline incorporates best management practices (BMPs) for management and integrity (**Appendix A**). An Arizona Water Quality Certification under CWA Section 401 will also be required from ADEQ with the permit to construct or operate a facility.

<u>Control or Structural Change on any Stream/Body of Water:</u> A CWA Section 404 Individual Permit would be secured prior to the construction of the pipeline Project for impacts to potential WOTUS.[4] An approved jurisdictional determination (AJD) has been completed for portions of the pipeline on TNF lands in the Queen Creek Drainage. A preliminary jurisdictional determination (PJD) for the Skunk Camp TSF and Revised Corridor has been completed for waters outside the Queen Creek watershed with direct impacts to potential WOTUS of 15.7 acres in the corridor, of which 0 acres are on lands administered by the TNF. A CWA permit application was submitted to the USACE, and public notice was issued for a 60-day comment period starting on September 6, 2019.

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[4] Information will be provided in *the Final Impact Statement for the Resolution Copper Project and Land Exchange* which is scheduled to be published in late 2020.

Existing Noise Level: Predicted noise and vibration during pipeline Project construction and operations at sensitive receptors are below thresholds of concern; rural character would not change due to noise (DEIS 2019, p. ES-22)

Land Surface: The pipeline Project would include the removal of native vegetation and soil disturbance during placement of the pipelines and access roads. Recontouring and revegetation would take place after temporary construction disturbances and reclamation. Revegetation success in these desert ecosystems is demonstrated. Reclamation of disturbed areas would decrease but not eliminate the likelihood of noxious weeds becoming established or spreading.[4]

Block 18. Describe the probable effects that the proposed project will have on (a) populations of fish, plant life, wildlife, and marine life, including threatened and endangered species; and (b) marine mammals, including hunting, capturing, collecting, or killing these animals.

Baseline biological surveys have been conducted in the vicinity of the proposed Revised Corridor since 2004. There will be no impacts to fish as there is no fish habitat within the TNF lands of the Revised Corridor and the pipeline will span stream crossings of Queen Creek and Devils Canyon at locations that do not have perennial flow.

There are no marine mammals or other marine life in the pipeline Project area.

Resolution has also completed surveys and baseline studies of vegetation and special status plant species within the Revised Corridor. Vegetation within the Revised Corridor is mapped as Shrubland Alliance and Sparsely Vegetated Area and Juniper Woodland Alliance. Detailed descriptions of species composition and densities within the Revised Corridor are described in the *Vegetation Assessment for the Proposed Skunk Camp Revised Corridor within U.S. Forest Service Lands* (**Appendix E**). Approximately 137 acres of Shrubland Alliance and Sparsely Vegetated Area and 38 acres of Juniper Woodland Alliance would be disturbed during construction and reclamation. The majority of vegetation impacts would be limited in duration and include the removal of native vegetation during a 2-year construction period. Areas disturbed would be reseeded with native seed as described in the Reclamation Plan. During operations, where practicable, the pipeline will be buried within the corridor with limited effects on vegetation. The pipeline will span crossings of Queen Creek and Devils Canyon, avoiding impacts to riparian vegetation at those locations. A 10-foot wide pipeline service road would be constructed and remain throughout the life of the mine, disturbing approximately 7 acres of Sparsely Vegetated Area and 2 acres of Juniper Woodland Alliance. Post-operations, the Revised Corridor would be disturbed again for pipeline removal and reseeded with a native seed mix approved by the TNF, as described in the Reclamation Plan.

Wildlife found in the TNF portions of the Revised Corridor include common species that typically exist in Interior Chapparal habitat. Mammals in Interior Chaparral include cottontail rabbit, various mice, and mule deer; birds include scrub jay, several towhees, and canyon wren; and reptiles include various rattlesnakes, kingsnake, and fence lizard.[5] Construction of the pipeline will have limited effects on wildlife other than light and noise. The pipeline will be buried where practicable and span crossings of Queen Creek and Devils Canyon. During operations effects to wildlife will be limited to pipeline monitoring activities and preventive maintenance that would occur on a regular basis and would involve physical activity along the Revised Corridor. Throughout the life of the project, regular patrols would be used to assess all areas of the pipeline route. Patrols would be conducted at least 26 times throughout each calendar year. Patrol would include walking, driving, or flying the length of the pipeline to inspect the surface conditions on or adjacent to the pipeline. Effects to wildlife during reclamation would be like those described for construction.

Effects to threatened and endangered species were analyzed in a Biological Assessment (BA) that the USFS submitted to the U.S. Fish and Wildlife Service (USFWS) in May 2020. The BA analyzed the potential effect from the proposed Resolution Copper Project and Land Exchange (which includes the pipeline Project) on species listed under the Endangered Species Act (ESA). The analysis includes an assessment of the potential effects from the proposed project on 24 species listed and 14 critical habitats proposed or designated under the ESA in Pinal and Gila counties. The BA determined that for 19 listed species and 11 proposed or designated critical habitats, the project would have no effect. Of the five remaining species, there are two, Arizona hedgehog cactus and yellow-billed cuckoo, that are known to occur within and near the pipeline Project.[6] The pipeline Project does not impact proposed or designated critical habitats.

The BA determined that the pipeline Project "would be expected to lead to habitat disturbance within the range of the Arizona hedgehog cactus and would lead to the removal of individual cacti." In species specific surveys conducted between 2004 and 2020, WestLand Resources, Inc., identified 60 cacti within the 500-foot wide Revised Corridor (**Appendix F**). Flexibility in the layout of the 200-foot wide pipeline construction area within the 500-foot wide Revised Corridor provides opportunities to avoid many of the Arizona hedgehog cacti identified within the Revised Corridor through micro-siting. Additionally, to reduce the potential impacts from construction activities on individual Arizona hedgehog cacti, the area of disturbance will be surveyed by a qualified biologist to identify any previously identified individuals and any that may have become established since the most recent survey. Any healthy individuals of the species that are suitable for transplant will be salvaged and planted into areas outside the area of disturbance prior to construction activities. Additional

[5] Brown, D.A. (ed.). 1994. *Biotic Communities: Southwestern United States and Northwestern New Mexico*. University of Utah Press, Salt Lake City, Utah, USA.

[6] Special status species lists were generated for the Revised Corridor, including a list from a USFWS Information for Planning and Conservation Report online query and a list from an Arizona Game and Fish Department Heritage Database Management System online environmental review tool query. The IPaC list identifies special status species and designated and proposed critical habitat that *may* occur within one or more delineated United States Geological Survey 7.5-minute quadrangles that the Assessment Area intersects. The AGFD HDMS online environmental review tool query was used to identify records of special status species within 5 miles of the Assessment Area. The special status plant species identified in these lists included Arizona hedgehog cactus (*Echinocereus triglochidiatus* var. *arizonicus*;), which is listed as endangered without critical habitat by the USFWS under the ESA; and yellow-billed cuckoo (*Coccyzus americanus*) which is listed as threatened with proposed critical habitat by the USFWS under the ESA.

conservation measures are listed in the BA and final conservation measures will be detailed in the USFWS Biological Opinion (BO).

The BA determined that for yellow-billed cuckoo, the potential effects from activities associated with pipeline construction (noise), and operations and maintenance (noise and traffic disturbances) are expected to be insignificant and unlikely to adversely affect the species. In 2019, an individual yellow-billed cuckoo was detected approximately 1 mile south of the Devils Canyon crossing of the pipeline Project.[7] Whenever possible, maintenance activities near the Devils Canyon crossing and/or other locations where recent surveys have shown cuckoos to be present will be conducted outside the breeding season. Additional conservation measures are listed in the BA and final conservation measures will be detailed in the USFWS BO.

Sonoran desert tortoise (*Gopherus morafkai*) is a TNF sensitive species with some potential to occur within the Revised Corridor.[6] Tortoise scat has been observed approximately 1.5 miles from the Revised Corridor[8] and there are Arizona Game and Fish Department (AGFD) Heritage Data Management System (HDMS) records of this species within 5 miles of the area. In 2015, the Cave Creek and Mesa Districts of the TNF joined and signed on to the Sonoran desert tortoise Candidate Conservation Agreement (CCA). As such, pipeline construction, operation, and reclamation will follow portions of the CCA that apply to lands administered by the TNF. If a Sonoran desert tortoise is encountered during project activities, handling guidelines developed by AGFD will be followed to reduce impacts to tortoises.[9]

Gila monster (*Heloderma suspectum*) is a USFWS Species of Concern. The Gila monster is not an ESA-listed species but is noted as a species that is declining or appears to need conservation. Gila monster has some potential to occur in the Revised Corridor, and there are HDMS records of this species within 5 miles of the Project. Pre-construction surveys for Gila monsters would be conducted before surface ground-disturbing activities begin. If a Gila monster is encountered during Project activities, work crews would stop work until a biological monitor has relocated the species out of harm's way.

Block 19. State whether any hazardous material, as defined in this paragraph, will be used, produced, transported or stored on or within the right-of-way or any of the right-of-way facilities, or used in the construction, operation, maintenance or termination of the right-of-way or any of its facilities. "Hazardous material" means any substance, pollutant or contaminant that is listed as hazardous under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. 9601 et seq., and its regulations. The definition of hazardous substances

7 WestLand Resources, Inc. 2019. 2019 Yellow-Billed cuckoo survey for the Resolution Copper Project. *Prepared for Resolution Copper*. Tucson, Arizona: WestLand Resources, Inc. June 9, 2020.

8 WestLand Resources, Inc. 2017. Sonoran Desert Tortoise Habitat Assessment for the Resolution Land Exchange and the Resolution General Plan of Operations. *Prepared for Resolution Copper*. Tucson, Arizona: WestLand Resources, Inc. August 2017.

9 Arizona Game and Fish Department. 2014. Guidelines for Handling Sonoran Desert Tortoises Encountered on Development Projects. Revised September 2,2014. Available at: https://s3.amazonaws.com/azgfd-portal-wordpress/PortalImages/files/wildlife/2014%20Tortoise%20handling%20guidelines.pdf

under CERCLA includes any "hazardous waste" as defined in the Resource Conservation and Recovery Act of 1976 (RCRA), as amended, 42 U.S.C. 6901 et seq., and its regulations. The term hazardous materials also include any nuclear or byproduct material as defined by the Atomic Energy Act of 1954, as amended, 42 U.S.C. 2011 et seq. The term does not include petroleum, including crude oil or any fraction thereof that is not otherwise specifically listed or designated as a hazardous substance under CERCLA Section 101(14), 42 U.S.C. 9601(14), nor does the term include natural gas.

No "hazardous material" as defined in this paragraph, will be used, produced, transported or stored on or within the right-of-way or any right-of-way facilities, or used in the construction, operation, maintenance of termination of the right-of-way or any of its facilities. The pipeline will be used to transport water and tailings from copper milling. The tailings are not categorized has hazardous wastes under either the Resource Conservation and Recovery Act (RCRA)[10] or the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The right-of-way will allow the tailings to be transported to a storage facility on private lands.

Block 20. Name all the department(s)/Agency(ies) where this application is being filed.

Tonto National Forest

Figures

Figure 1. Vicinity Map
Figure 2. Revised Corridor from West Plant Site to Skunk Camp

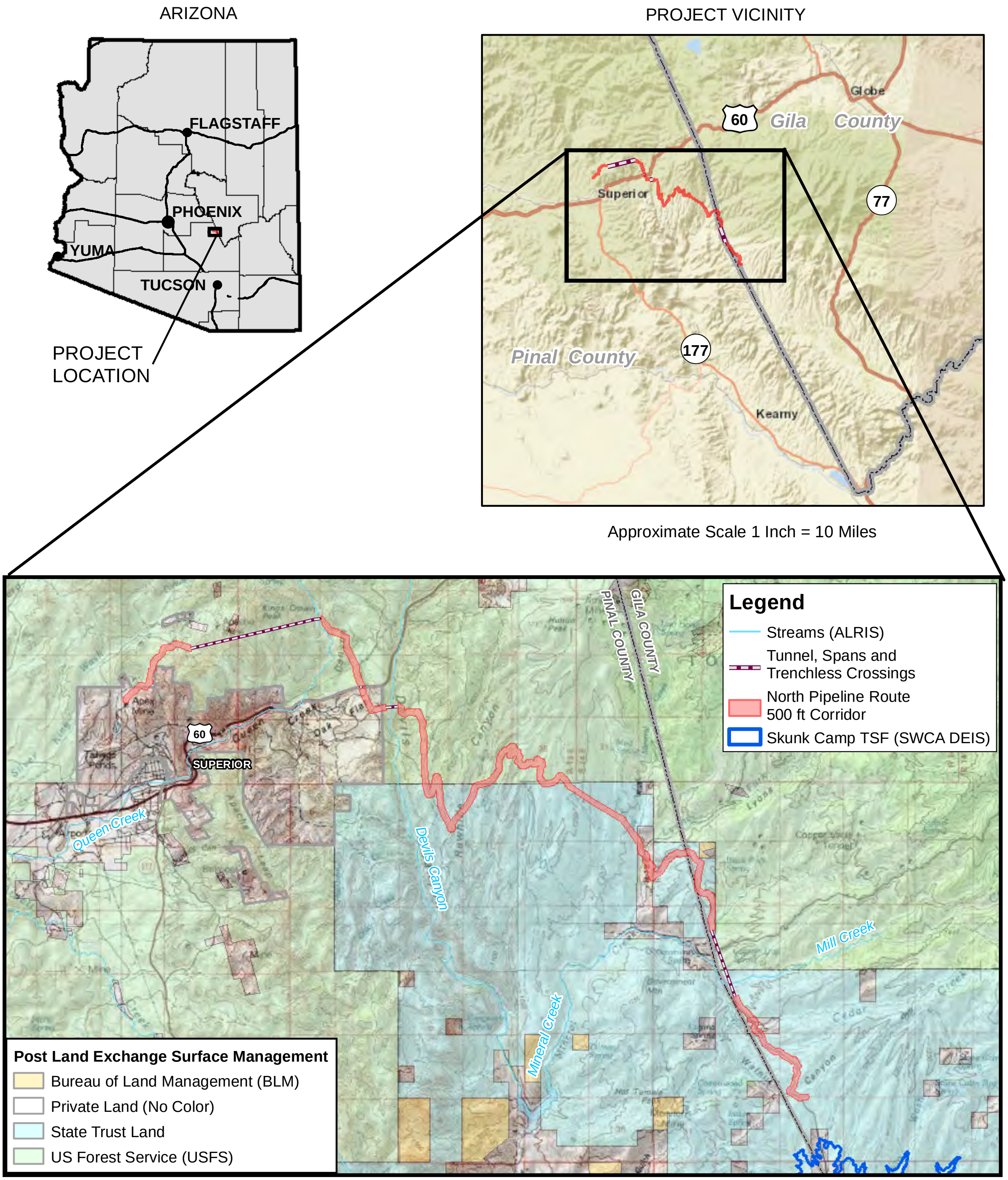
Appendices

Appendix A. Resolution Copper Skunk Camp Pipelines, Pipeline Protection and Integrity Plan
Appendix B. DEIS Alternatives Pipeline Disturbance Comparison and Skunk Camp Pipeline
Appendix C. Skunk Camp Pipeline and Powerline Disturbance Comparison
Appendix D. Road Use Plan - Revised August 2020
Appendix E. Vegetation Assessment for the Proposed Skunk Camp Revised Corridor within U.S. Forest Service Lands
Appendix F. Arizona Hedgehog Cactus Project Area Status 2020

[10] https://www.epa.gov/hw/special-wastes#mining

Figures

Path: M:\Jobs\800's\807.176\ENV\SkunkCamp\USFS_SpecialUsePermit\ReportFigures\Pipeline5_2020\01_VicinityMap_SCampSUPermit_6_12_2020.mxd Date: 6/19/2020 User: rwitzke



T1S, R12-13E; T2S, R13-14E,
Gila and Pinal Counties, Arizona,
Mesa and Globe 1:100,000 USGS Quadrangles.
Data Sources: SWCA DEIS 2018; Golder Associates, Pipeline Data, May 2020;
BLM Post Land Exchange Surface Management, WRI Modified 2017
Image Source: ArcGIS Online World Street Map

N

0 1.5 3 Miles

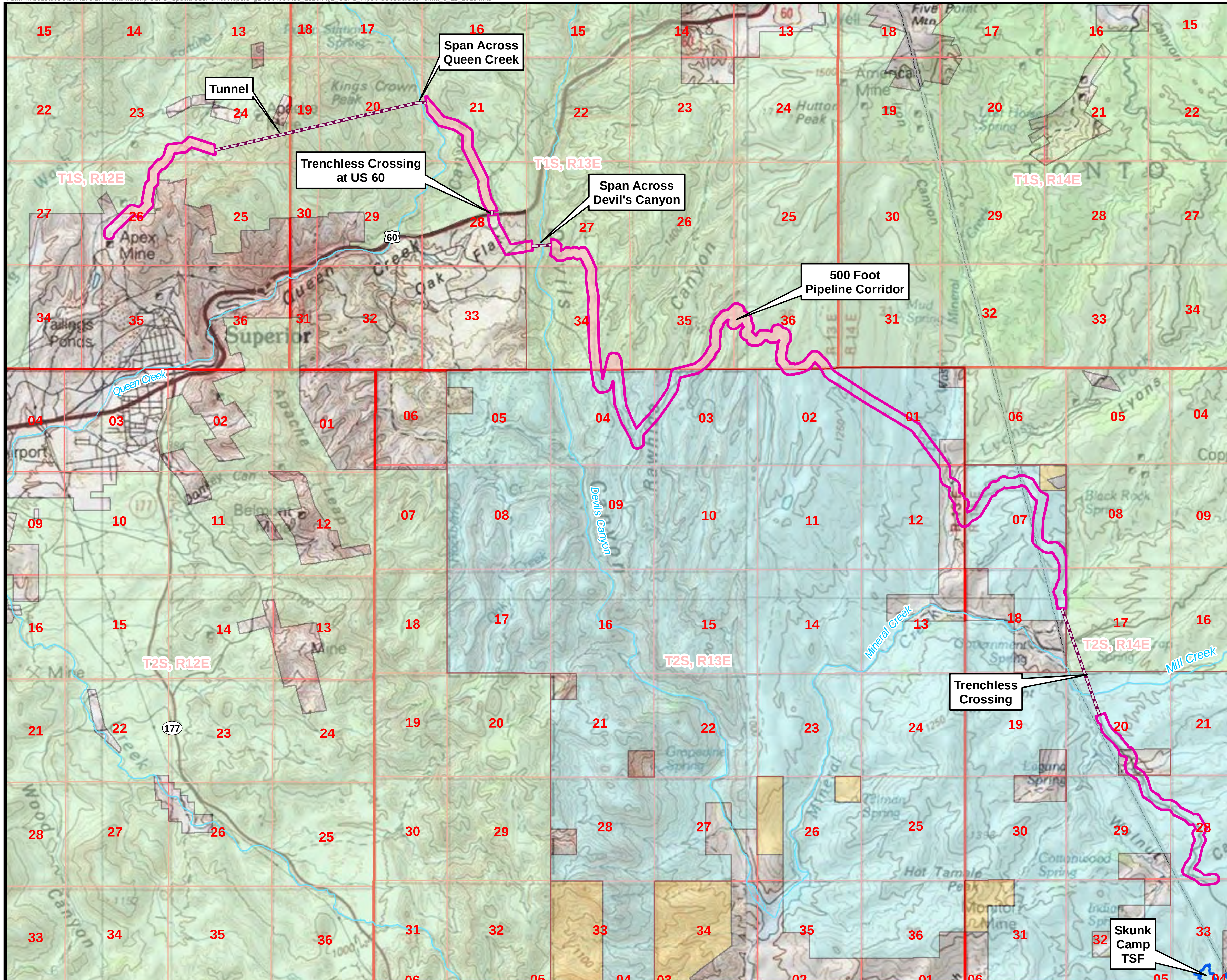
0 2.5 5 Kilometers

WestLand Resources

RESOLUTION COPPER
USFS Special Use Permit
Proposed North Pipeline Corridor

VICINITY MAP
Figure 1

Path: M:\Jobs\800's\807.176\ENV\SkunkCamp\USFS_SpecialUsePermit\ReportFigures\Pipeline5_2020\Fig2_USFS_PipelineSpecialUsePermit_6_12_2020.mxd Date: 6/19/2020 User: rwitzke



North Pipeline Corridor on USFS Land:
T1S, R12E, Portions of Sections 23, 24, and 26,
T1S, R13E, Portions of Sections 21, 27, 28, and 34-36,
Pinal County, Arizona,
Globe and Mesa 1:100,000 USGS Quadrangles
Data Sources: SWCA DEIS 2018; Golder Associates, Pipeline Data, May 2020;
BLM Post Land Exchange Surface Management,
WRI Modified 2017; and BLM PLSS Cadastral Data

Legend

- Streams (ALRIS)
- Tunnel, Spans and Trenchless Crossings
- North Pipeline Route on USFS Land (419.4 acres)
- North Pipeline Route 500 ft Corridor
- Skunk Camp TSF (SWCA DEIS)

Post Land Exchange Surface Management

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

N

0 2,500 5,000 Feet

0 800 1,600 Meters

WestLand Resources

RESOLUTION COPPER
USFS Special Use Permit
Proposed North Pipeline Corridor

PROPOSED NORTH PIPELINE
FROM WEST PLANT SITE TO SKUNK CAMP
Figure 2

Appendix A

REPORT

Resolution Copper Skunk Camp Pipelines

Pipeline Protection and Integrity Plan

Submitted to:

Resolution Copper
102 Magma Heights, Superior, Arizona, USA 85173

Submitted by:

Golder Associates Inc.
1575 Treat Blvd., Suite 100 Walnut Creek, California, USA 94598

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CCC.03-81900-EP-REP-00007_Rev0

May 15, 2020

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TABLES

APPENDIX A
Design Criteria

APPENDIX B
Geohazards Assessment

1.0 INTRODUCTION

Resolution Copper Mining, LLC (RCM) is proposing to develop an underground mine within the vicinity of the former Magma Copper Mine in the Pioneer Mining District near Superior, 65 miles east of Phoenix, Arizona. RCM is an LLC owned jointly by Resolution Copper Company (55%), a Rio Tinto plc subsidiary, and BHP Copper Inc. (45%), a BHP Billiton Ltd. subsidiary. Development of the project includes a panel cave mine approximately three miles east of Superior, a concentrator and associated facilities at the Concentrator Site (or West Plant Site, WPS) directly north of the town, and a tailings storage facility (TSF) connected to the concentrator by a tailings pipeline corridor.

Tailings produced at the proposed concentrator will be piped to the TSF and return water from the TSF returned to the concentrator for reuse. The design basis for the tailings pipeline corridor is a concentrator throughput of 132,000 short tons per day (stpd), as described in the Draft Environmental Impact Statement (DEIS) and Mine Plan of Operations.

The scavenger tailings and pyrite tailings will be thickened and transported separately by pipeline to the TSF. The pyrite tailings will be placed subaqueously during operations in order to manage and prevent acid rock drainage. Surplus water from the TSF will be recovered and recycled by pipeline to the concentrator for reuse in the process.

This Pipeline Protection and Integrity Plan outlines the potential failure modes and design considerations and environmental and spill control measures for pipeline construction and operation.

1.1 Climate Conditions

The regional climate is characterized as semi-arid, with long periods of little or no precipitation. Annual rainfall is between 9 and 19 inches and falls primarily during the winter and summer months, more than 50% between November and April. Temperatures frequently exceed 100°F in the summer, and occasionally dip below freezing in the winter.

2.0 PROJECT DESCRIPTION

2.1 General

The tailings will be pumped and transported as a thickened slurry in separate carbon steel, buried pipes from the Concentrator Site to the Skunk Camp TSF, located approximately 20 miles south-east following the proposed north route. Independent pipelines will be constructed for the Pyrite and Scavenger streams. A parallel return water pipeline will be installed in the same corridor to deliver reclaimed water from Skunk Camp TSF facility back to the Concentrator Site.

The pipelines will be buried and equipped with a modern control system permitting operation and monitoring of the entire system from a central control room and will include a leak detection system. The leak detection system uses process data (pressure, flow, fluid density) collected from the operating system to monitor pipeline status. Several intermediate pressure monitoring stations will be located along the pipeline at strategic locations to monitor intermediate conditions in the pipeline and support the leak detection system. The data supplements pressure, flow, and fluid density data available at the pump station and terminal station providing real-time information that supports the leak detection software system and pipeline operator decision-making.

All slurry pipelines will have intermediate facilities to support ongoing operations and monitoring of the system. These facilities will include emergency flushing tank and event pond, which will be used for extreme circumstances to prevent pipeline plugging and potentially mitigate a leak event. It is unlikely the facility will be used because there is emergency power at the pump station located at the concentrator site that can support flushing.

The pipeline Supervisory Control and Data Acquisition (SCADA) system will rely on a fiber optic cable which will be installed along the pipelines and connect remote monitoring stations to a central control room from which the pipeline operation will be monitored on a continuous basis.

All transport pipelines will include facilities to permit routine inspection with intelligent pigs to periodically assess pipeline condition. Intelligent pigs are instrumented plugs that are pumped down the pipeline to assess pipeline integrity through detection of pipeline wall loss due to corrosion and wear. This is consistent with transport pipelines designed in accordance with ASME B31.4 and with the anticipated regulatory guidelines for the proposed pipelines.

The components of the design are outlined below and described further in the following sections:

- The design basis for the tailings corridor is a concentrator average daily throughput of 132,000 stpd.
- Scavenger tails will be pumped from the tailings thickener to the TSF through a thick wall, high grade carbon steel pipeline.
- The pyrite tails will be pumped all the way to the TSF through a HDPE lined steel pipeline.
- Return water from the TSF will be pumped back to the process plant through a standard wall, carbon steel pipeline.
- The pipelines will be buried to the extent practicable.
- An access road will be constructed generally adjacent to pipelines, running along the same corridor except those areas with limited access, such as tunnel, bridge, and water crossing segments.
- Associated channels and culverts would be designed to allow passage of storm water to maintain existing upland runoff and major drainage paths that cross the corridor.
- Pipe bridges will be constructed where required to cross major drainages or washes.
- Overhead power lines will be constructed in the same vicinity generally parallel to the pipeline corridor.

2.2 Proposed Route

The tailings corridor route from the plant site to the TSF will accommodate separate pipelines for the transport of Scavenger tailings, pyrite tailings, and return water. An access road will be constructed adjacent to the pipelines and parallel overhead power lines to permit inspection of the pipeline right-of-way during operations.

The route includes a tunnel, pipeline bridges over substantial drainages or canyon, and various water and road crossings. The terrain is mountainous with a varying degree of drivability. Specific crossing designs for US Highway 60, Devil’s Canyon, Queen Creek, and the Mineral Creek have been developed and can be done using either aerial span (pipe bridge) or with trenchless crossing techniques. Bridges will be designed to span across the channel or canyon with no obstructions to ordinary high-water mark, trails, and roads and to minimize disturbance.

In general, longitudinal slopes are kept as low as practicable, bridge crossings are extended to avoid the ordinary high-water marks of major drainages and providing horizontal and vertical alignments that optimize the cut-and-fill balance as much as practicable, eliminating the need for long hauls of excavated or borrow materials. It was assumed that excavation slopes will average 1H:1V with fill slopes of 1.5H:1V.

A 500-ft wide corridor was used in the horizontal alignment. This will provide suitable distance to change the direction of or bend the selected pipes within their specified criteria. These curves allow a smooth transition of flow in select sections of the tailings pipeline.

The corridor will also include a gravel access road for inspections, maintenance, and repairs activities. Power for the tailings and recycle water systems along the corridor will be provided by solar power systems installed along the tailings corridor. Due to the low cost and maintenance requirements, solar power systems are selected to provide power for pipeline corridor facilities over multiple transformers to draw power from the parallel high voltage power transmission lines. The corridor will also include a multi-fiber optic cable for communication and instrumentation to support leak detection monitoring of the pipelines.

2.3 Drainage

Suitable drainage of the tailings corridor is essential in maintaining the integrity of this system. In general, all upland storm water runoff will be allowed to continue flowing down gradient within existing drainages via drainage culverts under the corridor. Where it is not practical to install a culvert along the alignment of an existing stream (e.g., where the corridor is in a cut), or where the discharges are small, runoff will be collected in the up gradient diversion channel and conveyed parallel to the corridor for conveyance through culverts placed at desired locations. Design of the drainage facilities and culvert sizing for major drainage paths under the corridor will need further optimizing.

2.4 Pipelines

2.4.1 Design Codes and Standards

Pipelines will be designed, manufactured, constructed, commissioned, and maintained in accordance with ASME B31.4 – Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids. The American Society of Mechanical Engineers (ASME) has been defining piping safety since 1922. Since then, the B31.4 code has become the governing code in the industry to prescribe requirements for the design, materials, construction, assembly, inspection, testing, operation, and maintenance of liquid pipeline systems between facilities (also called out-of-fence pipelines). For decades, numerous pipeline designers, owners, regulators, inspectors, and manufacturers have used B31.4 code to comply with applicable regulations within their jurisdictions.

Although tailings is not a hazardous liquid, additional applicable requirements specified in CFR Title 49 Part 195 – Transportation of Hazardous Liquids by Pipeline and will be implemented. This Part prescribes safety standards and reporting requirements for pipeline facilities used in the transportation of hazardous liquids. Primary industries served include most if not all long distance, cross country onshore pipeline systems that highly volatile liquid, transport crude oil, and other refined liquid petroleum products.

The combination of ASME and CFR represents the common practice for the design, construction, and maintenance of long distance hazardous liquid pipelines (i.e. hydrocarbon-based liquids) in United States and it certainly has a higher standard and more stringent requirements than other widely used non-hazardous liquid pipeline codes and standards (such as American Water Works Association, also called AWWA). Therefore, RCM pipelines will be designed, constructed, and maintained according to ASME and CFR, which would represent best practice in industry.

Furthermore, the pipeline systems will comply with applicable local regulations and standards, including Arizona Department of Transportation (DOT) rules. Where there is a conflict or discrepancy between any applicable codes and standards, the most stringent requirement shall apply.

Please refer to additional pipeline design codes and standards in Appendix A – Design Criteria.

2.4.2 Scavenger Tailings

The scavenger tailings pipeline is designed for 60-65% solids slurry. The slurry flow velocity is designed to exceed the expected settling velocity.

The scavenger tails will be pumped from the tailings thickener underflow through pipelines to the TSF. As the pipeline is likely to slowly erode due to some coarser particles in the slurry, a 1.25-inch (thickest pipe for pipeline construction) will be used. Pipe thicknesses will provide at least 21-year operating life based on a conservative estimate of corrosion and/or erosion potential in the pipeline. Regular intelligent pig inspection of the line will verify the rate of metal loss and may result in a longer pipe service life.

The selection of suitable pipe material for the steeper sections of the pipe will control the slurry velocity without the need for drop boxes. Controlling the velocity will help reduce the potential erosion of the pipe as well as safety screens to remove oversize material prior to entry into the pipeline. Drop boxes were eliminated as an environmental and safety improvement as presented in the original GPO to reduce the potential for leaks and eliminate wildlife and human contact with tailings as the drop boxes are open to the atmosphere. The removal of drop boxes from the design also allows for the access road to follow the same grade as the pipes, making visual inspections and maintenance easier and more effective and reduce overall disturbance.

2.4.3 Pyrite Tailings

The pyrite tailings pipeline was designed for a pumped flow of 45-50% solids. The slurry flow velocity exceeds the expected settling velocity. The pyrite tails will require pumping in series through a pipeline to the tailings impoundment. The pyrite slurry is fine particles which will not wear the steel pipe; however, the presence of pyrite creates are risk of a high corrosion rate in the line resulting in the addition of an internal HDPE liner as a corrosion barrier.

2.4.4 Return Water

The return water pipeline recycles water from the tailings and thickeners to a return water tank at the TSF site. From here, the system requires pumping to return the water to the concentrator for reuse.

2.4.5 Pipe Material

The following types of pipe are used in the design:

- Heavy Wall/High Grade Carbon Steel – The majority of pipelines for conveyance of scavenger tailings and recycle water will be comprised of heavy wall, high grade steel.
- HDPE-lined steel pipe will be used for transporting pyrite tailings to mitigate corrosion to negligible levels.

2.4.6 Pipe Installation

Except pipeline sections inside tunnel, at special crossings or facilities, open-cut installation method will be used for buried line pipe construction along the corridor. At intermittent facilities, piping will be installed above grade supported by pipe supports. The piping will be properly anchored at connections to rigid structures such as the tailings head tank. Expansion joints will be provided in cases where steel pipes need to be connected to rigid structures, as required.

2.5 Access Roads

The tailings corridor includes a gravel-surfaced access road running adjacent to the pipelines to provide access between the concentrator and the TSF. In fill areas, an earthen safety berm will be constructed alongside the road.

A wheel wash will be provided at the TSF end of the tailings corridor to ensure contact tailings material on site vehicles is removed before travelling along the corridor access road.

2.6 Tunnel

Drill-and-blast tunneling method is considered as the preferred construction method due to the relatively short-tunnel length. The tunnel cross-sectional area is nominally 15-ft wide by 15-ft tall horseshoe shaped. This tunnel size will not only provide adequate space to accommodate four operating and two replacement tailings pipelines, but also allow 24/7 access for construction and maintenance equipment.

2.7 Pipe Bridges

Pipe bridges will be constructed along the tailings corridor alignment to span major drainages outside of the ordinary high-water mark, including bridges over Queen Creek and over Devil's Canyon.

The pipe bridges would include a walkway and a vehicle access for inspections and maintenance purposes.

Steel piping on the pipe bridges will be designed to have sufficient flexibility and strength to accommodate its own expansion/contraction as well as the bridge's maximum deflection caused by the thermal expansion.

2.8 Road Crossings

The pipeline crossings at public or private roads will be designed to accommodate both the pipeline and road requirements in these areas. All pipelines at road crossings will be designed in accordance with API RP 1102.

All road crossing pipe segments of this corridor will be uncased. Uncased pipe is preferred than cased pipe due to various reasons. Recent comparative studies of scheduled or immediate responses/mile versus number of repairs from an Interstate Natural Gas Association of America (INGAA) study and the US Pipeline and Hazardous Materials Safety Administration (PHMSA) database suggests cased pipe segments are less safe than uncased segments. In addition, operational maintenance and the integrity of uncased crossings are better maintained due to not having the casing around the pipeline. Common casing pipe issues include failed casing end seals that let water and mud into the casing, or casing and spacers for the pipeline to short against partial electrolytic contact (water) and cause corrosion.

3.0 FAILURE MODES ANALYSIS

3.1 General Description

Pipelines have the potential to fail for several reasons, resulting in leaks or release of slurry. The most common causes of pipeline failure are outlined below. The prevention measures, to reduce the chance of failure, are identified in the risk assessment (Section 3.3) and further detailed in Section 4.0 of this plan.

3.1.1 Mechanical

Mechanical failures include punctures, cuts, crushing, and separation. The cause of these failures is primarily accidental impact from construction or operations equipment. A small number of mechanical failures are the result of manufacturing defects or inferior materials.

3.1.2 Operational

Operational failures include separation, collapse, accidental release, or failures related to pipe movement. An overpressure event will cause ruptures or separation at joints or equipment connections.

3.1.3 Corrosion and Erosion

Corrosion is a natural process that converts a refined metal to a different form, such as an oxide, hydroxide, or sulfate. It is the gradual destruction of metals by chemical reaction with their environment. Corrosion may be pitting, weld decay, crevice corrosion, and microbial corrosion.

Wear or abrasive erosion is defined as the gradual and progressive loss of material due to the relative motion between the pipe wall and a fluid containing solid particles. The magnitude of wear depends on the angle of impingement and the type of material being eroded.

Each of these can result in leaks and potential pipe failures if the pipeline segment is not repaired or replaced before becoming too thin.

3.1.4 Natural Hazards (Geohazards)

Natural hazards are events or processes in nature that can result in damage from ultraviolet light, rainfall, flooding, landslides and other geohazards such as seismicity, wind, lightning strikes, plants, and animals.

Geohazard assessment along the length of the pipeline corridor was completed and is contained in Appendix B.

3.1.4.1 Slope Instability

Several locations along the corridor alignment have been identified as having low to moderate potential for slope instability. All locations should be included in a slope monitoring program for the mainline, whereby site inspections are performed and measurements with geotechnical instrumentations are taken regularly to monitor slope performance.

3.1.4.2 Seismic

Common seismic risks include ground shaking, liquefaction, and surface fault rupture. The corridor alignment is located in an area of apparent low historical seismic activity and appears to have low potential for damage from future seismic activity.

The projected 475-year return period peak ground acceleration (PGA) values are low, averaging between about 0.04 g along most of the route, which is within the “low” hazard classification for seismic shaking. Ground motions at these levels are unlikely to produce structural damage to the pipeline. Conditions suitable for liquefaction are likely to be limited along the proposed pipeline alignments, due to the regionally dry climate and typically dry soil conditions for at least the first few feet of the subsurface. In addition, no active faults in the vicinity of the alignment were identified in any of the references reviewed.

3.1.4.3 Scour Potential

A number of watercourse crossings along the corridor alignment have been identified as exhibiting high potential for lateral and/or vertical scour. The integrity of the pipeline will be maintained by mitigation measures and design features to prevent this occurrence include appropriate depth of cover at watercourse crossings, crossing in non-saturated reaches, completely spanning the water course outside the OHWM (Queen Creek and Devil's Canyon) or going under the watercourse outside the OHWM (Mineral Creek).

3.1.4.4 Ground Subsidence

Potential hazards of ground subsidence have been identified across the conversion alignment, and include:

- underground mine areas near shaft 9 and 10
- potential and/or known karst areas and features near the Concentrator Site
- potential subsurface fluid withdrawal-related subsidence areas

Some areas along the alignment have been classified as having "moderate to high" potential for ground subsidence due to their close proximity to the underground mine subsidence. These areas will be further studied to observe on or in the immediate vicinity of the proposed corridor using aerial reconnaissance and will be monitored regularly during aerial patrols and ground inspections, as part of pipeline integrity management plan.

3.1.5 High Consequence Area (HCA)

This pipeline corridor has applied the concept of high consequence area (HCA) from US pipeline safety regulations (49 CFR Part 195). Due to the existence of critical habitats (such as Gila Chub), the mineral creek crossing is considered as the high consequence area.

Trenchless crossings are proposed at this location to drill below grade through state owned land and forest service land directly and will start and end outside the OHWM and critical habitat boundaries. Additionally, this area of the crossing is outside the saturated reach of Mineral Creek. Trenchless crossing is currently the preferable option to avoid disturbance of the critical habitats in the area and to mitigate the sour potential risk at this water crossing location.

3.1.6 Third-Party Damage

Third-party damage can be categorized as intentional / malicious damage, accidental damage, and incidental damage. Intentional / malicious damage would be the result of theft or intent to cause harm; historically there have been issues with people in the area shooting at objects for target practice. Accidental damage can take many forms including damage from private vehicles hitting the pipeline. Incidental damage is defined as damage to a pipeline that does not cause an immediate leak or failure but results in a failure over time.

3.2 Frequency of Failure

Historical data related to causes and frequency of failure of pipelines in Western Europe[1] were used in identifying the probability of failure. Conditions causing pipe failure under given circumstances are similar around the world, and this information on failure frequency is considered suitable for use in this analysis. It has been demonstrated that overland pipeline failures occur less than 0.01% of the time, generally as a result of third-party accidental, mechanical, and operational issues. Most of the time, 50% to 90%, these failures result in a leak size of 0.4 inches or less. Full-bore failure is usually caused by natural hazards but is the least frequent of the failures (0.001%).

3.3 Failure Modes Assessment and Mitigation Matrix

A matrix was developed for the pipelines running through the tailings corridor to align the hazard with potential failure modes with measures and design features to manage and minimize the failures during construction and operation. The matrix identifies how and where hazards and failure modes could originate and identify design features, preventive measures, and management strategies for the pipelines. The matrix is shown in Table 1. Additional pipeline design parameters, codes, and standards are included in Appendix A – Design Criteria.

Spill prevention and detection are the most important environmental aspects of the pipelines. The proposed corridor infrastructure and operational controls take these considerations into account over the entire alignment.

Best practice environmental protection measures and controls will be implemented to prevent leaks and spills from the pipelines. Preventive measures will be put in place and procedures followed throughout the life of the facility—from construction and operation. The proposed controls identified for each phase of work are outlined in the following section.

Quality assurance practices will help ensure the planned control measures are met during each phase. Equipment, materials, and the development of management plans will be in accordance with best practice design codes and standards covering the following:

- pipeline treatment and testing
- inspection procedures during fabrication
- identification of specific product parameters
- fabrication and welding control
- pipe coating inspection and testing
- valve manufacture and testing
- pipeline hydrotesting
- advanced pipeline control and monitoring system including leak detection
- routine pipeline inspection including internal intelligent pig runs to verify pipeline integrity

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[1] Data source – Consideration of Clean Air Water in Western Europe Report 98: Western European Cross-Country Oil Pipelines 25 Years Performance Statistics, June 1988 and European Gas Pipeline Incident Data Group.

- routine pipeline right-of-way inspections.

Table 1: Failure Modes and Mitigation Measures Matrix for Tailings Corridor Pipelines

Category	Potential Failure Mode	Defensive Design and Operational Measures	Details in Section
Geohazards	Landfill and Rock fall / Pipe damage, spill, and shutdown	• routing adjustments to avoid unstable slopes • slope stabilization, grade, revegetation, as required • implement best management practices (BMPs) and best construction practices (BCPs) • conduct field assessments to confirm and characterize each location and its potential associated hazards • conduct routine pipeline corridor inspections	**4.2.1, 4.2.2, 4.5.4**
	Seismic – ground shaking. Liquefaction, surfaces fault rupture / pipe damage, spill, and shutdown	• use heavy wall and high-grade carbon steel pipe • optimize trench dimensions and fill materials to minimize the additional stresses, as needed • specially designed aboveground fault crossings, if necessary • conduct routine pipeline corridor inspections	**4.2.1, 4.2.2, 4.2.3, 4.5.4**
	Ground Subsidence – Karst, Underground Mine, Fluid Withdrawal / Pipe damage, spill, and shutdown	• cross several areas of low to moderate subsidence hazards • a site-specific geophysical survey be completed to approximate the extent of any subsurface voids if they exist prior to construction • implement best management practices (BMPs) and best construction practices (BCPs) • conduct routine pipeline corridor inspections	**4.2.1, 4.2.2, 4.5.4**
Hydrology and Hydrogeology	Hydrotechnical Hazards / exposed pipeline in water streams and pipe damage, spill, and shutdown	• small re-routes for an improved pipeline alignment • deeper burial and/or placement of the pipeline into bedrock • channel armoring, in-channel structures, protective coatings, and erosion control measures • buoyancy control and pipeline protection measures • conduct routine pipeline corridor inspections • Trenchless crossing and/or pipe bridge span across major waterways (Queen Creek, Devil's Canyon, Mineral Creek) • locate crossings over major waterways outside areas of saturated reaches and perennial flow	**4.2.1, 4.2.2, 4.5.4**

Category	Potential Failure Mode	Defensive Design and Operational Measures	Details in Section
Hydrology and Hydrogeology (con't)	Sediment and erosion / exposed pipeline in water streams, pipe damage, spill, and shutdown	• gravel surface in pipeline corridor & road • upland runoff diverted to channels and culverts designed to 100-year discharge flow rates • revegetation as soon as practicable • sediment and erosion control – plan developed / equipment in place / team trained • conduct routine pipeline corridor inspections	**4.2.5, 4.3, 4.5.4**
Environment	Pipeline construction impact critical road, terrestrial or endangered aquatic biota	• cross environmental sensitive areas using other construction methods such as pipe bridge (Queen Creek, Devil's Canyon) or trenchless crossing (Mineral Creek) to avoid surface disturbance • cross highway 60 using horizontal directional drilling or boring to avoid traffic interruption • cross major waterways outside of the ordinary High-Water Mark (Queen Creek, Devil's Canyon and Mineral Creek) and outside critical habitat designations (Mineral Creek Gila Chub) • locate crossings over major waterways outside areas of saturated reaches and perennial flow	**4.2.6, 4.2.7**

	Threat of release of tails water or reclaimed water into environment	• compliant 24/7 leak detection / flow monitors in place
		• allow quick access for repairs
		• implement comprehensive pipeline integrity program that includes:
		    o maintain records for all available information about the integrity of the entire pipeline
		    o regular review of leak monitor data
		    o regular corridor inspections
		    o regular internal inspections using "smart-pigs"
		    o spill response – plan developed / equipment in place / team trained
			4.2.4, 4.2.5, 4.2.8, 4.6

Category	Potential Failure Mode	Defensive Design and Operational Measures	Details in Section
Construction Quality	Poor installation or welds results in pipe spills and shutdown	• QA/QC system in place during construction per various applicable codes and standards • conduct post-construction hydrotest in accordance with ASME B31.4 to prove the pipeline integrity • regular internal inspections using “smart-pigs” to monitor pipeline conditions	**4.2.3, 4.4, 4.5**
Operation and Maintenance	Planned or unexpected shutdowns results in tailings line blocking	• optimize route to keep pipe slope less than 15% as much as practicable • build pipeline tunnel to penetrate steep slope mountain ridge and maintain acceptable slope • flush tailings pipe regularly or during shutdowns either using backup power or emergency flush tank	**4.2.1, 4.5.5**
	Failures of pipeline corrosion control systems	• monitor pipeline external corrosion resistant coating • survey cathodic protection system that covers the entire pipeline length	**4.5.2**
Security	Malicious damage, vandalism or terrorism results in pipe damage, spill, and shutdown	• bury pipeline along the corridor as much as practicable • fence / gates at required locations, such as facilities, tunnel, bridge, etc. • maintain signs visible to the public around each facility, tunnel, bridge, road crossing, and water crossing location • conduct routine pipeline corridor inspections	**4.5.3, 4.5.4**

4.0 PREVENTION AND DETECTION OF PIPELINE FAILURES

4.1 General

Management of pipeline environmental protection involves various activities and procedures at different phases of the project. The success of the protection controls is highly dependent on thorough integration of the environmental objectives into the design of the pipelines and on proper implementation of spill monitor and control features, both during installation and when the pipes are operational.

4.2 Design Control Measures

All pipelines are designed in accordance with the relevant standards and guidelines, as listed previously in this document. The following control measures have been incorporated or taken into consideration in the design of the tailings corridor.

4.2.1 Pipeline Route Selection

If the pipe slope is too steep during a shutdown, the settled solids will slide down into the lower sections of the pipeline. Restart will generally be more difficult in such conditions since the entire cross section of the pipe at the bottom of the slope will be occupied by the solids. Therefore, the route has been optimized to maintain pipeline slope less than 15% as much as practicable.

In the Kings Crown Peak where it is impractical to maintain acceptable pipeline slope, multiple pipeline tunnel options were proposed and evaluated based on constructability, landowner feedbacks, and cost. The most suitable tunnel route has been selected to penetrate the ridge with a slope less than 15%.

Various regulators, agencies, communities, and landowners have been engaged, in particular during the DEIS comment period and during working group meetings. Pipeline route has been adjusted based on this feedback

The pipeline route will be optimized within the ROW to minimize environmental impact by reducing and balancing the amount of cut-and-fill and total overall disturbance. As much as is practicable, fill needs will be met with existing material on site, resulting in less disturbance.

Bends will be designed to minimize ground disturbance to the extent practicable and provide suitable distance to change direction or bend the selected pipe within their specified criteria without increasing risk of leaks.

4.2.2 Geohazards Mitigations

4.2.2.1 Unstable Slope Hazards

Slope instability is the most significant geohazard that could adversely affect safe operation of the pipeline. Geohazard assessments will be completed prior to construction along the selected alignment to identify locations where signs of active or historic landslides have been observed.

In locations where stability is a concern, site-specific geotechnical investigations will be carried out to understand the extent and characteristics of the instability for the purpose of selecting appropriate mitigation measures that could include:

- routing adjustments to avoid unstable slopes
- implementation of slope stabilization measures, including horizontal drains and/or toe buttressing, where applicable

- implementation of erosion protection measures, particularly at toe areas of watercourse crossings
- adapting construction methods to minimize surface disturbance and avoid reactivation of old slides
- selection of heavy wall pipe to increase the capacity of the pipeline to accommodate additional strains potentially induced by slides
- selection of low friction backfills to minimize the impact of potential slides, where required and applicable
- selection of reduced depth of cover to minimize the impact of potential slides and to facilitate strain relief, if necessary

4.2.2.2 Hydrotechnical Hazards

Where high potential for scour has been identified at watercourse crossings, engineering assessments will be done to formulate possible mitigation measures, including:

- routing adjustments to avoid areas of high energy concentration, if applicable
- additional depth of cover, extended zone of deep burial to accommodate potential scour, or both
- bank and bed protection using rip-rap materials
- pipe protection such as concrete coating and pipe shield, where applicable

Other construction methods, such as pipe bridge and trenchless crossings, are also considered to cross over major drainages above and outside the ordinary high-water mark of those drainages (i.e. Devil's Canyon, Queen Creek, Mineral Creek). Other major drainage channels along the corridor are designed to direct all adjacent natural runoff towards culverts that will control flow through the project site. These drainage structures are provided at fill areas to handle the runoff from storms and minimize the impact on existing natural water courses.

4.2.2.3 Seismic Hazards

Seismic events are typically not direct integrity threats to the pipelines, provided that the pipeline does not cross active faults. No records or signs of active faults have been identified along the selected pipeline alignment in the two seismic hazard evaluations completed for the area covering the pipeline and additionally, no active faults have been identified during field geotechnical investigations.

If signs of active fault zones are identified during construction of the pipeline, the following mitigation measures may be implemented depending upon the site conditions:

- heavy wall pipe to increase the capacity to accommodate additional stresses caused by differential movement in active fault zones
- increased trench width in combination with low density fill materials to minimize the additional stresses
- reduced depth of cover to minimize the additional stresses
- specially designed aboveground fault crossings, if necessary

4.2.2.4 Subsidence Hazards

If subsurface voids are encountered around any of these areas during pipeline construction, or are suspected to be present anywhere beneath the proposed pipeline, then a site-specific geophysical survey will be completed to approximate the extent of any subsurface voids and evaluate whether additional actions should be taken. If these conditions are not encountered or suspected, then no special actions will be taken beyond implementation of BMPs and BCPs during pipeline construction.

Please refer to Appendix B – Geohazard Assessment for additional details.

4.2.3 Pipeline Materials and Welding

The pipe will be made of carbon steel, low alloy-high strength that is able to withstand the internal pressures and external loads and pressures anticipated for the pipeline system. All mainline pipes in the corridor are designed with a nominal wall thickness of 1.25 inches and grade X70. The pipeline materials and thickness are selected specifically to maximize its life span and reduce pipeline replacement requirements.

All pipeline and fitting welding will be performed by a qualified welder or welding operator in accordance with welding procedures qualified under approved standards. Each welding procedure will be recorded in detail, including the results of the qualifying tests. This record will be retained and followed whenever the procedure is used.

Each weld will be inspected to ensure compliance with the engineering requirements. The weld inspection will be a visual inspection supplemented by suitable nondestructive testing.

4.2.4 Leak Detection

One of the main risks identified for the project is the potential to release either tailings or return water to the environment. The tailings and return pipelines will be monitored to detect leakage. The monitoring information will be used for alarm, interlock, and reporting functions. Multiple types of monitoring will be applicable to accommodate differing pipeline applications, the pipe installation, and to provide redundancy in the system.

The following methods will be used:

4.2.4.1 Flow and Pressure Monitoring

- Flow monitoring of recycle water and tailings lines will occur continuously. Measurements from each end of the pipelines will be input to the plant control system, and the values will be compared to evaluate leakage in the system. Pressure measurement and installation will be selected to suit each application with measuring points along the pipeline to support operation and the leak detection system.
- Closed-circuit television (CCTV) cameras at critical locations. Images will be available for recording / logging and will be displayed on monitors in the plant control room, security office, or other locations, as part of overall plant CCTV system.
- Regular inspections of complete pipeline system, system components (tunnel, bridge, etc.), and right-of-way.

4.2.4.2 Communications

Information will be delivered from the monitoring systems to the plant control systems using multiple methods:

- Pressure, flow, and density measurement analog signals using hard-wired connection to control system input modules at each end of the pipeline.
- CCTV as part of the fiber optic cabling / communications network.

4.2.4.3 Remote Monitoring Stations

It is estimated that three remote monitoring stations will be installed along the pipeline to collect information to support pipeline operation and monitoring (notably leak detection). Pressure will be measured in all pipelines at each station and transmitted to the central control room to verify proper operation. Estimated locations are at tunnel outlet, high point, between high point and skunk camp.

This will be a small building with roof-top solar to supply needed power. All parameters for the site will be monitored including but not limited to solar charging rate, battery status, building entry alarm to ensure proper function and security for the remote equipment. These alarms would allow RCM actions to correct if problems noted (such as theft of solar panels).

4.2.5 Access Roads

The pipeline corridor service road will run along the full length of the pipelines, at the same grade, to provide access between the concentrator and the TSF. The road will be interrupted at sensitive crossings (Queen Creek, Devil's Canyon and Mineral Creek) such that drive-around access will be required in some locations. The proposed road is designed to readily accommodate regular inspections and intermittent maintenance of the pipelines. This road will be designed to allow all-weather access and to prevent scouring and erosion. The pipeline corridor will be designed to allow for uninterrupted ranching and recreational use of existing Forest Services roads and to allow wildlife to pass through the area.

To reduce the risk of mechanical failure, the intent is to bury the pipeline along the entire length. Any section of the pipeline that is above ground will be buried or have on-surface barriers to prevent contact with equipment and vehicles. Additionally, the designated access road will ensure vehicles can travel along the length of the corridor separated from the above ground pipelines to prevent interaction.

Where required, fencing and gates will be installed to restrict public access and wildlife along the corridor and access road. Proper depth of cover and soil compaction will be maintained for the pipes where roads cross the pipelines.

The tailings corridor access road slopes away from the pipelines. This is combined with cutoff drains and bund walls that run along the length of the corridor into existing drainage paths. Rock protection will be provided for all drainage structures.

4.2.6 Trenchless Crossing

Environmental and engineering considerations are used to determine that trenchless construction would be the appropriate crossing methodology.

Trenchless crossings avoid traffic interruption, or in-stream works and ditching activities in the beds and banks of watercourses and avoid surface land disturbance. They can be installed in a number of different geotechnical conditions.

4.2.7 Pipe Bridge

Pipe bridges are proposed to cross Queen Creek and Devil's Canyon based on a combination of environmental and engineering considerations. Bridge will be selected to span the required widths with no obstructions, to minimize disturbance, and without the need for any intermediate supports along their length. The bridges across these two locations will be constructed outside of the ordinary high-water mark. This reduces environmental impact by minimizing disturbance and `eliminating any obstruction within the valleys and drainages.

A preliminary feasibility study of various pipe bridge options was performed to establish the preferred bridge type. Key considerations are site topography, constructability, environmental impact, and cost. Based on its advantages in constructability, minimum environmental impact, and least construction cost, the catenary cable bridge type is the recommended bridge type to build. The pipe bridge design will consider a maintenance vehicle path with enough width and load capacity to accommodate an H-10 service truck. This will allow quick responses any maintenance needs.

4.2.8 Corrosion Control Elements

The pipelines will be installed with an outer coating to prevent corrosion from ambient conditions in the pipe trench along the corridor. The primary coating for the external surface of the belowground pipe will be plant-applied fusion bonded epoxy. Field girth welds will be protected with a compatible liquid-applied coating. Abrasion-resistant coating will be used where pipe is installed using boring, drilling, or other methods that could cause abrasion to the coating during installation.

Additional mechanical protection systems such as sand padding, rock jacketing or rock shield will be used if large and/or angular backfill material is encountered.

In addition to the pipe coating, an impressed current cathodic protection (CP) system will be installed for the pipelines. The system will include ground beds and rectifiers. Where practical, the ground beds and rectifiers will be located at facility or remote sites where a convenient source of electrical power exists. Sacrificial anodes may also be used at specific locations.

Test points will be installed, where required, along the pipeline and at road, foreign pipeline, and utility crossings. These will allow the effectiveness of the operation of the system to be monitored during operation.

As high Voltage power line (115kV) will now be co-located with the pipeline within the same right of way, supplemental protection from induced alternating currents (AC) which could contribute to accelerated corrosion will be incorporated. This additional protection will comprise strategically placed anodes located in areas where the pipeline in the vicinity of the towers.

4.3 Stormwater Management

Before construction begins a stormwater pollution prevention plan, incorporating sediment and erosion controls, will be developed to describe how control measures are to be implemented and inspected, and to outline any requirements for analytical monitoring and recording. This will ensure that any areas prone to erosion and sediment flow during storms will be suitably controlled and stabilized, with drainage collection and diversion measures in place. A spill prevention and control plan will be prepared for both construction and operations, describing specific procedures for inspections, maintenance, incident actions and reporting, and emergency response.

4.4 Construction Control Measures

All pipelines will be fabricated and tested in accordance with the requirements of ASME B31.4 for quality assurance and quality control purposes. All pipelines will be tested using clean water at a test pressure that exceeds the maximum operating pressure to prove the pipeline system has adequate strength for operating conditions without leakage. The test records will be retained if the pipeline system tested is in use.

It is planned to construct the access road along the corridor first, together with drainage structures and sediment controls, so that the installation of pipelines, bridges, and other corridor facilities can proceed along a managed, contained access-way.

Daily activities during construction will include visual inspections as part of a routine monitoring program, good housekeeping, erosion control maintenance, pipeline construction QA/QC, and any necessary repairs. Similar activities, at an increased frequency, will be required during and after rainfall events.

Where required, fencing and gates will be installed to restrict public access and wildlife along the corridor and facilities. Signs will be maintained visible to the public around each facility, road crossing, water crossing, bridge, and tunnel. Each sign will contain the name of the operator and a telephone number where the operator can always be reached.

4.5 Operations Control Measures

Pipeline integrity is governed by its physical characteristics, its environment, and its operation and during operation, the pipeline will be managed by implementing the appropriate prevention and control measures and following a standard management approach (plan, implement, monitor, review, and revise). QA/QC systems will be in place to monitor operational compliance.

4.5.1 Internal Inspection Pigging (intelligent pigging)

Pigging in the context of pipelines refers to the practice of using devices known as “pigs” to perform various maintenance operations. This is completed without stopping the flow of the product in the pipeline. Pipeline pigs are devices that are placed inside the pipe and traverse the pipeline.

Internal inspection pigging is used primarily for defect monitoring, which enables potential problems to be identified and rectified well before leaks occur. Intelligent pigging is used as a tool for prevention of a leak by providing an assessment of pipeline integrity.

Intelligent pigging is carried out during the early period of pipeline operation to provide a baseline record of the pipe wall thickness and any anomalies that are present. Subsequent pig runs, as part of routine operations and preventive maintenance programs during the life of the operation, will identify any changes in wall thickness and the need for repairs.

4.5.2 Corrosion Protection Survey

A comprehensive aboveground coating evaluation survey shall be conducted on the mainline pipelines within 18 months but not sooner than 6 months following backfill to allow for settling and compaction.

This inspection is necessary to accomplish the following:

- Hold construction Contractors to quality metrics
- Identify pre-operation corrosion threats
- Identify regions where supplemental Cathodic Protection may be necessary
- Provide a catalogue of coating defects, including tabulated coordinates having minimum sub-meter accuracy that can later be correlated with future metal loss ILIs and close-interval Cathodic Protection surveys

Cathodic protection systems require periodic maintenance and testing to ensure that they are functioning properly. Generally, monthly checks are required to inspect exposed system components to ensure that equipment is intact. Potential damage to test stations, junction boxes, rectifier, or connections will be identified and repaired. Detailed yearly inspections and testing must be performed by qualified personnel, and the records should be reviewed by a qualified corrosion professional with follow up repairs completed by corrosion specialists.

4.5.3 Continuous Monitoring and Management

The operators will monitor flow, density, and pipeline pressures at selected locations in accordance with methods described in Section 4.2.4. A process-based pipeline leak detection system will be included with the control software and will continuously monitor conditions to identify any change that might indicate a potential leak. The operators will be notified of any potential event to permit immediate investigation.

A manual of written procedures will be prepared for conducting normal operations and maintenance activities and handling abnormal operations and emergencies. This manual will be reviewed regularly, and appropriate changes made as necessary to ensure that the manual is effective. This manual will be prepared before initial operations of a pipeline system commence.

4.5.4 Route Patrols

Regular patrols along the pipelines is a practical method of assessing all areas of the pipeline route. They are a visible reminder to people in the area of the presence of the pipeline and play a key role in preventing pipeline faults through third-party incidents. The patrols will ensure effective operation of the tailings corridor facilities and check for anomalies such as:

- pipeline leaks
- drainage sediment build-up, blockages and washouts
- access road erosion and damage
- pipe bridges and over / underpass damage
- landslides
- third party interference
- other potential hazards.

In addition to continual monitoring of pressure, flow, and leaks as well as CCTV monitoring, the pipelines will be patrolled to check for leaks and hazards and to ensure the security of the system. Consistent with CFR 49 Part 195, the route patrol will be conducted at intervals not exceeding 3 weeks, but at least 26 times each calendar year, to inspect the surface conditions on or adjacent to each pipeline right-of-way and each crossing under a navigable waterway will be inspected to determine the condition of the crossing. Methods of inspection include walking, driving, flying or other appropriate means of traversing the right-of-way.

4.5.5 Tailings Line Flushing

The tailings pipelines and recycled water lines will be flushed periodically using process water from the concentrator site to minimize line blocking and to align with regular preventive maintenance requirements.

During unexpected shutdowns, tailings lines should also be flushed to reduce the system start-up risk. Tailings lines can either be flushed from the concentrator site using emergency backup power supply or be flushed, as required, by the water stored in the flush tank placed at the high point.

4.6 Spill Response

RCM's General Plan of Operations includes information to be included in a Spill Prevention and Control Plan. Although spill response plans are developed to reflect specific facility designs, they generally include the following components:

- description of site operations
- leak detection procedures
- facility drainage systems
- spill prevention measures
- spare pipe, pipe clamps and other strategic supplies
- emergency and spill response and cleanup procedures
- spill reporting and notification procedures
- employee training and team drills.

RCM will have operators and staff working 24 hours per day throughout the life of the mine. Additional staff will be available on an emergency basis if needed during night shifts. Staff members will be supplied with radios for instant communication with the control room and other staff. The mine will own all necessary equipment or have contractors readily available on site for repair of a pipeline failure. Spill response kits will be stored at both ends of the tailings corridor, at the concentrator area, at the tailings administration complex, and also on the pipe bridges. The pipeline access road will provide reliable and immediate access to the full length of the line. If the situation requires additional resources or heavy equipment, they are readily available in nearby Globe-Miami or Phoenix / East Valley, Arizona.

Any suspected leak will be investigated. If a leak is identified, an appropriate prepared response plan will be initiated. This plan will include an evaluation of the need to stop the pumps or shut off the flow. Some leaks may be temporarily repaired safely without taking the pipe out of service. Any such temporary repair would be formally addressed during the next scheduled shutdown of the pipeline. Pipeline shutdowns are anticipated to be in line with concentrator shutdown timing.

Leaks will be evaluated by RCM staff to understand the root cause, quantity spilled, and regulatory reporting requirements.

Signature Page

Golder Associates Inc.

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WW/WJN

APPENDIX A

Design Criteria

APPENDIX A

DESIGN CRITERIA - RESOLUTION COPPER MINE SKUNK CAMP PIPELINE CORRIDOR

1.0 CODES, STANDARDS, AND REFERENCES

The following code, standards and references will be used by Golder for best practice design basis for the Skunk Camp pipeline corridor:

- API (American Petroleum Institute)
  - Standard 650 Welded Tanks for Oil Storage
  - Specification 5L Line Pipe
  - 6D Specification for Pipeline Valves
  - RP 1102 Steel Pipelines Crossing Railroads and Highways
  - RP 1130 Computational Pipeline Monitoring for Liquid Pipelines
- ASME (American Society of Mechanical Engineers)
  - B16.5 Pipe Flanges and Flanged Fittings NPS ½ through NPS 24 Metric/Inch Standard
  - B16.9 Factory-Made Wrought Butt Welding Fittings
  - B16.11 Forged Fittings, Socket-Welding and Threaded
  - B16.34 Valves – Flanged, Threaded, and Welding End
  - B16.20 Metallic Gaskets for Pipe Flanges – Ring-Joint, Spiral-Wound, and Jacketed
  - B31.3 Process Piping
  - B31.4 Pipeline Transportation Systems for Liquids and Slurries
  - ASME/BPVC SEC VIII-1 Section VIII Division 1 Rules for Construction of Pressure Vessels
  - ASME BPVC IX Boiler and Pressure Vessel Code (BPVC), Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operations
- ASTM (American Society for Testing and Materials)
  - A36/A36M Carbon Structural Steel
  - A105 Standard Specification for Carbon Steel Forgings for Piping Applications
  - A106 Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
  - A193 Standard Specification for Alloy-Steel and Stainless-Steel Bolting for High Temperature or High-Pressure Service and Other Special Purpose Applications
  - A194 Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure of High Temperature Service, or Both

- AWS (American Welding Society)
  - D1.1 Structural Welding Code – Steel Structural Welding Code – Steel
- AWWA (American Water Works Association)
  - M42 Steel Water-Storage Tanks
  - D100 Welded Carbon Steel Tanks for Water Storage
- CFR (Code of Federal Regulations)
  - 49 CFR Part 195 Transportation of Hazardous Liquids by Pipeline
- ICC (International Code Council)
  - IBC International Building Code
- NFPA (National Fire Protection Association)
  - 11 Standard for Low-, Medium-, and High-Expansion Foam
  - 30 Flammable and Combustible Liquids Code
  - 70 National Electrical Code
- MSS (Manufacturers Standardization Society)
  - SP 81 Stainless Steel, Bonnetless, Flanged Knife Gate Valves
  - SP 75 WPHY Pipe Fittings

2.0 SITE CONDITIONS

2.1 Design Temperatures

Based on the site location and ambient temperature changes throughout the year, the design temperatures assumed for this study are:

- Minimum Design Temperature: 0°F
- Installation Temperature: 60°F
- Maximum Design Temperature: 120°F

2.2 Design Life

The system design life is assumed to be 41 years per Mine Plan of Operations of Resolution Copper Mine.

2.3 Frost Depth

The site frost depth is 12 inches.

2.4 Mill Availability

The mill availability is assumed to be 92%.

3.0 HYDRAULIC ANALYSIS

3.1 Tailings Slurry Concentration

The weight percent solids and operating range solids concentration are determined by Resolution Copper Mine. The NPAG will be conveyed at a density of 60% solids and the PAG will be at 50% solids.

3.2 Design Throughput

Design flow rates for tailings slurry transport are calculated using the solid throughput along with the slurry specific gravity, calculated to be 1.73, and conversion factors. The tailings throughput would ramp up to 121,000 tons per day (tpd) for NPAG and 23,000 tpd for PAG by year 7 of the 41-year life of mine.

3.3 Tailings Particle Size Distribution

Physical characteristics of the PAG and NPAG tailings, both particle size distribution and rheology, are discussed below. These data were generated from bulk samples collected during past development activities and provided to Golder. The viscosity characteristics are will be adopted from the rheology data adopted from the Pilot scale testing.

3.3.1 NPAG Tailings

Table 2 shows the particle size distribution (PSD) for NPAG tailings that was used for the pipeline design. Table 3 presents the rheology for several ranges of percent solids. The specific gravity of the NPAG is 2.78.

Table 1: NPAG Tailings PSD

Size (µm)	US Mesh	Wt. % Retained	Cumulative Wt. % Passing	Cumulative Wt. % Retained
300	50	0.50	99.50	0.50
212	70	7.50	92.00	8.00
145	100	16.00	76.00	24.00
106	140	14.00	62.00	38.00
74	200	11.00	51.00	49.00
53	270	8.00	43.00	57.00
37	400	6.00	37.00	63.00
-37		37.00		
	Total	100%		

Note: Reference- Scavenger Tailings Cyclone- AVG Condition (KREBS)

- P_{95} - 244 microns
- P_{80} - 159 microns
- D_{50} – 71 microns

Table 2: NPAG Tailings Rheology

Percent Solids (Wt. %)	Coefficient of Rigidity (Pa)	Yield Stress (Pa)
72.4	0.210	45.4
70.7	0.121	33.5
66.9	0.054	14.1
60.9	0.022	4.3

Reference- Pocock 2015, Thickened Pyrite Rougher Tailings

3.3.2 PAG Tailings

Table 4 shows the particle size distribution (PSD) for PAG tailings that was used for the pipeline design. Table 5 presents the rheology for several ranges of percent solids. The specific gravity of the PAG is 3.5.

Table 3: PAG Tailings PSD

Size (µm)	US Mesh	Wt. % Retained	Cumulative Wt. % Passing	Cumulative Wt. % Retained
300	50	0.2	99.8	0.2
212	70	2.0	97.8	2.2
145	100	5.4	92.4	7.6
106	140	6.2	86.2	13.8
75	200	8.0	78.2	21.8
53	270	9.7	68.5	31.5
45	325	5.8	62.7	37.3
37	400	5.5	57.2	42.8
-37		57.3		
	Total	100%		

Note: Reference- Pyrite Tail Size Variability- Selective Flowsheet

- P_{95} - 177 microns
- P_{80} - 81 microns
- D_{50} - 31 microns

Table 4: PAG Tailings Rheology

Percent Solids (Wt. %)	Coefficient of Rigidity (Pa)	Yield Stress (Pa)
62.2	0.086	94.0
59.9	0.059	55.5
57.9	0.037	37.2
55.5	0.025	21.8

Reference- Pocock 2015, Thickened High Pyrite Tailings

3.4 Reclaim Water Properties

Reclaim water properties are assumed to be water properties at a fluid temperature of 70 degrees Fahrenheit.

3.5 Line Sizing Criteria

- Scavenger and pyrite tailings system

i) Maximum fluid velocity: 10 ft/s

ii) Minimum fluid velocity: 120% of calculated deposition velocity

- Reclaim water

i) Operating velocity of reclaim water is to be less than 10 ft/s to minimize pumping costs and pressure rating.

ii) Maximum operating pressure shall be less than the maximum allowable pressure per ASME B31.4.

4.0 PIPELINE AND MECHANICAL DESIGN BASIS

4.1 Pipeline Route Optimization in Response to DEIS Public Comments

The Skunk Camp North Pipeline route optimization process considers the following criteria, to the extent possible and practical, in the review and selection of alternatives to:

1) maintain pipeline slope no more than 15% as practical as possible

2) reduce the potential fragmentation of wildlife habitat

3) maximize the amount of temporary workspace located on existing disturbances

4) reduce the development of new access into remote areas

5) reduce the number and complexity of road, canyon, and watercourse crossings

6) avoid or reduce effects on identified environmentally sensitive areas

7) avoid or minimizing routing through areas of steep and unstable terrain

4.2 Pipeline Installation Method

Most of the proposed pipeline segments will be buried. Open trench installation method will be used for the pipeline construction except at the TSF and Concentrator (facility), tunnel, bridges, and trenchless crossing segments.

Trenchless installation methods, such as horizontal directional drilling (HDD), micro-tunneling, directional drilling and/or boring will be considered to bore a path underneath highway (US60), waterway, critical habitat, or proposed critical habitat (Mineral Creek) allowing for the pipe to be pulled through. Pipeline stress calculations will be completed to determine the bending, hoop and tensile stresses on the pipeline during installation and operating conditions. The calculations consider the pipe diameter, wall thickness, grade, depth and geometric design of the crossing.

4.3 Depth of Cover

The minimum depth of cover for the project will be equal or the greater of the depth of cover specified by ASME B31.4, and 49 CFR Part 195, as detailed below.

- Consolidated rock areas: 24 in.
- Road crossing areas: 48 in.
- Water crossing areas: 60 in. The requirement for increased burial depth will be evaluated and determined by the hydrology study at these locations in future phases.
- All other areas: 36 in.

4.4 Pipe Selection

4.4.1 Tailings Pipeline Material

Golder recommends the use of heavy wall carbon steel pipe for the NPAG line and HDPE-lined steel pipe for the PAG line.

4.4.2 Pipe Wall Thickness

The scavenger tailings transportation pipeline wall thickness is assumed to be 1.25 in to maximize the life span but remain exempt from post weld heat treatment requirements for each butt weld in accordance with ASME B31.4.

The pyrite tailings pipeline, the return water pipeline, and tailings process piping wall thickness will be determined based on fluid velocity and the design formula in ASME B31.4. This formula is used to calculate the required minimum wall thickness based on the yield strength of the pipe steel (determined by the grade of steel), maximum operating pressure, outside diameter, design factor, and weld joints.

All pipelines and facility piping are assumed to have the uniform nominal wall thickness throughout the span and the selected wall thickness would have higher allowable pressure than actual pressure. Actual pressure at specific points between the pump station and the receiving tank/sump is determined by calculating the change in hydrostatic pressure using the known elevation profile.

4.4.3 Slurry Corrosion/Erosion Rate

Golder has assumed an average wear rate of 24 mils (0.024 in) per year to estimate and optimize the scavenger pipe life span and the year of replacement. This average wear rate is obtained from actual yearly metal loss data from a benchmark site with similar tailings transportation system.

HDPE Liner for pyrite tailings pipeline would mitigates corrosion to negligible levels. Based on the extent of erosion, may require liner replacement which is analyzed to determine cost effectiveness against a rubber liner.

Historical data demonstrates that several factors can contribute to pipeline metal loss, including operating velocity, PSD, slurry pH, water quality, and dissolved oxygen content.

4.4.4 Pipe Specifications

Line pipe and facility piping specifications are summarized below:

- NPS 20 to 48: API 5L PSL2, Grade 70
- NPS 12 to 18: API 5L PSL2, Grade 60
- NPS 4 to 10: API 5L PSL2, Grade B
- NPS 3 or less: ASTM A106, Grade B

4.4.5 Valves and Fittings

- Whole tailings system valves will be flange to flange knife gate valves in accordance with MSS SP-81.
- Water system valves will be flange to flange, lugged-type butterfly, ball, or gate valves in accordance with API 6D and/or ASME B16.34.
- Pipe flanges and associated components will adhere to ASME B16.5, as applicable.
- Pipe fittings will adhere to MSS SP-75, ASME B16.9 or ASME B16.11, as applicable. All fittings used on whole tailings main pipeline shall be piggable.

4.5 Pipe Bend

Changes in pipeline alignment will be made with either field cold bends, shop fabricated hot bends (induction bends), or forged elbows.

All pipe bends shall have a minimum bend radius as specified below:

- Field bend: 40 x Pipe Diameter
- Hot bend: 6 x Pipe Diameter
- Elbow (whole tailings system): 5 x Pipe Diameter
- Elbow (return water system): 1.5 x Pipe Diameter

4.6 Corrosion/Erosion Control Elements

4.6.1 Pipe Coating

The coating systems used will be suitable for and specific to their application. Coating systems will meet or exceed current applicable industry codes and standards.

The primary coating for the external surface of the belowground pipe will be plant-applied fusion bonded epoxy. Field girth welds will be protected with a compatible liquid-applied coating.

Abrasion-resistant coating will be used where pipe is installed using boring, drilling or other methods that could cause abrasion to the coating during installation.

Additional mechanical protection systems such as sand padding, rock jacketing or rock shield will be used if large and/or angular backfill material is encountered.

4.6.2 Cathodic Protection

In addition to the pipe coating, an impressed current cathodic protection (CP) system will be installed for pipelines. The system will include ground beds and rectifiers, as determined during detailed design.

Where practical, the ground beds and rectifiers will be located at sites where a convenient source of electrical power exists nearby. Sacrificial anodes may also be used at specific locations, which will be identified during detailed design.

Test points will be installed, where required, along the pipeline and at road, foreign pipeline and utility crossings. These will allow the effectiveness of the operation of the system to be monitored during operation.

4.6.3 In-Line Inspection (ILI) Facilities

In-line inspection facilities, including launcher and receiver trap assemblies, will be installed to accommodate mainline ILI tools, cleaning tools and periodic maintenance activities.

The ILI system will be designed to ensure that the entire length of the tailings pipelines can be in-line inspected (excluding laterals and connections). Mainline launcher and receiver facilities will be in fenced areas at the West Plant and Skunk Camp TSF facility.

Launcher and receiver assemblies will be designed and constructed in accordance with ASME B31.4. Barrels will be removable pierces that can launch or receive the latest models of ILI tools and will be flanged to aid with removal for maintenance.

4.7 Water Crossing Design

Except for Queen Creek, Devil’s Canyon and Mineral Creek, all watercourses will be crossed using an open-cut crossing construction method. Given the relatively small size and low flows of most of the various watercourse crossings for the project, established trenched construction methods can be implemented with a high level of confidence.

4.8 Buoyancy Control

Along the pipeline route, conditions may exist under watercourses that require the implementation of buoyancy control measures using bolt-on weights. Weights and spacing are calculated based on empty pipe conditions.

4.9 Valve Placement

For tailings slurry pipelines, flanged valves are considered as potential leak points due to long term erosion. To minimize the effects of an accidental release, the design incorporates an approach where no mainline segment valves will be installed between the west plant and Skunk Camp TSF facility.

4.10 Leak Detection System

A computational pipeline monitoring (CPM) leak detection system will be considered at a high level in the study for the tailings pipelines in accordance with CFR 49 Part 195. The CPM system will comply with API RP 1130 in operating, maintaining, testing, record keeping, and dispatcher training of the system.

5.0 CIVIL AND STRUCTURAL DESIGN BASIS

5.1 Pipeline Tunnel and Borings

Pipeline tunnels will be considered for the segments with significant elevation change and steep slope to maintain less than 15% slope for the whole tailings pipeline. Pipeline tunnel and boring sections are planned based on geological data, tunnel length, access, and pipe constructability for the Silver King and Government Springs mountainous terrain areas as well as beneath US60.

5.2 Pipeline Bridge

A pipeline bridge option is part of the design for the Queen Creek and Devil's Canyon crossings. All pipelines installed on the bridge shall be designed to take the anticipated movements without exceeding the maximum allowable combined stress in accordance with ASME B31.4.

APPENDIX B

Geohazards Assessment

GOLDER

REPORT

GEOHAZARDS ASSESSMENT FOR THE SKUNK CAMP PIPELINE ROUTE

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May 15, 2020

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1.0 INTRODUCTION

This report is a summary of the results of a Geohazards Assessment conducted by Golder Associates Inc. (Golder) for Rio Tinto's Resolution Copper Mining (Resolution) Skunk Camp Pipeline Route located in Pinal and Gila Counties, Arizona. The proposed Skunk Camp pipeline would contain tailing transportation pipelines and a return water pipeline that would connect West Plant to the proposed tailings storage facility (TSF) at Skunk Camp (Figure 1).

The approach to geohazards assessment for pipelines is a systematic process that begins with a regional-scale, desktop assessment, intended to identify and begin to characterize geohazards that could affect a pipeline during or post-construction. We consider geohazards to be natural geologic or hydrotechnical conditions, processes, and natural or induced events that could adversely affect the construction, operation, or integrity of a pipeline.

The assessment provides an overview of a proposed pipeline system by considering a range of possible geohazards that could potentially affect that system, based on available data. The scope of the assessment is established based on a combination of the natural environment where the pipeline system is located (i.e., geologic, topographic, and climatic conditions), the length of the pipeline system, the types of geohazards requested for consideration by the operator, the type and quality of resources available, and the desired output by the operator.

1.1 Scope of Work

The scope of work consisted of identifying potential geohazards along a 1,000 foot wide corridor centered on the proposed pipeline route through a desktop assessment. Hydrotechnical hazards (i.e., erosion and scour) were evaluated at pipeline crossing locations and where channel migration may encroach upon the pipeline.

For this assessment the following potential geohazards were considered:

- Unstable slopes, including landslides and rockfall;
- Seismic hazards, including surface fault rupture, soil liquefaction, and strong ground shaking;
- Potential ground subsidence associated with underground mines, fluid withdrawal (oil and gas or groundwater), and karst/pseudokarst; and
- Hydrotechnical hazards including erosion, scour and channel migration at watercourse crossings and followings.

2.0 METHODOLOGY

To identify and evaluate potential hazards, the following desktop activities were completed:

- Review of publicly available and site-specific geologic maps and applicable resources to assess whether particular geohazards or adverse geologic or hydrotechnical conditions, occur along the proposed pipeline route.
- Review of publicly available aerial imagery (e.g., Google Earth™, Esri™, and State imagery) and LiDAR data along the proposed pipeline route to identify, delineate, and characterize geomorphic indicators that appear consistent with active geohazards considered for this assessment.

Note: Project-specific LiDAR data and aerial imagery were unavailable for this review. Therefore, the results of the geomorphic review were limited by the quality of publicly available resources. Public LiDAR data were available for the segments of the pipeline located in Gila county (Arizona Geographic Information Council [AGIC] 2020). Some of the public LiDAR data and aerial imagery available during this assessment were not considered up-to-date; thus, ground conditions interpreted from these resources may not accurately reflect present-day ground conditions.

- Assignment of relative hazard classifications (e.g., low, moderate, and high) that are specific to the potential hazards identified during this assessment. The classification criteria we used are provided in Appendix A, along with the rationale for their development.
- Preparation of a geospatial Geographic Information System (GIS) database that provides the results of this assessment, including geographic coordinates, hazard classifications, data source identification, and comments for potential geohazards identified in this assessment.

3.0 PHYSIOGRAPHY AND GEOLOGIC SETTING

The proposed pipeline route is located within the Basin and Range physiographic province (National Park Service [NPS] 2017 and Vigil et al. 2008). The topography in the Basin and Range province is the result of regional extension of the crust which thinned and cracked the crust, creating large faults (generally trending in a north-south direction). Because of the extension, the region is marked by alternating linear mountain ranges and valleys. The mountains generally consist of late Precambrian and Paleozoic rocks which erode and fill the adjacent valleys with sediment. Much of the region drains internally, in an area known as the Great Basin, where surface water cannot reach the ocean (due to blockage of water movement by high mountains and lack of sufficient water).

The proposed pipeline route traverses three distinct geologic settings (Richard 2015; Cornwall et al. 1971; Horton 2017), as shown in Figure 1. The western portion of the proposed pipeline route primarily traverses Middle Proterozoic aged metamorphic and sedimentary rocks and Early Tertiary to Late Cretaceous granitic rocks. The central portion of the proposed pipeline route primarily traverses the Apache Leap Tuff, a Tertiary aged ash-flow tuff. The eastern portion of the proposed pipeline route primarily traverses Tertiary to Quaternary aged sedimentary rocks and basin deposits including alluvium, gravel, and conglomerate. The western portion of the proposed pipeline route crosses highly faulted terrain, while the central and eastern portions of the proposed pipeline route appear to cross less faulted terrain.

4.0 HAZARD CLASSIFICATION CRITERIA

Appendix A describes our approach to and rationale for assigning hazard classifications to each hazard identified during the desktop Geohazards Assessment.

Hazard classifications are tailored to be project-specific but are based on general classification criteria that are commonly used for assessing geohazards for pipelines. It should be noted that the hazard classifications are relative to each hazard. For example, a high hazard with respect to liquefaction does not necessarily mean that the pipeline has a high potential for damage in high hazard areas, but rather that the hazard from liquefaction is higher than in areas identified as low or moderate hazards. Likewise, the hazard classifications are relative to each individual hazard; for example, a high hazard fault is not necessarily equivalent in potential severity or likelihood to a high hazard karst subsidence feature.

Hazard classifications are also intended to lump together features or areas that have similar recommendations, including recommendations for mitigation, construction practices, or for possible additional assessment. That is, a high hazard classification may indicate that there is a high uncertainty from the desktop assessment of the potential threat, and thus additional assessment is recommended; it does not necessarily indicate that the area is at high risk from that hazard type.

5.0 RESULTS

The following sections provide a summary of results for each respective hazard. Overview maps outlining the geographic distribution of potential hazards are referenced, as applicable. General background information for each type of hazard, as well as our hazard criteria, are provided in Appendix A.

5.1 Unstable Slopes (Landslides)

To assess possible landslide hazards in the vicinity of the proposed pipeline route, geologic maps and datasets with mapped landslides (i.e., Arizona Geological Survey [AZGS] 2019) were reviewed. A geomorphic analysis of publicly available aerial imagery (i.e., Google Earth™ and ESRI) and 2018 1-meter resolution LiDAR data (available only in Gila County) (AGIC 2020) was also completed. The results of the assessment are limited by the resolution of the data available.

Possible landslides were identified that were completely or partially within 500 feet of the proposed pipeline centerlines (i.e., a 1,000 foot-wide corridor centered on the proposed pipeline centerline). Therefore, if a landslide had any portion of the feature fall within 500 feet of a proposed pipeline, the landslide was identified and delineated. A possible total of two low hazard landslides and two moderate hazard landslides were identified along the proposed pipeline route. The distribution of landslide hazards identified in this assessment is shown in Figure 2 and a summary of the results is provided in Table 1.

5.2 Unstable Slopes (Rockfalls)

The majority of the potential rockfall hazard areas are located within the central portion of the proposed pipeline route, where the route traverses the Apache Leap Tuff geologic unit. As described by Richard (2015), the Apache Leap Tuff is a crystal-rich (40-50%), plagioclase, embayed quartz, sanidine, biotite-bearing ash-flow tuff. The tuff ranges from unwelded to densely welded, and it rarely contains more than a few percent lithic fragments. Pumice fragments are also sparse and generally difficult to see in outcrop. The base and top of this unit are locally, crudely thick-bedded, but the unit generally appears massive. The majority of the area where the Apache Leap Tuff underlies the proposed pipeline route is also marked by steep slopes, which could be susceptible to rockfalls.

The distribution of rockfall hazard areas identified in this assessment is shown in Figure 2 and a summary of the results is provided in Table 1.

5.3 Seismic (Ground Shaking)

The potential hazard from earthquake wave propagation is commonly measured by the ground shaking parameter of peak horizontal ground acceleration (PGA), expressed as a percentage of the Earth's gravitational acceleration (g). To estimate possible hazards associated with ground shaking, seismic hazard mapping developed by the U.S. Geological Survey (USGS) for ground motions having a 10-percent probability of exceedance in 50 years, which represents a return period of 475 years (Petersen et al. 2014) were used.

The projected 475-year return period PGA value for the proposed pipeline route is 0.04 g, which is within the low hazard classification for seismic ground shaking (Figure 3; Table 1).

5.4 Seismic (Liquefaction)

Areas assumed to have liquefaction potential contain the following characteristics: (1) regularly or permanently saturated near the ground surface (e.g., less than 30 feet below ground surface); (2) contain relatively young (i.e., Holocene) alluvium, lacustrine (i.e., lake bed) deposits, or similar, that appear to consist of loose to moderately dense granular soils; and (3) subjected to strong ground shaking. Areas where these conditions appear to be present over a length of at least 300 feet along the proposed pipeline alignment were qualitatively identified, and then correlated with seismic hazard mapping for a return period of 475 years (Petersen et al. 2014) to classify their liquefaction hazard potential.

Areas within 500 feet of the proposed pipeline alignment that appeared to be underlain by alluvial or lacustrine deposits were identified and mapped using a combination of geologic maps, available LiDAR data, topographic maps, and aerial imagery. In general, it was assumed that relatively flat, low-lying areas adjacent to stream channels and lakes were underlain by liquefaction susceptible soil, i.e., alluvial or lacustrine deposits. Areas along the proposed pipeline route identified to contain potentially liquefiable soils were given a low hazard classification based upon the associated projected 475-year return period PGA value as described above in Section 5.3. (Figure 3; Table 2).

Conditions suitable for liquefaction are likely to be limited along the proposed pipeline alignment, due to the regionally dry climate and typically dry soil conditions for at least the first few feet of the subsurface. Eight areas were identified along the proposed pipeline alignment that appear to cross Quaternary alluvium. However, these waterbody crossings appear ephemeral in nature, and thus are ordinarily dry. For completeness, we have included these areas as low hazard liquefaction areas.

5.5 Seismic (Surface Fault Rupture)

Potential fault rupture hazards were assessed within 500 feet of the proposed pipeline route by reviewing the USGS Quaternary Fault and Fold Database for the United States (USGS 2018) and published geologic maps and reports to identify and evaluate active or potentially active faults and fault zones in close proximity to the proposed pipeline route.

No Quaternary-active faults in the vicinity of the proposed pipeline route were identified in the USGS Quaternary Fault and Fold Database (USGS 2018). However, several faults are mapped on larger scale geology maps that cross the proposed pipeline route, which appear to consist of older- (i.e., pre-Quaternary) and possibly younger- (i.e., Quaternary) aged faults. Information on the age of most recent movement along the faults was not readily available in the sources reviewed for this assessment (i.e., Richard 2015; Cornwall et al. 1971; Horton 2017). Based on review of these mapped faults in available LiDAR data and aerial imagery, and based on the reported results of field investigations conducted by Lettis Consultants International, Inc. (LCI 2020), no evidence of Quaternary-active faults was identified in vicinity of the proposed pipeline route. Thus, no surface fault rupture hazards within 500 feet of the proposed pipeline route were identified.

5.6 Subsidence (Karst)

Karst subsidence hazards were assessed within a 1,000 foot wide corridor, centered on the proposed pipeline alignment, by reviewing published geologic maps and reports to identify areas where carbonate bedrock and/or evaporites (e.g., salt, gypsum) are reported to be present at or near the ground surface along the proposed pipeline route. Relevant karst maps and reports were also reviewed, to identify areas where karst topography and karst features are reported to occur along the pipeline alignment. Finally, a geomorphic review of available LiDAR data and/or aerial imagery was completed to identify potentially hazardous karst features in the vicinity of the pipeline alignment.

Along portions of the western extent of the proposed pipeline route, we identified carbonate bedrock units to underlie the proposed pipelines (Richard 2015). One of the units underlying the proposed pipeline route, the Escabrosa Limestone, is reported in the region to contain karst features including caves and sinkholes (e.g., Cook 2018; Hill 1999; Richard 2015). Umbrella cave is reported to exist near the project area (unconfirmed third-party data) within the Escabrosa Limestone, although precise coordinates are unknown. We did not identify evidence of caves or sinkholes underlying the proposed pipeline route during review of available LiDAR data and/or aerial imagery, although features such as caves may not be evident at the surface.

As such, we identified areas along the proposed pipeline route underlain by the Escabrosa Limestone to be moderate hazard areas, and the remaining areas underlain by other carbonate bedrock units to be low hazard areas.

The distribution of karst subsidence hazard areas identified in this assessment are shown in Figure 4 and a summary of the results is provided in Table 3.

5.7 Subsidence (Underground Mine)

Underground mine subsidence hazards were assessed within a 1,000 foot wide corridor, centered on the proposed pipeline route by reviewing publicly available reports, maps, and databases along with data provided by Resolution, to identify any documented or suspected underground mines or mine features in the vicinity of the proposed pipeline route. Additional information about mining areas or operations identified in the vicinity of the proposed pipeline route was assessed to ascertain whether the occurrence and extent of underground mines are well documented or uncertain. This research was supplemented by reviewing available LiDAR data and/or aerial imagery to identify any topographic depressions observed around underground mines that are proximal to the pipeline.

In terms of the available digital GIS data that represent potential underground mine locations in the area of the proposed pipelines, only point data, representing approximate locations of underground mines and/or underground mine features were identified. The precise location and dimensions of underground mines is unclear from point datasets; thus, in evaluating potential subsidence hazards, we considered an area around each point to potentially contain an underground mine and related subsidence hazards.

Possible mine subsidence hazard areas were identified based on the following point data:

- Metallic and non-metallic mines from the Mineral Resources Data System (USGS 2005), with an operation type of underground, surface-underground, or unknown. The positional information for this dataset is highly variable. In the best cases this information was provided by plotting the location on a 7.5-minute topographic map; however, many records were located on the basis of published reports containing imprecise or scant information on the specific geographic location.
- Data provided by Resolution. These points were utilized to classify several moderate hazard areas (i.e., areas within 200 to 500 feet from each point) and high hazard areas (i.e., areas within 200 feet from each point). The remainder of the areas along the proposed pipeline route were classified as low hazard areas, as underground mining activities (past, present, and future) are known to occur in the region.

The distribution of underground mine subsidence hazard areas identified in this assessment is shown in Figure 5 and a summary of the results is provided in Table 4.

5.8 Subsidence (Fluid Withdrawal)

Fluid withdrawal subsidence hazards were assessed within a 1,000 foot wide corridor, centered on the proposed pipeline route, by reviewing publicly available resources to identify areas where the pipeline crosses major groundwater aquifers, oil and gas well fields, and/or areas reported to have experienced subsidence. The results of this review were supplemented by further researching additional information that was available, as well as reviewing available LiDAR data and/or aerial imagery, to ascertain the types, rates, and areas of influence for any applicable subsidence hazards identified in the vicinity of the pipeline.

No existing oil and gas fields or wells within 500 feet of the proposed pipeline route were identified. However, 13 areas along the eastern half of the proposed pipeline alignment were identified to be underlain by oil and gas parcels located on State Trust Land (Arizona State Land Department [ASLD] 2017), with no mapped oil and gas extraction wells (Arizona Department of Environmental Quality [ADEQ] 2019). These areas were assigned as low hazard fluid withdrawal subsidence areas.

Based on a study by Konikow (2013), the entirety of the proposed pipeline route appears to be underlain by an area reported to have cumulative groundwater depletion from 1900 and 2008 ranging between 0 and 400 cubic kilometers (Konikow 2013). The entire proposed pipeline route was thus classified as a moderate hazard area for possible groundwater-related subsidence.

The distribution of fluid withdrawal subsidence hazard areas identified in this assessment is shown in Figure 6 and a summary of the results is provided in Table 5.

5.9 Hydrotechnical Waterbody Crossings

Hydrotechnical hazards were assessed at pipeline waterbody crossing locations and where channel migration may encroach upon the pipeline using the USGS National Hydrography Dataset (USGS 2019) stream data. The stream locations were reviewed in Google Earth^{TM} historical aerial imagery to assess current conditions and visible geomorphic processes to establish their hazard potential. A total of 60 drainage crossing locations were identified (Figure 6; Table 6). Crossings reviewed were primarily dry ephemeral channels and creeks. Review of these waterbodies also included available onsite photographs taken as part of previous corridor routing field reconnaissance. Engineering judgement and experience were used to identify and classify each waterbody crossing, as follows:

- 15 waterbody crossings as low hydrotechnical hazards.
- 16 waterbody crossings as moderate hydrotechnical hazards.
- 11 waterbody crossings as high hydrotechnical hazards.
- A total of 18 of the 60 waterbodies were assigned Non-Applicable as a hazard classification, at locations where the proposed pipeline route avoided the waterbody crossings by being located below the waterbody within a proposed tunnel.

6.0 CONCLUSIONS

This assessment based on a desktop review of existing information was intended to identify potential geohazards that might negatively affect construction and operation of the pipeline and to provide locations where further evaluation was required. All risks identified by this study will be considered with mitigation measures implemented during routing refinements, pipeline design, construction, and operation. Please refer to “CCC.03-81900-EP-REP-00007_Golder EIS Pipeline Protection and Integrity Plan” for detailed risk mitigations.

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Senior Geologist and Associate

David Thurman, PE
Senior Engineer

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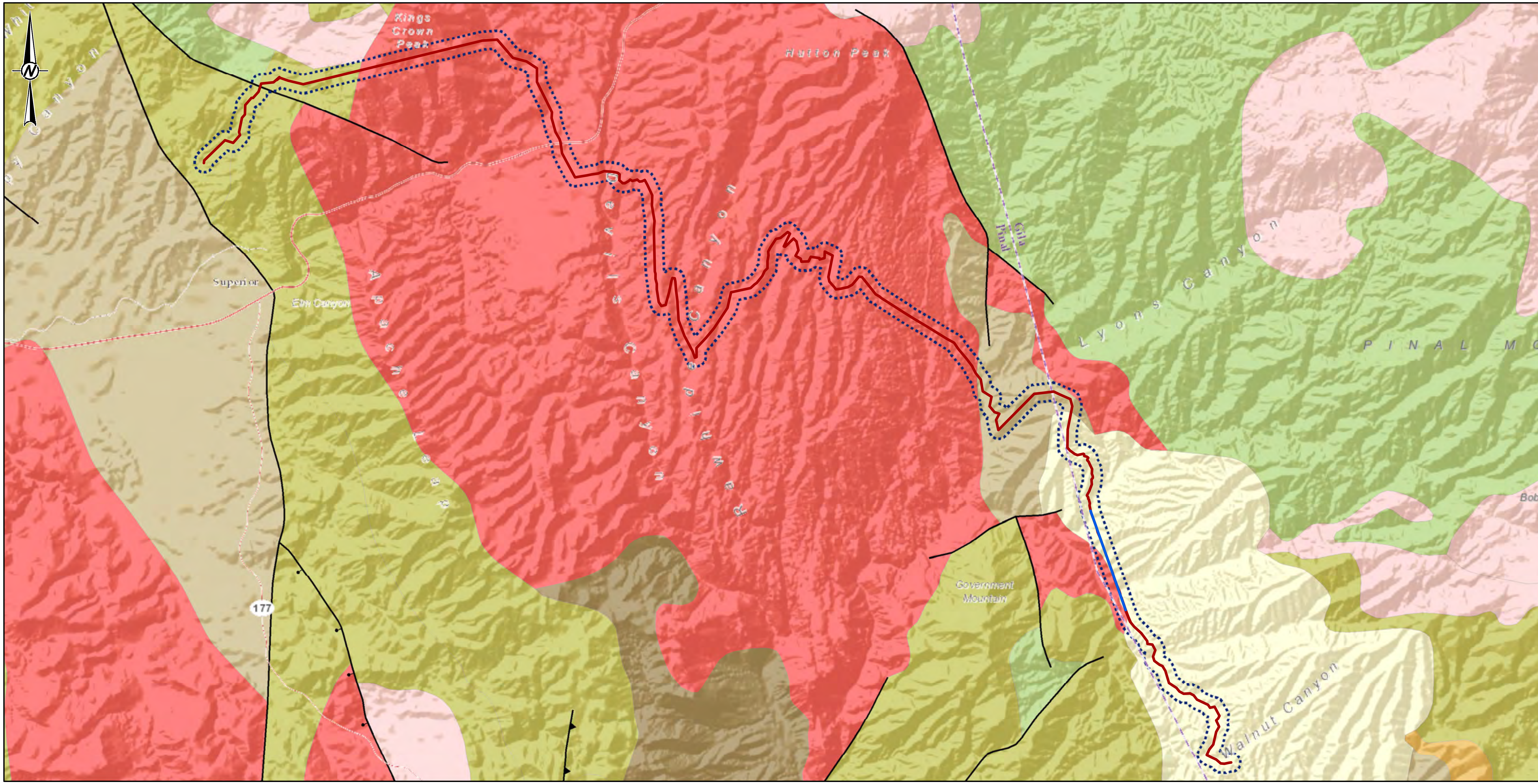
Figures



LEGEND

PROPOSED ALIGNMENT
- NORTH SKUNK CAMP
- REVISED TRENCHLESS CROSSING
- HAZARD ASSESSMENT CORRIDOR

GENERAL GEOLOGY UNIT
- IGNEOUS, INTRUSIVE
- IGNEOUS, VOLCANIC
- IGNEOUS AND SEDIMENTARY, UNDIFFERENTIATED
- METAMORPHIC, UNDIFFERENTIATED
- METAMORPHIC AND SEDIMENTARY, UNDIFFERENTIATED
- SEDIMENTARY, CLASTIC
- SEDIMENTARY, UNDIFFERENTIATED
- UNCONSOLIDATED, UNDIFFERENTIATED

GEOLOGIC STRUCTURE
- FAULT, UNKNOWN TYPE, CERTAIN
- NORMAL FAULT, CERTAIN (BALL ON DOWN SIDE)
- THRUST FAULT, CERTAIN (TEETH ON RIGHT FROM ORIGIN)

0 1 2
MILES

REFERENCE(S)
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 12N
2. IMAGERY SOURCES: ESRI, USGS, NOAA
SOURCES: ESRI, GARMIN, USGS, NPS
3. PIPELINES LOCATIONS PROVIDED BY RIO TINTO ON 5/11/2020.
4. GEOLOGIC MAP: HORTON 2017

CLIENT
RESOLUTION COPPER MINE

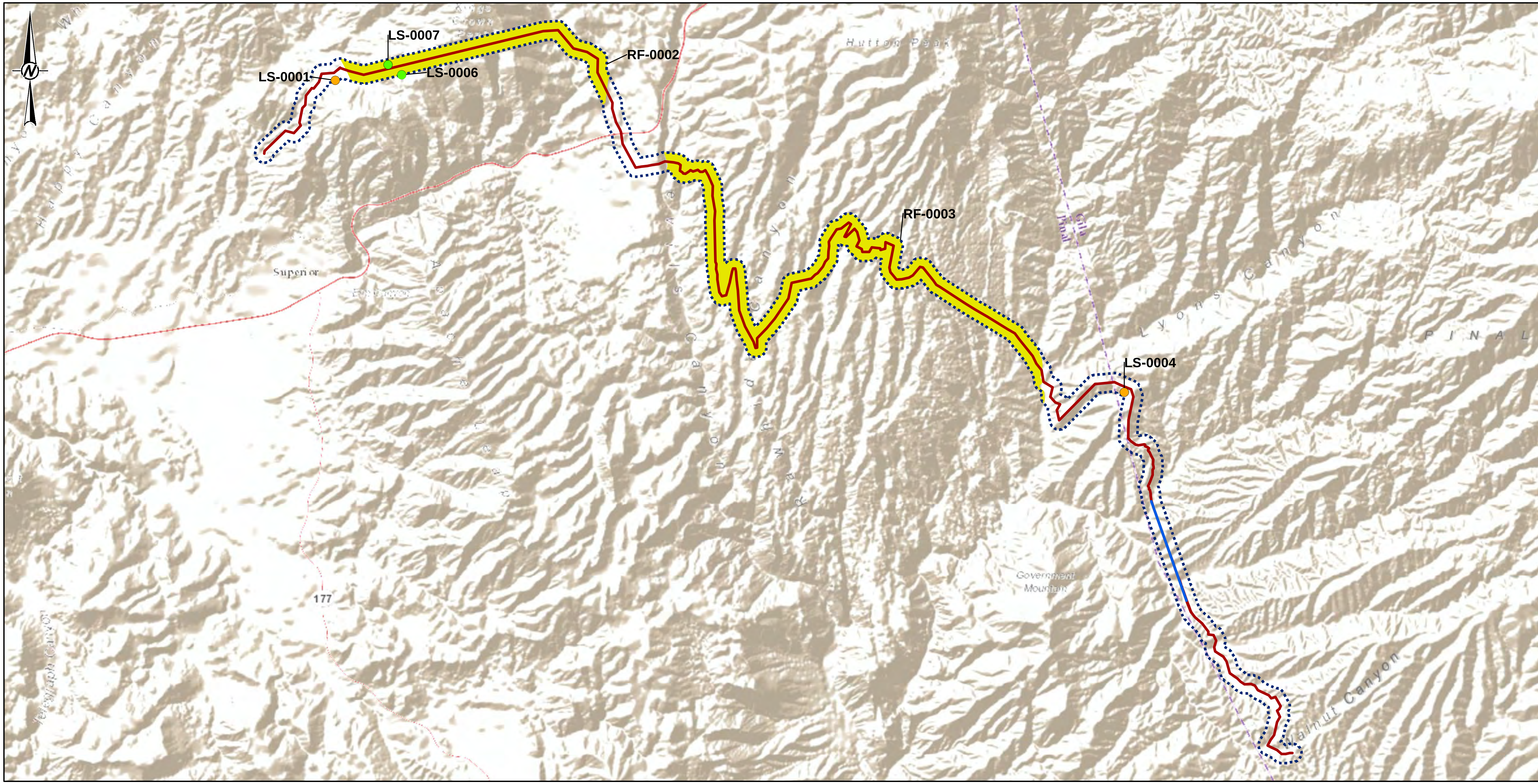
PROJECT
GEOHAZARDS ASSESSMENT FOR THE SKUNK CAMP PIPELINE ROUTE

CONSULTANT
GOLDER

YYYY-MM-DD	5/13/2020
DESIGNED	N/A
PREPARED	TLM
REVIEWED	BLT
APPROVED	WW

TITLE
PROJECT LOCATION MAP AND REGIONAL GEOLOGY

PROJECT NO.	CONTROL	REV.	FIGURE
1810598801	-	B	1



LEGEND

PROPOSED ALIGNMENT

- NORTH SKUNK CAMP
- REVISED TRENCHLESS CROSSING
- HAZARD ASSESSMENT CORRIDOR

ROCKFALL HAZARD AREAS*

- UNDEFINED

LANDSLIDE HAZARD AREAS*

- LOW
- MODERATE

0 1 2
MILES

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 12N
2. IMAGERY SOURCES: ESRI, USGS, NOAA
SOURCES: ESRI, GARMIN, USGS, NPS
3. PIPELINES LOCATIONS PROVIDED BY RIO TINTO ON 5/11/2020.
4. COMPLETE REFERENCES FOR HAZARD DATA CAN BE FOUND IN THE ACCOMPANYING REPORT.

CLIENT
RESOLUTION COPPER MINE

PROJECT
GEOHAZARDS ASSESSMENT FOR THE SKUNK CAMP PIPELINE ROUTE

CONSULTANT

GOLDER

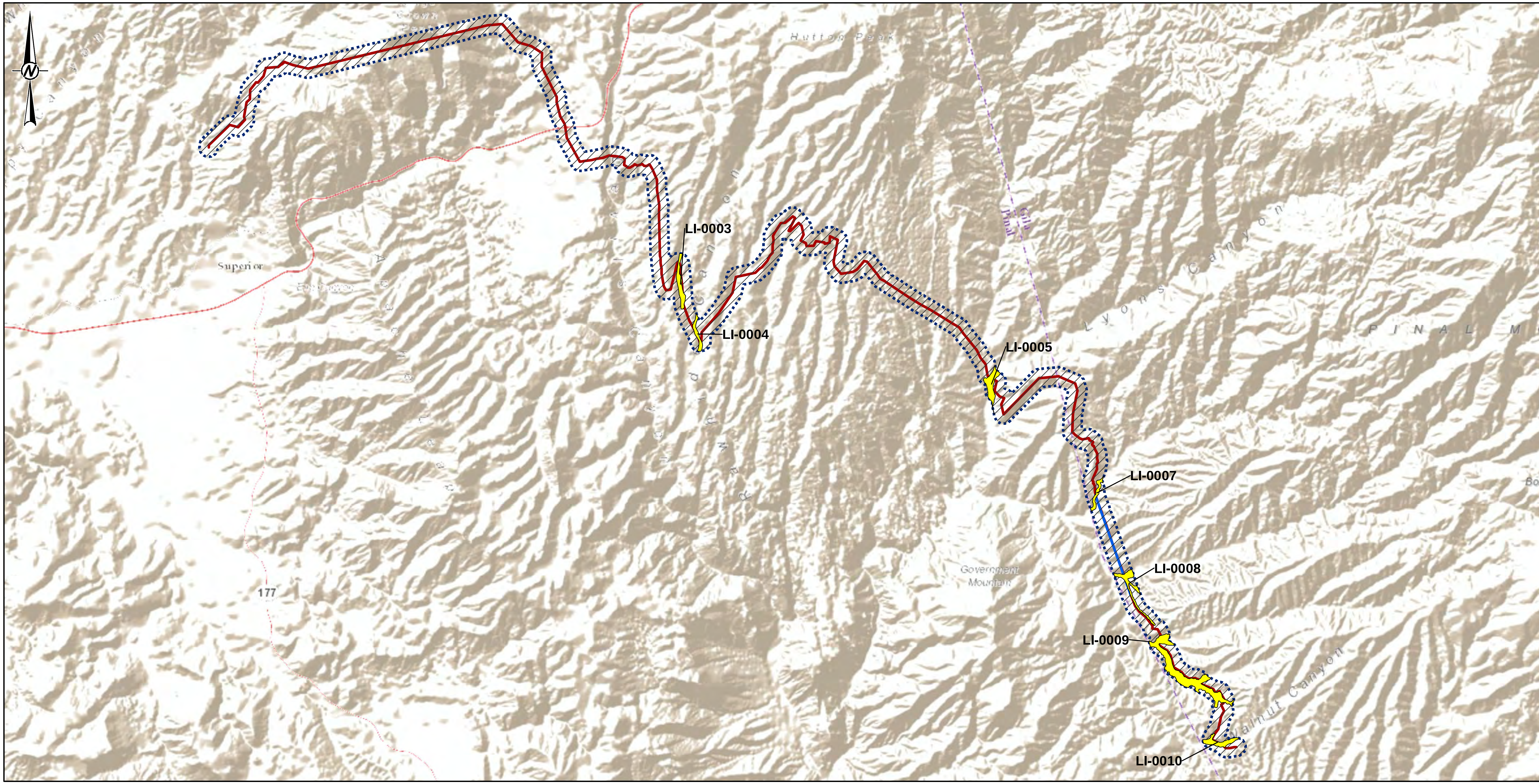
YYYY-MM-DD	5/14/2020
DESIGNED	N/A
PREPARED	TLM
REVIEWED	BLT
APPROVED	WW

TITLE
LANDSLIDE AND ROCKFALL HAZARDS MAP

PROJECT NO.	CONTROL	REV.	FIGURE
1810598801	-	B	2

*See Table A-1 for Hazard Classification Criteria

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B



LEGEND

PROPOSED ALIGNMENT

- NORTH SKUNK CAMP
- REVISED TRENCHLESS CROSSING
- HAZARD ASSESSMENT CORRIDOR

SEISMIC LIQUEFACTION HAZARD AREAS*

- LOW

SEISMIC GROUND SHAKING HAZARD AREAS*

- LOW

0 1 2

MILES

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 12N
2. IMAGERY SOURCES: ESRI, USGS, NOAA
SOURCES: ESRI, GARMIN, USGS, NPS
3. PIPELINES LOCATIONS PROVIDED BY RIO TINTO ON 5/11/2020.
4. COMPLETE REFERENCES FOR HAZARD DATA CAN BE FOUND IN THE ACCOMPANYING REPORT.

CLIENT

RESOLUTION COPPER MINE

PROJECT

GEOHAZARDS ASSESSMENT FOR THE SKUNK CAMP PIPELINE ROUTE

CONSULTANT

GOLDER

YYYY-MM-DD	5/13/2020
DESIGNED	N/A
PREPARED	TLM
REVIEWED	BLT
APPROVED	WW

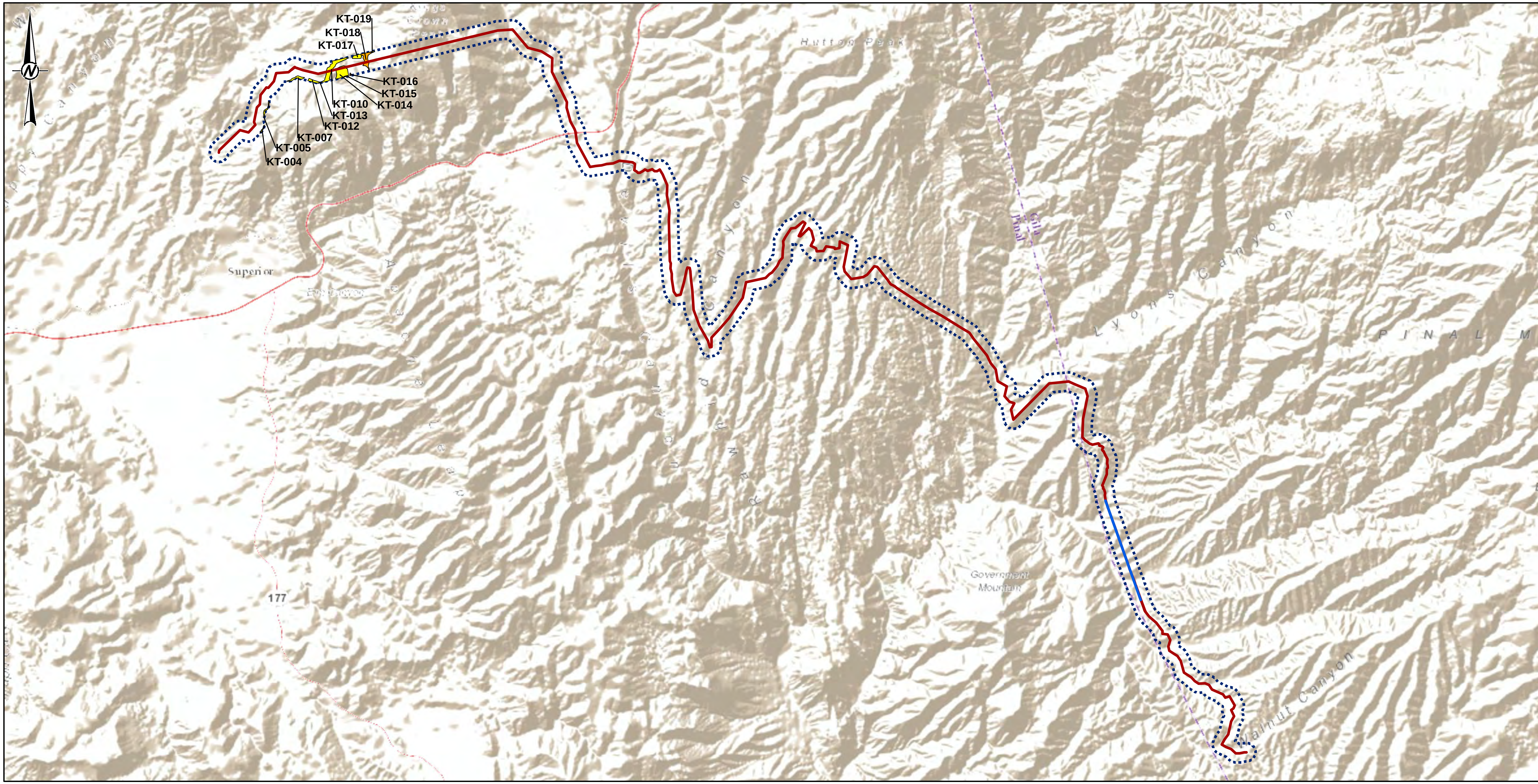
TITLE

SEISMIC HAZARDS MAP

PROJECT NO.	CONTROL	REV.	FIGURE
1810598801	-	B	3

*See Table A-1 for Hazard Classification Criteria

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B



LEGEND

PROPOSED ALIGNMENT

- NORTH SKUNK CAMP
- REVISED TRENCHLESS CROSSING
- HAZARD ASSESSMENT CORRIDOR

KARST SUBSIDENCE HAZARD AREAS*

- LOW
- MODERATE

*See Table A-1 for Hazard Classification Criteria

0 1 2

MILES

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 12N
2. IMAGERY SOURCES: ESRI, USGS, NOAA
SOURCES: ESRI, GARMIN, USGS, NPS
3. PIPELINES LOCATIONS PROVIDED BY RIO TINTO ON 5/11/2020.
4. COMPLETE REFERENCES FOR HAZARD DATA CAN BE FOUND IN THE ACCOMPANYING REPORT.

CLIENT
RESOLUTION COPPER MINE

PROJECT
GEOHAZARDS ASSESSMENT FOR THE SKUNK CAMP PIPELINE ROUTE

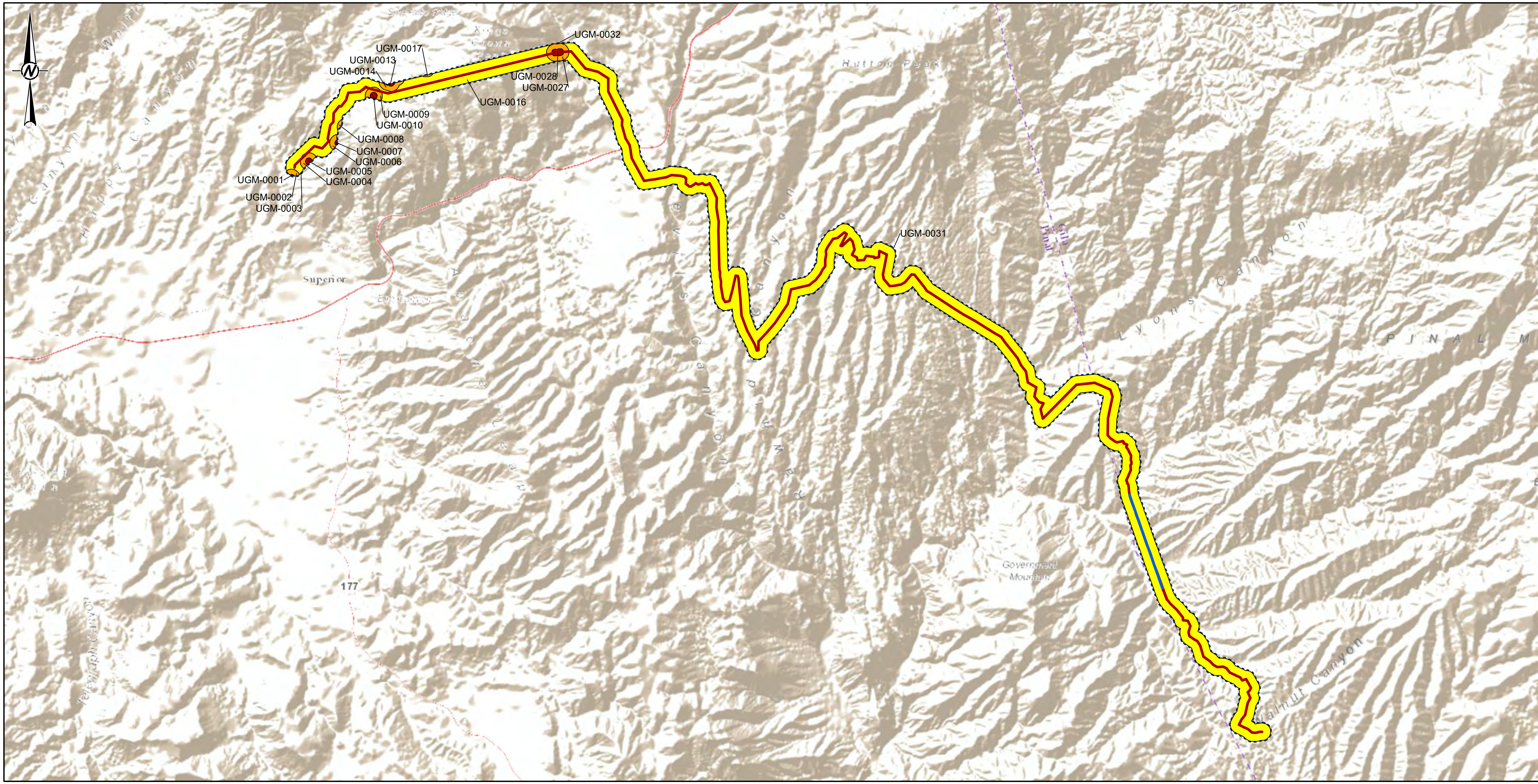
CONSULTANT
GOLDER

YYYY-MM-DD	5/13/2020
DESIGNED	N/A
PREPARED	TLM
REVIEWED	BLT
APPROVED	WW

TITLE
KARST SUBSIDENCE HAZARDS MAP

PROJECT NO.	CONTROL	REV.	FIGURE
1810598801	-	B	4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B



LEGEND

PROPOSED ALIGNMENT

- NORTH SKUNK CAMP
- REVISED TRENCHLESS CROSSING
- HAZARD ASSESSMENT CORRIDOR

UNDERGROUND MINE SUBSIDENCE HAZARD AREAS*

- LOW
- MODERATE
- HIGH

*See Table A-1 for Hazard Classification Criteria

0 1 2
MILES

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 12N
2. IMAGERY SOURCES: ESRI, USGS, NOAA
SOURCES: ESRI, GARMIN, USGS, NPS
3. PIPELINES LOCATIONS PROVIDED BY RIO TINTO ON 5/11/2020.
4. COMPLETE REFERENCES FOR HAZARD DATA CAN BE FOUND IN THE ACCOMPANYING REPORT.

CLIENT
RESOLUTION COPPER MINE

PROJECT
GEOHAZARDS ASSESSMENT FOR THE SKUNK CAMP PIPELINE ROUTE

CONSULTANT
GOLDER

YYYY-MM-DD	5/13/2020
DESIGNED	N/A
PREPARED	TLM
REVIEWED	BLT
APPROVED	WW

TITLE
UNDERGROUND MINE SUBSIDENCE HAZARDS MAP

PROJECT NO.	CONTROL	REV.	FIGURE
1810598801	-	B	5

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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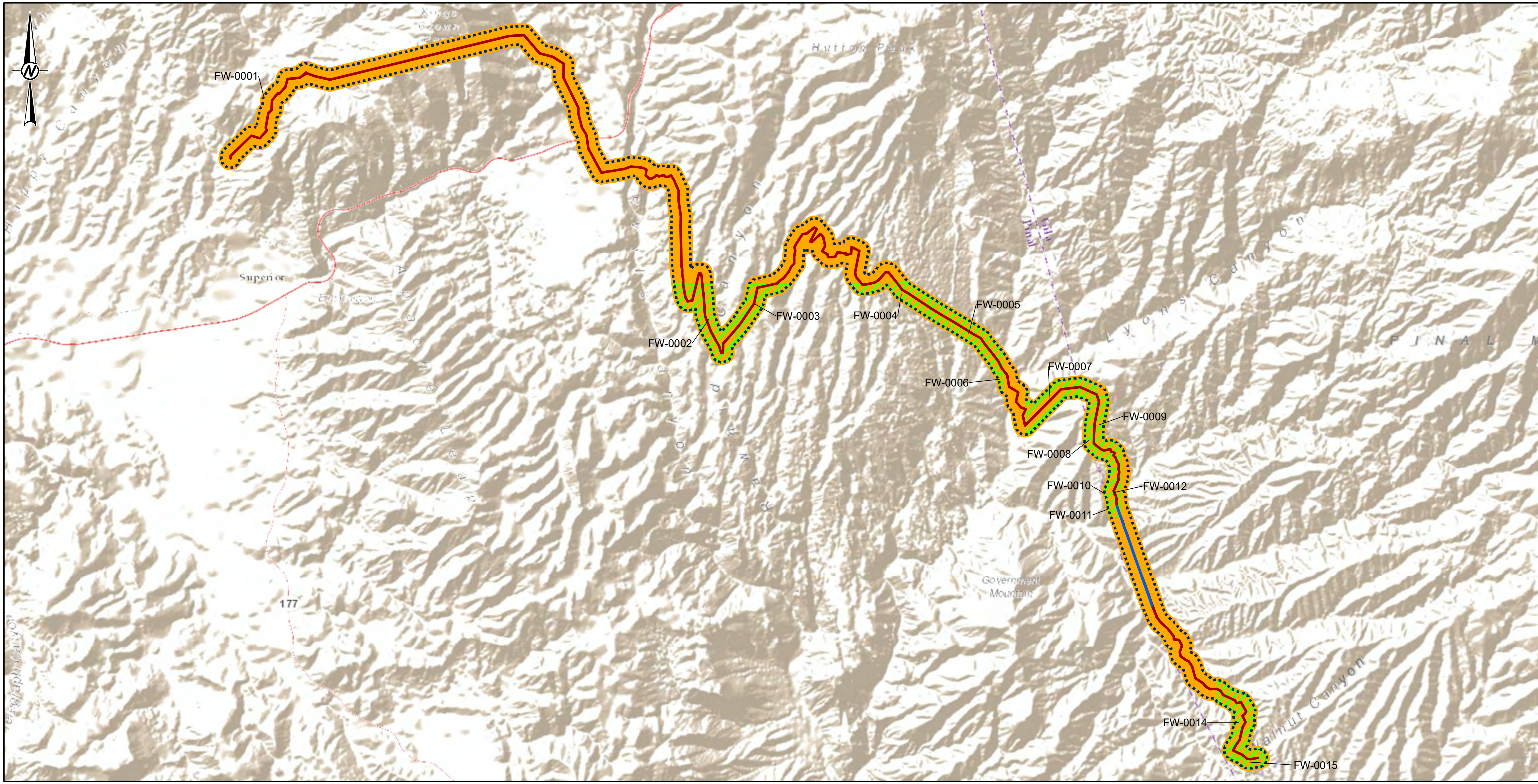


LEGEND

PROPOSED ALIGNMENT

- NORTH SKUNK CAMP
- REVISED TRENCHLESS CROSSING
- HAZARD ASSESSMENT CORRIDOR

FLUID WITHDRAWAL SUBSIDENCE HAZARD AREAS*

- LOW (OIL AND GAS PARCELS)
- MODERATE (GROUNDWATER DEPLETION)

0 1 2
MILES

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 12N
2. IMAGERY SOURCES: ESRI, USGS, NOAA
SOURCES: ESRI, GARMIN, USGS, NPS
3. PIPELINES LOCATIONS PROVIDED BY RIO TINTO ON 5/11/2020.
4. COMPLETE REFERENCES FOR HAZARD DATA CAN BE FOUND IN THE ACCOMPANYING REPORT.

CLIENT
RESOLUTION COPPER MINE

PROJECT
GEOHAZARDS ASSESSMENT FOR THE SKUNK CAMP PIPELINE ROUTE

CONSULTANT
GOLDER

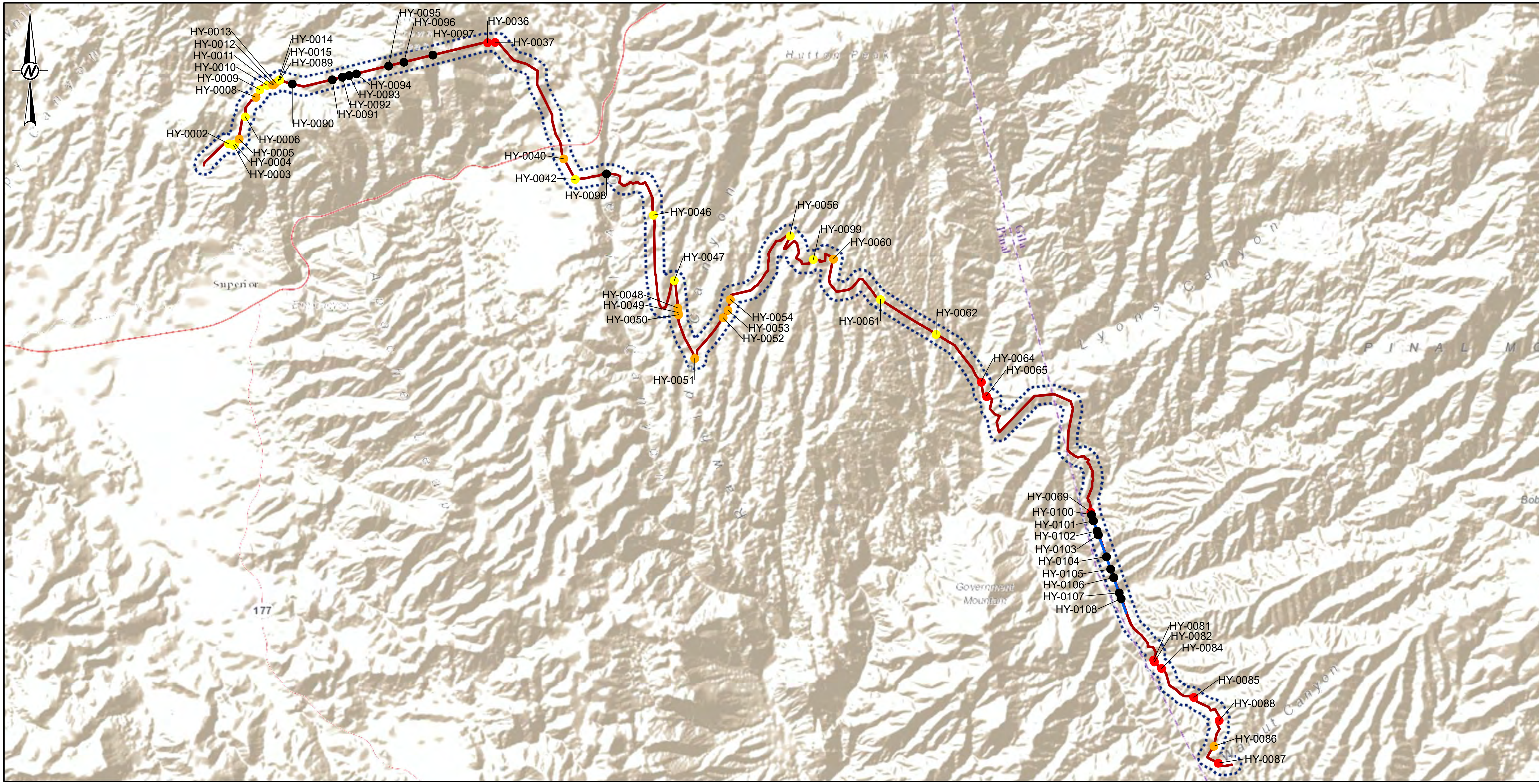
YYYY-MM-DD	5/13/2020
DESIGNED	N/A
PREPARED	TLM
REVIEWED	BLT
APPROVED	WW

TITLE
FLUID WITHDRAWAL SUBSIDENCE HAZARDS MAP

PROJECT NO.	CONTROL	REV.	FIGURE
1810598801	-	B	6

*See Table A-1 for Hazard Classification Criteria

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B



LEGEND

PROPOSED ALIGNMENT
- NORTH SKUNK CAMP
- REVISED TRENCHLESS CROSSING
- HAZARD ASSESSMENT CORRIDOR

HYDROTECHNICAL HAZARDS (WATERBODY CROSSINGS)*
- LOW
- MODERATE
- HIGH
- N/A

0 1 2
MILES

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 12N
2. IMAGERY SOURCES: ESRI, USGS, NOAA
SOURCES: ESRI, GARMIN, USGS, NPS
3. PIPELINES LOCATIONS PROVIDED BY RIO TINTO ON 5/11/2020.
4. COMPLETE REFERENCES FOR HAZARD DATA CAN BE FOUND IN THE ACCOMPANYING REPORT.

CLIENT
RESOLUTION COPPER MINE

PROJECT
GEOHAZARDS ASSESSMENT FOR THE SKUNK CAMP PIPELINE ROUTE

CONSULTANT
GOLDER

YYYY-MM-DD	5/15/2020
DESIGNED	N/A
PREPARED	TLM
REVIEWED	BLT
APPROVED	WW

TITLE
HYDROTECHNICAL WATERBODY CROSSING HAZARDS MAP

PROJECT NO.	CONTROL	REV.	FIGURE
1810598801	-	B	7

*See Table A-1 for Hazard Classification Criteria

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Tables

Table 1: Summary of Results – Landslide and Rockfall Hazards

Hazard ID	Hazard Classification	Latitude	Longitude	Comments	Source
Landslide Hazards					
LS-0001	Moderate	33.322984	-111.094345	Possible debris flow where depositional area crosses the current proposed pipeline.	Google Earth
LS-0004	Moderate	33.275620	-110.952844	Possible active shallow landslide visible in LiDAR and imagery. Disturbance may be erosional in nature.	LiDAR; Google Earth
LS-0006	Low	33.323258	-111.081992	Possible debris flow. Possible excavuated area visible in Google Earth; depositional area not distinct.	Google Earth
LS-0007	Low	33.324763	-111.084397	Possible debris flow. Possible excavuated area visible in Google Earth; depositional area not distinct.	Google Earth
Rockfall Hazards					
RF-0002	Undefined	33.326336	-111.066350	Area with shallow or exposed fractured/fragmented bedrock with topographic relief sufficient for possible rockfall hazards to exist.	Horton 2017; Google Earth
RF-0003	Undefined	33.293636	-111.005882	Area with shallow or exposed fractured/fragmented bedrock with topographic relief sufficient for possible rockfall hazards to exist.	Horton 2017; Google Earth

Table 2: Summary of Results – Seismic Hazards

Hazard ID	Hazard Classification	Latitude	Longitude	Comments	Source
Ground Shaking Hazards					
GS-0001	Low	33.288904	-111.005125	PGA 0.04 g	Petersen et al. 2014
Liquefaction Hazards					
LI-0003	Low	33.291010	-111.022163	Potential liquefaction conditions present in area where PGA is <0.1 g.	Mapped by Golder based on Google Earth Imagery; Petersen et al. 2014
LI-0004	Low	33.283445	-111.019114	Potential liquefaction conditions present in area where PGA is <0.1 g.	Mapped by Golder based on Google Earth Imagery; Petersen et al. 2014
LI-0005	Low	33.275876	-110.966572	Potential liquefaction conditions present in area where PGA is <0.1 g.	Mapped by Golder based on Google Earth Imagery; Petersen et al. 2014
LI-0007	Low	33.259476	-110.947773	Potential liquefaction conditions present in area where PGA is <0.1 g.	Mapped by Golder based on Google Earth Imagery; Petersen et al. 2014
LI-0008	Low	33.245280	-110.941509	Potential liquefaction conditions present in area where PGA is <0.1 g.	Mapped by Golder based on Google Earth Imagery; Petersen et al. 2014
LI-0009	Low	33.232605	-110.931855	Potential liquefaction conditions present in area where PGA is <0.1 g.	Mapped by Golder based on Google Earth Imagery; Petersen et al. 2014
LI-0010	Low	33.222213	-110.925988	Potential liquefaction conditions present in area where PGA is <0.1 g.	Mapped by Golder based on Google Earth Imagery; Petersen et al. 2014

Table 3: Summary of Results – Karst Subsidence Hazards

Hazard ID	Hazard Classification	Latitude	Longitude	Comments	Source
KT-004	Low	33.314931	-111.098754	Mescal Limestone (Ym); Geologic Unit Lithology: Calcareous carbonate sedimentary rock	Richard 2015
KT-005	Low	33.317896	-111.098106	Mescal Limestone (Ym); Geologic Unit Lithology: Calcareous carbonate sedimentary rock	Richard 2015
KT-007	Low	33.322619	-111.092659	Mescal Limestone (Ym); Geologic Unit Lithology: Calcareous carbonate sedimentary rock	Richard 2015
KT-010	Low	33.323997	-111.086333	Mescal Limestone (Ym); Geologic Unit Lithology: Calcareous carbonate sedimentary rock	Richard 2015
KT-012	Low	33.322212	-111.089644	Martin Limestone (Dm); Geologic Unit Lithology: Dolomitic or magnesian sedimentary rock	Richard 2015
KT-013	Moderate	33.321960	-111.088496	Escabrosa Limestone (Me); Geologic Unit Lithology: Calcareous carbonate sedimentary rock	Richard 2015
KT-014	Low	33.323546	-111.084541	Martin Limestone (Dm); Geologic Unit Lithology: Dolomitic or magnesian sedimentary rock	Richard 2015
KT-015	Moderate	33.322936	-111.083791	Escabrosa Limestone (Me); Geologic Unit Lithology: Calcareous carbonate sedimentary rock	Richard 2015
KT-016	Moderate	33.323205	-111.082995	Escabrosa Limestone (Me); Geologic Unit Lithology: Calcareous carbonate sedimentary rock	Richard 2015
KT-017	Low	33.325854	-111.081771	Martin Limestone (Dm); Geologic Unit Lithology: Dolomitic or magnesian sedimentary rock	Richard 2015
KT-018	Moderate	33.325510	-111.080191	Escabrosa Limestone (Me); Geologic Unit Lithology: Calcareous carbonate sedimentary rock	Richard 2015
KT-019	Low	33.326613	-111.079100	Martin Limestone (Dm); Geologic Unit Lithology: Dolomitic or magnesian sedimentary rock	Richard 2015

Table 4: Summary of Results – Underground Mine Subsidence Hazards

Hazard ID	Hazard Classification	Latitude	Longitude	Comments	Source	Site Name	Mine Name(s)	Operation Type	Main Commodity
UGM-0001	High	33.310202	-111.106952	Area within 200 feet of a point representing an underground mine location.	USGS 2005	Magma Apex Property	Magma Extension	Underground	Silver, Manganese
UGM-0002	Moderate	33.310636	-111.106799	Area 200-500 feet from a point representing an underground mine location.	USGS 2005	Magma Apex Property	Magma Extension	Underground	Silver, Manganese
UGM-0003	Moderate	33.310606	-111.105257	Area 200-500 feet from a point representing an underground mine location.	USGS 2005	Sam Thorpe Mining Co Property	West Horn Silver, Prince, Rainbow, New Telluride, Black Prince	Underground	Gold, Silver
UGM-0004	Moderate	33.312736	-111.104176	Area 200-500 feet from a point representing a portal (Resolution Portal: SP_West_Portal).	Resolution		Resolution	Underground	
UGM-0005	High	33.312488	-111.103890	Area within 200 feet of a point representing an underground mine location (Resolution Portal: SP_West_Portal).	Resolution		Resolution	Underground	
UGM-0006	Moderate	33.315580	-111.099153	Area 200-500 feet from a point representing an underground mine location.	USGS 2005	Magma Chief Copper Mine	Magma Chief Mine	Unknown	Silver
UGM-0007	High	33.315426	-111.098612	Area within 200 feet of a point representing an underground mine location.	USGS 2005	Magma Chief Copper Mine	Magma Chief Mine	Unknown	Silver
UGM-0008	Moderate	33.318298	-111.097990	Area 200-500 feet from a point representing an underground mine location.	USGS 2005	Magma Chief Group	Patented Claims M S 3482, Patented Claim M S 3483	Underground	Lead, Manganese, Silver, Zinc
UGM-0009	Moderate	33.323307	-111.091388	Area 200-500 feet from a point representing an underground mine location.	USGS 2005	Baltimore		Underground	Manganese, Silver
UGM-0010	High	33.322907	-111.091492	Area within 200 feet of a point representing an underground mine location.	USGS 2005	Baltimore		Underground	Manganese, Silver
UGM-0013	High	33.324664	-111.088254	Area within 200 feet of a point representing an underground mine location (Resolution Portals: National West Portal & CS_West_Portal).	Resolution		Resolution	Underground	
UGM-0014	Moderate	33.324385	-111.088225	Area 200-500 feet from a point representing a portal (Resolution Portals: National West Portal & CS_West_Portal & Havaliena West Portal).	Resolution		Resolution	Underground	

Table 4: Summary of Results – Underground Mine Subsidence Hazards

Hazard ID	Hazard Classification	Latitude	Longitude	Comments	Source	Site Name	Mine Name(s)	Operation Type	Main Commodity
UGM-0016	Low	33.323184	-111.084239	Area where underground mines are reported to be relatively common in the vicinity of the proposed pipeline centerline, but no evidence of underground mines, related features, or surface subsidence was identified within 500 feet of the proposed pipeline centerline based on the available resources.	Based on regional presence of mining				
UGM-0017	Moderate	33.326121	-111.081163	Area 200-500 feet from a point representing an underground mine location.	USGS 2005	Apache		Underground	Copper, Silver
UGM-0027	Moderate	33.329843	-111.056552	Area 200-500 feet from a point representing a portal (Resolution Portals: Havaliena East Portal; Queens Creek East Portal; QC_East_Portal).	Resolution		Resolution	Underground	
UGM-0028	High	33.329840	-111.056550	Area within 200 feet of a point representing an underground mine location (Resolution Portals: Havaliena East Portal; Queens Creek East Portal; QC_East_Portal).	Resolution		Resolution	Underground	
UGM-0031	Low	33.281048	-110.986992	Area where underground mines are reported to be relatively common in the vicinity of the proposed pipeline centerline, but no evidence of underground mines, related features, or surface subsidence was identified within 500 feet of the proposed pipeline centerline based on the available resources.	Based on regional presence of mining				
UGM-0032	Low	33.331201	-111.056723	Area where underground mines are reported to be relatively common in the vicinity of the proposed pipeline centerline, but no evidence of underground mines, related features, or surface subsidence was identified within 500 feet of the proposed pipeline centerline based on the available resources.	Based on regional presence of mining				

Table 5: Summary of Results – Fluid Withdrawal Subsidence Hazards

Hazard ID	Hazard Classification	Latitude	Longitude	Comments	Source
FW-0001	Moderate	33.288904	-111.005125	Groundwater aquifers in the US that show depletion over the period 1900-2008.	Konikow 2013
FW-0002	Low	33.287347	-111.021007	Oil and gas parcel on AZ State Trust land, with no known extraction wells.	Arizona State Land Department 2017; Arizona Department of Environmental Quality 2019
FW-0003	Low	33.289552	-111.012734	Oil and gas parcel on AZ State Trust land, with no known extraction wells.	Arizona State Land Department 2017; Arizona Department of Environmental Quality 2019
FW-0004	Low	33.291017	-110.986568	Oil and gas parcel on AZ State Trust land, with no known extraction wells.	Arizona State Land Department 2017; Arizona Department of Environmental Quality 2019
FW-0005	Low	33.285150	-110.974539	Oil and gas parcel on AZ State Trust land, with no known extraction wells.	Arizona State Land Department 2017; Arizona Department of Environmental Quality 2019
FW-0006	Low	33.278207	-110.968892	Oil and gas parcel on AZ State Trust land, with no known extraction wells.	Arizona State Land Department 2017; Arizona Department of Environmental Quality 2019
FW-0007	Low	33.274924	-110.960006	Oil and gas parcel on AZ State Trust land, with no known extraction wells.	Arizona State Land Department 2017; Arizona Department of Environmental Quality 2019
FW-0008	Low	33.269134	-110.953044	Oil and gas parcel on AZ State Trust land, with no known extraction wells.	Arizona State Land Department 2017; Arizona Department of Environmental Quality 2019
FW-0009	Low	33.271547	-110.951213	Oil and gas parcel on AZ State Trust land, with no known extraction wells.	Arizona State Land Department 2017; Arizona Department of Environmental Quality 2019
FW-0010	Low	33.261121	-110.950120	Oil and gas parcel on AZ State Trust land, with no known extraction wells.	Arizona State Land Department 2017; Arizona Department of Environmental Quality 2019
FW-0011	Low	33.258819	-110.949450	Oil and gas parcel on AZ State Trust land, with no known extraction wells.	Arizona State Land Department 2017; Arizona Department of Environmental Quality 2019
FW-0012	Low	33.261288	-110.948546	Oil and gas parcel on AZ State Trust land, with no known extraction wells.	Arizona State Land Department 2017; Arizona Department of Environmental Quality 2019
FW-0014	Low	33.226697	-110.926191	Oil and gas parcel on AZ State Trust land, with no known extraction wells.	Arizona State Land Department 2017; Arizona Department of Environmental Quality 2019
FW-0015	Low	33.220810	-110.924206	Oil and gas parcel on AZ State Trust land, with no known extraction wells.	Arizona State Land Department 2017; Arizona Department of Environmental Quality 2019

Table 6: Summary of Results – Hydrotechnical Waterbody Crossing Hazards

Hazard ID	Hazard Classification	Latitude	Longitude	Comments	Source	Stream Name (NHD)	Feature Type (NHD)	Stream Type (NHD)
HY-0002	Low	33.314692	-111.102102		Identified by Golder from aerial imagery (Google Earth)			
HY-0003	Low	33.314487	-111.101255		Identified by Golder from aerial imagery (Google Earth)			
HY-0004	Low	33.314686	-111.101040		Identified by Golder from aerial imagery (Google Earth)			
HY-0005	Moderate	33.315424	-111.100244		NHD		Stream/River	Ephemeral
HY-0006	Low	33.318718	-111.099183		Identified by Golder from aerial imagery (Google Earth)			
HY-0008	Moderate	33.321693	-111.097218	Headcut potential from downstream side of road	NHD		Stream/River	Ephemeral
HY-0009	Low	33.322788	-111.096513		NHD		Stream/River	Ephemeral
HY-0010	Low	33.323466	-111.095232		Identified by Golder from aerial imagery (Google Earth)			
HY-0011	Moderate	33.323541	-111.094259		Identified by Golder from aerial imagery (Google Earth)			
HY-0012	Moderate	33.323580	-111.094040	Almost follows pipeline	NHD		Stream/River	Ephemeral
HY-0013	Moderate	33.323810	-111.093722	Steep drainage with incision potential	Identified by Golder from aerial imagery (Google Earth)			
HY-0014	Moderate	33.324123	-111.093290	Steep drainage with incision potential	Identified by Golder from aerial imagery (Google Earth)			
HY-0015	Low	33.324306	-111.093037		NHD	Conley Spring Wash	Stream/River	Ephemeral
HY-0036	High	33.329889	-111.055838	Location of tunnel exit is within active erosion area	NHD		Stream/River	Ephemeral
HY-0037	High	33.329966	-111.054488	Active bed channel crossing road	NHD	Queen Creek	Stream/River	Intermittent
HY-0040	Moderate	33.312475	-111.042179	Active bed within meander bend	NHD		Stream/River	Ephemeral
HY-0042	Low	33.309384	-111.040185	Within road impoundment pond	NHD		Stream/River	Ephemeral
HY-0046	Low	33.304026	-111.026186		NHD		Stream/River	Ephemeral
HY-0047	Low	33.294197	-111.022474		NHD		Stream/River	Ephemeral
HY-0048	Moderate	33.290078	-111.021799		NHD		Stream/River	Ephemeral
HY-0049	Moderate	33.289383	-111.021743		NHD		Stream/River	Ephemeral
HY-0050	Moderate	33.289058	-111.021717		NHD		Stream/River	Ephemeral
HY-0051	Moderate	33.282519	-111.018807		NHD		Stream/River	Ephemeral
HY-0052	Moderate	33.288617	-111.013737	Following downstream of cattle tank	NHD		Stream/River	Ephemeral
HY-0053	Moderate	33.289742	-111.012849	Following downstream of cattle tank	NHD		Stream/River	Ephemeral
HY-0054	Moderate	33.291357	-111.012425	Cattle Tank/Following	NHD		Stream/River	Ephemeral
HY-0056	Low	33.300891	-111.001708		NHD		Stream/River	Ephemeral
HY-0060	Moderate	33.297395	-110.994015		NHD		Stream/River	Ephemeral
HY-0061	Low	33.291368	-110.985609	Boulders through crossing	NHD		Stream/River	Ephemeral
HY-0062	Low	33.286134	-110.975650	Boulders through crossing	NHD		Stream/River	Ephemeral
HY-0064	High	33.278929	-110.967577	Meandering dynamic creek	NHD	Dry Wash Mineral Creek	Stream/River	Intermittent
HY-0065	High	33.276777	-110.966606	Wide floodplain with evidence of meandering	NHD	Lyons Fork	Stream/River	Intermittent
HY-0069	High	33.259429	-110.948019	Dynamic location at confluence	NHD	Milky Wash	Stream/River	Intermittent

Table 6: Summary of Results – Hydrotechnical Waterbody Crossing Hazards

Hazard ID	Hazard Classification	Latitude	Longitude	Comments	Source	Stream Name (NHD)	Feature Type (NHD)	Stream Type (NHD)
HY-0081	High	33.237232	-110.936780		NHD		Stream/River	Ephemeral
HY-0082	High	33.236925	-110.936685		NHD	Cedar Creek	Stream/River	Intermittent
HY-0084	High	33.235933	-110.935429	Meandering channel following road and alignment	Identified by Golder from aerial imagery (Google Earth)			
HY-0085	High	33.231566	-110.929639		NHD		Stream/River	Ephemeral
HY-0086	Moderate	33.224254	-110.926051		Identified by Golder from aerial imagery (Google Earth)			
HY-0087	High	33.221693	-110.925300		NHD		Stream/River	Ephemeral
HY-0088	High	33.228100	-110.925143	Headcut potential from downstream side of road	NHD		Stream/River	Ephemeral
HY-0089	Low	33.324265	-111.092973	NEW	NHD	Conley Spring Wash	Stream/River	Ephemeral
HY-0090	N/A	33.323683	-111.090750	Tunnel	NHD		Stream/River	Ephemeral
HY-0091	N/A	33.324338	-111.083616	Tunnel	Identified by Golder from aerial imagery (Google Earth & ESRI)			
HY-0092	N/A	33.324711	-111.081794	Tunnel	NHD		Stream/River	Ephemeral
HY-0093	N/A	33.324945	-111.080595	Tunnel	Identified by Golder from aerial imagery (Google Earth & ESRI)			
HY-0094	N/A	33.325211	-111.079306	Tunnel	NHD		Stream/River	Ephemeral
HY-0095	N/A	33.326400	-111.073552	Tunnel	NHD		Stream/River	Ephemeral
HY-0096	N/A	33.326965	-111.070794	Tunnel	Identified by Golder from aerial imagery (Google Earth & ESRI)			
HY-0097	N/A	33.328024	-111.065606	Tunnel	NHD		Stream/River	Ephemeral
HY-0098	N/A	33.310237	-111.034598	Bridge	NHD		Stream/River	Intermittent
HY-0099	Low	33.297356	-110.997591		NHD		Stream/River	Ephemeral
HY-0100	N/A	33.259009	-110.947906	Trenchless	NHD	Milky Wash	Stream/River	Intermittent
HY-0101	N/A	33.258097	-110.947528	Trenchless	NHD		Stream/River	Ephemeral
HY-0102	N/A	33.256568	-110.946896	Trenchless	Identified by Golder from aerial imagery (Google Earth & ESRI)			
HY-0103	N/A	33.255982	-110.946671	Trenchless	Identified by Golder from aerial imagery (Google Earth & ESRI)			
HY-0104	N/A	33.252692	-110.945259	Trenchless	NHD		Stream/River	Ephemeral
HY-0105	N/A	33.250862	-110.944488	Trenchless	NHD	Mineral Creek	Stream/River	Intermittent
HY-0106	N/A	33.249566	-110.943941	Trenchless	Identified by Golder from aerial imagery (Google Earth & ESRI)			
HY-0107	N/A	33.247298	-110.942989	Trenchless	NHD	Mill Creek	Stream/River	Intermittent
HY-0108	N/A	33.246412	-110.942603	Trenchless	NHD		Stream/River	Ephemeral

APPENDIX A

Classification Criteria for Geohazard Assessments

1.0 CLASSIFICATION CRITERIA FOR PHASE I GEOHAZARD ASSESSMENTS

The following sections provide a brief introduction to the respective geohazard and describe our approach toward identification and classification of geohazards for Phase I Assessments. The rationale used to develop our hazard classification criteria are provided for each section. The hazard criteria presented are project-specific but are based on typical classification schemes used for Geohazard Assessments for pipelines. Table A-1 provides a summary list of our classification criteria.

1.1 Unstable Slopes (Landslides)

A landslide is the "movement of a mass of rock, debris, or earth down a slope" and encompasses geologic processes such as debris or mud flows, rotational slides (slumps), translational slides, earth flows, rockfalls, or debris slides (Cruden 1991; Cruden and Varnes 1996). Landslide hazards can potentially pose a serious threat to pipeline integrity because the nature and magnitude of ground movement can impose differential loading on pipelines that may ultimately exceed pipe strength capacity (INGAA 2016). Landslides can damage pipelines by shearing or bending the pipe along the lateral limits or failure planes of the landslide, by compressing and tensioning the pipe during downslope movement of soil and rock, by undercutting and exposing the pipe (in the event that material flows out from underneath the pipeline), or by physically impacting the pipe in the event of a rapid debris flow or rockfall.

Landslide hazard classifications are based on the apparent threat to a pipeline from a landslide during or post-construction, and are based on a combination of the landslide characteristics such as size, type, and nature and level of activity, and the spatial relationship of the landslide to the pipeline. For this assessment, we have addressed rockfall hazards separately from other types of landslides (see Section 1.2).

Our landslide hazard classifications are as follows:

<u>Low Hazard</u>

In general, a low hazard landslide is a mapped landslide location that appears to have a low potential to impact the pipeline. A low hazard landslide is defined as a:

- Dormant or relict landslide crossed by or within 20 feet of a proposed pipeline centerline with low potential for renewed activity.
- Landslide (of any age) located between 20 and 100 feet of the proposed pipeline centerline.
- Active or recently active landslide that has been mitigated or repaired, which shows no signs of new ground movement post-repair.

Justification: In some instances, landslides may have occurred under climatic or topographic conditions that are no longer present, such as the climatic condition present during the latest Pleistocene[1] and early Holocene[2] (Cruden and Varnes 1996). If a landslide could be clearly identified as dormant or relict, and appeared to have a low potential for reactivation, the landslide was classified as a low hazard.

A landslide in close proximity to but not actually crossing a pipeline centerline may represent a long-term potential hazard to a pipeline, but probably does not pose an imminent threat.

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[1] The time period from approximately 10,000 years ago to about 50,000 years ago (Walker and Geissman 2009).
[2] The period from approximately 5,000 to 10,000 years ago (Walker and Geissman 2009).

A landslide that has been mitigated or repaired may have a decreased potential for future ground movement if the conditions which caused the initial failure have been altered or removed during the mitigation process. Although a mitigated or repaired landslide may still have the potential for future ground movement, a lack of evidence of post-repair movement is assumed to indicate at least a temporary state of stability has been obtained for the landslide.

Moderate Hazard

In general, a moderate hazard landslide is a mapped landslide location where it does not appear that the pipeline will likely be impacted, based on the current footprint and/or activity level of the landslide, but where the pipeline may have the potential to be impacted with the enlargement or reactivation of the landslide. A moderate hazard landslide is defined as an:

- Active or recently active landslide with geomorphic or instrumental evidence of disturbance within 5 to 20 feet of the proposed pipeline centerline.
- Debris flow where the run-out/depositional area is crossed by a proposed pipeline centerline.

Justification: A landslide in close proximity to but not actually crossing a pipeline centerline may represent a potential future hazard to a pipeline if the landslide reactivates or expands toward the pipeline. Landslides could also be sensitive to disturbance during or after construction (i.e., a landslide could be triggered or reactivated in these areas), and existing landslides in proximity to the alignment could enlarge (such as from landslide retrogression) and intersect the alignment at a future time.

High Hazard

In general, a high hazard landslide is a mapped landslide location where it appears that there may be an immediate threat to the pipeline from landslide movement. A high hazard landslide is defined as an:

- Apparently or possibly active landslides within 5 feet of the proposed pipeline centerline.
- Debris flow source areas or debris flow channel that crosses the proposed pipeline centerline.

Justification: Active landslides that cross the pipeline centerline or that are located proximally to the alignment may have a high potential to adversely affect the pipeline(s), with the apparent potential higher than that for moderate landslide hazard areas.

1.2 Unstable Slopes (Rockfalls)

Rockfall hazards can potentially pose a serious threat to pipeline integrity by undercutting and exposing the pipe (in the event that material flows out from underneath the pipeline), or by physically impacting the pipe either through direct contact (for exposed or surface pipes) or through energy propagated downward from the surface (for buried pipelines).

The potential for rockfall hazards to impact a pipeline is difficult to evaluate in a meaningful way from only a desktop assessment. An evaluation of potential rockfall areas in the field is critical to assess possible source areas and runout zones relative to proposed infrastructure. Thus, we have opted not to develop a hazard classification breakdown for rockfalls for this phase of assessment, but rather to treat all identified potential rockfalls areas as containing an undefined threat level.

1.3 Seismic (Ground Shaking)

Strong ground shaking from large earthquakes can potentially strain and damage pipelines as a result of lateral and vertical ground movements, or accelerations from seismic wave propagation (O’Rourke and Liu 1999, 2012).

The potential hazard from earthquake wave propagation is commonly measured by the ground shaking parameter of peak horizontal ground acceleration (PGA), expressed as a percentage of the Earth's gravitational acceleration (g). Earthquake strong ground shaking may also trigger liquefaction and lateral spreading of saturated soil (discussed in Section 1.3), as well as landslides.

We developed general PGA thresholds to characterize low, moderate, and high ground shaking hazards based on empirical correlations between ground motions and reported damage (e.g., Wald et al. 1999). These PGA thresholds correspond with seismic hazard mapping developed by the USGS for ground motions having a 10-percent probability of exceedance in 50 years, which represents a return period of 475 years (Petersen et al. 2014).

Our seismic ground shaking hazard classifications are as follows:

Low Hazard: PGA <0.15 g

Moderate Hazard: PGA 0.15 g to 0.25 g

High Hazard: PGA >0.25 g

Justification: Empirical correlations of potential damage related to ground motions indicate that light damage to engineered surface structures generally occurs in the acceleration range of 0.09 g to 0.18 g; moderate damage occurs in the acceleration range of about 0.18 g to 0.34 g; and moderate to severe damage occurs at accelerations from 0.34 g to 1.24+ g (e.g., Wald et al. 1999). With these correlations, we conservatively selected our hazard classification criteria listed above to highlight areas where corresponding PGA values suggest there may be elevated potential for earthquake shaking to affect a pipeline.

1.4 Seismic (Liquefaction)

Liquefaction involves the transformation of a granular material from a solid to a liquefied state as a result of increased pore-water pressure and reduced effective stress (Youd et al. 2001). Seismic liquefaction typically occurs when loose to moderately dense granular soils with poor drainage such as silty sands, or sands and gravels containing seams of impermeable sediment, are saturated during strong ground shaking events (Youd et al. 2001). Liquefaction of soils involving a pipeline can potentially result in pipe strain or rupture from settlement, heave (buoyancy), and/or lateral displacements. Mass movements, including permanent ground deformation, may also develop as a result of lateral spreading, which occurs when liquefied ground cannot support even shallow slope gradients such that liquefied material flows downslope (O'Rourke and Liu 1999, 2012).

Our liquefaction hazard classifications are as follows:

Low Hazard: Potential liquefaction conditions present in areas where PGA is <0.1 g.

Moderate Hazard: Potential liquefaction conditions present in areas where PGA is 0.1 g to 0.2 g.

High Hazard: Potential liquefaction conditions present in areas where PGA is >0.2 g.

Justification: Liquefaction occurrence is primarily dependent on the presence of loose to moderately dense granular soils with poor drainage such as silty sands, or sands and gravels containing seams of impermeable sediment, that may be frequently or permanently saturated at or near the ground surface and subject to strong ground shaking (Youd et al. 2001). In the absence of site-specific soil, groundwater, and seismic hazard characterization, it is practical to assign qualitative soil liquefaction hazard classifications based on interpreted soil types, groundwater conditions, and published PGA levels (Petersen et al. 2014).

Note: We use slightly lower PGA threshold values to define low, moderate, and high liquefaction hazards than those used to define ground shaking hazards because we assume the effects on a pipeline from liquefaction would be greater than the effects from ground shaking alone. We make this assumption because pipelines tend to have lower rates of damage from ground shaking than from permanent ground deformation as a result of liquefaction-related phenomena (O'Rourke and Liu 1999, 2012).

1.5 Seismic (Surface Fault Rupture)

Surface fault rupture from earthquakes causes permanent ground deformation that induces tensile and compressional forces on pipelines, which have resulted in many pipeline breaks (e.g., rupture, buckling) from fault movement during past earthquakes (O'Rourke and Liu 1999, 2012).

Our fault rupture hazard classifications, which apply to faults that extend into the area 500 feet from the proposed pipeline alignment, are as follows:

Low Hazard

- Faults and fault zones that are mapped by the USGS (2018) as Class B[3] faults and fault zones.
- Faults and fault zones that are reported as active during the Quaternary, but with no information as to age of most recent fault displacement or slip-rate.
- Faults and fault zones with latest movement between 130,000 and 750,000 years ago and slip-rates less than 0.2 millimeter per year (mm/yr).
- Faults and fault zones active during the Quaternary with latest movement >750,000 years ago and slip-rates less than 1 mm/yr.

Justification: Low hazard faults represent faults and fault zones that either appear to be inactive or are considered to have a very low probability of rupturing during the lifetime of the pipeline system.

Moderate Hazard

- Faults and fault zones with latest movement between 15,000 and 130,000 years ago and slip-rates less than 0.2 mm/yr.
- Faults and fault zones with latest movement between 130,000 and 750,000 years ago and slip-rates of 0.2 to 1 mm/yr.
- Faults and fault zones active in the Quaternary with latest movement >750,000 years ago and slip-rates between 1 to 5 mm/yr.

[3]*Class B* faults are defined by the USGS (2006) as "Geologic evidence demonstrates the existence of a fault or suggests Quaternary deformation, but either (1) the fault might not extend deeply enough to be a potential source of significant earthquakes, or (2) the currently available geologic evidence is too strong to confidently assign the feature to Class C [insufficient evidence] but not strong enough to assign it to Class A [demonstrable evidence]."

- Unmapped geomorphic lineaments[4] that do not appear to displace mapped Quaternary deposits or Holocene-aged geomorphic features and deposits.

Justification: Moderate hazard faults represent potentially active faults and fault zones considered to have a higher probability of future displacement than faults identified as low hazards, but a lower probability of displacement than those identified as high hazards, based on fault data compiled by the USGS (2018). Lineaments identified from the available LiDAR data and/or aerial imagery that do not appear to displace mapped Quaternary deposits or Holocene-aged (<12,000 years) geomorphic features and deposits (e.g., stream terraces) are less likely to be active faults than those that do, yet there is uncertainty regarding their origin, age, and hazard potential.

High Hazard

- Faults and fault zones with latest movement <15,000 years ago (any slip rate).
- Faults and fault zones with latest movement between 15,000 and 130,000 years ago and slip-rates greater than 0.2 mm/yr.
- Faults and fault zones with latest movement between 130,000 and 750,000 years ago and slip-rates greater than 1 mm/yr.
- Faults and fault zones active in the Quaternary with latest movement >750,000 years ago and slip-rates greater than 5 mm/yr.
- Unmapped geomorphic lineaments that appear to displace mapped Quaternary deposits or Holocene-aged geomorphic features and deposits.

Justification: High hazard faults represent potentially active faults and fault zones that have the highest probability of future displacement because these features have either reportedly experienced movement in the past 15,000 years or have relatively high slip-rates for their reported age. Lineaments identified from the available LiDAR data and/or aerial imagery that appear to displace mapped Quaternary deposits or Holocene-aged geomorphic features and deposits are more likely to be active faults than those that do not; thus, there is greater uncertainty regarding their hazard potential.

1.6 Subsidence (Karst)

Karst generally refers to topography and features that typically form as a result of dissolution of carbonate rocks such as limestone and dolomite.[5] Common karst features observed in karst topography include sinkholes, ridgetop ponds, caves, disappearing streams (i.e., sinks), and reappearing streams (i.e., springs) that are often interrelated through complex subsurface drainage networks.

Karst processes that mainly result in potential hazards to pipelines involve the formation of sinkholes. Three types of sinkholes commonly form from karst processes (after Tihansky 1999):

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[4]*Lineaments* are linear geomorphic features of regional extent that may represent previously unrecognized faults that have ruptured the ground surface. Lineaments are not always indicative of active faulting and may otherwise be related to structural joints, bedding planes, or magmatic dikes (as examples).
[5]Karst-like features that form from dissolution of non-carbonate evaporites such as gypsum and salt, or that form from erosion of non-carbonate rocks such as sandstone, are often referred to as *pseudokarst.* In the strictest definition, karst refers to dissolution of carbonate rocks such as limestone and dolomite.

Dissolution: A process by which surface drainage dissolves carbonate bedrock from the surface-down, forming shallow depressions that may fill with sediment or ponded water. Dissolution sinkholes develop very slowly and typically have little impact on human activity.

Cover-subsidence: A process by which overlying granular sediments settle or erode into cavities formed by dissolution of the carbonate bedrock below, causing gradual down-warping at the surface. Cover-subsidence sinkholes may develop over months or years and are capable of causing damage to surface facilities.

Cover-collapse: A process that results in abrupt formation of sinkholes that can cause catastrophic damage to surface facilities. Cover-collapse sinkholes form when an underground cavity expands upward due to gradual dissolution and erosion until the overlying materials fail suddenly and collapse into the cavity within minutes or hours.

Although dissolution sinkholes typically have little impact on human activity, they are often indistinguishable from the more hazardous cover-subsidence and cover-collapse sinkholes based on surface expression alone. Therefore, we assume that all possible sinkholes or potentially hazardous karst features identified in the vicinity of the pipeline alignment are either the result of, or are indicative of, ongoing cover-subsidence or cover-collapse processes.

Our karst subsidence hazard classifications are as follows:

Low Hazard

- Areas where carbonate bedrock or evaporites are reported to be present at or near the ground surface and no potentially hazardous karst features were identified within 500 feet of the proposed pipeline centerline based on the available resources.
- Areas where karst features may occur, but where the distribution of karst features are reported and/or appear to be limited relative to the pipeline alignment; and no potentially hazardous karst features were identified within 500 feet the proposed pipeline centerline based on the available resources.

Justification: The occurrence of karst sinkholes and related features is primarily dependent on the presence of carbonate rocks or evaporites at or near the ground surface (Weary and Doctor 2014). The occurrence of carbonate rocks or evaporites, or a relatively limited distribution of karst features, suggests that conditions suitable for karst development may be present along the pipeline alignment, but potentially hazardous karst features do not appear to be prevalent. Therefore, in the absence of potentially hazardous karst features within 500 feet of the pipeline alignment, we classify these areas as low hazards.

Moderate Hazard

- Potentially hazardous karst features identified between 200 and 500 feet from the proposed pipeline centerline.
- Areas where the distribution of karst features are reported and/or observed to be prevalent relative to the proposed pipeline centerline, but an absence of potentially hazardous karst features within 200 feet of the proposed pipeline centerline can be confidently observed based on the available resources.

Justification: Moderate hazard karst areas represent areas where potentially hazardous karst features and processes appear more likely to impact a pipeline than low hazard karst areas based on the proximity and/or observed prevalence of karst features relative to the pipeline.

High Hazard

- Potentially hazardous karst features identified within 200 feet of the proposed pipeline centerline.
- Areas where the distribution of karst features are reported and/or observed to be prevalent relative to the proposed pipeline centerline, but an absence of potentially hazardous karst features within 200 feet of the proposed pipeline centerline cannot be confidently observed based on the available resources.

Justification: High hazard karst areas represent areas where potentially hazardous karst features and processes appear most likely to impact a pipeline based on their close proximity to the pipeline; or there is greater uncertainty regarding the occurrence of karst features within 200 feet of the pipeline in areas where karst features are reported and/or observed to be prevalent.

1.7 Subsidence (Underground Mine)

Collapse or subsidence of underground voids left by underground mining can produce sinkholes similar to those produced by karst. These sinkholes can result from collapse of overlying overburden into a mine or mine related feature (such as air shafts), or the gradual or sudden collapse of the mine itself.

Our underground mine subsidence hazard classifications are as follows:

Low Hazard

- Areas where underground mines are reported to be relatively common in the vicinity of the proposed pipeline centerline, but no evidence of underground mines, related features, or surface subsidence was identified within 500 feet of the proposed pipeline centerline based on the available resources.

Justification: In evaluating potential subsidence from underground mines, available references may range from well-located and well-defined maps of mining operations to poorly-located point data. The mapped extents of underground mines may be well-defined, incomplete, or unavailable. Low hazard mine subsidence areas are intended to highlight areas where regional evidence of underground mining suggests there is greater potential for undocumented mine openings to exist beneath the pipeline, but no evidence of underground mines, mining features, or surface subsidence could be identified within 500 feet of the pipeline based on the available resources.

Moderate Hazard

- Areas within 200 and 500 feet of underground mines and/or related features with no evidence of mine-related subsidence.

Justification: As discussed above in the low hazard section, maps of underground mines may be well-defined, incomplete, or unavailable. Areas in close proximity to mapped underground mines are more likely to be underlain by undocumented underground mine features. In addition, subsidence associated with underground mines may also affect the area outside the limits of the mapped mine area, depending on the severity and extent of the subsidence.

High Hazard

- Areas within 200 feet of underground mines and/or related features with no evidence of mine-related subsidence.
- Areas where underground mines and/or related features are reported to occur within 500 feet of the proposed pipeline centerline and there is evidence of mine-related subsidence.
- Areas within 500 feet of the proposed pipeline centerline where there is predicted future subsidence based on ongoing or planned mining activities.

Justification: As discussed in the previous sections, areas underlain by underground mines have the highest probability of experiencing mine related subsidence, and maps of underground mines may be well-defined, incomplete, or unavailable. Subsidence from underground mines may affect areas that are proximal to an underground mine. Therefore, we consider these conditions to be high underground mine subsidence hazards due to their close proximity to the pipeline and/or history of mine-related subsidence proximal to the pipeline.

1.8 Subsidence (Fluid Withdrawal)

Subsidence from fluid withdrawal can cause permanent ground deformation that may stress pipelines and ultimately lead to pipe rupture. Noticeable or measurable fluid withdrawal subsidence occurs through withdrawal and drawdown of underground fluids in combination with geologic conditions favorable to subsidence (Poland 1984). Typically, fluid withdrawal subsidence occurs when the volume of fluids being removed from a subsurface aquifer is greater than the volume of fluids recharging the aquifer, and when soil or bedrock within the aquifer is compressible (Galloway and Riley 1999).

In most cases, fluid withdrawal subsidence occurs slowly over a large area, with little differential movement within the subsiding areas. In some instances, scarps, fissures, and/or sinkholes may form in response to differential movement within subsiding areas, or from rapid surface subsidence or collapse (e.g., ALSG 2007; Paine et al. 2009, 2012).

Our fluid withdrawal subsidence hazard classifications are as follows:

Low Hazard

- Areas where oil and gas resources exist (e.g., shale plays, tight gas plays, etc.), but where extraction may or may not be presently occurring.
- Areas where major groundwater aquifers exist, but where groundwater depletion is not reported.

Justification: Areas underlain by potential oil and gas or groundwater resources are areas where fluid withdrawal may currently be occurring, or where it could occur in the future. Current or future planned activities in such regions may be unknown or poorly constrained in terms of location or could be undocumented altogether. As such, although these areas are not known to currently pose a threat for ground subsidence related to fluid withdrawal, it is possible undocumented hazards could exist, or that future activities in these areas could pose a future threat.

Moderate Hazard

- Areas that contain well fields or wells for oil and gas exploration and development within 1,000 feet of the pipeline.
- Areas with reported groundwater depletion, but with no reports of fluid withdrawal related ground subsidence.

Justification: Pumping of oil and gas or groundwater from subsurface aquifers is an essential precondition for fluid withdrawal subsidence. However, in most instances, pumping of underground fluids is not associated with noticeable or measurable subsidence because the local geologic conditions are not susceptible to subsidence, because not enough fluid withdrawal has occurred, or because the rate of withdrawal is too low. We have classified areas where fluid withdrawal is likely occurring with no reports found of fluid withdrawal subsidence (at the time of this assessment) as moderate potential fluid withdrawal subsidence hazard areas. While subsidence could potentially occur in these areas, subsidence either is not occurring, is too small in magnitude to have been widely reported or is located in too remote of an area to have been widely noticed.

High Hazard

- Areas that contain well fields or wells for oil and gas exploration and development within 1,000 feet of the pipeline or areas with reported groundwater depletion, where ground subsidence has been reported.
- Areas of reported subsidence may or may not correspond to areas of damaged infrastructure or areas with significant evidence of differential ground displacement, such as fissures or faults.

Justification: Areas with known or probable fluid withdrawal subsidence represent areas where this subsidence could potentially affect a pipeline. In densely populated areas, a lack of reports concerning damage resulting from this subsidence could indicate that the subsidence is relatively minor and is unlikely to significantly affect a pipeline. Conversely, in rural or remote areas, a lack of reports concerning damage could simply indicate that the area is too sparsely populated to have experienced widespread damage. We have classified these areas as high hazard potential fluid withdrawal subsidence areas because they represent locations where a pipeline could be potentially affected.

1.8 Hydrotechnical Hazards (Waterbody Crossings)

A hydrotechnical review of waterbody crossings focuses potential hazards to a pipeline related to fluvial geomorphic erosion and scour processes. This review is often limited by project-specific data, if available, and the quality of publicly available resources including LiDAR data and/or aerial imagery. River and stream channels undergo fluvial geomorphic processes driven by water conveyance that modify channel geometry over time and thereby can pose a threat to pipeline integrity. Channels geomorphic evolution covers a wide range of processes of which are driven by vertical scour/degradation and deposition/aggradation, as well as horizontal bank erosion and lateral channel migration. These specific erosional processes can scour down to the pipeline or erode through channel banks to expose pipeline sagbends.

To classify the potential threat to the proposed pipeline from these fluvial geomorphic processes at river, stream and other drainage crossings, our hydrotechnical hazard classifications are as follows:

Low Hazard

- Waterbodies having minimal observed or future potential for vertical degradation of the channel bed and low lateral erosion of the banks.

Justification: Waterbodies without observable sediment transport processes generally have a lower likelihood of experiencing fluvial geomorphic processes that would experience scour in the bed down to the pipe depth. Low hazard crossings are more likely to be noted as having more stability through increased vegetation both in the channel bed and on the banks, and through local geology restricting erosion. Headcutting processes may still present in a low hazard environment that might not otherwise be visibly apparent in a desktop review.

Moderate Hazard

- Waterbodies having observed or future potential for active vertical aggradation/degradation of the channel bed and/or some visible bank erosion.

Justification: Waterbodies with observable sediment transport processes have a greater potential to experience fluvial geomorphic processes that could scour in the bed down to the pipe depth. Moderate hazard crossings are more likely to have an active channel where aggradation or degradation of the channel bed is visible from a desktop review; however, the specific channel erosion or depositional trends are unknown and can change as channels sort through and balance sediment loads. Moderate hazard channels also may experience some bank erosion; however, active and larger scale lateral migration is typically not observed.

High Hazard

- Waterbodies having observed or future potential for more dynamic riverine processes with active vertical aggradation/degradation of the channel bed and potentially active lateral migration of the main channel and banks throughout, and in some situations beyond the current floodplain.

Justification: Waterbodies with observable sediment transport processes in combination with potential for lateral migration have a greater potential to experience geomorphic processes that could scour in the bed down to the pipe depth. Likewise, the main channel of such waterbodies could migrate and the banks erode laterally through or beyond the current floodplain to expose pipeline sagbends or extended portions of the pipeline buried through the floodplain. The high hazard crossing designation is given for channels with this more dynamic and/or combined threat potential. High hazard crossings are more frequently associated with dynamic geomorphic conditions, higher peak discharge systems, and with correspondingly larger floodplains.

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Table A-1: Geohazard Classification Criteria

Hazard Type		Hazard Classification: Low	Hazard Classification: Moderate	Hazard Classification: High	Comment
Unstable Slopes (Landslides)		- Dormant or relict landslide crossed by or within 20 feet of a proposed pipeline centerline with low potential for renewed activity.	- Active or recently active landslide with geomorphic or instrumental evidence of disturbance within 5 to 20 feet of the proposed pipeline centerline.	- Apparently or possibly active landslides within 5 feet of the proposed pipeline centerline.	
		- Landslide (of any age) located between 20 and 100 feet of the proposed pipeline centerline. - Active or recently active landslide that has been mitigated or repaired, which shows no signs of new ground movement post-repair.	- Debris flow where the run-out/depositional area is crossed by a proposed pipeline centerline.	- Debris flow source areas or debris flow channel that crosses the proposed pipeline centerline.	
Unstable Slopes (Rockfalls)		-	-	-	All identified potential rockfalls areas were classified as an undefined threat level until more a detailed assessment (i.e., field) can be completed.
Seismic (Ground Shaking)		- Areas with < 0.15 g peak ground acceleration (PGA)	- Areas with 0.15 g to 0.25 g PGA	- Areas with > 0.25 g PGA	Assuming probabilistic seismic hazard ground shaking risk level of 10% probability of exceedance in a 50-year period (475-year return period).
Seismic (Liquefaction)		- Potential liquefaction conditions present in areas where PGA is <0.1 g.	- Potential liquefaction conditions present in areas where PGA is 0.1 g to 0.2 g.	- Potential liquefaction conditions present in areas where PGA is >0.2 g.	Assuming probabilistic seismic hazard ground shaking risk level of 10% probability of exceedance in a 50-year period (475-year return period) combined with interpretations of nature, age, and saturation of soil.
Surface Fault Rupture: Seismic	**Age of Fault (years)**	Slip Rate (mm/year)			
	<15,000	-	-	Any Rate	
	15,000 – 130,000	-	< 0.2	≥ 0.2	
	130,000 – 750,000	< 0.2	0.2 – 1.0	> 1.0	
	>750,000	< 1.0	1.0 – 5.0	> 5.0	
	N/A	- Faults and fault zones that are mapped by the USGS (2018) as Class B faults and fault zones. - Faults reported as active within the Quaternary, but with no information as to age of most recent movement or slip-rate	- Unmapped geomorphic lineaments that do not appear to displace mapped Quaternary deposits, or Holocene-aged geomorphic features and deposits.	- Unmapped geomorphic lineaments that appear to displace mapped Quaternary deposits, or Holocene-aged geomorphic features and deposits.	
Subsidence (Karst)		- Areas where carbonate bedrock or evaporites are reported to be present at or near the ground surface and no potentially hazardous karst features were identified within 500 feet of the proposed pipeline centerline based on the available resources.	- Potentially hazardous karst features identified between 200 and 500 feet from the proposed pipeline centerline.	- Potentially hazardous karst features identified within 200 feet of the proposed pipeline centerline.	
		- Areas where karst features may occur, but where the distribution of karst features are reported and/or appear to be limited relative to the pipeline alignment; and no potentially hazardous karst features were identified	- Areas where the distribution of karst features are reported and/or observed to be prevalent relative to the proposed pipeline centerline, but an absence of potentially hazardous karst features within 200 feet of	- Areas where the distribution of karst features are reported and/or observed to be prevalent relative to the proposed pipeline centerline, but an absence of potentially hazardous karst features within 200 feet of	

Hazard Type		Hazard Classification: Low	Hazard Classification: Moderate	Hazard Classification: High	Comment
		within 500 feet the proposed pipeline centerline based on the available resources.	the proposed pipeline centerline can be confidently observed based on the available resources.	the proposed pipeline centerline cannot be confidently observed based on the available resources.	
Subsidence (Underground Mine)		- Areas where underground mines are reported to be relatively common in the vicinity of the proposed pipeline centerline, but no evidence of underground mines, related features, or surface subsidence was identified within 500 feet of the proposed pipeline centerline based on the available resources.	- Areas within 200 and 500 feet of underground mines and/or related features with no evidence of mine-related subsidence.	- Areas within 200 feet of underground mines and/or related features with no evidence of mine-related subsidence. - Areas where underground mines and/or related features are reported to occur within 500 feet of the proposed pipeline centerline and there is evidence of mine-related subsidence. - Areas within 500 feet of the proposed pipeline centerline where there is predicted future subsidence based on ongoing or planned mining activities.	
Subsidence (Fluid Withdrawal)		- Areas where oil and gas resources exist (e.g., shale plays, tight gas plays, etc.), but where extraction may or may not be presently occurring.	- Areas that contain well fields or wells for oil and gas exploration and development within 1,000 feet of the pipeline.	- Areas that contain well fields or wells for oil and gas exploration and development within 1,000 feet of the pipeline or areas with reported groundwater depletion, where ground subsidence has been reported.	
		- Areas where major groundwater aquifers exist, but where groundwater depletion is not reported.	- Areas with reported groundwater depletion, but with no reports of fluid withdrawal related ground subsidence.	- Areas of reported subsidence may or may not correspond to areas of damaged infrastructure or areas with significant evidence of differential ground displacement, such as fissures or faults.	
Hydrotechnical Hazards	**Watercourse Crossing Erosion and Scour**	- Waterbodies having minimal observed or future potential for vertical degradation of the channel bed and low lateral erosion of the banks.	- Waterbodies having observed or future potential for active vertical aggradation/degradation of the channel bed and/or some visible bank erosion.	- Waterbodies having observed or future potential for more dynamic riverine processes with active vertical aggradation/degradation of the channel bed and potentially active lateral migration of the main channel and banks throughout, and in some situations beyond the current floodplain.	

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Appendix B

DEIS ALTERNATIVES PIPELINE DISTURBANCE COMPARISON

Prepared for: Resolution Copper

Prepared by: WestLand Resources, Inc.

Date: May 28, 2020; updated July 8, 2020

Project No.: 0807.176

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1. INTRODUCTION AND BACKGROUND

Resolution Copper Mining, LLC (Resolution), engaged WestLand Resources, Inc. (WestLand), to compare potential direct impacts from the Draft Environmental Impact Statement Resolution Copper Project and Land Exchange (DEIS; USDA 2019) alternatives tailings pipeline disturbances. This document compares the calculated disturbance acres for the following DEIS pipeline corridors, which are the pipeline alternatives that will be carried forward in the final EIS.

- Alternatives 2 and 3 – Near West (pipeline disturbance for both alternatives are the same)
- Alternative 4 – Silver King
- Alternative 5 – Peg Leg East Pipeline
- Alternative 6 – Skunk Camp North Pipeline (USFS Preferred Alternative)
- Alternative 6 – Skunk Camp South Pipeline

This technical memo presents a comparison of potential direct disturbance between these DEIS alternative pipeline corridors in acres by post land exchange surface management. The Skunk Camp North alternative is the only DEIS alternative that includes a new powerline, so this memo only includes the DEIS pipeline corridor disturbance for comparison. There is a separate document that compares the DEIS Preferred Alternative (Skunk Camp North) pipeline and powerline corridors with the Skunk Camp Revised Corridor that has the pipeline and most of the powerline co-located within the same corridor as much as practicable.

The DEIS alternative pipeline corridors were analyzed with different widths for disturbance, as noted below. For comparison, the calculated acres disturbed by post land exchange surface management were scaled to an assumed 200-foot-wide disturbance within the corridor. Additional acres comparisons include potential disturbance to:

- endangered Gila chub (*Gila intermedia*) designated critical habitat
- Yellow-billed cuckoo (*Coccyzus americanus;* YBC) proposed critical habitat
- Southwestern Willow Flycatcher (*Empidonax traillii extimus*; SWFL) proposed critical habitat
- Waters of the U.S. (WOTUS) and Ordinary High Water Mark (OHWM)
- groundwater dependent ecosystems (GDE as defined in Chapter 3 Section 3.7.1 of the DEIS)
- endangered Arizona hedgehog cactus (*Echinocereus coccineus var. arizonicus*; AHC) predicted habitat (Baker 2013) (not included in this memo – only applies to Skunk Camp North) and
- Visual Quality Objectives (VQO) and Recreational Opportunity Spectrum (ROS) management classes for two standards and guidelines in Management Areas 2F and 3I of the Tonto National Forest (TNF) Land and Resources Management Plan (TNF 1985).

The DEIS Near West tailings pipeline disturbance footprint was originally estimated using 100-percent disturbance in an average 270-foot-wide pipeline corridor. The Silver King pipeline disturbance footprint was originally estimated using 100-percent disturbance in a 1,000-foot-wide pipeline corridor, and for Peg Leg East, Skunk Camp North, and Skunk Camp South 100-percent disturbances in 500-foot-wide pipeline corridors were used. WestLand used calculations to compare these DEIS alternatives with pipeline disturbance areas of 200-foot-width (Disturbance Area) within an overall 500-foot-wide corridor to scale the disturbance. The estimated acreage for the 200-foot-wide disturbance area within the pipeline corridors was calculated using a scaling factor for each of the DEIS pipeline alternatives. For scaling the 270-foot-wide corridor to 200-foot-wide, a scaling factor of 200/270 (0.7) was used. For scaling the 1,000-foot-wide disturbance to 200-foot-wide, a scaling factor of 200/1000 (0.2) was used. For scaling the 500-foot-wide disturbance to 200-foot-wide, a scaling factor of 200/500 (0.4) was used. The 500-foot-wide corridor allows for flexibility in locating the pipeline along the route.

Ultimately, direct disturbance would be limited to access roads and pipeline placement (to be installed in a trench below grade where practicable). Bridge crossings would avoid the ordinary high water marks (OHWMs) of major drainages.

Trenchless methods (horizontal directional drilling, micro tunneling and other boring methods) would be used to cross under roads, waterways, or for high-point mountain passes. The proposed pipeline crossings of Queen Creek and Devils Canyon would be spanned using bridges, and the crossing of Mineral Creek would use a trenchless method (Golder 2020). The crossing of the Gila River for the Peg Leg East alternative would use a trenchless method. Therefore, actual disturbances are likely overestimated by using a 200-foot-wide corridor.

2. DEIS ALTERNATIVES PIPELINE DISTURBANCE COMPARISON

To analyze direct disturbance of selected resources, WestLand compared the DEIS alternatives pipeline corridor footprints using Geographical Information Systems (GIS) data, except for the Near West alternative pipeline. For the Near West alternative, WestLand calculated the estimated pipeline disturbance area from DEIS information on the Tailings Storage Facility (TSF) plus pipeline disturbance and subtracted the DEIS TSF disturbance area to estimate the pipeline disturbance area. Data sources include:

- Bureau of Land Management (BLM) 2012, WestLand Modified 2017; BLM PLSS Cadastral Data, and DEIS data 8-20-2018
- Critical Habitat (USFWS 2005, USFWS 2014)
- Potential WOTUS (WestLand 2018b)
- Wetlands (Montgomery and WestLand 2017)
- GDE (Montgomery and WestLand 2017, USDA 2019)

- AHC predicted habitat (Baker 2013)
- AHC locations (WestLand 2004, 2008, 2010, 2011, 2013a, b, c, 2014, 2015, 2017, 2018a, 2019)
- TNF VQO (TNF 1985)[1]
- TNF ROS (TNF 1985)[2]

2.1. SURFACE MANAGEMENT

The estimated surface disturbance for the DEIS pipeline corridors using 270-foot wide disturbance (Near West), 1,000-foot wide disturbance (Silver King) or 500-foot wide disturbance (Peg Leg East, Skunk Camp North and Skunk Camp South) which were reflected in the DEIS are shown in **Table 1** by surface management ownership (post land exchange) and by alternative. The surface management categories are:

- Private – Resolution Copper will own the land after the land exchange is completed
- ASLD – Arizona State Trust Land, managed by the Arizona State Land Department
- USFS – U.S. Forest Service land managed by Tonto National Forest
- BLM – Bureau of Land Management
- BOR – Bureau of Reclamation

Table 1. DEIS Pipeline Acres of Disturbance (270-foot, 1000-foot or 500-foot disturbance) by Post Land Exchange Surface Management

Surface Management	Alt. 2/3 Near West 270-ft width (acres)	Alt. 4 Silver King 1000-ft width (acres)	Alt. 5 Peg Leg East 500-ft width (acres)	Alt. 6 Skunk Camp North 500-ft width (acres)	Alt. 6 Skunk Camp South 500-ft width (acres)
Private	0	39.0	93.7	346.3	458.0
ASLD	0	0	195.5	677.0	913.1
USFS	175.0	277.5	477.9	440.5	717.1
BLM	0	0	475.0	0	0
BOR	0	0	135.7	0	0
Total	**175.0**	**316.5**	**1377.8**	**1463.8**	**2088.2**

The estimated surface acres of disturbance for DEIS pipeline corridors scaled to a 200-foot wide disturbance area are provided in **Table 2.** These calculations were completed by scaling the 270-foot width, 1,000-foot width and 500-foot width to 200-foot width disturbances.

1 Visual analysis GIS layers for Tonto National Forest were updated in 2007 and provided via Personal Communication from Chris Garrett, SWCA Environmental Consultants to Aaron Graham, WestLand Resources, Inc. on March 9, 2020.

2 Recreational analysis GIS layers for Tonto National Forest were updated in 2011 and provided via Personal Communication from Chris Garrett, SWCA Environmental Consultants to Aaron Graham, WestLand Resources, Inc. on March 9, 2020.

Table 2. DEIS Pipeline Acres of Disturbance (Scaled to 200-foot disturbance) by Post Land Exchange Surface Management

Surface Management	Alt. 2/3 Near West 200-ft width (acres)	Alt. 4 Silver King 200-ft width (acres)	Alt. 5 Peg Leg East 200-ft width (acres)	Alt. 6 Skunk Camp North 200-ft width (acres)	Alt. 6 Skunk Camp South 200-ft width (acres)
Private	0	7.8	37.5	138.5	183.2
ASLD	0	0	78.2	270.8	365.2
USFS	129.6	55.5	191.2	176.2	286.8
BLM	0	0	190.0	0	0
BOR	0	0	54.3	0	0
Total	**129.6**	**63.3**	**551.1**	**585.5**	**835.3**

2.2. CRITICAL HABITAT

Three of the DEIS pipeline alternatives cross designated critical habitat for Gila chub, and/or proposed critical habitat for YBC and SWFL (**Table 3**). The Near West Alternative 2/3 and Silver King Alternative 4 pipelines do not cross any designated or proposed critical habitat and are not included in this comparison. **Table 4** compares the DEIS pipeline corridors critical habitat disturbance acres for a calculated 200-foot-width. These calculations were completed by scaling the disturbance from a 500-foot width to a 200-foot width.

For the DEIS Alternatives comparison, the AHC predicted habitat is only present in the Skunk Camp North pipeline corridor. The AHC predicted habitat disturbances are compared in detail in the separate memo for the DEIS Preferred Alternative (Skunk Camp North) and Revised Corridor comparison memo.

The acres of disturbance to critical habitat may be avoided by using trenchless methods for each DEIS alternative.

Table 3. DEIS Pipeline Disturbance (500-ft width) Designated and Proposed Critical Habitat Acreage Comparison by Post Land Exchange Surface Management

Surface Management	Alt. 5 Peg Leg East			Alt. 6 Skunk Camp North			Alt. 6 Skunk Camp South		
	Gila Chub	YBC	SWFL	Gila Chub	YBC	SWFL	Gila Chub	YBC	SWFL
	Critical Habitat (acres)								
Private	0	0	0	112.8	84.5	0	112.8	84.5	0
ASLD	0	0	0	26.8	31.8	0	26.8	31.8	0
USFS	0	0	0	1.3	1.0	0	1.3	1.0	0
BLM	0	0	0	0	0	0	0	0	0
BOR	0	18.6	17.0	0	0	0	0	0	0
Total	0	**18.6**	**17.0**	**140.9**	**117.3**	0	**140.9**	**117.3**	0

Table 4. DEIS Pipeline Disturbance (Scaled to 200-ft width) Designated and Proposed Critical Habitat Acreage Comparison by Post Land Exchange Surface Management

Surface Management	Alt. 5 Peg Leg East			Alt. 6 Skunk Camp North			Alt. 6 Skunk Camp South		
	Gila Chub	YBC	SWFL	Gila Chub	YBC	SWFL	Gila Chub	YBC	SWFL
	Critical Habitat (acres)								
Private	0	0	0	45.1	33.8	0	45.1	33.8	0
ASLD	0	0	0	10.7	12.7	0	10.7	12.7	0
USFS	0	0	0	0.5	0.4	0	0.5	0.4	0
BLM	0	0	0	0	0	0	0	0	0
BOR	0	7.4	6.8	0	0	0	0	0	0
Total	0	**7.4**	**6.8**	**56.4**	**46.9**	0	**56.4**	**46.9**	0

2.3. POTENTIAL WATERS OF THE U.S.

The DEIS pipeline corridors that may have impacts to potential jurisdictional WOTUS are the Silver King, Peg Leg East, Skunk Camp North, and Skunk Camp South alternatives. Alternative 2/3 Near West pipeline corridor does not impact any potential jurisdictional WOTUS. Peg Leg East pipeline disturbance is within the Gila River watershed, which is assumed to remain a WOTUS under the new Navigable Waters Protection Rule that was published on April 21, 2020. Calculation of acres of disturbance for **Tables 5 and 6** are based on the Rapanos decision for determining potential jurisdictional WOTUS. Alternative 2/3 Near West and Alternative 4 Silver King pipeline disturbances each have small areas in the Queen Creek watershed, which is not jurisdictional. Skunk Camp North and Skunk Camp South pipeline disturbances are within the Queen Creek and Mineral Creek watersheds. Mineral Creek is potentially jurisdictional in the Skunk Camp North and Skunk Camp South area. Total acreage of OHWM calculated for each pipeline disturbance within those watersheds scaled to 200-ft width is provided in **Table 5**. Impact by watershed is calculated for each pipeline disturbance in **Table 6**. These acres of disturbance may be eliminated using trenchless methods where practicable.

Table 5. DEIS Pipeline Disturbance (200-ft disturbance) OHWM Acres by Post Land Exchange Surface Management

Surface Management	Alt. 2/3 Near West 200-ft Pipeline Disturbance (acres)	Alt. 4 Silver King 200-ft Pipeline Disturbance (acres)	Alt. 5 Peg Leg East 200-ft Pipeline Disturbance (acres)	Alt. 6 Skunk Camp North 200-ft Pipeline Disturbance (acres)	Alt. 6 Skunk Camp South 200-ft Pipeline Disturbance (acres)
Private	0	0	0.1	4.6	4.9
ASLD	0	0	4.9	7.0	7.8
BLM	0	0	9.6	0	0
BOR	0	0	2.0	0	0
USFS	0.5	0.1	2.6	2.4	3.3
Total OHWM	**0.5**	**0.1**	**19.6**	**14.1**	**16.0**

Table 6. DEIS Pipeline Disturbance (200-ft disturbance) Acres by Watershed and Potential Waters of the U.S.

Watershed	Alt. 2/3 Near West	Alt. 4 Silver King	Alt. 5 Peg Leg East		Alt. 6 Skunk Camp North		Alt. 6 Skunk Camp South	
	200-ft Pipeline Disturbance (acres)**	200-ft Pipeline Disturbance (acres)**	200-ft Pipeline Disturbance (acres)	Jurisdictional (acres)	200-ft Pipeline Disturbance (acres)	Jurisdictional (acres)	200-ft Pipeline Disturbance (acres)	Jurisdictional (acres)
Gila River Watershed			16.5	16.5				
Queen Creek Watershed	0.5	0.3	3.1		1.3		3.5	
Mineral Creek Watershed*					12.8	12.8	12.4	12.4
Total Impacts	**0.5**	**0.3**	**19.6**	**16.5**	**14.1**	**12.8**	**16.0**	**12.4**

* Mineral Creek watershed is considered potentially jurisdictional, therefore OHWM acreage would be considered potential WOTUS.
** Alt. 2/3 Near West and Alt. 4 Silver King Alternatives do not cross any potentially jurisdictional watershed, so that column is not included in Table 6.

2.4. GROUNDWATER DEPENDENT ECOSYSTEMS

The Near West Alternative 2/3 pipeline corridor does not impact any GDEs. The Silver King, Peg Leg East, Skunk Camp North, and Skunk Camp South pipeline alternatives are the DEIS alignments that will potentially disturb GDEs. The disturbances in linear feet are based on the U.S. Fish and Wildlife Service Arizona Wetland Inventory (**Table 7**).

Table 7. DEIS Pipeline Disturbance of GDEs in Linear Feet

Resources Disturbed	Alt. 4 Silver King (linear feet)	Alt. 5 Peg Leg East (linear feet)	Alt. 6 Skunk Camp North (linear feet)	Alt. 6 Skunk Camp South (linear feet)
Groundwater Dependent Ecosystems (GDEs)	3,273.3	35,210.2	63,350.0	78,848.3

2.5. VISUAL QUALITY OBJECTIVE AND RECREATION OPPORTUNITY SPECTRUM COMPARISON

The DEIS notes that amendments to the 1985 forest plan would be needed under the DEIS Alternative to reconcile the VQO and ROS management classes for two standards and guidelines in Management Areas 2F and 3I (USDA 2019). **Tables 8 and 9** show the disturbance acreages within TNF, post land exchange, (200-ft width) by VQO category for the DEIS pipeline corridors. **Tables 10 and 11** show the disturbed acreages within TNF, post land exchange, (200-ft width) by ROS management class for the DEIS pipeline corridors. GIS mapped VQO acres impacted are assumed to degrade to the modification category. For example, retention and partial retention would degrade to modification after pipeline installation.

TNF requested that the VQO and ROS impacts be categorized by construction (2 years), operation (40 years), and reclamation (2 years). The maximum estimated impacts on VQO and ROS are expected to occur during both construction and reclamation (**Tables 8 and 10**), and those estimates assume that the entire pipeline will be removed (dug up and hauled out) during reclamation. The calculation used for operation impacts is based on the centerline length of the pipeline within TNF multiplied by a 20-foot wide roadway within the 200-foot-wide area and converted to acres (**Tables 9 and 11**).

In the DEIS calculations there are areas included in VQO calculations as 'not rated' that are outside of TNF, and areas included in ROS calculations as 'urban' that are outside of TNF.

Table 8. DEIS Pipeline VQO Acreage Disturbance (200-ft width) by Category Comparison – Construction and Reclamation Phases Maximum Impacts (temporary impacts estimated for 2-years each)

VQO Category	Alt. 2/3 Near West	Alt. 4 Silver King	Alt. 5 Peg Leg East	Alt. 6 Skunk Camp North	Alt. 6 Skunk Camp South
	200-ft Width (acres)				
Retention	10.0	0	139.6	72.3	137.9
Partial Retention	132.2	55.2	80.1	70.0	146.5
Modification	0	0.1	0	55.3	30.4
Maximum Modification	0	0	0	0	0
Not Rated	0	8.1	4.8	10.9	48.8
Total	**142.2**	**63.3**	**224.5**	**208.6**	**363.7**

Table 9. DEIS Pipeline VQO Acreage Disturbance by Category Comparison – Operation Phase Impacts (20-ft Road)

VQO Category	Alt. 2/3 Near West	Alt. 4 Silver King	Alt. 5 Peg Leg East	Alt. 6 Skunk Camp North	Alt. 6 Skunk Camp South
	20-ft Road (acres)				
Retention	0.9	0	14.1	5.6	12.5
Partial Retention	12.0	5.9	7.8	5.6	11.8
Modification	0	0.1	0	5.9	3.4
Maximum Modification	0	0	0	0	0
Not Rated	0	0.9	0.5	1.1	4.9
Total	**12.9**	**6.9**	**22.4**	**18.2**	**32.5**

Table 10. DEIS Pipeline ROS Acreage Disturbance by ROS Management Classes Comparison, Construction and Reclamation Phases Maximum Impacts (temporary impacts estimated for 2-years each)

ROS Management Classes	Alt. 2/3 Near West	Alt. 4 Silver King	Alt. 5 Peg Leg East	Alt. 6 Skunk Camp North	Alt. 6 Skunk Camp South
	200-ft Width (acres)				
Roaded Natural	56.5	0	180.0	28.7	156.8
Semi-primitive Motorized	134.8	47.8	0.8	123.0	118.7
Semi-primitive Nonmotorized	0	0	0	0.8	0.8
Urban	28.7	15.5	43.8	56.2	87.7
Total	**220.0**	**63.3**	**224.5**	**208.8**	**364.1**

Table 11. DEIS Pipeline ROS Acreage Disturbance by ROS Management Classes Comparison, Operation Phase Impacts (20-ft Road)

ROS Management Classes	Alt. 2/3 Near West	Alt. 4 Silver King	Alt. 5 Peg Leg East	Alt. 6 Skunk Camp North	Alt. 6 Skunk Camp South
	20-ft Road Corridor (acres)				
Roaded Natural	3.3	0	18.0	2.8	15.7
Semi-primitive Motorized	7.9	5.3	0	10.2	7.9
Semi-primitive Nonmotorized	0	0	0	0.2	0.2
Urban	1.7	1.6	4.4	5.1	8.8
Total	**12.9**	**6.9**	**22.4**	**18.3**	**32.6**

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Appendix C

SKUNK CAMP PIPELINE AND POWERLINE DISTURBANCE COMPARISON

Prepared for: Resolution Copper

Prepared by: WestLand Resources, Inc.

Date: July 8, 2020

Project No.: 0807.176

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APPENDIX

1. INTRODUCTION AND BACKGROUND

Resolution Copper Mining, LLC (Resolution), engaged WestLand Resources, Inc. (WestLand), to compare potential direct impacts from the preferred alternative for the tailings powerline and pipelines described in the *Draft Environmental Impact Statement Resolution Copper Project and Land Exchange* (DEIS; USDA 2019) to a revised co-located corridor. The DEIS preferred alternative for the tailings powerline and pipelines (DEIS Alternative) is the Skunk Camp North alternative, which consists of two corridors following separate alignments: 1) Pipeline corridor and access road, approximately 23 miles long, 500-feet-wide; and 2) Powerline corridor and access road, approximately 19 miles long, 1,000-feet-wide. The revised alignment is designed to include both the tailings pipeline and most of the 115-kV powerline collocated within the same corridor (Revised Corridor).

In response to public comments and in consultation with the U.S. Forest Service (USFS) and cooperating agencies, Resolution has developed the Revised Corridor to reduce disturbance to public lands and resources (**Figure 1**). Updated information for the Revised Corridor was developed during the second Workgroup Meeting held on February 11, 2020; this memo addresses Action Item GS-15.

Revisions to the DEIS Alternative include:

- Collocation of the Skunk Camp North tailings pipeline and 115-kV powerline within the same corridor (Revised Corridor) from the Skunk Camp Tailings Storage Facility (TSF) to the 230-kV powerline corridor. At the intersection with the 230-kV powerline corridor, the tailings pipeline corridor travels west towards the West Plant Site (WPS; **Figure 1**); while the 115-kV powerline corridor travels northeast, along the 230-kV powerline corridor, towards the Silver King Substation. The 230-kV powerline applies to all the DEIS TSF alternatives; therefore, it is not included in this comparison.
- Revised alignment to avoid potential impacts to endangered Gila chub (*Gila intermedia*) designated critical habitat and Yellow-billed cuckoo (*Coccyzus americanus;* YBC) proposed critical habitat, waters of the U.S. (WOTUS), groundwater dependent ecosystems (GDE as defined in Chapter 3 Section 3.7.1 of the DEIS), the endangered Arizona hedgehog cactus (*Echinocereus coccineus var. arizonicus*; AHC) predicted habitat (Baker 2013), and Visual Quality Objectives (VQO) and Recreational Opportunity Spectrum (ROS) management classes for two standards and guidelines in Management Areas 2F and 3I of the Tonto National Forest (TNF) Land and Resources Management Plan (TNF 1985).
- Disturbance footprint reduced to 200-foot width (Disturbance Area) within an overall 500-foot-wide corridor. The 500-foot-wide corridor allows for flexibility in locating the pipeline and powerline along the route. Ultimately, direct disturbance would be limited to access roads, pipeline placement (to be installed below grade where practicable), and powerline structure footprints.

- Repositioning the pipeline tunnel, located north of U.S. Highway 60, to avoid other private land and mineral claims.

This technical memo presents a comparison of potential disturbance between the DEIS preferred alternative and the Revised Corridor to:

- endangered Gila chub (*Gila intermedia*) designated critical habitat
- Yellow-billed cuckoo (*Coccyzus americanus;* YBC) proposed critical habitat
- Southwestern Willow Flycatcher (*Empidonax traillii extimus*; SWFL) proposed critical habitat (comparison not included in this memo because not relevant to Skunk Camp North)
- WOTUS and Ordinary High Water Mark (OHWM)
- groundwater dependent ecosystems (GDE as defined in Chapter 3 Section 3.7.1 of the DEIS)
- endangered Arizona hedgehog cactus (*Echinocereus coccineus var. arizonicus*; AHC) predicted habitat (Baker 2013) and
- Visual Quality Objectives (VQO) and Recreational Opportunity Spectrum (ROS) management classes for two standards and guidelines in Management Areas 2F and 3I of the Tonto National Forest (TNF) Land and Resources Management Plan (TNF 1985).

The DEIS Alternative disturbance footprint was originally estimated using 100-percent disturbance in a 500-foot-wide pipeline corridor and in a 1,000-foot-wide powerline corridor. The estimated acreage for the 200-foot-wide disturbance areas within the pipeline and powerline corridors was calculated using a scaling factor for the DEIS Alternative and the Revised Corridor. For scaling the 500-foot-wide pipeline corridor to 200-foot-wide, a scaling factor of 200/500 (0.4) was used. For scaling the 1,000-foot-wide powerline corridor to 200-foot-wide, a scaling factor of 200/1,000 (0.2) was used. The 500-foot-wide corridor allows for flexibility in locating the pipeline and powerline along the route.

Ultimately, direct disturbance would be limited to access roads, powerline poles and pipeline placement (to be installed in a trench below grade where practicable). The disturbance acres due to powerline poles for the Revised Corridor were calculated only for poles that were outside of the pipeline corridor to avoid double counting. Each pole disturbance was calculated assuming a 50-foot by 50-foot (2,500 square feet or 0.057 acre) disturbance around the pole. Bridge crossings would avoid the ordinary high water marks (OHWM) of major drainages.

Trenchless methods (horizontal directional drilling, micro tunneling and other boring methods) would be used to cross under roads, waterways, or for high-point mountain passes. The proposed pipeline crossings for the Skunk Camp North alternative of Queen Creek and Devils Canyon would be spanned using bridges, and the crossing of Mineral Creek would use a trenchless method (Golder 2020). Therefore, actual disturbances are likely overestimated by using a 200-foot-wide corridor.

2. DEIS ALTERNATIVE AND REVISED CORRIDOR DISTURBANCE COMPARISON

To analyze disturbance of selected resources, WestLand compared the DEIS Alternative pipeline and powerline footprints to the Revised Corridor footprint using Geographical Information Systems (GIS) data. Data sources include:

- Bureau of Land Management (BLM) 2012, WestLand Modified 2017; BLM PLSS Cadastral Data, and DEIS data 8-20-2018
- Critical Habitat (USFWS 2005, USFWS 2014)
- Potential WOTUS (WestLand 2018b)
- Wetlands (Montgomery and WestLand 2017)
- GDE (Montgomery and WestLand 2017, USDA 2019)
- AHC predicted habitat (Baker 2013)
- AHC locations (WestLand 2004, 2008, 2010, 2011, 2013a, b, c, 2014, 2015, 2017, 2018a, 2019, 2020)
- TNF VQO (TNF 1985)[1]
- TNF ROS (TNF 1985)[2]

2.1. SURFACE MANAGEMENT

Powerline and pipeline corridor estimated surface disturbances are shown in **Table 1** by post land exchange surface management and by alternative (DEIS Alternative and Revised Corridor). The pipeline tunnel was repositioned to avoid other private lands and mineral claims, and the tunnel acreage is not included in the pipeline disturbance acres. Results obtained by scaling the 1,000-foot-wide powerline disturbance and 500-foot-wide pipeline disturbance to 200-foot-width disturbance areas are provided in **Table 2**. For the Revised Corridor, the powerline acres of disturbance reflects only the disturbance for the eight poles (three on private land, five on ASLD land) that are outside of the collocated pipeline corridor, using a 2,500 square foot (0.057 acre) per pole disturbance. The surface management categories are:

- Private – Resolution Copper will own the land after the land exchange is completed
- ASLD – Arizona State Trust Land, managed by the Arizona State Land Department
- USFS – Forest Service land managed by Tonto National Forest

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[1] Visual analysis GIS layers for Tonto National Forest were updated in 2007 and provided via Personal Communication from Chris Garrett, SWCA Environmental Consultants to Aaron Graham, WestLand Resources, Inc. on March 9, 2020.

[2] Recreational analysis GIS layers for Tonto National Forest were updated in 2011 and provided via Personal Communication from Chris Garrett, SWCA Environmental Consultants to Aaron Graham, WestLand Resources, Inc. on March 9, 2020.

Table 1. Skunk Camp North Pipeline and Powerline Acres of Disturbance (500-ft or 1000-ft width) by Post Land Exchange Surface Management

Surface Management	DEIS Skunk Camp North 500-ft width Pipeline (acres)*	DEIS Skunk Camp North 1,000-ft width Powerline (acres)	Revised Corridor 500-ft width Pipeline (acres)*	Revised Corridor Powerline Poles and Access Roads (acres)**
Private	346.3	225.5	118.3	0.3
ASLD	677.0	725.8	475.4	0.7
USFS	440.5	471.6	419.4	0
Total	**1,463.8**	**1,422.9**	**1013.1**	**1.0**

* Note that Skunk Camp North Pipeline disturbance acreage does not include tunnel.

** Revised Corridor powerline disturbance is calculated for poles outside of the pipeline corridor using a 2,500 square foot (0.057 acre) per pole disturbance, and 10-foot-wide access roads outside of the corridor.

Table 2. Skunk Camp North Pipeline and Powerline Acres of Disturbance (Scaled to 200-foot width) by Post Land Exchange Surface Management

Surface Management	DEIS Skunk Camp North 200-ft width Pipeline (acres)*	DEIS Skunk Camp North 200-ft width Powerline (acres)	DEIS Skunk Camp North 200-ft Pipeline Plus 200-ft Powerline (acres)	Revised Corridor 200-ft width Pipeline (acres)	Revised Corridor Powerline Poles and Access Roads (acres)**	Revised Corridor 200-ft Pipeline Plus Powerline Poles and Access Roads (acres)
Private	138.5	45.1	183.6	47.3	0.3	47.6
ASLD	270.8	145.2	416.0	190.2	0.7	190.9
USFS	176.2	94.3	270.5	167.8	0	167.8
Total	**585.5**	**284.6**	**870.1**	**405.3**	**1.0**	**406.3**

* Note that Skunk Camp North Pipeline disturbance acreage does not include tunnel.

** Revised Corridor powerline disturbance is calculated for poles outside of the pipeline corridor, using a 2,500 square foot (0.057 acre) per pole disturbance, and 10-foot-wide access roads outside of the corridor.

Table 3. Skunk Camp North Pipeline Plus Powerline Acres of Disturbance (200-foot-width) by Post Land Exchange Surface Management Difference

Surface Management	DEIS Skunk Camp North 200-ft Pipeline Plus 200-ft Powerline (acres)	Revised Corridor 200-ft Pipeline Plus Powerline Poles and Access Roads (acres)	Difference: DEIS Skunk Camp North 200-ft Pipeline Plus 200-ft Powerline Minus Revised Corridor 200-ft Pipeline Plus Powerline Poles and Access Roads (acres)
Private	183.6	47.6	136.0
ASLD	416.0	190.9	225.1
USFS	270.5	167.8	102.7
Total	**870.1**	**406.3**	**463.8**

2.2. Critical Habitat

The DEIS Alternative and the Revised Corridor both cross designated critical habitat for Gila chub and proposed critical habitat for YBC. The Revised Corridor pipeline would either span or be installed through trenchless methods at the Mineral creek crossing, avoiding disturbances to both Gila chub and YBC critical habitat.

The DEIS Alternative and the Revised Corridor do not cross any SWFL proposed critical habitat; therefore, that is not included in the comparison. The comparison between the DEIS Alternative and the Revised Corridor is shown in **Table 4** (Gila Chub) and **Table 7** (YBC). Results obtained by scaling the 1,000-foot-wide powerline disturbance and 500-foot-wide pipeline disturbance to 200-foot-width disturbance are provided in **Table 5** (Gila Chub) and **Table 8** (YBC). The calculated difference in disturbed acres based on 200-foot-wide disturbance is shown in **Table 6** (Gila Chub) and **Table 9** (YBC).

The potential disturbance to critical habitat for the Revised Corridor is shown in the powerline access roads disturbance column because the area where the pipeline and powerline cross critical habitat are collocated. There is no disturbance to critical habitat from the pipeline because of spans or trenchless installation. There are no powerline poles that impact Gila Chub or YBC critical habitat.

Table 4. Skunk Camp North Pipeline and Powerline Disturbance (500-ft or 1,000-ft width) to Designated Gila Chub Critical Habitat Acreage Comparison by Post Land Exchange Surface Management

Surface Management	DEIS Skunk Camp North 500-ft Pipeline (acres)	DEIS Skunk Camp North 1,000-ft Powerline (acres)	Revised Corridor 500-ft Pipeline (acres)	Revised Corridor Powerline Access Roads (acres)*
Private	112.8	118.1	0	0
ASLD	26.8	50.4	0	0.2
USFS	1.3	4.2	0	0
Total	**140.9**	**172.7**	**0**	**0.2**

* Revised Corridor powerline disturbance is calculated for 10-foot-wide access roads.

Table 5. Skunk Camp North Pipeline and Powerline Disturbance (200-foot-width) to Designated Gila Chub Critical Habitat Acreage Comparison by Post Land Exchange Surface Management

Surface Management	DEIS Skunk Camp North 200-ft Pipeline (acres)	DEIS Skunk Camp North 200-ft Powerline (acres)	DEIS Skunk Camp North 200-ft Pipeline Plus 200-ft Powerline (acres)	Revised Corridor 200-ft Pipeline (acres)	Revised Corridor Powerline Access Roads (acres)*	Revised Corridor 200-ft. Pipeline Plus Powerline Access Roads (acres)
Private	45.1	23.6	68.8	0	0	0
ASLD	10.7	10.1	20.8	0	0.2	0.2
USFS	0.5	0.8	1.3	0	0	0
Total	**56.4**	**34.5**	**90.9**	**0**	**0.2**	**0.2**

* Revised Corridor powerline disturbance is calculated for 10-foot-wide access roads.

Table 6. Skunk Camp North Pipeline Plus Powerline Disturbance (200-foot-width) to Designated Gila Chub Critical Habitat Acreage by Post Land Exchange Surface Management Difference

Surface Management	DEIS Skunk Camp North 200-ft Pipeline Plus 200-ft Powerline (acres)	Revised Corridor 200-ft Pipeline Plus Powerline Access Roads (acres)	Difference: DEIS Skunk Camp North Minus Revised Corridor 200-ft Pipeline Plus Powerline Access Roads (acres)
Private	68.8	0	68.8
ASLD	20.8	0.2	20.6
USFS	1.3	0	1.3
Total	**90.9**	**0.2**	**90.7**

Table 7. Skunk Camp North Pipeline and Powerline Disturbance to Proposed YBC Critical Habitat Acreage Comparison by Post Land Exchange Surface Management

Surface Management	DEIS Skunk Camp North 500-ft Pipeline (acres)	DEIS Skunk Camp North 1000-ft Powerline (acres)	Revised Corridor 500-ft Pipeline (acres)	Revised Corridor Powerline Access Roads (acres)*
Private	84.5	83.3	0	0
ASLD	31.8	38.7	0	0.2
USFS	1.0	1.0	0	0
Total	**117.3**	**123.0**	**0**	**0.2**

* Revised Corridor powerline disturbance is calculated for 10-foot-wide access roads.

Table 8. Skunk Camp North Pipeline and Powerline Disturbance (200-foot-width) to Proposed YBC Critical Habitat Acreage Comparison by Post Land Exchange Surface Management

Surface Management	DEIS Skunk Camp North 200-ft Pipeline (acres)	DEIS Skunk Camp North 200-ft Powerline (acres)	DEIS Skunk Camp North 200-ft Pipeline plus 200-ft Powerline (acres)	Revised Corridor 200-ft Pipeline (acres)	Revised Corridor Powerline Access Roads (acres)	Revised Corridor 200-ft Pipeline Plus Powerline Access Roads (acres)
Private	33.8	16.7	50.5	0	0	0
ASLD	12.7	7.7	20.5	0	0.2	0.2
USFS	0.4	0.2	0.6	0	0	0
Total	**46.9**	**24.6**	**71.6**	**0**	**0.2**	**0.2**

* Revised Corridor powerline disturbance is calculated for 10-foot-wide access roads.

Table 9. Skunk Camp North Pipeline Plus Powerline Disturbance (200-foot-width) to Proposed YBC Critical Habitat Acreage by Post Land Exchange Surface Management Difference

Surface Management	DEIS Skunk Camp North 200-ft Pipeline Plus 200-ft Powerline (acres)	Revised Corridor 200-ft Pipeline Plus Powerline Access Roads (acres)	Difference: DEIS Skunk Camp North Minus Revised Corridor 200-ft Pipeline Plus Powerline Access Roads (acres)
Private	50.5	0	50.5
ASLD	20.5	0.2	20.3
USFS	0.6	0	0.6
Total	**71.6**	**0.2**	**71.4**

2.3. Potential Waters of the U.S.

Both the DEIS Alternative and Revised Corridor pipelines fall within the Queen Creek and Mineral Creek watersheds (**Figures 1 and 2**). Total acreage of OHWM calculated for each pipeline corridor by surface management is provided in **Table 10**. Calculation of acres of disturbance for **Tables 10 and 11** are based on the Rapanos decision for determining potential jurisdictional WOTUS. Mineral Creek is potentially jurisdictional in the Skunk Camp North area. The powerline will not have any impact to OHWM and is not included in these tables. Impact by watershed is calculated in **Table 11**.

Table 10. Skunk Camp North Pipeline Disturbance Acres by Post Land Exchange Surface Management OHWM Acreage

Surface Management	DEIS Skunk Camp North 500-ft Pipeline (acres)	Revised Corridor 500-ft Pipeline (acres)	Difference: DEIS Skunk Camp North Minus Revised Corridor 500-ft Pipeline (acres)
Private	11.6	3.9	7.7
ASLD	17.6	10.1	7.5
USFS	6.1	3.8	2.3
Total OHWM	**35.3**	**17.8**	**17.5**

Table 11. Skunk Camp North Pipeline Disturbance Acres by Watershed and Potential Waters of the U.S.

Watershed	DEIS Skunk Camp North 500-ft Pipeline (acres)	DEIS Skunk Camp North Jurisdictional (acres)	Revised Corridor 500-ft Pipeline (acres)**	Revised Corridor Jurisdictional (acres)
Queen Creek Watershed	3	0	2.2	0
Mineral Creek Watershed*	31	31	15.7	15.7
Total	**34**	**31**	**17.9**	**15.7**

* Mineral Creek watershed is considered potentially jurisdictional, therefore OHWM acreage would be considered potential WOTUS.

** Queen Creek, Devils Canyon, and Mineral Creek acreages are not included in these totals because they are underbored for pipeline installation and not disturbed.

2.4. Groundwater Dependent Ecosystems

The DEIS Alternative pipeline installation would potentially disturb a continually saturated reach along Mineral Creek (Mineral Creek GDE; **Figures 1 and 2**). The DEIS Alternative parallels the Mineral Creek GDE, disturbing approximately 63,350 linear feet along the GDE (**Table 12**). The Revised Corridor avoids the Mineral Creek GDE reducing the disturbance to GDEs by 63,350 linear feet. The pipeline within the Revised Corridor would be installed using a trenchless crossing approximately 1.2 miles upstream of the Mineral Creek GDE, at an ephemeral reach (**Appendix A**).

Table 12. Skunk Camp North Pipeline Disturbance of GDEs (Linear Feet) Comparison

Resources Disturbed	DEIS Skunk Camp North Disturbance (linear feet)	Revised Corridor Disturbance (linear feet)	Difference
			DEIS Skunk Camp North Minus Revised Corridor (linear feet)
Groundwater Dependent Ecosystems (GDE)	63,350	0	**63,350**

2.5. Arizona Hedgehog Cactus

Numerous surveys within the predicted habitat for AHC (Baker 2013) have been conducted by WestLand (WestLand 2004, 2008, 2010, 2011, 2013a, b, c, 2014, 2015, 2017, 2018a, 2019). Targeted surveys were conducted within and in the immediate vicinity of the DEIS Alternative (WestLand 2019) and the Revised Corridor (WestLand 2020). The density and distribution of individual AHC within the predicted habitat varies across the landscape. The DEIS Alternative traverses areas of high AHC concentration both north and south of U.S. Highway 60. The Revised Corridor avoids most of these dense AHC concentrations. Additionally, with the flexibility in construction of the pipeline, and minimal footprint of the powerline poles and access roads, disturbance to AHC individuals within the Revised Corridor can be minimized, or avoided, where possible.

The comparison of disturbance acres in **Table 13** assumes 100-percent disturbance to the 500-foot width pipeline corridor and the 1000-foot width powerline corridor for the DEIS Alternative and 100-percent disturbance to the 500-foot width pipeline corridor and the 500-foot width powerline corridor for the Revised Corridor. Results obtained by scaling the 1,000-foot width or 500-foot width powerline disturbances and 500-foot width pipeline disturbances to 200-foot width disturbances are provided in **Table 14**. The calculated difference in disturbed acres based on 200-foot width disturbances is shown in **Table 15**. This comparison of 200-foot width disturbances may not be accurate due to the modeling used to predict habitat for AHC and the scaling factor used to reduce the DEIS disturbance to 200-foot-width.

Table 13. Skunk Camp North Pipeline and Powerline Disturbance to Predicted AHC Habitat Acreage Comparison by Post Land Exchange Surface Management

Surface Management	DEIS Skunk Camp North 500-ft Pipeline (acres)	DEIS Skunk Camp North 1,000-ft Powerline (acres)	Revised Corridor 500-ft Pipeline (acres)	Revised Corridor 500-ft Powerline (acres)*
Private	53.6	0	32.9	0
USFS	232.8	308.8	108.9	0
Total	**286.4**	**308.8**	**141.8**	**0**

* The potential disturbance to predicted habitat for AHC for the Revised Corridor is included in the pipeline disturbance. The areas where the pipeline and powerline cross predicted habitat are collocated.

Table 14. Skunk Camp North Pipeline and Powerline Disturbance (200-ft width) to Predicted AHC Habitat Acreage Comparison by Post Land Exchange Surface Management

Surface Management	DEIS Skunk Camp North 200-ft Pipeline (acres)	DEIS Skunk Camp North 200-ft Powerline (acres)	DEIS Skunk Camp North 200-ft Pipeline plus 200-ft Powerline (acres)	Revised Corridor 200-ft Pipeline (acres)	Revised Corridor 200-ft Powerline (acres)*	Revised Corridor 200-ft Pipeline Plus 200-ft Powerline (acres)
Private	21.4	0	21.4	13.2	0	13.2
USFS	93.1	61.8	154.9	43.5	0	43.5
Total	**114.5**	**61.8**	**176.3**	**56.7**	**0**	**56.7**

* The potential disturbance to predicted habitat for AHC for the Revised Corridor is included in the pipeline disturbance. The areas where the pipeline and powerline cross predicted habitat are collocated.

Table 15. Skunk Camp North Pipeline Plus Powerline Disturbance (200-foot width) to Predicted AHC Habitat Acreage by Post Land Exchange Surface Management Difference

Surface Management	DEIS Skunk Camp North 200-ft Pipeline Plus 200-ft Powerline (acres)	Revised Corridor 200-ft Pipeline Plus 200-ft Powerline (acres)	Difference: DEIS Skunk Camp North Minus Revised Corridor 200-ft Pipeline Plus 200-ft Powerline (acres)
Private	21.4	13.2	8.2
USFS	154.9	43.5	111.4
Total	**176.3**	**56.7**	**119.6**

2.6. VISUAL QUALITY OBJECTIVE AND RECREATION OPPORTUNITY SPECTRUM COMPARISON

The DEIS notes that amendments to the 1985 forest plan would be needed under the DEIS Alternative to reconcile the VQO and ROS management classes for two standards and guidelines in Management Areas 2F and 3I (USDA 2019). **Tables 16 and 17** show the disturbance acreages within TNF, post land exchange, (200-ft width) by VQO category for the Skunk Camp North pipeline and powerline corridors. **Tables 18 and 19** show the disturbance acreages within TNF, post land exchange, (200-ft width) by ROS management class for the Skunk Camp North pipeline and powerline corridors. GIS mapped VQO acres impacted are assumed to degrade to the modification category. For example, retention and partial retention would degrade to modification after pipeline installation.

TNF requested that the VQO and ROS impacts be categorized by construction (2 years), operation (40 years), and reclamation (2 years). The maximum estimated impacts on VQO and ROS are expected to occur during both construction and reclamation (**Tables 16 and 18**), and those estimates assume that the entire pipeline and powerline will be removed (dug up and hauled out) during reclamation. The calculation used for operation impacts is based on the centerline length of the pipeline within TNF multiplied by a 20-ft wide roadway within the 200-foot-wide area and converted to acres (**Tables 17 and 19**).

In the DEIS calculations there are areas included in VQO calculations as 'not rated' that are outside of TNF, and areas included in ROS calculations as 'urban' that are outside of TNF.

Table 16. Skunk Camp North Pipeline and Powerline VQO Acreage Disturbance (200-foot-width) by Category Comparison – Construction and Reclamation Phases Maximum Impacts

VQO Category	DEIS Skunk Camp North 200-ft Pipeline (acres)	DEIS Skunk Camp North 200-ft Powerline (acres)	DEIS Skunk Camp North 200-ft Pipeline Plus 200-ft Powerline (acres)	Revised Corridor 200-ft Pipeline (acres)	Revised Corridor Powerline Poles and Access Roads (acres)*	Revised Corridor 200-ft Pipeline Plus Powerline Poles and Access Roads (acres)
Retention	72.3	16.6	88.9	30.0	0	30.0
Partial Retention	70.0	30.2	100.2	46.4	0	46.4
Modification	55.3	47.6	102.9	97.2	0	97.2
Maximum Modification	0	0	0	0	0	0
Not Rated	10.9	0	10.9	10.9	0	10.9
Total	**208.6**	**94.5**	**303.0**	**184.5**	**0**	**184.5**

* Each disturbance calculated for installation of power poles and access roads outside of the pipeline corridor were less than 0.1 acre.

Table 17. Skunk Camp North Pipeline VQO Acreage Disturbance by Category Comparison – Operation Phase Impacts (20-ft Road)

VQO Category	DEIS Skunk Camp North 20-ft Road (acres)	Revised Corridor 20-ft Road (acres)	Difference: DEIS Skunk Camp North Minus Revised Corridor 20-ft Road (acres)
Retention	5.6	3.0	2.6
Partial Retention	5.6	5.0	0.6
Modification	5.9	10.2	- 4.3
Maximum Modification	0	0	0
Not Rated	1.1	1.0	0.1
Total	**18.2**	**19.2**	**-1.0**

Table 18. Skunk Camp North Pipeline and Powerline ROS Acreage Disturbance (200-foot-width) by ROS Management Classes Comparison – Construction and Reclamation Phases Maximum Impacts

ROS Management Classes	DEIS Skunk Camp North 200-ft Pipeline (acres)	DEIS Skunk Camp North 200-ft Powerline (acres)	DEIS Skunk Camp North 200-ft Pipeline Plus 200-ft Powerline (acres)	Revised Corridor 200-ft Pipeline (acres)	Revised Corridor Powerline Poles and Access Roads (acres)	Revised Corridor 200-ft Pipeline Plus Powerline Poles and Access Roads (acres)
Roaded Natural	28.7	26.1	54.8	29.3	0	29.3
Semi-primitive Motorized	123.0	68.2	191.2	92.1	0.1	92.2
Semi-primitive Nonmotorized	0.8		0.8	25.5	0	25.5
Urban	56.2		56.2	39.5	0	39.5
Total	**208.8**	**94.3**	**303.1**	**186.4**	**0.1**	**186.5**

Table 19. Skunk Camp North Pipeline Corridors ROS Acreage Disturbance by ROS Management Classes Comparison – Operation Phase Impacts (20-ft Road)

ROS Management Classes	DEIS Skunk Camp North 20-ft Road Corridor (acres)	Revised Skunk Camp North 20-ft Road Corridor (acres)	Difference
			DEIS Skunk Camp North Minus Revised Corridor 20-ft Road Corridor (acres)
Roaded Natural	2.8	2.9	- 0.1
Semi-primitive Motorized	10.2	9.9	0.3
Semi-primitive Nonmotorized	0.2	2.6	- 2.4
Urban	5.1	4.1	1.0
Total	**18.3**	**19.5**	**- 1.2**

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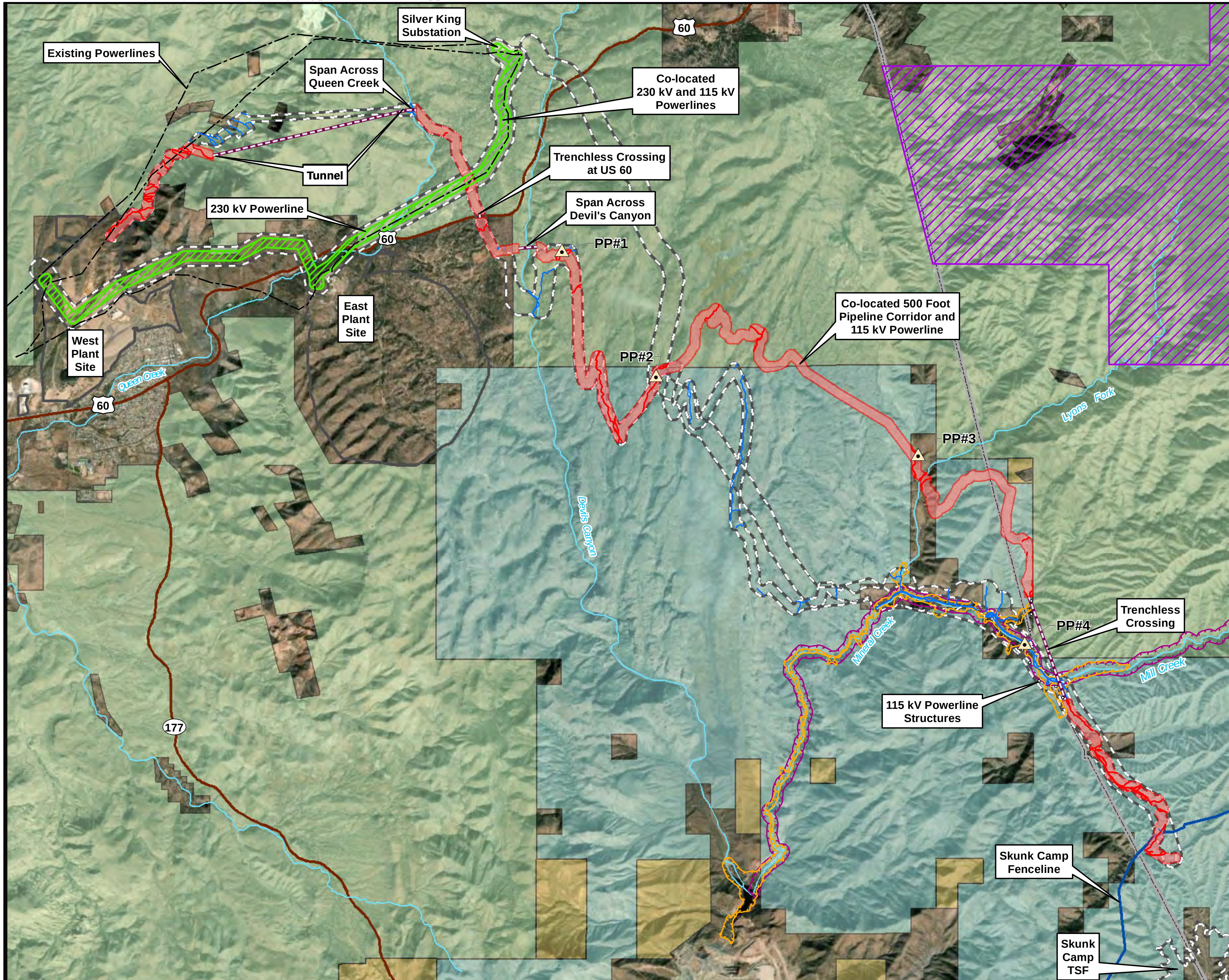
FIGURES



Pinal and Gila Counties, Arizona
Globe and Mesa 1:100,000 USGS Quadrangles
Data Sources: Post Land Exchange Surface Management, BLM, WRI Modified 2017, SWCA DEIS 8-20-2018, SRP Powerline Data, 6-2020, Golder Associates, 5-2020, and USFWS Critical Habitat.
Image Source: ArcGIS Online World Imagery, 2-6-2018

Legend

- 115 kV Power Structure
- Potential Wetland Survey Photo Point
- Streams (ALRIS)
- Existing Powerlines
- Skunk Camp Tunnel, Spans and Trenchless Crossings
- Skunk Camp Revised North Pipeline OHWM
- Skunk Camp North Pipeline DEIS OHWM
- 230 kV Powerline 500 ft Corridor
- North Pipeline Route 500 ft Corridor
- Skunk Camp Fenceline
- Skunk Camp Pipeline-Powerline Corridors (DEIS)

USFWS Critical Habitat

- Gila Chub Designated 2005-11-02
- Mexican spotted owl Designated 2004-08-31
- Yellow-billed Cuckoo Proposed 2020-02-27

Post Land Exchange Surface Management

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

Note: Within the 500 Foot Corridor for the North Pipeline Route, only 200 feet will actually be disturbed.

N
0 2,600 5,200 Feet
0 800 1,600 Meters

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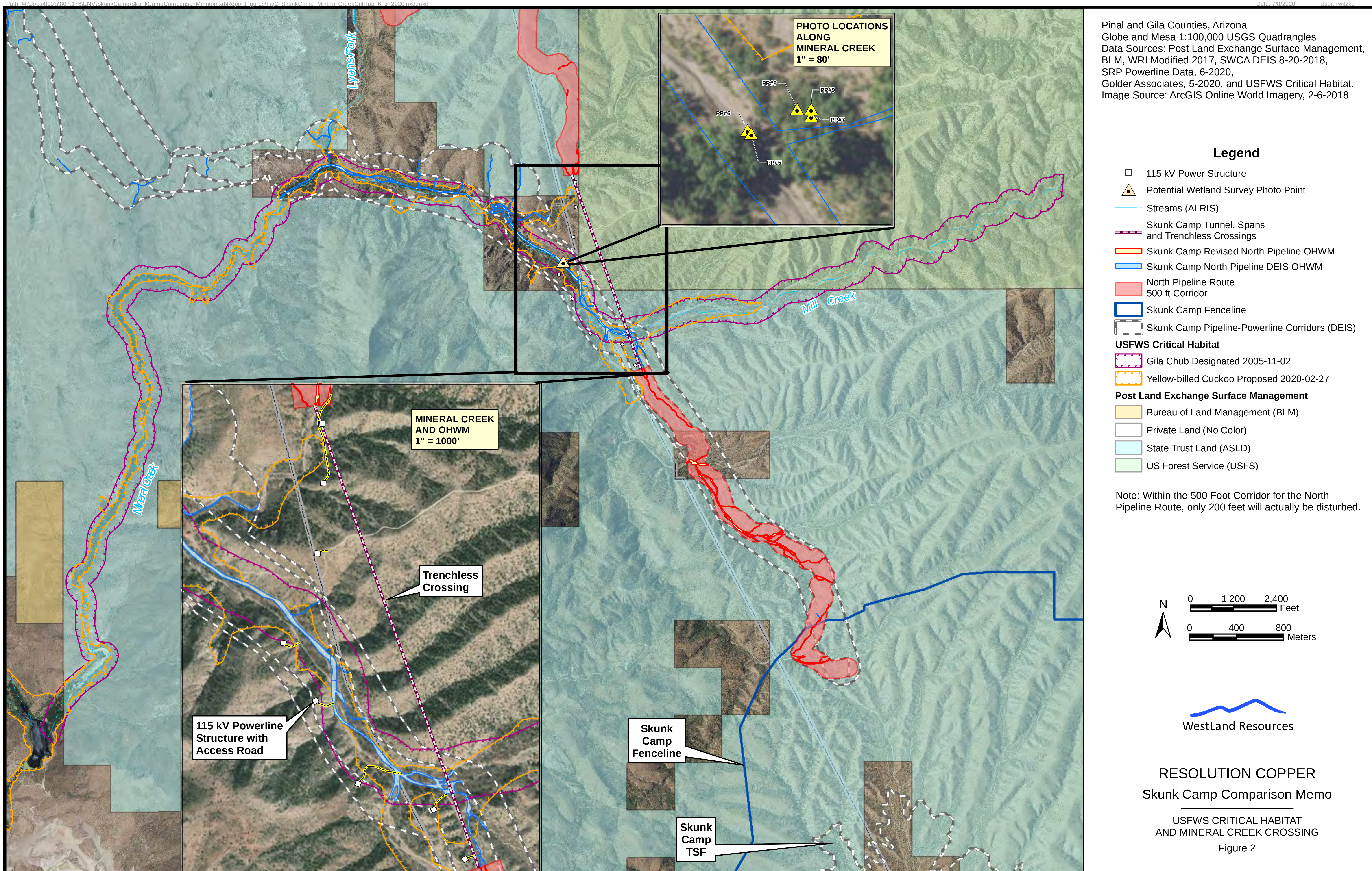
Skunk Camp Comparison Memo

SKUNK CAMP NORTH PIPELINE AND POWERLINE CORRIDORS FROM WEST PLANT SITE TO SKUNK CAMP

Figure 1



Pinal and Gila Counties, Arizona
Globe and Mesa 1:100,000 USGS Quadrangles
Data Sources: Post Land Exchange Surface Management, BLM, WRI Modified 2017, SWCA DEIS 8-20-2018, SRP Powerline Data, 6-2020, Golder Associates, 5-2020, and USFWS Critical Habitat.
Image Source: ArcGIS Online World Imagery, 2-6-2018
Legend
115 kV Power Structure
Potential Wetland Survey Photo Point
Streams (ALRIS)
Skunk Camp Tunnel, Spans and Trenchless Crossings
Skunk Camp Revised North Pipeline OHWM
Skunk Camp North Pipeline DEIS OHWM
North Pipeline Route 500 ft Corridor
Skunk Camp Fenceline
Skunk Camp Pipeline-Powerline Corridors (DEIS)
USFWS Critical Habitat
Gila Chub Designated 2005-11-02
Yellow-billed Cuckoo Proposed 2020-02-27
Post Land Exchange Surface Management
Bureau of Land Management (BLM)
Private Land (No Color)
State Trust Land (ASLD)
US Forest Service (USFS)
Note: Within the 500 Foot Corridor for the North Pipeline Route, only 200 feet will actually be disturbed.
N
0 1,200 2,400 Feet
0 400 800 Meters
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RESOLUTION COPPER
Skunk Camp Comparison Memo
USFWS CRITICAL HABITAT AND MINERAL CREEK CROSSING
Figure 2
PHOTO LOCATIONS ALONG MINERAL CREEK 1" = 80'
PP#8
PP#9
PP#7
PP#6
PP#5
MINERAL CREEK AND OHWM 1" = 1000'
Trenchless Crossing
115 kV Powerline Structure with Access Road
Lyons Fork
Mill Creek
Mineral Creek
Skunk Camp Fenceline
Skunk Camp TSF

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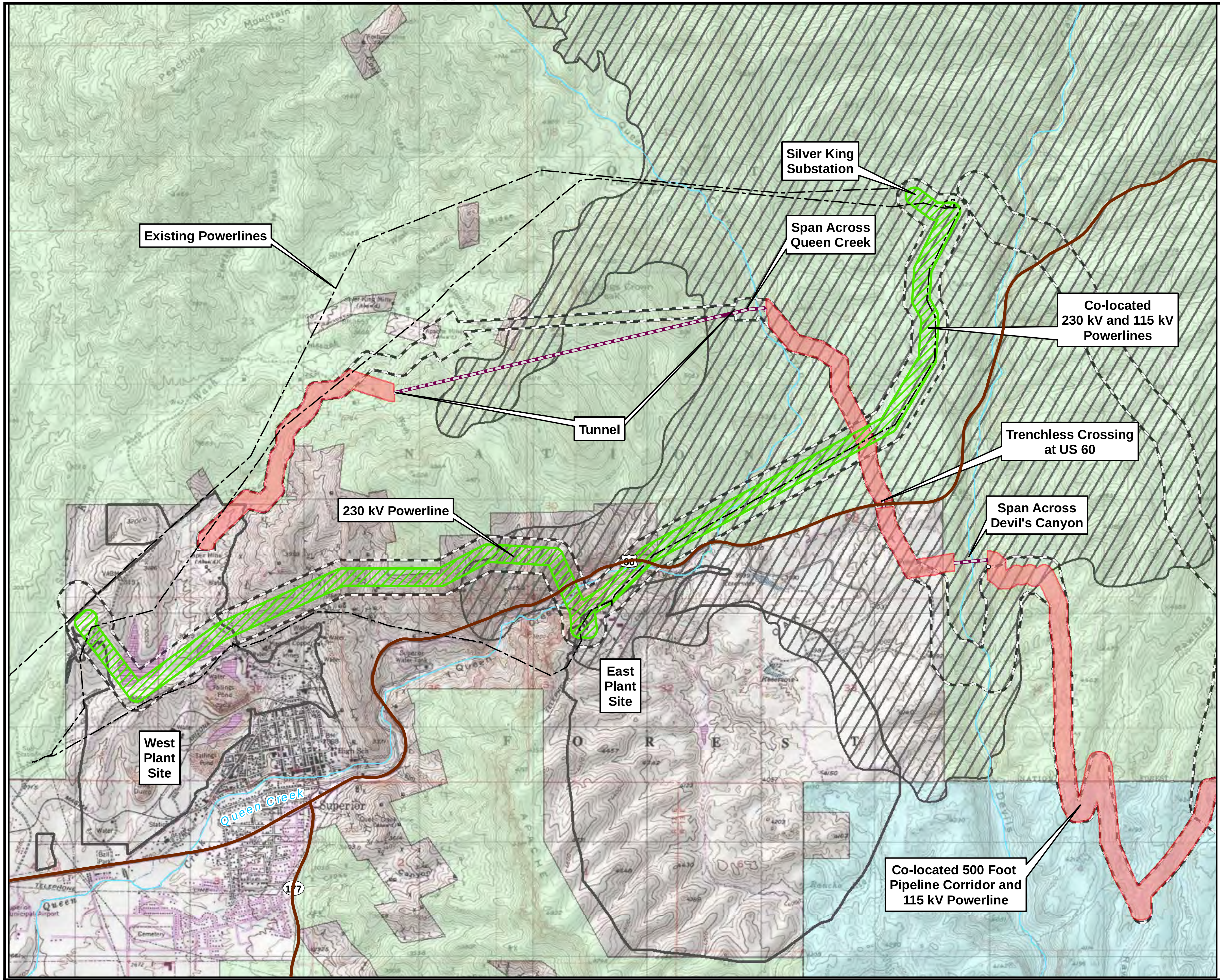

Pinal and Gila Counties, Arizona
Globe and Mesa 1:100,000 USGS Quadrangles
Data Sources: Post Land Exchange Surface Management, BLM, WRI Modified 2017, SWCA DEIS 8-20-2018, SRP Powerline Data, 6-2020, and Golder Associates, 5-2020

Legend

- Existing Powerlines
- Skunk Camp Tunnel, Spans and Trenchless Crossings
- 230 kV Powerline 500 ft Corridor
- North Pipeline Route 500 ft Corridor
- Skunk Camp Pipeline-Powerline Corridors (DEIS)
- AHC Predicted Habitat (Baker 2013)

Post Land Exchange Surface Management

- Private Land (No Color)
- State Trust Land (ASLD)
- US Forest Service (USFS)

Note: Within the 500 Foot Corridor for the North Pipeline Route, only 200 feet will actually be disturbed.

N

0 2,600 5,200 Feet

0 800 1,600 Meters

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Skunk Camp Comparison Memo

ARIZONA HEDGEHOG CACTUS PREDICTED HABITAT

Figure 3

APPENDIX A

Results of Field Reconnaissance of Mineral Creek at the Skunk Camp Tailings Pipeline and 115-kV Transmission Line Corridor

RESULTS OF FIELD RECONNAISSANCE OF MINERAL CREEK AT THE REVISED SKUNK CAMP TAILINGS PIPELINE AND 115-KV TRANSMISSION LINE CORRIDOR

Prepared for: Resolution Copper

Prepared by: WestLand Resources, Inc.

Date: April 21, 2020

Project No.: 0807.176

To assess potential impacts to wetlands within the co-located Skunk Camp tailings pipeline and 115-kV transmission line corridors (Revised Corridor), a wetland delineation was conducted along appropriate areas on February 12 and 13, 2020. Prior to field surveys, aerial photos and GIS layers of the Revised Corridor were reviewed to prioritize areas of interest. Evaluations were made at sites where potential wetlands may occur, specifically, cattle tanks and associated drainages along the corridor between Mineral Creek and Oak Flat. Sampling locations included inspections of two unnamed earthen tanks (**Photos 1 and 2**), areas where the corridor traversed Lyons Fork tributary (**Photo 3**), and its crossing in Mineral Creek (**Photo 4**). Site assessment methodologies consisted of taking area photographs, documenting the presence or absence of wetland obligate or facultative plants, inspecting soil characteristics typical of wetland soils, and recording hydrology of the vicinity.

No wetlands were found within the Revised Corridor. None were found inside or in the vicinity of cattle tanks or within the corridor along Lyons Fork tributary. No surface water or evidence of wetlands were observed in the corridor crossing area of Mineral Creek including areas within the Ordinary High Water Mark (OHWM) and outside of the mapped jurisdictional boundary. Overall, soils in the sites were sandy-loam and well drained limiting the potential for the development of hydric soils. Upland and xeroriparian vegetation were present within potential wetland areas indicating that water was not present within the soil for appropriate periods to lead to changes in community.

Inspections of this corridor crossing within designated critical habitat for the endangered Gila Chub of Mineral Creek yielded no surface water or wetlands (**Photos 5 through 9**). This crossing segment of Mineral Creek appears to be ephemeral. The conditions within the greater area were wet from recent rainfall and winter snow melt. Surface water was present in several tributaries to Mineral Creek, including Lyons Fork tributary and along Mineral Creek downgradient of the crossing. Despite the presence of surface water within portions of the Mineral Creek drainage, the segment where the corridor crossed was dry.

Photo 1; Photo Point 1.
Potential wetland evaluated in the vicinity of an earthen tank near Rawhide Canyon. No surface water was present.

Photo 2; Photo Point 2.
Potential wetland area evaluated in vicinity of an earthen tank near Devils Canyon. No surface water was present.

Photo 3; Photo Point 3.
Potential wetland area evaluated in the Lyons Fork tributary to Mineral Creek. No surface water was present.

Photo 4; Photo Point 4.
Potential wetland area evaluated in Mineral Creek. No surface water was present.

Photo 5; Photo Point 4.
Upstream view of section of Mineral Creek where Study Corridor will cross within Gila chub designated critical habitat. No surface water was present.

Photo 6; Photo Point 4.
Downstream view of section of Mineral Creek where Study Corridor will cross within Gila chub designated critical habitat. No surface water was present.

Photo 7; Photo Point 4.
View of Mineral Creek where the Study Corridor will cross in areas where OHWM was mapped. No surface water was present. Upland and xero riparian vegetation were present.

Photo 8; Photo Point 4.
View of Mineral Creek where the Study Corridor will cross where OHWM is mapped. No surface water was present. Upland and xero riparian vegetation were present.

Photo 9; Photo Point 4.
View of Mineral Creek where the Study Corridor will cross where OHWM is mapped. No surface water was present. Upland and xero riparian vegetation were present.

Appendix D

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General Plan of Operations

Road Use Plan

Revised August 2020

TABLE OF CONTENTS

TABLES
(follow text)

FIGURES
(follow text)

1. INTRODUCTION

Resolution Copper Mining, LLC (Resolution or Applicant) submitted a General Plan of Operations (Plan or GPO), dated November 2013, to the Tonto National Forest (TNF) for authorization to construct an underground mine, ore processing operation, and associated facilities and infrastructure near Superior, Pinal County, Arizona. These components are collectively identified as the Resolution Copper Project (Resolution Project or Project). The proposed location for the Project is referred to as the General Project Area (GPA) as defined in the submitted Plan. The Road Use Plan has been updated to include roads in the vicinity of the GPA that will not be adversely impacted by the Project, as well as roads that will be used to access the U.S. Forest Service (USFS) preferred alternative identified in the Environmental Impact Statement (EIS) with the Skunk Camp Tailings Storage Facility location

The main sites and associated primary Project elements within the GPA that are located on or accessed from TNF lands include:

- East Plant Site (EPS) – Underground mine and attendant shafts and surface support facilities;
- West Plant Site (WPS) – Concentrator (ore processing facilities), and administrative facilities;
- 230 kilovolt (kV) powerline corridor and access roads (230-kV corridor);
- Tailings Storage Facility (TSF) – Skunk Camp tailings storage area and associated Tailings Pipeline and Powerline Corridor (distribution pipelines, 115-kV powerline, and access roads [Utility Corridor]); and
- The Magma Arizona Railroad Company (MARRCO) Corridor (existing rail line, existing and future pipelines).

Development of project sites and elements would require the use of, maintenance of existing U.S. Forest Service Roads (FRs) as well as construction of Proposed New Roads (PNRs) both on and off TNF lands. With the exception of the TSF and ancillary infrastructure, the Project will be conducted primarily underground and on previously disturbed areas.

Proposed access routes within and adjacent to the GPA are identified on an overview map index and associated figures (**Figures 1 through 7**). Details of the activities associated with the proposed access routes are provided in **Tables 1 through 3**.

The Road Use Plan is intended to provide general guidance for minimizing impacts to areas, resources, and people adjoining, served by, or otherwise affected by FRs and PNRs proposed for use by Resolution and its agents to access Project sites throughout the duration of the Project. This Road Use Plan, prepared in accordance with USFS regulations for travel management and motor vehicle use on National Forest System (NFS) lands (36 CFR Parts 212, 251, 261, and 295), identifies and describes the following:

1. The Applicant's proposed access within and adjacent to the GPA and anticipated use of routes;
2. The intended public use and access allowed on the existing system of open FRs in and adjacent to the GPA, and the PNRs;

3. The design, construction, and/or maintenance standards for roads under the responsibility of Resolution; and
4. The estimated disturbance area to TNF lands associated with the construction of PNRs and maintenance of existing FRs required to complete the proposed activities.

2. EXISTING U.S. FOREST SERVICE ROADS

2.1. APPLICANT USE

All the FRs proposed for use in, and in the vicinity of, the GPA are currently designated as open authorized, open unauthorized, or open authorized restricted to motorized vehicles. Existing FRs would be used for access to, from, and within the GPA. Some portions of the roads would require routine maintenance for the Project duration. Some existing FRs, as well as several unauthorized roads, not officially within the USFS road system, will require decommissioning due to their location within the disturbance area of the GPA.

2.2. PUBLIC USE

Resolution will maintain public access on NFS roads to the areas surrounding the GPA throughout all phases of the Project to the extent practicable as depicted in **Figures 1 through 7**. The plan for public access is described in the following sections which are organized by main Project site and associated primary project elements.

2.3. MARRCO CORRIDOR

There are 17 proposed access points along the MARRCO Corridor for use in the Project for both construction and operation/maintenance purposes. All 17 of these MARRCO Corridor Access points (MCAs) will be accessed from within the MARRCO Corridor. The pipeline infrastructure within the MARRCO Corridor will be buried via trench installation during construction. Several FRs intersect the MARRCO Corridor and include: Hewitt Canyon Road (FR 357), FR 1933, FR 3454A, FR 3454C, FR 252, FR 293, FR 8, FR 2397, and FR 2395 (**Figures 2, 3, and 4**). The sections of FRs that cross the pipeline will be temporarily closed in coordination with the USFS and/or other relevant land management agencies (e.g. Arizona State Land Department [ASLD]), and then reestablished to their existing maintenance level after construction in coordination with the USFS and/or ASLD. During construction, alternate access directions will be provided to recreational users to allow access and connections via other FRs. Gates will be placed on either side of the FRs with appropriate signing (per USFS guidelines and Manual on Uniform Traffic Control Devices [MUTCD]) to restrict access to the MARRCO Corridor and Resolution's MARRCO access road and associated infrastructure. Although not a FR, the Arizona Trail (AZT) currently crosses the MARRCO Corridor. During construction of that section, that portion of the AZT will be temporarily closed to public access and a temporary crossing within the corridor in another location will be established to allow continued passage for recreational users. Additionally, to the extent practicable, the construction of that section will occur during low recreational use (summer months).

2.3.1. Tailings Storage Facility and Utility Corridor

The construction of the TSF will not impact any TNF roads but will restrict public access to unimproved existing county roads that traverse the proposed TSF area with the installation of a gate (**Figure 7**). PNR-10 will be constructed within the TSF footprint and is described in **Section 3**. Dripping Spring Road, a county road, will be used to access PNR-10, and a gate will be installed at the TSF fence line, restricting public access to the TSF. Dripping Spring Road within the footprint of the TSF will be decommissioned. Alternate access to Dripping Spring Road and areas north of the TSF will be via FR 899 to an unnamed county road that connects to Dripping Spring Road (**Figure 6**).

The TSF requires Tailings Pipelines and a 115-kV Powerline, which share the same corridor from the TSF to the 230-kV Corridor. At the intersection of the 230-kV Corridor, the Tailings Pipeline corridor travels west towards the WPS; while the 115-kV Powerline corridor travels northeast, along the 230-kV Corridor, towards the Silver King Substation. Both the Utility Corridor and 230-kV Corridor will cross TNF roads. The pipeline infrastructure within the Utility Corridor will be buried via trench installation during construction (except for tunnel and bridge span sections). The sections of FRs that cross the pipeline will be temporarily closed in coordination with USFS and ASLD as needed, and then reestablished to their existing maintenance level after construction in coordination with USFS, ASLD, and the county as needed. Road maintenance obligations will not change. The Utility Corridor will cross four existing FRs between the TSF and WPS (**Figures 4 through 7**). The Utility Corridor begins at the TSF and will travel north along the existing Dripping Spring Road crossing an SLR that connects to FR 248, east of the Utility Corridor. Public access between Dripping Spring Road and FR 248 will remain publicly accessible. After diverging from Dripping Spring Road, the pipeline is installed via a trenchless crossing near Mill Creek. No access roads are needed at this trenchless crossing. For the 115-kV Powerline, PNR-3 through PNR-9 will be constructed along Dripping Spring Road for access to the power structures (**Figure 6**). Each access road will have a gate located at Dripping Spring Road, prohibiting access to the public. FR 899 will still be publicly accessible from Dripping Spring Road through a connecting County road. PNR-3 will provide access to the 115-kV Powerline and connect to PNR-2, the Utility Corridor access road. From this point, PNR-2 travels north until it once again intersects with Dripping Springs Road. At this intersection, two gates will be installed at both sides of Dripping Springs Road restricting public access to PNR-2 (**Figure 5**). PNR-2 continues to travel northwest until it intersects with SLR-3. At this point, a gate will be installed restricting public access to southbound PNR-2. Resolution will use portions of SLR-1 through 3 as well as FR 2466 along the Utility Corridor. These portions will remain open to the public and maintained as-is (**Figure 5**). FR 2469 will remain accessible to the public. Where FR 2466 meets PNR-1, another gate will be installed restricting public access north within the Utility Corridor.

PNR-1 travels north, then west until it reaches Devils Canyon (**Figures 4 and 5**). At Devils Canyon, PNR-1 will span the canyon via a proposed private bridge then resume traveling north. Proposed bridge will be reviewed by USFS prior to construction. Prior to construction, a bridge inspection schedule will be determined by Resolution and USFS. At the intersection of PNR-1 and U.S. Highway 60, two gates will be installed restricting public access northbound and southbound on PNR-1. Once PNR-1 intersects the 230-kV Corridor, the 115-kV Powerline will begin to travel northeast (within the 230-kV Corridor) and utilize the existing 115-kV access road. The 230-kV Corridor will only contain transmission towers and lines, allowing public access to FR 342 and FR 2459 to be maintained. Two gates will be installed at the intersection of these two FRs and PNR-1, restricting public access northbound and southbound on PNR-1. PNR-1 will continue to head north, following the Utility Corridor, intersecting FR 2458 which will remain publicly accessible. Just past the intersection with FR 2458 the pipeline corridor is bored under the mountains. On the west side of the mountain boring, the Utility Corridor will utilize FR 1010 for access to the WPS. FR 1010 will have a gate installed at the intersection with FR 2445, to restrict public access into the WPS. FR 2446 public access will be maintained via U.S. Highway 60 to FR 8, then to FR 3152, FR 229, and FR 2445. Design standards for PNR-1 through PNR-10 are described in **Section 3**.

Details on FRs and PNRs are presented in **Tables 1 through 3**.

2.3.2. West Plant Site

The WPS is primarily located on private lands, with only the Silver King Mine Road alternate entrance located on TNF lands (**Figure 4**). FR 229 is proposed for use as the main access for construction and operations into WPS (light and heavy-duty delivery vehicle traffic). Public access will be maintained along FR 229 but will be controlled at the security gate where the road then crosses onto private lands. The planned alternative access route to bypass the section of FR 229 on private lands will be FR 8 to FR 3152, which will then connect back to FR 229 north of WPS as shown in **Figure 4**.

2.3.3. East Plant Site

The EPS encompasses the proposed underground mine, associated shafts, and surface support facilities. The existing plant and related surface support facilities are currently located on private lands. During construction and operations of the Magma Copper Mine at EPS, between the late 1960s through 1996, the main mine access road was FR 469 which is also called the "Magma Mine Road." For Resolution, at full build-out and production, EPS will expand only onto private land. Additional area encompassed by EPS includes the land surface above the ore body. This land surface area above the ore body is noted in **Figure 4** as the EPS Fracture Zone and correlates with the limit of the fracture zone at the end of the mine life. The following public access roads will be within the subsidence area on Resolution's private property and will be decommissioned: FR 2432, FR 2433, FR 2434, and FR 3153. The portion of FR 315 located on Resolution's private property and within the subsidence zone will also be decommissioned. The following roads on Resolution's private property will remain open for access to the Oak Flat Campground and upper/middle Devils Canyon and will be renamed as private roads: FR 469, FR 2439, and FR 2438. A portion of FR 2438 will be closed due to impacts from subsidence. Gates will be installed at private lands along segments of these FRs to restrict public access (**Figure 4**). Public access to public lands in the vicinity of EPS will be maintained via SR 177 on the west side, FR 315 on the south side, and US 60 on the north via FR 469, FR 2439, and FR 2438. FR 469, FR 2439, and FR 2438 are on private lands owned by Resolution and will remain publicly accessible. Portions will be restricted in the future. **Tables 1 and 3** list all existing FRs impacted, their intended use, and access route descriptions for the Project.

2.3.4. 230-kV Corridor

The 230-kV Corridor is located on both private and TNF lands and runs from the WPS, through the EPS to the Silver King Substation (**Figure 4**). From the Silver King Substation, the 230-kV Corridor will utilize the existing 115-kV road as access. While the remainder of the 230-kV Corridor is on private lands, the corridor would intersect FR 229, near the WPS. As discussed in **Section 2.3.2.**, this portion of FR 229 will be restricted from public access.

2.4. ROUTINE MAINTENANCE TO EXISTING U.S. FOREST SERVICE ROADS

2.4.1. Maintenance Level Descriptions

As defined by the TNF (1985), USFS Road Maintenance Levels are as follows:

- Level 1 (Basic Custodial Care) – Roads are not open to traffic; they are maintained to protect the road investment and its surrounding resources. These roads may be opened for a specific activity and returned to Level 1 upon completion of the activity.
- Level 2 (High-Clearance Vehicles) – Roads are maintained open for limited passage of traffic. Roads in this maintenance level are primitive type facilities intended for high clearance vehicles. Passenger car traffic is not a consideration.
- Level 3 (Suitable for Passenger Cars) – Roads are maintained open and safe for travel by a prudent driver in a passenger car. However, user comfort and convenience are not considered a priority.
- Level 4 (Moderate Degree of User Comfort) – Roads are maintained to provide a moderate degree of user comfort and convenience at moderate travel speeds.
- Level 5 (High Degree of User Comfort) – Roads are maintained to provide a high degree of user comfort and convenience. These roads are normally two lanes with aggregate or paved surface.

2.4.2. Maintenance Activities

A description of maintenance activities required for each FR to be used during the proposed Project is provided in **Table 1**. Maintenance activity for roads requiring routine maintenance will be performed within the existing roadway width; therefore, maintenance is not considered as new disturbance. Schedule of road maintenance meetings between Resolution and USFS will be determined at time of the Road Use permit submittal. Additionally, upon submittal of the Road Use Permit, the parties responsible for road maintenance (e.g. USFS, Resolution, or approved contractor) will be determined also.

2.5. MAINTENANCE OF EXISTING U.S. FOREST SERVICE ROADS

To enable access to the GPA, certain segments of the existing FRs will require maintenance. All existing FRs being utilized for the Project will be maintained and repaired to maintenance levels as designated by the TNF. Maintained roads will adhere to the design standards described in the following subsections (Keller and Sherar 2003). Details of existing FRs are summarized in **Tables 1 and 3**.

2.5.1. Design Standards

2.5.1.1. Traveled Way

The maintained width of the traveled way of the existing FRs will be based on existing width. The majority of the existing FRs requiring maintenance will be used as temporary access to the pipeline and waterline for the MARRCO Corridor and pipeline and electrical maintenance access to the TSF from the EPS. (**Figures 1 through 7**).

All maintained roadways will be cleared of vegetative cover as needed for planned traffic. The road prism will be maintained to provide for passage of the specified maintenance level vehicles. Slides and slumps will be removed or repaired, as needed, to control resource damage. No new disturbance is anticipated for maintenance of existing FRs.

2.5.1.2. Crossing Existing Forest Service Roads

The Utility Corridor access road will intersect seven FR roads: FR 2469, FR 2466, FR 2459, FR 342, FR 2458, FR 2445, and FR 1010 (**Figures 4 and 5**). The Utility Corridor will be used for pipeline and powerline maintenance and is not intended as primary access to and from the WPS and TSF, so impacts on these road crossings will be minimal. Primary access to recreational areas north of the WPS and Utility Corridor are provided through FR 650 and FR 3152.

Hewitt Canyon Road (FR 357) serves as a temporary access route to areas west and north of the GPA (**Figures 2 through 4**). This road currently crosses the MARRCO Corridor. There is an existing 18-inch dewatering line and an existing 12-inch Arizona Water line along the MARRCO Corridor. A new 36-inch steel pipe waterline and 2- to 8-inch concentrate lines will be added to the MARRCO Corridor right-of-way and will be buried along with the existing lines at the current crossings. No other changes will occur to the current crossings. The route will be accessible to the public to provide access to public and private lands, apart from temporary closures in coordination with USFS as needed during pipeline construction.

2.5.2. Maintenance Methods

Roads being used for the Project will be maintained in coordination with USFS and ASLD as needed, using typical road construction and maintenance equipment (i.e. bulldozers, graders, excavators, water truck). Maintenance will include filling and leveling of heavily eroded areas, placement of temporary low water crossings and placement of leveling fill or aggregate surfacing in the roadway. There will be no new disturbance to NFS lands outside the existing FR footprints.

2.5.3. Environmental Protection Measures

During maintenance of existing FRs, Resolution will minimize or eliminate erosion and subsequent downstream sedimentation through the implementation of erosion control Best Management Practices (BMPs). These BMPs include the following:

- To the extent practicable, vegetation will not be removed except from those areas to be directly affected by road maintenance activities.

- To the extent practicable, removal of primary growth medium material will be scheduled for the dry months to reduce the potential for erosion and high soil losses.
- Cut and fill slopes for road maintenance will be designed to prevent soil erosion. Drainage ditches with cross drains will be maintained. Disturbed slopes will be revegetated, mulched, or otherwise stabilized to minimize erosion as soon as practicable following maintenance.
- Road embankment slopes will be graded and stabilized with vegetation or rock as practicable to prevent erosion.
- Runoff from roads will be handled through BMPs, including sediment traps, settling ponds, berms, sediment filter fabric, wattles, etc. Design of these features will be based on an analysis of local hydrologic conditions. These will be designed as recommended in the *Low-Volume Roads Engineering Best Management Practices Field Guide* (Keller and Sherar 2003).
- Off-road vehicle travel will generally be avoided near FRs during construction and operations.
- During construction and operations, diversion channels will be constructed around affected areas to minimize erosion. A number of BMPs including check dams, dispersion terraces, and filter fences also will be used during construction and operations.
- Permanent diversion channels will be designed for long-term stability.
- Reclamation and revegetation will be implemented as soon as practicable for long-term stability.

3. PROPOSED NEW ROADS ON TNF AND STATE LANDS

3.1. APPLICANT USE

Resolution will construct PNRs for the proposed TSF and Utility Corridor. These roads include the Utility Corridor access roads (PNR-1 and PNR-2), the 115-kV Powerline access roads (PNR-3 through PNR-9), and the TSF perimeter road (PNR-10). These roads will be used for mine activities only. Closure of these roads will be addressed as part of the overall Project Closure Plan.

3.2. PUBLIC USE

The current plan is that the newly constructed PNR-1 through PNR-9 will be closed to the public and primarily used for pipeline and powerline maintenance. PNR-10 will not be open for public use because it is designated as a mine road. Gates will be installed to restrict public use (see **Figures 2 through 7**).

3.3. DESIGN STANDARDS

PNRs will be designed to minimize land disturbance to the greatest extent practicable based on the descriptions that follow.

PNR-1 and PNR-2: Utility Corridor Access Roads

PNR-1 and PNR-2 will be used for access along the Utility Corridor and will provide access to pipelines and powerlines along the corridor as well as alternative access from the WPS to the TSF (**Figures 4 through 7**).

These roads will be constructed and maintained to a Level 2 maintenance to generally achieve the High-Clearance Vehicles management designation.

PNR-3 through PNR-9: 115-kV Powerline Access Roads

PNR-3 through PNR-9 will be used for access to the 115-kV Powerline structures (**Figure 6**). These roads will be constructed and maintained to a Level 2 maintenance to generally achieve the High-Clearance Vehicles management designation.

PNR-10: TSF Perimeter Road

PNR-10 is a roadway that will provide access along the entire toe of the TSF and to surrounding facilities such as the TSF diversion channels and the seepage collection dams (**Figure 7**). This road will change over time as the TSF changes. For the purpose of this report, PNR-10 is modeled at build-out of the mine. The roadway will be constructed and maintained by Resolution and is within the TSF footprint.

3.3.1. Traveled Way

PNRs have varied design widths. PNR-1 through PNR-9 are access roads into mine property or maintenance routes, and will have a traveled width of approximately 10 ft. PNR-10 will have a traveled width of approximately 50 ft. Each roadway will be cleared of vegetative cover as needed for planned traffic, and the road prism will be maintained to provide for passage. Calculated new disturbance for PNRs are provided in **Table 3**.

3.3.2. Drainage Improvements

Drainage improvements to the PNRs will generally include sloped roadways to prevent erosion and ponding in the traveled way and culverts and/or ford-style low water crossings at existing drainage crossings. All necessary culverts will be installed under the provisions of the CWA, Individual Permit, assuming potentially jurisdictional waters are encountered. More specific drainage features that will be incorporated for each PNR are as follows.

PNR-1 and PNR-2

The Utility Corridor Access Roads will be mine operations roads only. The roadway will be sloped to drain either off the road or into a drainage ditch along the road. Drainage ditch locations will be determined in the field based upon actual water flow patterns and road surface erosion characteristics. Drainage ditch locations will be determined in the field based upon actual water flow patterns and road surface erosion characteristics. Culvert take-offs will direct the flow from the ditches off the roadway where overland flow may cause erosion on the fill embankments. Other erosion and stormwater control BMPs that may be incorporated will be detailed in the Project Stormwater Pollution Prevention Plan (SWPPP).

PNR-3 through PNR-9

The road will be designed to generally allow all stormwater to run off to the road shoulder over the embankments. The road fill slopes will be designed to prevent soil erosion. Disturbed slopes will be re-vegetated, mulched, stabilized with rock, or otherwise stabilized to minimize erosion. Culverts will be installed where the realignment crosses existing drainages. Should there be a large concentration of runoff in cut sections, drainage ditches on either side of the road will be constructed and culvert take-offs installed. These culvert take-offs will only be installed where the potential exists for erosion to fill embankments, otherwise the flow from the ditches will be allowed to run off over the embankment. Other erosion and stormwater control BMPs that may be incorporated will be detailed in the Project SWPPP.

PNR-10

The TSF Perimeter road will be located within the TSF Project area and will be constructed and maintained under the jurisdiction of MSHA. The roadway will be sloped to drain either off the road or into a drainage ditch along the road. Drainage ditch locations will be determined in the field based upon actual water flow patterns and road surface erosion characteristics. Culvert take-offs will direct the flow from the ditches off the roadway where overland flow may cause erosion on the fill embankments. Since this roadway will be used for mine operations it will require a berm. Breaks in the berm will be incorporated as necessary to prevent ponding on the roadway. Culverts or ford-style low water crossings will be constructed as needed at drainage crossings. However, any stormwater potentially impacted by the tailings must be directed to the seepage collection dams. This will prevent any impacted waters from going offsite. Other erosion and stormwater control BMPs that may be incorporated will be detailed in the Project SWPPP.

3.4. CONSTRUCTION METHODS

New PNRs will be constructed using typical road construction and maintenance equipment (i.e. bulldozers, graders, excavators, water truck). An excavator may be used to reduce the size of large boulders when necessary. Drilling or blasting may be required for PNR construction if non-rippable material is encountered. Drilling or blasting will be coordinated with USFS and ASLD as needed, prior to beginning. Prior to construction, surveys will be conducted for exact placement of PNRs and related infrastructure.

3.5. ENVIRONMENTAL PROTECTION MEASURES

The erosion control BMPs to be implemented in the construction of the PNRs are the same as described in **Section 2.4.3** for the existing FR maintenance.

4. REFERENCES

Keller, Gordon, and James Sherar. 2003. Low-Volume Roads Engineering Best Management Practices Field Guide. *Prepared for U.S. Agency for International Development (USAID) in Cooperation with USDA Forest Service, International Programs and Conservation Management Institute Virginia Polytechnic Institute and State University*: U.S. Department of Agriculture. July 2003.

U.S. Forest Service. 1985. Tonto National Forest Plan. *edited by Southwest Region*: U.S. Department of Agriculture. October 1985. 329 p.

TABLES

Table 1. Proposed Forest Service Road Condition during Plan of Operations

Roadway ID	Existing Forest Service Road Maintenance Level	Planned Road Condition During Plan of Operations
FR 8	Level 2 - High Clearance Vehicles	Segment from FR 229 to FR 3152 will remain publicly accessible as Level 2.
FR 229	Level 3 - Suitable for Passenger Cars	Segment from FR 2445 to FR 8 is on private property and will be restricted from public access within the boundaries of the WPS. Segments north and south of WPS will remain publicly accessible as Level 3.
FR 252	Level 2 - High Clearance Vehicles	Segment from FR 2383 to MCA 8 will remain publicly accessible as Level 2.
FR 293	Level 2 - High Clearance Vehicles	Segment from FR 8 to MCA-7 will remain publicly accessible as Level 2. Road to be temporarily closed during pipeline construction and will be re-established to existing maintenance level.
FR 315 at EPS	Level 4 - Moderate Degree of User Comfort	Segment within the subsidence zone is on private property and will be decommissioned and restricted from public access.
FR 342	Level 3 - Suitable for Passenger Cars	Segment will remain publicly accessible as Level 3. Segment that overlaps PNR-1 to be decommissioned. Access to TNF via FR 2459 and FR 2458.
FR 357	Level 4 - Moderate Degree of User Comfort	Segment to remain publicly accessible as Level 4. Road to be temporarily closed during pipeline construction and will be re-established to existing maintenance level.
FR 469	Level 4 - Moderate Degree of User Comfort	Segment west of the campground will become private road (post-land exchange), however, a portion will remain open for public access to the Oak Flat campground and Devils Canyon connecting to FR2438 and FR2439.
FR 1010	Administration Access Only	Segment to be restricted from public access.
FR 1933	Level 2 - High Clearance Vehicles	Segment between MCA-15 through MCA-17 will remain publicly accessible as Level 2. Road to be temporarily closed during pipeline construction and will be re-established to existing maintenance level.
FR 2395	Level 2 - High Clearance Vehicles	Segment between MCA-2 and 4 will remain publicly accessible as Level 2. Road to be temporarily closed during pipeline construction and will be re-established to existing maintenance level.
FR 2397	Level 2 - High Clearance Vehicles	Segment between FR 8 and FR 2395 will remain publicly accessible as Level 2.
FR 2432	Level 3 - Suitable for Passenger Cars	On private property, will be decommissioned and restricted from public access.
FR 2433	Level 1 - Basic Custodial Care	On private property, will be restricted from public access.
FR 2434	Level 1 - Basic Custodial Care	On private property, will be restricted from public access.
FR 2435	Level 1 - Basic Custodial Care	On private property, will be decommissioned and restricted from public access.

Table 1. Proposed Forest Service Road Condition during Plan of Operations

Roadway ID	Existing Forest Service Road Maintenance Level	Planned Road Condition During Plan of Operations
FR 2438	Level 2 - High Clearance Vehicles	Road to remain publicly accessible as Level 2 for access to the Oak Flat campground. Minor sections to be decommissioned and restricted from public access at a future date within the subsidence area.
FR 2439	Level 2 - High Clearance Vehicles	Road to remain publicly accessible as Level 2 for access to the Oak Flat campground.
FR 2445	Level 2 - High Clearance Vehicles	Segment between FR 229 and FR 1010 will remain publicly accessible as Level 2.
FR 2458	Administration Access Only	Segment between PNR-1 and FR 2459 will remain as-is.
FR 2459	Level 2 - High Clearance Vehicles	Segment between FR 469 and PNR-1 will remain publicly accessible as Level 2.
FR 2466	Level 2 - High Clearance Vehicles	Segment between SLR-1 and PNR-1 to be maintained as Level 2.
FR 3152	Administration Access Only	Segment between FR 8 and FR 229 to remain as-is.
FR 3153	Level 1 - Basic Custodial Care	On private property, will be decommissioned and restricted from public access.
FR 3454A	Administration Access Only	Segment between FR 357 and MCA-14 will remain publicly accessible. Road to be temporarily closed during pipeline construction and will be re-established to existing maintenance level.
FR 3454C	Level 1 - Basic Custodial Care	Segment between FR 357 and MCA-11 will remain publicly accessible. Road to be temporarily closed during pipeline construction and will be re-established to existing maintenance level.

Notes:

- All FRs proposed for use in this Road Use Plan can be seen in detail in **Figures 1 through 7**.
- Detailed descriptions of purpose of, use of, improvements, and new disturbance area to FRs can be found in **Table 3**.

Table 2. Proposed New Road Condition during Plan of Operations

Roadway ID	Planned Maintenance Level	Planned Road Condition During Plan of Operations
PNR-1	Level 2	New access road along Utility Corridor to provide access from EPS to the TSF and to maintain facilities along the Utility Corridor. Will be maintained to generally achieve the High-Clearance Vehicles management designation.
PNR-2	Level 2	New access road along Utility Corridor to provide access from EPS to the TSF and to maintain facilities along the Utility Corridor. Will be maintained to generally achieve the High-Clearance Vehicles management designation.
PNR-3	Level 2	New access road along PNR-04 to provide access to 115-kV powerline.
PNR-4	Level 2	New access road along FR 899 to provide access to 115-kV powerline.
PNR-5	Level 2	New access road along Dripping Spring Road to provide access to 115-kV powerline.
PNR-6	Level 2	New access road along Dripping Spring Road to provide access to 115-kV powerline.
PNR-7	Level 2	New access road along Dripping Spring Road to provide access to 115-kV powerline.
PNR-8	Level 2	New access road along Dripping Spring Road to provide access to 115-kV powerline.
PNR-9	Level 2	New access road along Dripping Spring Road to provide access to 115-kV powerline.
PNR-10	No Classification	Perimeter road along the toe of the TSF.

Notes:
- PNR-3 through PNR-10 are not located on TNF lands, but for the purpose of the Road Use Plan, TNF road use maintenance levels are used.
- PNRs are shown in detail in **Figures 4 through 7**.
- Detailed descriptions of purpose of, use of, improvements, and new disturbance area of PNRs on TNF lands can be found in **Table 3**.

Table 3. Access Route Disturbance by Surface Land Management

Road ID	Purpose and Use	Road Length[1] Linear Feet	Improvement Description	Length (Ft)[2]		New Disturbance Area (Acres)
				Forest Service Land	Non-Forest Service Land	Forest Service Land
FR 8	East Happy Camp Road. Provides temporary access to FR 650 and MARRCO Corridor.	6,324	No improvements, 1.2 miles of roadway to remain publicly accessible.	6,171	153	0
FR 229	Silver King Mine Road provides access to the WPS	12,590	No improvements, 1.7 miles of roadway to remain publicly accessible, 0.7miles of roadway on private property and to be restricted from public access.	9,023	3,567	0
FR 252	Provides temporary access to MARRCO Corridor from FR 2383	3,147	No improvements, 0.6 miles of roadway to remain publicly accessible.	3,147	0	0
FR 293	Provides temporary access to MARRCO Corridor	9,677	1.8 miles of roadway to remain publicly accessible. Road to be temporarily closed during pipeline construction and will be re-established to existing maintenance level.	9,677	0	0
FR 342	Provides access between Silver King Substation and Utility Corridor access road PNR-1.	11,345	No improvements, 1.7 miles of roadway to remain publicly accessible, 0.4 miles of roadway to be decommissioned.	11,345	0	0
FR 357	Provides temporary access to the MARRCO Corridor and Queen Valley Pump Station	38,036	7.2 miles of roadway to remain publicly accessible. Road to be temporarily closed during pipeline construction and will be re-established to existing maintenance level.	33,914	4,122	0
FR 469	Provides access to campground and EPS	3,913	No improvements, 0.7 miles of roadway to remain publicly accessible.	20	3,893	0
FR 1010	Provides access to WPS and Utility Corridor from FR 2445.	7,218	No improvements, 0.4 miles of roadway on private property, all 1.4 miles to be restricted from public access as it leads into WPS.	5,252	1966	0
FR 1933	Provides access from FR 357 to MCA-15 and 16	5,097	1.0 mile of roadway to remain publicly accessible. Road to be temporarily closed during pipeline construction and will be re-established to existing maintenance level.	5,097	0	0

Table 3. Access Route Disturbance by Surface Land Management

Road ID	Purpose and Use	Road Length[1] Linear Feet	Improvement Description	Length (Ft) [2]		New Disturbance Area (Acres)
				Forest Service Land	Non-Forest Service Land	Forest Service Land
FR 2395	Provides temporary access between MCA-2 through 4 along the MARRCO Corridor	6,630	1.3 miles of roadway to remain publicly accessible. Road to be temporarily closed during pipeline construction and will be re-established to existing maintenance level.	6,630	0	0
FR 2397	Provides access between FR 8 and FR 2395	2,012	0.4 miles of roadway to remain publicly accessible.	2,012	0	0
FR 2438	Located adjacent to subsidence zone. Provides access to Oak Flat Campground	13,469	No improvements, on private property; however, 2.1 miles of roadway to remain publicly accessible for access to the Oak Flat campground. Minor sections (0.4 miles) to be decommissioned and restricted from public access at a future date within the subsidence area.	0	13,469	0
FR 2439	Located adjacent to subsidence zone. Provides access to Oak Flat Campground	1,041	No improvements, on private property and TNF lands, 0.2 miles of roadway to remain publicly accessible for access to the Oak Flat campground.	545	496	0
FR 2445	Provides access between FR 229 and FR 1010	4,418	No improvements, 0.8 miles of roadway to remain publicly accessible.	4,418	0	0
FR 2458	Provides access between PNR-03 and FR 2459, to access the 230-kV Corridor	9,793	No improvements, 1.9 miles of roadway to remain publicly accessible.	9,793	0	0
FR 2459	Provides access between PNR-03 and FR 469 along the 230-kV Corridor	1,864	No improvements, 0.4 miles of roadway to remain publicly accessible.	1,864	0	0
FR 2466	Provides access along the Utility Corridor	1,656	0.3 miles of roadway to be maintained at existing maintenance level.	1,656	0	0
FR 3153	Located within subsidence zone, accessed by FR 2438	6,861	On private property, 1.3 miles of roadway decommissioned / restricted from public access	0	6,861	0
FR 3152	Provides access between FR 8 and FR 229	8,973	No improvements, 1.7 miles of roadway to remain publicly accessible.	6,250	2,723	0

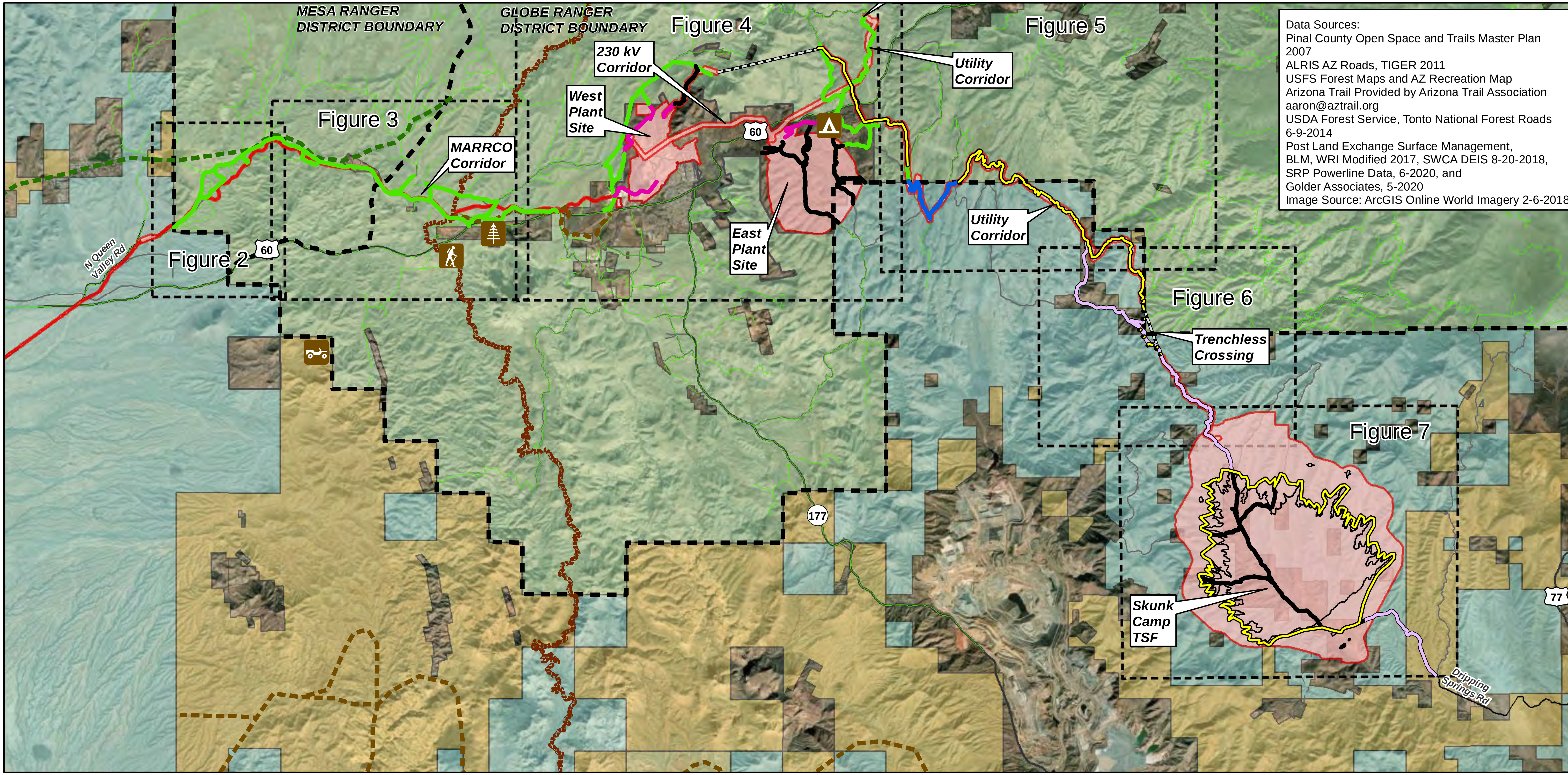
Table 3. Access Route Disturbance by Surface Land Management

Road ID	Purpose and Use	Road Length[1] Linear Feet	Improvement Description	Length (Ft) [2]		New Disturbance Area (Acres)
				Forest Service Land	Non-Forest Service Land	Forest Service Land
FR 3454A	Provides access between FR 357 and MCA-14	1,358	0.3 miles of roadway to remain publicly accessible. Road to be temporarily closed during pipeline construction and will be re-established to existing maintenance level.	1,358	0	0
FR 3454C	Provides access between FR 357 and MCA-11	2,685	0.5 miles of roadway to remain publicly accessible. Road to be temporarily closed during pipeline construction and will be re-established to existing maintenance level.	2,685	0	0
PNR-1	New access road along the Utility Corridor	18,355	3.5 miles of new road construction; 10 ft disturbance width assumed.	15,427	2,928	3.5
PNR-2	New access road along the Utility Corridor	40,292	7.6 miles of new road construction; 10 ft disturbance width assumed.	14,578	25,714	3.3
PNR-3	New access road along PNR-04	1,115	0.2 miles of new road construction; 10 ft disturbance width assumed.	0	1,115	0
PNR-4	New access road along FR-899	127	0.02 miles of new road construction; 10 ft disturbance width assumed.	0	127	0
PNR-5	New access road along Dripping Spring Road	199	0.04 miles of new road construction; 10 ft disturbance width assumed.	0	199	0
PNR-6	New access road along Dripping Spring Road	206	0.04 miles of new road construction; 10 ft disturbance width assumed.	0	206	0
PNR-7	New access road along Dripping Spring Road	640	0.1 miles of new road construction; 10 ft disturbance width assumed.	0	640	0
PNR-8	New access road along Dripping Spring Road	241	0.05 miles of new road construction; 10 ft disturbance width assumed.	0	241	0
PNR-9	New access road along Dripping Spring Road	111	0.02 miles of new road construction; 10 ft disturbance width assumed.	0	111	0
PNR-10	TSF perimeter road	102,761	194 miles of new road construction; disturbance area is within the TSF footprint disturbance area accounted for in the Plan; 50 ft disturbance width assumed.	0	102,761	0

[1] Total road length for USFS land, Private land, and State Trust land
[2] Length of road to be used within the GPA or as access to the GPA

FIGURES

Path: M:\Jobs\800's\807.176\ENV\RoadUsePlan\mxd\Fig1_RoadUsePlan_Overview_7_8_2020_AllAccess.mxd



Legend

- Offroad
- Arboretum
- Campground
- Trailhead
- Proposed New Road
- Existing Road To Be Decommissioned-Restricted from Public Access
- Existing State Land Road - Public Access To Be Maintained
- Existing County Road - Public Access To Be Maintained
- Existing Forest Road - Public Access To Be Maintained
- Private Road
- Trail
- Proposed Drainage Trail
- Arizona National Scenic Trail Polyline
- TNF Ranger District Boundary
- 115 kV Power Structure
- Skunk Camp Tunnel, Spans and Trenchless Crossings
- Preferred Alternative
- Skunk Camp Seepage Dam
- Sheet Index
- TNF Roads
- US Highways
- Highways
- Arterials
- Streets
- Primitive Roads
- Post Land Exchange Resolution Holdings

Post Land Exchange Surface Management

- Bureau of Land Management (BLM)
- Bureau of Reclamation
- Private Land (No Color)
- State Trust Land
- National Forest System

N

0 5,000 10,000 Feet

RESOLUTION COPPER
General Plan of Operations

ROAD USE PLAN
OVERVIEW

Figure 1

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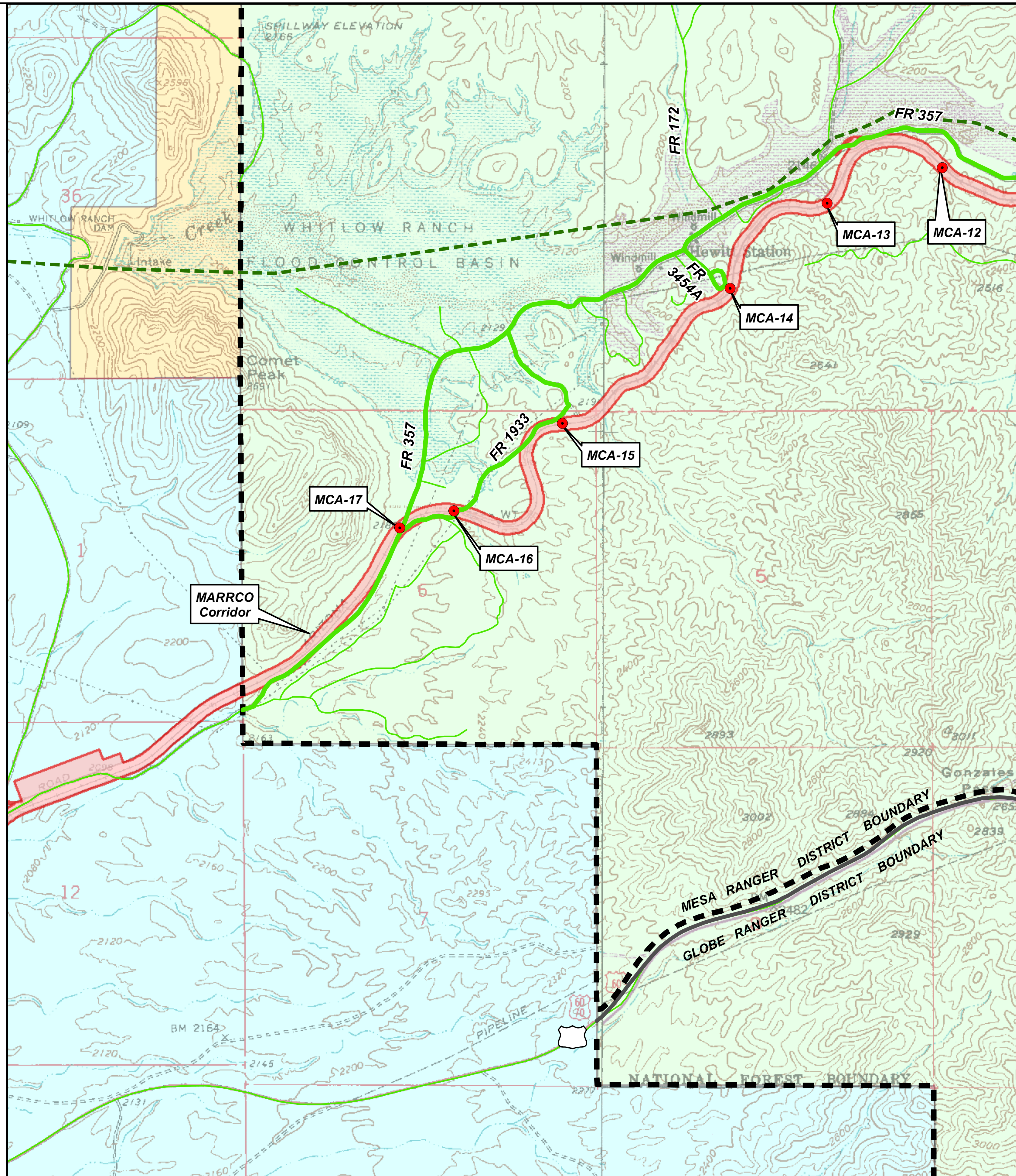


Legend

- MARRCO Corridor Access Point (MCA)
- Existing Forest Road - Public Access To Be Maintained
- Proposed Drainage Trail
- TNF Ranger District Boundary
- TNF Roads
- Preferred Alternative

Post Land Exchange Surface Management

- Bureau of Land Management (BLM)
- Private Land (No Color)
- State Trust Land
- National Forest System

Data Sources:
Pinal County Open Space and Trails Master Plan 2007
USDA Forest Service, Tonto National Forest Roads 6-9-2014
SWCA DEIS 8-20-2018
Post Land Exchange Surface Management, BLM, WRI Modified 2017
Image Source: Florence Junction & Picketpost Mountain USGS 7.5 Minute Quadrangles

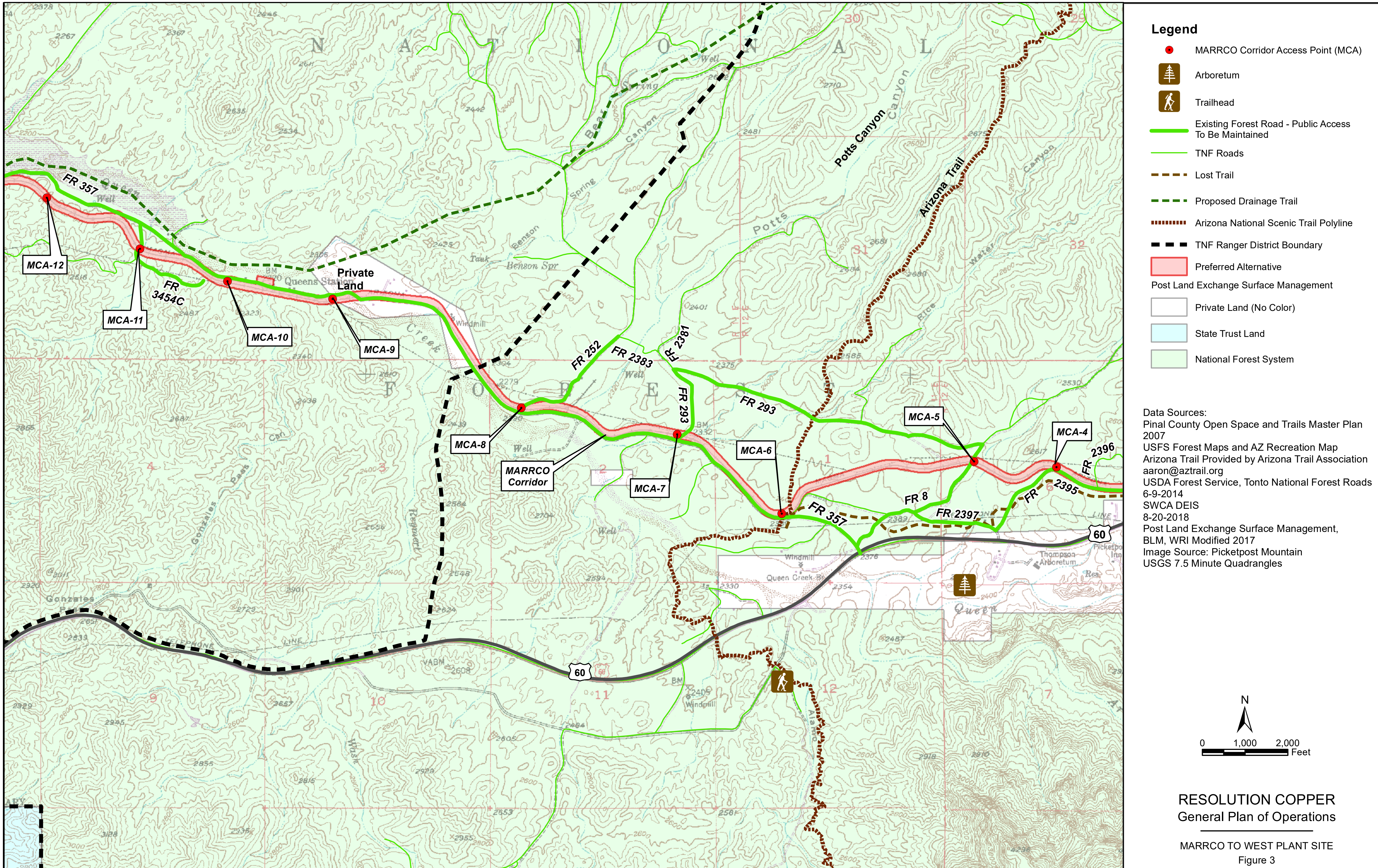
N

0 900 1,800 Feet

RESOLUTION COPPER
General Plan of Operations

MARRCO
Figure 2

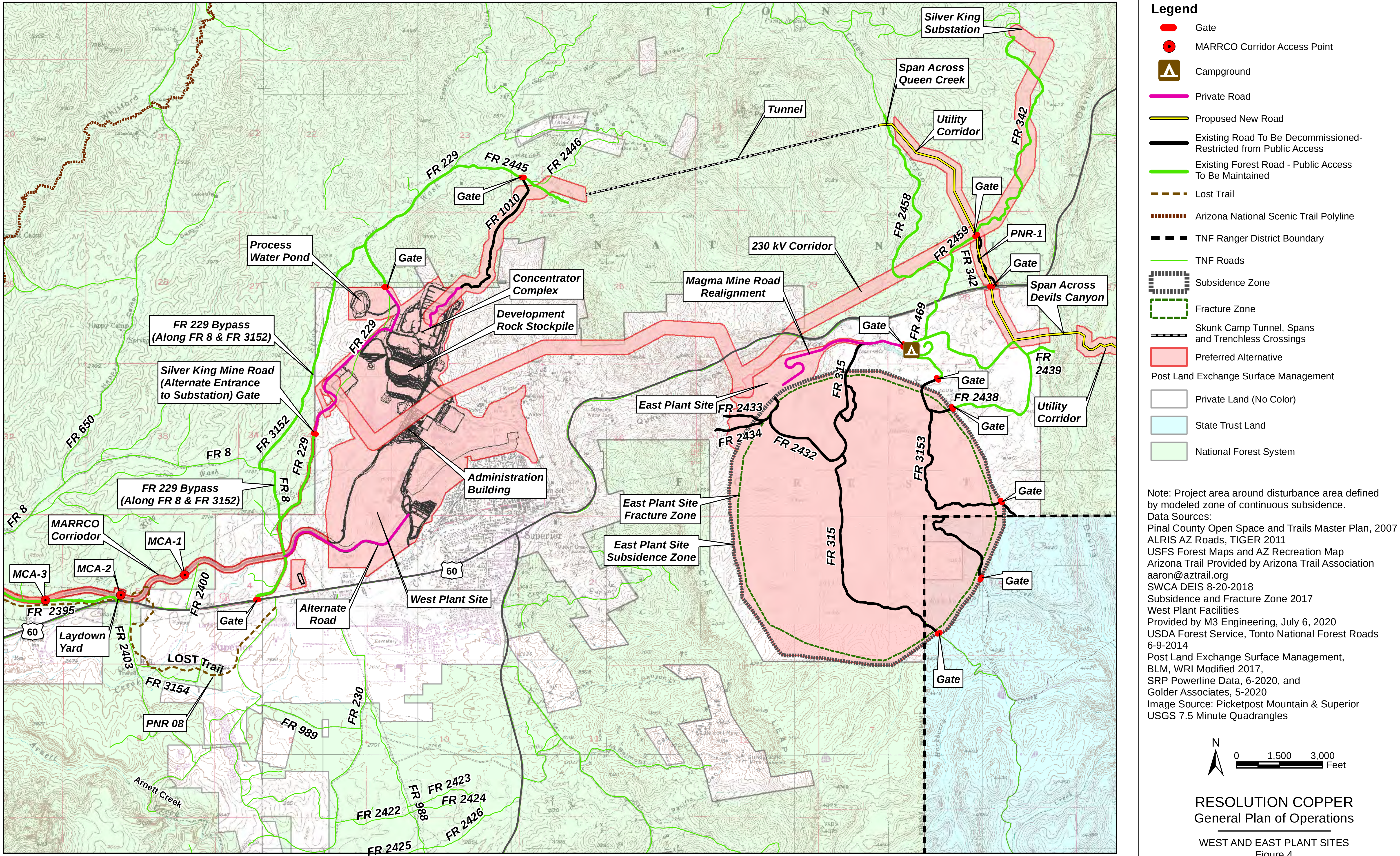
Path: M:\Jobs\800's\807.176\ENV\RoadUsePlan\mxd\Fig3_MARRCO_to_WPS_7_9_2020.mxd



RESOLUTION COPPER
General Plan of Operations

MARRCO TO WEST PLANT SITE
Figure 3

Path: M:\Jobs\800's\807.176\ENV\RoadUsePlan\mxd\Fig4_WPS_EPS_7_9_2020.mxd

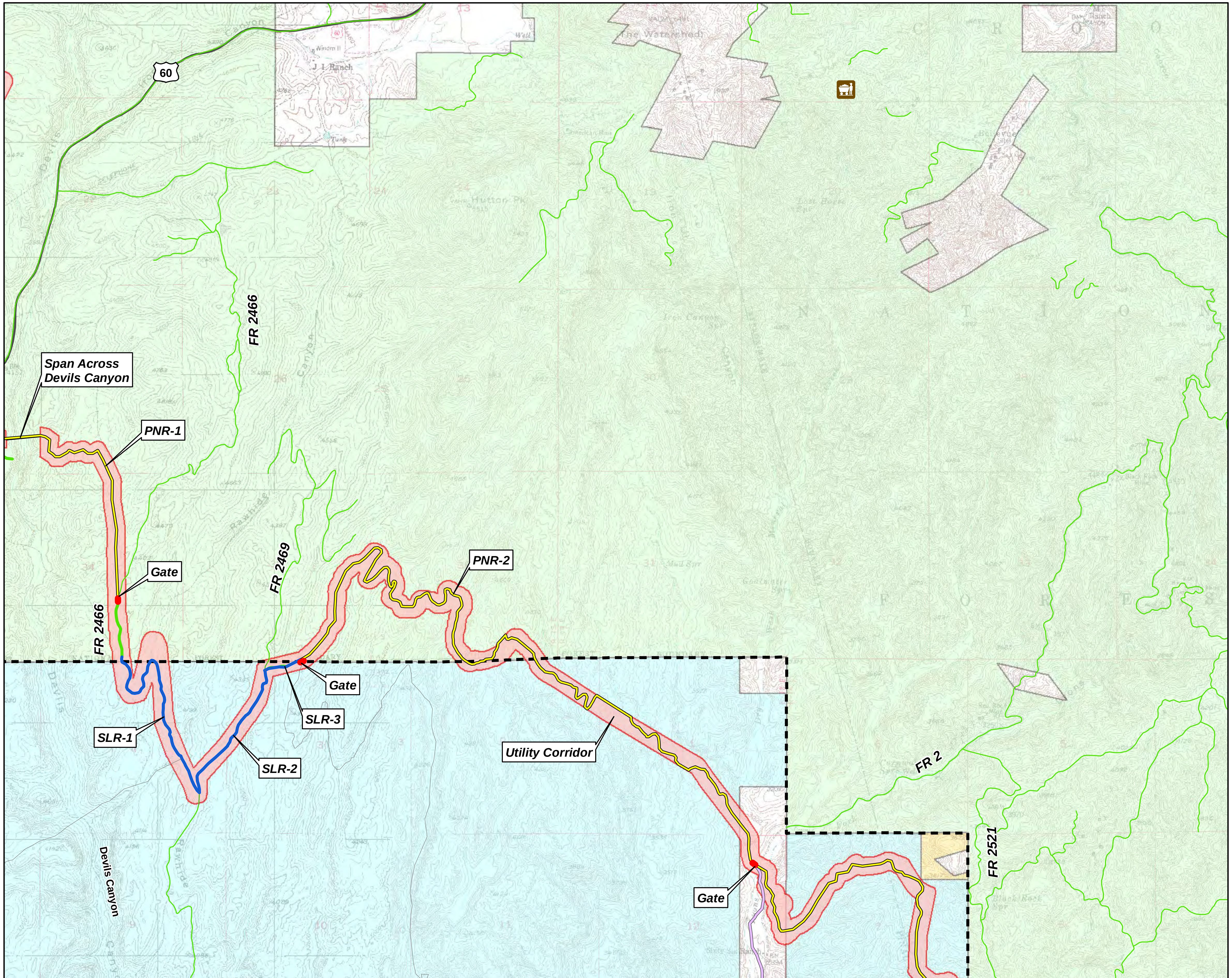


Note: Project area around disturbance area defined by modeled zone of continuous subsidence.
Data Sources:
Pinal County Open Space and Trails Master Plan, 2007
ALRIS AZ Roads, TIGER 2011
USFS Forest Maps and AZ Recreation Map
Arizona Trail Provided by Arizona Trail Association
aaron@aztrail.org
SWCA DEIS 8-20-2018
Subsidence and Fracture Zone 2017
West Plant Facilities
Provided by M3 Engineering, July 6, 2020
USDA Forest Service, Tonto National Forest Roads 6-9-2014
Post Land Exchange Surface Management,
BLM, WRI Modified 2017,
SRP Powerline Data, 6-2020, and
Golder Associates, 5-2020
Image Source: Picketpost Mountain & Superior
USGS 7.5 Minute Quadrangles

RESOLUTION COPPER
General Plan of Operations

WEST AND EAST PLANT SITES
Figure 4

Path: M:\Jobs\800's\807.176\ENV\RoadUsePlan\mxd\Fig5_North_SCamp_UtilCorr_7_10_2020.mxd



Legend

- Gate
- Mine
- Proposed New Road
- Existing State Land Road - Public Access To Be Maintained
- Existing County Road - Public Access To Be Maintained
- Existing Forest Road - Public Access To Be Maintained
- TNF Ranger District Boundary
- TNF Roads
- Skunk Camp Tunnel, Spans and Trenchless Crossings
- Preferred Alternative

Post Land Exchange Surface Management

- Bureau of Land Management (BLM)
- Private Land (No Color)
- State Trust Land
- National Forest System

Data Sources:
ALRIS AZ Roads, TIGER 2011
USDA Forest Service, Tonto National Forest Roads 6-9-2014
Post Land Exchange Surface Management, BLM, WRI Modified 2017,
SRP Powerline Data, 6-2020, and
Golder Associates, 5-2020
Image Source: Superior and Pinal Ranch USGS 7.5 Minute Quadrangles

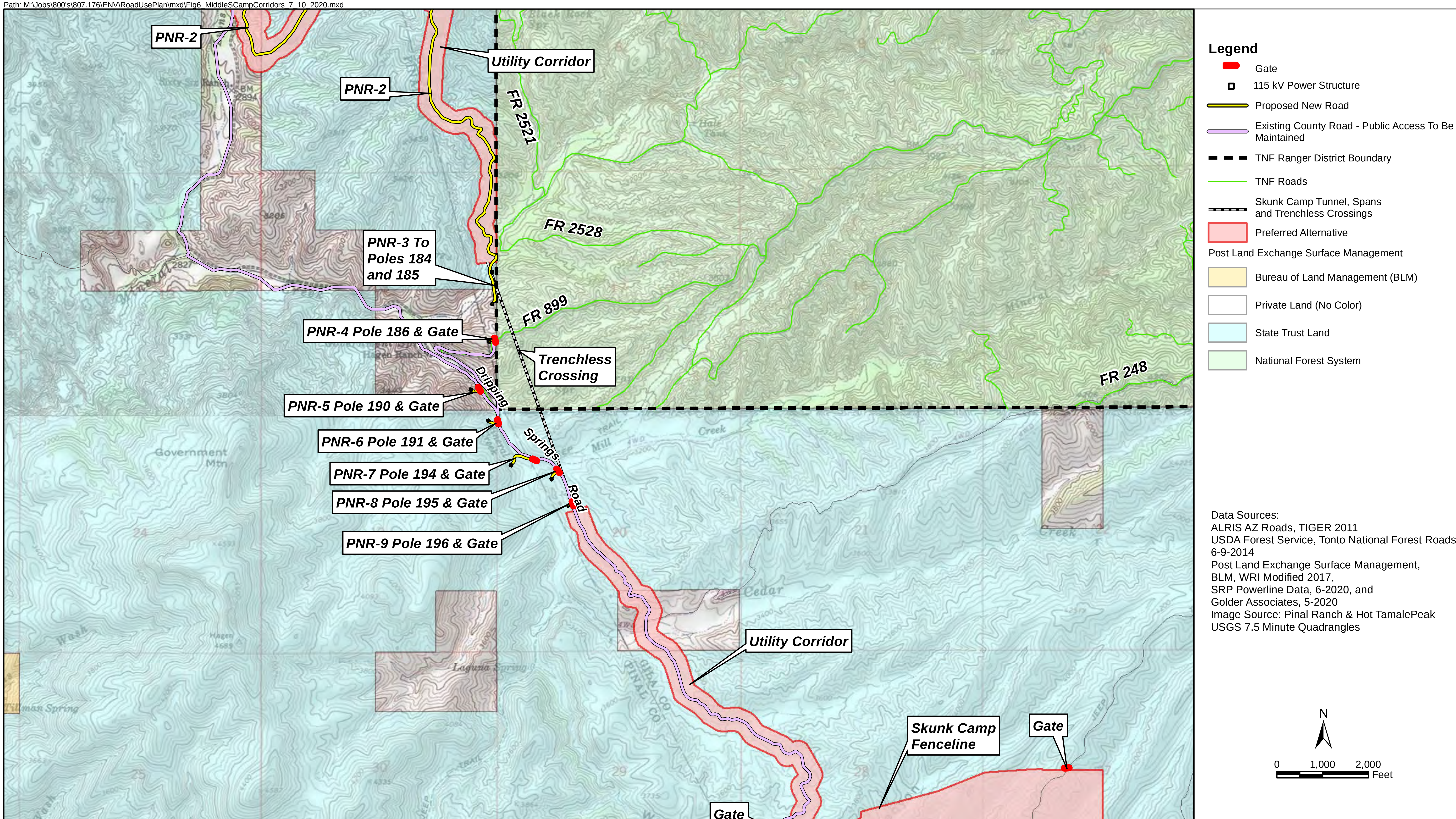
N

0 1,400 2,800
Feet

RESOLUTION COPPER
General Plan of Operations

UTILITY CORRIDOR
Figure 5

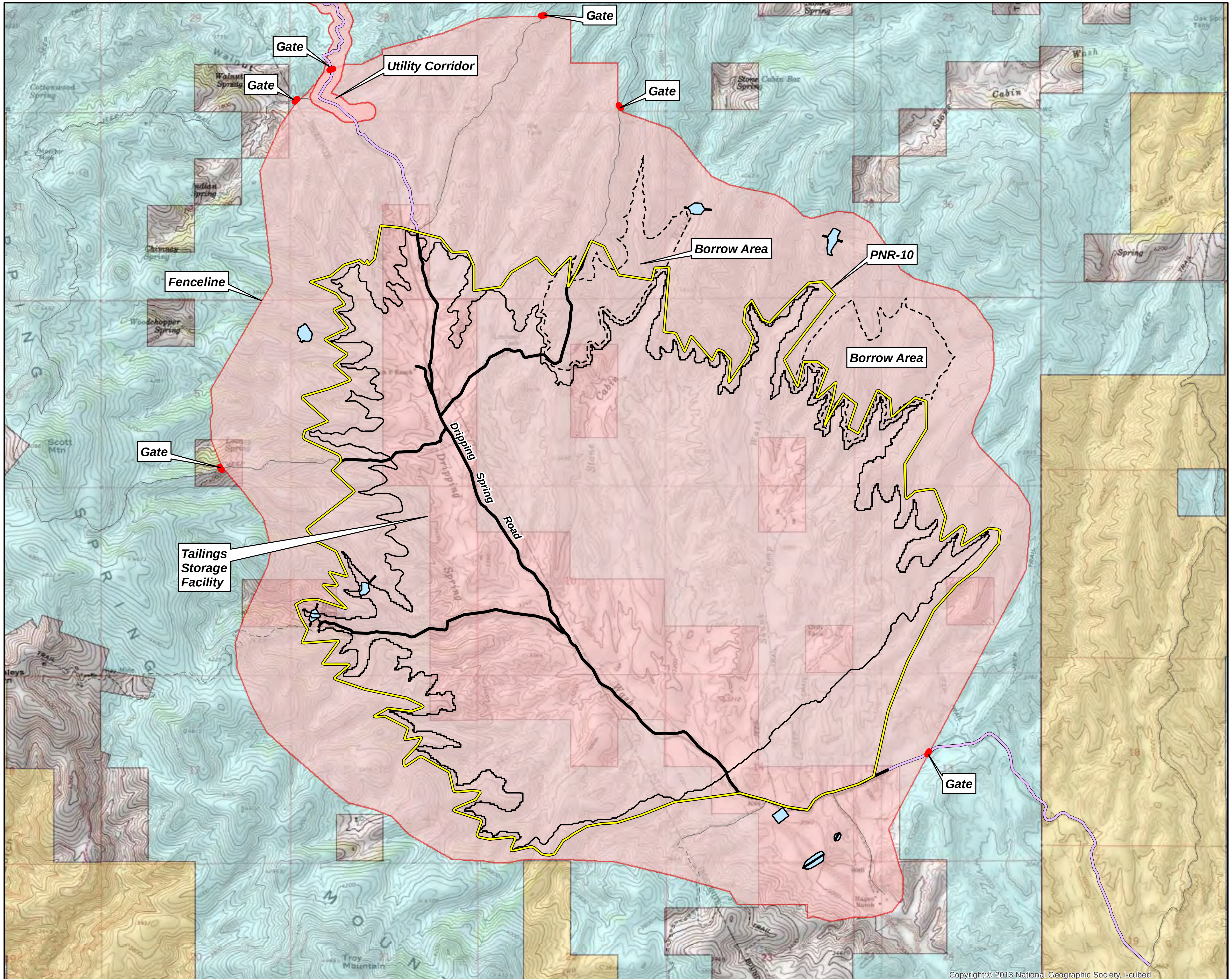
Path: M:\Jobs\800's\807.176\ENV\RoadUsePlan\mxd\Fig6_MiddleSCampCorridors_7_10_2020.mxd



RESOLUTION COPPER
General Plan of Operations

UTILITY CORRIDOR NORTH OF TSF
Figure 6

Path: M:\Jobs\800's\807.176\ENV\RoadUsePlan\mxd\Fig7_SkunkCampTSF_7_10_2020.mxd



Legend

- Gate
- Proposed New Road
- Existing Road To Be Decommissioned-Restricted from Public Access
- Existing County Road - Public Access To Be Maintained
- Skunk Camp TSF
- Skunk Camp Diversion Dikes and Seepage Dams
- TSF Borrow Areas
- Preferred Alternative

Post Land Exchange Surface Management

- Bureau of Land Management (BLM)
- Private Land (No Color)
- State Trust Land

Data Sources:
ALRIS AZ Roads, TIGER 2011
Post Land Exchange Surface Management, BLM, WRI Modified 2017,
SWCA DEIS 8-20-2018,
SRP Powerline Data, 6-2020, and
Golder Associates, 5-2020
Image Source: Hot Tamale Peak and El Capitan Mountain USGS 7.5 Minute Quadrangles

N

0 1,400 2,800
Feet

RESOLUTION COPPER
General Plan of Operations

SKUNK CAMP TSF
Figure 7

Appendix E

VEGETATION ASSESSMENT FOR THE PROPOSED SKUNK CAMP REVISED CORRIDOR WITHIN U.S. FOREST SERVICE LANDS

Prepared for: Resolution Copper

Prepared by: WestLand Resources, Inc.

Date: August 4, 2020

Project No.: 807.176 (807.194)

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FIGURES

(follow text)

1. INTRODUCTION AND BACKGROUND

WestLand Resources, Inc. (WestLand), prepared this vegetation assessment memo in support of two Applications for Transportation and Revised Systems and Facilities on Federal Lands submitted to the Tonto National Forest by Resolution Copper (Resolution) as part of USFS review of the Resolution Copper Project and Land Exchange. This memo presents a subset of the data from WestLand's *Vegetation Assessment for the Proposed Skunk Camp Tailings Storage Facility, Revised Corridor, and Borrow Areas*. It includes only those portions of the Revised Corridor on U.S. Forest Service (USFS) land administered by the Tonto National Forest (TNF) (Assessment Area, **Figure 1**).

WestLand conducted vegetation surveys in the Assessment Area in April and May 2020 with the following objectives:

1. Identify general vegetation present.
2. Estimate the density and abundance of native/non-native species.
3. Determine if any special-status plant species[1] or potential habitat occurs.

The Assessment Area is located on approximately 420 acres of TNF lands, within portions of Sections 23, 24 and 26, Township 1 South, Range 12 East; and portions of Sections 21, 27, 28 and 34-36, Township 1 South, Range 13 East of the Gila and Salt River Baseline and Meridian, Pinal County, Arizona (**Figure 2**). The 500-foot-wide Assessment Area contains two biotic communities, as broadly mapped by Brown and Lowe, Interior Chaparral and Arizona Upland Subdivision of Sonoran Desertscrub.[2] Elevation in the Assessment Area ranges from approximately 2,900 to approximately 5,100 feet above mean sea level.

2. VEGETATION ASSESSMENT RESULTS

OBJECTIVE 1. IDENTIFY GENERAL VEGETATION PRESENT

In total, two vegetation alliances were identified within the Assessment Area: Juniper Woodland Alliance, and Shrubland Alliance and Sparsely Vegetated Areas (**Figure 2**).

OBJECTIVE 2. ESTIMATE THE DENSITY, ABUNDANCE OF NATIVE/NON-NATIVE SPECIES

Juniper Woodland Alliance

In total, 23 percent of the Assessment Area (95.2 acres) was mapped as Juniper Woodland Alliance (**Figure 2**). The Juniper Woodland Alliance occurs on north-facing slopes, in drainages, and in a variety of other situations. Within the Assessment Area, these woodlands are visually characterized by

[1] Special-status species are defined as U.S. Fish and Wildlife Service threatened, endangered, candidate, and species of concern, as well as Tonto National Forest Sensitive Species.
[2] The Nature Conservancy. 2012. Brown and Lowe's Biotic Communities of the Southwest. *Digital version of David E. Brown and Charles H. Lowe's 1981 Map*: The Nature Conservancy of Arizona. June 27, 2012.

juniper-pinyon pine as elevation increases. The most abundant canopy species in this alliance was one-seed juniper (*Juniperus monosperma*). Other species contributing to the canopy stratum included netleaf hackberry (*Celtis reticulata*), blue palo verde (*Parkinsonia florida*), pinyon pine (*Pinus monophylla*), velvet mesquite (*Prosopis velutina*), scrub oak (*Quercus turbinella*), and sugar sumac (*Rhus ovata*). In the shrub stratum, juniper was still abundant, but dominance was shared by other species including catclaw acacia (*Acacia greggii*), scrub oak, turpentine bush (*Ericameria laricifolia*), velvet mesquite, and whitethorn acacia (*Acacia constricta*). Fairy duster (*Calliandra eriophylla*), scrub oak, and pointleaf mazanita (*Arctostaphylos pungens*) accounted for the highest relative density in the basal stratum.

Shrubland Alliance and Sparsely Vegetated Areas

In total, 77 percent of the Assessment Area (324.2 acres) was mapped as Shrubland Alliance and Sparsely Vegetated Areas (**Figure 2**). The Shrubland Alliance contains a diverse mosaic of different habitat types and includes species rich areas with high diversity and species poor areas with little vegetation such as roads or cattle enclosures. Abundance in the canopy stratum was sparse or in some cases nonexistent as would be expected for this alliance. The most abundant species in the shrub stratum were scrub oak and juniper. Visually dominant shrub species are more typical of chaparral communities, especially manzanita, within the northern sections of the Assessment Area. Relative density also varied across the Assessment Area but showed similar trends in the basal and shrub strata as would be expected for the Shrubland Alliance.

Non-native Species

Cluster sampling and opportunistic documentation resulted in the detection of non-native taxa within the Assessment Area. Widespread non-native species include red brome (*Bromus rubens*), stork's-bill (*Erodium cicutarium*), and London rocket (*Sisymbrium irio*). Non-native species with more limited occurrence included Bermuda grass (*Cynodon dactylon)*, common mallow (*Malva neglecta*), desert mustard (*Brassica tournefortii*), golden-top grass (*Lamarckia aurea*), oats (*Avena* sp.), Russian thistle (*Salsola tragus*), shepherd's purse (*Capsella bursa-pastoris*), stinkgrass (*Eragrostis cilianensis*), and tree tobacco (*Nicotiana glauca*).

OBJECTIVE 3. DETERMINE IF ANY SPECIAL-STATUS PLANT SPECIES OF POTENTIAL HABITAT OCCURS

Prior to conducting the field survey, WestLand reviewed special-status species lists generated for the Assessment Area, including a list from a U.S. Fish and Wildlife Service (USFWS) Information for Planning and Conservation Report (IPaC) online query[3] and a list from an Arizona Game and Fish Department (AGFD) Heritage Database Management System (HDMS) online environmental review tool query.[4,5] The plant species identified in these lists include Arizona hedgehog cactus (*Echinocereus*

3 The IPaC list identifies special status species and designated and proposed critical habitat that *may* occur within one or more delineated United States Geological Survey 7.5-minute quadrangles that the Assessment Area intersects.

4 The AGFD HDMS online environmental review tool query was used to identify records of special status species within 5 miles of the Assessment Area.

5 WestLand Resources, Inc. 2018. Biological Evaluation for the Proposed Skunk Camp Tailings Storage Facility, Gila and Pinal Counties, Arizona. *Prepared for Resolution Copper.* Tucson, Arizona: WestLand Resources, Inc. June 2018.

triglochidiatus var. *arizonicus*;), which is listed as endangered without critical habitat by the USFWS under the Endangered Species Act[6] and as Highly Safeguarded under Arizona Native Plant Law.[7] Arizona hedgehog cactus is present within the northern section of the Assessment Area, but only where population health is already being monitored,[5] within their predicted occurrence, and especially within steep, rocky habitat.[8] No additional taxa of conservation concern have been identified.

6 U.S. Fish and Wildlife Service. 2000. Arizona Hedgehog Cactus (*Echinocereus triglochidiatus* var. *arizonicus*). *General Species Information*: U.S. Fish and Wildlife Service Arizona Ecological Services. June 2000.

7 Arizona Department of Agriculture. 2016. Arizona Administrative Code. Article 11. Arizona Native Plants. Arizona Department of State. March 31, 2016

8 Baker, Marc A. 2013. Draft Recovery Plan for (*Echinocereus arizonicus)* subsp. *arizonicus* (Arizona Hedgehog Cactus). *Prepared for the U.S. Fish and Wildlife Service*. September 19, 2013

FIGURES

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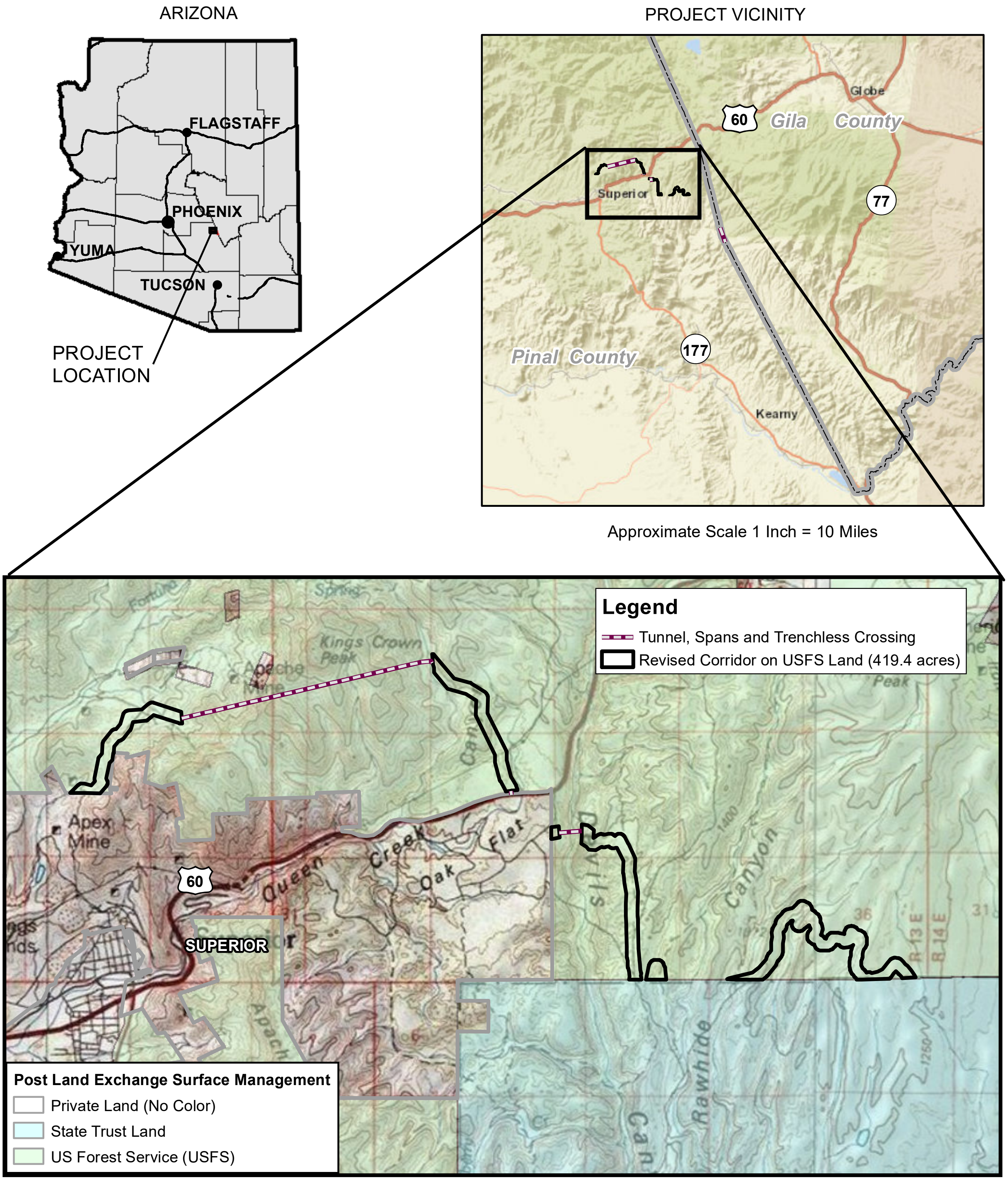


T1S, R12E and T1S, R13E,
Pinal County, Arizona,
Mesa and Globe 1:100,000 USGS Quadrangles.
Data Sources: Golder Associates, Pipeline Data, May 2020;
BLM Post Land Exchange Surface Management, WRI Modified 2017
Image Source: ArcGIS Online World Street Map

WestLand Resources

N

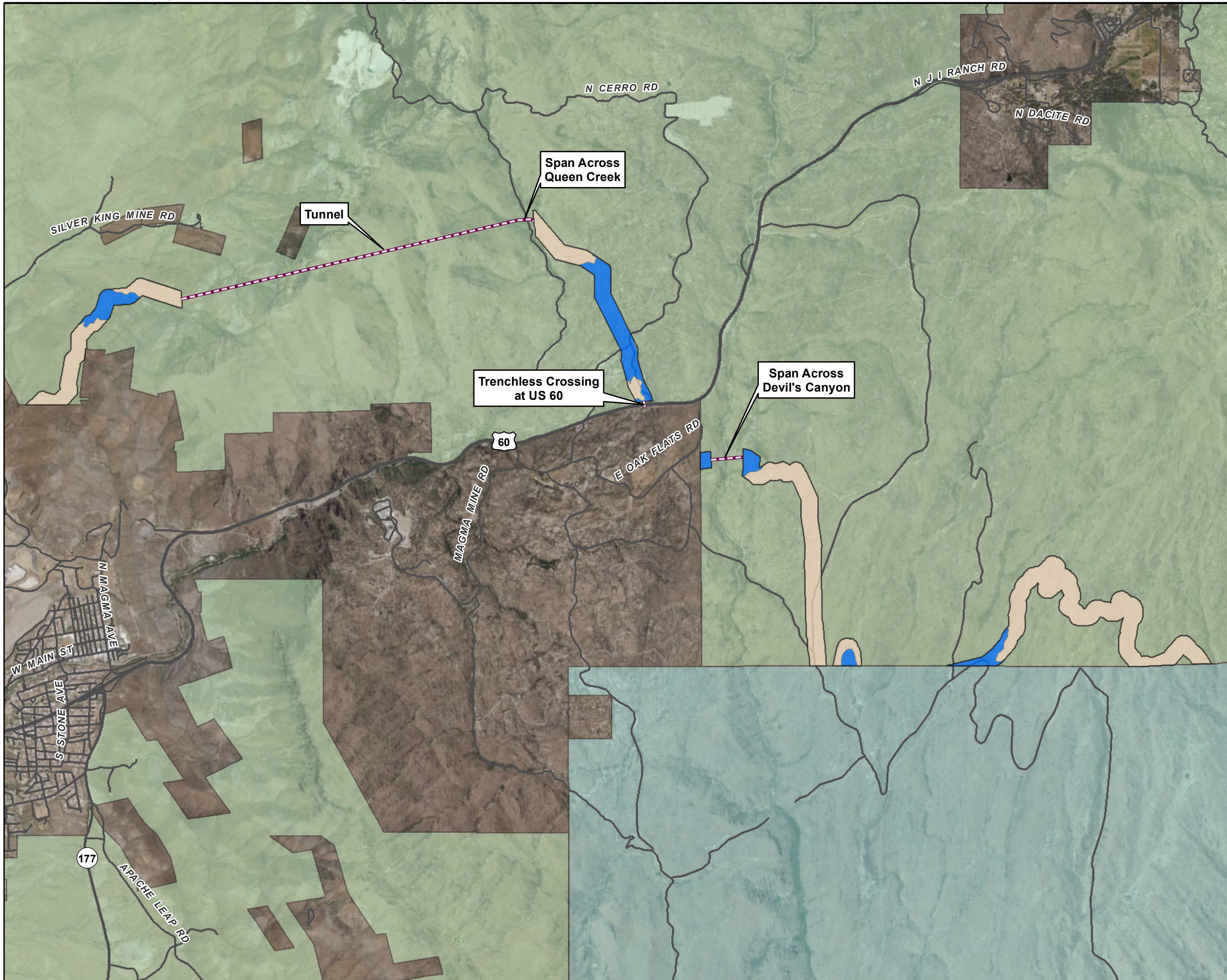
0 3,000 6,000 Feet

0 1,000 2,000 Meters

RESOLUTION COPPER
USFS Special Use Permit
Vegetation Assessment for the
Proposed Skunk Camp Revised Corridor

VICINITY MAP
Figure 1

Path: M:\Jobs\800's\807.176\ENV\SkunkCamp\USFS_SpecialUsePermit\ReportFigures\PipelineVegetation\02 PipelineNorthUSFS_VegMap.mxd Date: 7/30/2020 User: rwitzke



North Pipeline Corridor on USFS Land:
T1S, R12E, Portions of Sections 23, 24, and 26,
T1S, R13E, Portions of Sections 21, 27, 28, and 34-36,
Pinal County, Arizona,
Data Sources: Golder Associates, Pipeline Data, May 2020;
BLM Post Land Exchange Surface Management,
WRI Modified 2017
Image Source: 2019 USDA NAIP Orthophoto

Legend

Tunnel, Spans and Trenchless Crossing

Revised Corridor on USFS Land (419.4 acres)

Vegetation Types

Shrubland Alliance and Sparsely Vegetated Area (324.2 ac)

Juniper Woodland Alliance (95.2 ac)

Post Land Exchange Surface Management

Private Land (No Color)

State Trust Land

US Forest Service (USFS)

N

0 1,500 3,000 Feet

0 450 900 Meters

WestLand Resources

RESOLUTION COPPER

USFS Special Use Permit
Vegetation Assessment for the
Proposed Skunk Camp Revised Corridor

VEGETATION MAP
Figure 2

Appendix F

ARIZONA HEDGEHOG CACTUS
PROJECT AREA STATUS 2020
Resolution Copper

Prepared for:

RESOLUTION COPPER

102 Magma Heights – Superior, Arizona 85173

Project Number: 807.176

June 16, 2020

WestLand Resources

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

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TABLES

FIGURES

(follow text)

1. INTRODUCTION

WestLand Resources, Inc. (WestLand), was retained by Resolution Copper (Resolution) to provide a summary of Arizona hedgehog cacti (AHC; *Echinocereus triglochidiatus* var. *arizonicus*) that have been documented to date within the proposed disturbance limits of the Resolution Copper Project (the Project). The Project Area is defined as the preferred alternative as described in the *Draft Environmental Impact Statement Resolution Copper Project and Land Exchange* (DEIS; USDA 2019) combined with the Skunk Camp North Revised Corridor, as described below. Portions of the Project Area where AHC have been documented are on private lands and on U.S. Forest Service (USFS) lands administered by the Tonto National Forest (TNF), within Pinal County, Arizona (**Figure 1**).

The DEIS preferred alternative for the tailings storage facility (TSF) powerline and pipelines (DEIS Alternative) is the Skunk Camp North alternative, which consists of two corridors following separate alignments: 1) Pipeline corridor and access road, approximately 23 miles long, 500 feet wide; and 2) Powerline corridor and access road, approximately 19 miles long, 1,000 feet wide. The Skunk Camp North Revised Corridor is designed to include both the tailings pipeline and most of the 115-kV powerline collocated within the same corridor. At the intersection with the 230-kV powerline corridor, the tailings pipeline corridor travels west towards the West Plant Site; while the 115-kV powerline corridor travels northeast, along the 230-kV powerline corridor, towards the Silver King Substation (**Figure 2**). This assessment of AHC within the Resolution Project Area has been revised from earlier iterations to incorporate the results of surveys within the Skunk Camp North Revised Corridor.

WestLand has conducted numerous AHC surveys in the Project Area and vicinity (WestLand 2004, 2008, 2010, 2011, 2013a, d, 2014, 2016a, b, 2017, 2018, 2019, 2020) and has detected AHC during surveys of the Pre-feasibility Action Area (WestLand 2008, 2010, 2013b, 2014, 2016b, 2018), the East Plant Site (WestLand 2016a, 2017, 2020), the 230-kV powerline corridor, and the Skunk Camp North Revised Corridor (WestLand 2020, Figure 2). In May 2020, an additional AHC survey was completed on approximately 100 acres of a since dismissed alternative powerline route that was being considered as part of the Skunk Camp North Revised Corridor. Ultimately, direct disturbance would be limited to access roads, pipeline placement (to be installed below grade where practicable), powerline structure footprints, and the mine subsidence area (or Fracture Zone).

The purpose of this report is to provide a summary of AHC that have been recorded within the currently defined Resolution Project Area. AHC have been found within the footprints of different components of the Project Area. These areas are identified in this document as the Skunk Camp North Revised Corridor, the 230-kV powerline corridor (powerline structure footprints), the Magma Mine Road Realignment, and the Fracture Zone (USDA 2019). The number of AHC considered alive is reported for each of these Project components. A total of 78 different AHC have been identified to date within the Project Area, including 77 that were alive when last visited and are presumed to be alive (**Figure 3**) currently.

The remaining sections in this document provide the following: background information about the AHC (**Section 2**), a brief description of the different components of the Project Area where AHC have been found (**Section 3**), a summary of AHC recorded within the Project Area (**Section 4**), and references cited (**Section 5**).

2. ARIZONA HEDGEHOG CACTUS BACKGROUND

The AHC is federally listed under the Endangered Species Act (ESA) as endangered without critical habitat (USFWS 1979b). Draft recovery plans for the species have been developed (Baker 2013, Fletcher 1984) but a plan has yet to be finalized. In 2019, the U.S. Geological Survey in cooperation with the U.S. Fish and Wildlife Service (USFWS) and Arizona Ecological Services published an open file report compiling and assessing available AHC survey and monitoring data to support the recovery of the species (Thomas et al. 2019). AHC is also protected under Arizona Revised Statute (ARS) Chapter 7, (Arizona State Legislature 2019) as a Highly Safeguarded Native Plant and is protected from international trade by the Convention on International Trade in Endangered Species (UNEP-WCMC 2014).

AHC was collected at the type locality in 1922 and named *E. arizonicus* in 1926 (Orcutt 1926). AHC was identified as variety *arizonicus*, one of eight varieties of *E. triglochidiatus*, in *The Cacti of the United States and Canada* (Benson 1982). AHC has also been named *E. coccineus* var. *arizonicus* (Ferguson 1989), but more recent studies have proposed *E. arizonicus, E. coccineus* and *E. triglochidiatus* as separate species based on morphology, number of chromosomes, molecular studies, and habitat (Baker 2006, Blum et al. 1998, Zimmerman and Parfitt 2003). The PLANTS Database, U.S. Department of Agriculture (USDA), refers to Ferguson (1989) in naming AHC *E. coccineus* var. *arizonicus* (NRCS 2019). However, based on Baker's (2006) report of *E. coccineus* as a tetraploid species and *E. arizonicus* as a diploid species, Ferguson's (1989) classification appears to be incorrect. Two online databases, Interagency Taxonomic Information System (ITIS), which serves as a standard for classifications that has gained broad acceptance in taxonomic literature, and Nature Serve Explorer, which provides information about rare and endangered species, accept *E. arizonicus* (Rose ex Orcutt) as correct (ITIS 2019, NatureServe 2019). The Flora of North America (Zimmerman and Parfitt 2003) and Baker (2006, 2013) refer to AHC as *E. arizonicus* subsp. *arizonicus*. While revisions to the taxonomy of AHC may need to be addressed at the federal level, AHC is currently listed under the ESA as *E. triglochidiatus* var. *arizonicus* (USFWS 1979b), and this document follows that nomenclature.

AHC is a green succulent with cylindroid stems and brilliant red flowers (AGFD 2003, Thomas et al. 2019). Stems occur singly or most often in clusters of four to twenty (AGFD 2003), though up to 143 stems have been recorded on a single individual (Baker 2013). Stems are robust, averaging 3 inches in diameter but commonly exceeding 4 inches, and are generally longer than the stems of similar varieties of hedgehog cacti (AGFD 2003). Stems have an average of nine ribs (AGFD 2003, Baker 2013). Spines are smooth and occur on areoles, with each areole containing an average of nine radial spines and three central spines (Baker 2013). Central spines are thick, averaging nearly 1 millimeter (mm) in diameter (Baker 2013). The largest central spine per areole is typically deflexed (pointed downwards) (AGFD 2003). Relative to other *Echinocereus*, AHC spines are shorter and more robust (AGFD 2003). Flowers occur on the upper-third of stem ribs (AGFD 2003) and are stout, mostly erect, and measure up to 16 mm broad and 93 mm long (Baker 2013). The reported flower blooming period ranges from mid-April to mid-May (AGFD 2003, Baker 2013).

AHC occupies portions of the highlands of Pinal and Gila Counties between Superior and Globe, Arizona. Its known range extends from the Superstition Wilderness south to Devils Canyon, east along US 60 to Top of the World, Arizona and south to the Mescal and Pinal mountains (AGFD 2003, Baker 2013, Viert 1996, WestLand 2013c). The range includes two small subpopulations: the Apache Peak subpopulation north of the city of Globe and the El Capitan subpopulation south of Globe (Baker 2013). Other varieties of red claret-cup cacti are intermingled with AHC at the edge of its distribution (Baker 2013), but only red claret-cup cacti near the type locality for AHC are considered "classical var. *arizonicus*", and these are the only populations subject to protection under the ESA (USFWS 1979a, Viert 1996).

The majority of predicted AHC habitat occurs on lands managed by TNF, with smaller portions of predicted habitat occurring on lands managed by the San Carlos Apache Tribe, Bureau of Land Management, Arizona State Land Department, and private entities (Baker 2013). AHC occurs from 3,300 ft to 5,700 ft (AGFD 2003) in Interior Chaparral and Madrean Evergreen Woodland habitats as mapped by Brown and Lowe (1980). Suitable substrate includes bedrock, open slopes where individuals occur in cracks and crevices and between boulders on stable rock formations such as Apache Leap Tuff, Schultze Granite and Pioneer Quartzite (Viert 1996). Pinal Schist, another rock type associated with AHC occupancy, weathers more rapidly and creates a soil substrate that is often colonized by dense stands of vegetation and is inhabited by AHC at lower densities (WestLand 2013c).

3. PROJECT AREA DESCRIPTION

The occurrence of AHC within the Project Area is limited to its northern and eastern portions. Within these areas, the different components of the Project Area in which AHC have been found are the Skunk Camp North Revised Corridor, the 230-kV powerline corridor (powerline structure footprints), the Magma Mine Road Realignment, and the Fracture Zone.

The Skunk Camp North Revised Corridor is depicted with a width of 500 feet (**Figure 3**), but the disturbance footprint will be reduced to 200-foot width within an overall 500-foot-wide corridor. Disturbance for the 115-kV powerline structures that are outside of the Skunk Camp North Revised Corridor will be a 50-foot by 50-foot area for each support structure. Disturbance within the 230-kV powerline corridor includes a 50-foot by 50-foot area around each of the support structure locations. The Magma Mine Road Realignment is based on engineering drawings that depict the area of cut and fill for the road. The Fracture Zone is as described in the DEIS.

4. AHC WITHIN PROJECT AREA

The AHC identified in this report have been found during numerous survey efforts, as noted in **Section 1**, spanning the years from 2004 through 2020. Some of these AHC have been found during binocular surveys of geologic features that could not be approached due to safety concerns. When found, most AHC have been marked with a numbered metal tag. Data collection has evolved over time and has generally included the following:

- Field identification number.
- Tag number
- Location coordinates
- Photographs of the plant
- Health Assessment: Good, Fair, or Poor
- Number of live stems
- Number of reproductive structures
- Plant height
- Plant width
- Presence or absence of plant herbivory evidence

AHC that were detected only during binocular surveys have limited data collection. Those AHC were assigned a unique field identification number, a compass bearing, estimated distance to the AHC relative to the detection location, general characteristics of each identified AHC, and surrounding vegetation and substrate based on what could be determined through binoculars.

The collected data have been entered into a Microsoft Access™ AHC database that WestLand maintains for Resolution for ongoing data management, analysis, and archiving purposes.

5. RESULTS AND DISCUSSION

A total of 78 AHC plants were documented as occurring within the Project Area. One of these AHC has since been confirmed dead; currently the known population of AHC within the Project Area that are presumed alive is 77. The number of AHC found within the Project Area is outlined by Project component in **Table 1**.

There are 60 AHC within the Skunk Camp North Revised Corridor component of the Project Area. It is important to note that this component is currently 500 feet wide for planning purposes, but that the final Skunk Camp North Revised Corridor will ultimately be reduced to a width of 200 feet, reducing that component of the Project Area by 60 percent.

AHC presumed alive in other Project Area components include 1 within the estimated disturbance area of support structures in the 230-kV powerline area, 2 within the Magma Mine Road Realignment, and 14 within the Fracture Zone.

Table 1. AHC Found within the Resolution Project Area, 2004-2020

Project Component	Number of AHC Found	Number of Confirmed Dead AHC	Number of AHC Presumed Alive
Skunk Camp North Revised Corridor	60	0	60
230-kV Powerline	1	0	1
Magma Mine Road Realignment	3	1	2
Fracture Zone	14	0	14
TOTAL	**78**	**1**	**77**

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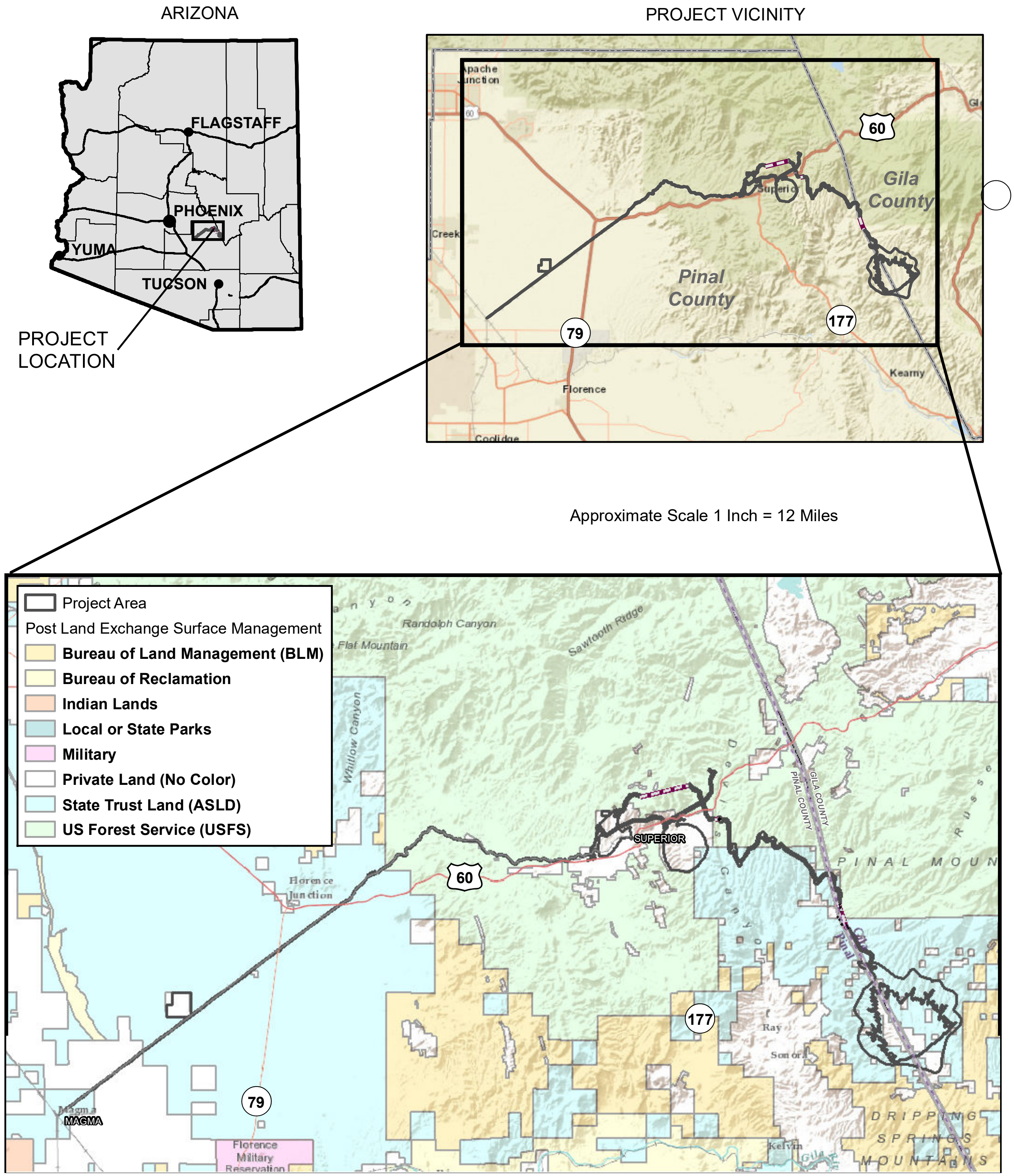
FIGURES



Pinal and Gila Counties, Arizona
Mesa and Globe 1:100,000 USGS Quadrangles
Data Sources: SWCA DEIS, Golder Associates, SRP, and Post Land Exchange Surface Management, BLM, WRI Modified 2017
Image Source: ArcGIS Online World Terrain and World Street Maps

WestLand Resources

N

0 3 6 Miles

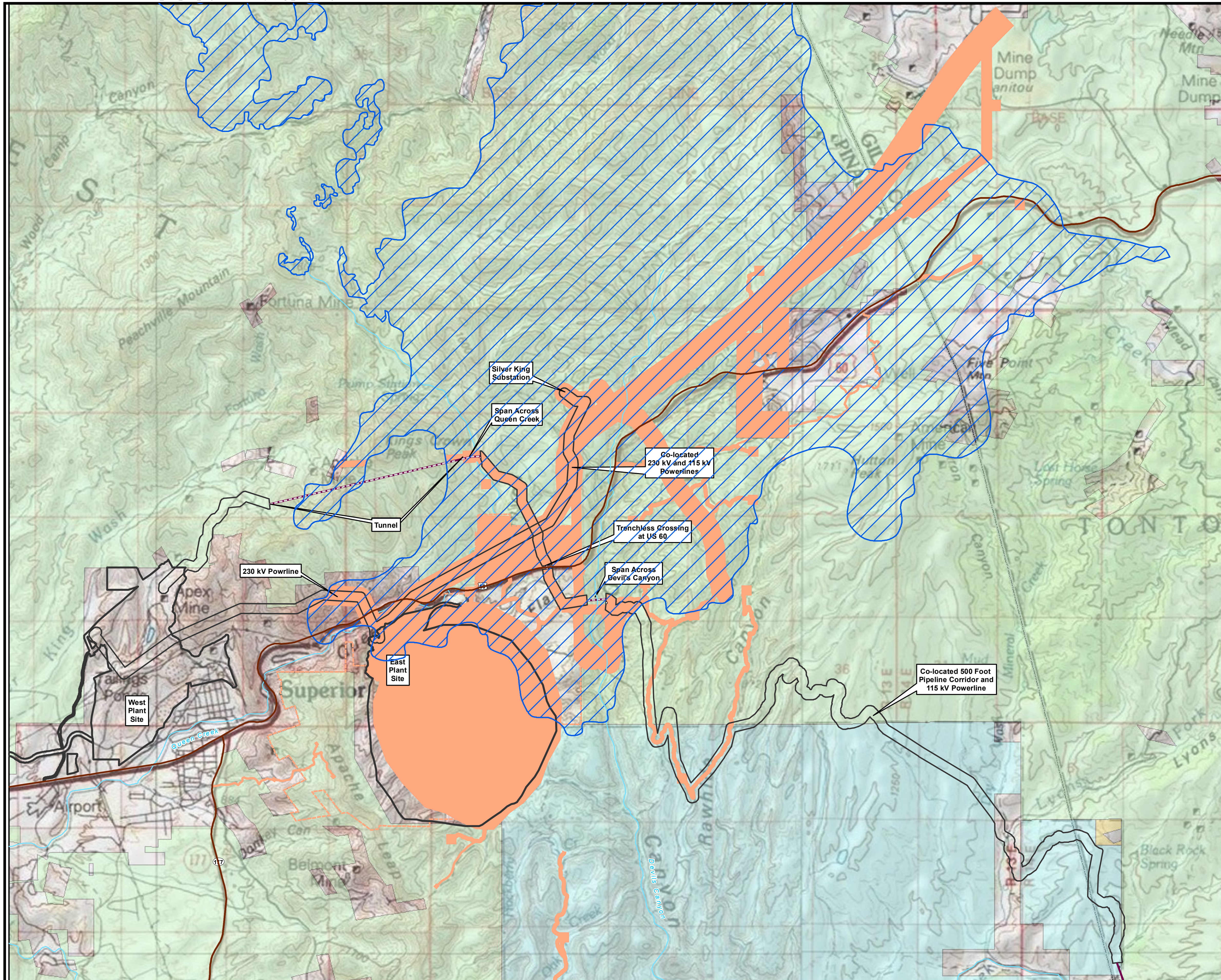
0 5 10 Kilometers

RESOLUTION COPPER
Arizona Hedgehog Cactus
Project Area Status 2020

VICINITY MAP
Figure 1

Path: M:\Jobs\800's\807.173\ENV\AHC\mxd\RCM_2020_AHC_ProjectAreaStatusReport\Fig2_AHC_SurveyArea.mxd

Date: 6/13/2020 User: rwitzke



Pinal and Gila Counties, Arizona
Globe and Mesa 1:100,000 USGS Quadrangles
Data Sources: Post Land Exchange Surface Management, BLM, WRI Modified 2017, SWCA DEIS 8-20-2018, SRP Powerline Data, 5-2020, and Golder Associates, 5-2020

Legend

- Skunk Camp Tunnel, Spans and Trenchless Crossings
- Project Area
- AHC Survey Areas 2004-2020
- AHC Predicted Habitat (Baker 2013)

Post Land Exchange Surface Management

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

N

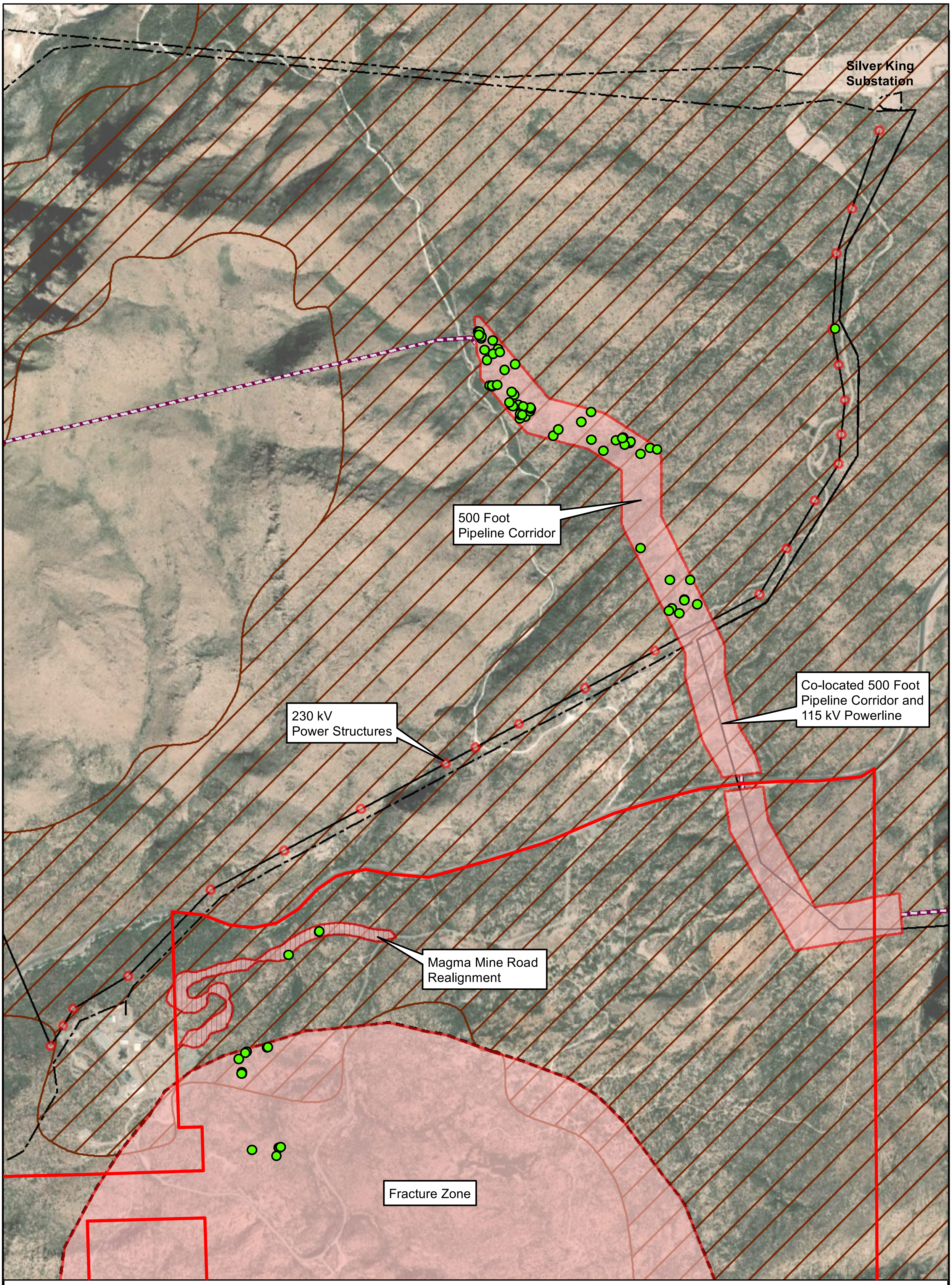
0 2,500 5,000 Feet

0 800 1,600 Meters

WestLand Resources

RESOLUTION COPPER
Arizona Hedgehog Cactus
Project Area Status 2020

AHC SURVEY AREAS
2004-2020
Figure 2



Pinal County, Arizona
Data Source: DEIS Fracture Zone, Golder Associates 5-2020,
SRP Powerline Data 6-2020
Image Source: ArcGIS Online World Imagery, 2-6-2018

N

0 600 1,200 Feet

0 200 400 Meters

WestLand Resources

- 77 Live AHC Located Within Disturbed Areas (1 Dead)
- Proposed Power Span
- Existing Powerline
- Skunk Camp Tunnel, Spans and Trenchless Crossings
- Project Disturbance Area
- Magma Mine Road Realignment
- Fracture Zone - Year 41
- AHC Predicted Habitat (Baker 2013)
- Oak Flat Land Exchange Parcel

Note: 60 AHC are within the 500 Foot Corridor for the Revised North Pipeline. Only a 200 foot corridor will actually be disturbed.

RESOLUTION COPPER

Arizona Hedgehog Cactus Project Area Status 2020

AHC DETECTION LOCATIONS

Figure 3