TECHNICAL MEMORANDUM

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RESPONSE TO COMMENT ON THE RESOLUTION COPPER PROJECT DEIS: ACTION ITEM AQ3 – EXPANDED DEPOSITION ANALYSIS TO ADDRESS CONSTITUENTS NOTED IN PUBLIC COMMENTS

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Executive Summary

USDA – Forest Service, Tonto National Forest (TNF) received comments on the Resolution Copper Draft Environmental Impact Statement (DEIS) pertaining to potential health effects due to emissions of toxic substances (i.e., hazardous air pollutants (HAPs)[1], including inorganic metals, that may be present in particulate emissions (i.e., process and fugitive dust) due to material handling and fugitive dust emission sources at the proposed Resolution Copper Project (Project). The geochemical characteristics of the ore body that will be mined at the Project have been extensively analyzed. Inorganic metals are naturally present in the ore body in very low concentrations and may be contained in the particulate matter emissions due to underground mining activities, surface activities, and windblown dust from disturbed areas.

The results of a screening health risk assessment to estimate potential health effects associated with a lifetime of exposure to emissions of hazardous air pollutants (including inorganic metals) are disclosed in the DEIS (Section 3.6.2.2). For all alternatives, the human health risk associated with exposure to the maximum potential air concentrations of inorganic metals is estimated to be below the United States Environmental Protection Agency's (US EPA) Regional Screening Levels (RSC) of concern.

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[1] Hazardous air pollutants (HAPs) are those pollutants that are known or suspected to cause cancer or other serious health effects.

In order to address specific matters included in comments on the DEIS, the TNF has requested more specific information pertaining to reasonably foreseeable HAPs emissions and, as applicable, associated potential health effects.

Overview

For the purposes of the NEPA analysis, the ability to meet air quality standards is considered protective of public health.[2] Therefore, a separate health-based analysis of individual constituents, particularly those associated with particulate emissions, is not necessary in order to disclose impacts on human health (SWCA Environmental Consultants 2018b). (DEIS Section 3.6.2.2). However, the levels of inorganic metals deposition associated with particulate emissions were estimated and compared with Regional Screening Levels for which the EPA has derived carcinogenic and/or non-carcinogenic chronic health effects. The results of that analysis are disclosed in DEIS 3.6.2.2. Estimated human health risk associated with the maximum air concentration of inorganic metals are below 1.0 for cancer (less than 1x10-6 cancer risk) and below 1.0 for non-carcinogenic chronic health effects.

The information included in this technical memorandum addresses several air contaminants mentioned in public comments on the DEIS.

PM_{10} Concentrations at Receptors of Interest

To address public comments on the DEIS related to deposition and health effects, TNF requested PM_{10} impact concentrations at several receptors of interest. Table 1 lists the 24-hour and annual PM_{10} concentrations for the model receptors that are closest to the locations of the receptors of interest identified by TNF and represented by the yellow dots on the map of the Project area (Figure 1, which is DEIS Figure 3.4.3.1)). The dots have been labeled with letters (A-P) which have been used to cross reference the PM_{10} concentrations provided in Table 1. Impact concentrations are estimated based on the Project's PM10 emissions (no background) using the near-field AERMOD model runs for the DEIS.

[2] The NAAQS are promulgated to protect human health with an adequate margin of safety (see Clean Air Act 109(b) and 40 CFR 50.2).

Table 1. PM_{10} Impacts Due to Project Emissions at Receptors of Interest

	Coordinates		Impacts Due to Project Emissions (μg/m³)	
Receptor ID	UTM X	UTM Y	24-hour*	Annual
A	455537.4	3669556	0.57	0.06
B	457537.5	3668556	0.73	0.06
C	457938.2	3669505	1.15	0.08
D	458036.8	3672056	0.62	0.07
E	473537.4	3684556	2.84	0.31
F	480736.7	3684356	9.98	1.11
G	485636.7	3687256	10.74	1.37
H	486537.8	3688057	23.80	3.58
I	485537.8	3682056	5.48	0.28
J	489836.7	3683156	11.76	1.02
K	490675.9	3684343	23.84	2.17
L	492936.7	3684356	10.68	0.40
M	494173.8	3684951	49.66	1.93
N	500530.9	3662553	1.43	0.13
O	503030.7	3662553	1.21	0.11
P	515529.7	3667553	1.54	0.12

*24-hour impacts due to project emissions are equal to the sum of the 3rd-high AEMOD modeled concentrations at each receptor from the 4 facility-based runs. These values are a conservative representation of the estimated 24- hour impacts due to the project but are not an estimate of the maximum 24-hour impact.

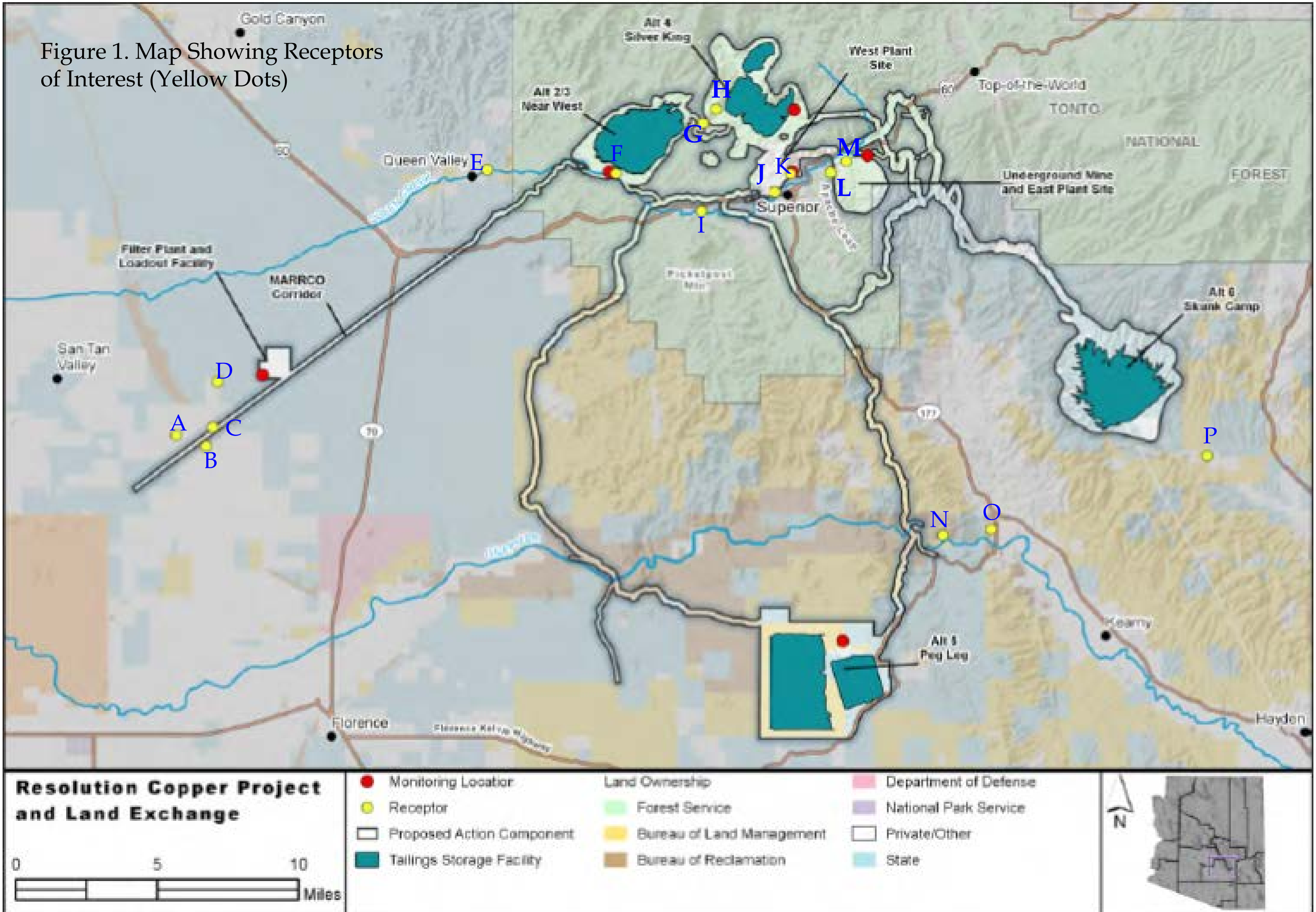

Figure 3.4.3-1. Land use, sensitive areas/receptors identification, and measurement locations

Discussion of Reasonably Foreseeable Air Contaminants Noted in Public Comments

Chromium

Chromium (Cr) concentrations in analyzed ore samples from the Project represent total Cr. Cr is a naturally-occurring element found in rocks and soil, where it exists in combination with other elements to form various compounds. Average total Cr concentrations in ore samples from the Project is 0.028%. The three main forms of Cr are:

- Ch(0)Trivalent
- Cr (Cr(III))
- Hexavalent Cr (Cr(VI))

Cr(III) in soil is mostly present in insoluble carbonate and oxide of Cr(III) and is not mobile in soil.[3] Cr(VI) is generally produced by industrial processes[4] and is generally considered to pose the greater human health risk among the three Cr oxidation states because it is more toxic, more mobile, and more soluble than Cr(III). Cr(VI) is a strong oxidant and is readily reduced to Cr(III) (an important process that limits the mobility of Cr(VI) in natural rocks and soil to ground water).[5] For these reasons, Cr(III) and Cr(VI) were not reasonably expected to be of concern based on what was known during scoping and, therefore, ore samples were not analyzed for Cr(III) and Cr(VI). However, the characteristics of the Cr oxidation states suggest that the concentration of Cr(VI) in dust emissions due to ore mining, handling and processing and TSF fugitive emissions will be a minimal fraction of the concentration of total Cr.

Health problems involving the respiratory tract, including cancer, can be caused by exposure to Cr. Health effects occur at much lower concentrations for Cr(VI) compared to Cr(III). The United States Occupational Safety & Health Administration (OSHA) has set a legal limit for Cr(VI) in workplace air that is 100 times more stringent than Cr(III) and 200 times more stringent than Cr.[6] US EPA's regional screening levels (RSL) include a carcinogenic screening

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[3] https://www.atsdr.cdc.gov/toxprofiles/tp7-c6.pdf

[4] https://www.niehs.nih.gov/health/materials/hexavalent_chromium_508.pdf

[5] https://books.google.com/books?id=Dh2hX8TbCfAC&pg=PA28&lpg=PA28&dq=ratio+Cr+to+CrVI+in+soil&source=bl&ots=y2glnPl_EU&sig=ACfU3U1P_mtLeWAsGTacqN3jfvT0FFxYtw&hl=en&sa=X&ved=2ahUKEwic5PmAuq_qAhXTWM0KHTPFBMgQ6AEwBXoECAoQAQ#v=onepage&q=ratio%20Cr%20to%20CrVI%20in%20soil&f=false

[6] https://www.atsdr.cdc.gov/phs/phs.asp?id=60&tid=17

level (for $1x10^{-6}$ target risk) for Cr(VI) of $1.2e10^{-5}$ µg/m3 for Cr(VI). US EPA does not provide carcinogenic screening levels for Cr(0) or Cr(III).

With the indication that naturally occurring concentration of Cr(VI) in ore (and, therefore, process and fugitive dust from the Project) is negligible and the comparatively low health risk thresholds known to be associated with Cr(0) and Cr(III), a lifetime of exposure to anticipated total Cr emissions (including its naturally occurring oxidation states) from the Project would not be expected to change the conclusion of the screening health risk assessment disclosed in the DEIS that the estimated human health risk associated with the maximum air concentration of inorganic metals are below 1.0 for cancer (less than $1x10^{-6}$ cancer risk) and below 1.0 for non-carcinogenic chronic health effects.

Lead (Pb)

Annual emissions of lead (Pb) are estimated in the emission inventory for the Project. Lead is a minor constituent in diesel emissions, is present at very low concentrations in the ore body and may be present in increases in particulate matter (PM) concentrations caused by emission sources at the Project.

Total maximum annual emissions of lead are estimated to be 0.023 tons Pb/year. Estimated Pb impact concentrations due to Pb emissions from the Project are estimated by scaling the PM_{10} annual average impact (7 µg/m^3)[7] by the appropriate factors to a) scale (by multiplying by 4) [8] the estimated annual average impacts to a 3-month rolling average impact (4 x annual = 28 µg/m^3); and b) scale the 3-month average PM_{10} impact by the Pb/PM_{10} annual facility-wide emissions ratio (0.023 tons Pb/year / 328 tons PM_{10} year = 0.00007). The resulting Pb 3-month average impact concentration is 0.002 µg/m^3. Adding a conservative background concentration of lead of 0.04 µg/m3 (the 3-month rolling average for the period 2015-2017 for Miami, AZ[9] where a copper smelter is in operation) to the estimated Pb impact results in a total (impact plus background) Pb ambient 3-month concentration of 0.042 µg/m^3. This is below the NAAQS for Pb of 0.15 µg/m^3 (3-month rolling average).

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[7] Annual average impact concentrations for the receptor at which the maximum annual average impact concentration was modeled (as disclosed in the DEIS (Table 3.6.4-1)).

[8] Scaling factor of 4.0 to scale annual average modeled impacts to 3-month average is from guidance for the CTSCREE, a model included on US EPA's list of air quality dispersion models. (https://www.epa.gov/scram/air-quality-dispersion-modeling-screening-models).

[9] "Annual Ambient Air Assessment Report 2017", Arizona Department of Environmental Quality,

Radioactive Substances

Geochemical analysis of ore recovered from exploration boreholes drilled at resolution, based on 5,987 samples, show very low trace levels of thorium (median 3.0 ppm) and uranium (median 2.0 ppm). "Trace" for these elements is generally defined as any concentration less than 1,000 ppm. Additional geochemical characterization of 224 samples of ore and development rock show median levels of radium-226 and radium-228 to be very low (0.69 pCi/g and 2.5 pCi/g. respectively). Process waters developed in advanced metallurgical testing meet US EPA MCL values for uranium, radium (both Ra-226 and Ra-228) and gross alpha and gross beta radiation (Duke HydroChem, 2019). Further information on these analyses is contained in DEIS Section 3.7.2.

Based on these comprehensive studies, there is no evidence to suggest that there is any mechanism in the Resolution process circuit likely to result in technologically enhanced naturally occurring radioactive material (TENORM) in tailings, concentrate, or process water. The technical memorandum, "Potential for Technologically Enhanced Naturally Occurring Radioactive Material (TENORM) in Tailings from Processing of the Resolution Copper Deposit" (Duke Hydro|Chem, 2019) presents the data and analysis that support this conclusion and was disclosed in the DEIS (chapter 3, Section 3.7, page 418).

Asbestos

Measured asbestos amounts in the ore are small (up to 1.75 wt.%) and mainly located in the skarn-type alterations zones (7%) of the ore body. Tremolite/actinolite are the only potentially asbestiform minerals detected in the Resolution ore body.

Based on these values, estimated abundances of asbestiform minerals in the mine panels range from approximately 0 to 0.1 wt.%. For reference, the U.S. Code of Federal Regulations 40 CFR 61.141 (2002) defines asbestos containing material as "...more than 1 percent asbestos as determined by...Polarized Light Microscopy." Asbestos abundance in Resolution ore and development rock falls well below this criterion. Based on analysis of asbestos occurrence in Resolution ore it is expected that asbestos abundances in the tailings will also be low. Based on conservative estimate of the amount of asbestos in tailings (e.g., upper end of asbestos (0.1 wt.%) in ore and the assumption that all asbestos reports to NPAG tailings (unsaturated), the abundance of asbestos in tailings is low ((0.12 wt.%) (also below the 1 wt.% criterion for asbestos-containing waste). (See technical memorandum, "Occurrence of Asbestiform Minerals in Resolution Ore and Development Rock" (Duke Hydro|Chem, 2019)).

Valley Fever

Coccidioidomycosis (Valley Fever) in a human fungal infection caused by inhaling fungi spores in certain geographic areas in Arizona. This infection is endemic to Arizona and can occur as a result of many activities (e.g., construction activities, gardening, farming, windy weather, dirt biking, driving ATVs). Most of the disturbance of surface soils associated with the Project will occur during the construction of the tailings storage facility (TSF).

The construction of the TSF incorporates carefully designed and engineered features to reduce emissions (including windblown dust) and impacts to air quality. These emission reduction features are in compliance with applicable state and local air district regulations. PM and HAPs are addressed in the DEIS as are applicant-committed environmental protection measures ((Ch. 3, p. 283); App. J includes air quality controls). RC will be required to adhere to PCAQCD air permit requirements to limit emissions and protect health-based air quality standards. The well-controlled sources of fugitive dust during construction activities are not expected to increase the rate at which fungi spores are entrained to ambient air beyond typical levels for the Project area.