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Resolution Copper Project NEPA Air Quality Impacts Analyses

PREPARED FOR:
TONTO NATIONAL FOREST

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LIST OF ABBREVIATIONS

AAB	Ambient Air Boundary
AAQS	Ambient Air Quality Standards
ACEC	Areas of Critical Environmental Concern
ADEQ	Arizona Department of Environmental Quality
ADJ_U*	Adjusted Friction Velocity
AERMET	AERMOD Meteorological Preprocessor
AERMAP	AERMOD Terrain Data Preprocessor
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
AERSURFACE	AERMOD Land Cover Preprocessor
AMSL	Above Mean Sea Level
AP-42	AP-42 Compilation of Air Pollutant Emission Factors
AQCR	Air Quality Control Region
AQRV	Air Quality Related Value
B_o	Midday Bowen Ratio
BLM	U.S. Bureau of Land Management
BPIP-PRIME	Building Profile Input Program with the Plume Rise Model Enhancement
CAI	Central Arizona Intrastate
CFR	Code of Federal Regulations
CR	Code of Regulations
DAT or DATs	Deposition Analysis Thresholds
DEIS	Draft Environmental Impact Statement
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EP	East Plant
EPS	East Plant Site
ET	Evapotranspiration
FLAG	Federal Land Managers' Air Quality Related Values Work Group
FLM	Federal Land Managers
FP&LF	Filtration Plant and Concentrate Loadout Facility
GAQM	Guideline on Air Quality Models
GPA	General Project Area

GPO	General Plan of Operations
GWA	Galiuro Wilderness Area
HAPs	Hazardous Air Pollutants
HYSPLIT	Hybrid Single Particle Lagrangian Integrated Trajectory
IOA	Index of Agreement
IWAQM	Interagency Workgroup on Air Quality Modeling
ISR	NO_2/NO_X In-Stack Ratios
Lakes	Lakes Environmental
LHD	Load-Haul-Dump
LOM	Life-of-Mine
MACT	Maximum Achievable Control Technology
Magma	Magma Junction
MARRCO	Magma Arizona Railroad Company
MERP or MERPs	Modeled Emission Rates for Precursors
MMIF	Mesoscale Model Interface
Modeling Plan	Resolution Copper Project Air Quality Impacts Analysis Modeling Plan for the National Environmental Policy Act
Modeling Report	Resolution Copper Project – NEPA Air Quality Impacts Analyses Modeling Report
MPRM	Meteorological Processor for Regulatory Models
MWA	Mazatzal Wilderness Area
NAAQS	National Ambient Air Quality Standards
NAD83	North American Datum of 1983
NED	National Elevation Dataset
NLCD92	1992 National Land Cover Data
NEWA	Needle's Eye Wilderness Area
NOAA	National Oceanic and Atmospheric Administration
NPAG	Non-Potentially Acid Generating
NPS	National Park Service
NSPS	New Source Performance Standards
NSR	New Source Review
NWS	National Weather Service
OLM	Ozone Limiting Method
PAG	Potentially Acid Generating

PCAQCD	Pinal County Air Quality Control District
PGM	Photochemical Grid Modeling
PLUVUE II	Plume Visibility Model
Project	Resolution Copper Project
PSD	Prevention of Significant Deterioration
r	Midday Albedo
Resolution Copper	Resolution Copper Mining, LLC
Resolution Project	Resolution Copper Project
RH	Relative Humidity
RMSE	Root Mean Square Error
ROM	Run-of-Mine
SAG	Semi-Autogenous Grinding
SAWA	Sierra Ancha Wilderness Area
SNP	Saguaro National Park
SIL or SILs	Significant Impact Levels
SoDAR	Sonic Detection and Ranging
SR	State Route
SWA	Superstition Wilderness Area
TNF	Tonto National Forest
TSF	Tailings Storage Facility
u*	Surface Friction Velocity
USDA	United States Department of Agriculture
USFS	United States Forest Service
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
WC ACEC	White Canyon Area of Critical Environmental Concern
WRF	Weather Research and Forecast Model
WP	West Plant
WPS	West Plant Site
WRCC	Western Regional Climate Center
z_o	Surface Roughness Length

LIST OF POLLUTANTS

CO	Carbon Monoxide
H_2SO_4	Sulfuric Acid
HNO_3	Nitric Acid
PM	Total Particulate Matter
PM_{10}	Particulate Matter Less than 10 Micrometers (µm) in Aerodynamic Diameter
$PM_{2.5}$	Particulate Matter Less than 2.5 µm in Aerodynamic Diameter
PMC	Coarse Particulate Matter (portion of PM_{10} greater than 2.5 µm)
PMF	Fine Particulate Matter (remainder of non-carbon filterable PM)
N	Nitrogen
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NO_3	Nitrate
NO_X	Oxides of Nitrogen
O_3	Ozone
S	Sulfur
SO_2	Sulfur Dioxide
SO_4	Sulfate
VOC	Volatile Organic Compounds

LIST OF UNITS

°F	Degrees Fahrenheit
°K	Degrees Kelvin
ft	Foot or Feet
g/cm3	Grams per Cubic Centimeter
g/kg	Grams per Kilogram
hr	Hour
in	Inch
km	Kilometers
lb	pound
m	Meter
$\mu g/m^3$	Micrograms Per Cubic Meter
µm	Micrometers
μm^3	Cubic Micrometers
m/s	Meters per Second
ppb	Parts per Billion
ppm	Parts per Million
tpy	Tons per Year
yr	Year

1.0 INTRODUCTION

Resolution Copper Mining, LLC (Resolution Copper) is the operating company and the proponent of the Resolution Copper Project (Resolution Project or Project) in Pinal County in central Arizona, approximately 65 miles east of Phoenix. The proposed project includes underground mining, ore processing operations, and the associated facilities and infrastructure described herein.

This Air Quality Impacts Analysis Modeling Report for the National Environmental Policy Act (Modeling Report) is for submittal to Tonto National Forest (TNF) as part of an Environmental Impact Statement (EIS) to evaluate and disclose the potential environmental effects from the proposed Project. This report is consistent with the Resolution Copper Project General Plan of Operations (GPO), final range of alternatives for detailed analysis[1] and pertinent local, state[2], and federal[3] requirements.

This Modeling Report includes a description of the methods and datasets used in the air quality modeling analyses to estimate the Resolution Project's air quality impacts relative to the applicable Ambient Air Quality Standards (AAQS) for criteria pollutants and to Air Quality Related Values (AQRV) in the near-field domain (Class I Superstition Wilderness Areas [SWA], White Canyon Area of Critical Environmental Concern [WC ACEC], Class II Needle's Eye Wilderness Area [NEWA]) and in several Class I Wilderness Areas in the far-field domain (Sierra Ancha Wilderness Area [SAWA], Mazatzal Wilderness Area [MWA], Galiuro Wilderness Area [GWA], and Saguaro National Park [SNP). These analyses for the EIS are technically consistent with and in addition to the analyses prepared to demonstrate compliance with the applicable Pinal County Air Quality Control District (PCAQCD) and National Ambient Air Quality Standards (NAAQS), as required by the permit application requirements in applicable PCAQCD rules.[4]

The analyses described in this Modeling Report are consistent with the Air Quality Impacts Analysis Modeling Plan for the National Environmental Policy Act (Modeling Plan). The Modeling Plan was developed in consultation with the TNF, Arizona Department of Environmental Quality – Air Quality Division (ADEQ), PCAQCD, and the TNF's third-party contractor, SWCA Environmental Consultants.

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[1] http://www.resolutionmineeis.us/public-involvement/snapshots

[2] Arizona Department of Environmental Quality (ADEQ) "Air Dispersion Modeling Guidelines for Arizona Air Quality Permits" (ADEQ 2015a)

[3] "Guideline on Air Quality Models" specified in Appendix W to Part 51 of the Code of Federal Regulations (CFR), Title 40 (Protection of Environment) and Federal Land Managers' Air Quality Related Values Work Group (FLAG), Phase I Report (FLAG 2010)

[4] The "Air Quality Impacts Analysis Modeling Plan for Permitting" has been approved by PCAQCD and submitted to the TNF for review and comment, and the document, its appendices, and associated review, comments, responses, and approvals are hereby incorporated by reference.

This Modeling Report includes the following information:

- Detailed descriptions of the Project area and the Project, including estimated emissions expected from the Project during operations, estimated emissions due to construction of the project, and estimated emissions for several alternatives that were evaluated in the EIS
- Detailed descriptions of the methodologies used and results from several air quality analyses for the project, including the following:
    - Near-field assessment of impacts to applicable AAQS
    - Near-field assessment of impacts to AQRVs in the Class I SWA and the WC ACEC
    - Far-field assessment of impacts to AQRVs in the Class I SAWA, MWA, and GWA

This Modeling Report includes specific technical details about the Project and the air quality analyses performed to support the TNF and SWCA in their preparation of the EIS. Resolution Copper and its air quality consultant have provided these details to document the modeling methods and inputs used for the air quality analyses and to present the results of the analyses.

2.0 PROJECT DESCRIPTION

The proposed Resolution Project facilities and attendant infrastructure components will be located in north-central Pinal County. A location map showing proposed Project facility locations, hereafter referred to as the General Project Area (GPA), is presented in Figure 2-1. A full description of the project is contained in the latest version of the Mine's GPO (available at http://www.resolutionmineeis.us/documents/resolution-copper-gpo).

The East Plant Site (EPS) encompasses the proposed underground mine, associated shafts, and surface support facilities. The support facilities are located in the previously disturbed footprint of the Magma Copper mine and include Shaft 9 which was constructed in the early 1970s. The EPS is accessed from Highway US 60 by turning south on Magma Mine Road (also known as Forest Road 469), which terminates at the EPS guard gate. The existing mine site and related surface support facilities are currently located on private lands. Expansion associated with the Project will occur on United States Forest Service (USFS) lands as well as state and private lands, although this area would become private upon completion of the land exchange.[5]

The ore processing operations will be located at the West Plant Site (WPS), approximately 6 miles west of the EPS. These facilities are also located in a previously disturbed footprint of the Magma Copper mine and processing facilities. A new copper concentrate Filtration Plant and Concentrate Loadout Facility (FP&LF) will be constructed on private land near Magma Junction (Magma), proximate to the existing disturbed Magma Arizona Railroad Company (MARRCO) right-of-way. An alternative location for the FP&LF within the footprint of the WPS is also being considered. The air quality analysis assesses the air quality impacts associated with both alternative locations.

The project will require a Tailings Storage Facility (TSF), and several alternative locations and designs of the TSF are being considered. In general, tailings will be delivered to the TSF from the WPS via a pipeline that traverses the intervening area (along with other infrastructure) along the Tailings Corridor. The air quality analysis assesses air quality impacts associated with the alternative locations being considered for the TSF.

Linear infrastructure elements of the Project will include ore conveyors, roads, power lines, copper concentrate pipelines, tailings pipelines, the MARRCO Railroad, and water supply pipelines; these will be primarily located within the Tailings Corridor, within the MARRCO Corridor alongside existing disturbed land or underground.

Resolution Copper will use an underground mining method known as panel caving, which is a variation of caving. Panel caving allows for the mining of large, underground ore bodies by

[5] In 2014, Congress passed legislation that approved the land exchange. Per the United States Department of Agriculture (USDA) Agreement to Initiate the land exchange, the land exchange is scheduled to become final in 2020.

dividing the deposit into smaller strips, or panels, so that the ore can be removed in a safe and efficient manner.

The benefits of a panel cave mine at the Resolution Project include limited development rock piles at the surface and no large open pits with terraced pit walls. One result of panel cave mines is surface subsidence or settling above the ore deposit. Surface subsidence occurs as the material above the ore body gradually moves downward to replace the ore that has been mined. The settling amount is less than the amount of ore removed due to the "bulking" of the rock underground; that is, the volume of the caved rock fragments will be larger relative to the rock's in-place volume, which is a major factor controlling subsidence (Holzer 1984).

Nominal ore production from the underground operations is expected to be a 120,000 tonnes per day[6] after an extensive construction and ramp-up period.

Ore material will be crushed underground and then transported by underground haul trucks to two production shafts and hoisted to an underground midway offloading station within the two production shafts at the EPS. The crushed ore will be transferred via underground conveyors to an overland stacker and stockpiled at the WPS. The stockpiled ore will be transferred to a concentrator facility via apron feeders and a reclaim tunnel located underneath the stockpile, where it will be processed using traditional copper sulfide recovery techniques. The concentrator facility will consist of conventional grinding and flotation circuits and will produce copper and molybdenum concentrates. Tailings material, the non-economic excess ground rock with a sand-like consistency that remains after concentrates have been removed during ore processing, will be piped as a slurry to the TSF located west of the WPS. The TSF will be located on land administered by the TNF. Molybdenum concentrates will be bagged at the concentrator facility and shipped to market via trucks. Copper concentrates will be transported as slurry via pipeline to FP&LF near Magma for final filtration and train loadout for shipment to domestic and/or global markets for additional processing.

Resolution Copper anticipates that the project will have a total operational life of approximately 40 years, not including initial site construction, which will span approximately 10 years, and not including final reclamation work (demolition, regrading, and revegetation), which could take up to an additional 10 years. In total, the Project will have a lifespan of approximately 60 years.

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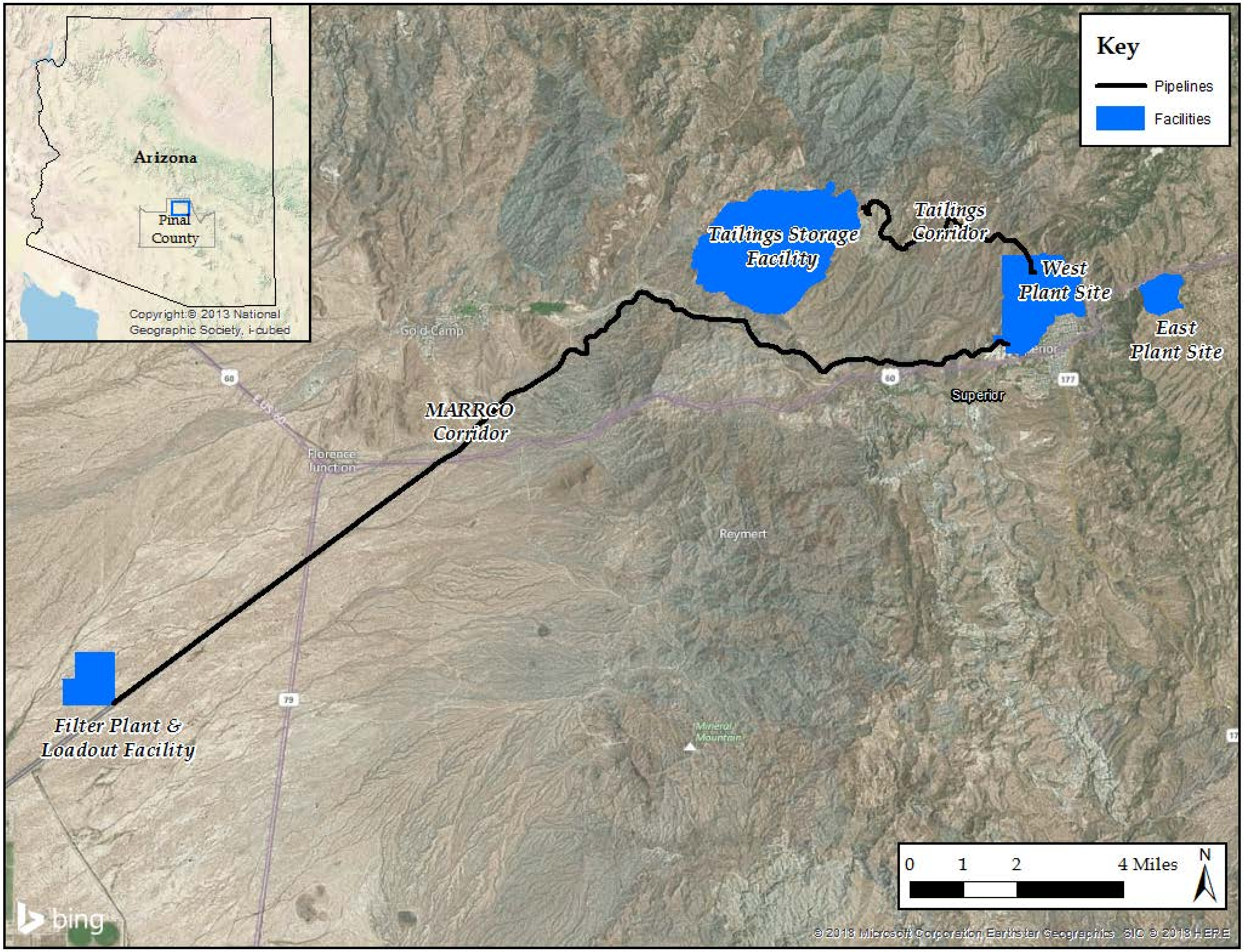
[6] A process rate of 143,750 tonnes per day was used for modeling based on the nominal ore process rate multiplied by a 15% design factor and approximately 4% for moisture.

Figure 2-1. Resolution Project Location (Proposed Action)



2.1 Regional Topographical Characteristics

The GPA lies within the Basin and Range physiographic province, generally characterized by a series of smooth-floored basins separated by mountain ranges (Chronic 1983). The northeastern edge of the province is a mountainous region that is transitional to the Central Highlands bordering the Colorado Plateau province. This mountainous region consists of belts of generally linear ridges and valleys, where the rugged ranges predominate over the valleys. This is in contrast to much of the Basin and Range province and the western portion of the GPA, where broad valleys predominate over relatively narrow mountain ranges. As such, the GPA includes a combination of nearly flat terrain of the broad basin to the west and rugged mountainous terrain (Superstition, Dripping Spring, and Pinal Mountains) to the north and east.

The elevations within the GPA range from 1,520 ft above mean sea level (AMSL) at the western terminus of the MARRCO Corridor to 4,648 ft AMSL at Apache Leap.

2.2 Local Topographical Characteristics

The Project features, which include the FP&LF, MARRCO Corridor, TSF and Tailings Corridor, WPS, and EPS, span approximately 31.8 miles from the southwestern corner of the GPA near Magma to the northeastern corner of the GPA at the EPS, east of Superior. The vast majority of Project activity will take place at the EPS, WPS, and TSF. The following discussion describes the Project features as they occur in geographic order across the GPA from northeast to southwest.

2.2.1 EPS

The EPS will be located in the mountains immediately east of the town of Superior in a transition zone on the northeastern edge of the Basin and Range physiographic province, bordering the Central Highlands. The elevation ranges from 3,100 ft AMSL near Queen Creek to 4,648 ft AMSL at a high point on the Apache Leap escarpment, overlooking Superior. The western edge of this area is generally very steep, with the cliffs of the Apache Leap escarpment rising abruptly above Superior. East of Apache Leap, there is an area of parallel ridges and valleys trending northeast. The northeastern portion of the EPS is relatively flat.

2.2.2 WPS

The WPS will be located at the transition from the basin (in which the town of Superior is situated) to the mountains that border the Central Highlands north of Superior. The southwestern part of the site, adjacent to the town of Superior, is moderately sloped with a base elevation of approximately 2,680 ft AMSL. The site ascends into deeply incised canyons in the rocky slopes along the northern portion of the WPS up to an elevation of approximately 3,400 ft AMSL.

2.2.3 TSF Alternatives and Tailings Corridor(s)

The proposed action is the Near West TSF and Tailings Corridor to be located in a transition zone on the northeastern edge of the Basin and Range physiographic province. The topography in the vicinity is characterized by a series of parallel ridges formed from differential erosion of a tilted fault block dipping to the southeast (Spencer and Richard 1995). The ridges are separated by valleys with thin alluvial deposits in the valley bottoms. The valleys are relatively narrow at higher elevations and widen as elevation decreases toward Queen Creek. The design of the proposed action TSF includes modified centerline construction and two tailings streams[7] (non-potentially acid generating [NPAG] and potentially acid generating [PAG]).

The TSF footprint is bounded by Roblas Canyon to the west and Potts Canyon to the east. Elevations of the TSF footprint range from approximately 2,240 ft AMSL in the southwest portion to 2,920 ft AMSL in the northern extents.

The Tailings Corridor for the proposed action extends from the northeast corner of the TSF to the WPS, traversing multiple ridges and valleys. The main valleys from west to east are Potts Canyon, Happy Camp Canyon, and Silver King Wash. Elevations along the Tailings Corridor range from approximately 2,690 ft AMSL at the tie-in location on the northeast side of the TSF to 3,050 ft AMSL at the WPS.

A final range of TSF alternatives for detailed analysis in the Draft Environmental Impact Statement (DEIS) has been determined by the USFS as well as some additional alternatives that have been presented for consideration. Each alternative was evaluated for potential impacts to air quality resources. The alternatives are:

1 – No Action

2 – Modified Proposed Action – Near West "wet" (slurry tailings; unlined; subaqueous PAG; modified centerline dam embankment). Location: west of the WPS and north of Queen Station within the TNF.

3 –Near West "dry" (modified centerline dam; thickened; separate PAG cell). Location: west of the WPS and north of Queen Station within the TNF.

4 – Silver King Filtered (filtered tailings, two separate areas for PAG and NPAG). Location: North of WPS.

5 – Peg Leg (centerline dam for NPAG thickened tailings; separate downstream dam for PAG cells incorporating a water cover). Location: Approximately 29 kilometers (km) south of the WPS and 25 km east of Florence, AZ.

6 – Skunk Camp (centerline dam for NPAG with thickened tailings; separate downstream dam for PAG cells incorporating a water cover). Location: Approximately 15 miles south east of Superior, AZ.

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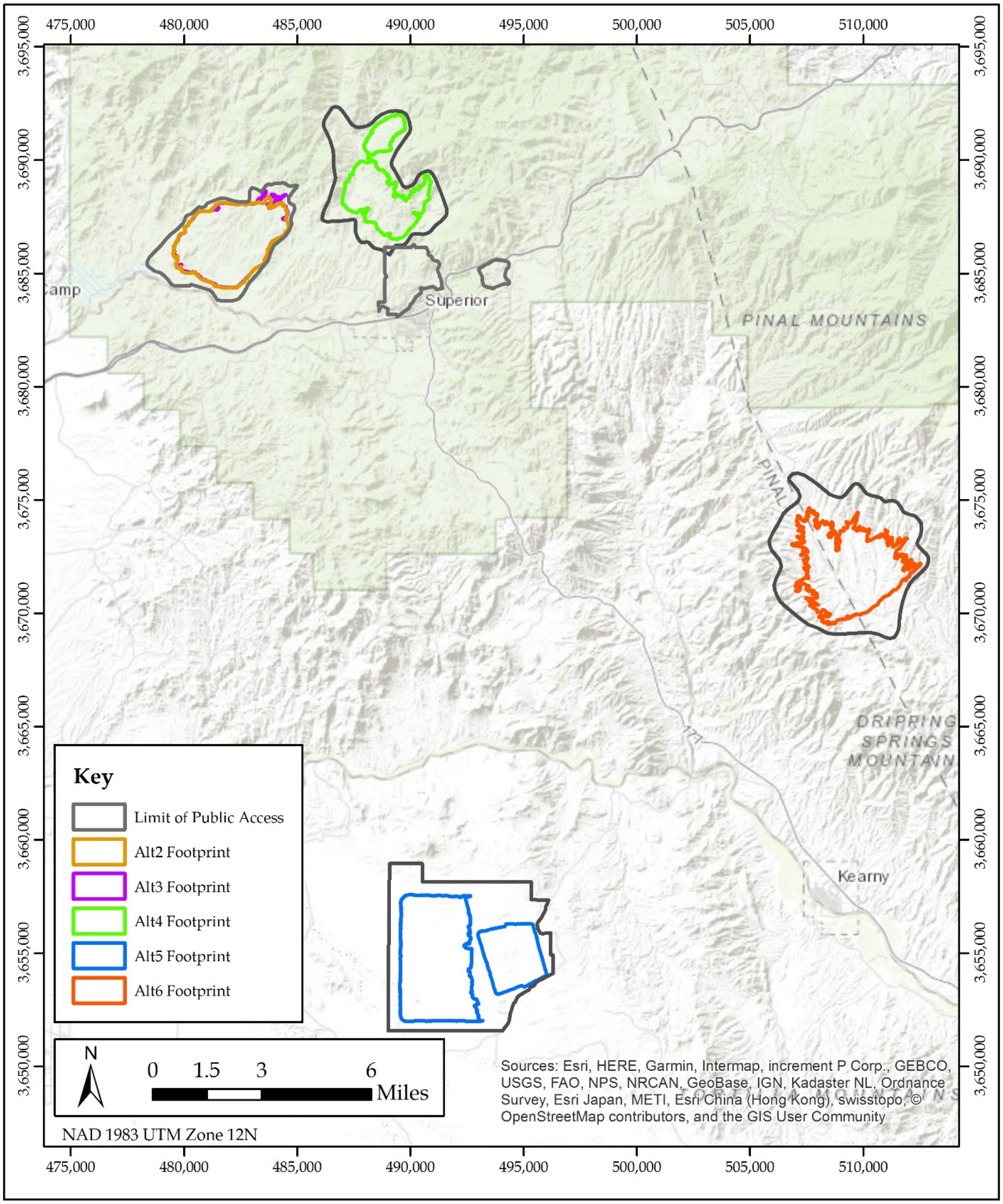
[7] "Scavenger" (85%, non-potentially acid generating [NPAG]) and "cleaner" (15% potentially acid generating [PAG]).

Figure 2-2 shows the location of the proposed action and alterative TSF's along with the limit of public access for each location, or Ambient Air Boundary (AAB). See Section 3.1.4.

Figure 2-2. Tailings Storage Facility (TSF) Locations



2.2.4 MARRCO Corridor

The existing MARRCO Corridor extends northeast from Magma past the highway crossing at US highway 60 east of Florence Junction to the WPS, a distance of approximately 27 miles. The elevations in this corridor range from a minimum of approximately 1,520 ft AMSL at Magma to a maximum of 3,000 ft AMSL at the WPS. The general trend of the corridor is a gradual increase in elevation from west to east, with minor rises and drops over channels. The western terminus of the corridor in the GPA is at Magma.

2.2.5 FP&LF

The FP&LF will be located approximately 7 miles northeast of Magma and adjacent to the MARRCO Corridor. The site is in a relatively flat area. The elevation of the site is approximately 1,670 ft AMSL. An alternative location for the FP&LF within the footprint of the WPS is also being considered.

2.3 Regional Climatology

The regional climate is characterized as semiarid; long periods often occur with little or no precipitation (WRCC 2012). Precipitation falls in a bimodal pattern: most of the annual rainfall within the region occurs during the winter and summer months, with dry periods characterizing spring and fall. The total average annual precipitation varies between 15.7 inches (in) and 18.8 in, with 52 percent of the precipitation occurring between November and April. Although snow may occur at higher elevations, it does not typically accumulate in the region. 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 due to the convective nature of thunderstorms.

2.4 Local Climatology

The National Oceanic and Atmospheric Administration's (NOAA) Climate Data Online (NOAA 2013) and the Western Regional Climate Center (WRCC 2013) maintain data records for several weather stations that surround the GPA. A summary of weather stations in the Project vicinity is provided in Table 2-1.

Table 2-1. Weather Stations in Project Area

Station Name	Elevation (ft)	Latitude	Longitude	Data Period
Miami	3,560	33.40°	110.87°	Feb. 1914 to Mar. 2013
Superior	2,859	33.30°	111.10°	Jul. 1920 to Aug. 2006
Roosevelt	2,205	33.67°	111.15°	Jul. 1905 to Mar. 2013

Source: NOAA 2013

Table 2-2 presents a summary of climatic conditions at each of the Project areas based on the three nearby weather stations. Weather conditions in this region are strongly influenced by elevation; therefore, these data are primarily based on the weather station closest in elevation rather than closest by distance. The data, unless otherwise noted, were derived from WRCC 2013.

Table 2-2. Project Area 30-yr Historical Climatological Summary

Project Area	Elevation (ft)	Weather Station	Ann Mean Daily Avg Temp (°F)	Ann Mean Daily Max Temp (°F)	Ann Mean Daily Min Temp (°F)	Ann Mean Total Snow (in)	Ann Mean Total Precip (in)	Ann ET Rate[(1)] (in)
FP&LF	1,670	Roosevelt	68	81	55	0.2	15.7	67
MARRCO Corridor (west of SR 79)	1,520	Roosevelt	68	81	55	0.2	15.7	67
MARRCO Corridor (east of SR 79)	3,000	Superior	69	79	59	1.4	18.3	63
TSF and Tailings Corridor (Preferred Alt.)	2,240 - 3,050	Superior	69	79	59	1.4	18.3	63
WPS	2,680 - 3,400	Superior	69	79	59	1.4	18.3	63
EPS	3,100 - 4,648	Miami	64	77	51	2.6	18.8	55

[(1)] Yitayew 1990

Ann = Annual, Avg = Average, Temp = Temperature, Max = Maximum, Min = Minimum, Precip = Precipitation, ET = Evapotranspiration, SR = State Route, °F = Degrees Fahrenheit

As shown in Table 2-2, for the three weather stations selected as representative of the GPA, the annual average maximum temperature ranged from 77 °F to 81°F, and the average minimum temperature ranged from 51°F to 59°F. The total rainfall per year ranged from 15.7 in to 18.8 in across the three weather stations (WRCC 2013).

2.5 Process Description and Emission Sources

The Resolution deposit is located between 5,000 and 7,000 ft below the surface and will be mined using a variation of block caving called panel caving. The mine and process operations will operate on a continuous, 24-hours-per-day basis. A process flow diagram showing the underground operations at the EPS is provided in Figure 2-3, and the subsequent ore processing and transport operations are presented in Figure 2-4.

Figure 2-3. Process Flow Diagram – EPS

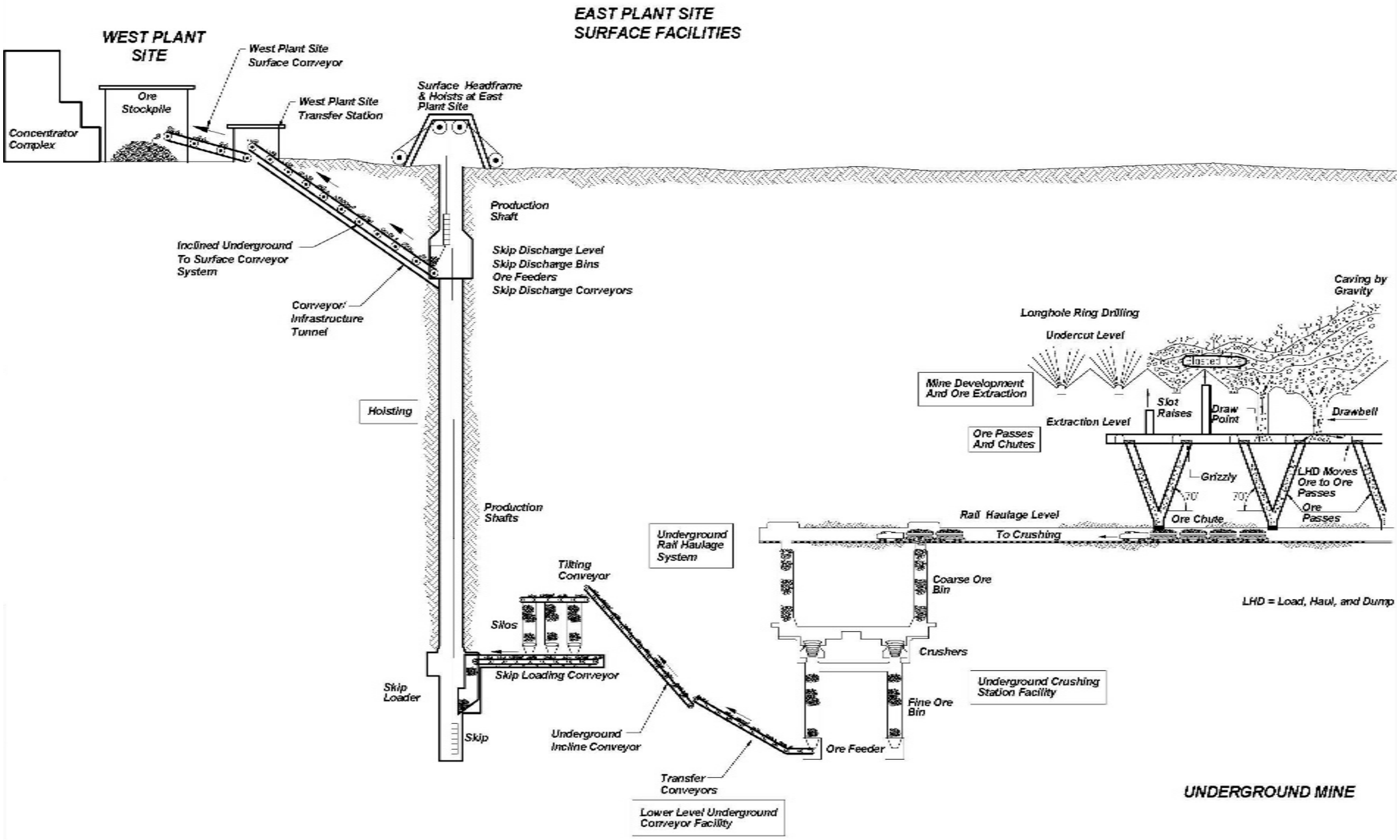
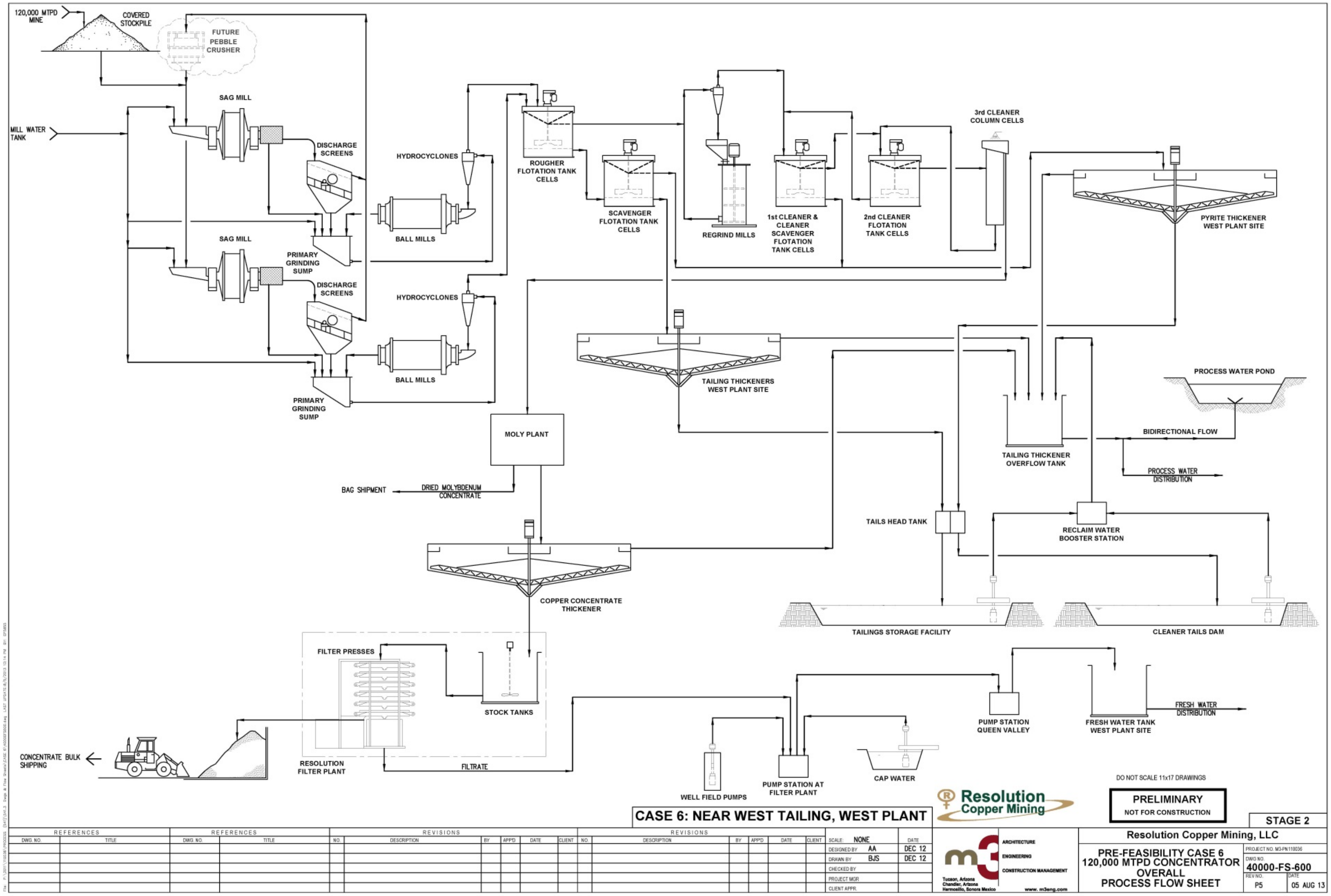


Figure 2-4. Process Flow Diagram – Ore Processing and Transport Operations



2.5.1 EPS Underground Operations – Panel Caving and Ore Preparation

The initial step of the mining process includes preparing the area to be mined. In panel caving, the ore body is mined from the bottom by first breaking up the copper-bearing ore. Once the ore is initially broken up, funnel-shaped cavities are created to direct the broken ore down to be removed and transported. Blasting is used to initially break up the ore body and to create the funnel-shaped openings. Each blast hole is drilled and loaded with an ammonium nitrate and fuel oil-based explosive. Gravity pulls the ore from the ore body down to the draw points where it is loaded into load-haul-dump (LHD) loaders.

The run-of-mine (ROM) ore is transported from the draw points underneath the ore body by LHD loaders to haul trucks. Haul trucks transport the ROM ore underground to one of three gyratory crushers that can process a total of up to 6,889 tons of ore per hour. After a series of underground feeders, conveyors, and bins, the ore is loaded into skips that hoist the ore to an underground midway offloading station, and it is discharged onto an underground conveyor system that transports coarse (crushed) ore to the WPS.

Pollutant emissions from panel cave mining will consist of fugitive emissions from drilling and blasting, ore hauling, loading, and unloading activities; process dust emissions from ore transfers and crushing; and non-road engine tailpipe emissions. Fugitive dust will be controlled by employing dust control measures and best practical methods. Process emissions will be controlled using baghouses and water sprays at process points where feasible. Tailpipe (non-road engine) emissions will be compliant with applicable EPA emission standards.

Three additional mine features act as controls that reduce particulate emissions from underground sources: water droplets in mine shafts, heat rejection sprays, and gravitational settlement. These features' individual scrubbing efficiencies, as well as total effective scrubbing efficiencies, are summarized in Table 2-3.

Table 2-3. Effective Control for Underground Sources

	PM	PM_{10}	$PM_{2.5}$
Water Droplets in Shafts (1)	30.9%	30.9%	4.2%
Heat Rejection Sprays (1)	30.0%	30.0%	2.5%
Gravitational Settlement(2)	60.4%	6.7%	0.4%
Effective Control	80.9%	54.9%	7.0%

(1) These control efficiencies were derived using Moreby 2008.

(2) These control efficiencies were derived using particulate matter terminal settling velocity (Perry's Chemical Handbook, 1997) and Stokes Law (reference: Subsurface Ventilation and Environmental Engineering, McPherson, M.J., 1993.).

PM = Total Particulate Matter, PM_{10} = Particulate Matter Less than 10 Micrometers (μm) in Aerodynamic Diameter, $PM_{2.5}$ = Particulate Matter Less than 2.5 μm in Aerodynamic Diameter

Water Droplets in Shafts Removal Mechanism. Due to the saturated nature of the exhaust air, water droplets will form inside the mine shafts and will scrub a fraction of PM from the exhaust air. This, in combination with an approximate shaft depth of 7,000 ft (and the resulting long time for exhaust air to come in contact with these droplets), results in the scrubbing efficiencies summarized in Table 2-3. Moreby's (2008) analysis demonstrates that exhaust air from the ventilation shafts will be saturated, that water droplets will coagulate particulate matter, and that all water droplets in the air stream will be discharged through surface fans. Through these mechanisms, a significant portion of particulate matter will be removed from the ventilation exhaust. No scrubbing effect for gaseous pollutants is assumed from these droplets.

Heat Rejection Spray Removal Mechanism. The underground heat rejection sprays serve as another control for underground emissions. The heat rejection sprays are employed underground to reject heat from the underground refrigeration plant. As designed, a large fraction (at least 50 percent) of the exhaust air will pass through these chambers where heat rejection will occur. No scrubbing effect for gaseous pollutants is assumed from these sprays. The scrubbing efficiencies for particulates are presented in Table 2-3.

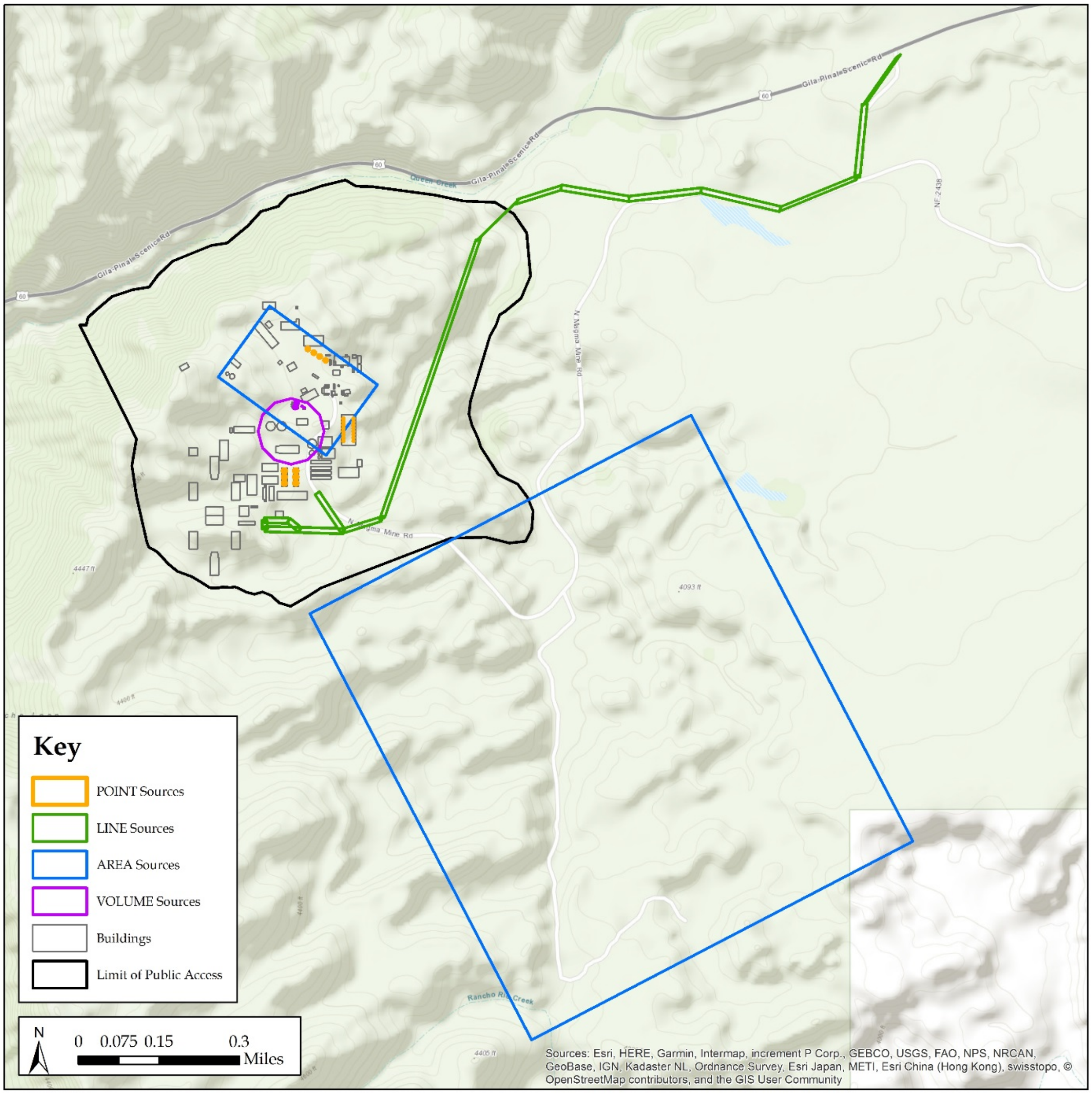
Gravitational Settlement Removal Mechanism. The final particulate control measure assumed for underground sources is gravitational settlement. The exhaust chambers are very long; therefore, gravitational settlement for PM will occur. Using the terminal settling velocity in Perry's Chemical Engineering Handbook (Perry and Green 1997), an efficiency due to gravitational settlement was determined. These efficiencies for PM, PM_{10}, and $PM_{2.5}$ are presented in Table 2-3.

2.5.2 EPS Surface Operations

The surface operations at the EPS will consist of support for underground operations above the ore body. Such activities include cooling towers; miscellaneous non-road equipment; and wind erosion of exposed areas, including the subsidence zone. Particulate matter from roads will be controlled with periodic water and/or chemical dust suppressant application. Figure 2-5 shows the locations of the modeled sources at the EPS surface operations, and an overview of the sources' characterizations for modeling is provided in Section 3.1.8.

The eventual extent of the subsidence zone is represented by the larger blue area source rectangle in Figure 2-5. Fugitive particulate emissions from the subsidence zone may occur due to wind erosion of newly disturbed areas within the subsidence zone.

Figure 2-5. EPS Modeled Source Locations



2.5.3 WPS – Ore Processing

The coarse ore transported from the EPS via an underground conveyor system drops onto an overland feed conveyor at WPS, which transfers the ore to a covered stockpile. The stockpiled coarse ore is drawn through a series of apron feeders and a reclaim tunnel located underneath the stockpile for further processing in the concentrator building. The ore reclaim and transfer operations will be equipped with dust collectors to control particulate emissions.

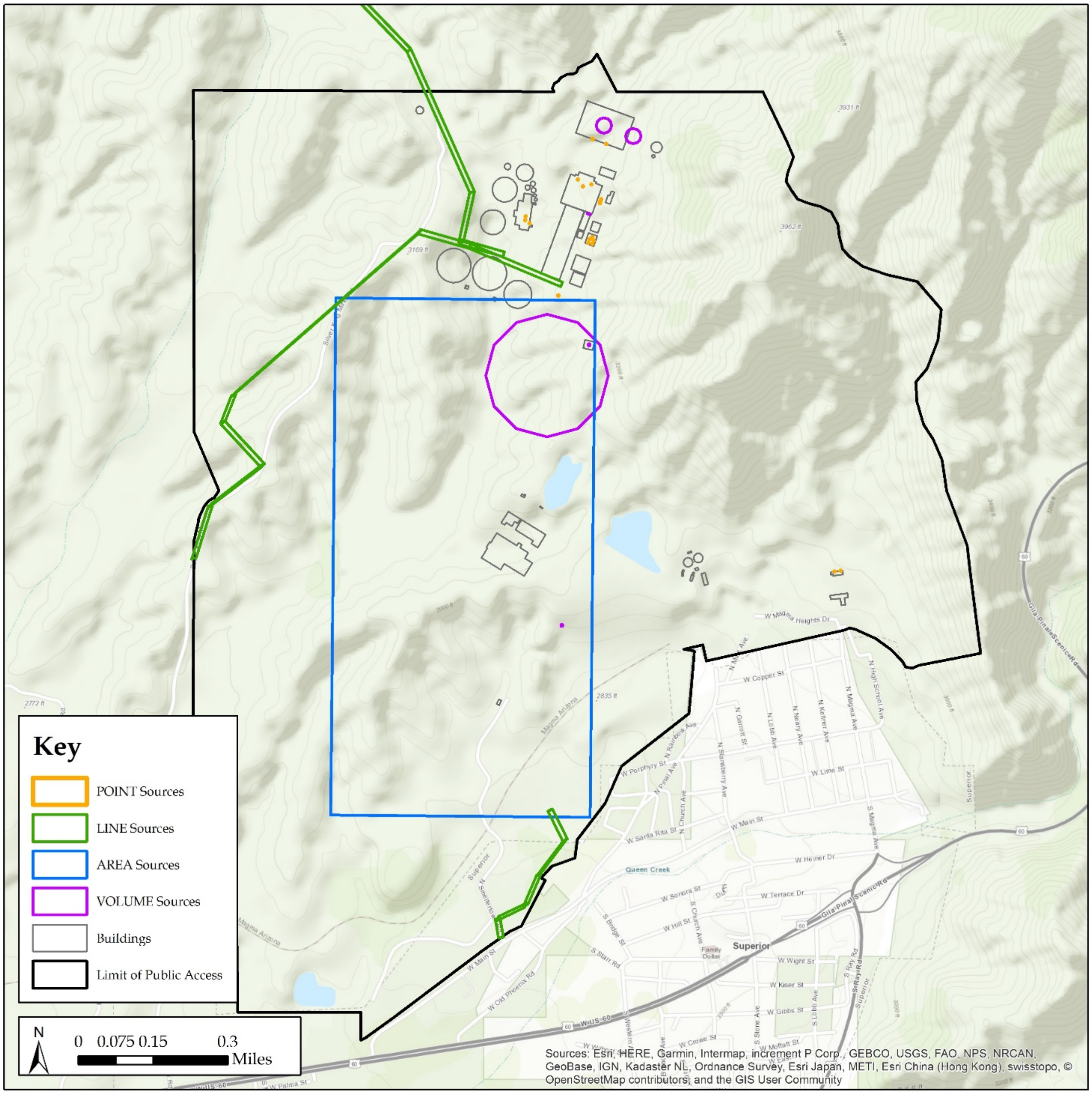
The overall grinding configuration at the concentrator building will consist of two semi-autogenous grinding (SAG) mills, in parallel, followed by a chemical flotation circuit. Each SAG mill will be designed to operate at a maximum rate of 5,512 tons per hour. Process water will be added to the SAG mill feed to provide the correct slurry density for grinding. Chemical additives will also be added to the SAG mill feed. Several reagents will be added during different processing stages to condition the concentrate slurry. Particulate emissions from dry reagent handling and mixing will be enclosed in the concentrator building to control dust emissions. The SAG mill discharge will be screened and oversized pebbles will be conveyed to one of two pebble crushers. Crushed pebbles will be returned to the SAG mill feed conveyors. All conveyor transfer points will be enclosed in the concentrator building which will control dust emissions. The flotation circuit following the SAG mill will consist of a primary ball mill and flotation circuits followed by thickeners. Figure 2-6 shows the locations of the modeled sources at the WPS, and an overview of the sources' characterizations for modeling is provided in Section 3.1.8.

A small filter plant will be located at the WPS for the purpose of filtering and drying molybdenum concentrate. The molybdenum concentrate will be pumped to additional processing to remove the majority of the liquid before entering a dryer. The dried molybdenum concentrate will be packaged and shipped offsite. Particulate emissions from concentrate handling will be controlled by an enclosure of the concentrator building. Sulfur dioxide (SO_2) emissions from the processing of molybdenum concentrate will be controlled by a gas quencher and packed bed scrubber.

Once the molybdenum concentrate is filtered out, the copper concentrate will be removed and the remaining material will be tailings. The copper concentrate, in a slurry form, will be pumped via an approximately 20-mile-long pipeline along the MARRCO Corridor to the FP&LF near Magma. Sandy slurry containing tailings material will be transferred through an approximately 6-mile-long pipeline along the Tailings Corridor to the TSF.

The WPS will include an area south of the mill site that will be dedicated to a variety of support and ancillary activities, including: development rock stockpiles, laydown yards, contact water ponds, administration buildings, and warehouses. Emissions associated with the activity in this area will be due to mobile fleet travel, grading of maintained areas, and wind erosion.

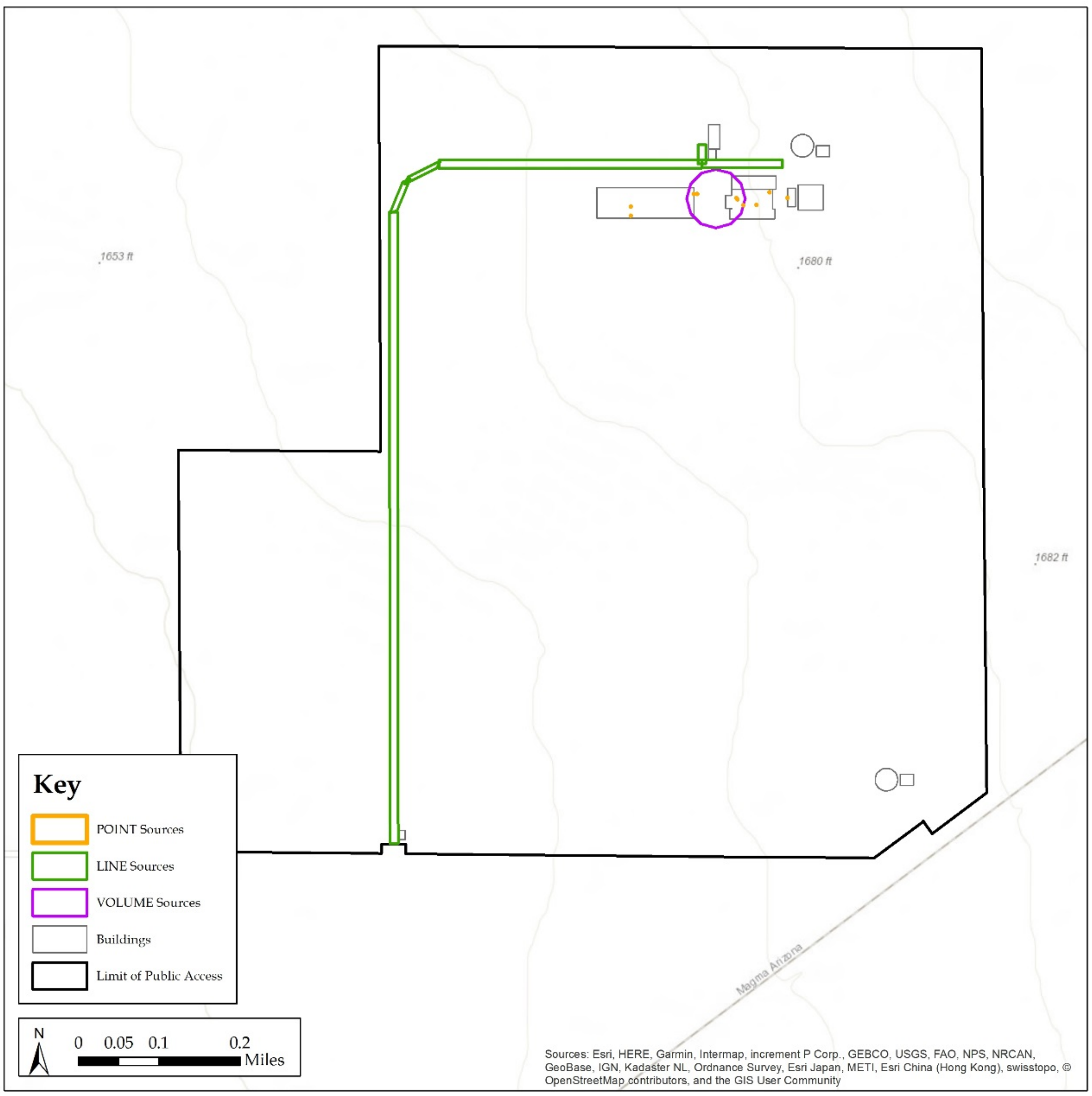
Figure 2-6. WPS Modeled Source Locations



2.5.4 FP&LF

The liquid concentrate slurry arriving at the FP&LF will be pumped to a series of filters to remove the majority of the liquid. Following filtering, the copper concentrate will be loaded onto a series of conveyors to the dry copper concentrate storage and loadout shed. A front-end loader will transfer the copper concentrate from the storage shed into hoppers that feed rail cars to ship the dried copper concentrate offsite. Particulate emissions from concentrate handling will be enclosed in the loadout building and storage shed to minimize emissions. A small amount of fugitive particulate emissions will be generated by light duty traffic and wind erosion from the on-site access road (represented as a LINE source in the model. For all alternatives except Alternative 4 – Silver King Filtered, the FP&LF will be located 7 miles northeast of Magma and adjacent to the MARRCO corridor. For Alternative 4, the FP&LF will be located within the footprint of the WPS. Applicable to either FP&LF location, Figure 2-7 shows the locations of the modeled sources at the FP&LF, and an overview of the sources' characterizations for modeling is provided in Section 3.1.8.

Figure 2-7. Filter Plant & Load-out Facility (FP&LF) Modeled Source Locations



2.5.5 TSF

The TSF will receive tailings slurry from the concentrator at the WPS. A series of piping and valves will control the location of tailings placement. Over time, the TSF will form a beach area, mainly at the perimeter. Wind erosion emissions from the beach area and other un-reclaimed areas on the surface of the TSF dam will be controlled by deposition as a slurry and with sprinklers. The tailings dam will be constructed as needed. Figure 2-8 through Figure 2-12 show the locations of modeled sources at the preferred (Figure 2-8) and alternative sites being considered for the TSF, and an overview of the sources' characterizations for modeling is provided in Section 3.1.8..

2.5.6 Emergency Equipment

Fourteen diesel-fired emergency generators, rated at 3,263 kilowatts each, will be installed to provide power to the EPS in the event of emergency situations. These generators will power critical systems (ventilation, personnel transport, etc.). Additional diesel-fired emergency generators rated at 500 kilowatts each will be located at other process areas. Three generators located at the WPS, one generator at the TSF, and one generator located at the FP&LF will be used to provide power to critical operations in emergency situations.

Figure 2-8. Alternative 2 (Modified Proposed Action) Near West TSF Modeled Source Locations

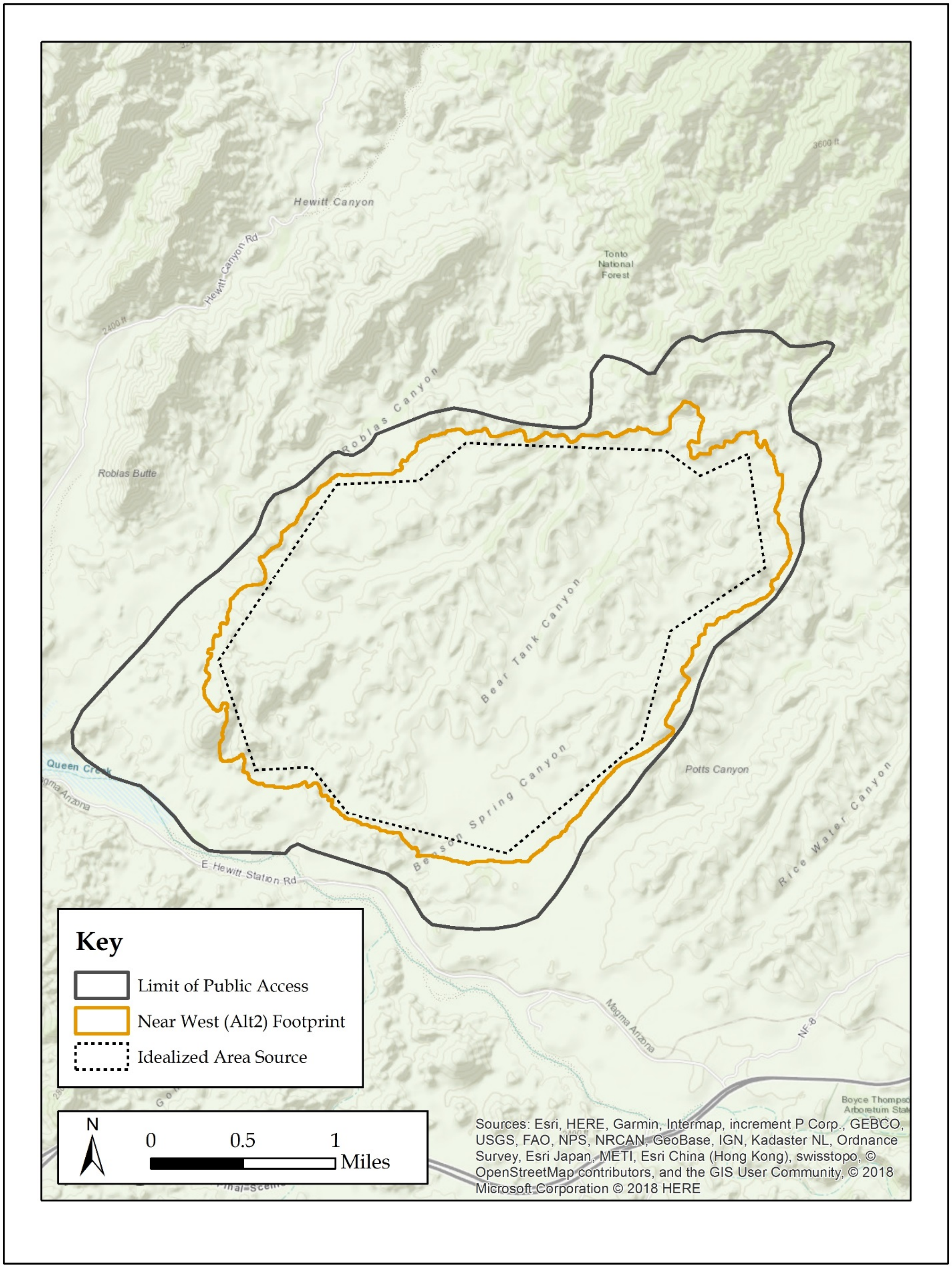


Figure 2-9. Alternative 3 Near West TSF Modeled Source Locations

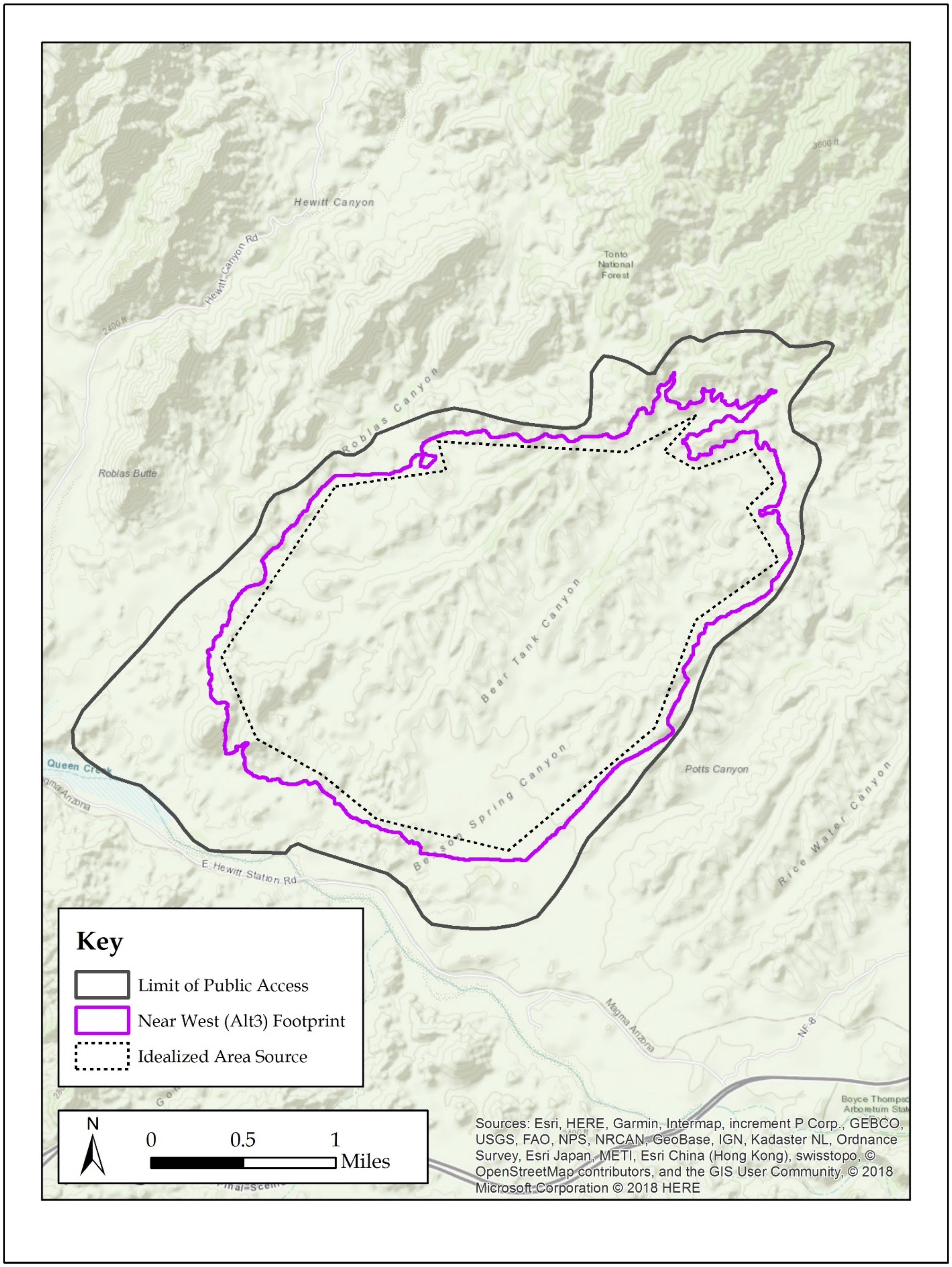


Figure 2-10. Alternative 4 Silver King Filtered TSF Modeled Source Locations

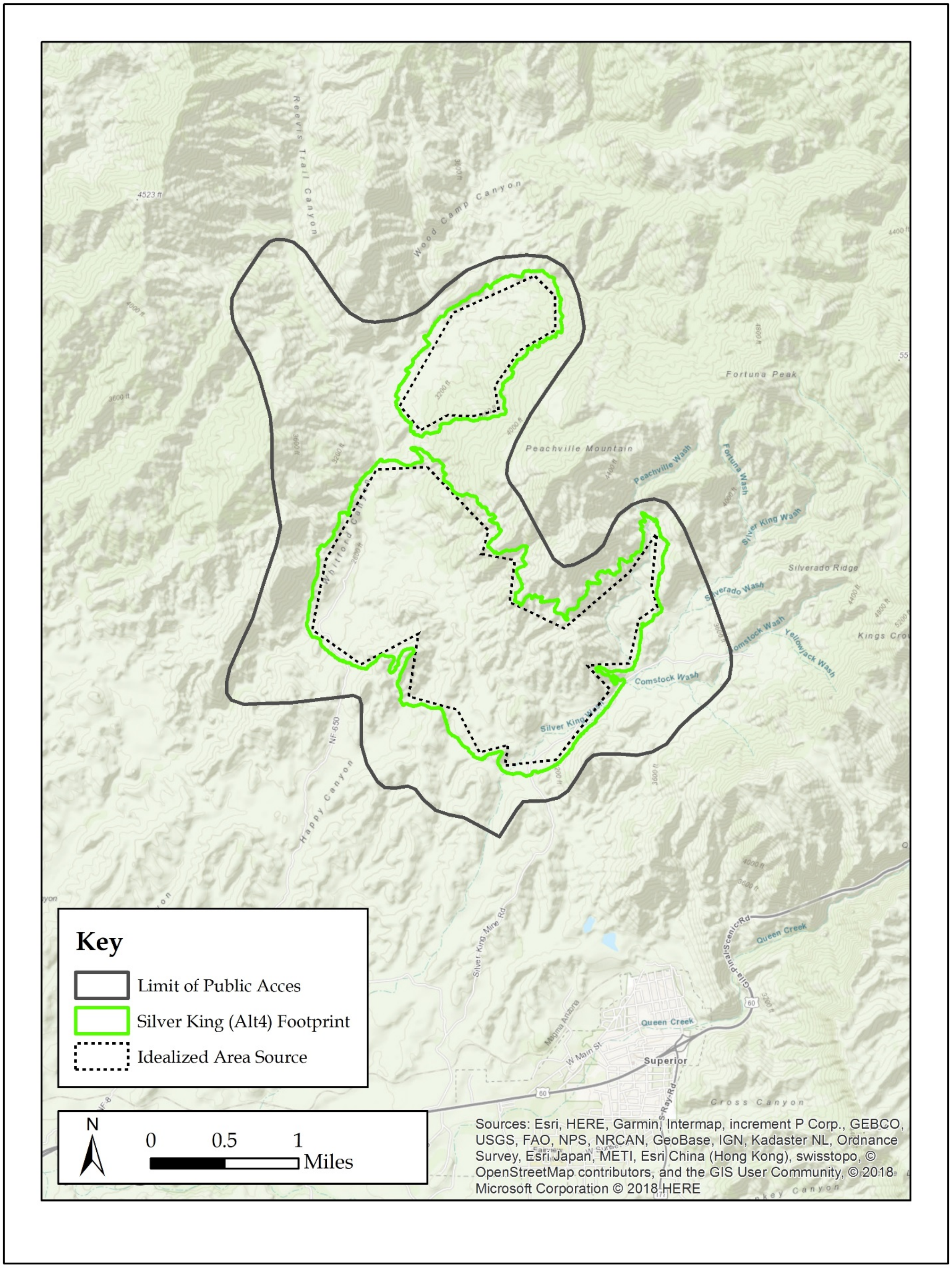


Figure 2-11. Alternative 5 Peg Leg TSF Modeled Source Locations

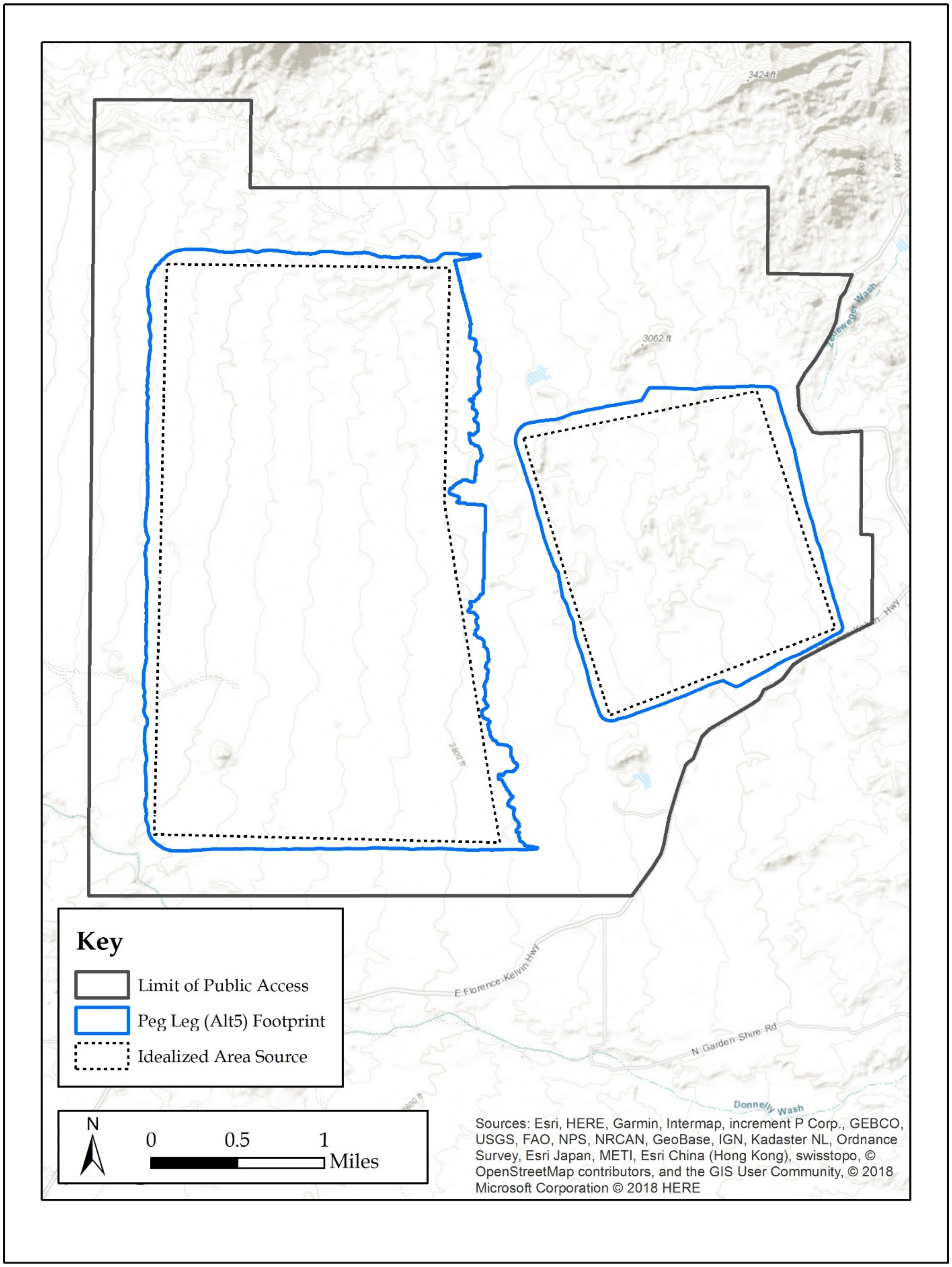
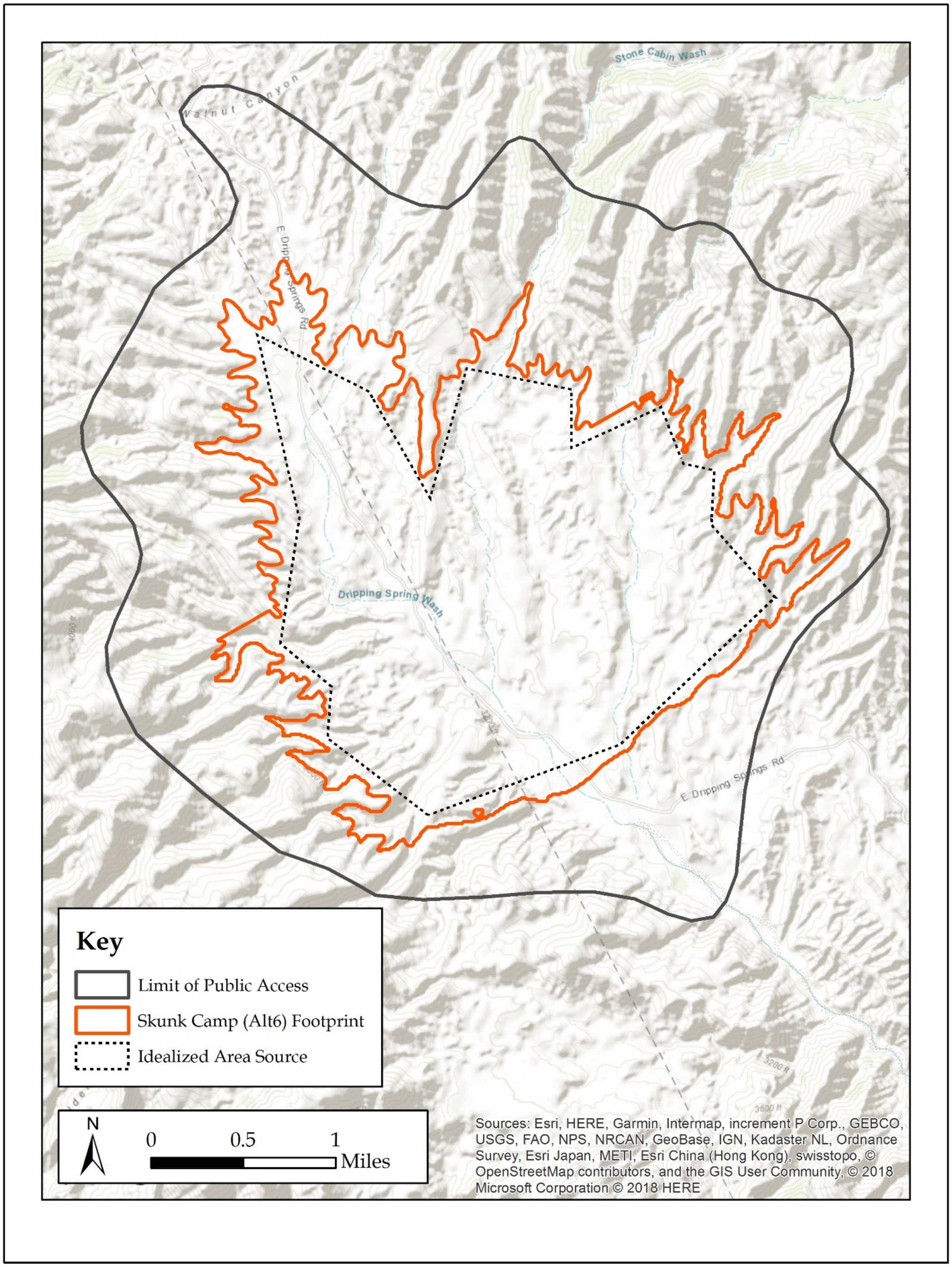


Figure 2-12. Alternative 6 Skunk Camp TSF Modeled Source Locations



2.6 Annual Emission Estimates

Emissions due to underground sources at the EPS will include: dust emissions[8] from underground mining activities (drilling, blasting, material handling and transfers, and crushing) and combustion emissions[9] from blasting, operation of underground mining, and transport equipment. Emissions from underground sources will exit the underground workings via the mine ventilation system near the surface activities at the EPS. Emissions from surface activities at the EPS include light vehicle travel, backup power generation, and wind-blown dust from disturbed surfaces. Sources of particulate emissions from ore preparation activities at the WPS will include ore and reagent handling. Sources of combustion emissions will be limited to fuel and freight transportation and light vehicle travel. The maximum potential Project total annual emissions in short tons per year (ton/yr) are provided in Table 2-4.

Table 2-4. Resolution Project Maximum Potential Emissions Summary (ton/yr)

Project Facility	Emissions Type	CO	NO_X	$PM_{2.5}$	PM_{10}	SO_2	VOC
EPS	Process	8.1	33.5	21.3	31.1	0.2	3.3
	Fugitive	26.7	5.1	9.9	47.5	1.6	0.0
	Mobile (Combustion)	170.0	17.7	0.8	0.5	0.2	8.3
	Subtotal	204.8	56.2	32.0	79.1	2.0	11.7
WPS	Process	10.6	10.8	7.6	17.1	14.8	66.0
	Fugitive	2.1	0.4	3.1	19.2	0.1	0.0
	Mobile (Combustion)	30.6	4.6	0.2	0.2	0.1	2.9
	Subtotal	43.3	15.8	10.9	36.4	15.0	68.9
Loadout	Process	1.0	0.1	0.2	1.4	0.0	0.0
	Fugitive	--	--	0.1	1.0	--	0.0
	Mobile (Combustion)	24.4	5.6	0.2	0.2	0.1	1.5
	Subtotal	25.3	5.7	0.5	2.5	0.06	1.5
TSF	Process	1.0	0.1	0.0	0.0	0.0	0.0
	Fugitive	--	--	32.3	208.8	--	0.1
	Mobile (Combustion)	341.6	40.6	2.0	2.0	0.7	20.5
	Subtotal	342.5	40.7	34.3	210.8	0.7	20.6
Facility Wide	Process	20.6	44.4	29.2	49.5	15.0	69.3
	Fugitive	28.8	5.5	45.4	276.4	1.8	0.2
	Mobile (Combustion)	566.5	68.5	3.2	2.9	1.0	33.2
	Total	615.9	118.4	77.8	328.9	17.8	102.7

The emissions provided in Table 2-4 are the maximum expected potential emissions from the Resolution Project. The emissions shown in this table represent the maximum mining activity (fugitive and mobile machinery) expected to occur during the life-of-mine (LOM) year 14 and process sources operating at maximum design capacity. However, the blasting activity will

[8] PM, $PM_{2.5}$, and PM_{10}

[9] $PM_{2.5}$, PM_{10}, Carbon Monoxide (CO), Oxides of Nitrogen (NO_X), Sulfur Dioxide (SO_2), Volatile Organic Compounds (VOC), and greenhouse gases

wane by LOM year 14. Further, the maximum area susceptible to wind erosion at the TSF is expected to occur during LOM year 41. Therefore, to be comprehensive and conservative, the peak blasting activity that will occur during development and the maximum estimated wind erosion emissions anticipated for the TSF have been combined with LOM year 14 and used in this analysis as a conservative approach. A detailed emissions inventory for the Resolution Project is provided in Appendix A.

In addition to the criteria pollutant emissions discussed in this section, there will be small amounts of Hazardous Air Pollutants (HAPs) emitted from the proposed Resolution Project sources. The estimated potential HAP emissions from the Project are less than the Maximum Achievable Control Technology (MACT) thresholds of 10 ton/yr of a single HAP or 25 ton/yr of combined HAPs. Therefore, the Resolution Project will be classified as an area (or minor) source and will not be subject to MACT review required by 40 CFR 63. The HAP emissions inventory and calculations are also provided in Appendix A.

2.7 Regulatory Basis

The Resolution Project is located in the Central Arizona Intrastate (CAI) Air Quality Control Region (AQCR). The current attainment status of the CAI AQCR and location of Resolution Project facilities are presented in Figure 2-13. This figure shows that the EPS will be partially located in the Hayden PM_{10} Nonattainment area. The FP&LF will be located in the West Pinal PM_{10} Nonattainment area. All remaining facilities will be located in areas that are unclassifiable or in attainment for all criteria pollutants. All facilities are located outside of EPA's recently determined nonattainment area (also shown in Figure 2-13) for the 2015 8-hour ozone NAAQS. Table 2-5 compares the facility-wide[10] process emissions[11] to the major source thresholds. Since some of the sources will be located in moderate PM_{10} nonattainment areas, a 100 ton/yr major source threshold is used for PM_{10}. For all other air pollutants, the Prevention of Significant Deterioration (PSD) major source threshold of 250 ton/yr is used.

Table 2-5. Resolution Project Major Source Status Determination

Parameter	CO	NO_X	$PM_{2.5}$	PM_{10}	SO_2	VOC
Process Source Emissions (ton/yr)	20.6	44.4	30.7	80.8	15.0	69.3
PSD/NSR Major Source Threshold (ton/yr)	250	250	250	100	250	250
PSD/NSR Review Triggered	No	No	No	No	No	No

PSD = Prevention of Significant Deterioration; NSR = New Source Review

This table shows that the Resolution Project's potential process source emissions are less than the applicable major source thresholds; therefore, it is not a major source, and the air quality analysis follows the guidelines for non-major (minor) sources set forth in ADEQ 2015a.

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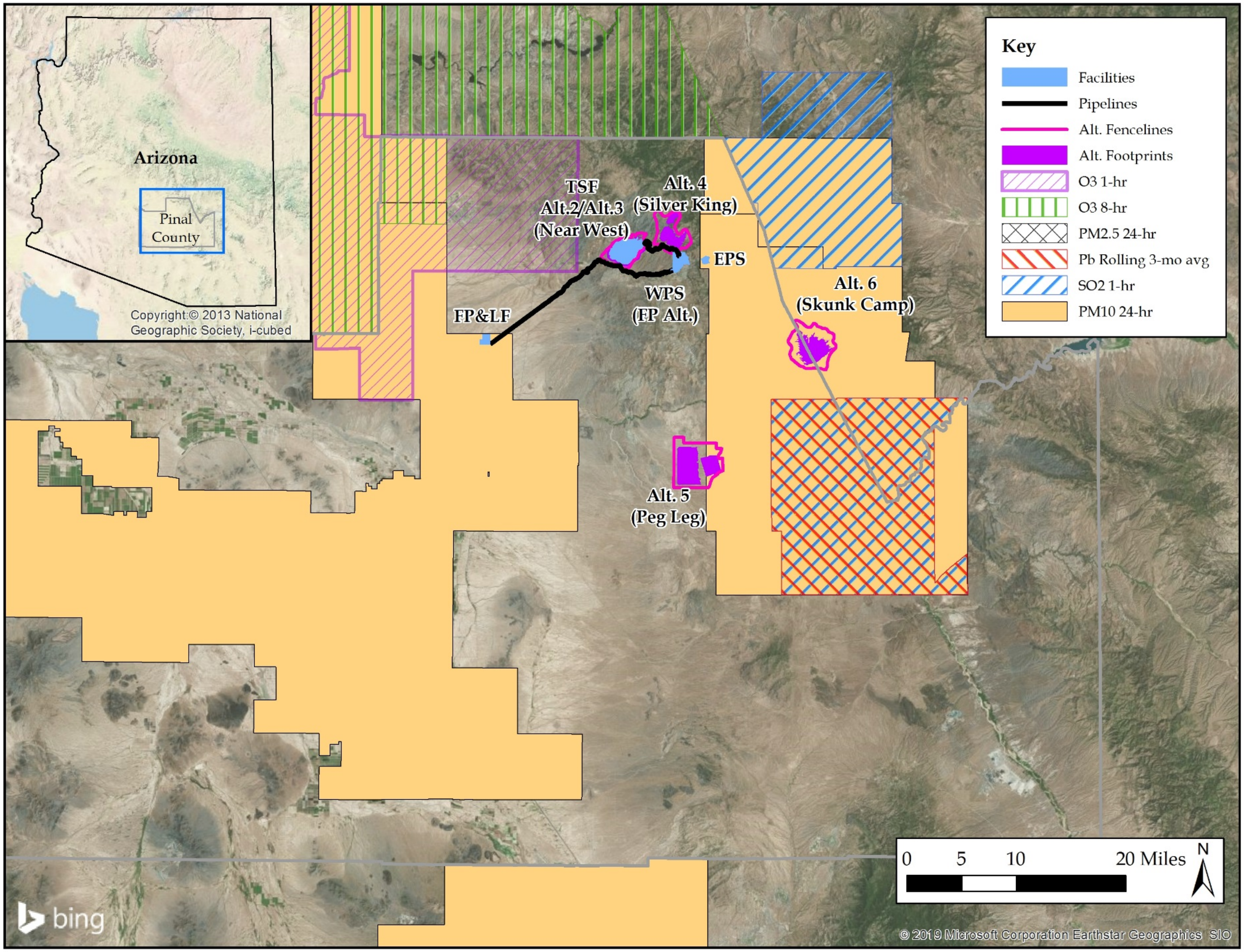
[10] While the various operational areas (EPS, WPS, TSF, and FP&LF) constitute separate sources, for purposes of this comparison, their emissions are combined.

[11] For purposes of this comparison, all process emissions are assumed to be "point" source emissions. Fugitive and tailpipe/non-road emissions are not included for major source determination per 40 CFR 52.21(b)(1)(iii) (PSD) and 40 CFR 21.165(a)(1)(iv)(C) (major nonattainment NSR). Additionally, the inherent mine features particulate control efficiencies in Table 2-3 are not applied to the underground emissions for regulatory applicability purposes.

Figure 2-13. CAI AQCR Attainment Status and GPA Location



Based on the permit application requirements provided in Chapter 3 of PCAQCD Code of Regulations (CR) and ADEQ 2015a, a separate air quality modeling analysis, consistent with the analysis described in this Modeling Report, will be prepared and submitted to PCAQCD to support the air permitting for the project by demonstrating compliance with the applicable PCAQCD (Chapter 2 of PCAQCD CR) and national (40 CFR 50) AAQS provided in Table 2-6, in units of micrograms per cubic meter (µg/m^3) and/or parts per million (ppm). If a PCAQCD standard differs from the corresponding national standard, only the more stringent standard is provided in this table and used for compliance demonstration.

Table 2-6. AAQS for Compliance Demonstration

Pollutant	Averaging Period	AAQS (ppm)	AAQS (µg/m^3)	AAQS Form
CO	8-Hour	9	10,000	Not to be exceeded more than once per year
	1-Hour	35	40,000	
Nitrogen Dioxide (NO_2)	Annual	0.053	100	Annual mean
	1-Hour	0.1	188	98th percentile, averaged over 3 years
Ozone	8-hour(1)	0.070	--	Fourth-highest daily maximum, averaged across 3 consecutive years
$PM_{2.5}$	Annual (2)	--	12	Annual mean, averaged over 3 years
	24-Hour (3)	--	35	98th percentile, averaged over 3 years/second-high
PM_{10}	Annual (4)	--	50	Annual mean
	24-Hour	--	150	Not to be exceeded more than once per year on average over 3 years
SO_2	Annual (4)	0.03	80	Annual mean
	24-Hour (4)	0.14	365	Not to be exceeded more than once per year
	3-Hour (5)	0.5	1,300	Not to be exceeded more than once per year
	1-Hour	0.075	196	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
Lead	Rolling 3-Month (1)	--	0.15	Not to be exceeded

(1) PCAQCD standard is 0.080 ppm.

(2) PCAQCD standard is 15 µg/m^3.

(3) PCAQCD standard is 65 µg/m^3.

(4) PCAQCD standard only, no national standard.

(5) Secondary standard only, no primary standard.

Lead emissions at the Resolution Project are well below the significant increase thresholds defined in 40 CFR 52.21. Therefore, lead is not addressed further.

The Project will emit precursor emissions that can cause secondary formation of ozone (O_3) and $PM_{2.5}$. Unlike the other criteria pollutants that are directly emitted from sources, O_3 and secondary $PM_{2.5}$ are not directly emitted from emission sources. Rather, they are formed through a series of physical and/or photochemical reactions involving SO_2 and NO_x (precursor emissions for secondary $PM_{2.5}$) and VOC and NO_X (precursor emissions for O_3) in the atmosphere on a regional scale. Because of this, ADEQ modeling guidelines assert that, "*Modeling involving pollutant transformations (i.e. ozone, sulfates, etc.) is not generally required for new or modified sources and is not addressed in this guidance document*" (ADEQ 2015a). Section 3.1.13 Secondary $PM_{2.5}$ and O_3 Formation describes the non-modeling approach, consistent with federal guidance, that was used to characterize the Project's expected contribution to ambient ozone concentrations and secondary $PM_{2.5}$ formation in the Project area.

2.8 Baseline Conditions

Resolution Copper has been monitoring and collecting ambient meteorological and air quality data since April 2012 at the EPS and WPS to establish baseline conditions for the air quality analysis. Table 2-7 lists the parameters and locations of the meteorological, upper air wind, and ambient air data that are collected in the GPA.

Table 2-7. Meteorological and Ambient Air Data Collected in the GPA

		Height (m)	East Plant	West Plant	Hewitt
AERMOD Meteorological Data	Horizontal wind speed (meters per second [m/s])	20			✓
	Horizontal wind direction (degrees [°])	20			✓
	Horizontal wind direction standard deviation (sigma theta)	20			✓
	Horizontal wind speed (meters per second [m/s])	10	✓	✓	✓
	Horizontal wind direction (degrees [°])	10	✓	✓	✓
	Horizontal wind direction standard deviation (sigma theta)	10	✓	✓	✓
	Air temperature (degrees Celsius [°C])	2	✓	✓	✓
	Vertical temperature difference (ΔT, Delta T, [°C])	2,10	✓	✓	✓
	Relative humidity (percent [%])	2	✓	✓	✓
	Solar radiation (watts per square meter [W/m^2])	2	✓	✓	✓
	Barometric pressure (millimeters of mercury [mmHg])	1	✓	✓	✓
	Precipitation (inches [in])	Ground	✓	✓	
Upper -Air	Wind speed by vector component (u,v,w; [m/s]))	Variable			✓
	Wind direction by sub-hourly scalar mean (degrees [°])	Variable			✓
	Standard deviation of vector component (u, v, w)	Variable			✓
Ambient Air Data	FEM* Particulate matter less than 10 microns (PM_{10})	2,3	✓	✓	
	FEM* Particulate matter less than 2.5 microns ($PM_{2.5}$)	2,3	✓	✓	
	Sulfur dioxide (SO_2)	3	✓		
	Ozone (O_3)	3	✓		
	Nitrogen dioxide (NO_2)	3	✓		

*Federal Equivalent Method

Resolution Copper's meteorological and air quality data program is described in detail in the Resolution Copper Meteorological and Air Quality Monitoring Plan ("Monitoring Plan") prepared in consultation with PCAQCD and approved by PCAQCD on November 15, 2011 and July 20, 2016. The monitoring methods and procedures described in the Monitoring Plan were designed to meet the quality system requirements in 40 CR Part 58, Appendix A. Quarterly summaries and data files of these monitoring data are submitted to PCAQCD.

In 2015, Resolution Copper began meteorological monitoring, including surface and boundary layer (Sonic Detection and Ranging [SoDAR]) observations at the Hewitt station, located near the base of the site of the Near West TSF. Data from the Hewitt station have been used for modeling of particulate emissions from the TSF. Quarterly data summaries and data files for the Hewitt station data have been provided to PCAQCD.

The quality control procedures for metrological ambient air data include weekly site checks, as well as quarterly sampler audits and calibrations. Multi-point calibrations of the NO_X, SO_2, and O_3 analyzers occurred upon installation and are now conducted biannually and in the event of malfunction, equipment relocation, or audit failures. Multi-point calibrations are used to assess the linearity of the analyzers. Multi-point audits of the NO_X, SO_2, and O_3 analyzers are conducted quarterly or as needed. Multi-point audits are used to assess the data accuracy and analyzer performance using certified, traceable standards different than those used for quality control calibration operations. Flow audits are performed on the PM_{10} and $PM_{2.5}$ samplers on a monthly basis.

The ambient air monitoring sites were primarily selected due to the representativeness of the locations and areas of potential emission sources at the Project as well as the distance from large terrain features. Criterion of secondary importance included the availability of line power and cellular communications. The site selection followed the EPA siting requirements outlined in 40 CFR Part 58, Appendix E and were approved by PCAQCD.

Data summaries for the EPS and WPS meteorological data are provided in Section 3.1.6, and pollutant- and averaging-period-specific baseline air quality data are discussed in Section 3.1.7.

3.0 AIR QUALITY ANALYSES

This section describes the modeling methods, procedures, and datasets that were used for the Resolution Copper air quality analyses to support TNF in its preparation of the EIS. The methods, procedures, and datasets described herein were utilized to prepare air quality analyses for the following scenarios:

- Proposed Action – Operations (TSF Alternative 2 – Near West; FP&LF near Magma Junction)
- Alternatives - Operations
    - FP&LF located within the footprint of West Plant (with TSF Alternative 4)
    - TSF Alternatives:
        - Alternative 3 – Modified Proposed Action – Near West
        - Alternative 4 – Silver King Filtered
        - Alternative 5 – Peg Leg
        - Alternative 6 – Skunk Camp
- Proposed Action – Construction (TSF Alternative 2 – Near West; FP&LF near Magma Junction).

3.1 Ambient Air Quality Analysis

3.1.1 Model Selection

The 18081 version of the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) modeling system was used for this air quality analysis. AERMOD is an enhanced steady-state, Gaussian plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources and both simple and complex terrain (EPA 2004). The AERMOD modeling system is listed as the recommended model for short-range (near-field) analyses (up to 50 km) in 40 CFR 51, Appendix W.

3.1.2 Pollutants and Averaging Periods

The air quality analysis includes dispersion modeling for the pollutants and averaging periods presented in Table 3-1. This table also shows the short-term (up to 24-hour) modeled design values that were used for compliance demonstration.

Table 3-1. Pollutants and Averaging Periods

Pollutant	Averaging Period	Compliance Design Value
CO	8-Hour	2nd High
	1-Hour	
NO_2	Annual	
	1-Hour	8th High (98th percentile, averaged over 3 years)
$PM_{2.5}$	Annual	
	24-Hour	8th High (98th percentile, averaged over 3 years)
PM_{10}	Annual	
	24-Hour	Not to be exceeded more than once per year on average over 3 years
SO_2	Annual	
	24-Hour	2nd High
	3-Hour	2nd High
	1-Hour	4th High (99th percentile, averaged over 3 years)

3.1.3 Building Downwash

The effects of the building-induced downwash were incorporated into this analysis. The building downwash parameters were calculated using version 04274 of the Building Profile Input Program with the Plume Rise Model Enhancement (BPIP-PRIME). Planned building locations and dimensions were acquired from Resolution Copper.

3.1.4 Ambient Air Boundary

To demonstrate compliance with federal and state ambient air standards, air dispersion models are used to simulate the atmospheric dispersion of an air pollutant to determine air pollution concentrations that result from a source's emissions. As part of the modeling setup process, Resolution Copper, in consultation with PCAQCD[12] has determined ambient air boundaries (AAB) that delineate where public access is effectively precluded. The air quality modeling includes receptors along Resolution's AAB and receptor grids outside the AAB.

Pursuant to EPA guidance, and consistent with ADEQ 2015a, Section 3.4, the effective AAB can consist of a combination of fences and gates, physical barriers (including natural barriers), warning signage, manned guard shacks, and periodic security patrols. Each project area may use a combination of the following measures to preclude public access:

[12] The "Air Quality Impacts Analysis Modeling Plan for Permitting," approved by PCAQCD, includes the determination of ambient air boundaries for the Project.

- Fencing, berms, and locking gates – Fencing and locking gates will be used along public access roads and other locations near areas of heavy recreational use.

- Signage – Warning and/or no-trespassing signage will be posted on fences and near areas of natural barriers, trails, and recreation.

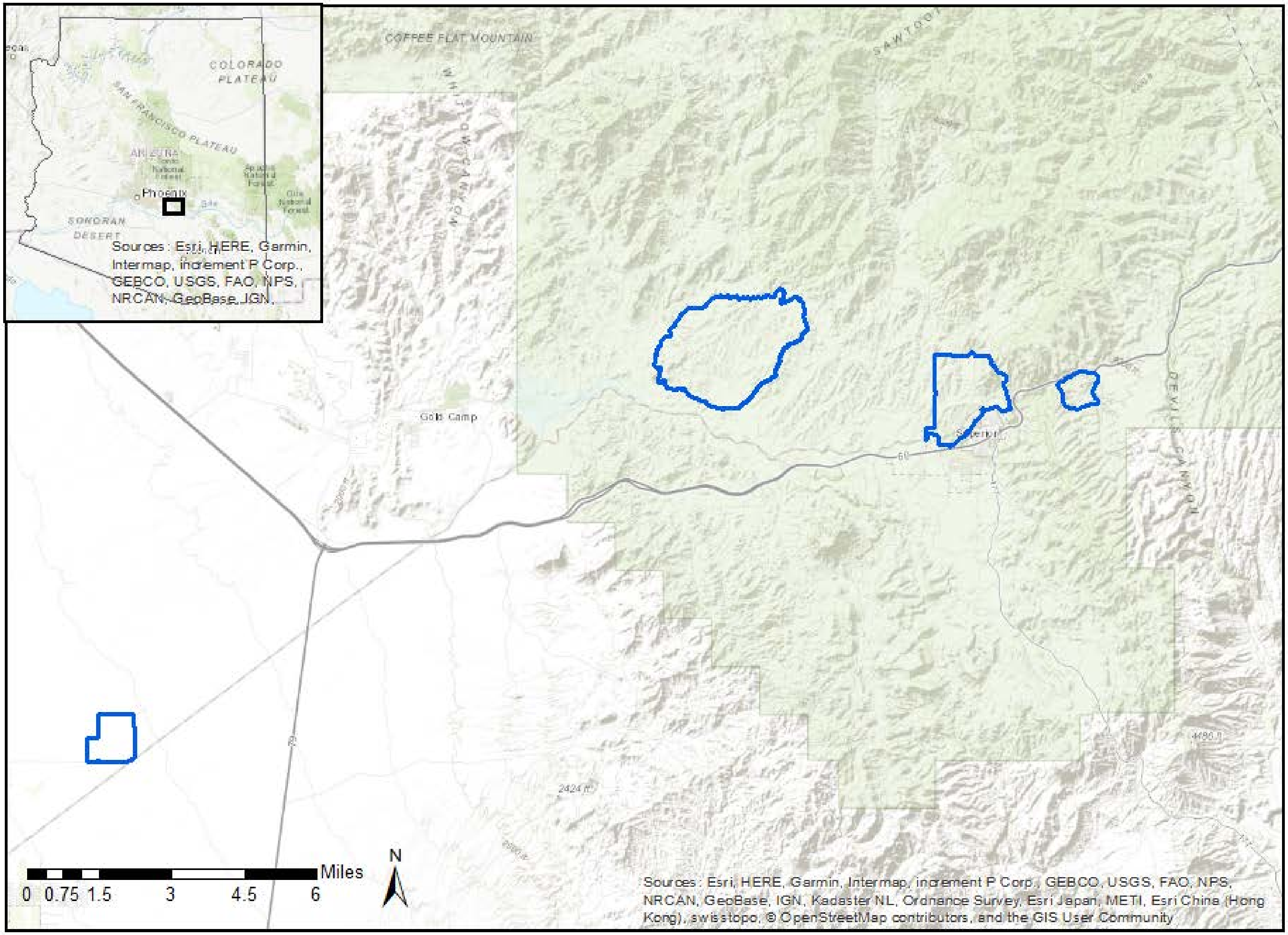
- Natural barrier/steep terrain – Steep slopes around the project areas will serve as natural barriers or impediments to site access. In general, steep terrain is considered to be terrain with a grade of 25 to 30 percent or greater.

- Periodic patrols – Mine security will routinely patrol the mine facilities and roads for unauthorized individuals. In addition, all onsite personnel will be briefed on the necessity of restricting public access to areas within the AAB. Any suspected trespassing will be immediately reported to security.

- Site security – Authorized access will be controlled by guard shacks, where a check-in/check-out system will be implemented. All mine personnel and visitors must gain access to the site through one of these points.

The AAB for the Proposed Action are shown in Figure 3-1. The ambient air boundaries for the alternative TSF locations are the limit of public access shown in Figure 2-2.

Figure 3-1. Ambient Air Boundaries and Preclusion of Public Access (Proposed Action)



3.1.5 Modeling Receptors

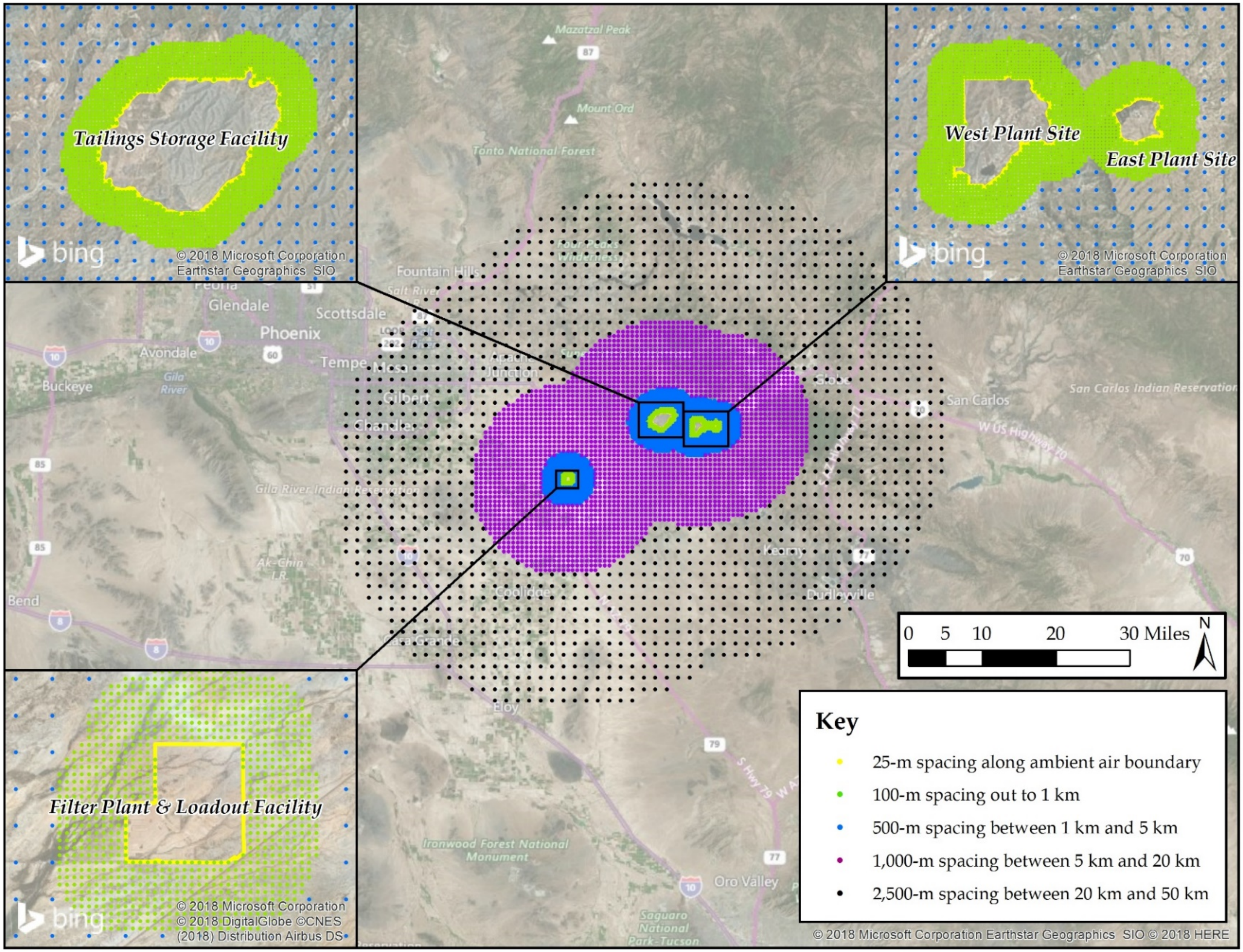
A series of nested receptor grids were used for this analysis to estimate ambient pollutant concentrations resulting from the potential emissions. The following receptor spacing and extents around each facility, in accordance with ADEQ 2015a, Section 3.6, were used for this analysis:

- 25-meter (m) spacing along the AAB
- 100-m spacing out to 1 km from the AAB
- 500-m spacing between 1 km and 5 km from the AAB
- 1,000-m spacing between 5 km and 20 km from the AAB
- 2,500-m spacing between 20 km and 50 km from the AAB
- Additional receptors of interest, as appropriate, on the boundaries or within the Class I SWA, the WC ACEC, and Class II NEWA (for near-field evaluation of impacts to AQRVs only)

The 18081 version of the AERMOD terrain preprocessor, AERMAP, was used to develop the receptor elevations and hill heights. A 1/3 arc-sec (10-m) resolution United States Geological Survey (USGS) National Elevation Dataset (NED) file was used for this processing.

The AERMOD receptor network is presented in Figure 3-2. Receptor networks surrounding the alternative TSF facilities were developed per the receptor spacing and extents listed above. The alternative receptor grids started with the preferred alternative grid and were modified as follows. A 25-meter spacing along the tailings footprint was added, any grid receptors that fell within this boundary were removed, and for alternatives not located at the Near West site, a 100-m spacing fill grid covering the Near West footprint was added. For the filter plant alternative location at West Plant (Alternative 4), a 100-m spacing fill grid for the far west site was also added.

Figure 3-2. AERMOD Receptor Network



3.1.6 Meteorological Data

AERMOD requires an input of hourly meteorological data to estimate pollutant concentrations in ambient air resulting from modeled source emissions. The EPA's Guideline on Air Quality Models states that "*5 years of NWS meteorological data or at least l year of site specific data is required*" for an air quality modeling analysis (40 CFR 51, Appendix W, 8.3.1.2 b.).

The 16216 version of the AERMOD meteorological preprocessor (AERMET) was used to generate AERMOD-input-ready hourly meteorological files for this analysis. Each of the site-specific datasets (detailed below) was supplemented with cloud cover data from a representative National Weather Service (NWS) station (e.g., Phoenix-Mesa located approximately 35 miles west of the GPA) and twice-daily upper-air data from the Tucson NWS station, located approximately 75 miles south of the GPA.

3.1.6.1 Surface Meteorological Datasets

For this analysis, Resolution Copper used two years of site-specific hourly surface meteorological data collected at the EPS, WPS, and Hewitt monitoring stations from January 1, 2015, through December 31, 2016. These monitoring stations were sited and have been operated per the Resolution Copper Mining Monitoring Plan that has been prepared according to applicable ADEQ and EPA guidance and submitted to, reviewed, and approved by PCAQCD. The EPS sources were modeled using the EPS meteorological data (tower sensors mounted at 10-meter height), the tailings facilities (the Proposed Action and alternatives) were modeled using the Hewitt meteorological data (SoDAR data collected at 10-meter increments from 20 meters to 190 meters),[13] and West Plant, the FP&LF, and MARRCO Corridor were modeled using the WPS meteorological data (tower sensors mounted at 10-meter height).

The Hewitt meteorological dataset was used to model the tailings activity impacts for the proposed action and each of the alternatives. By modeling the Hewitt meteorological dataset for all alternatives with the tailings site emissions, direct comparisons can be made between the alternatives' impacts and wind erosion emissions. Further, the vertical wind profile data from the SoDAR was processed with AERMET into a profile file used by AERMOD to determine the wind speed and direction for a variety of altitudes.

The locations of the onsite monitoring and associated NWS stations in relation to the Resolution Project facilities are provided in Figure 3-3. The wind frequency distribution diagrams for the onsite monitoring stations are presented in Figure 3-4.

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[13] In the absence of valid SoDAR data for any given hour(s) in the 2-year meteorological dataset, the 20-meter Hewitt tower wind speed and direction data was substituted.

Figure 3-3. Location of Monitoring Stations

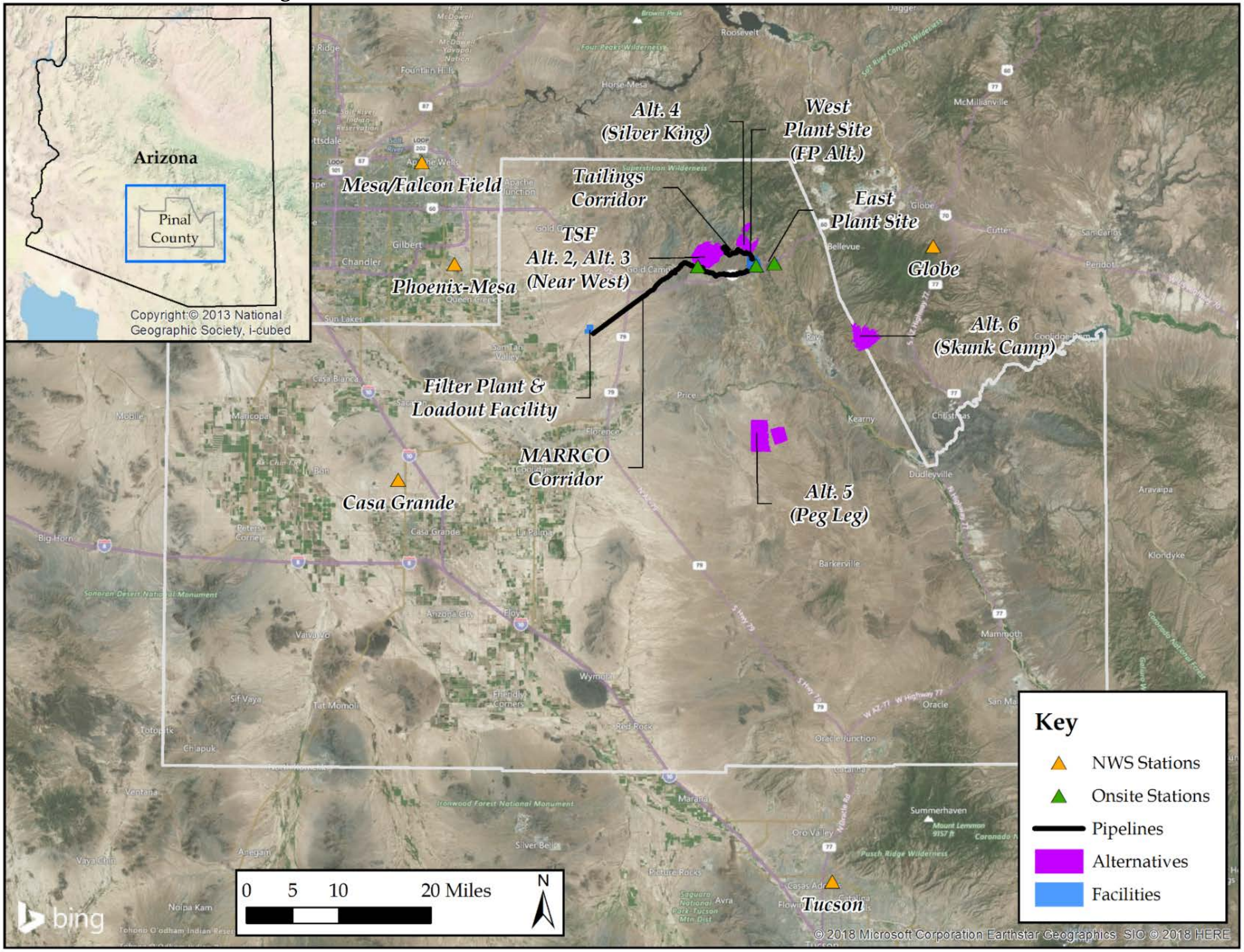
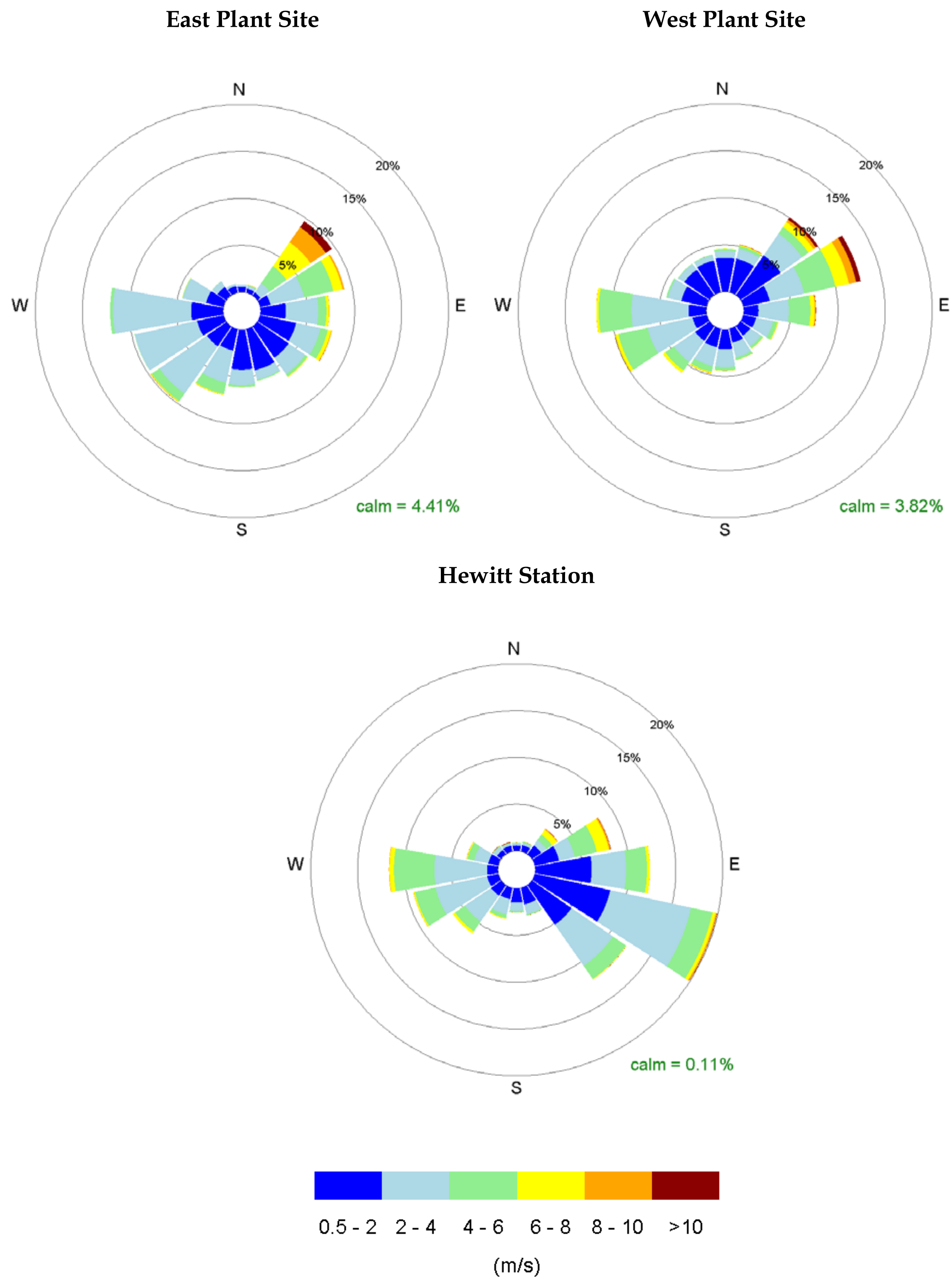


Figure 3-4. Wind Frequency Distribution for Resolution Monitoring Stations, 2015-2016



3.1.6.2 Adjusted Friction Velocity Calculation Method

EPA integrated adjusted friction velocity (ADJ_U*) as a regulatory default option in the AERMET (beginning in version 16216) meteorological processor for AERMOD to address issues with model overprediction of ambient concentrations associated with the underprediction of the surface friction velocity (u*) during light wind and stable wind conditions. ADJ_U* is a processing option that affects the meteorology for low wind speeds during stable (nighttime) conditions (EPA 2014a). Based on a series of model evaluation studies, the ADJ_U* option improves model performance for low release height sources whose impacts occur under low wind speed conditions (EPA 2017).

PCAQCD has approved the application of the ADJ_U* method for the Resolution Project AERMOD modeling analysis as the terrain, meteorological, and emission characteristics meet the criteria under which the default option in AERMOD (i.e., no low wind speed correction) is known to overpredict ambient concentrations. The ADJ_U* method is intended to significantly improve AERMOD's performance for sites and sources similar to the Resolution Project, where emissions are released at low heights (typical of mining sources), low wind speeds are present for significant periods (as indicated in the wind roses presented in Figure 3-4, and the project is located in a region with complex terrain.

In the 2017 Revisions to Appendix W to CFR 40 Part 51 and AERMOD version 16216r, the EPA adopted the ADJ_U* method as a regulatory default option. The EPA has stated that AERMOD may possibly underpredict impacts when the ADJ_U* option is combined with site-specific turbulence data. Therefore, the EPA adopted ADJ_U* as a default option only when used without turbulence data (EPA 2017).

Considering the poor performance of the non-ADJ_U* method for low release height sources and the significant improvement by the ADJ_U* method, Resolution Copper processed the modeling met data with the ADJ_U* option. Additionally, when processing the meteorological data with AERMET and ADJ_U*, Resolution Copper removed site-specific turbulence parameters so that AERMOD could be run in the default mode. This adjustment to the processed meteorological data addressed two important matters to improve the model:

1. AERMOD may be run in the default mode.
2. AERMOD is less likely to underpredict impacts

3.1.6.3 Surface Characteristics for AERMET Processing

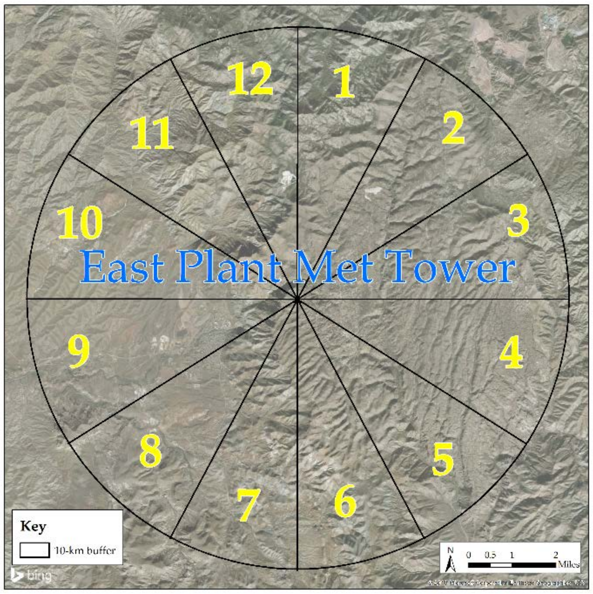
AERMET requires the input of three surface boundary layer parameters: midday Bowen ratio (B_o), midday albedo (r), and surface roughness length (z_o). These parameters are dependent on the land use and vegetative cover of the area being evaluated. The EPA has provided the recommended methods for determining these surface parameters based on 1992 National Land Cover Data (NLCD92) and released an AERMOD land cover preprocessor (AERSURFACE) for this purpose.

The 13016 version of AERSURFACE was used to estimate the surface characteristic parameters for meteorological data processing. AERSURFACE requires the input of land cover data from the USGS NLCD92 archives, which it uses to determine the land cover types for the user-specified location. Each of the land cover categories in the NLCD92 archive is linked within AERSURFACE to a set of seasonal surface characteristics.

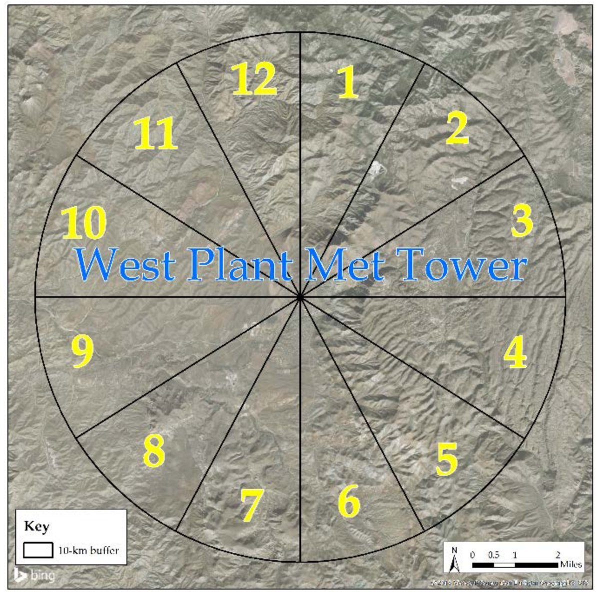
AERSURFACE was run for each onsite meteorological tower location with 12 sectors (in 30-degree increments starting from north). High-resolution aerial photographs showing a 10-km radius and the surface roughness length segments around the three onsite meteorological towers are provided in Figure 3-5 for the three Resolution monitoring stations.

Figure 3-5. Surface Roughness Length Segments – Resolution Monitoring Stations

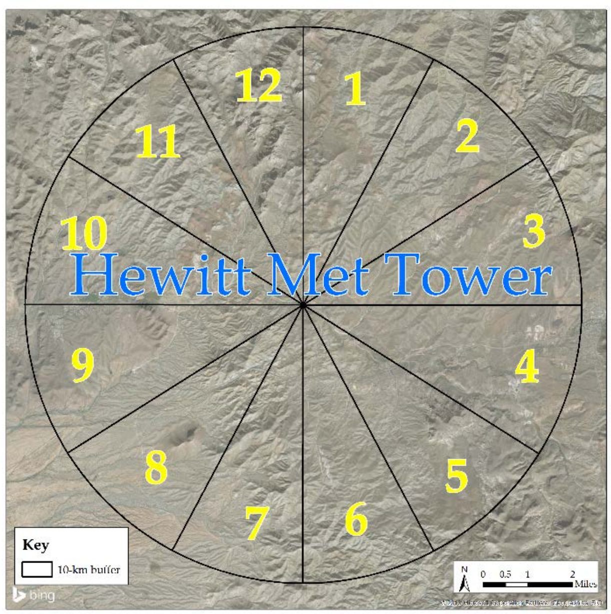
East Plant Site



West Plant Site



Hewitt Station



The determination of B_o is dependent on ambient moisture conditions (i.e., wet, average, or dry). For this purpose, historic 30-year precipitation data from the representative nearby NWS station shown in Table 2-2 are used. The 70th and 30th percentile values estimated from the 30-year precipitation data were used to assign a moisture class to each calendar month per the following scheme: monthly precipitation greater than 70th percentile as wet, between 70th and 30th percentile as average, and less than 30th percentile as dry (EPA 2008, revised 2013). The monthly estimated B_o and the seasonal estimated z_o for the EPS (r = 0.23), WPS (r = 0.24), and Hewitt (r = 0.25) are presented in Table 3-2 to Table 3-7.

Table 3-2. Bowen Ratio (B_o) by Month – EPS

Year	Month	Moisture Class	Bowen Ratio
2015	January	Wet	1.51
2015	February	Dry	7.42
2015	March	Average	4.34
2015	April	Wet	0.84
2015	May	Wet	0.84
2015	June	Wet	0.84
2015	July	Average	2.76
2015	August	Average	2.76
2015	September	Wet	1.13
2015	October	Wet	1.51
2015	November	Wet	1.51
2015	December	Average	4.34
2016	January	Wet	1.51
2016	February	Average	4.34
2016	March	Dry	7.42
2016	April	Average	2.33
2016	May	Wet	0.84
2016	June	Wet	0.84
2016	July	Wet	1.13
2016	August	Dry	4.39
2016	September	Dry	4.39
2016	October	Average	4.34
2016	November	Wet	1.51
2016	December	Wet	1.51

Table 3-3. Surface Roughness Length (z_o) by Sector and Season – EPS

Sector	Winter	Spring	Summer	Fall
1	0.196	0.205	0.209	0.209
2	0.177	0.187	0.191	0.191
3	0.187	0.187	0.188	0.188
4	0.187	0.187	0.187	0.187
5	0.166	0.166	0.166	0.166
6	0.163	0.163	0.163	0.163
7	0.162	0.162	0.162	0.162
8	0.156	0.156	0.156	0.156
9	0.154	0.154	0.154	0.154
10	0.161	0.161	0.161	0.161
11	0.160	0.162	0.163	0.163
12	0.187	0.194	0.197	0.197

Source: USGS NLCD92; AERSURFACE

Table 3-4. Bowen Ratio (B_o) by Month – WPS

Year	Month	Moisture Class	Bowen Ratio
2015	January	Wet	1.68
2015	February	Dry	8.23
2015	March	Average	4.87
2015	April	Wet	0.90
2015	May	Wet	0.90
2015	June	Wet	0.90
2015	July	Average	3.16
2015	August	Average	3.16
2015	September	Wet	1.26
2015	October	Wet	1.68
2015	November	Wet	1.68
2015	December	Average	4.87
2016	January	Wet	1.68
2016	February	Average	4.87
2016	March	Dry	8.23
2016	April	Average	2.56
2016	May	Wet	0.90
2016	June	Wet	0.90
2016	July	Wet	1.26
2016	August	Dry	4.91
2016	September	Dry	4.91
2016	October	Average	4.87
2016	November	Wet	1.68
2016	December	Wet	1.68

Table 3-5. Surface Roughness Length (z_o) by Sector and Season – WPS

Sector	Winter	Spring	Summer	Fall
1	0.186	0.188	0.188	0.188
2	0.21	0.218	0.218	0.218
3	0.197	0.210	0.210	0.210
4	0.214	0.245	0.247	0.247
5	0.274	0.334	0.338	0.338
6	0.289	0.354	0.357	0.356
7	0.299	0.344	0.347	0.347
8	0.24	0.248	0.249	0.249
9	0.218	0.222	0.222	0.222
10	0.082	0.082	0.082	0.082
11	0.107	0.108	0.108	0.108
12	0.203	0.209	0.209	0.209

Source: USGS NLCD92; AERSURFACE

Table 3-6. Bowen Ratio (B_o) by Month – Hewitt

Year	Month	Moisture Class	Bowen Ratio
2015	January	Wet	1.97
2015	February	Dry	9.78
2015	March	Average	5.90
2015	April	Wet	0.99
2015	May	Wet	0.99
2015	June	Wet	0.99
2015	July	Average	3.92
2015	August	Average	3.92
2015	September	Wet	1.48
2015	October	Wet	1.97
2015	November	Wet	1.97
2015	December	Average	5.90
2016	January	Wet	1.97
2016	February	Average	5.90
2016	March	Dry	9.78
2016	April	Average	2.96
2016	May	Wet	0.99
2016	June	Wet	0.99
2016	July	Wet	1.48
2016	August	Dry	5.89
2016	September	Dry	5.89
2016	October	Average	5.90
2016	November	Wet	1.97
2016	December	Wet	1.97

Table 3-7. Surface Roughness Length (z_o) by Sector and Season – Hewitt

Sector	Winter	Spring	Summer	Fall
1	0.150	0.150	0.150	0.150
2	0.150	0.150	0.150	0.150
3	0.150	0.150	0.150	0.150
4	0.154	0.154	0.154	0.154
5	0.157	0.158	0.158	0.158
6	0.150	0.150	0.150	0.150
7	0.150	0.150	0.150	0.150
8	0.150	0.150	0.150	0.150
9	0.152	0.152	0.152	0.152
10	0.154	0.155	0.156	0.156
11	0.150	0.150	0.150	0.150
12	0.150	0.150	0.150	0.150

Source: USGS NLCD92; AERSURFACE

3.1.7 Background Concentrations

Resolution Copper has collected ambient particulate ($PM_{2.5}$ and PM_{10}) concentrations at both the EPS and the WPS monitoring stations, and gaseous (NO_2, O_3, and SO_2) concentrations at the EPS monitoring station, for the period of April 2012 through December 2017 to establish pre-construction baseline concentrations. The monitored pollutant concentrations are considered to be representative of background air quality that is influenced by air pollution from several sources:

- Emissions from nearby existing sources
- Air pollution transported to the project area from more distant urban areas and industrial sources
- Natural sources of pollution

In the modeling analysis, the monitored background concentrations were added to the modeled concentrations given project emissions. The total concentration (background plus modeled impact) accounts for air pollution sources that influence air quality in the project area but were not expressly modeled. The Air Quality Impacts Analysis Modeling Plan for Permitting (as approved by PCAQCD) includes detailed documentation and analysis of the development of representative background concentrations to be used for the permitting and NEPA analyses.

Datasets of monitored and representative background pollutant data were selected based on availability and completeness. The data years used for representative background pollutant concentrations are noted in Table 3-8. The background value for CO was extracted from the 2014, 2015, and 2016 ADEQ Annual Ambient Air Assessment Reports (ADEQ 2015b, ADEQ 2016, ADEQ 2017). All data through 2017 have been reviewed and approved by PCAQCD. For

NO_2 (1-hour), a temporally varying background profile developed from the EPS monitoring station hourly data was used.

A paired-sums approach for PM_{10} and $PM_{2.5}$ was used. In this method, for total ambient 24-hour $PM_{10}/PM_{2.5}$ concentrations to be compared to the 24-hour NAAQS, the modeled impact for each calendar day is added to the measured onsite $PM_{10}/PM_{2.5}$ concentration for that day in accordance with ADEQ 2015a, Section 7.4.1. This method more accurately characterizes predicted total $PM_{10}/PM_{2.5}$ concentrations because of the correlations between meteorological conditions, monitored $PM_{10}/PM_{2.5}$ concentrations, and modeled concentrations. The availability of contemporaneously monitored $PM_{10}/PM_{2.5}$ concentrations and meteorological data allows for the monitored PM concentration to be compared in time with the modeled concentration.

Within the monitored particulate dataset for use in the paired-sums approach, there are days of elevated PM_{10} and/or $PM_{2.5}$ concentrations at the EPS and WPS stations. This project is located in a region that occasionally experiences elevated ambient particulate concentrations influenced by natural events such as wind-generated dust storms and wildfires. In addition, elevated particulate concentrations have been influenced by particulate pollution from nearby anthropogenic activities that are temporary and unlikely to reoccur (e.g., major highway construction on the portion of Highway 60 that runs through Superior). Given the purpose of the monitoring data, which is to establish background concentrations for modeling considered representative of the project area during mining operations, and consistent with applicable state and federal guidance, rules, and policy, an analysis was undertaken in order to identify monitored data that was influenced by natural events or unusual anthropogenic activity. Only monitored concentrations that were four times the standard deviation above the median were considered in this analysis. (Statistically, this provides an indication of a potential outlier, or non-representative data point.) If available information supported the occurrence of natural events or unusual anthropogenic activity, such data were excluded from the background concentration dataset.

In accordance with this methodology, a total of ten days were identified that suggested concentrations potentially influenced by natural events or unusual anthropogenic activity. Several sources of data and information were used for the analyses, including: pollution roses, onsite meteorological data and particulate concentrations, surface weather maps, wind fields, images from regional cameras, Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) forward and reverse trajectory models, particulate monitors from the PCAQCD monitoring network, satellite imagery, radar, regional air quality indexes, and BlueSky smoke models. The analyses were summarized in “dashboards” (Appendix B of the Model Plan for Permitting) that were reviewed by PCAQCD. Based on PCAQCD’s review (summarized in a December 7, 2017 letter), particulate data from three days (out of the possible ten days) were removed from the background dataset.

For the paired-sums approach to add monitored background $PM_{10}/PM_{2.5}$ concentrations to modeled impacts, a background concentration is required for every day of the modeling period (January 1, 2015 – December 31, 2016). Particulate data that are missing, invalid, or removed from the background dataset were replaced using the following two-tier gap-filling procedure specified by PCAQCD (K. Walch email, August 28, 2017):

- Tier 1 - Any missing PM_{10} or $PM_{2.5}$ data should be filled using the measured PM_{10} and/or $PM_{2.5}$ collected data at the closest monitoring site if available. For the town of Superior sites, this would be East Plant and West Plant or vice-versa.

- Tier 2 - When the monitoring data are missing at the closest monitoring location, a monthly gap-fill value shall be determined for each monitoring site. For $PM_{10,}$ the highest monitored concentration for the month averaged over the monitoring program period shall be used. For $PM_{2.5,}$ the second-highest monitored concentration for the month averaged over the duration of monitoring program period shall be used.

The design background concentrations developed from the EPS and WPS monitoring data, presented in Table 3-8, were used for this analysis to account for the prevailing ambient pollutant concentrations. These design concentrations were developed following the guidance provided in ADEQ 2015a.

Table 3-8. Concentrations used for Background in Modeling

Pollutant	Averaging Period	Background Concentration (μg/m³)	Value	Unit	Form of Background Concentration
CO	8-Hour	2,519	2.2	ppm	Highest Concentration from 3 years (2014 - 2016)
	1-Hour	3,550	3.1	ppm	
NO_2	Annual	3.01	1.6	ppb*	Highest Concentration from 3 years (Q2 2012 – Q1 2015)
	1-Hour	Profile	--	--	3-Year Average Highest Monthly Hour-of-Day Concentrations (Q2 2012 – Q1 2015)
East Plant $PM_{2.5}$	Annual 24-Hour	Profile	--	--	24-hour Monitored Concentration Paired with Modeled Impact Concentration for Same Day
East Plant PM_{10}	Annual 24-Hour	Profile	--	--	24-hour Monitored Concentration Paired with Modeled Impact Concentration for Same Day
West Plant $PM_{2.5}$	Annual 24-Hour	Profile	--	--	24-hour Monitored Concentration Paired with Modeled Impact Concentration for Same Day
West Plant PM_{10}	Annual 24-Hour	Profile	--	--	24-hour Monitored Concentration Paired with Modeled Impact Concentration for Same Day
SO_2	Annual	2.1	0.8	ppb	Highest Annual Concentration from 3 years (2013, 2015, 2016)
	24-Hour	11.0	4.2	ppb	Highest 24-hour Concentration from 3 years (2013, 2015, 2016)
	3-Hour	30.7	11.7	ppb	Highest 3-hour Concentration from 3 years (2013, 2015, 2016)
	1-Hour	24.4	9.3	ppb	99th Percentile of the Annual Distribution of Daily Maximum 1-Hour Values Averaged Over 3 Years (2013, 2015, 2016)

*ppb = parts per billion

3.1.8 Emissions and Characterization

3.1.8.1 Source Emissions – Proposed Action

A comprehensive emissions inventory for the Resolution Project has been developed and is provided in Appendix A. A variety of sources, including AP-42 emission factors, performance data from similar sources, manufacturer specifications, New Source Performance Standards (NSPS), best operating practices, engineering design of the facility, and technical literature has been utilized to develop the Resolution Project emissions inventory.

A summary of the Resolution Project maximum potential emissions for model input, by source category, is provided in Table 3-9.

Table 3-9. Maximum Potential Emissions Summary by Source Category (ton/yr)

Source Category	CO	NO_X	$PM_{2.5}$	PM_{10}	SO_2
Process	7.7	10.5	28.0	48.4	14.8
Fugitive	28.8	5.5	45.4	276.4	1.8
Mobile	566.5	68.5	3.2	2.9	1.0
Emergency	12.96	33.89	1.14	1.14	0.21
Total	615.9	118.4	77.8	328.9	17.8

The emissions provided in Table 3-9 are based on the maximum design rates for the process (including process fugitive) sources, and the fugitive and mobile machinery emissions represent the maximum annual emissions over the project life (Section 2.6). The emergency equipment emissions are based on 500 hours per year in accordance with PCAQCD guidance.[14]

Maximum potential emissions for the various source types were estimated based for short-term and long-term averaging periods as summarized in the Table 3-10.

Table 3-10. Emission Calculation Techniques per Averaging Period

	Emission Rate Averaging Period		
Source Type	1-hour	24-hour	Annual
Process	Intermittent sources' emissions based on annual average activity rates (See Section 3.1.11); all other sources' emissions based on maximum hourly activity rates.	All sources' emissions based on maximum hourly activity rates.	All sources' emissions based on maximum annual process rates.
Fugitive & Mobile	All sources' emissions based on maximum hourly activity rates.	All sources' emissions based on maximum hourly activity rates.	Unpaved road emissions' estimates incorporate precipitation correction factor; all other sources' based on annual average activity rates.

The process sources with exhaust stacks, such as generators, heaters, and baghouse/dust-collector-equipped sources (crushers, silos, transfer points, apron feeders, etc.), were modeled as POINT sources with design release characteristics. The fugitive process sources, such as ore transfers, were characterized as VOLUME sources in the model.

[14] Based on up to 100 hours of non-emergency use (per New Source Performance Standard (NSPS) 40 CFR 60.4211.f.2) and total annual use of 500 hours (emergency and non-emergency use). Email correspondence with K. Walch (PCAQCD), April 14, 2014.

Emissions from underground operations at the EPS will exit through a mine ventilation system (mine vents). The mine vents were modeled as POINT sources.

Emissions from employee and delivery traffic (tailpipe and roadway dust) were modeled as LINE sources placed along the appropriate routes for each facility with line width calculated from the approximate roadway width (10 meters) and estimated average vehicle height (3 meters), using the recommendations for two-lane traffic presented in the Haul Road Workgroup Recommendations (EPA 2012). Emissions from railway activity were similarly characterized based on estimates of locomotive height (4.9 meters) and width (3 meters), rail bed width (7 meters), and single lane recommendations.

Emissions from surface activities which are expected to occur in variable locations (mobile equipment emissions, drilling, blasting, etc.) were aggregated to fugitive activity sources, one for each facility. The fugitive activity sources were modeled as a VOLUME sources. The applicable model input physical parameters were developed based on polygons within the actual footprint of fugitive activity locations.

Hourly emissions profiles for wind erosion from exposed surfaces (tailings dry beach, tailings dam, and subsidence area) were developed using the fastest-mile method specified in AP-42, Section 13.2.5. Using this method, each hourly wind speed was converted to a fastest mile by multiplying it by a factor of 1.2.[15] The estimated hourly fastest-mile values were used to calculate the friction velocity using AP-42, Section 13.2.5, Equation 4. When a friction velocity exceeded the material-specific threshold friction velocity, a wind erosion potential (in grams of particulate per square meter of erodible surface) was calculated using AP-42, Section 13.2.5, Equation 3. Hourly wind erosion potentials were multiplied by the applicable erodible surface areas to calculate the particulate emissions for every hour.

The new erodible area (A_{New}) for surface that is not re-disturbed (tailings beach and dam, subsidence) between wind erosion events is calculated, as:

$$A_{New} = A_{Hourly} \times Hr_{Elapsed}$$

Where:

> A_{Hourly} is the annual average hourly newly created surface area; and
> $Hr_{Elapsed}$ is the number of hours elapsed since the previous wind erosion event.

The hourly emissions profile was input into AERMOD using an external file and the HOUREMIS keyword in the input file. Sample wind erosion emission calculations are provided in Appendix C. The wind erosion model sources were characterized as AREA sources (for EPS, WPS, and FP&LF locations) and AREAPOLY sources (for the TSF).

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[15] Adopted from EPA's guidance document for modeling fugitive dust impacts from coal mines (EPA 1994).

Source-specific model input emission rates in grams per second (or grams per second per meter squared) and release parameters are provided in Appendix B.

3.1.8.2 Source Emissions - Alternatives

A comprehensive emissions inventory for the Resolution Project Alternatives has been developed. A variety of information sources, including AP-42 emission factors, manufacturer specifications, NSPS, best operating practices, engineering design of the facility, and technical literature has been utilized to develop the Resolution Project Alternatives emissions inventory.

The emissions are based on the maximum design rates for the process (including process fugitive) sources, and the fugitive and mobile machinery emissions represent the maximum annual emissions over the project life. Emissions from emergency equipment were based on 500 hours per year in accordance with PCAQCD guidance.

The model emission sources' characterizations for the alternative scenarios (Alt. 3, Alt. 4, Alt. 5, and Alt. 6) were similar to the Alt. 2 characterizations (POINT, VOLUME, AREA, LINE, and related parameters), with exception of TSF employee and delivery traffic emissions for Alt. 4, Alt. 5, and Alt. 6. The specific locations of roadways for these were undetermined, so the related emissions were allocated to the fugitive activity sources.

A summary of estimated annual emissions from the alternative TSFs being considered for the Project is presented in Table 3-11. A summary of annual emissions from each site for all pollutants is included in Appendix A. Additionally, detailed emissions calculations for the preferred alternative (Alternative 2) scenario are presented in Appendix A. Each of the other alternatives' emissions were calculated using identical methods and emission factors as those used for Alternative 2, therefore only Alternative 2 is presented in Appendix A.

Table 3-11. Maximum Potential Annual Emissions Summary by Alternative (ton/yr)

Alternative	Description	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Alt. 2	Near West, "wet", modified centerline, subaqueous PAG	328.9	77.8	615.9	118.4	17.8	102.7
Alt. 3	Near West, thickened NPAG ("dry"),, modified centerline, PAG under water cover and segregated	323.9	77.3	610.8	117.8	17.8	102.4
Alt. 4	Silver King, filtered tailings, two separate areas for NPAG and PAG	324.7	90.6	667.8	128.5	17.9	104.5
Alt. 5	Peg Leg centerline dam, thickened NPAG, separate PAG (downstream dam and water cover)	423.5	79.6	716.1	130.0	18.0	108.1
Alt. 6	Skunk Camp centerline dam, thickened NPAG, separate PAG (downstream dam and water cover)	329.8	77.9	612.4	117.9	17.8	102.4

3.1.8.3 Construction Emissions – Proposed Action

An emissions inventory for the construction of each of the four facilities (EPS, WPS, TSF, FP&LF), as well as the tailings corridor, has been developed. A variety of information sources, including AP-42 emission factors, contractor estimates, NSPS, best operating practices, engineering design of the facility, and technical literature has been utilized to develop the construction emissions inventory.

The emission estimates are based on the operating capacities for the process (including process fugitive) sources, and the fugitive and mobile machinery emissions are based on the expected maximum annual emissions over the construction period.[16]

Stationary process sources with exhaust stacks, such as generators, were modeled as POINT sources with representative (i.e., "as designed" or per data on technical specification sheets from equipment manufactures) release characteristics. The fugitive process sources, such as uncontrolled ore transfers, were characterized as VOLUME sources in the model.

Emissions from fugitive activities at each construction area (fugitive dust and tailpipe emissions) were aggregated and assigned to appropriate modeled fugitive activity locations. Each model input fugitive location was appropriately characterized as a VOLUME or an AREA source. The applicable model input physical parameters for VOLUME and AREA sources were developed based on appropriate polygons within the actual footprint of each fugitive activity location.

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[16] Estimated durations for the construction periods: 12 months for EPS, 18 months for WPS, 18 months for TSF Corridor, 36 months for TSF, and 18 months for FP&LF.

Source-specific model input emission rates were converted to grams per second (or grams per second per meter squared) for input to AERMOD.

Hourly emissions profiles for wind erosion from exposed surfaces (from areas susceptible to wind erosion) were developed using the fastest-mile method specified in AP-42, Section 13.2.5. Using this method, each hourly wind speed was converted to a fastest mile by multiplying it by a factor of 1.2. The estimated hourly fastest-mile values were used to calculate the friction velocity using AP-42, Section 13.2.5, Equation 4. When a friction velocity exceeds the material-specific threshold friction velocity, a wind erosion potential (in grams of particulate per square meter of erodible surface) was calculated using AP-42, Section 13.2.5, Equation 3. Hourly wind erosion potentials were multiplied by the applicable erodible surface areas to calculate the particulate emissions for every hour.

A summary of estimated annual emissions from the construction activities for the Project is presented in Table 3-12. A detailed emissions inventory for the Resolution Project construction phase is provided in Appendix D.

Table 3-12. Maximum Potential Annual Emissions Summary for Construction Activities (Proposed Action) (ton/yr)

Location	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
West Plant	136	14	135	73	3	51
East Plant	108	11	129	62	4	38
TSF Corridor	74	7	20	17	0	16
TSF (Alt. 2)	126	20	222	140	4	106
Filter Plant	25	3	14	15	1	15
Total	**468**	**54**	**520**	**309**	**12**	**226**

3.1.8.4 Construction Emissions – Alternatives

Construction emissions estimates for each of the Alternative TSFs have been estimated and assessed using the information sources utilized for the construction emissions inventory of the Proposed Action (Alternative 2 – Near West).

The emission estimates are based on the maximum design rates for the process (including process fugitive) sources, and the fugitive and mobile machinery emissions represent the maximum annual emissions over the construction period. Resolution has estimated the type and number of pieces of equipment needed for buildout of each of the TSF alternatives. The duration (anticipated to be three years), construction activities, and scale of the construction effort for the Alternative TSF sites are similar. Equipment engine technologies, dust control procedures, and best management practices during construction are identical. Emissions due to construction of Alternatives 3, 4, 5, or 6 were estimated to be the same or less than the estimated emissions to construct the Proposed Action (Alternative 2 – Near West) (see Table 3-12).

Construction emissions for the alternative of placing the FP&LF Plant within the footprint of the West Plant Site are also expected to be equal to or less than the construction emissions estimated for the FP&LF (Table 3-12). Resolution has estimated the type and number of pieces of equipment needed for buildout of the FP&LF. The duration (eighteen months), construction activities, and scale of the construction effort for the alternative FP&LF are similar. Equipment engine technologies, dust control procedures, and best management practices during construction are identical.

3.1.9 Coordinate System

The Universal Transverse Mercator (UTM) coordinate system projected in North American Datum of 1983 (NAD83), Zone 12, was used in this analysis to define all locations in the modeling domain (sources, buildings, and receptors).

3.1.10 NO_2 Modeling

The NO_X emissions from the combustion sources are principally composed of nitric oxide (NO) and NO_2. Once in the atmosphere, the NO can convert to NO_2 through chemical reactions with ambient O_3. To address this atmospheric conversion process, the Guideline on Air Quality Models (40 CFR 51, Appendix W) recommends the following three-tiered screening approach for evaluating the NO_2 impacts:

- Tier 1: Assume total conversion of NO to NO_2.
- Tier 2: Assume representative equilibrium NO_2/NO_X ratio (0.75 for annual and 0.80 for 1-hour).
- Tier 3: Use a detailed screening method on a case-by-case basis.

The default option of the Ozone Limiting Method (OLM), a Tier 3 method from 40 CFR 51, Appendix W, was used to estimate the NO_2 1-hour and annual impacts for this analysis. This method was chosen because the necessary information is available, and the method is expected to produce more representative model results. The OLM determines the limiting factor for NO_2 formation by comparing the estimated maximum NO_X concentration and the ambient O_3 concentration. The model assumes a total NO-to-NO_2 conversion when the ambient O_3 concentration is greater than the estimated maximum NO_X concentration; otherwise, it is limited by the ambient O_3 concentration (Cole and Summerhays 1979).

The combined plume option (keywords OLMGROUP ALL) of the OLM in AERMOD was used for this analysis.

The use of the OLM requires the following additional input parameters:

- Background O_3 Concentrations – The use of the OLM option in AERMOD requires the input of O_3 concentrations. The O_3 concentration values may be input as a single value, as hourly values to correspond with the meteorological data, or as temporally varying profiles. This analysis used the onsite (EPS) monitored hourly O_3 data.

- Ambient Equilibrium NO_2/NO_X Ratio – The AERMOD default NO_2/NO_X ambient equilibrium ratio of 0.9 was used for this analysis. The equilibrium ratio of 0.9 is the AERMOD default (i.e., AERMOD will automatically use this value if it is not provided in an input file), documented in EPA's Addendum to the AERMOD User's Guide.[17]

- In-Stack NO_2/NO_X Ratio – The majority of NO_X emissions at Resolution Copper are associated with diesel combustion. A literature search and a review of available stack tests, including the EPA database (http://www.epa.gov/scram001/no2_isr_database.htm), was conducted to identify representative NO_2/NO_X ratios for different combustion source categories. Based on this research, 0.11 is an appropriate and conservative NO_2/NO_X ratio for diesel combustion engines and used in this analysis.

The main stationary emergency diesel generators at the Project are expected to be CAT175-16. EPA's NO_2/NO_x in-stack ratios (ISR) database contains source test ISR values for the CAT175-16 at three engine loads. Taking the maximum plus one standard deviation of these ISR values gives a value of 0.04 for these generators. However, in an effort to be consistent and conservative Resolution modeled these engines with the ISR of 0.11. In addition, there are several smaller emergency diesel engines anticipated for the Project for which Resolution Copper used an ISR of 0.11. Resolution Copper anticipates that much of the equipment to be purchased will be new, will comply with the then current emission standards, and that the ISR's will continue to generally decline as engine technology progresses. Therefore, emissions and associated impacts of NO_2 from the to-be-purchased equipment are predicted to be lower than the as-modeled equipment.

A temporally varying NO_2 background concentration profile was integrated into AERMOD using the BACKGRND keyword. For this purpose, a monthly hour-of-day NO_2 concentration profile was used (developed from the onsite (EPS) monitored hourly NO_2 data) and is provided in Table 3-13 in ppb. This profile consists of the highest value for each monthly hour-of-day per ADEQ 2015a.

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[17] EPA. 2015. *Addendum: User's Guide for the AMS/EPA Regulatory Model – AERMOD (EPA-454/B-03-001, September 2004*. Office of Air Quality Planning and Standards, Air Quality Assessment Division. June 2015. Accessed October 6, 2016. http://www.epa.gov/ttn/scram/models/aermod/aermod_userguide.zip.

Table 3-13. Monthly Hour-of-Day NO_2 Profile (ppb)

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	4.4	3.4	2.4	7.8	6.8	4.1	4.1	6.9	6.0	7.4	8.4	10.3
2	2.5	3.0	3.2	6.3	6.3	4.8	4.0	6.2	6.6	8.7	8.8	9.3
3	2.9	4.2	2.3	9.1	9.9	5.7	4.4	7.0	7.9	12.0	7.1	12.0
4	3.6	4.4	2.2	7.1	10.6	5.3	3.7	5.2	8.0	7.7	8.6	12.3
5	3.0	4.2	2.1	5.9	5.5	6.6	7.2	4.6	6.3	7.8	7.4	7.1
6	3.0	3.9	3.2	9.1	6.2	8.7	5.8	5.8	12.6	10.7	8.4	8.5
7	4.4	4.0	2.6	6.6	8.8	6.9	4.4	11.8	7.0	6.6	10.3	7.9
8	8.1	7.7	3.3	9.3	12.2	5.0	3.7	6.0	5.2	7.6	11.4	8.2
9	8.6	7.1	5.8	4.5	4.5	3.0	2.3	4.4	6.1	10.1	8.5	8.4
10	5.4	8.4	2.5	3.3	4.3	2.7	3.8	6.4	1.5	4.0	6.1	5.7
11	4.5	4.7	5.6	2.4	3.6	2.5	0.8	2.8	1.8	4.0	8.4	5.1
12	5.1	4.0	1.7	1.3	2.0	2.0	1.2	2.5	0.6	3.6	5.8	4.6
13	5.0	4.4	1.5	2.1	1.2	1.0	0.9	1.6	0.8	3.7	4.4	3.4
14	3.7	3.9	1.2	1.6	1.3	1.3	0.8	2.6	1.3	3.3	4.1	3.3
15	3.5	2.4	1.1	2.2	1.1	0.9	0.9	1.6	1.7	2.8	4.9	3.0
16	4.2	2.3	2.0	1.5	0.8	1.0	0.6	3.3	1.0	2.8	4.7	3.9
17	3.9	2.5	1.2	2.1	0.8	0.5	0.6	0.5	0.6	3.0	4.5	3.7
18	5.3	3.0	1.0	2.0	1.7	0.4	1.9	0.4	1.3	2.2	6.8	5.3
19	10.5	4.7	1.3	1.7	2.4	0.3	3.3	1.3	9.5	3.8	6.2	6.2
20	8.0	4.4	1.5	3.0	1.3	0.4	2.5	3.7	2.3	4.9	5.8	5.0
21	4.0	4.7	1.6	5.2	1.8	1.4	2.6	2.7	3.9	5.6	6.7	6.0
22	4.0	3.7	2.5	5.8	2.7	3.3	3.7	2.5	5.3	7.9	6.6	8.5
23	3.6	3.7	3.7	10.5	3.5	7.6	3.0	6.6	6.6	6.7	7.0	7.2
24	4.8	4.3	3.2	7.9	5.9	5.1	4.9	9.0	9.3	8.0	9.1	13.1

3.1.11 Treatment of Intermittent Sources for NO_2 and SO_2 1-Hour Analyses

In its most recent guidance on NO_2 and SO_2 1-hour modeling (EPA 2011), the EPA has recognized that intermittent sources that do not operate continuously or frequently enough (e.g., emergency generators) are less likely to contribute significantly to the annual distribution of daily maximum 1-hour values. The EPA recommends "*that compliance demonstrations for the 1-hour NO_2 NAAQS be based on emission scenarios that can logically be assumed to be relatively continuous or which occur frequently enough to contribute significantly to the annual distribution of daily maximum 1-hour concentrations*" (EPA 2011).

The emergency equipment proposed at the Resolution Project includes backup power generators. This equipment is essential to ensure safety and will power critical systems (ventilation, personnel transport, etc.) in case of unforeseen power failure and/or other emergency situations. It is anticipated that this equipment will operate for only limited, periodic maintenance purposes (approximately 50 hours per year); however, potential to emit has been based on 500 hours per year of operation. Thus, the operation of the emergency equipment will not be frequent enough, and inclusion of its emissions does not represent a logical emission scenario to contribute significantly to the annual distribution of daily maximum 1-hour concentrations. Therefore, emissions from the proposed emergency equipment was based on continuous operation at the average hourly rate, that is, the maximum hourly rate times 500 hours per year divided by 8,760 hours per year for the NO_2 and SO_2 1-hour analyses.

3.1.12 Particulate Modeling

Default particulate modeling methods, including deposition (AERMOD Method 1, to account for depletion due to particulate settling), was used for estimating PM_{10} and $PM_{2.5}$ impacts for this analysis. To account for particulate settling, AERMOD requires the following source-specific variables:

1. Mass-mean aerodynamic particle diameter for each particle size bin
2. Mass fraction for each particle size bin
3. Particle density for each particle size bin

A list of references used to develop broad source-category-based particle size bins and associated mass fractions is provided in Table 3-14. This table also provides the particle densities in grams per cubic centimeter (g/cm^3) for each broad source category and associated reference.

Table 3-14. References Used to Develop Deposition Parameters

Source Category	Reference	Density	Density Reference
Underground Fugitive Dust	AP-42, Pg. 13.2.4-4, 11/06, Resolution Exhaust Shaft Emissions Report, 05/08	2.775	Resolution Copper's 2016 geologic model
Ore Handling	AP-42, Pg. 13.2.4-4, 11/06	2.775	Resolution Copper's 2016 geologic model
Road Traffic and Maintenance	AP-42, Sec. 13.2.2, Eqs. 1a and 2, & Tab. 13.2.2-2, 11/06	2.775	Resolution Copper's 2016 geologic model
Baghouses	AP-42, App. B-1, Pg. B.1-77, Sec. 11.21 (Phosphate Rock Processing: Roller Mill and Bowl Mill Grinding), 10/86	2.775	Resolution Copper's 2016 geologic model
Gasoline and Diesel Engines	AP-42, App. B-2, Tab. B.2-2, Pg. B.2-11 (Category 1, Stationary Internal Combustion Engines, Gasoline and Diesel Fuel), 01/95	2.25	Assumption; density of carbon
Boilers	AP-42, App. B-2, Tab. B.2.2, Pg. B.2-12 (Category 2, Combustion, Mixed Fuels, Boilers), 01/95	2.25	Assumption; density of carbon
Wind Erosion	AP-42, Pg. 13.2.5-3, 11/06	2.775	Resolution Copper's 2016 geologic model
Tailings Wind Erosion	AP-42, Pg. 13.2.5-3, 11/06	2.67	Scavenger specific gravity, KCB's Near West Tailings Management, Order of Magnitude Study.
Cooling Towers	Resolution Water Drop Size Distribution for Low Efficiency Drift Eliminators (Resolution_Surface_Cooling.xlsx, 2018-02-21)	2.7	Density of TDS constituents
Aggregate, Cement, and Sand Handling	AP-42, Pg. 13.2.4-4, 11/06	1.435	Average of cement, sand, lime, gravel from AP-42, App A

An example calculation of deposition parameters for ore handling emissions is provided in Table 3-15. In addition to the deposition parameters, this table also shows the step-by-step calculations to determine mass mean diameter for each bin.

Table 3-15. Deposition Parameters for Ore Handling Emissions

Step	Parameter	PM_{10} Bin 0 (1)	PM_{10} Bin 1	PM_{10} Bin 2	PM_{10} Bin 3	$PM_{2.5}$ Bin 0 (1)	$PM_{2.5}$ Bin 1
	Bin Upper Diameter (μm)	1.60	2.50	5.00	10.00	1.60	2.50
	Particle Size Multiplier	--	0.05	0.20	0.35	--	0.05
1	Cumulative Mass Fraction	--	0.15	0.57	1.00	--	1.00
2	Mass Fraction	--	0.15	0.42	0.43	--	1.00
3	Spherical Volume (μm^3)	2.14	8.18	65.45	523.60	2.14	8.18
4	Mean Spherical Volume (μm^3)	--	5.16	36.82	294.52	--	5.16
5	Mass Mean Diameter (μm)	--	2.14	4.13	8.25	--	2.14
	Particle Density (g/cm^3)	--	2.78	2.78	--	--	2.78

(1) Bin 0 is not input to the model. It is only used to estimate the mass mean diameter of Bin 1. The upper diameter for Bin 0 is estimated by linear interpolation of Bins 1 and 2 and by setting the particle size multiplier for Bin 0 to zero. μm^3 = cubic micrometers

The calculation steps listed in Table 3-15 are described below. All example calculations provided in these steps are for PM_{10} deposition parameters.

Step 1: The cumulative mass fraction for each bin is calculated by dividing the particle size multiplier by that of the highest bin: Bin 3 in this case. Examples:

- Bin 3 cumulative mass fraction (1.0) = Bin 3 particle size multiplier (0.35) divided by Bin 3 particle size multiplier (0.35)
- Bin 2 cumulative mass fraction (0.57) = Bin 2 particle size multiplier (0.2) divided by Bin 3 particle size multiplier (0.35)

Step 2: The mass fraction for each bin is calculated by subtracting the cumulative mass fraction of the next lower bin from the cumulative mass fraction for that bin. Examples:

- Bin 3 mass fraction (0.43) = Bin 3 cumulative mass fraction (1.0) minus Bin 2 cumulative mass fraction (0.57)
- Bin 2 mass fraction (0.42) = Bin 2 cumulative mass fraction (0.57) minus Bin 1 cumulative mass fraction (0.15)

Step 3: The spherical volume for each bin is calculated as: $4/3 \times \pi \times (\text{Bin Upper Diameter} \div 2)^3$.

Step 4: The mean spherical volume for each bin is calculated as the average of spherical volumes of that bin and the next lower bin. Examples:

- Bin 3 mean spherical volume (294.52) = The average of Bin 3 (523.6) and Bin 2 (65.45) spherical volumes
- Bin 2 mean spherical volume (36.82) = The average of Bin 2 (65.45) and Bin 1 (8.18) spherical volumes

Step 5: The mass mean diameter for each bin is calculated from the mean spherical volume as: $[\text{Mean Spherical Volume} \times 3 \div (4 \times \pi)]^{1/3} \times 2$

The deposition parameters for the source categories are provided in Table 3-16.

Table 3-16. Deposition Parameters by Source Category

Source Category	Parameter	PM10					PM2.5		
		Bin 0 (1)	Bin 1	Bin 2	Bin 3	Bin 4	Bin 0 (1)	Bin 1	Bin 2
Underground Fugitive Dust	Bin Upper Diameter (µm)	1.32	2.50	5.00	10.00	--	1.32	2.50	--
	Mass Fraction	--	0.31	0.67	0.02	--	--	1.00	--
	Mass Mean Diameter (µm)	--	2.08	4.13	8.26	--	--	2.08	--
	Particle Density (g/cm3)	--	2.78	2.78	2.78	--	--	2.78	--
Ore Handling	Bin Upper Diameter (µm)	1.60	2.50	5.00	10.00	--	1.60	2.50	--
	Mass Fraction	--	0.15	0.42	0.43	--	--	1.00	--
	Mass Mean Diameter (µm)	--	2.14	4.13	8.26	--	--	2.14	--
	Particle Density (g/cm3)	--	2.78	2.78	2.78	--	--	2.78	--
Road Traffic and Maintenance	Bin Upper Diameter (µm)	1.67	2.50	10.00	--	--	1.67	2.50	--
	Mass Fraction	--	0.10	0.90	--	--	--	1.00	--
	Mass Mean Diameter (µm)	--	2.16	7.98	--	--	--	2.16	--
	Particle Density (g/cm3)	--	2.78	2.78	--	--	--	2.78	--
Baghouses	Bin Upper Diameter (µm)	0.56	2.50	6.00	10.00	--	0.56	2.50	--
	Mass Fraction	--	0.28	0.50	0.22	--	--	1.00	--
	Mass Mean Diameter	--	1.99	4.87	8.47	--	--	1.99	--
	Particle Density (g/cm3)	--	2.78	2.78	2.78	--	--	2.78	--
Gasoline and Diesel Engines	Bin Upper Diameter (µm)	--	1.00	2.50	6.00	10.00	--	1.00	2.50
	Mass Fraction	--	0.85	0.08	0.03	0.03	--	0.91	0.09
	Mass Mean Diameter (µm)	--	0.79	2.03	4.87	8.47	--	0.79	2.03
	Particle Density (g/cm3)	--	2.25	2.25	2.25	2.25	--	2.25	2.25
Boilers	Bin Upper Diameter (µm)	--	1.00	2.50	6.00	10.00	--	1.00	2.50
	Mass Fraction	--	0.29	0.28	0.32	0.11	--	0.51	0.49
	Mass Mean Diameter (µm)	--	0.79	2.03	4.87	8.47	--	0.79	2.03
	Particle Density (g/cm3)	--	2.25	2.25	2.25	2.25	--	2.25	2.25
Wind Erosion	Bin Upper Diameter (µm)	1.18	2.50	10.00	--	--	1.18	2.50	--
	Mass Fraction	--	0.15	0.85	--	--	--	1.00	--
	Mass Mean Diameter (µm)	--	2.05	7.98	--	--	--	2.05	--
	Particle Density (g/cm3)	--	2.78	2.78	--	--	--	2.78	--
Tailings Wind Erosion	Bin Upper Diameter (µm)	1.18	2.50	10.00	--	--	1.18	2.50	--
	Mass Fraction	--	0.15	0.85	--	--	--	1.00	--
	Mass Mean Diameter (µm)	--	2.05	7.98	--	--	--	2.05	--
	Particle Density (g/cm3)	--	2.67	2.67	--	--	--	2.67	--
Cooling Towers	Bin Upper Diameter (µm)	--	2.28	2.50	6.00	10.00	--	2.28	2.50
	Mass Fraction	--	0.04	0.10	0.53	0.33	--	0.27	0.73
	Mass Mean Diameter (µm)	--	1.81	2.39	4.87	8.47	--	1.81	2.39
	Particle Density (g/cm3)	--	2.70	2.70	2.70	2.70	--	2.70	2.70
Aggregate, Cement, and Sand Handling	Bin Upper Diameter (µm)	1.60	2.50	5.00	10.00	--	1.60	2.50	--
	Mass Fraction	--	0.15	0.42	0.43	--	--	1.00	--
	Mass Mean Diameter (µm)	--	2.14	4.13	8.26	--	--	2.14	--
	Particle Density (g/cm3)	--	1.44	1.44	1.44	--	--	1.44	--

(1) Bin 0 is not input to the model. It is only used to estimate the mass mean diameter of Bin 1. The upper diameter for Bin 0 is estimated by linear interpolation of Bins 1 and 2 and by setting the particle size multiplier for Bin 0 to zero.

3.1.13 Secondary $PM_{2.5}$ and O_3 Formation

3.1.13.1 Regulatory Background

On January 17, 2017, the EPA promulgated an update to its Guideline on Air Quality Models (GAQM) (EPA 2017b) in 40 CFR 51, Appendix W, to incorporate a tiered demonstration approach to address the secondary chemical formation of $PM_{2.5}$ and ozone associated with precursor emissions from single sources (such as the Resolution Copper Project).

The 2017 GAQM outlines a two-tiered approach for addressing single-source $PM_{2.5}$ and ozone impacts:

- **Tier 1:** The first tier of assessment involves those situations where existing technical information is available (e.g., results from existing photochemical grid modeling [PGM], published empirical estimates of source-specific impacts, or reduced-form models) in combination with other supportive information and analysis for the purposes of estimating secondary impacts from a particular source. According to the EPA, the existing technical information should provide a credible and representative estimate of the secondary impacts from the project source.

- **Tier 2:** If the first-tier analysis is not suitable, then a second-tier analysis would be accomplished, which involves the application of more sophisticated, case-specific air quality modeling analyses using chemical transport models.

The EPA's expectation is that the first-tier analysis should be appropriate for most permit applicants; the second-tier analysis may only be necessary in special situations (EPA 2016c).

In addition to the 2017 GAQM updates, the EPA issued single-source ozone and secondary $PM_{2.5}$ guidance on December 2, 2016 (EPA 2016b). This guidance provides information for the development of modeled emission rates for precursors (MERPs) as a Tier 1 demonstration tool for ozone. MERPs are maximum emission rates of precursors (NO_X and SO_2 for $PM_{2.5}$ and NO_x and VOC for ozone) that would not be expected to exceed critical air quality thresholds (assumed to be equal to significant impact levels (SIL) [$PM_{2.5}$ daily = 1.2 µg/m^3, $PM_{2.5}$ annual = 0.2 g/µm^3; 8-hour ozone 1 part per billion (ppb)]), and thus would not cause or contribute to air quality violations for these pollutants. To derive a MERP value, the model predicted the relationship between precursor emissions from hypothetical sources, and their downwind maximum impacts can be combined with a critical air quality threshold using the following equation:

*MERP = Critical Air Quality Threshold * (Modeled emission rate from hypothetical source / Modeled air quality impact (ppb) from hypothetical source)*

3.1.13.2 $PM_{2.5}$ Analysis

The estimated annual NO_X and SO_2 emissions from the Project are well below the lowest (most conservative) illustrative $PM_{2.5}$ MERP value for these pollutants shown in the EPA's guidance (Table 7.1) of any source modeled by the EPA in the Western U.S. Using this methodology, air quality impacts of $PM_{2.5}$ from the Project would be expected to be below the annual $PM_{2.5}$ critical air quality thresholds (0.2 μg/m³) and the daily $PM_{2.5}$ critical air quality threshold (1.2 μg/m³).

The NO_2 and SO_2 precursor contributions to secondary $PM_{2.5}$ formation need to be considered together to determine if the source's air quality impact would be expected to exceed the critical air quality threshold. The proposed emissions increase can be expressed as a percentage of the lowest MERP for each precursor and then summed. A value less than 100% indicates that the critical air quality threshold is not expected to be exceeded when considering the combined impacts of NO_x and SO_2 precursors on annual or daily $PM_{2.5}$.

Using the lowest illustrative MERP value for the Western U.S., the summed precursor method calculations are as follows:

Daily $PM_{2.5}$ = 118 tpy NOx_{source}/1,115 tpy NOx_{MERP} +

17.8 tpy $SO2_{source}$/225 tpy $SO2_{MERP}$ = 19%

Annual $PM_{2.5}$ = 118 tpy NOx_{source}/3,184 tpy NOx_{MERP} +

17.8 tpy $SO2_{source}$/2,289 tpy $SO2_{MERP}$ = 4%

The Tier-1, summed precursor method indicates that the Project's emissions will not cause increases to secondary PM2.5 concentrations in the project area that exceed the critical air quality thresholds.

3.1.13.3 Ozone Analysis

The estimated annual NO_X and VOC emissions from the Project are well below the lowest (most conservative) illustrative O_3 MERP value shown in the EPA's guidance (Table 7.1) of any source modeled by the EPA in the Western U.S. Using this methodology, air quality impacts of O_3 from the Project would be expected to be below the critical air quality threshold (1 ppb).

The NOx and VOC precursor contributions to 8-hour daily O_3 formation need to be considered together to determine if the source's air quality impact would be expected to exceed the critical air quality threshold. The proposed emissions increase can be expressed as a percentage of the lowest MERP for each precursor and then summed. A value less than 100% indicates that the critical air quality threshold will not be exceeded when considering the combined impacts of NOx and VOC precursors on 8-hour daily O_3.

Using the lowest illustrative MERP value for the Western U.S., the summed precursor method calculations are as follows:

$$\text{8-hour } O3 = 118.4 \text{ tpy } NOx_{source}/184 \text{ tpy } NOx_{MERP} + 102.7 \text{ tpy } VOC_{source}/1{,}049 \text{ tpy } VOC_{MERP} = 74\%$$

The Tier-1, summed precursor method indicates that the Project's emissions will not cause increases in ozone concentrations in the project area that exceed the critical air quality thresholds.

3.1.14 Modeling Technique

Each site was modeled with appropriate meteorological data. The model output files from separate model runs were post-processed to generate combined results and output files for each pollutant and associated averaging periods.

Objectives of the AERMOD model execution and post-processing routines for modeling results include:

- Model each facility's emissions sources with meteorological data that is representative for the facility area.
- Add background pollutant concentrations that are representative for the facility area (and avoid double-counting). This includes adding representative paired-in-time background concentrations of PM_{10} and $PM_{2.5}$.
- Account for impacts from all facilities at every receptor (and avoid double counting).
- Produce appropriate results of modeled impacts (all facilities) plus representative background in the form of the standard to compare to the NAAQS.

To accomplish these objectives, Air Sciences developed a plan for AERMOD model execution and results post-processing that is summarized in Figure 3-6. This schematic displays the key steps in model execution and results post-processing:

1. Each facility (i.e., EPS, WPS, TSF (Proposed Action [Alternative 2] and each alternative TSF site), FP&LF (Proposed Action (near Magma Junction), and the alternative location within the footprint of West Plant) are modeled separately with two years of representative (i.e., facility-specific) meteorological data, as described in Section 3.1.6.
2. Each facility's model produces impacts at each receptor in the entire receptor grid described in Section 3.1.5 of the Modeling Report.

3. The model run for each facility produces two output files of results in the form of the standard at every receptor in the grid:

   i. Modeled impacts from facility sources

   ii. Modeled impacts from facility sources plus representative background pollutant concentrations

      - For those pollutants where a single background concentration value was used, as described in Table 3-8, the background value were added to the modeled impact.

      - For 1-hour NO_2, 24-hour and annual $PM_{2.5}$, and 24-hour and annual PM_{10}, the temporal background profiles provided to AERMOD were added to the modeled impact.

4. To use the most representative background for each receptor, each receptor is assigned to a specific facility as shown in Figure 3-7.

For the Proposed Action, post-processing routines (that are well documented and straightforward to replicate) were implemented to sum, at every facility-assigned receptor, that facility's modeled impacts, representative background, and the modeled form of the standard impact (e.g., high-3rd-high modeled concentration of 24-hour PM_{10} at the receptor) for each of the other facilities. This method of adding the form of the standard impact is a more conservative approach than adding the paired-in-time modeled impacts from the other facilities.

The post-processing routines were applied similarly to assess the impacts to ambient air quality associated with the evaluated TSF alternatives.

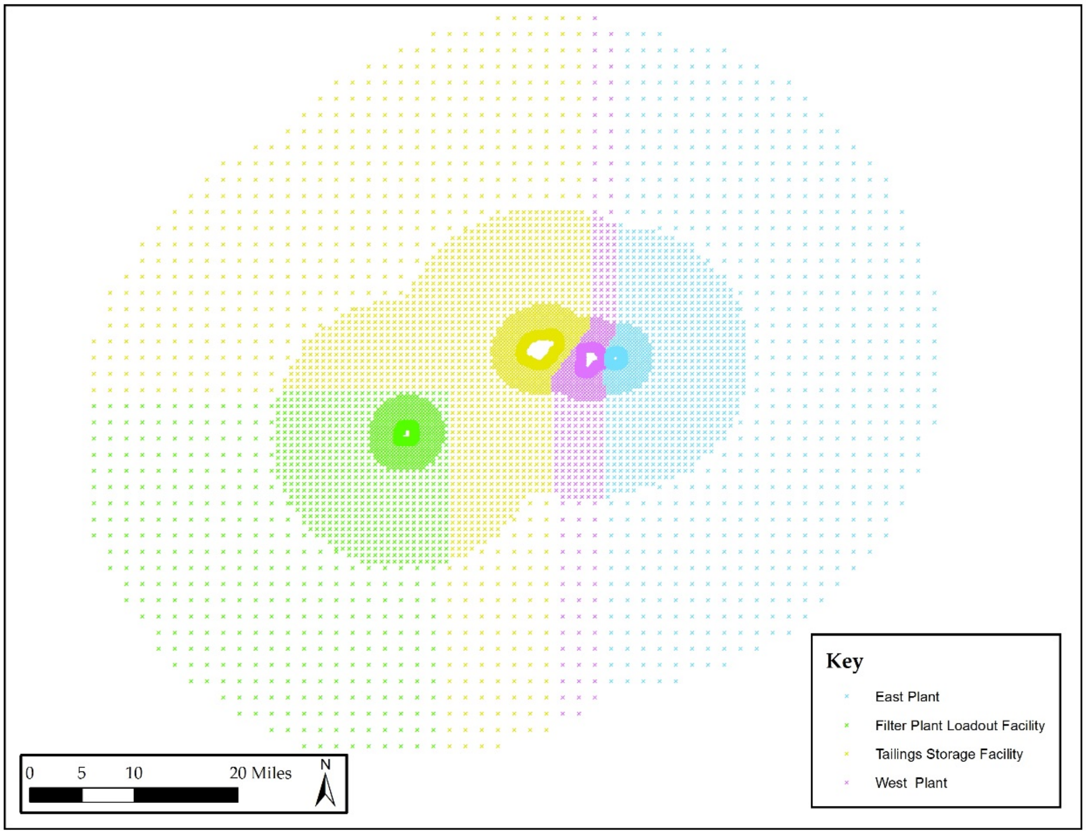
Figure 3-6. Modeling and Post-Processing Schematic

AERMOD Run	Model Inputs				Model Outputs	
	Met. Data	Receptors	Emissions	Background	Facility-Only Impacts	Facility + Background
East Plant	East Plant	All	East Plant	PM: East Plant CO: ADEQ Report Other: East Plant	East Plant	East Plant + Background
West Plant	West Plant	All	West Plant	PM: West Plant CO: ADEQ Report Other: East Plant	West Plant	West Plant + Background
Alt 2 - TSF	Hewitt	All	TSF	PM: West Plant CO: ADEQ Report Other: East Plant	TSF	TSF + Background
Filter Plant	West Plant	All	Filter Plant	PM: West Plant CO: ADEQ Report Other: East Plant	Filter Plant	Filter Plant + Background
Alt - West Plant w/ Filter Plant	West Plant	All	West Plant	PM: West Plant CO: ADEQ Report Other: East Plant	West Plant	West Plant + Background
Alts 3, 4, 5 & 6 - TSF	Hewitt	All	Alts 3, 4, 5 & 6 - TSF	PM: West Plant CO: ADEQ Report Other: East Plant	Alts 3, 4, 5 & 6 - TSF	Alt TSF + Background

Post Processing

Figure 3-7 Receptor Color	Figure 3-7 Specific Facility	Post Processing Result			
Blue	East Plant	East Plant + Background	+ West Plant	+ TSF	+ Filter Plant
Magenta	West Plant	+ East Plant	West Plant + Background	+ TSF	+ Filter Plant
Magenta	West Plant (Alt. with FP&LF)	+ East Plant	West Plant w/ FP&LF + Background	+ TSF	
Orange	TSF (Alts 2, 3, 4, 5 & 6)	+ East Plant	+ West Plant	TSF + Background	+ Filter Plant
Green	Filter Plant	+ East Plant	+ West Plant	+ TSF	Filter Plant + Background

Figure 3-7. Facility-Specific Paired Impacts-Plus-Background Assignments



3.1.15 AAQS Modeling Results

The AERMOD dispersion model results (plus background) for the Resolution Project proposed action and alternatives are provided and compared to the AAQS in Table 3-17. The results provided in Table 3-17 include the impacts from all of the modeled facilities plus the receptor-specific backgrounds, combined as described in Section 3.1.14. The appropriate design values used for comparison to the AAQS are provided in Table 3-8. Table 3-17 shows that the maximum total concentrations (Resolution Project sources' impacts plus background) do not exceed the applicable AAQS for the considered alternatives.

Table 3-17. AAQS Modeling Results for the Proposed Action and Alternatives

Pollutant	Averaging Time	Alt. 2 Proposed Action (μg/m³)	Alt. 3 Near West (μg/m³)	Alt. 4 Silver King (μg/m³)	Alt. 5 Peg Leg (μg/m³)	Alt. 6 Skunk Camp (μg/m³)	AAQS (μg/m³)	Below AAQS (all)
CO	1 hour	8,080.8	8,080.7	8,099.8	8,079.8	8,090.5	40,000.0	Yes
	8 hours	3,558.8	3,558.8	3,559.7	3,558.2	3,559.3	10,000.0	Yes
NO_2	1 hour	146.4	146.4	149.8	146.5	148.1	188.0	Yes
	1 year	4.7	4.7	4.7	4.2	4.2	100.0	Yes
PM_{10}	24 hours	96.8	96.8	97.1	99.5	97.0	150.0	Yes
	1 year	24.5	24.4	24.5	23.5	21.2	50.0	Yes
$PM_{2.5}$	24 hours	17.7	17.7	17.8	17.7	17.8	35.0	Yes
	1 year	5.9	5.9	6.0	5.9	5.9	12.0	Yes
SO_2	1 hour	116.6	116.6	117.1	116.6	116.6	196.0	Yes
	3 hours	86.4	86.4	86.4	86.4	86.4	1,300.0	Yes
	24 hours	20.4	20.4	20.4	20.4	20.4	365.0	Yes
	1 year	2.9	2.9	2.9	2.9	2.9	80.0	Yes

Model results impact figures showing the locations of the impacts in Table 3-17 are presented in Appendix E.

3.2 Class I Areas and ACEC Analyses

Pursuant to its obligations under NEPA, TNF is requiring an evaluation of potential air quality impacts due to emissions from the Project on Class I areas located within 100 km of the Project. Additionally, the U.S. Department of Interior, Bureau of Land Management (BLM) has designated certain areas under its management as Areas of Critical Environmental Concern (ACEC). The ACEC designation highlights areas where special management attention is needed to protect and prevent irreparable damage to important historic, cultural, and scenic values, fish or wildlife resources, or other natural system or processes; or to protect human life and safety from natural hazards.

The Superstition Wilderness Area (SWA) is a Class I area in the near-field. SWA is located to the north of the Project and an assessment of potential air quality impacts at SWA was performed. An assessment of the potential air quality impacts due to emissions from the TSF alternatives and alternative location for the FP& LF was also performed.

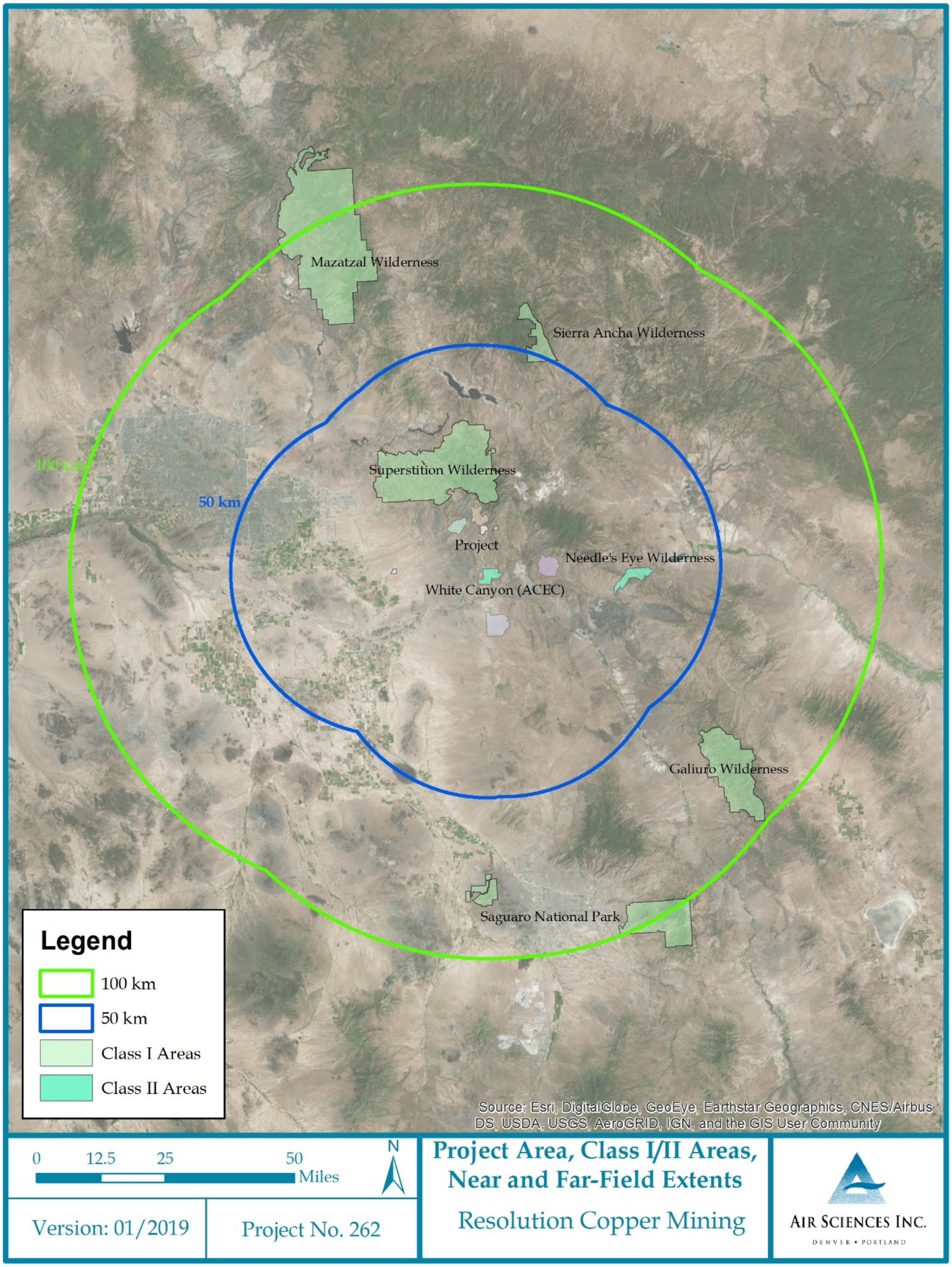
The White Canyon ACEC (WC ACEC) is a 5,790-acre property, in the near-field, about 7 miles south of Superior, AZ against a boundary of the TNF that runs north-south through the southeast end of the Mineral Mountains. The TNF is requiring consideration of air quality impacts to important resources in the WC ACEC, and the following air quality analyses include an assessment of air quality impacts to the WC ACEC.

The Needle's Eye Wilderness Area (NEWA) is located on the southeastern edge of Gila County, AZ, southwest of the San Carlos Reservoir. Air quality impacts were assessed in the NEWA due to the relative proximity of the Skunk Camp alternative tailings facility location.

In the far-field analysis (farther than 50 km but less than 100 km), the following Class I areas were evaluated for air quality impacts: SAWA, MWA, GWA, and SNP.

The Resolution Copper Project location, Class I areas included in the analyses, WC ACEC, and NEWA are shown in Figure 3-8.

Figure 3-8. Near- and Far-Field Modeling Extents and Class I & II Areas



This section describes the air dispersion modeling methods, procedures, and datasets used for the air quality analyses in the Class I areas, WC ACEC, and NEWA, including the following:

1. Class I air quality analysis to demonstrate impacts below the Class I PSD Increments in the near-field (less than 50 km), (Section 3.2.1);
2. Class I air quality analysis to demonstrate compliance with the Class I SIL in the far-field (greater than 50 km), (Section3.2.2);
3. Visibility analysis in the near-field, (Section 3.2.3);
4. Visibility analysis in the far-field, (Section 3.2.4);
5. Acid deposition analysis in the near-field and far-field, (Section 3.2.5).

3.2.1 Class I Increment Analysis for the Near-Field Areas

The methods used to estimate the Project's emissions potential impacts to the increment standards within the SWA, WC ACEC, and NEWA (near-field areas) are similar to the methods for the Ambient Air Quality Analysis, detailed above in Section 3.1. Differences between the analyses include the forms of the design values, receptor sets, and the treatment of emergency generator and short-term underground mobile fugitive emissions at East Plant.

3.2.1.1 PSD Increment Standards and Design Values

The Class I air quality analysis provided in this report includes dispersion modeling to estimate impacts to be compared with the Class I PSD increments. The PSD increments (specified in Title 40 of the Code of Federal Regulations, Part 52 [40 CFR 52]) are provided in Table 3-18.

Table 3-18. Class I and Class II area Increments

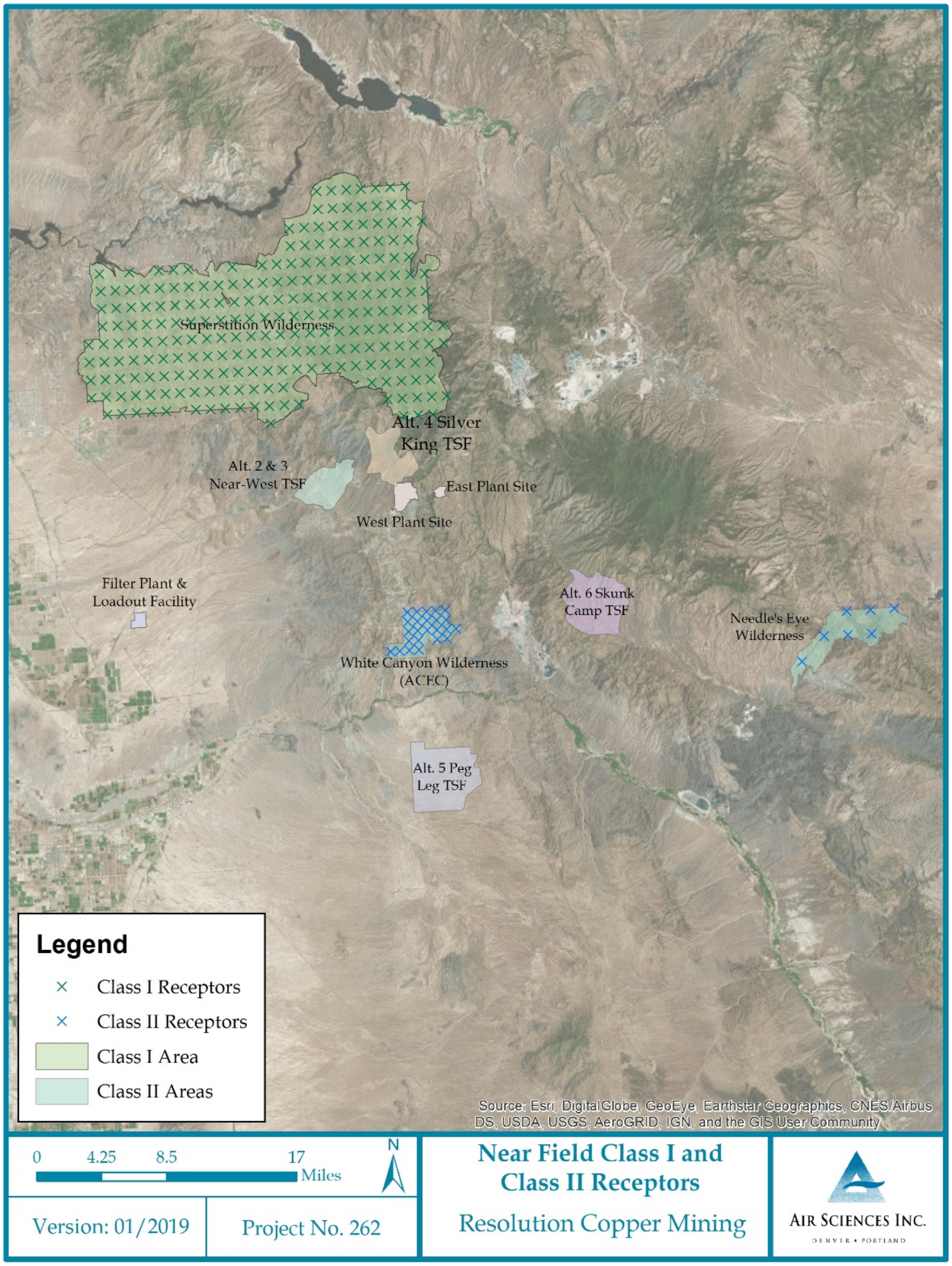
Pollutant	Averaging Time	Class I Area Increment	Class II Area Increment
NO_2	1 Year	2.5	25
$PM_{2.5}$	1 Year	1	4
	24 hours	2	9
PM_{10}	1 Year	4	17
	24 hours	8	30
SO_2	1 Year	2	20
	24 hours	5	91
	3 Hours	25	512

For any period, other than an annual period, the applicable maximum allowable increase may be exceeded during one such period per year at any one location. Therefore, for the short-term increment analyses, the modeled second highest concentration from the Project's emissions at each receptor was compared to the increment. For annual impacts, the annual concentration at the maximum modeled receptor (at each Class I area) was compared to the annual increment.

3.2.1.2 Near-Field Modeling Receptors

Receptors for the SWA Class I area were downloaded from the National Park Service (NPS) Class I Area Receptors website (NPS 2018). For the WC ACEC area, gridded receptors with a 1-km grid spacing within the area were used. For the NEWA, gridded receptor s with a 2.5 km spacing were used. The near-field SWA Class I area, WC ACEC, and Class II NEWA receptors are shown in Figure 3-9.

Figure 3-9. Receptors for the SWA, WC ACEC, and NEWA



3.2.1.3 Emissions for Near-Field Modeling

The emissions rates and characterization as described in Section 3.1.8 were modeled for the near-field increment analysis, with the following differences:

1. East Plant emergency generator emissions were not included.
2. Underground fugitive emissions from support equipment were modeled at annual average emission rates.

For the AAQS analysis, emergency generators were modeled as operating 500 hours per year, in order to capture maximum potential emissions. For the increment analysis, emergency generator emissions from the East Plant were excluded in order to represent a realistic worst-case scenario. During emergency conditions at the East Plant (when emergency generators may operate continuously), other emission sources associated with normal mining activity would not operate. In an emergency scenario, total emissions can reasonably be expected to be below the emission rates represented in the increment modeling. The non-emergency scenario represents the maximum actual emissions and is appropriate in determining increment impacts.

For the AAQS analysis, short-term emissions (except for the 1-hour NO_2 and SO_2) were modeled at the maximum hourly rates. This is similar in the increment analysis, except that the underground mobile fugitive emissions from vehicle travel (road dust) for support equipment were modeled at the annual average rate. The support equipment, in this context of modeling the underground activities, includes all equipment that does not handle or transport mining material. The emissions were modeled in this manner to more closely represent actual emissions from underground activities (and is consistent with applicable modeling guidance for increment impact assessment). A summary of the Resolution Project emissions for increment modeling input, by alternative, is provided in Table 3-19.

Table 3-19. Increment Modeling Emissions Summary by Alternative (ton/yr)

Alternative	Description	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Alt. 2	Near West, "wet", modified centerline, subaqueous PAG	328.3	76.5	607.8	84.9	17.6	99.3
Alt. 3	Near West, thickened NPAG ("dry"), modified centerline, PAG under water cover and segregated	323.4	76.0	602.7	84.3	17.6	99.1
Alt. 4	Silver King, filtered tailings, two separate areas for NPAG and PAG	324.2	89.3	659.6	95.0	17.7	101.2
Alt. 5	Peg Leg centerline dam, thickened NPAG, separate PAG (downstream dam and water cover)	423.0	78.4	708.0	96.5	17.8	104.8
Alt. 6	Skunk Camp centerline dam, thickened NPAG, separate PAG (downstream dam and water cover)	329.3	76.6	604.3	84.4	17.6	99.1

3.2.1.4 Modeling Results for Near-Field Areas

Table 3-20 Table 3-21 and Table 3-22 provide the maximum modeled concentrations and their comparison with the applicable increments for the SWA, WC ACEC, and NEWA, respectively, showing that the modeled concentrations within area s are below the applicable PSD increments for all alternatives.

Table 3-20. Increment Modeling Results at the Superstition Wilderness Area

Pollutant	Averaging Time	Alt.-2 µg/m³	Alt.-3 µg/m³	Alt.-4 µg/m³	Alt.-5 µg/m³	Alt.-6 µg/m³	Class I Increment	Below Increment
NO_2	1 Year	0.1	0.1	0.1	0.0	0.0	2.5	Yes
$PM_{2.5}$	24 hours	1.526	1.524	1.574	1.469	1.508	2	Yes
	1 Year	0.066	0.065	0.119	0.048	0.051	1	Yes
PM_{10}	24 hours	4.241	4.233	4.257	3.994	4.107	8	Yes
	1 Year	0.246	0.240	0.318	0.130	0.142	4	Yes
SO_2	3 hours	4.406	4.406	4.411	4.398	4.402	25	Yes
	24 hours	0.993	0.993	0.994	0.992	0.993	5	Yes
	1 Year	0.006	0.006	0.008	0.006	0.006	2	Yes

Table 3-21. Increment Modeling Results at the White Canyon ACEC

Pollutant	Averaging Time	Alt.-2 µg/m³	Alt.-3 µg/m³	Alt.-4 µg/m³	Alt.-5 µg/m³	Alt.-6 µg/m³	Class II Increment[18]	Below Increment
NO_2	1 Year	0.025	0.025	0.038	0.034	0.060	25	Yes
$PM_{2.5}$	24 hours	0.556	0.555	0.707	0.658	0.834	9	Yes
	1 Year	0.023	0.023	0.033	0.029	0.053	4	Yes
PM_{10}	24 hours	1.516	1.509	1.741	2.169	2.459	30	Yes
	1 Year	0.051	0.051	0.068	0.098	0.168	17	Yes
SO_2	3 hours	2.526	2.526	2.548	2.538	2.544	512	Yes
	24 hours	0.473	0.473	0.476	0.475	0.478	91	Yes
	1 Year	0.022	0.022	0.023	0.023	0.023	20	Yes

[18] Class I increment standards are applicable only at mandatory or redesignated Federal Class I areas. The White Canyon ACEC and Needle's Eye Wilderness Area are not a Class I areas. Therefore, modeled impacts due to emissions from the Project are compared to Class II increment standards.

Table 3-22. Increment Modeling Results at the Needle's Eye Wilderness Area

Pollutant	Averaging Time	Alt.-2 μg/m³	Alt.-3 μg/m³	Alt.-4 μg/m³	Alt.-5 μg/m³	Alt.-6 μg/m³	Class II Increment	Below Increment
NO_2	1 Year	0.006	0.006	0.007	0.009	0.011	25	Yes
$PM_{2.5}$	24 hours	0.095	0.094	0.102	0.104	0.146	9	Yes
	1 Year	0.006	0.006	0.007	0.008	0.010	4	Yes
PM_{10}	24 hours	0.308	0.305	0.288	0.387	0.454	30	Yes
	1 Year	0.013	0.013	0.014	0.024	0.030	17	Yes
SO_2	3 hours	0.331	0.331	0.333	0.334	0.332	512	Yes
	24 hours	0.065	0.065	0.065	0.066	0.065	91	Yes
	1 Year	0.003	0.003	0.003	0.003	0.003	20	Yes

3.2.2 Class I SIL Analysis for Far-Field Areas

Resolution conducted three levels of increment/SIL analysis for the Class I areas that are farther than 50 km and less than 100 km from the project area (SAWA, MWA, GWA, and SNP):

1. Q/D Screening Analysis;
2. AERMOD modeling at the extent of the near-field domain in the direction of each Class I area;
3. CALPUFF modeling at receptors within the Class I areas.

3.2.2.1 Q/D Screening Analysis

Per the FLAG guidance initial screening criteria methodology, the USDA – FS, TNF will consider a source located more than 50 km from a Class I area to have negligible impacts with respect to Class I AQRVs if the result of the calculation of the sources' total SO_2, NO_x, PM_{10}, and Sulfuric Acid (H_2SO_4) annual emissions (in tons per year, based on 24-hour maximum allowable emissions), divided by the distance (in km) from the Class I area equals 10 or less. This screening criteria method is referred to as the Q/D method (where "Q" refers to total annual emissions (tons) and "D" refers to distance to the Class I area (km)).

The Project's (Proposed Action) estimated maximum annual emissions of SO_2, NO_x, and PM_{10} are shown in Table 3-23; no H_2SO_4 emissions are expected.[19] The emissions represent the maximum mining activity (fugitive and mobile machinery) expected to occur during the LOM year 14 and process sources operating at maximum design capacity. These emission rates are based on maximum 24-hour mining/production rates (per FLAG guidance). A detailed emissions inventory for the Resolution Project is provided in Appendix A where Q/D values

[19] Consistent with guidance, emission totals exclude emissions from intermittent sources (i.e., the maximum, non-emergency operating scenario is used for the Q/D analysis) and maximum daily wind erosion emissions are estimates from the hourly wind erosion calculations.

can be found on page 8. Table 3-24 shows the distance to Class I areas within 100 km of the Project and the results of the Q/D calculation. The results of the Q/D analysis demonstrate that analyses of potential impacts to increment, visibility, and acid deposition are required for the far-field Class I Areas that are within 100 km of the Project.

Table 3-23. Resolution Copper Estimated Maximum Daily Emissions

Pollutant	Max. Daily Emissions	
	(lb / day)	(ton / year)
PM_{10}	4,129.0	753.5
NO_X	1,575.2	287.5
SO_2	296.3	54.1
Total (Q)	6,000.6	**1,095.1**

Table 3-24. Q/D Analysis

Class I Area	Distance (D) (km)	Q / D (tpy / km)	More than 10?
Sierra Ancha Wilderness	52.9	20.7	Yes
Mazatzal Wilderness	75.3	14.5	Yes
Galiuro Wilderness	92.6	11.8	Yes
Saguaro National Park	93.7	11.7	Yes

3.2.2.2 Increment Analysis at the Extent of the AERMOD Domain

To fully utilize the modeling results generated by the PCAQCD-approved near-field modeling methods using the EPA-preferred/recommended dispersion model, AERMOD, modeled impacts at receptors at the extent of the modeling domain in the direction of each of the far-field Class I areas were compared to PSD increments to determine whether impacts should be analyzed using the CALPUFF modeling system or could be expected to be below the increment.

The emissions and methods applied to modeling impacts for comparison the PSD increment levels at the extent of the domain were identical to the described above in Section 3.2.1, except the receptors that were located in the arcs at 50 km extents in the direction of the respective far-field Class I areas. The analysis was performed for all alternatives.

The results of the modeled impacts from AERMOD at the extents are provided in Table 3-25, Table 3-26, Table 3-27, and Table 3-28 for the SAWA, MWA, GWA, and SNP respectively. The tables show that the modeled impacts are below the PSD increments at the extent of the AERMOD modeling domain. Since concentrations from an emission source can be expected to decrease with increased distance, it is reasonable to expect that modeled AERMOD impacts are below the increment thresholds within the Class I areas.

Table 3-25. Impacts at the Extent of the AERMOD Modeling Domain toward Sierra Ancha

Pollutant	Averaging Time	Alt.-2 μg/m³	Alt.-3 μg/m³	Alt.-4 μg/m³	Alt.-5 μg/m³	Alt.-6 μg/m³	Class I Increment	Below Increment
NO_2	1 Year	0.005	0.005	0.007	0.005	0.005	2.5	Yes
$PM_{2.5}$	24 hours	0.111	0.111	0.123	0.099	0.098	2	Yes
	1 Year	0.005	0.005	0.006	0.004	0.005	1	Yes
PM_{10}	24 hours	0.417	0.415	0.463	0.414	0.421	8	Yes
	1 Year	0.017	0.017	0.018	0.015	0.016	4	Yes
SO_2	3 hours	0.378	0.378	0.380	0.378	0.378	25	Yes
	24 hours	0.080	0.080	0.080	0.080	0.080	5	Yes
	1 Year	0.001	0.001	0.002	0.001	0.001	2	Yes

Table 3-26. Impacts at the Extent of the AERMOD Modeling Domain toward Mazatzal

Pollutant	Averaging Time	Alt.-2 μg/m³	Alt.-3 μg/m³	Alt.-4 μg/m³	Alt.-5 μg/m³	Alt.-6 μg/m³	Class I Increment	Below Increment
NO_2	1 Year	0.007	0.007	0.008	0.005	0.005	2.5	Yes
$PM_{2.5}$	24 hours	0.118	0.117	0.125	0.109	0.112	2	Yes
	1 Year	0.007	0.007	0.009	0.005	0.005	1	Yes
PM_{10}	24 hours	0.394	0.392	0.388	0.334	0.336	8	Yes
	1 Year	0.018	0.018	0.020	0.015	0.014	4	Yes
SO_2	3 hours	0.294	0.294	0.293	0.292	0.293	25	Yes
	24 hours	0.076	0.076	0.076	0.076	0.076	5	Yes
	1 Year	0.001	0.001	0.001	0.001	0.001	2	Yes

Table 3-27. Impacts at the Extent of the AERMOD Modeling Domain toward Galiuro

Pollutant	Averaging Time	Alt.-2 μg/m³	Alt.-3 μg/m³	Alt.-4 μg/m³	Alt.-5 μg/m³	Alt.-6 μg/m³	Class I Increment	Below Increment
NO_2	1 Year	0.005	0.005	0.006	0.009	0.007	2.5	Yes
$PM_{2.5}$	24 hours	0.080	0.080	0.099	0.110	0.139	2	Yes
	1 Year	0.005	0.005	0.005	0.007	0.007	1	Yes
PM_{10}	24 hours	0.280	0.279	0.289	0.476	0.397	8	Yes
	1 Year	0.010	0.010	0.010	0.027	0.019	4	Yes
SO_2	3 hours	0.241	0.241	0.244	0.246	0.251	25	Yes
	24 hours	0.052	0.052	0.052	0.053	0.053	5	Yes
	1 Year	0.003	0.003	0.003	0.003	0.003	2	Yes

Table 3-28. Impacts at the Extent of the AERMOD Modeling Domain toward Saguaro

Pollutant	Averaging Time	Alt.-2 μg/m³	Alt.-3 μg/m³	Alt.-4 μg/m³	Alt.-5 μg/m³	Alt.-6 μg/m³	Class I Increment	Below Increment
NO_2	1 Year	0.005	0.005	0.005	0.010	0.006	2.5	Yes
$PM_{2.5}$	24 hours	0.088	0.087	0.121	0.173	0.135	2	Yes
	1 Year	0.004	0.004	0.005	0.008	0.005	1	Yes
PM_{10}	24 hours	0.286	0.284	0.308	0.793	0.383	8	Yes
	1 Year	0.009	0.009	0.009	0.028	0.011	4	Yes
SO_2	3 hours	0.334	0.334	0.340	0.340	0.338	25	Yes
	24 hours	0.052	0.052	0.052	0.054	0.053	5	Yes
	1 Year	0.002	0.002	0.002	0.002	0.002	2	Yes

3.2.2.3 CALPUFF Modeling for Far-Field Areas

The Project's potential impacts to the AQRVs of the far-field Class I areas were evaluated using the CALPUFF model. The CALPUFF model is an advanced non-steady state Lagrangian puff model that simulates the transport and chemical transformation of discrete puffs of pollutants released into the atmosphere. As wind flow changes geographically from hour to hour, the path of each puff is altered to follow the new wind direction. CALPUFF is the appropriate modeling platform for the far-field AQRV analyses.

The CALPUFF modeling system consists the following components:

CALMET - a diagnostic three-dimensional meteorological model

CALPUFF - an air quality dispersion model

CALSUM – a post-processing program to aggregate CALPUFF outputs

POSTUTIL – a post-processing program to prepare the CALSUM outputs for CALPOST

CALPOST - a post-processing package to extract modeling results

In addition, there are numerous other processors that are used to prepare geophysical (land use and terrain) data and meteorological (surface, upper-air, and precipitation) data. The modeling domain is 300 km by 300 km, centered around the facility. The domain size was selected to cover the 100 km from the source with an additional 50-km buffer to allow for puff recirculation.

3.2.2.3.1 Meteorological Data for CALPUFF

For this analysis, the CALMET processor was not used. Rather, Air Sciences contracted with Lakes Environmental (Lakes) to provide a three-year wind field dataset based on the Weather Research and Forecast Model (WRF). Lakes ran WRF and processed the output using the Mesoscale Model Interface (MMIF) Program to generate a CALPUFF-ready wind field dataset. Specifications of the dataset are:

- 300 km by 300 km at a 4-km resolution
- Three years of data (2015 to 2017)
- Lambert Conformal Conic Coordinate system: (RLAT0 = 33.266 N, RLON0 = 111.242W, XLAT1 = 32.766N, XLAT2 = 33.766 N. DATUM = NWS-84, XORIGKM = -150, YORGINKM = -150)
- Ten vertical levels (Face heights = 20, 40, 80, 160, 320, 640, 1200, 2000, 3000, 4000 meters)
- For the MMIF Program processing, PBL_RECALC was set to TRUE, and STABILITY was set to GOLDER.

The CALPUFF-ready wind field was evaluated against DS472.0 stations' observational data using the MMIFstat program. The details of this evaluation are provided in Appendix F. The evaluation shows that the WRF data set generally performs well when values in the WRF dataset are compared to the benchmarks.

3.2.2.3.2 CALPUFF Source Characterization

Sources from the near-field AERMOD modeling files were used to build the CALPUFF inputs in order to maintain a setup consistent with the AERMOD runs as much as possible. Changes were only made when CALPUFF did not support the AERMOD implementation. The text below describes the differences.

In AERMOD, point sources that release at ambient air temperature (e.g., baghouses) were provided with a stack temperature of zero degrees Kelvin, which AERMOD then models as being released with the contemporaneous ambient temperature. For CALPUFF, these point sources are assumed to release at a stack temperature of 293.15 degrees Kelvin.

Access roads and rail roads were modeled in AERMOD using LINE sources. In CALPUFF, these sources were modeled as a set of widely spaced VOLUME sources, with a spacing of 250 m. The lateral dispersion components were set to road width (16 m for the roads, 10 m for the rails) divided by 4.3, the release heights were the same as the AERMOD LINE sources' (2.55 m for the roads, 3.86 m for the rails), and the vertical component of initial dispersion was set to double the release heights (5.1 m for roads, 7.71 m for rails).

3.2.2.3.3 Receptors for CALPUFF

Receptors for each Class I area, as provided via National Park Service website, were used. https://www.nature.nps.gov/air/Maps/Receptors/index.cfm.

3.2.2.3.4 Emissions for CALPUFF

Emissions input to the CALPUFF model were identical to the emissions described in Section 3.1.8.

3.2.2.3.5 CALPUFF Model Settings

The last approved regulatory versions of the models (CALPUFF - Version 5.8.5 - Level 151214, and CALPOST - Version 6.221 - Level 080724) were used. Table 3-29 provides the non-default CALPUFF settings for the far-field SIL analysis.[20]

Table 3-29. Non-Default Options for SIL Modeling in CALPUFF

Option	Setting	Notes
Control Information		
NSPEC	7	SO_2, SO_4, NO_X, HNO_3, NO_3, PMC, PMF
NSE	5	SO_2, SO_4, NO_X, PMC, PMF
Technical Options		
MCHEM	0	Chemistry turned off for increment
MWET	0	Deposition turned off for increment
MDRY	0	Deposition turned off for increment
MREG	0	When chemistry or deposition are turned off, MREG must be turned off
Map and Grid Controls		
PMAP	LCC	Per meteorological data
FEAST	0	Per meteorological data
FNORTH	0	Per meteorological data
UTMHEM	N	Per meteorological data
RLAT0	33.266N	Per meteorological data
RLON0	111.242W	Per meteorological data
XLAT1	32.766N	Per meteorological data

[20] The SIL are pollutant-specific concentrations established by EPA. A proposed source that can demonstrate that modeled ambient air quality impacts are below the SIL is presumed to cause or contribute to a violation of the NAAQS or PSD increment.

Option	Setting	Notes
XLAT2	33.766N	Per meteorological data
DATUM	NWS-84	Per meteorological data
NX	75	Per meteorological data
NY	75	Per meteorological data
NZ	10	Per meteorological data
DGRIDKM	4	Per meteorological data
ZFACE	10 levels	Per meteorological data
XORIGKM	-150	Per meteorological data
YORIGKM	-150	Per meteorological data
IBCOMP	1	Per meteorological data
JBCOMP	1	Per meteorological data
IECOMP	75	Per meteorological data
JECOMP	75	Per meteorological data
LSAMP	F	Per meteorological data
IBSAMP	1	Per meteorological data
JBSAMP	1	Per meteorological data
IESAMP	75	Per meteorological data
JESAMP	75	Per meteorological data
MESHDN	1	Per meteorological data
Gaseous Dry Deposition	NA	Deposition turned off for increment
Particulate Deposition	NA	Deposition turned off for increment
Chemistry Parameters		
MOZ	NA	Chemistry turned off for increment
BCKO3	NA	Chemistry turned off for increment
BCKNH3	NA	Chemistry turned off for increment
Miscellaneous Parameters		
IURB1	1	Per meteorological data
IURB2	1	Per meteorological data
SVMIN	0.5*6, 0.5*6	
WSCAT	ISC RURAL	
PLX0	ISC RURAL	

Table 3-29 shows that deposition and chemistry were turned off in the CALPUFF modeling options, along with the related regulatory switch (MREG). In default settings, chemistry and deposition can reduce modeled air concentrations by converting and depositing pollutants. By turning these settings off, conservative estimates of concentrations at the Class I area receptors are modeled.

3.2.2.4 Class I SILs and Design Values

Table 3-18 shows the Class I Area SIL. The maximum concentration modeled with the CALPUFF modeling system were compared to the Class I SILs for each pollutant to determine compliance.

Table 3-30. Class I Area SILs

Pollutant	Averaging Time	Class I Area SIL
NO_2	1 Year	0.1
$PM_{2.5}$	1 Year	0.05
	24 hours	0.27
PM_{10}	1 Year	0.2
	24 hours	0.3
SO_2	1 Year	0.1
	24 hours	0.2
	3 Hours	1

3.2.2.5 SIL Modeling Results for the Far-Field Areas

The results of the CALPUFF modeling are provided in Table 3-31, Table 3-32, Table 3-33, and Table 3-34 for the SAWA, MWA, GWA, and SNP respectively. The tables show that the modeled impacts are below the Class I SILs for all receptors, pollutants, and averaging periods for all modeled alternatives.

Table 3-31. CALPUFF Modeling Results for the Sierra Ancha Wilderness Area

Pollutant	Averaging Time	Alt.-2 μg/m³	Alt.-3 μg/m³	Alt.-4 μg/m³	Alt.-5 μg/m³	Alt.-6 μg/m³	Class I SIL	Below SIL
NO_2	1 year	0.0022	0.0022	0.0026	0.0021	0.0021	0.1	Yes
$PM_{2.5}$	24 hours	0.0521	0.0521	0.0546	0.0522	0.0527	0.27	Yes
	1 year	0.0013	0.0013	0.0017	0.0012	0.0012	0.05	Yes
PM_{10}	24 hours	0.1546	0.1545	0.1771	0.1569	0.1582	0.3	Yes
	1 year	0.0050	0.0049	0.0058	0.0044	0.0042	0.2	Yes
SO_2	3 hours	0.0845	0.0845	0.0847	0.0845	0.0845	1	Yes
	24 hours	0.0194	0.0194	0.0195	0.0194	0.0194	0.2	Yes
	1 year	0.0003	0.0003	0.0003	0.0003	0.0003	0.1	Yes

Table 3-32. CALPUFF Modeling Results for the Mazatzal Wilderness Area

Pollutant	Averaging Time	Alt.-2 µg/m³	Alt.-3 µg/m³	Alt.-4 µg/m³	Alt.-5 µg/m³	Alt.-6 µg/m³	Class I SIL	Below SIL
NO_2	1 year	0.0014	0.0014	0.0014	0.0011	0.0010	0.1	Yes
$PM_{2.5}$	24 hours	0.0345	0.0345	0.0727	0.0338	0.0383	0.27	Yes
	1 year	0.0009	0.0009	0.0010	0.0007	0.0006	0.05	Yes
PM_{10}	24 hours	0.1481	0.1448	0.2868	0.1372	0.1418	0.3	Yes
	1 year	0.0044	0.0043	0.0038	0.0035	0.0025	0.2	Yes
SO_2	3 hours	0.0628	0.0628	0.0649	0.0629	0.0630	1	Yes
	24 hours	0.0166	0.0166	0.0172	0.0166	0.0166	0.2	Yes
	1 year	0.0002	0.0002	0.0002	0.0002	0.0002	0.1	Yes

Table 3-33. CALPUFF Modeling Results for the Galiuro Wilderness Area

Pollutant	Averaging Time	Alt.-2 µg/m³	Alt.-3 µg/m³	Alt.-4 µg/m³	Alt.-5 µg/m³	Alt.-6 µg/m³	Class I SIL	Below SIL
NO_2	1 year	0.0011	0.0011	0.0012	0.0019	0.0013	0.1	Yes
$PM_{2.5}$	24 hours	0.0214	0.0212	0.0215	0.0324	0.0327	0.27	Yes
	1 year	0.0007	0.0007	0.0008	0.0012	0.0009	0.05	Yes
PM_{10}	24 hours	0.1247	0.1221	0.0971	0.2513	0.1849	0.3	Yes
	1 year	0.0030	0.0029	0.0029	0.0077	0.0040	0.2	Yes
SO_2	3 hours	0.0211	0.0211	0.0214	0.0212	0.0213	1	Yes
	24 hours	0.0059	0.0059	0.0059	0.0060	0.0059	0.2	Yes
	1 year	0.0002	0.0002	0.0002	0.0002	0.0002	0.1	Yes

Table 3-34. CALPUFF Modeling Results for the Saguaro National Park

Pollutant	Averaging Time	Alt.-2 µg/m³	Alt.-3 µg/m³	Alt.-4 µg/m³	Alt.-5 µg/m³	Alt.-6 µg/m³	Class I SIL	Below SIL
NO_2	1 year	0.0006	0.0006	0.0006	0.0010	0.0006	0.1	Yes
$PM_{2.5}$	24 hours	0.0214	0.0212	0.0519	0.0205	0.0395	0.27	Yes
	1 year	0.0004	0.0004	0.0005	0.0007	0.0004	0.05	Yes
PM_{10}	24 hours	0.1189	0.1165	0.2243	0.1725	0.2265	0.3	Yes
	1 year	0.0018	0.0018	0.0018	0.0044	0.0017	0.2	Yes
SO_2	3 hours	0.0273	0.0273	0.0279	0.0273	0.0273	1	Yes
	24 hours	0.0047	0.0047	0.0047	0.0047	0.0047	0.2	Yes
	1 year	0.0001	0.0001	0.0001	0.0001	0.0001	0.1	Yes

3.2.3 Visibility Impacts in the Near-Field

Plume blight is a distinct band or coherent layer of visible air pollution, often from a single pollution source. Particulate matter and nitrogen oxides in the plume scatter and absorb light so that the plume can appear brighter or darker than its viewing background (e.g., the sky or a terrain feature such as a mountain), or the pollution can reduce the contrast of the background view, or it can alter the color of the view. Three levels of visibility analysis are defined in the EPA's Workbook for Plume Visual Impact Screening and Analysis (Revised) (EPA 1992). These three levels of analysis imply varying degrees of accuracy in estimating visibility impacts from plume blight. For this Modeling Report, a Level-3 Near-Field Refined Analysis using PLUVUE II was used to estimate potential plume blight in the nearby SWA and WC ACEC. Air quality incremental impacts for NO_2, SO_2, and PM were all substantially lower in the NEWA Class II area than respective impacts in the SWA or WC ACEC; therefore, it is reasonable to assume that visibility impacts at NEWA would be less than visibility impacts at the SWA and WC ACEC. Level-3 analysis is considered to be a comprehensive analysis of the magnitude and frequency of occurrence of plume visual impacts as observed at a sensitive Class I area vista. PLUVUE II is a straight-line, simple terrain, Gaussian plume model designed to calculate the visual impairment from pollutants of a single point or area source. PLUVUE II uses the actual source location, receptor locations, meteorological conditions, and time of day to determine the geometries of the sun, plume, and observer for the optical calculations.

3.2.3.1 PLUVUE II Modeling

PLUVUE II was run in observer-mode to evaluate the view for five vistas within the Superstition Class I area and one in the White Canyon ACEC. The locations of these vistas, along with the project and alternatives locations, are shown in Table 3-35 and Figure 3-10. The observer locations were chosen at high points to provide the best vantage point for looking out over the terrain.

Each modeling scenario is comprised of emissions from East Plant, West Plant, and a tailing storage alternative. Since West Plant (WP) emissions are much lower than East Plant (EP), the WP emissions were combined with the EP source, and the two facilities were modeled as one. (Combining emission sources is necessary given the set-up requirements of the PLUVUE II model.) Then, EP was run in conjunction with a tailing storage alternative. Thus, there were four alternatives evaluated (EP with Near West TSF, EP with Silver King TSF, EP with Peg Leg TSF, and EP with Skunk Camp TSF). For evaluation purposes, the proposed action (Alternative 2) and Alternative 3 were assumed to be nearly identical and were consolidated.

Table 3-36 shows the maximum 24-hour operation emissions of NO_X, SO_2, and PM_{10} for each alternative. Note that Table 3-36 does not include the windblown emissions from the tailings' storage. The TSF windblown emissions were determined on an hour-by-hour basis using the wind speed and windblown dust methodology from the AERMOD emissions inventory.

There is no recommended procedure for conducting analyses of multiple sources with PLUVUE II, so multiple coherent plumes should be treated individually or combined (FLAG Section 3.3.3). Given the distance between EP and the TSF and elevation differences, the TSF and EP sources were modeled separately using different meteorological datasets. For hours in which both the EP and TSF plume are visible from a particular vista, the plume impacts are added, regardless of whether the plumes actually overlap or not. This provides a conservative estimate of the merged plume impact.

Table 3-35. **Project and Vista Locations**

Facility	ID	UTM-X (m)	UTM-Y (m)	Elevation (ft)
East Plant	EP	493,640	3,685,170	4,166
Tailings Storage	TSF	487,200	3,702,700	2,558
Silver King Alt	SK	488,390	3,688,599	3,046
Peg Leg Alt	PL	491,684	3,654,886	2,726
Skunk Camp Alt	SC	509,380	3,672,000	3,234
Superstition Observer Locations		UTM-X (m)	UTM-Y (m)	Elevation (ft)
Montana Mt.	VMontana	485,630	3,696,165	5,557
Government Hill	VGovHill	492,795	3,696,480	5,445
Iron Mountain	VIronM	484,180	3,699,270	6,056
Mound Mountain	VMoundMt	487,190	3,703,690	6,268
Superstition Mountain Ridge Line	VSMRL	462,750	3,696,925	5,057
White Canyon Observer Locations		UTM-X (m)	UTM-Y (m)	Elevation (ft)
White Canyon	VWC1	492,985	3,672,320	3,996

Figure 3-10. Map of Vista Locations in Relation to Project

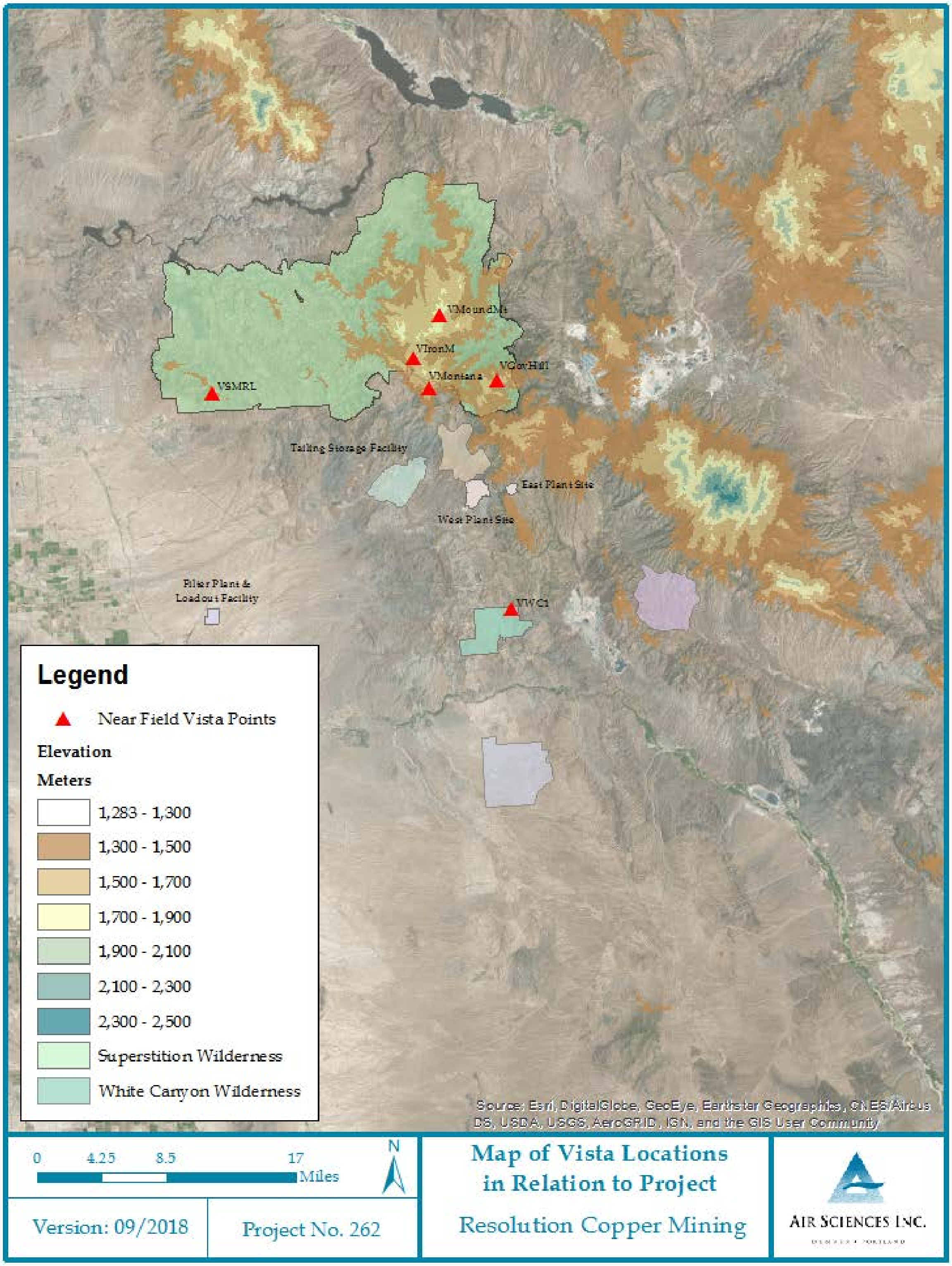


Table 3-36. PLUVUE Short-term (24-hour) Maximum Allowable Emissions* (tons/day)

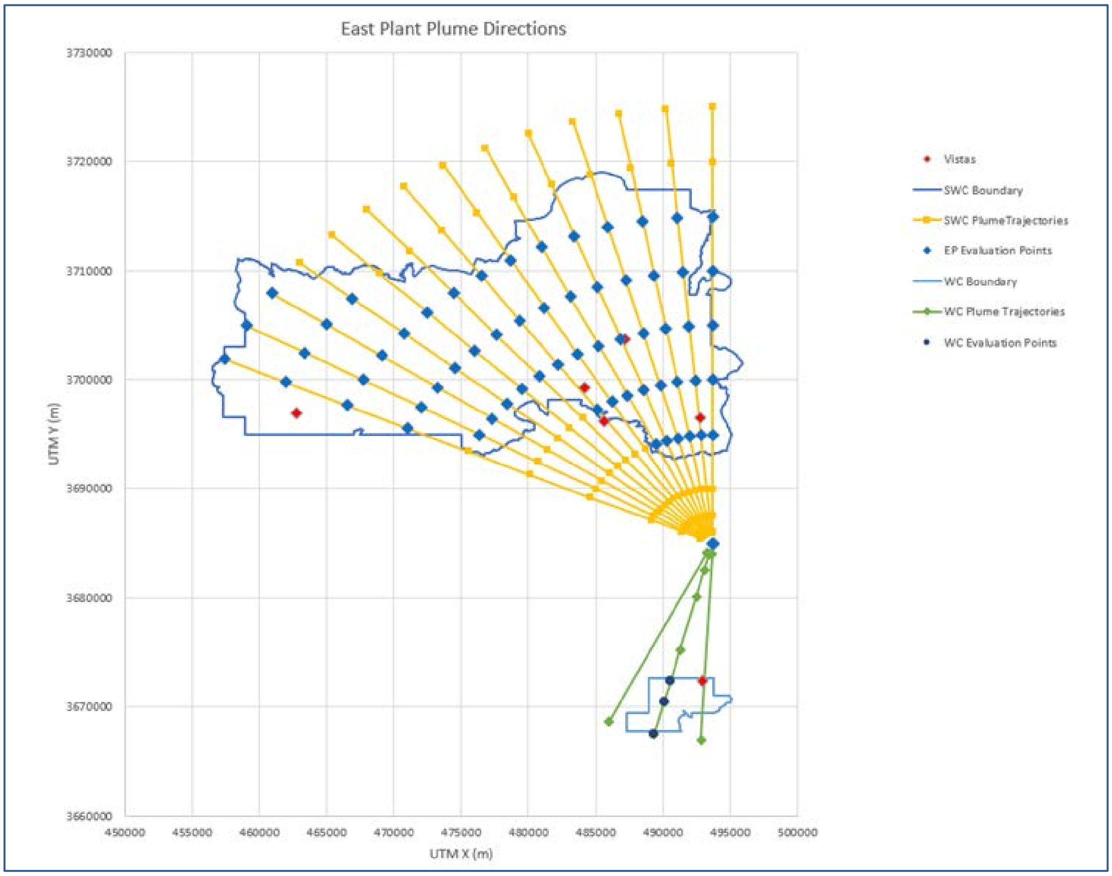
Source	NO_X	SO_2	PM_{10}^
<u>*Proposed Action*</u>			
East Plant + West Plant	0.54	0.15	0.99
TSF Alt 2 (TSF)	0.17	0.003	1.02
Total	*0.71*	*0.15*	*2.00*
<u>*Alternative 3*</u>			
East Plant + West Plant	0.54	0.15	0.98
TSF Alt 3 (TSF)	0.17	0.003	0.99
Total	*0.71*	*0.15*	*1.97*
<u>*Alternative 4*</u>			
East Plant + West Plant	0.54	0.15	0.98
TSF Alt 4 (Silver King)	0.40	0.004	1.00
Total	*0.93*	*0.15*	*1.98*
<u>*Alternative 5*</u>			
East Plant + West Plant	0.54	0.15	0.98
TSF Alt 5 (Peg Leg)	0.21	0.004	1.43
Total	*0.75*	*0.15*	*2.41*
<u>*Alternative 6*</u>			
East Plant + West Plant	0.54	0.15	0.98
TSF Alt 6 (Skunk Camp)	0.17	0.003	1.01
Total	*0.71*	*0.15*	*1.99*

*Emissions from emergency generators have been removed from maximum 24-hour emissions; emergency generators will be used only in "upset conditions" and emissions from the emergency generators are not representative of maximum 24-hour emissions during normal operations.

^PM_{10} emissions due to wind erosion have been removed from maximum 24-hour emissions; PLUVUE II emissions input were based on hourly emissions profiles for wind erosion from exposed surfaces (tailings dry beach, tailings dam, and subsidence area) using the fastest-mile method specified in AP-42, Section 13.2.5

For the Superstition Wilderness, plume trajectories were binned into representative directions passing through the Superstition Wilderness with 5-degree spacing as shown on Figure 3-11. In PLUVUE II, the user must specify the downwind locations along these trajectories where the chemistry and impairment calculations are made. As per the PLUVUE guidance, the first four downwind distance were set to 1, 2.5, 5, and 10 km in order to provide an accurate prediction of the oxidation of NOx to NO_2. Beyond 10 km, an evaluation point was placed every 5 km until the Class I area was spanned. Although PLUVUE makes the calculation at each evaluation point, only points within the Class I area were considered. These points are identified by the blue dots in Figure 3-11.

Figure 3-11. **Source Plume Trajectories**



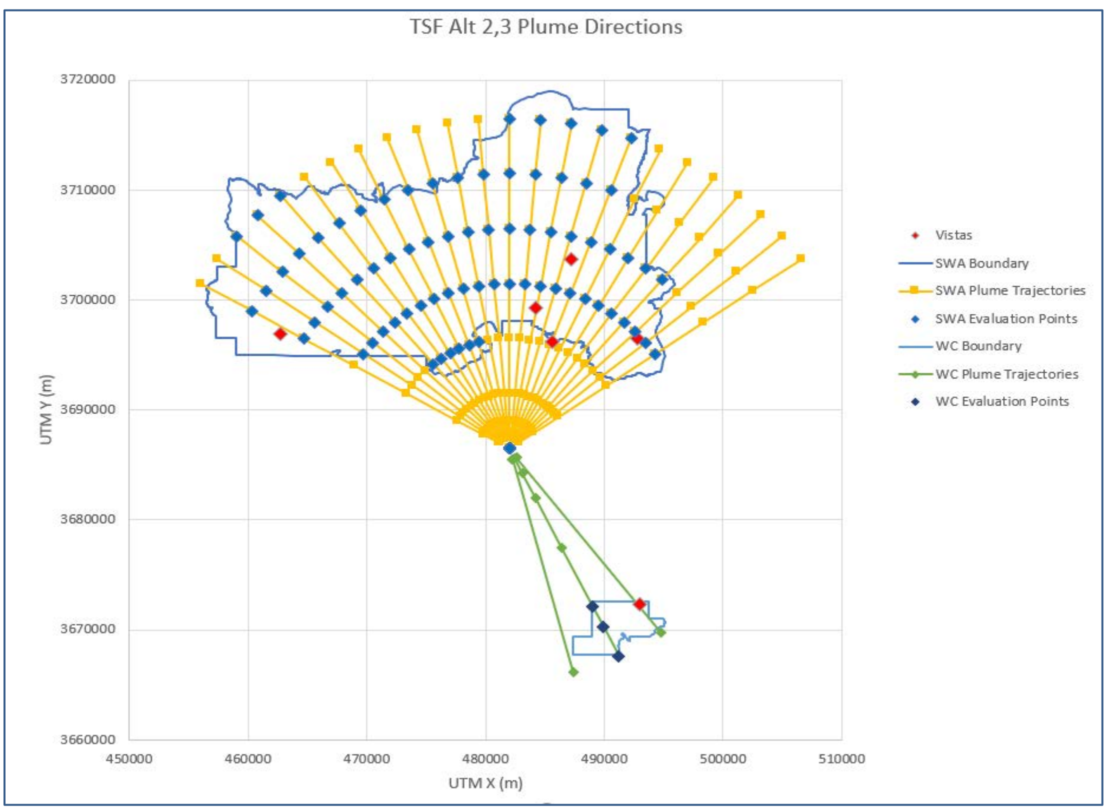
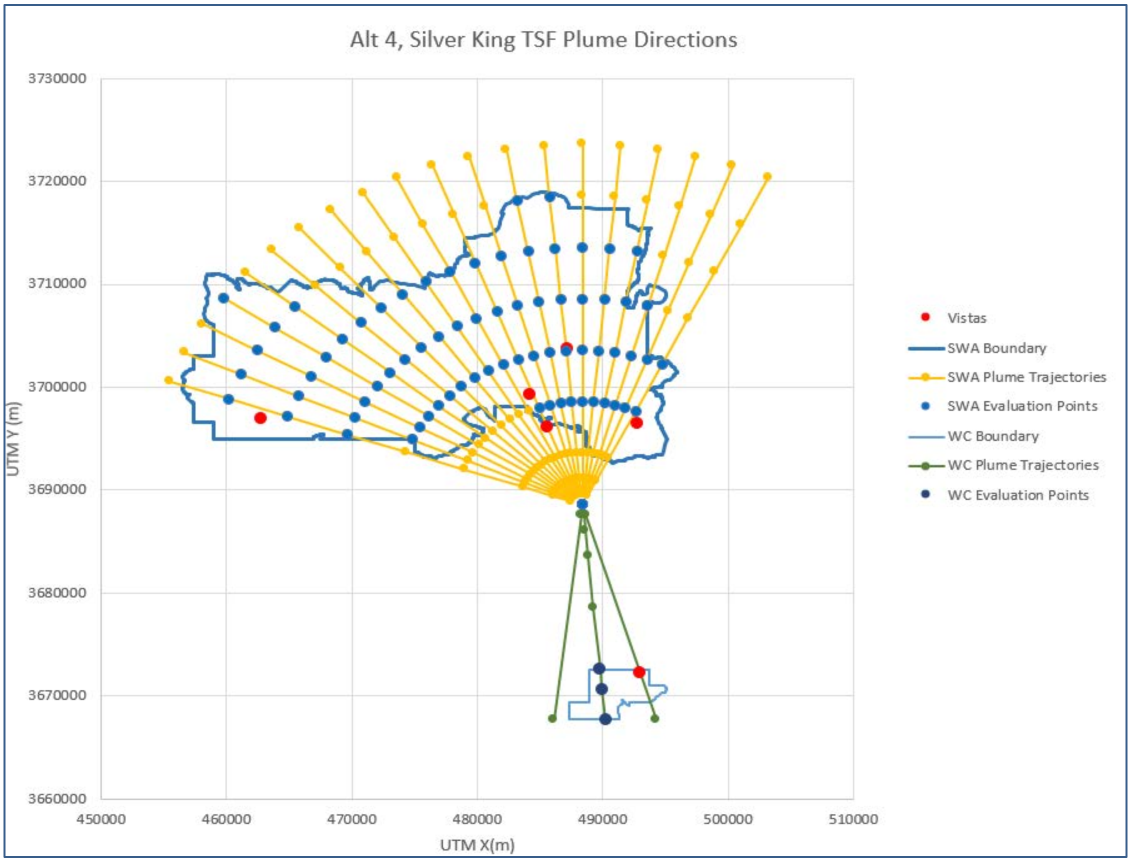


Figure 3-11. Source Plume Trajectories (continued)



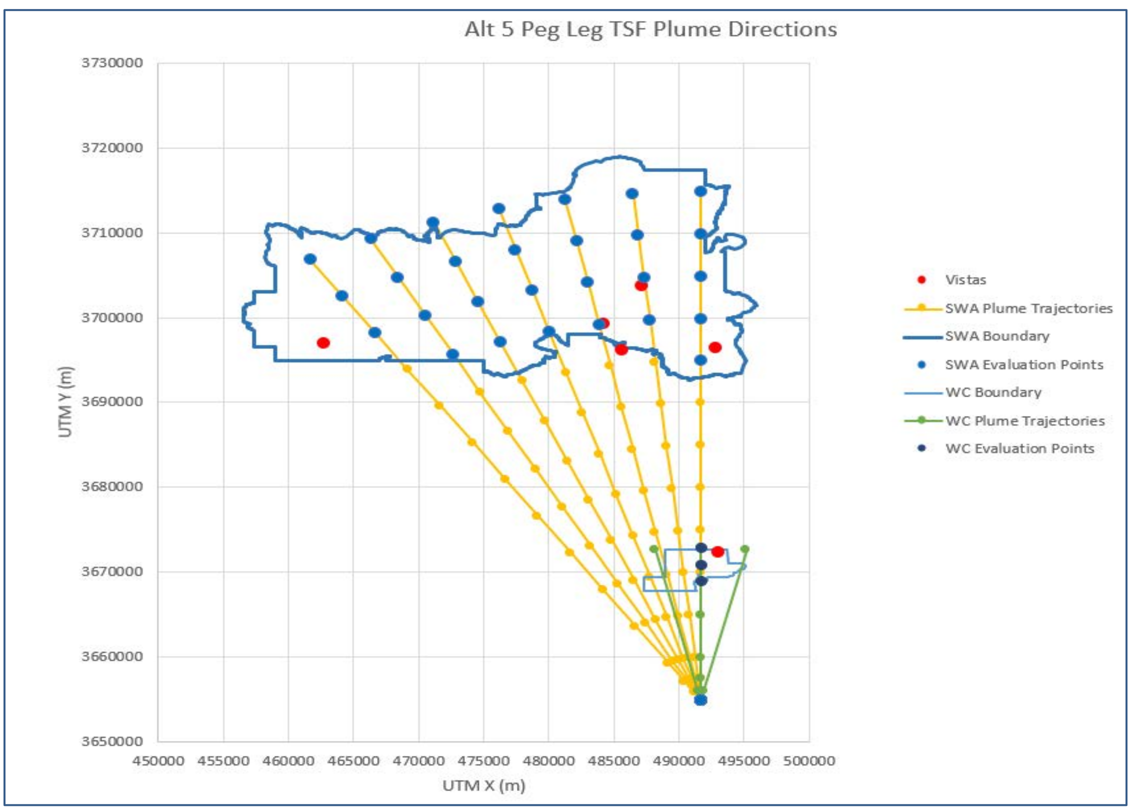
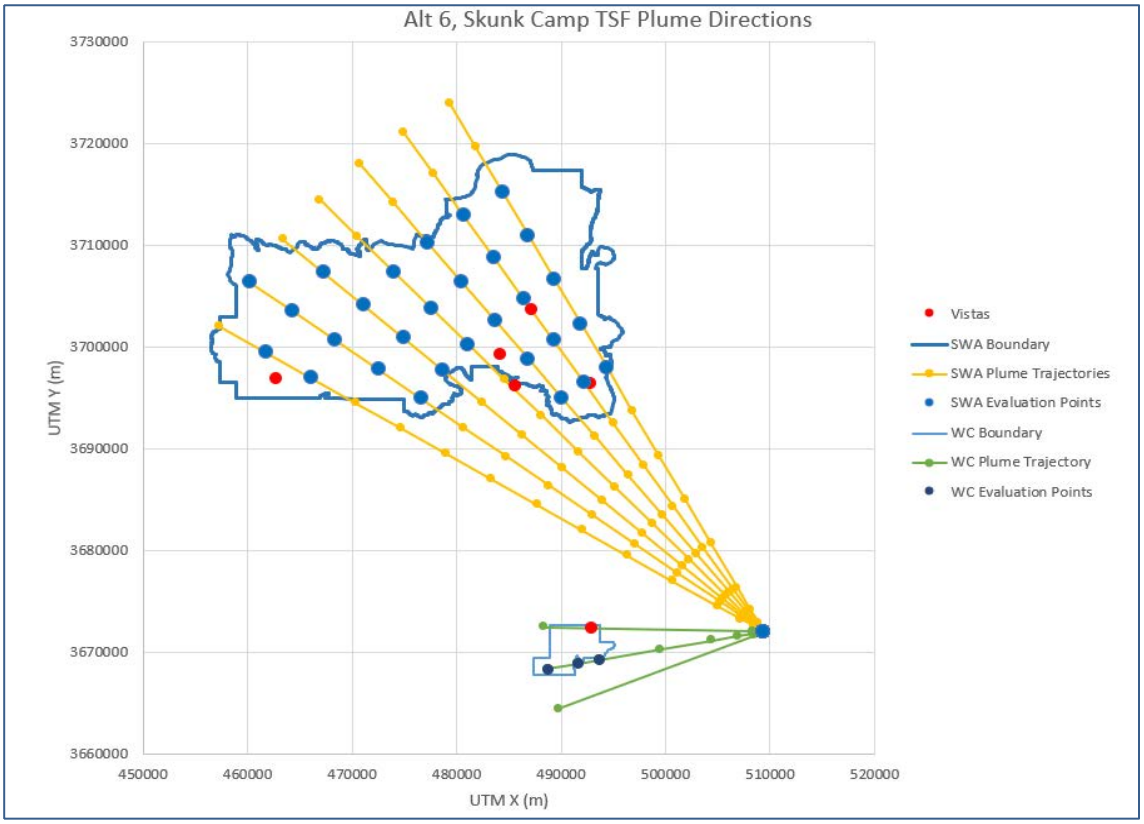


Figure 3-11. Source Plume Trajectories (continued)



For the White Canyon ACEC, a single plume trajectory was used for all plume paths that crossed into the area (shown as the green lines in Figure 3-16). The evaluation points were set to 1, 2.5, 5, 10 km, on the leading edge of the wilderness boundary, in the middle of the area, and on the back edge of the area.

Elevated terrain can block and channel airflow, especially during stable conditions, and it can also increase mechanical mixing and enhance diffusion. To account for this, the stability class was lowered by one step (e.g., from F to E) if the observer was at least 500 meters above the source or if there was terrain between the observer and the source. Complex terrain can also limit the distance and direction a given observer can see. The effects of plume obstruction on views within the Class I area were accounted for in the modeling. For each vista, the view distance can be defined at 15-degree increments. The viewing distance was set to the distance to blocking terrain or the edge of the wilderness area (whichever was closest), with a minimum value of 5 km. The view distances were determined by comparing terrain elevations along a view to the observer elevation. If the terrain exceeded the observer elevation, then the terrain was assumed blocked. Also, views with a plume offset angle of less than 11.25 degrees were eliminated.

The PLUVUE II model requires background pollutant levels for NO_X, NO_2, SO_2, PM_{10}, and ozone (O_3). For these pollutants, average monthly values were calculated from the three years (Quarter 2, 2012 through Quarter 1, 2015) of the EPS onsite monitoring data (shown in Table 3-37). The model also requires background visual range. For this analysis, FLAG 2010 monthly average natural conditions visual range values for the SWA were used (FLAG 2010, Table 10). Table 3-38 provides the average visual range conditions used.

Two years (2015 and 2016) of meteorological data were used for the analysis. For sources near the main project, the closest meteorological station was used (e.g., the East Plant tower for the East Plant source, the Hewitt tower for the TSF, and the West Plant tower for the Silver King area). The approach was to extract the needed parameters (wind speed and direction, temperature, relative humidity, mechanical and convective mixing height, ceiling height and cloud cover) from the AERMET files. Stability class, which is not in AERMOD, was calculated separately using the algorithm from Meteorological Processor for Regulatory Models (MPRM). For the Peg Leg and Skunk Camp alternatives, no nearby meteorological tower data were available, so meteorological data were extracted from the nearest nodes in the MMIF WRF wind field data used for the CALPUFF modeling. Since the MMIF WRF data includes stability class as one of the parameters, stability from the set was used and only adjusted so that the stability class only changed one step in an hour (as per MPRM).

Only daylight hours in which the wind blows towards the Class I area were evaluated. Each applicable hour was evaluated individually, with the wind speed, direction, relative humidity and temperature used. From this, statistics on the estimated frequency and magnitude of the impairment were calculated for the two-year period.

Table 3-37. Background Pollutant Concentrations for Visibility Modeling

Pollutant	Averaging Period	Background Concentration ppb	Background Concentration ($\mu g/m^3$)
SO_2	Jan	0.880	2.26
	Feb	0.707	1.81
	Mar	0.547	1.40
	Apr	0.561	1.44
	May	0.616	1.58
	Jun	0.654	1.68
	Jul	0.601	1.54
	Aug	0.545	1.40
	Sep	0.407	1.04
	Oct	0.869	2.23
	Nov	0.848	2.18
	Dec	1.084	2.78
NO_2	Jan	1.008	3.23
	Feb	0.965	3.09
	Mar	0.267	0.85
	Apr	0.886	2.84
	May	0.639	2.05
	Jun	0.635	2.04
	Jul	0.395	1.27
	Aug	0.436	1.40
	Sep	0.515	1.65
	Oct	1.075	3.44
	Nov	1.685	5.40
	Dec	1.371	4.40
NO_X	Jan	1.340	4.29
	Feb	1.221	3.91
	Mar	0.361	1.16
	Apr	1.090	3.49
	May	0.891	2.86
	Jun	0.906	2.90
	Jul	0.574	1.84
	Aug	0.691	2.22
	Sep	0.685	2.19
	Oct	1.527	4.89
	Nov	2.058	6.60
	Dec	1.638	5.25
O_3	Jan	35.697	68.5
	Feb	40.935	78.6
	Mar	46.362	89.0
	Apr	50.611	97.2
	May	54.777	105.2
	Jun	45.109	86.6
	Jul	45.520	87.4
	Aug	43.912	84.3
	Sep	41.090	78.9
	Oct	41.906	80.5
	Nov	37.245	71.5
	Dec	36.033	69.2

Table 3-38. Average Visual Range Conditions for SWA (km)

Superstition Wilderness Area	
Jan	254
Feb	256
Mar	259
Apr	262
May	263
Jun	264
Jul	261
Aug	258
Sep	259
Oct	260
Nov	258
Dec	254
Average	259

FLAG2010, Table 10

3.2.3.2 Near-Field Visibility Analysis Results

Plume blight is evaluated using absolute contrast (|C|) and the difference in color contrast (ΔE). |C| is the contrast parameter which accounts for the relative difference in intensity between a viewed object and its background. In PLUVUE II, the calculations are done at one wavelength (0.55 μm), which is green in the middle of the spectrum. ΔE is a color contrast parameter that is calculated for the entire visible spectrum and indicates how different the brightness and color of the plume and background are. ΔE is probably the best single indicator of the perceptibility of a plume to both its contrast and its color with respect to a viewing background. An ΔE of 1.0 represents a condition where the viewer is actively looking for a sharp-edged plume under ideal viewing conditions with a uniform viewing background. Under more diffuse plume conditions, a plume with a ΔE of about 2 would be perceivable to many people. Thus, the larger the value, the greater the perceptibility of the plume. For a Level-3 analysis, the more conservative thresholds of |C|=0.02 and ΔE=1 were used (FLAG, 2010). In contrast, the Level-1 and 2 use thresholds of |C|=0.05 and ΔE=2, which correspond to an upper bound threshold of a casual observer in the field (EPA, 1992).

The model was run for each hour that the wind blew towards the wilderness areas to determine if the |C| or ΔE were exceeded in that hour. The model considered view with sky, white, gray and black backgrounds. After the runs (roughly 30,000 total), the results were tabulated to determine the number of hours the threshold was exceeded for each alternative and vista as shown in Table 3-39 and in Figure 3-12, Figure 3-13, Figure 3-14, and Figure 3-15.

Table 3-39. PLUVUE II Results Compared to Threshold Values

Resolution PLUVUE 2 Modeling									
Total Hours:		17544							
Daylight hours:		8772							
Alterative 2,3: East Plant + TSF									
White Canyon:			**Percent**	**Superstition Wilderness Area**					**Percent**
		Hours	**Daylight**	**SRML**	**Montana**	**IronMt**	**MMT**	**GovH**	**Daylight**
Number of daylight hours blows toward area		189	2.2%					2755	31.4%
Parameter	**Viewing Background**	**Hours Over**	**Percent**			**Hours Over**			**Percent**
Contrast	Sky	21	0.2%	266	412	388	332	408	4.7%
Delta E	Sky	17	0.2%	281	378	353	294	363	4.3%
Contrast	White	33	0.4%	319	450	429	408	387	5.1%
Delta E	White	30	0.3%	317	448	434	401	379	5.1%
Contrast	Gray	55	0.6%	565	340	353	337	219	6.4%
Delta E	Gray	28	0.3%	495	271	286	275	177	5.6%
Contrast	Black	114	1.3%	754	796	775	803	661	9.2%
Delta E	Black	67	0.8%	638	590	567	574	487	7.3%
Alterative 4: East Plant + Silver King									
White Canyon:			**Percent**	**Superstition Wilderness Area**					**Percent**
		Hours	**Daylight**	**SRML**	**Montana**	**IronMt**	**MMT**	**GovH**	**Daylight**
Number of daylight hours blows toward area		162	1.8%					2384	27.2%
Parameter	**Viewing Background**	**Hours Over**	**Percent**			**Hours Over**			**Percent**
Contrast	Sky	34	0.4%	207	364	345	305	426	4.9%
Delta E	Sky	30	0.3%	226	328	313	279	379	4.3%
Contrast	White	43	0.5%	262	415	424	394	405	4.8%
Delta E	White	38	0.4%	259	389	394	367	357	4.5%
Contrast	Gray	54	0.6%	421	306	391	380	201	4.8%
Delta E	Gray	35	0.4%	374	249	301	297	143	4.3%
Contrast	Black	93	1.1%	595	783	849	930	715	10.6%
Delta E	Black	63	0.7%	502	568	609	640	501	7.3%
Alternative 5: East Plant + Peg Leg									
White Canyon:			**Percent**	**Superstition Wilderness Area**					**Percent**
		Hours	**Daylight**	**SRML**	**Montana**	**IronMt**	**MMT**	**GovH**	**Daylight**
Number of daylight hours blows toward area		365	4.2%					1303	14.9%
Parameter	**Viewing Background**	**Hours Over**	**Percent**			**Hours Over**			**Percent**
Contrast	Sky	43	0.5%	178	262	255	223	281	3.2%
Delta E	Sky	31	0.4%	174	221	216	188	237	2.7%
Contrast	White	57	0.6%	204	265	273	260	247	3.1%
Delta E	White	51	0.6%	200	254	258	233	221	2.9%
Contrast	Gray	55	0.6%	322	193	217	187	132	3.7%
Delta E	Gray	31	0.4%	293	165	190	153	100	3.3%
Contrast	Black	156	1.8%	422	397	427	422	387	4.9%
Delta E	Black	87	1.0%	361	317	326	313	284	4.1%
Alterative 6: East Plant + Skunk Camp									
White Canyon:			**Percent**	**Superstition Wilderness Area**					**Percent**
		Hours	**Daylight**	**SRML**	**Montana**	**IronMt**	**MMT**	**GovH**	**Daylight**
Number of daylight hours blows toward area		455	5.2%					1930	22.0%
Parameter	**Viewing Background**	**Hours Over**	**Percent**			**Hours Over**			**Percent**
Contrast	Sky	46	0.5%	171	256	249	218	276	3.1%
Delta E	Sky	41	0.5%	171	225	228	195	245	2.8%
Contrast	White	53	0.6%	209	263	277	261	247	3.2%
Delta E	White	49	0.6%	208	253	266	248	225	3.0%
Contrast	Gray	70	0.8%	327	212	241	205	144	3.7%
Delta E	Gray	48	0.5%	298	181	206	173	114	3.4%
Contrast	Black	143	1.6%	458	436	470	444	402	5.4%
Delta E	Black	87	1.0%	380	341	365	335	300	4.3%

Plumes from East Plant are in all of the alternatives, so the main difference in the impacts is due to the location and magnitude of the tailing storage alternatives.

Because White Canyon ACEC has a smaller footprint and is not in the path of a predominant wind direction downwind from the Project's emission sources, all alternatives are modeled to have a much lower frequency of impacting this area. Under worst-case conditions (e.g., |C| with a black background), plumes are slightly more visible in the Peg Leg (1.8% of daylight hours) and Skunk Camp (1.6%) alternatives than the northern alternatives (1.3% for Alt 2/3 and 1.1% at Silver King). For SWA, the wilderness footprint is much larger and some of the alternatives are relatively close to the boundary, so the frequency of impacts is higher. Under worst-case conditions (e.g., |C| with a black background), plumes from the Silver King alternative are most visible (10.6% of daylight hours), followed by the Alternatives 2/3 (9.2 %). Because Peg Leg (4.9%) and Skunk Camp (5.4%) alternatives are more distant (> 20 km) from the SWA boundary, their overall impact modeled with PLUVUE II is lower.

In all cases, the highest ΔE and |C| values are for the black backgrounds, which indicates that the plumes are lighter in color (as shown in Figure 3-12 and Figure 3-13). Note that gray backgrounds are less problematic for views on the eastern side of the wilderness area than on the west (e.g., Superstition Mountain Ridge Line) where the plume is backlit from the morning sun.

Figures Figure 3-13 and Figure 3-14 show the |C| and ΔE values by background (sky, white, gray, and black) and alternatives for each vista. Each column shows the number of hours that the impact is modeled to be over the threshold and the color bands indicate the magnitude (in four impairment ranges). Note that the columns are not additive and should not be summed. The lowest bins (blue) represent hours in which the plume would be unlikely to be noticed by a casual observer. The other classes are more likely to be noticed by an observer. For the SWA, the northern sites have the highest impairment, ranging up to 350 hours per year. For the WC ACEC, the worst-case impacts are less frequent, ranging to about 50 hours per year.

Figure 3-15 shows the time of day the impacts occur using the maximum vista ΔE. The results indicate that > 85% of the impacts occur in the morning hours when wind speeds and plume dispersion are lower. At the WC ACEC, impacts show lower frequency of occurrence and still mostly occur in early morning hours. At the WC ACEC, the Alternative 6 (Silver King) scenario shows a higher percentage of impacts in afternoon hours.

Figure 3-12. Percent of Daylight Hours of Modeled Perceptible Visibility Impact (based on |C| with a black background)

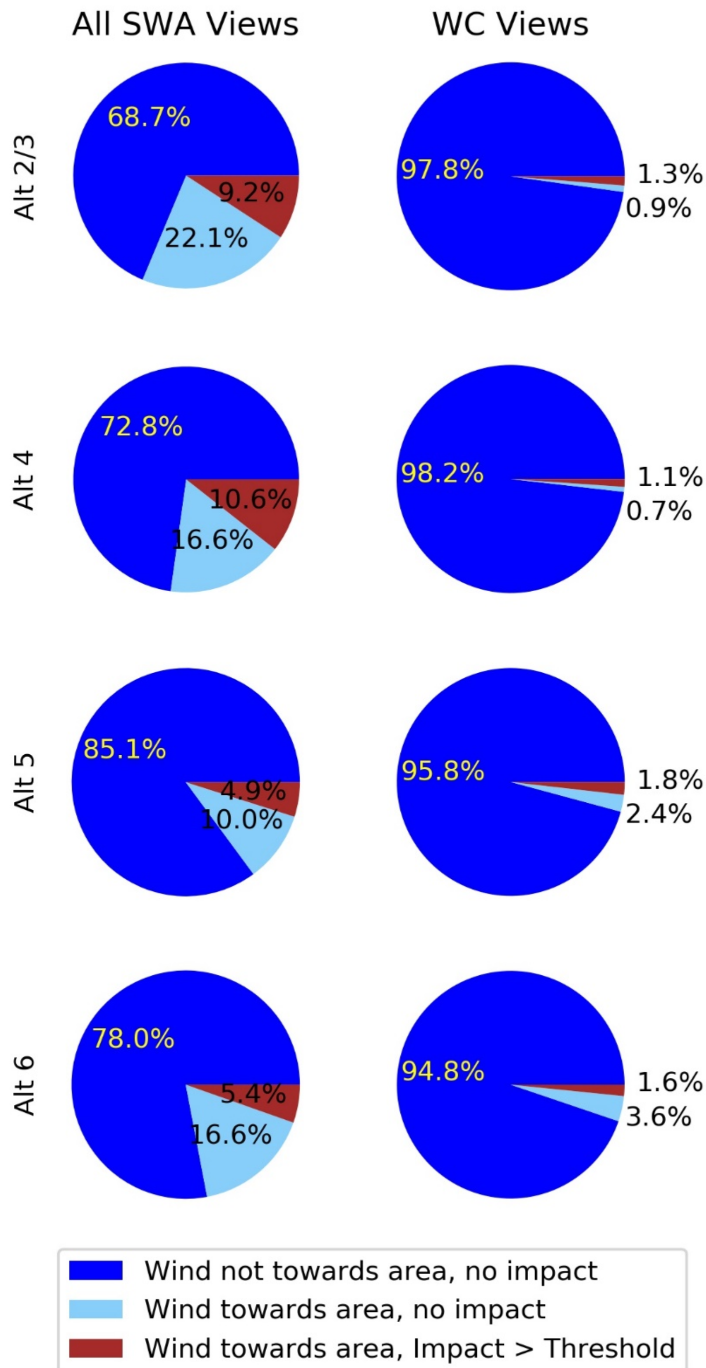


Figure 3-13. **Color Contrast by Vista and Alternative**

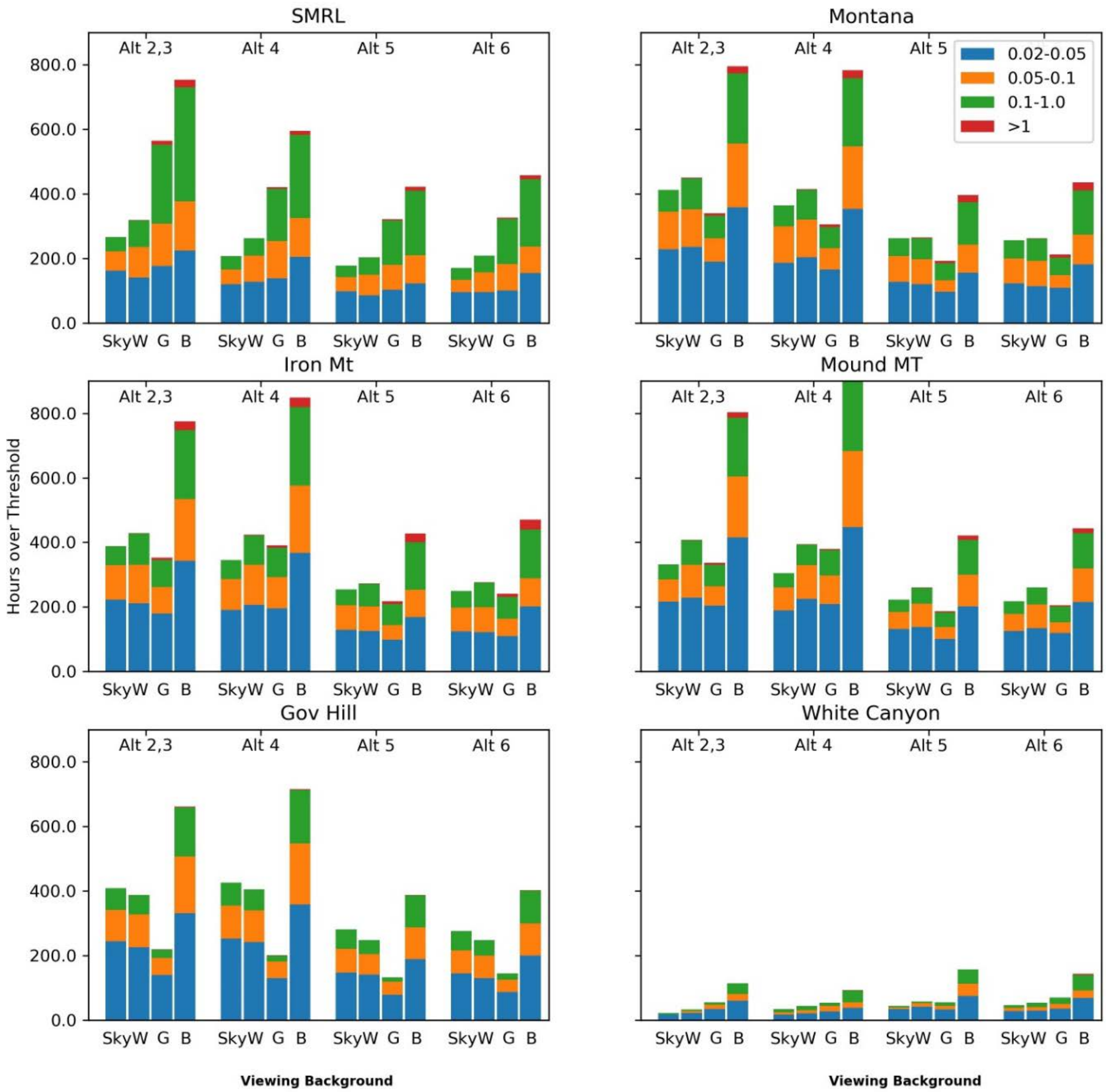


Figure 3-14. ΔE by Vista and Alternative

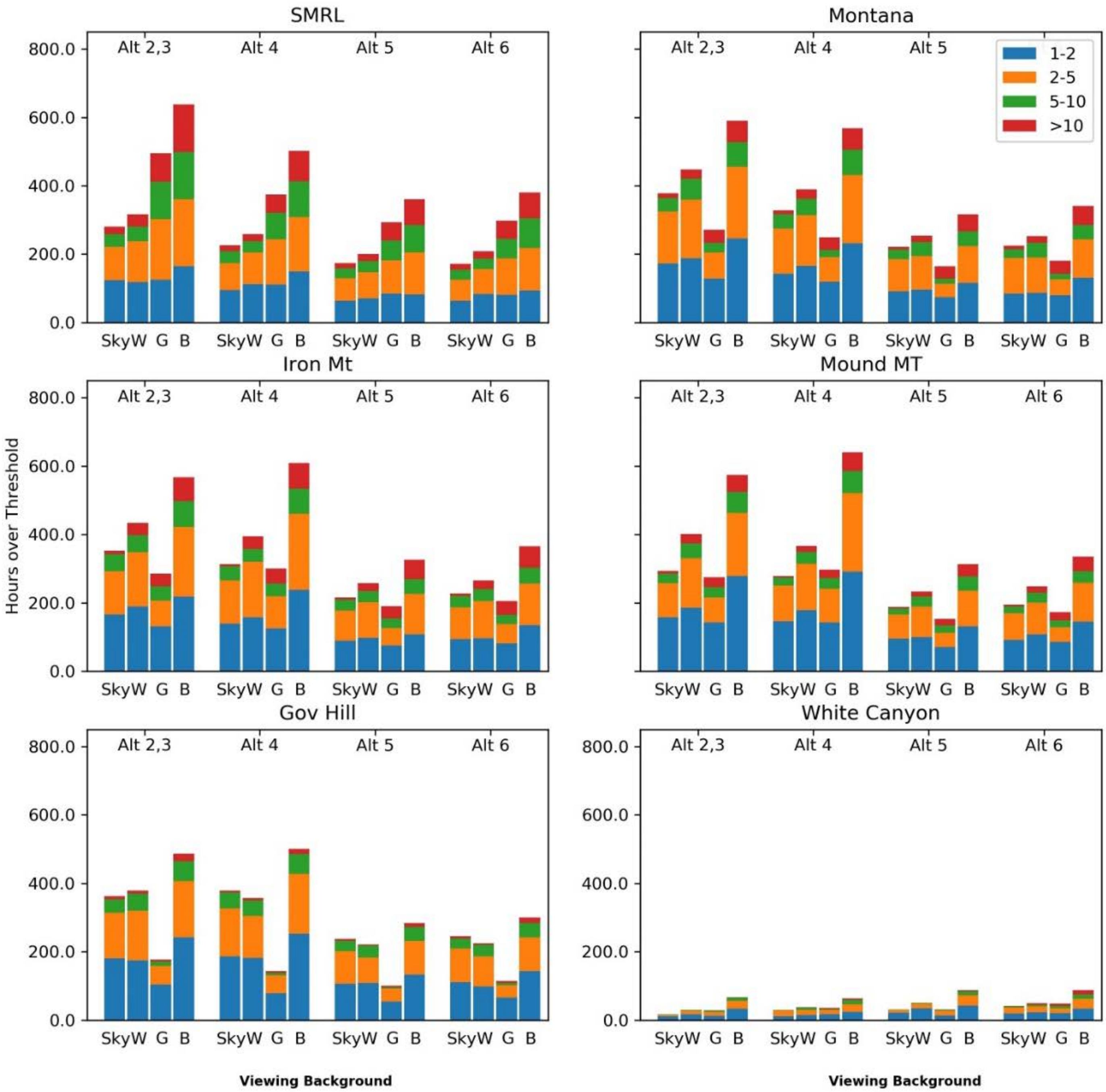
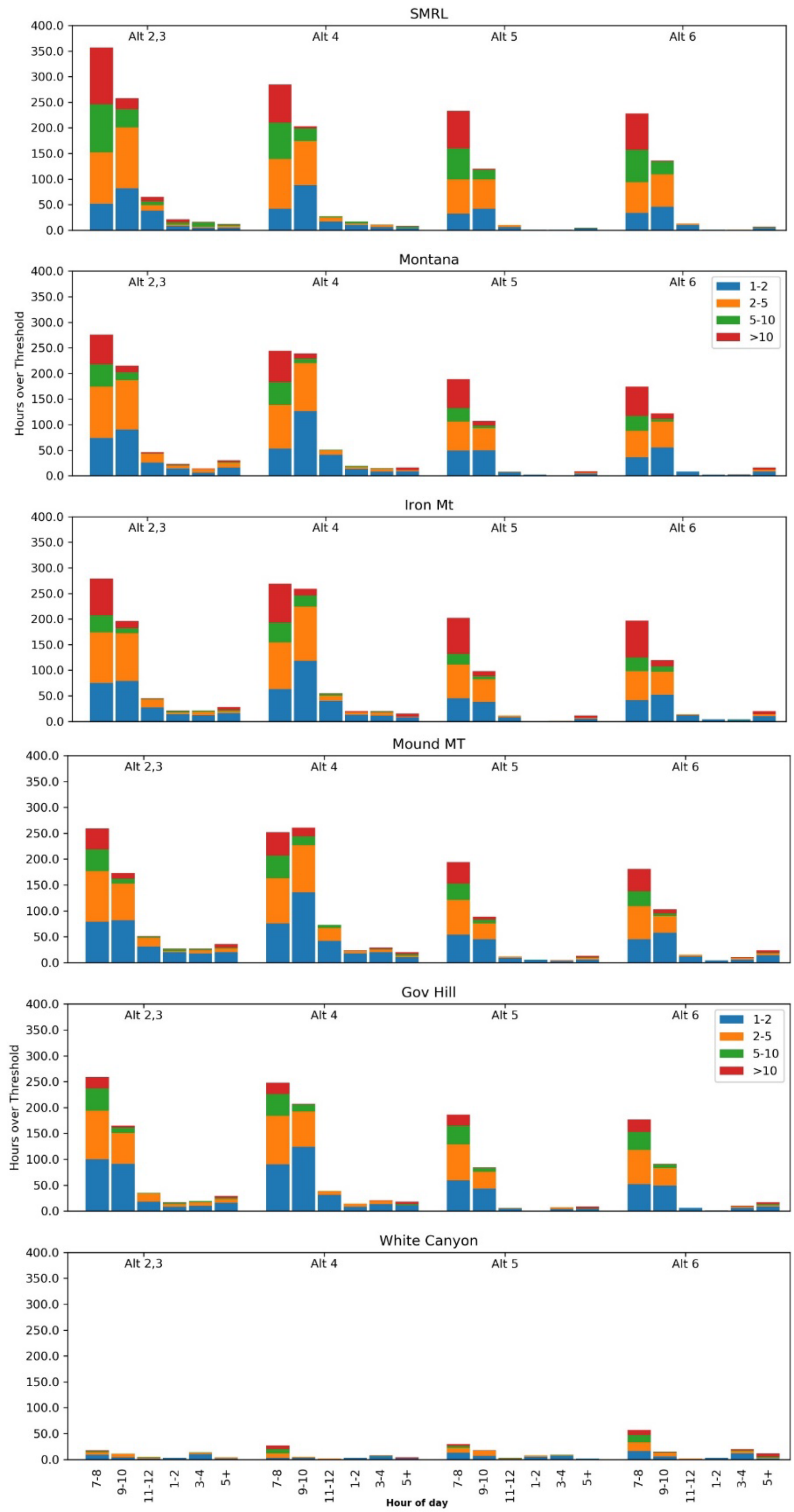


Figure 3-15. Vista Maximum ΔE by Hour



3.2.4 Visibility Impacts in the Far-Field

For the far-field Class I areas (SAWA, MWA, GWA, and SNP), the CALPUFF modeling system was used to estimate the 98th percentile change in light extinction due to the Project emissions for each of the Alternatives. In accordance with the FLAG 2010 report, the modeled extinction changes were compared to a 5% threshold to determine whether any of the Alternatives can be expected to contribute to regional haze visibility impacts.

3.2.4.1 CALPUFF Far-Field Visibility Modeling

The meteorological data, source characterization, receptors, and emissions used for the far-field analyses were identical to the far-field SIL analysis described above in Section 3.2.2.3.4. The visibility extinction threshold is compared to daily modeled visibility extinction, so the short-term emission rates were modeled. However, model settings were different than the SIL analysis; settings appropriate for visibility and deposition modeling were used. Table 3-40 provides the non-default CALPUFF settings for the far-field visibility and deposition analyses. The MESOPUFF II five-pollutant (SO_2, SO_4, NO_X, HNO_3, NO_3) conversion scheme was used.

Table 3-40. Non-Default Options for Visibility & Deposition Modeling in CALPUFF

Option	Setting	Notes
Control Information		
NSPEC	7	SO_2, SO_4, NO_X, HNO_3, NO_3, PMC, PMF
NSE	5	SO_2, SO_4, NO_X, PMC, PMF
Technical Options		
MCHEM	1	Default Option
MWET	1	Default Option
MDRY	1	Deposition turned off for SIL/increment analyses
MREG	0	When chemistry or deposition are turned off, MREG must be turned off
Map and Grid Controls		
PMAP	LCC	Per meteorological data
FEAST	0	Per meteorological data
FNORTH	0	Per meteorological data
UTMHEM	N	Per meteorological data
RLAT0	33.266N	Per meteorological data
RLON0	111.242W	Per meteorological data
XLAT1	32.766N	Per meteorological data
XLAT2	33.766N	Per meteorological data
DATUM	NWS-84	Per meteorological data
NX	75	Per meteorological data
NY	75	Per meteorological data
NZ	10	Per meteorological data
DGRIDKM	4	Per meteorological data
ZFACE	10 levels	Per meteorological data

Option	Setting	Notes
XORIGKM	-150	Per meteorological data
YORIGKM	-150	Per meteorological data
IBCOMP	1	Per meteorological data
JBCOMP	1	Per meteorological data
IECOMP	75	Per meteorological data
JECOMP	75	Per meteorological data
LSAMP	F	Per meteorological data
IBSAMP	1	Per meteorological data
JBSAMP	1	Per meteorological data
IESAMP	75	Per meteorological data
JESAMP	75	Per meteorological data
MESHDN	1	Per meteorological data
Gaseous Dry Deposition	*	See Table 3-41
Particulate Deposition	*	See Table 3-42
Chemistry Parameters		
MOZ	0	Monthly ozone background
BCKO3	*	See Table 3-43
BCKNH3	12*1	(NPS 2010)
Miscellaneous Parameters		
IURB1	1	Per meteorological data
IURB2	1	Per meteorological data
SVMIN	0.5*6, 0.5*6	
WSCAT	ISC RURAL	
PLX0	ISC RURAL	

The parameters used in CALPUFF's gaseous dry and particulate dry and wet deposition algorithms are provided in Table 3-41 and Table 3-42, respectively.

Table 3-41. Gaseous Dry Deposition Parameters

Pollutant	Diffusivity (cm^2/s)	Alpha Star	Reactivity	Mesophyll Resistance (s/cm)	Henry's Law
HNO_3	0.1628	1	18	0	8.00E-08
NO_X	0.1656	1	8	5	3.5
SO_2	0.1509	1,000	8	0	0.04

cm^2/s = square centimeters per second; s/cm = seconds per centimeter

Table 3-42. Particulate Dry and Wet Deposition Parameters

Pollutant	Geometric Mass Mean Diameter (μm)	Geometric Standard Deviation (μm)	Liquid Scavenging Coefficients (s^{-1})	Frozen Precip. Scavenging Coefficients (s^{-1})
SO_2			0.00003	0
SO_4	0.48	2	0.0001	0.00003
NO_X			0	0
HNO_3			0.00006	0
NO_3	0.48	2	0.0001	0.00003
PMC	6.92	3	0.0001	0.00003
PMF	0.48	2	0.0001	0.00003

μm = micrometers; s^{-1} = inverse seconds

The monthly average ozone profile developed from Resolution's ozone monitoring site at East Plant is provided in Table 3-43. The background ammonia was taken from Interagency Workgroup on Air Quality Modeling (IWAQM) guidance, which for arid lands is 1 ppb (EPA 1998).

Table 3-43. Monthly Average Ozone Values, Resolution East Plant Monitoring Site (ppb)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2015	34.5	42.9	48.4	53.7	53.5	49.3	40.9	46.5	40.2	39.3	39.2	36.5
2016	37.1	45.4	54.0	52.1	52.6	49.5	47.7	48.7	39.8	39.7	41.6	38.1
2017	38.9	42.3	48.9	54.9	52.8	42.2	36.9	47.1	45.5	45.0	39.2	42.6

3.2.4.2 POSTUTIL and CALPOST settings for Visibility

The POSTUTIL options to recalculate the HNO_3/NO_3 concentration partition prior to performing other actions were implemented. MNITRATE was set to 1 to recalculate the partition for the all source concentration fields (SO_4, NO_3, HNO_3). POSTUTIL was also set to read the input meteorological files to retrieve the humidity and temperature for the calculation.

CALPOST was set to conform to the configuration outlined in the FLAG guidance (by setting MVISCHECK = 1), which uses annual average aerosol levels and relative humidity factors to calculate the background light extinction (MVISBK = 8, M8_MODE = 5). The background hygroscopic and non-hygroscopic aerosol levels for annual average natural conditions from Table 6 of the FLAG guidance (NPS 2010) were used, provided in Table 3-44 for the selected Class I areas. The monthly average relative humidity (RH) adjustment factors from Tables 7 to 9 of the FLAG guidance were used, provided in Table 3-45, Table 3-46, and Table 3-47.

Table 3-44. **Class I Annual Average Natural Conditions - Concentrations and Rayleigh Scattering**

Class I Area	$(NH_4)_2SO_4$ µg/m³	NH_4NO_3 µg/m³	OM µg/m³	EC µg/m³	Soil µg/m³	CM µg/m³	Sea Salt µg/m³	Rayleigh Mm^{-1}
Sierra Ancha	0.12	0.1	0.6	0.02	0.5	3	0.02	10
Mazatzal	0.12	0.1	0.6	0.02	0.5	3	0.02	10
Galiuro	0.12	0.1	0.6	0.02	0.5	3	0.03	10
Saguaro	0.12	0.1	0.6	0.02	0.5	3	0.06	10

NPS 2010, Table 6

Table 3-45. Class I Monthly $f_L(RH)$ - Large $(NH_4)_2SO_4$ and NH_4NO_3 RH Adjustment Factors

Class I Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sierra Ancha	1.9	1.8	1.6	1.3	1.3	1.1	1.4	1.7	1.5	1.5	1.7	1.9
Mazatzal	1.9	1.8	1.6	1.3	1.3	1.1	1.4	1.6	1.5	1.5	1.6	1.9
Galiuro	1.8	1.7	1.5	1.2	1.2	1.1	1.4	1.7	1.5	1.4	1.6	1.9
Saguaro	1.7	1.6	1.4	1.1	1.1	1.1	1.4	1.6	1.5	1.4	1.5	1.8

Table 3-46. Class I Monthly $f_S(RH)$ - Small $(NH_4)_2SO_4$ and NH_4NO_3 RH Adjustment Factors

Class I Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sierra Ancha	2.4	2.2	1.9	1.5	1.4	1.2	1.6	2.0	1.8	1.7	2.0	2.4
Mazatzal	2.4	2.2	1.9	1.5	1.4	1.2	1.5	1.9	1.7	1.7	1.9	2.3
Galiuro	2.2	2.0	1.7	1.3	1.3	1.1	1.6	2.0	1.8	1.6	1.8	2.3
Saguaro	2.0	1.8	1.6	1.2	1.2	1.1	1.5	1.9	1.7	1.5	1.7	2.3

Table 3-47. Class I Monthly $f_{SS}(RH)$ – Sea Salt RH Adjustment Factors

Class I Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sierra Ancha	2.6	2.4	2.0	1.5	1.4	1.2	1.7	2.1	2.0	1.8	2.2	2.6
Mazatzal	2.6	2.4	2.0	1.5	1.4	1.2	1.7	2.1	1.9	1.8	2.1	2.6
Galiuro	2.4	2.2	1.8	1.4	1.3	1.2	1.8	2.2	1.9	1.7	2.0	2.5
Saguaro	2.2	2.0	1.7	1.2	1.2	1.1	1.7	2.1	1.9	1.7	1.9	2.4

3.2.4.3 Far-Field Visibility Analysis Results

The modeling results (98th percentile change in visible light extinction) for all alternative are shown in Table 3-48 for the Sierra Ancha, Mazatzal, and Galiuro Wilderness Areas. The results are compared with the extinction change threshold (5%). Table 3-48 shows that the expected changes in visibility in the far-field Class I areas are below the 5% threshold.

Table 3-48. Far-Field Class I Visibility Results

Class I Area	Alt.-2	Alt.-3	Alt.-4	Alt.-5	Alt.-6	Extinction Threshold	Below
Sierra Ancha	0.28%	0.28%	0.35%	0.28%	0.27%	5%	Yes
Mazatzal	0.15%	0.15%	0.15%	0.13%	0.14%	5%	Yes
Galiuro	0.13%	0.13%	0.16%	0.16%	0.15%	5%	Yes
Saguaro	0.12%	0.12%	0.13%	0.17%	0.12%	5%	Yes

3.2.5 Acid Deposition

In order to assess potential acid deposition impacts at the Class I areas and WC ACEC, Resolution performed an analysis to evaluate annual sulfur (S) and nitrogen (N) deposition due to project emissions. Guidance suggests that N and S deposition should be evaluated for areas closer than 50 km to the Project, as well as areas more than 50 km for which the Q/D result is greater than 10 (FLAG 2011). The SWA and WC ACEC are less than 50 km from the Project; as detailed above in Section 3.2.2.1, SAWA, MWA, GWA, and SNP are Class I areas for which the Q/D was greater than 10. Therefore, Resolution has modeled N and S deposition rates due to Project emissions in these areas. The estimate rates were compared to the Deposition Analysis Thresholds (DATs), as outlined in the Federal Land Managers' Interagency Guidance for Nitrogen and Sulfur Deposition Analyses (FLAG 2011). A DAT is defined as the additional amount of N or S deposition due to a new or modified source, below which estimated impacts from a proposed new or modified source are considered negligible. The DATs used for S and N (5 g/hectare/year) are applicable to western Federal Land Managers' (FLM) areas.

3.2.5.1 CALPUFF Modeling for N and S Deposition

The CALPUFF modeling system was selected and used to estimate deposition rates for each evaluated FLM area and for each of the Alternatives. Both dry and wet deposition were considered. The model source configuration was identical to the far-field visibility described above in Section 3.2.4.1. The DATs are an annual threshold, so the emissions were identical to long-term emissions described in Section 3.2.2.3.4. Receptors for the Class I areas and the WC ACEC are described above in Sections 3.2.1.2 and 3.2.2.3.3. Table 3-40 provides the non-default CALPUFF settings for the far-field visibility and deposition analyses. The MESOPUFF II five-pollutant (SO_2, SO_4, NO_X, HNO_3, NO_3) conversion scheme was used as were POSTUTIL settings for N and S Deposition.

POSTUTIL was used to process the modeled deposition rates into N and S. A factor is applied to each modeled species deposition rate based on molecular weights. The POSTUTIL settings used to perform this conversion are presented in Table 3-49.

The modeled nitrogen and sulfur deposition rates (g/hectare/year) are provided in Table 3-50 and Table 3-51 for all alternatives and FLM areas. As shown in the tables, the deposition rates were below the applicable DATs for all alternatives and areas.

Table 3-49. POSUTIL Settings for N and S Deposition

Option	Setting	Notes
Control Information		
NSPECINP	7	SO_2, SO_4, NO_X, HNO_3, NO_3, PMC, PMF
NSPECOUT	2	N
NSPECCMP	2	S
CSPECCMP	N	
SO_2	0	
SO_4	0.2917	
NO_X	0.3043	
HNO_3	0.2222	
NO_3	0.4516	
PMC	0	
PMF	0	
CSPECCMP	S	
SO_2	0.5	
SO_4	0.3333	
NO_X	0	
HNO_3	0	
NO_3	0	
PMC	0	
PMF	0	

3.2.5.2 N and S Deposition Analysis Results

The modeled nitrogen and sulfur deposition rates (g/hectare/year) are provided in Table 3-50 and Table 3-51 for all alternatives and FLM areas. As shown in the tables, the deposition rates were below the applicable DATs for all alternatives and areas.

Table 3-50. Nitrogen Deposition Modeling Results

Area	Alt.-2	Alt.-3	Alt.-4	Alt.-5	Alt.-6	DAT	Below
Superstition	2.68	2.67	4.18	2.38	2.39	5	Yes
White Canyon	1.16	1.15	1.48	1.77	2.94	5	Yes
Needle's Eye	0.47	0.47	0.52	0.65	1.06	5	Yes
Sierra Ancha	0.29	0.29	0.33	0.28	0.28	5	Yes
Mazatzal	0.19	0.19	0.18	0.17	0.15	5	Yes
Galiuro	0.09	0.09	0.10	0.15	0.11	5	Yes
Saguaro	0.03	0.03	0.04	0.05	0.03	5	Yes

Table 3-51. Sulfur Deposition Modeling Results

Area	Alt.-2	Alt.-3	Alt.-4	Alt.-5	Alt.-6	DAT	Below
Superstition	1.33	1.33	1.42	1.31	1.31	5	Yes
White Canyon	0.73	0.73	0.74	0.74	0.77	5	Yes
Needle's Eye	0.20	0.20	0.20	0.20	0.22	5	Yes
Sierra Ancha	0.16	0.16	0.16	0.16	0.16	5	Yes
Mazatzal	0.10	0.10	0.10	0.10	0.10	5	Yes
Galiuro	0.04	0.04	0.04	0.05	0.05	5	Yes
Saguaro	0.01	0.01	0.01	0.02	0.01	5	Yes

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Appendix A – Detailed Emission Calculations

Appendix B – Model Input Parameters

Appendix C – Wind Erosion Calculations

Appendix D – Construction Emissions Inventory (Proposed Action)

Appendix E – AERMOD Model Result Impact Figures

Appendix F Evaluation of CALPUFF-ready Meteorological Data

The CALPUFF-ready wind field, described in Section 3.2.2.3.1, was evaluated against DS472.0 stations' observational data using the MMIFstat program. The available DS472.0 stations within the domain are listed in Table F-1 and shown in Figure F-1. The MMIFstat package performs statistics for air temperature, relative humidity, and winds. The metrics computed are those that have been commonly reported for mesoscale model evaluation for air quality modeling.

Table F-1. DS472.0 Stations within CALPUFF Modeling Domain

Station ID	Station/City/Airport Name	Latitude (degrees)	Longitude (degrees)
KBXK	Buckeye	33.4204	-112.6862
KCGZ	Casa Grande	32.9549	-111.7668
KCHD	Chandler	33.27	-111.82
KDMA	Davis-Monthan AFB	32.1667	-110.8833
KDVT	Deer Valley	33.6903	-112.0656
KFFZ	Falcon Field	33.4667	-111.7333
KGEU	Glendale	33.527	-112.2953
KGYR	Goodyear	33.4167	-112.3833
KIWA	Willams Gateway	33.3	-111.6667
KLUF	Luke AFB	33.535	-112.3832
KPAN	Payson	34.2568	-111.3393
KPHX	Sky Harbor International	33.4333	-112.0167
KRYN	Ryan Field	32.1422	-111.1746
KSDL	Scottsdale	33.6225	-111.9083
KSOW	Show Low	34.2667	-110.0
KTUS	Tucson International	32.1167	-110.9333

Performance benchmarks were used to evaluate the WRF simulations. After a review of the literature, the list of applicable benchmarks was developed and is provided in Table F-2, with different benchmarks for simple and complex conditions. Wind speed parameters are provided in m/s, wind directions are in degrees (°) clockwise from north, temperatures values are in degrees Kelvin (°K), and mixing ratios are in grams per kilogram (g/kg) units in Figure F-2. As the humidity benchmark is based on mixing ratio rather than relative humidity, a second step was needed to convert the hourly MMIFstat relative humidity output into mixing ratios for comparison to the benchmark.

Figure F-1. Location of DS472.0 Stations

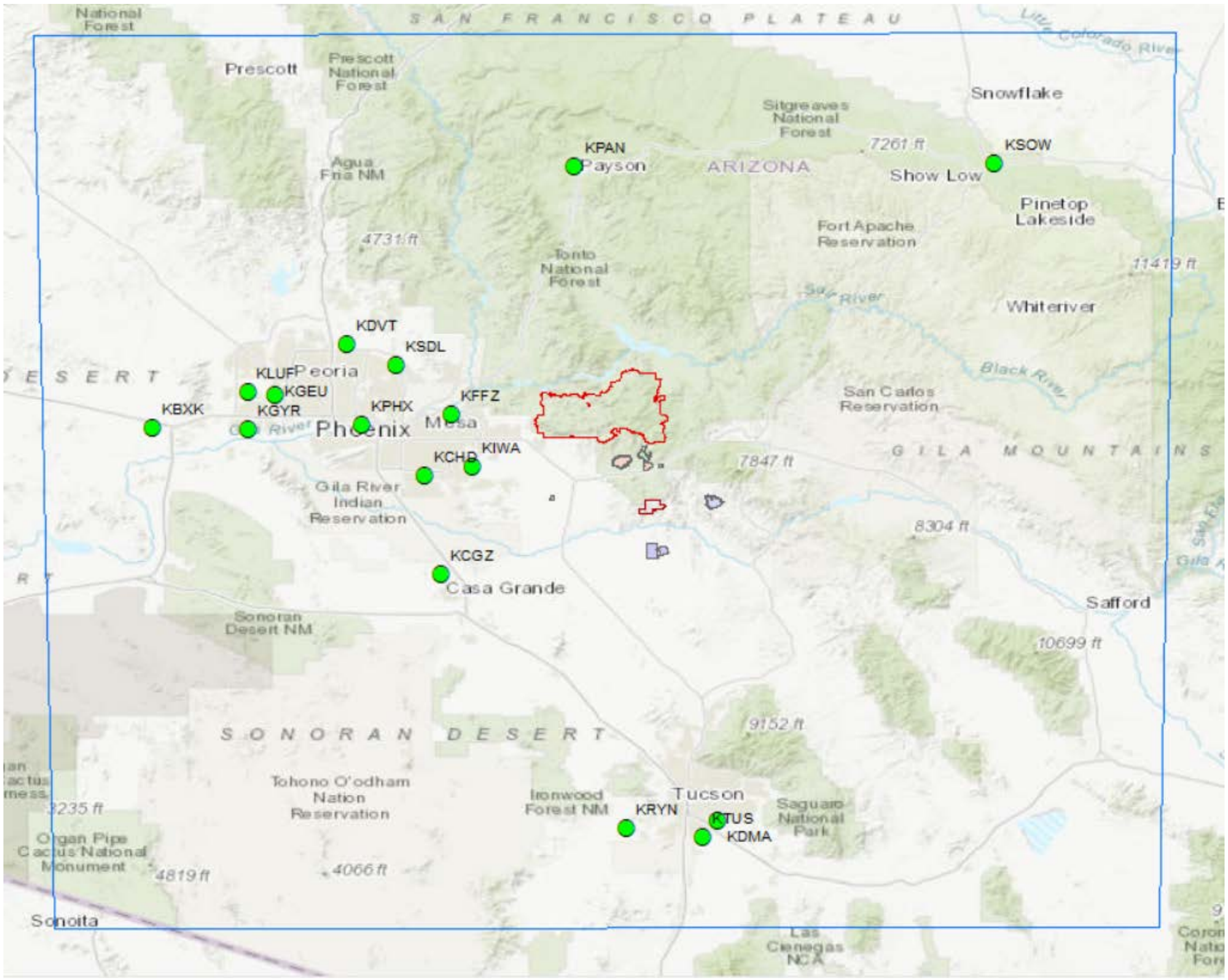


Table F-2. Meteorological Model Performance Benchmarks

Parameter	Simple (Emery et al. 2001)	Complex (Kemball-Cook et al. 2005)	Complex (McNally, D. 2009)	Applied Benchmark
Wind Speed (m/s) Bias	≤ ±0.5	≤ ±1.5	--	≤ ±1.5
Wind Speed (m/s) RMSE	≤ 2.0	≤ 2.5	--	≤ 2.5
Wind Speed IOA	≥ 0.6	--	--	≥ 0.6
Wind Direction (°) Bias	≤ ±10	--	--	≤ ±10
Wind Direction (°) Error	≤ 30	≤ 55	--	≤ 55
Temperature (°K) Bias	≤ ±0.5	≤ ±2.0	≤ ±1.0	≤ ±2.0
Temperature (°K) Error	≤ 2.0	≤ 3.5	≤ 3.0	≤ 3.5
Temperature IOA	≥ 0.8	--	--	≥ 0.8
Mixing Ratio (g/kg) Bias	≤ ±1.0	≤ ±0.8	≤ ±1.0	≤ ±1.0
Mixing Ratio (g/kg) Error	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0
Mixing Ratio IOA	≥ 0.6	--	--	≥ 0.6

The equations for bias, error, root mean square error (RMSE), and Index of Agreement (IOA) are given below.

$$Bias = \left[\frac{1}{N}\sum_{i}^{N}(P_i - O_i)\right]$$

$$Error = \left[\frac{1}{N}\sum_{i}^{N}(|P_i - O_i|)\right]$$

$$RMSE = \left[\frac{1}{N}\sum_{i}^{N}(P_i - O_i)^2\right]^{0.5}$$

$$IOA = 1 - \left[\frac{\sum_i^N (P_i - O_i)^2}{\sum_i^N (|P_i - M| + |O_i - M|)^2}\right]$$

where N is the total number of valid entries over all sites and hours, P_i is the predicted (PRD) value for entry i, O_i is the observed (OBS) value for entry i, and M is the mean observation value.

As much of the modeling domain is in complex conditions, the complex conditions benchmarks were applied. Note that because these benchmarks have been used in annual meteorological modeling studies that include areas with complex terrain and more complicated meteorological conditions, they must be viewed as being applied as guidelines and not bright-line numbers, i.e., the purpose of these benchmarks is not to give a passing or failing grade to any one meteorological model application, but rather to put its results into the proper context of other models and meteorological datasets. Table F-3 and Figure F-2 show the three-year domain-wide statistics for the entire meteorological dataset. The model meets the benchmarks except for the wind speed and mixing ratio IOAs (which are based on the simple terrain benchmarks).

Table F-4, Figure F-3, Figure F-4, and Figure F-5 show the individual station statistics. Figure F-3, Figure F-4, and Figure F-5 show scatterplots of the observed versus predicted daily average wind speed, hourly wind direction, and daily average temperature, respectively, for each station for the three-year period.

The evaluation shows that the WRF data set generally performs well when values in the WRF dataset are compared to the benchmarks. For wind speed, temperature, and mixing ratio, the error and bias comparisons are within the performance benchmarks for all stations. For wind direction, the gross error is within the benchmark for all stations. The wind direction comparisons for some stations show a level of bias which is outside the benchmark, although on average the bias is within the benchmark. The IOAs generally do not show a performance on par with the benchmark, which could be due to the scale of the WRF nodes and complex terrain of the region. Overall, the good performance of the WRF dataset values against the benchmarks confirms that the WRF dataset can be considered to reasonably represent the meteorology of the modeling domain.

Table F-3. Three-Year Meteorological Data Statistics

Parameter	Measure	Benchmark	3-yr Value	Meets Benchmark
Wind Speed (m/s)	Mean OBS		3.52	
	Mean PRD		3.56	
	Bias	≤ ±0.5	0.04	Yes
	Error		1.48	
	RMSE	≤ 2.5	1.84	Yes
	IOA	≥ 0.6	0.52	No
Wind Direction (°)	Mean OBS		190.2	
	Mean PRD		187.0	
	Bias	≤ ±10	7.66	Yes
	Error	≤ 55	46.7	Yes
Temperature (°K)	Mean OBS		295.7	
	Mean PRD		296.0	
	Bias	≤ ±2	0.34	Yes
	Error	≤ 3.5	1.9	Yes
	RMSE		2.3	
	IOA	≥ 0.8	0.91	Yes
Humidity Mixing Ratio (g/kg)	Mean OBS		6.06	
	Mean PRD		5.65	
	Bias	≤ ±1	-0.41	Yes
	Error	≤ 2	1.05	Yes
	RMSE		1.24	
	IOA	≥ 0.6	0.55	No

Figure F-2. Three-Year Meteorological Data Statistics

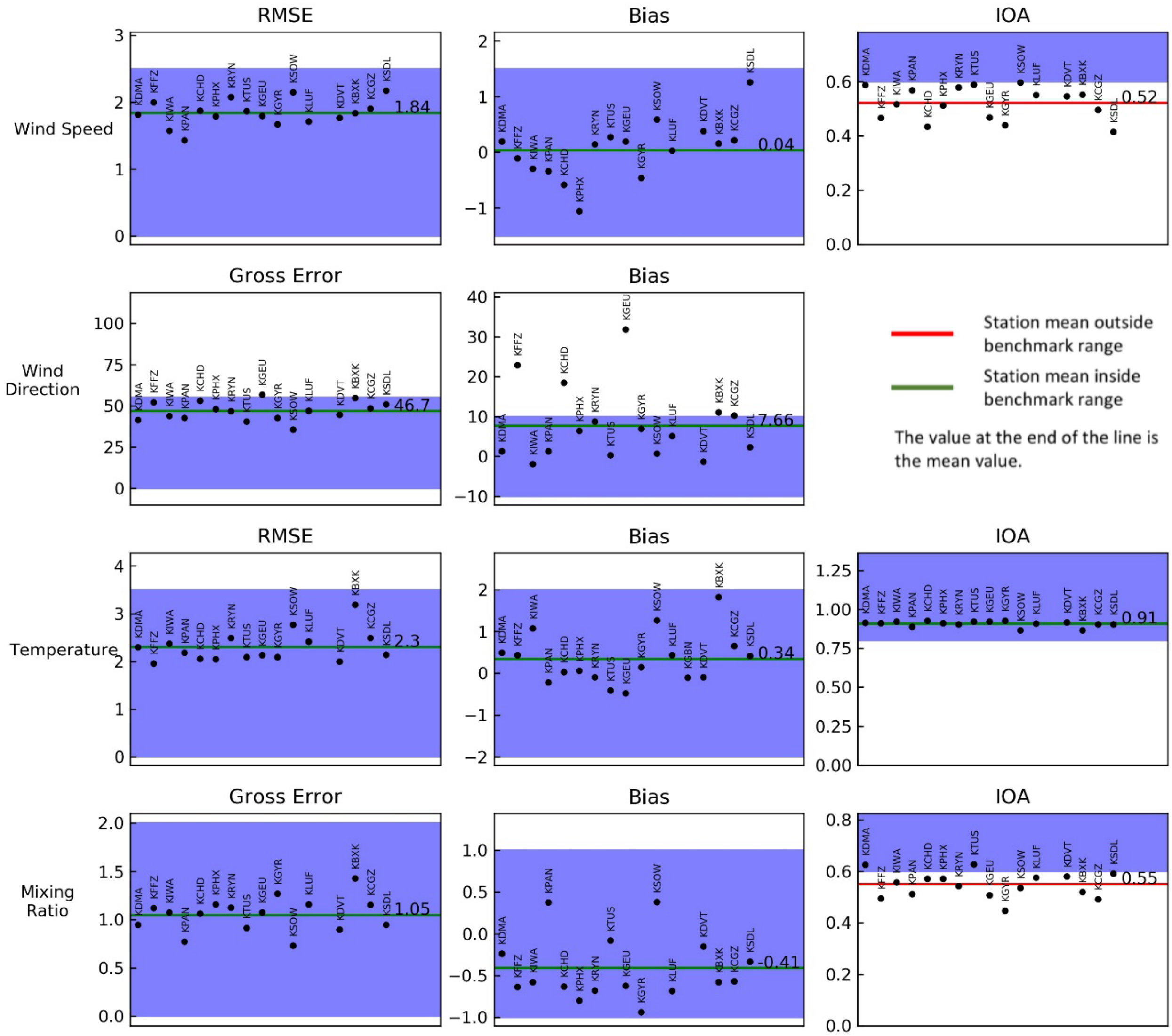


Table F-4. Performance Statistics for Individual Stations

Parameter	KBXK	KCGZ	KCHD	KDMA	KDVT	KFFZ	KGEU	KGYR
Wind Speed (m/s) Mean OBS	3.20	3.43	3.75	3.53	3.29	4.02	3.36	3.71
Wind Speed (m/s) Mean PRD	3.36	3.64	3.18	3.73	3.67	3.91	3.56	3.25
Wind Speed (m/s) Bias	0.16	0.22	-0.58	0.20	0.38	-0.11	0.20	-0.46
Wind Speed - Gross Error	1.47	1.52	1.50	1.43	1.41	1.64	1.43	1.38
Wind Speed (m/s) RMSE	1.84	1.90	1.88	1.82	1.77	2.00	1.80	1.67
Wind Speed (m/s) IOA	0.55	0.50	0.43	0.59	0.55	0.47	0.47	0.44
Wind Direction (°) Mean OBS	166	193	210	189	171	209	173	183
Wind Direction (°) Mean PRD	166	202	206	190	169	175	193	190
Wind Direction (°) Bias	11.1	10.3	18.5	1.3	-1.3	23	32	7
Wind Direction (°) Gross Error	54.77	48.48	52.97	41.52	44.50	52.06	56.73	42.72
Temperature (°K) Mean OBS	295.83	296.51	298.43	294.63	296.65	299.42	299.27	298.57
Temperature (°K) Mean PRD	297.65	297.17	298.47	295.12	296.56	299.86	298.80	298.72
Temperature (°K) Bias	1.83	0.66	0.03	0.49	-0.09	0.44	-0.47	0.14
Temperature (°K) Gross Error	2.67	2.06	1.67	1.90	1.62	1.64	1.74	1.72
Temperature (°K) RMSE	3.19	2.49	2.05	2.30	2.00	1.96	2.13	2.09
Temperature (°K) IOA	0.87	0.91	0.93	0.91	0.92	0.91	0.92	0.93
Humidity (g/kg) Mean OBS	6.47	6.78	6.26	6.15	5.88	6.50	6.26	6.58
Humidity (g/kg) Mean PRD	5.89	6.21	5.63	5.91	5.73	5.87	5.64	5.64
Humidity (g/kg) Bias	-0.58	-0.57	-0.63	-0.24	-0.15	-0.63	-0.62	-0.94
Humidity (g/kg) Gross Error	1.43	1.15	1.06	0.95	0.89	1.12	1.08	1.27
Humidity (g/kg) IOA	1.81	1.35	1.24	1.13	1.08	1.30	1.23	1.43
Humidity (g/kg) RMSE	0.52	0.49	0.57	0.63	0.58	0.50	0.51	0.45

Table F-4. Performance Statistics for Individual Stations (continued)

Parameter	KIWA	KLUF	KPAN	KPHX	KRYN	KSDL	KSOW	KTUS
Wind Speed (m/s) Mean OBS	3.19	3.16	3.35	3.39	3.99	2.66	4.66	3.70
Wind Speed (m/s) Mean PRD	2.90	3.19	3.02	2.33	4.14	3.92	5.25	3.98
Wind Speed (m/s) Bias	-0.29	0.03	-0.33	-1.05	0.14	1.26	0.59	0.28
Wind Speed - Gross Error	1.23	1.36	1.15	1.46	1.69	1.78	1.73	1.48
Wind Speed (m/s) RMSE	1.57	1.71	1.43	1.79	2.08	2.18	2.15	1.87
Wind Speed (m/s) IOA	0.52	0.55	0.57	0.51	0.58	0.42	0.60	0.59
Wind Direction (°) Mean OBS	164.78	220.68	189.50	173.95	220.89	204.62	187.30	187.23
Wind Direction (°) Mean PRD	165.83	205.86	181.32	184.27	223.63	173.20	178.89	191.44
Wind Direction (°) Bias	-1.88	5.21	1.36	6.43	8.82	2.38	0.70	0.34
Wind Direction (°) Gross Error	43.87	46.96	42.52	47.85	46.71	50.82	35.50	40.51
Temperature (°K) Mean OBS	295.61	296.76	288.72	298.18	297.61	297.02	284.28	295.39
Temperature (°K) Mean PRD	296.69	297.19	288.51	298.24	297.52	297.43	285.55	294.99
Temperature (°K) Bias	1.08	0.44	-0.21	0.06	-0.09	0.41	1.27	-0.41
Temperature (°K) Gross Error	1.98	2.01	1.80	1.69	2.05	1.76	2.28	1.73
Temperature (°K) RMSE	2.37	2.41	2.18	2.05	2.49	2.14	2.77	2.09
Temperature (°K) IOA	0.92	0.91	0.89	0.91	0.90	0.91	0.87	0.92
Humidity (g/kg) Mean OBS	6.44	6.67	4.64	6.39	6.30	5.94	4.09	6.01
Humidity (g/kg) Mean PRD	5.87	5.99	5.02	5.59	5.62	5.61	4.47	5.93
Humidity (g/kg) Bias	-0.58	-0.68	0.38	-0.80	-0.68	-0.33	0.38	-0.08
Humidity (g/kg) Gross Error	1.07	1.16	0.77	1.16	1.13	0.95	0.73	0.91
Humidity (g/kg) IOA	1.27	1.37	0.91	1.36	1.30	1.14	0.87	1.10
Humidity (g/kg) RMSE	0.56	0.58	0.51	0.57	0.54	0.59	0.54	0.63

Figure F-3. OBS vs. PRD Daily Average Wind Speed Scatterplot by Station (m/s)

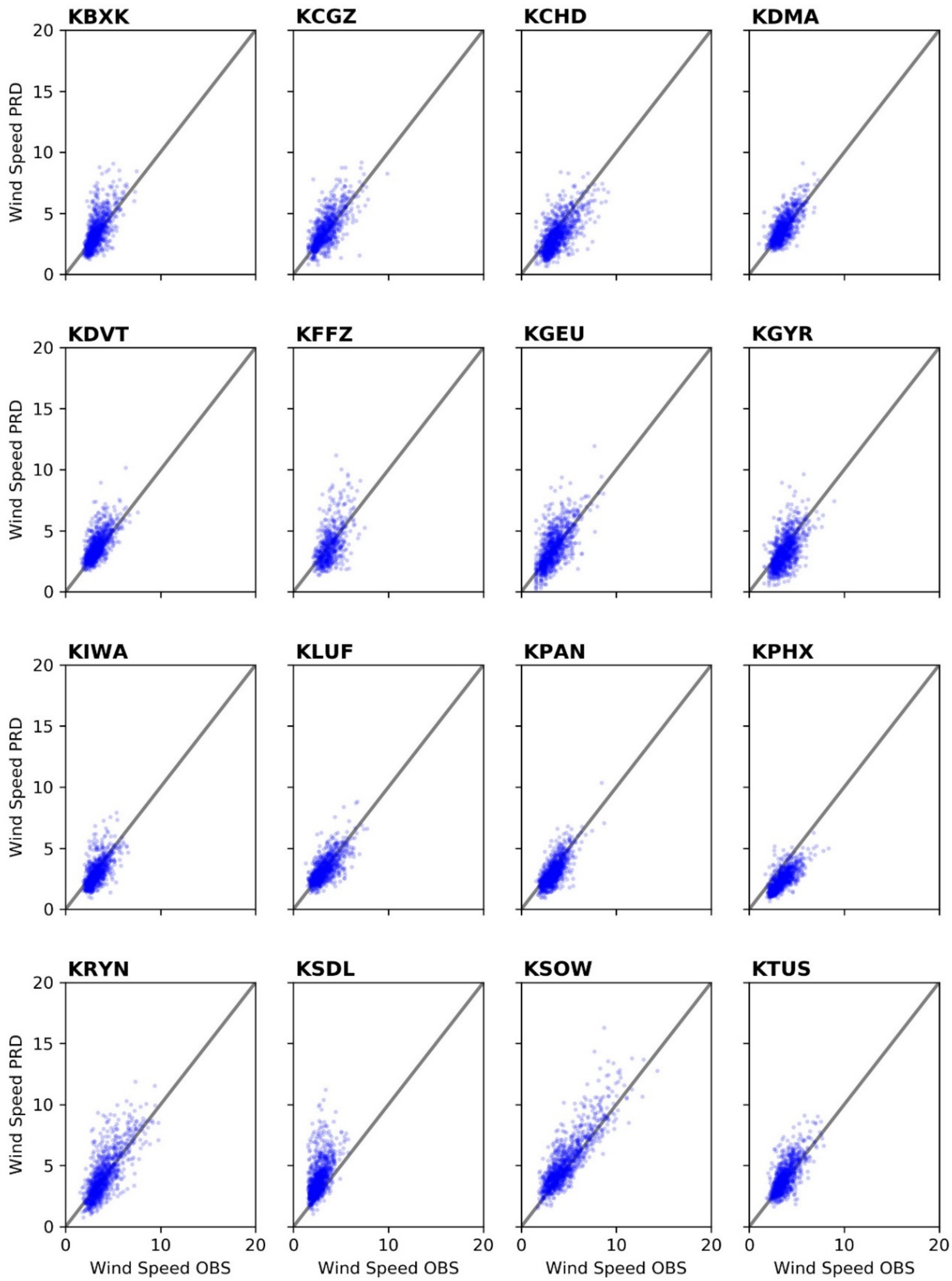
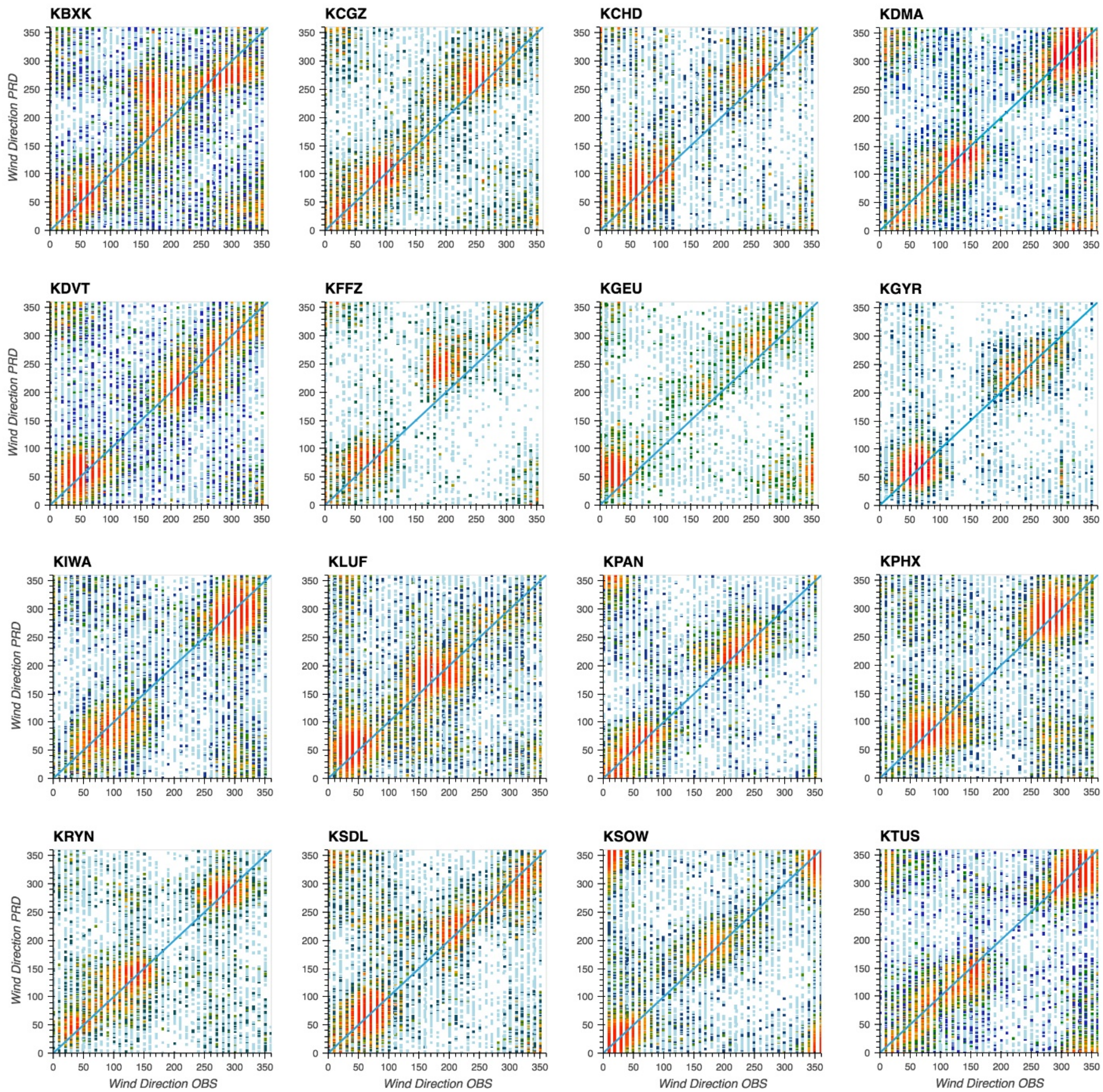
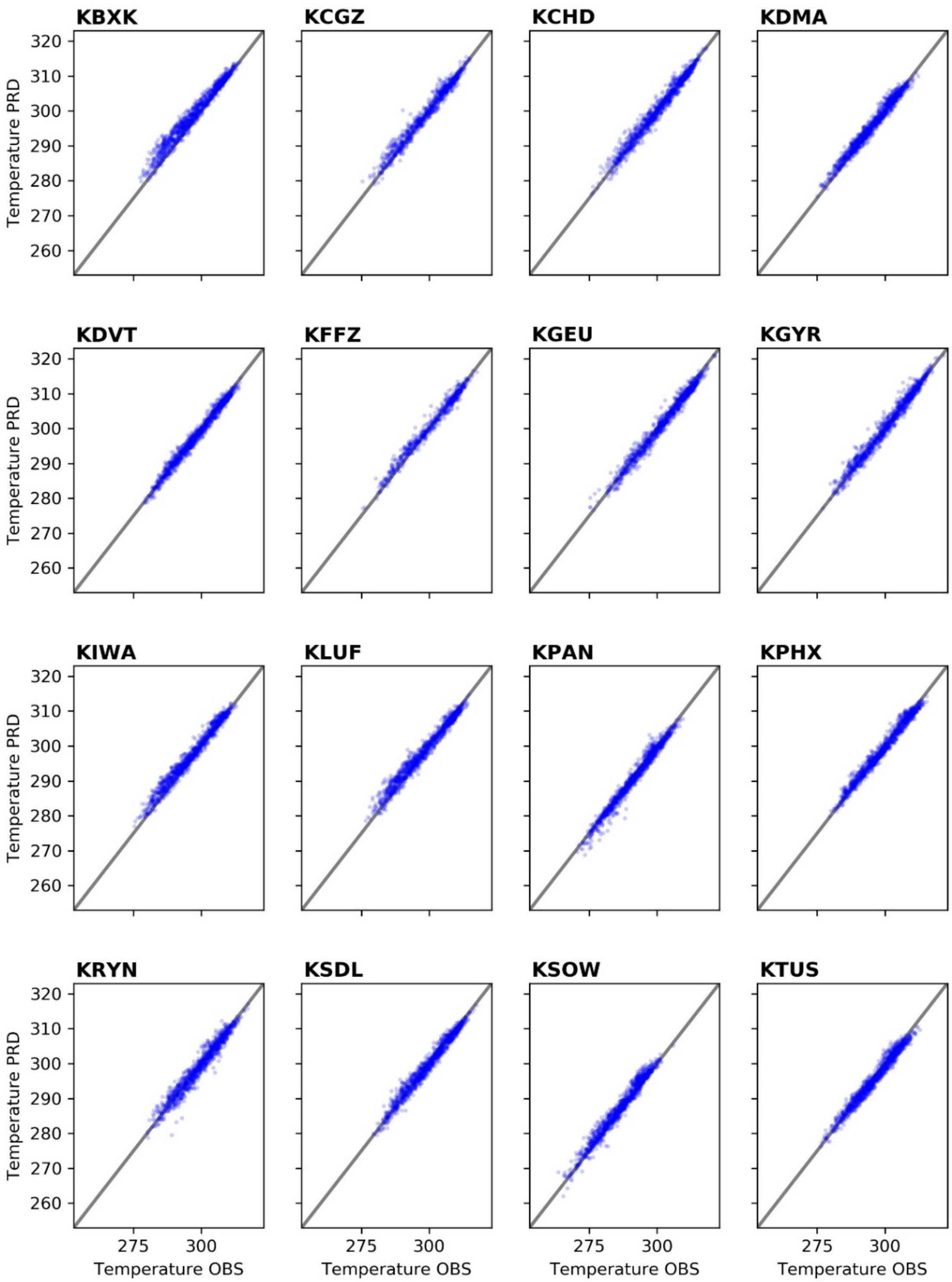


Figure F-4. OBS vs. PRD Hourly Wind Direction Scatterplot by Station (°)



The marker color represents the number of counts (blue = low and red = high) in any wind direction bin. The blue line is the 1-to-1 line.

Figure F-5 OBS vs. PRD Daily Average Temperature Scatterplot by Station (°K)



Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: D. Steen		
	PROJECT NO: 262	PAGE: 1	OF: 1	SHEET: TOC
AIR EMISSION CALCULATIONS	SUBJECT: Appendix A - Table of Contents	DATE: January 28, 2019		

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
	PROJECT NO: 262	PAGE: 1	OF: 2	SHEET: Gen Info
AIR EMISSION CALCULATIONS	SUBJECT: General Mining and Milling Information	DATE: January 11, 2019		

Mining Information

Mine Throughput

	Production	
tonne/hr	8,940	*Resolution*
tonne/day	143,750	*Resolution*
tonne/yr	45,625,000	*Resolution*
ton/hr	9,855	
ton/day	158,457	
ton/yr	50,292,894	

Material Moisture Content and Wind Speed

Location	Solids* %	Ore Moisture* Content %		Air/Wind Speed* *mph*	*m/s*
EAST PLANT					
LHD/Ore Pass/Grizzly		4.0		1.4	0.6
Haulage Ore Flow		4.0		2.2	1.0
Primary Crushing Ore Flow		4.0		4.0	1.8
Lower Level Conveyor Ore Flow		4.0		2.4	1.1
Hoisting System Ore Flow		4.0		1.3	0.6
Upper Level Conveyor System Ore Flow		4.0		4.5	2.0
WEST PLANT					
Incline Conveyor to Mine Transfer Conveyor	96.0	4.0		1.3	**
Enclosed Stockpile	95.8	4.2		1.3	**
Stockpile Reclaim	95.8	4.2		1.3	**
SAG Feeder Conveyors		4.8	**	1.3	**
Pebble Recycle		4.8	**	1.3	**
Holoflite Dryer - In		4.8	**	1.3	**
Holoflite Dryer - Out		4.8	**	1.3	**
LOADOUT					
All		4.8	**	1.3	**

** Resolution*
*** AP-4, Ch. 13.2.4*

Silt Content

Surface	3.0%	*AP-42, Chapter 13.2.2, Related Information, r13s0202_dec03.xls*

Conversions

1.10231	*ton/tonne*
907.185	*kg/ton*
2.237	*mph/mps*
24	*hr/day*
365	*day/yr*
8,760	*hr/yr*

Blue values are input; black values are calculated or linked

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
	PROJECT NO: 262	PAGE: 2	OF: 2	SHEET: Gen Info
AIR EMISSION CALCULATIONS	SUBJECT: General Mining and Milling Information	DATE: January 11, 2019		

Milling Information

Mill Throughput

	Coarse Ore Stockpile	Entering Each SAG Mill (2)	Each SAG Mill Processing (2)	Each Screen Screen O'Size (2)	Entering Each Ball Mill (4)
tonne/hr	8,940	4,296	4,296	1,060	7,011
tonne/day	143,750	94,875	94,875	23,390	154,808
tonne/yr	45,625,000	30,112,500	30,112,500	7,424,100	49,134,616
ton/hr	9,855	4,736	4,736	1,168	7,728
ton/day	158,457	104,582	104,582	25,783	170,646
ton/yr	50,292,894	33,193,310	33,193,310	8,183,660	54,161,579

Mill Throughput Continued

	Pebble Circuit	Moly Filter Cake to Dryer	Dried Moly Concentrate	Cu Concentrate Loadout
tonne/hr	1,042	10.0	9.0	414
tonne/day	23,000	238.0	213.0	9,942
tonne/yr	7,300,000	41,176.0	36,842.0	3,338,889
ton/hr	1,149	11	10	456
ton/day	25,353	262	235	10,959
ton/yr	8,046,863	45,389	40,611	3,680,491

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: D. Steen		
	PROJECT NO: 262	PAGE: 1	OF: 2	SHEET: Summary_DISP
AIR EMISSION CALCULATIONS	SUBJECT: Facility-Wide Emissions	DATE: January 11, 2019		

FACILITY - CONTROLLED - EMISSIONS SUMMARY (INCLUDING FUGITIVES)

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Location	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
EP Surface Subtotal	34.6	11.6	134	33.8	0.80	0.21	9.9	8.7	5.3	2.4	13.4	3.4
EP UG Subtotal	265	193	35.4	22.4	6.9	1.8	50.4	70.3	14.8	29.7	6.9	8.3
West Plant Subtotal	42.0	43.3	10.1	15.8	5.2	15.0	26.5	36.4	4.9	10.9	23.3	68.9
Loadout Subtotal	18.6	25.3	6.8	5.7	3.0E-2	5.9E-2	0.77	2.5	0.26	0.52	1.1	1.5
Tailings Subtotal	119	343	14.7	40.7	0.25	0.73	84.9	211	13.5	34.3	7.7	20.6
FACILITY TOTAL	***479***	***616***	***201***	***118***	***13.2***	***17.8***	***172***	***329***	***38.8***	***77.8***	***52.4***	***103***

FACILITY - UNCONTROLLED - EMISSIONS SUMMARY (INCLUDING FUGITIVES)

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Location	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
EP Surface Subtotal	34.6	11.6	134	33.8	0.80	0.21	100	51.7	18.5	8.4	13.4	3.4
EP UG Subtotal	265	193	35.4	22.4	6.9	1.8	1,866	2,271	288	483	6.9	8.3
West Plant Subtotal	42.0	43.3	10.1	15.8	84.9	272	345	622	126	360	175	558
Loadout Subtotal	18.6	25.3	6.8	5.7	3.0E-2	5.9E-2	3.0	11.3	0.53	1.6	1.1	1.5
Tailings Subtotal	119	343	14.7	40.7	0.25	0.73	807	1,999	106	265	7.7	20.6
FACILITY TOTAL	***479***	***616***	***201***	***118***	***92.9***	***275***	***3,122***	***4,955***	***538***	***1,117***	***204***	***592***

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: D. Steen		
	PROJECT NO: 262	PAGE: 2	OF: 2	SHEET: Summary_DISP
AIR EMISSION CALCULATIONS	SUBJECT: Facility-Wide Emissions	DATE: January 11, 2019		

FACILITY - CONTROLLED - EMISSIONS SUMMARY (EXCLUDING FUGITIVES)

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Location	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
*EP Surface Subtotal (NF)**	32.6	8.1	134	33.5	0.80	0.20	8.2	5.2	5.1	1.8	13.3	3.3
*EP UG Subtotal (NF)**							8.9	25.9	5.2	19.6		
*West Plant Subtotal (NF)**	16.1	10.6	3.8	10.8	4.5	14.8	5.4	17.1	2.2	7.6	20.6	66.0
*Loadout Subtotal (NF)**	3.9	0.96	0.35	8.7E-2	9.0E-3	2.2E-3	0.35	1.4	5.9E-2	0.21	1.7E-2	4.3E-3
*Tailings Subtotal (NF)**	3.9	0.96	0.35	8.7E-2	9.0E-3	2.2E-3	7.7E-3	1.9E-3	7.7E-3	1.9E-3	1.7E-2	4.3E-3
FACILITY TOTAL	***56.4***	***20.6***	***138***	***44.4***	***5.3***	***15.0***	***22.8***	***49.5***	***12.5***	***29.2***	***33.9***	***69.3***

(NF) no fugitive or mobile emissions*

FACILITY - UNCONTROLLED - EMISSIONS SUMMARY (EXCLUDING FUGITIVES)

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Location	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
*EP Surface Subtotal (NF)**	32.6	8.1	134	33.5	0.80	0.20	86.7	38.2	17.0	6.8	13.3	3.3
*EP UG Subtotal (NF)**							137	350	114	290		
*West Plant Subtotal (NF)**	16.1	10.6	3.8	10.8	84.2	272	144	454	105	342	172	555
*Loadout Subtotal (NF)**	3.9	0.96	0.35	8.7E-2	9.0E-3	2.2E-3	0.35	1.4	5.9E-2	0.21	1.7E-2	4.3E-3
*Tailings Subtotal (NF)**	3.9	0.96	0.35	8.7E-2	9.0E-3	2.2E-3	7.7E-3	1.9E-3	7.7E-3	1.9E-3	1.7E-2	4.3E-3
FACILITY TOTAL	***56.4***	***20.6***	***138***	***44.4***	***85.0***	***272***	***368***	***843***	***236***	***639***	***186***	***558***

(NF) no fugitive or mobile emissions*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: D. Steen		
	PROJECT NO: 262	PAGE: 1	OF: 3	SHEET: Atty_DISP
AIR EMISSION CALCULATIONS	SUBJECT: Emission by Class	DATE: January 11, 2019		

F A C I L I T Y - C O N T R O L L E D - E M I S S I O N S S U M M A R Y (I N C L U D I N G F U G I T I V E S)

	Potential Emissions											
	CO		**NO_X**		**SO_2**		**PM_{10}**		**$PM_{2.5}$**		**VOC**	
Location	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
East Plant Surface												
*Stack**	*32.6*	*8.1*	*134*	*33.5*	*0.80*	*0.20*	*5.2*	*3.9*	*4.6*	*1.6*	*13.3*	*3.3*
*Process Fugitive**							*3.0*	*1.3*	*0.46*	*0.20*		
Fugitive							*1.7*	*3.4*	*0.20*	*0.57*	*3.3E-4*	*1.4E-3*
Mobile	*2.0*	*3.4*	*0.32*	*0.35*	*3.3E-3*	*6.8E-3*	*5.3E-2*	*8.3E-2*	*2.0E-2*	*2.4E-2*	*9.7E-2*	*0.11*
Subtotal	*34.6*	*11.6*	*134*	*33.8*	*0.80*	*0.21*	*9.9*	*8.7*	*5.3*	*2.4*	*13.4*	*3.4*
East Plant Underground												
Stack							*1.8*	*7.8*	*3.5*	*15.2*		
Process Fugitive							*7.1*	*18.1*	*1.7*	*4.3*		
Fugitive	*109*	*26.7*	*20.9*	*5.1*	*6.7*	*1.6*	*41.2*	*44.1*	*9.0*	*9.3*	*4.8E-3*	*2.1E-2*
Mobile	*155*	*167*	*14.6*	*17.3*	*0.14*	*0.15*	*0.33*	*0.39*	*0.68*	*0.80*	*6.9*	*8.2*
Subtotal	*265*	*193*	*35.4*	*22.4*	*6.9*	*1.8*	*50.4*	*70.3*	*14.8*	*29.7*	*6.9*	*8.3*
West Plant												
*Stack**	*16.1*	*10.6*	*3.8*	*10.8*	*4.5*	*14.8*	*1.8*	*6.5*	*1.7*	*6.0*	*20.6*	*65.9*
*Process Fugitive**							*3.6*	*10.5*	*0.55*	*1.6*	*1.7E-2*	*7.2E-2*
Fugitive	*0.67*	*2.1*	*2.1*	*0.40*	*0.67*	*0.13*	*20.8*	*19.2*	*2.5*	*3.1*	*4.0E-3*	*1.7E-2*
Mobile	*25.3*	*30.6*	*4.3*	*4.6*	*4.8E-2*	*5.6E-2*	*0.22*	*0.22*	*0.17*	*0.20*	*2.7*	*2.9*
Subtotal	*42.0*	*43.3*	*10.1*	*15.8*	*5.2*	*15.0*	*26.5*	*36.4*	*4.9*	*10.9*	*23.3*	*68.9*
Loadout												
*Stack**	*3.9*	*0.96*	*0.35*	*8.7E-2*	*9.0E-3*	*2.2E-3*	*7.7E-3*	*1.9E-3*	*7.7E-3*	*1.9E-3*	*1.7E-2*	*4.3E-3*
*Process Fugitive**							*0.34*	*1.4*	*5.1E-2*	*0.21*		
Fugitive							*0.24*	*0.97*	*3.0E-2*	*0.12*	*3.1E-3*	*1.3E-2*
Mobile	*14.7*	*24.4*	*6.4*	*5.6*	*2.1E-2*	*5.7E-2*	*0.17*	*0.20*	*0.17*	*0.19*	*1.0*	*1.5*
Subtotal	*18.6*	*25.3*	*6.8*	*5.7*	*3.0E-2*	*5.9E-2*	*0.77*	*2.5*	*0.26*	*0.52*	*1.1*	*1.5*
Tailings												
*Stack**	*3.9*	*0.96*	*0.35*	*8.7E-2*	*9.0E-3*	*2.2E-3*	*7.7E-3*	*1.9E-3*	*7.7E-3*	*1.9E-3*	*1.7E-2*	*4.3E-3*
*Process Fugitive**												
Fugitive							*84.2*	*209*	*12.8*	*32.3*	*3.1E-2*	*0.13*
Mobile	*115*	*342*	*14.4*	*40.6*	*0.24*	*0.72*	*0.71*	*2.0*	*0.71*	*2.0*	*7.7*	*20.5*
Subtotal	*119*	*343*	*14.7*	*40.7*	*0.25*	*0.73*	*84.9*	*211*	*13.5*	*34.3*	*7.7*	*20.6*
FACILITY TOTAL	***479***	***616***	***201***	***118***	***13.2***	***17.8***	***172***	***329***	***38.8***	***77.8***	***52.4***	***103***

**Stack and process fugitive sources considered "process" sources*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI			BY: D. Steen
	PROJECT NO: 262	PAGE: 2	OF: 3	SHEET: Atty_DISP
AIR EMISSION CALCULATIONS	SUBJECT: Emission by Class	DATE: January 11, 2019		

F A C I L I T Y - U N C O N T R O L L E D - E M I S S I O N S S U M M A R Y (I N C L U D I N G F U G I T I V E S)

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Location	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
East Plant Surface												
*Stack**	*32.6*	*8.1*	*134*	*33.5*	*0.80*	*0.20*	*5.2*	*3.9*	*4.6*	*1.6*	*13.3*	*3.3*
*Process Fugitive**							*81.6*	*34.3*	*12.4*	*5.2*		
Fugitive							*13.5*	*13.4*	*1.5*	*1.6*	*3.3E-4*	*1.4E-3*
Mobile	*2.0*	*3.4*	*0.32*	*0.35*	*3.3E-3*	*6.8E-3*	*5.3E-2*	*8.3E-2*	*2.0E-2*	*2.4E-2*	*9.7E-2*	*0.11*
Subtotal	*34.6*	*11.6*	*134*	*33.8*	*0.80*	*0.21*	*100*	*51.7*	*18.5*	*8.4*	*13.4*	*3.4*
East Plant Underground												
*Stack**							*42.9*	*110*	*26.6*	*67.9*		
*Process Fugitive**							*94.1*	*240*	*87.1*	*222*		
Fugitive	*109*	*26.7*	*20.9*	*5.1*	*6.7*	*1.6*	*1,729*	*1,920*	*173*	*192*	*4.8E-3*	*2.1E-2*
Mobile	*155*	*167*	*14.6*	*17.3*	*0.14*	*0.15*	*0.73*	*0.87*	*0.73*	*0.87*	*6.9*	*8.2*
Subtotal	*265*	*193*	*35.4*	*22.4*	*6.9*	*1.8*	*1,866*	*2,271*	*288*	*483*	*6.9*	*8.3*
West Plant												
*Stack**	*16.1*	*10.6*	*3.8*	*10.8*	*84.2*	*272*	*111*	*359*	*94.3*	*305*	*172*	*555*
*Process Fugitive**							*32.8*	*94.2*	*10.7*	*36.9*	*1.7E-2*	*7.2E-2*
Fugitive	*0.67*	*2.1*	*2.1*	*0.40*	*0.67*	*0.13*	*201*	*169*	*20.7*	*18.0*	*4.0E-3*	*1.7E-2*
Mobile	*25.3*	*30.6*	*4.3*	*4.6*	*4.8E-2*	*5.6E-2*	*0.22*	*0.22*	*0.17*	*0.20*	*2.7*	*2.9*
Subtotal	*42.0*	*43.3*	*10.1*	*15.8*	*84.9*	*272*	*345*	*622*	*126*	*360*	*175*	*558*
Loadout												
*Stack**	*3.9*	*0.96*	*0.35*	*8.7E-2*	*9.0E-3*	*2.2E-3*	*7.7E-3*	*1.9E-3*	*7.7E-3*	*1.9E-3*	*1.7E-2*	*4.3E-3*
*Process Fugitive**							*0.34*	*1.4*	*5.1E-2*	*0.21*		
Fugitive							*2.4*	*9.7*	*0.30*	*1.2*	*3.1E-3*	*1.3E-2*
Mobile	*14.7*	*24.4*	*6.4*	*5.6*	*2.1E-2*	*5.7E-2*	*0.17*	*0.20*	*0.17*	*0.19*	*1.0*	*1.5*
Subtotal	*18.6*	*25.3*	*6.8*	*5.7*	*3.0E-2*	*5.9E-2*	*3.0*	*11.3*	*0.53*	*1.6*	*1.1*	*1.5*
Tailings												
*Stack**	*3.9*	*0.96*	*0.35*	*8.7E-2*	*9.0E-3*	*2.2E-3*	*7.7E-3*	*1.9E-3*	*7.7E-3*	*1.9E-3*	*1.7E-2*	*4.3E-3*
*Process Fugitive**												
Fugitive							*807*	*1,997*	*105*	*262*	*3.1E-2*	*0.13*
Mobile	*115*	*342*	*14.4*	*40.6*	*0.24*	*0.72*	*0.71*	*2.0*	*0.71*	*2.0*	*7.7*	*20.5*
Subtotal	*119*	*343*	*14.7*	*40.7*	*0.25*	*0.73*	*807*	*1,999*	*106*	*265*	*7.7*	*20.6*
FACILITY TOTAL	***479***	***616***	***201***	***118***	***92.9***	***275***	***3,122***	***4,955***	***538***	***1,117***	***204***	***592***

**Stack and process fugitive sources considered "process" sources*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: D. Steen		
	PROJECT NO: 262	PAGE: 3	OF: 3	SHEET: Atty_DISP
AIR EMISSION CALCULATIONS	SUBJECT: Emission by Class	DATE: January 11, 2019		

FACILITY - MAXIMUM DAILY EMISSIONS - Q/D ANALYSIS

	Potential Emissions					
	PM_{10}		NO_X		SO_2	
Location	*lb/hr*	*lb/day*	*lb/hr*	*lb/day*	*lb/hr*	*lb/day*
East Plant Surface						
Non-emergency Stack	0.6	15.1				
*Emergency Generators**	4.5	108.9	133.8	3,211.7	0.799	19.17
Process Fugitive	3.0	73.1				
*Exposed Area Wind Erosion***	3.3	79.7				
Other Fugitives	1.3	31.5				
Mobile Combustion	0.1	1.3	0.3	7.8	0.003	0.08
Q/D Subtotal		200.8		7.8		0.08
East Plant Underground						
Non-emergency Stack	1.8	42.5				
*Emergency Generators**						
Process Fugitive	7.1	170.3				
*Exposed Area Wind Erosion***						
Other Fugitives	41.2	989.0	20.9	500.8	6.732	161.56
Mobile Combustion	0.3	7.9	14.6	349.3	0.138	3.30
Q/D Subtotal		1,209.7		850.1		164.86
West Plant						
Non-emergency Stack	1.8	42.9	2.7	65.1	4.494	107.86
*Emergency Generators**	0.0	0.6	1.0	25.2	0.027	0.65
Process Fugitive	3.6	86.3				
*Exposed Area Wind Erosion***	0.1	2.3				
Other Fugitives	20.8	499.6	2.1	49.8	0.669	16.05
Mobile Combustion	0.2	5.4	4.3	103.0	0.048	1.16
Q/D Subtotal		636.6		217.9		125.07
Loadout						
Non-emergency Stack						
*Emergency Generators**	0.0	0.2	0.3	8.4	0.009	0.22
Process Fugitive	0.3	8.1				
*Exposed Area Wind Erosion***						
Other Fugitives	0.2	5.9				
Mobile Combustion	0.2	4.2	6.4	154.4	0.021	0.51
Q/D Subtotal		18.2		154.4		0.51
Tailings						
Non-emergency Stack						
*Emergency Generators**	0.0	0.2	0.3	8.4	0.009	0.22
Process Fugitive						
*Exposed Area Wind Erosion***	1.3	30.5				
Other Fugitives	84.0	2,016.3				
Mobile Combustion	0.7	17.1	14.4	345.0	0.242	5.81
Q/D Subtotal		2,063.8		345.0		5.81
Q/D TOTAL		4,129.0		1,575.2		296.3

** Emergency generator emissions are excluded from the Q/D subtotals.*
*** Maximum daily rate calculated from hourly emissions profile for the 2015-2016 meteorological data.*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI			BY: D. Steen
	PROJECT NO: 262	PAGE: 1	OF: 18	SHEET: EPS_DISP
AIR EMISSION CALCULATIONS	SUBJECT: East Plant	DATE: January 11, 2019		

EAST PLANT - CONTROLLED UNDERGROUND - EMISSIONS SUMMARY

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Source ID	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
2_EP_UG_DB	*Drilling & Blasting*											
EP_UG_DRILL							*5.6E-2*	*4.1E-2*	*0.12*	*8.4E-2*		
EP_UG_BLAST	*109*	*26.7*	*20.9*	*5.1*	*6.7*	*1.6*	*1.6*	*0.40*	*0.19*	*4.7E-2*		
2_EP_UG_EXTRACT	*Extraction Level Ore Flow*											
EP_UG_OVER							*3.6E-2*	*9.1E-2*	*7.3E-2*	*0.19*		
2_EP_UG_OREPASS	*LHD/Ore Pass/Grizzly*											
EP_UG_GRIZ							*3.3*	*8.4*	*0.46*	*1.2*		
2_EP_UG_RAIL	*Haulage Ore Flow*											
EP_UG_TRAIN							*0.67*	*1.7*	*0.21*	*0.53*		
EP_UG_COARSE							*0.36*	*1.6*	*0.73*	*3.2*		
2_EP_UG_1CRUSH	*Primary Crushing Ore Flow*											
EP_UG_FINE												
2_EP_UG_LOW_ORE	*Lower Level Conveyor Ore Flow*											
EP_UG_CV103												
EP_UG_CV104							*8.1E-2*	*0.35*	*0.16*	*0.72*		
EP_UG_CV105							*0.73*	*1.9*	*0.23*	*0.58*		
EP_UG_SILO							*0.36*	*1.6*	*0.73*	*3.2*		
EP_UG_FEED												
EP_UG_CV106_111												
EP_UG_Chute							*0.73*	*1.9*	*0.23*	*0.58*		
EP_UG_FLASK							*0.54*	*2.4*	*1.1*	*4.8*		
2_EP_UG_HOIST	*Hoisting System Ore Flow*											
EP_UG_SKIP												
EP_UG_BIN												
2_EP_UG_UP_ORE	*Upper Level Conveyor System Ore Flow*											
EP_UG_FEED112_115							*0.36*	*1.6*	*0.73*	*3.2*		
EP_UG_CV102_105												
EP_UG_INC_CONV115							*1.6*	*4.2*	*0.51*	*1.3*		
2_EP_UG_D	*Non-Emergency Underground Diesel Fleet*											
EP_UG_D_C	*155*	*167*	*14.6*	*17.3*	*0.14*	*0.15*	*0.33*	*0.39*	*0.68*	*0.80*	*6.9*	*8.2*
EP_UG_D_DOZ							*0.51*	*0.22*	*0.68*	*0.29*		
EP_UG_D_FUG							*39.0*	*43.4*	*8.0*	*8.9*		
2_EP_UG_REF	*Underground Refrigeration Plant*											
EP_UG_COOL							*8.5E-2*	*0.37*	*2.6E-2*	*0.12*		
2_EP_UG_FUEL	*Diesel Storage Tanks*											
EP_UG_FUEL1											*4.8E-3*	*2.1E-2*
3_EP_UG_TOTAL	***265***	***193***	***35.4***	***22.4***	***6.9***	***1.8***	***50.4***	***70.3***	***14.8***	***29.7***	***6.9***	***8.3***

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: D. Steen		
	PROJECT NO: 262	PAGE: 2	OF: 18	SHEET: EPS_DISP
AIR EMISSION CALCULATIONS	SUBJECT: East Plant	DATE: January 11, 2019		

EAST PLANT - CONTROLLED SURFACE - EMISSIONS SUMMARY

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Source ID	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
2_EP_S_EGEN	*Emergency Generators (Total)*											
E_GEN1	15.1	3.8	27.7	6.9	3.3E-2	8.2E-3	0.86	0.22	0.86	0.22	5.6	1.4
E_GEN2	2.6	0.65	4.9	1.2	5.6E-3	1.4E-3	0.15	3.7E-2	0.15	3.7E-2	0.96	0.24
E_GEN3	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12
E_GEN4	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12
E_GEN5	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12
E_GEN6	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12
E_GEN7	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12
E_GEN8	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12
E_GEN9	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12
E_GEN10	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12
E_GEN11	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12
E_GEN12	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12
E_GEN13	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12
E_GEN14	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12
E_GEN15	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12
E_GEN16	1.1	0.27	7.2	1.8	5.4E-2	1.4E-2	0.25	6.3E-2	0.25	6.3E-2	0.48	0.12
2_EP_S_REF	*Surface Refrigeration Plant*											
E_COOL1							0.10	0.46	1.6E-2	7.0E-2		
E_COOL2							0.10	0.46	1.6E-2	7.0E-2		
E_COOL3							0.10	0.46	1.6E-2	7.0E-2		
E_COOL4							0.10	0.46	1.6E-2	7.0E-2		
E_COOL5							0.10	0.46	1.6E-2	7.0E-2		
E_COOL6							0.10	0.46	1.6E-2	7.0E-2		
2_EP_S_CBP	*Cement Batch Plant*											
B_AGDEL							0.21	0.12	3.2E-2	1.8E-2		
B_SNDEL							0.11	6.1E-2	1.6E-2	9.3E-3		
B_AGCHUT							1.6E-2	1.1E-2	2.5E-3	1.6E-3		
B_SNCHUT							1.3E-2	5.3E-3	2.0E-3	8.5E-4		
B_AGSTOR							1.6E-2	1.1E-2	2.5E-3	1.6E-3		
B_SNSTOR							1.3E-2	5.3E-3	2.0E-3	8.5E-4		
B_WHOPLD							0.18	8.6E-2	2.7E-2	1.3E-2		
B_WHOPAG							1.6E-2	1.1E-2	2.5E-3	1.6E-3		
B_WHOPSN							1.3E-2	5.3E-3	2.0E-3	8.5E-4		
B_CEMSLO							2.6E-2	1.1E-2	3.9E-3	1.6E-3		
B_FLYSLO							4.8E-2	2.4E-2	7.2E-3	3.7E-3		
B_SILSLO							1.9E-2	5.2E-3	2.9E-3	7.9E-4		
B_SLOHOP							2.5E-3	1.0E-3	3.8E-4	1.6E-4		
B_SLOCNY							2.5E-3	1.0E-3	3.8E-4	1.6E-4		
B_SLOTRK							2.4	0.98	0.36	0.15		
2_EP_S_FUEL	*Diesel Storage Tanks*											
EP_S_FUEL1											3.3E-4	1.4E-3
2_EP_S_WE	*Miscellaneous Fugitives*											
E_WE_RD							3.3E-2	0.14	4.9E-3	2.2E-2		
E_WE_EXP							2.6E-3	1.2E-2	4.0E-4	1.7E-3		
E_WE_SUB							0.35	1.2	5.2E-2	0.19		
EP_S_EFD							1.5E-2	0.62	3.6E-3	0.15		
EP_S_E_C	0.45	2.0	2.1E-2	9.2E-2	1.1E-3	4.9E-3	1.1E-2	5.0E-2	2.0E-3	8.9E-3	4.9E-3	2.1E-2
EP_S_DFD							6.3E-2	0.47	1.6E-2	0.11		
EP_S_D_C	4.3E-2	3.3E-2	0.13	9.9E-2	4.0E-4	3.1E-4	3.2E-2	2.5E-2	9.3E-3	7.1E-3	9.6E-3	7.4E-3
2_EP_S_D	*Non-Emergency Surface Diesel Fleet*											
EP_S_F_C	1.5	1.4	0.17	0.16	1.8E-3	1.6E-3	8.7E-3	8.1E-3	8.7E-3	8.1E-3	8.3E-2	7.7E-2
EP_S_D_DOZ												
EP_S_D_FUG							1.2	0.92	0.12	9.2E-2		
3_EP_S_TOTAL	**34.6**	**11.6**	**134**	**33.8**	**0.80**	**0.21**	**9.9**	**8.7**	**5.3**	**2.4**	**13.4**	**3.4**

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: D. Steen		
	PROJECT NO: 262	PAGE: 3	OF: 18	SHEET: EPS_DISP
AIR EMISSION CALCULATIONS	SUBJECT: East Plant	DATE: January 11, 2019		

EAST PLANT - UNCONTROLLED UNDERGROUND - EMISSIONS SUMMARY

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Source ID	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
2_EP_UG_DB	*Drilling & Blasting*											
EP_UG_DRILL							*0.12*	*9.1E-2*	*0.12*	*9.1E-2*		
EP_UG_BLAST	*109*	*26.7*	*20.9*	*5.1*	*6.7*	*1.6*	*3.6*	*0.87*	*0.21*	*5.0E-2*		
2_EP_UG_EXTRACT	*Extraction Level Ore Flow*											
EP_UG_OVER							*7.9E-2*	*0.20*	*7.9E-2*	*0.20*		
2_EP_UG_OREPASS	*LHD/Ore Pass/Grizzly*											
EP_UG_GRIZ							*85.7*	*219*	*85.7*	*219*		
2_EP_UG_RAIL	*Haulage Ore Flow*											
EP_UG_TRAIN							*1.5*	*3.8*	*0.22*	*0.57*		
EP_UG_COARSE							*1.5*	*3.8*	*0.22*	*0.57*		
2_EP_UG_1CRUSH	*Primary Crushing Ore Flow*											
EP_UG_FINE							*23.7*	*60.4*	*23.7*	*60.4*		
2_EP_UG_LOW_ORE	*Lower Level Conveyor Ore Flow*											
EP_UG_CV103							*1.6*	*4.1*	*0.24*	*0.62*		
EP_UG_CV104							*1.6*	*4.1*	*0.24*	*0.62*		
EP_UG_CV105							*1.6*	*4.1*	*0.24*	*0.62*		
EP_UG_SILO							*1.6*	*4.1*	*0.24*	*0.62*		
EP_UG_FEED							*1.6*	*4.1*	*0.24*	*0.62*		
EP_UG_CV106_111							*1.6*	*4.1*	*0.24*	*0.62*		
EP_UG_Chute							*1.6*	*4.1*	*0.24*	*0.62*		
EP_UG_FLASK							*1.6*	*4.1*	*0.24*	*0.62*		
2_EP_UG_HOIST	*Hoisting System Ore Flow*											
EP_UG_SKIP							*0.76*	*1.9*	*0.11*	*0.29*		
EP_UG_BIN												
2_EP_UG_UP_ORE	*Upper Level Conveyor System Ore Flow*											
EP_UG_FEED112_115							*3.6*	*9.2*	*0.55*	*1.4*		
EP_UG_CV102_105							*3.6*	*9.2*	*0.55*	*1.4*		
EP_UG_INC_CONV115							*3.6*	*9.2*	*0.55*	*1.4*		
2_EP_UG_D	*Non-Emergency Underground Diesel Fleet*											
EP_UG_D_C	*155*	*167*	*14.6*	*17.3*	*0.14*	*0.15*	*0.73*	*0.87*	*0.73*	*0.87*	*6.9*	*8.2*
EP_UG_D_DOZ							*1.1*	*0.48*	*0.74*	*0.32*		
EP_UG_D_FUG							*1,724*	*1,919*	*172*	*192*		
2_EP_UG_REF	*Underground Refrigeration Plant*											
EP_UG_COOL							*0.19*	*0.82*	*2.9E-2*	*0.12*		
2_EP_UG_FUEL	*Diesel Storage Tanks*											
EP_UG_FUEL1											*4.8E-3*	*2.1E-2*
3_EP_UG_TOTAL	***265***	***193***	***35.4***	***22.4***	***6.9***	***1.8***	***1,866***	***2,271***	***288***	***483***	***6.9***	***8.3***

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: D. Steen		
	PROJECT NO: 262	PAGE: 4	OF: 18	SHEET: EPS_DISP
AIR EMISSION CALCULATIONS	SUBJECT: East Plant	DATE: January 11, 2019		

E A S T P L A N T - U N C O N T R O L L E D S U R F A C E - E M I S S I O N S S U M M A R Y

	Potential Emissions											
	CO		**NO_X**		**SO_2**		**PM_{10}**		**$PM_{2.5}$**		**VOC**	
Source ID	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
2_EP_S_EGEN	*Emergency Generators (Total)*											
E_GEN1	*15.1*	*3.8*	*27.7*	*6.9*	*3.3E-2*	*8.2E-3*	*0.86*	*0.22*	*0.86*	*0.22*	*5.6*	*1.4*
E_GEN2	*2.6*	*0.65*	*4.9*	*1.2*	*5.6E-3*	*1.4E-3*	*0.15*	*3.7E-2*	*0.15*	*3.7E-2*	*0.96*	*0.24*
E_GEN3	*1.1*	*0.27*	*7.2*	*1.8*	*5.4E-2*	*1.4E-2*	*0.25*	*6.3E-2*	*0.25*	*6.3E-2*	*0.48*	*0.12*
E_GEN4	*1.1*	*0.27*	*7.2*	*1.8*	*5.4E-2*	*1.4E-2*	*0.25*	*6.3E-2*	*0.25*	*6.3E-2*	*0.48*	*0.12*
E_GEN5	*1.1*	*0.27*	*7.2*	*1.8*	*5.4E-2*	*1.4E-2*	*0.25*	*6.3E-2*	*0.25*	*6.3E-2*	*0.48*	*0.12*
E_GEN6	*1.1*	*0.27*	*7.2*	*1.8*	*5.4E-2*	*1.4E-2*	*0.25*	*6.3E-2*	*0.25*	*6.3E-2*	*0.48*	*0.12*
E_GEN7	*1.1*	*0.27*	*7.2*	*1.8*	*5.4E-2*	*1.4E-2*	*0.25*	*6.3E-2*	*0.25*	*6.3E-2*	*0.48*	*0.12*
E_GEN8	*1.1*	*0.27*	*7.2*	*1.8*	*5.4E-2*	*1.4E-2*	*0.25*	*6.3E-2*	*0.25*	*6.3E-2*	*0.48*	*0.12*
E_GEN9	*1.1*	*0.27*	*7.2*	*1.8*	*5.4E-2*	*1.4E-2*	*0.25*	*6.3E-2*	*0.25*	*6.3E-2*	*0.48*	*0.12*
E_GEN10	*1.1*	*0.27*	*7.2*	*1.8*	*5.4E-2*	*1.4E-2*	*0.25*	*6.3E-2*	*0.25*	*6.3E-2*	*0.48*	*0.12*
E_GEN11	*1.1*	*0.27*	*7.2*	*1.8*	*5.4E-2*	*1.4E-2*	*0.25*	*6.3E-2*	*0.25*	*6.3E-2*	*0.48*	*0.12*
E_GEN12	*1.1*	*0.27*	*7.2*	*1.8*	*5.4E-2*	*1.4E-2*	*0.25*	*6.3E-2*	*0.25*	*6.3E-2*	*0.48*	*0.12*
E_GEN13	*1.1*	*0.27*	*7.2*	*1.8*	*5.4E-2*	*1.4E-2*	*0.25*	*6.3E-2*	*0.25*	*6.3E-2*	*0.48*	*0.12*
E_GEN14	*1.1*	*0.27*	*7.2*	*1.8*	*5.4E-2*	*1.4E-2*	*0.25*	*6.3E-2*	*0.25*	*6.3E-2*	*0.48*	*0.12*
E_GEN15	*1.1*	*0.27*	*7.2*	*1.8*	*5.4E-2*	*1.4E-2*	*0.25*	*6.3E-2*	*0.25*	*6.3E-2*	*0.48*	*0.12*
E_GEN16	*1.1*	*0.27*	*7.2*	*1.8*	*5.4E-2*	*1.4E-2*	*0.25*	*6.3E-2*	*0.25*	*6.3E-2*	*0.48*	*0.12*
2_EP_S_REF	*Surface Refrigeration Plant*											
E_COOL1							*0.10*	*0.46*	*1.6E-2*	*7.0E-2*		
E_COOL2							*0.10*	*0.46*	*1.6E-2*	*7.0E-2*		
E_COOL3							*0.10*	*0.46*	*1.6E-2*	*7.0E-2*		
E_COOL4							*0.10*	*0.46*	*1.6E-2*	*7.0E-2*		
E_COOL5							*0.10*	*0.46*	*1.6E-2*	*7.0E-2*		
E_COOL6							*0.10*	*0.46*	*1.6E-2*	*7.0E-2*		
2_EP_S_CBP	*Cement Batch Plant*											
B_AGDEL							*0.27*	*0.15*	*4.1E-2*	*2.3E-2*		
B_SNDEL							*0.13*	*7.6E-2*	*2.0E-2*	*1.2E-2*		
B_AGCHUT							*0.23*	*0.15*	*3.5E-2*	*2.3E-2*		
B_SNCHUT							*0.18*	*7.6E-2*	*2.8E-2*	*1.2E-2*		
B_AGSTOR							*0.23*	*0.15*	*3.5E-2*	*2.3E-2*		
B_SNSTOR							*0.18*	*7.6E-2*	*2.8E-2*	*1.2E-2*		
B_WHOPLD							*0.72*	*0.34*	*0.11*	*5.2E-2*		
B_WHOPAG							*0.23*	*0.15*	*3.5E-2*	*2.3E-2*		
B_WHOPSN							*0.18*	*7.6E-2*	*2.8E-2*	*1.2E-2*		
B_CEMSLO							*35.8*	*14.7*	*5.4*	*2.2*		
B_FLYSLO							*10.7*	*5.5*	*1.6*	*0.83*		
B_SILSLO							*4.3*	*1.2*	*0.65*	*0.18*		
B_SLOHOP							*0.25*	*0.10*	*3.8E-2*	*1.6E-2*		
B_SLOCNY							*0.25*	*0.10*	*3.8E-2*	*1.6E-2*		
B_SLOTRK							*27.9*	*11.6*	*4.2*	*1.7*		
2_EP_S_FUEL	*Diesel Storage Tanks*											
EP_S_FUEL1											*3.3E-4*	*1.4E-3*
2_EP_S_WE	*Miscellaneous Fugitives*											
E_WE_RD							*0.33*	*1.4*	*4.9E-2*	*0.22*		
E_WE_EXP							*2.6E-2*	*0.12*	*4.0E-3*	*1.7E-2*		
E_WE_SUB							*0.35*	*1.5*	*5.2E-2*	*0.23*		
EP_S_EFD							*0.15*	*0.62*	*3.6E-2*	*0.15*		
EP_S_E_C	*0.45*	*2.0*	*2.1E-2*	*9.2E-2*	*1.1E-3*	*4.9E-3*	*1.1E-2*	*5.0E-2*	*2.0E-3*	*8.9E-3*	*4.9E-3*	*2.1E-2*
EP_S_DFD							*0.63*	*0.47*	*0.16*	*0.11*		
EP_S_D_C	*4.3E-2*	*3.3E-2*	*0.13*	*9.9E-2*	*4.0E-4*	*3.1E-4*	*3.2E-2*	*2.5E-2*	*9.3E-3*	*7.1E-3*	*9.6E-3*	*7.4E-3*
2_EP_S_D	*Non-Emergency Surface Diesel Fleet*											
EP_S_F_C	*1.5*	*1.4*	*0.17*	*0.16*	*1.8E-3*	*1.6E-3*	*8.7E-3*	*8.1E-3*	*8.7E-3*	*8.1E-3*	*8.3E-2*	*7.7E-2*
EP_S_D_DOZ												
EP_S_D_FUG							*12.0*	*9.2*	*1.2*	*0.92*		
3_EP_S_TOTAL	***34.6***	***11.6***	***134***	***33.8***	***0.80***	***0.21***	***100***	***51.7***	***18.5***	***8.4***	***13.4***	***3.4***

EAST PLANT - CONTROLLED UNDERGROUND - EMISSION FACTORS

Source ID	Emission Factors						
	CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$	VOC	Units & Notes
2_EP_UG_DB	*Drilling & Blasting*						
EP_UG_DRILL							*See "Drill & Blast" Sheet*
EP_UG_BLAST							*See "Drill & Blast" Sheet*
2_EP_UG_EXTRACT	*Extraction Level Ore Flow*						
EP_UG_OVER				*8.0E-5*	*8.0E-5*		*lb/ton*
2_EP_UG_OREPASS	*LHD/Ore Pass/Grizzly*						
EP_UG_GRIZ				*7.4E-4*	*5.0E-5*		*lb/ton*
2_EP_UG_RAIL	*Haulage Ore Flow*						
EP_UG_TRAIN				*1.5E-4*	*2.3E-5*		*lb/ton*
EP_UG_COARSE							*Dust Collectors (915,420 dscf/hr, 0.002 gr/dscf)*
2_EP_UG_1CRUSH	*Primary Crushing Ore Flow*						
EP_UG_FINE							*Emissions accounted for in EP_UG_COARSE*
2_EP_UG_LOW_ORE	*Lower Level Conveyor Ore Flow*						
EP_UG_CV103							*Emissions accounted for in EP_UG_COARSE*
EP_UG_CV104							*Dust Collectors (207,495 dscf/hr, 0.002 gr/dscf)*
EP_UG_CV105				*1.6E-4*	*2.5E-5*		*lb/ton*
EP_UG_SILO							*Dust Collectors (915,420 dscf/hr, 0.002 gr/dscf)*
EP_UG_FEED							*Emissions accounted for in EP_UG_SILO*
EP_UG_CV106_111							*Emissions accounted for in EP_UG_SILO*
EP_UG_Chute				*1.6E-4*	*2.5E-5*		*lb/ton*
EP_UG_FLASK							*Dust Collectors (691,651 dscf/hr, 0.002 gr/dscf)*
2_EP_UG_HOIST	*Hoisting System Ore Flow*						
EP_UG_SKIP							*Emissions accounted for in EP_UG_FLASK*
EP_UG_BIN							
2_EP_UG_UP_ORE	*Upper Level Conveyor System Ore Flow*						
EP_UG_FEED112_115							*Dust Collectors (691,651 dscf/hr, 0.002 gr/dscf)*
EP_UG_CV102_105							*Emissions accounted for in EP_UG_FEED112_115*
EP_UG_INC_CONV115				*3.7E-4*	*5.6E-5*		*lb/ton*
2_EP_UG_D	*Non-Emergency Underground Diesel Fleet*						
EP_UG_D_C							*See "EP_Fleet" Sheet*
EP_UG_D_DOZ							*See "EP_Fleet" Sheet*
EP_UG_D_FUG							*See "EP_Fleet" Sheet*
2_EP_UG_REF	*Underground Refrigeration Plant*						
EP_UG_COOL							*See "EP Cooling" Sheet*
2_EP_UG_FUEL	*Diesel Storage Tanks*						
EP_UG_FUEL1							*See "Fuel Tanks" Sheet*

EAST PLANT - CONTROLLED SURFACE - EMISSION FACTORS

	Emission Factors						
Source ID	**CO**	**NO_X**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**VOC**	**Units & Notes**
2_EP_S_EGEN	*Emergency Generators (Total)*						
E_GEN1							*See "E_Gen" Sheet*
E_GEN2							*See "E_Gen" Sheet*
E_GEN3							*See "E_Gen" Sheet*
E_GEN4							*See "E_Gen" Sheet*
E_GEN5							*See "E_Gen" Sheet*
E_GEN6							*See "E_Gen" Sheet*
E_GEN7							*See "E_Gen" Sheet*
E_GEN8							*See "E_Gen" Sheet*
E_GEN9							*See "E_Gen" Sheet*
E_GEN10							*See "E_Gen" Sheet*
E_GEN11							*See "E_Gen" Sheet*
E_GEN12							*See "E_Gen" Sheet*
E_GEN13							*See "E_Gen" Sheet*
E_GEN14							*See "E_Gen" Sheet*
E_GEN15							*See "E_Gen" Sheet*
E_GEN16							*See "E_Gen" Sheet*
2_EP_S_REF	*Surface Refrigeration Plant*						
E_COOL1							*See "Cooling" Sheet*
E_COOL2							*See "Cooling" Sheet*
E_COOL3							*See "Cooling" Sheet*
E_COOL4							*See "Cooling" Sheet*
E_COOL5							*See "Cooling" Sheet*
E_COOL6							*See "Cooling" Sheet*
2_EP_S_CBP	*Cement Batch Plant*						
B_AGDEL							*See "BatchPlant" Sheet*
B_SNDEL							*See "BatchPlant" Sheet*
B_AGCHUT							*See "BatchPlant" Sheet*
B_SNCHUT							*See "BatchPlant" Sheet*
B_AGSTOR							*See "BatchPlant" Sheet*
B_SNSTOR							*See "BatchPlant" Sheet*
B_WHOPLD							*See "BatchPlant" Sheet*
B_WHOPAG							*See "BatchPlant" Sheet*
B_WHOPSN							*See "BatchPlant" Sheet*
B_CEMSLO							*See "BatchPlant" Sheet*
B_FLYSLO							*See "BatchPlant" Sheet*
B_SILSLO							*See "BatchPlant" Sheet*
B_SLOHOP							*See "BatchPlant" Sheet*
B_SLOCNY							*See "BatchPlant" Sheet*
B_SLOTRK							*See "BatchPlant" Sheet*
2_EP_S_FUEL	*Diesel Storage Tanks*						
EP_S_FUEL1							*See "Fuel Tanks" Sheet*
2_EP_S_WE	*Miscellaneous Fugitives*						
E_WE_RD				*0.2*	*0.0*		*ton/acre-yr*
E_WE_EXP							*See Wind Workbook*
E_WE_SUB							*See Wind Workbook*
EP_S_EFD							*See "Employees" Sheet*
EP_S_E_C							*See "Employees" Sheet*
EP_S_DFD							*See "Deliveries" Sheet*
EP_S_D_C							*See "Deliveries" Sheet*
2_EP_S_D	*Non-Emergency Surface Diesel Fleet*						
EP_S_F_C							*See "EP_Fleet" Sheet*
EP_S_D_DOZ							*See "EP_Fleet" Sheet*
EP_S_D_FUG							*See "EP_Fleet" Sheet*

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AIR EMISSION CALCULATIONS	SUBJECT: East Plant	DATE: January 11, 2019		

EAST PLANT - UNCONTROLLED UNDERGROUND - EMISSION FACTORS

Source ID	Emission Factors						
	CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$	VOC	Units & Notes
2_EP_UG_DB	*Drilling & Blasting*						
EP_UG_DRILL							*See "Drill & Blast" Sheet*
EP_UG_BLAST							*See "Drill & Blast" Sheet*
2_EP_UG_EXTRACT	*Extraction Level Ore Flow*						
EP_UG_OVER				*8.0E-5*	*8.0E-5*		*lb/ton*
2_EP_UG_OREPASS	*LHD/Ore Pass/Grizzly*						
EP_UG_GRIZ				*8.7E-3*	*8.7E-3*		*lb/ton*
2_EP_UG_RAIL	*Haulage Ore Flow*						
EP_UG_TRAIN				*1.5E-4*	*2.3E-5*		*lb/ton*
EP_UG_COARSE				*1.5E-4*	*2.3E-5*		*lb/ton*
2_EP_UG_1CRUSH	*Primary Crushing Ore Flow*						
EP_UG_FINE				*2.4E-3*	*2.4E-3*		*lb/ton*
2_EP_UG_LOW_ORE	*Lower Level Conveyor Ore Flow*						
EP_UG_CV103				*1.6E-4*	*2.5E-5*		*lb/ton*
EP_UG_CV104				*1.6E-4*	*2.5E-5*		*lb/ton*
EP_UG_CV105				*1.6E-4*	*2.5E-5*		*lb/ton*
EP_UG_SILO				*1.6E-4*	*2.5E-5*		*lb/ton*
EP_UG_FEED				*1.6E-4*	*2.5E-5*		*lb/ton*
EP_UG_CV106_111				*1.6E-4*	*2.5E-5*		*lb/ton*
EP_UG_Chute				*1.6E-4*	*2.5E-5*		*lb/ton*
EP_UG_FLASK				*1.6E-4*	*2.5E-5*		*lb/ton*
2_EP_UG_HOIST	*Hoisting System Ore Flow*						
EP_UG_SKIP				*7.7E-5*	*1.2E-5*		*lb/ton*
EP_UG_BIN							
2_EP_UG_UP_ORE	*Upper Level Conveyor System Ore Flow*						
EP_UG_FEED112_115				*3.7E-4*	*5.6E-5*		*lb/ton*
EP_UG_CV102_105				*3.7E-4*	*5.6E-5*		*lb/ton*
EP_UG_INC_CONV115				*3.7E-4*	*5.6E-5*		*lb/ton*
2_EP_UG_D	*Non-Emergency Underground Diesel Fleet*						
EP_UG_D_C							*See "EP_Fleet" Sheet*
EP_UG_D_DOZ							*See "EP_Fleet" Sheet*
EP_UG_D_FUG							*See "EP_Fleet" Sheet*
2_EP_UG_REF	*Underground Refrigeration Plant*						
EP_UG_COOL							*See "EP Cooling" Sheet*
2_EP_UG_FUEL	*Diesel Storage Tanks*						
EP_UG_FUEL1							*See "Fuel Tanks" Sheet*

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AIR EMISSION CALCULATIONS	SUBJECT: East Plant	DATE: January 11, 2019		

EAST PLANT - UNCONTROLLED SURFACE - EMISSION FACTORS

	Emission Factors						
Source ID	CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$	VOC	Units & Notes
2_EP_S_EGEN	*Emergency Generators (Total)*						
E_GEN1							*See "E_Gen" Sheet*
E_GEN2							*See "E_Gen" Sheet*
E_GEN3							*See "E_Gen" Sheet*
E_GEN4							*See "E_Gen" Sheet*
E_GEN5							*See "E_Gen" Sheet*
E_GEN6							*See "E_Gen" Sheet*
E_GEN7							*See "E_Gen" Sheet*
E_GEN8							*See "E_Gen" Sheet*
E_GEN9							*See "E_Gen" Sheet*
E_GEN10							*See "E_Gen" Sheet*
E_GEN11							*See "E_Gen" Sheet*
E_GEN12							*See "E_Gen" Sheet*
E_GEN13							*See "E_Gen" Sheet*
E_GEN14							*See "E_Gen" Sheet*
E_GEN15							*See "E_Gen" Sheet*
E_GEN16							*See "E_Gen" Sheet*
2_EP_S_REF	*Surface Refrigeration Plant*						
E_COOL1							*See "Cooling" Sheet*
E_COOL2							*See "Cooling" Sheet*
E_COOL3							*See "Cooling" Sheet*
E_COOL4							*See "Cooling" Sheet*
E_COOL5							*See "Cooling" Sheet*
E_COOL6							*See "Cooling" Sheet*
2_EP_S_CBP	*Cement Batch Plant*						
B_AGDEL							*See "BatchPlant" Sheet*
B_SNDEL							*See "BatchPlant" Sheet*
B_AGCHUT							*See "BatchPlant" Sheet*
B_SNCHUT							*See "BatchPlant" Sheet*
B_AGSTOR							*See "BatchPlant" Sheet*
B_SNSTOR							*See "BatchPlant" Sheet*
B_WHOPLD							*See "BatchPlant" Sheet*
B_WHOPAG							*See "BatchPlant" Sheet*
B_WHOPSN							*See "BatchPlant" Sheet*
B_CEMSLO							*See "BatchPlant" Sheet*
B_FLYSLO							*See "BatchPlant" Sheet*
B_SILSLO							*See "BatchPlant" Sheet*
B_SLOHOP							*See "BatchPlant" Sheet*
B_SLOCNY							*See "BatchPlant" Sheet*
B_SLOTRK							*See "BatchPlant" Sheet*
2_EP_S_FUEL	*Diesel Storage Tanks*						
EP_S_FUEL1							*See "Fuel Tanks" Sheet*
2_EP_S_WE	*Miscellaneous Fugitives*						
E_WE_RD				*0.2*	*0.0*		*ton/acre-yr*
E_WE_EXP							*See Wind Workbook*
E_WE_SUB							*See Wind Workbook*
EP_S_EFD							*See "Employees" Sheet*
EP_S_E_C							*See "Employees" Sheet*
EP_S_DFD							*See "Deliveries" Sheet*
EP_S_D_C							*See "Deliveries" Sheet*
2_EP_S_D	*Non-Emergency Surface Diesel Fleet*						
EP_S_F_C							*See "EP_Fleet" Sheet*
EP_S_D_DOZ							*See "EP_Fleet" Sheet*
EP_S_D_FUG							*See "EP_Fleet" Sheet*

EAST PLANT - UNDERGROUND - PROCESS RATES

	Process Rates		
Source ID	**Unit/Hr**	**Unit/Yr**	**Units & Notes**
2_EP_UG_DB *Drilling & Blasting*			
EP_UG_DRILL			*See "Drill & Blast" Sheet*
EP_UG_BLAST			*See "Drill & Blast" Sheet*
2_EP_UG_EXTRA *Extraction Level Ore Flow*			
EP_UG_OVER	*985*	*5,029,289*	*ton*
2_EP_UG_OREPA *LHD/Ore Pass/Grizzly*			
EP_UG_GRIZ	*9,855*	*50,292,894*	*ton*
2_EP_UG_RAIL *Haulage Ore Flow*			
EP_UG_TRAIN	*9,855*	*50,292,894*	*ton*
EP_UG_COARSE	*9,855*	*50,292,894*	*ton*
2_EP_UG_1CRUS *Primary Crushing Ore Flow*			
EP_UG_FINE	*9,855*	*50,292,894*	*ton*
2_EP_UG_LOW_(*Lower Level Conveyor Ore Flow*			
EP_UG_CV103	*9,855*	*50,292,894*	*ton*
EP_UG_CV104	*9,855*	*50,292,894*	*ton*
EP_UG_CV105	*9,855*	*50,292,894*	*ton*
EP_UG_SILO	*9,855*	*50,292,894*	*ton*
EP_UG_FEED	*9,855*	*50,292,894*	*ton*
EP_UG_CV106_111	*9,855*	*50,292,894*	*ton*
EP_UG_Chute	*9,855*	*50,292,894*	*ton*
EP_UG_FLASK	*9,855*	*50,292,894*	*ton*
2_EP_UG_HOIST *Hoisting System Ore Flow*			
EP_UG_SKIP	*9,855*	*50,292,894*	*ton*
EP_UG_BIN	*9,855*	*50,292,894*	*ton*
2_EP_UG_UP_OR *Upper Level Conveyor System Ore Flow*			
EP_UG_FEED112_115	*9,855*	*50,292,894*	*ton*
EP_UG_CV102_105	*9,855*	*50,292,894*	*ton*
EP_UG_INC_CONV115	*9,855*	*50,292,894*	*ton*
2_EP_UG_D *Non-Emergency Underground Diesel Fleet*			
EP_UG_D_C			*See "EP_Fleet" Sheet*
EP_UG_D_DOZ			*See "EP_Fleet" Sheet*
EP_UG_D_FUG			*See "EP_Fleet" Sheet*
2_EP_UG_REF *Underground Refrigeration Plant*			
EP_UG_COOL			*See "EP Cooling" Sheet*
2_EP_UG_FUEL *Diesel Storage Tanks*			
EP_UG_FUEL1	*937*	*1,594,904*	*gal*

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E A S T   P L A N T - S U R F A C E - P R O C E S S   R A T E S

Source ID		Process Rates		
		Unit/Hr	Unit/Yr	Units & Notes
2_EP_S_EGEN	*Emergency Generators (Total)*			
E_GEN1				*See "E_Gen" Sheet*
E_GEN2				*See "E_Gen" Sheet*
E_GEN3				*See "E_Gen" Sheet*
E_GEN4				*See "E_Gen" Sheet*
E_GEN5				*See "E_Gen" Sheet*
E_GEN6				*See "E_Gen" Sheet*
E_GEN7				*See "E_Gen" Sheet*
E_GEN8				*See "E_Gen" Sheet*
E_GEN9				*See "E_Gen" Sheet*
E_GEN10				*See "E_Gen" Sheet*
E_GEN11				*See "E_Gen" Sheet*
E_GEN12				*See "E_Gen" Sheet*
E_GEN13				*See "E_Gen" Sheet*
E_GEN14				*See "E_Gen" Sheet*
E_GEN15				*See "E_Gen" Sheet*
E_GEN16				*See "E_Gen" Sheet*
2_EP_S_REF	*Surface Refrigeration Plant*			
E_COOL1				*See "Cooling" Sheet*
E_COOL2				*See "Cooling" Sheet*
E_COOL3				*See "Cooling" Sheet*
E_COOL4				*See "Cooling" Sheet*
E_COOL5				*See "Cooling" Sheet*
E_COOL6				*See "Cooling" Sheet*
2_EP_S_CBP	*Cement Batch Plant*			
B_AGDEL				*See "BatchPlant" Sheet*
B_SNDEL				*See "BatchPlant" Sheet*
B_AGCHUT				*See "BatchPlant" Sheet*
B_SNCHUT				*See "BatchPlant" Sheet*
B_AGSTOR				*See "BatchPlant" Sheet*
B_SNSTOR				*See "BatchPlant" Sheet*
B_WHOPLD				*See "BatchPlant" Sheet*
B_WHOPAG				*See "BatchPlant" Sheet*
B_WHOPSN				*See "BatchPlant" Sheet*
B_CEMSLO				*See "BatchPlant" Sheet*
B_FLYSLO				*See "BatchPlant" Sheet*
B_SILSLO				*See "BatchPlant" Sheet*
B_SLOHOP				*See "BatchPlant" Sheet*
B_SLOCNY				*See "BatchPlant" Sheet*
B_SLOTRK				*See "BatchPlant" Sheet*
2_EP_S_FUEL	*Diesel Storage Tanks*			
EP_S_FUEL1		*12.2*	*22,621*	*gal*
2_EP_S_WE	*Miscellaneous Fugitives*			
E_WE_RD			*7.6*	*acre*
E_WE_EXP			*21.3*	*acre*
E_WE_SUB			*279*	*acre*
EP_S_EFD				*See "Employees" Sheet*
EP_S_E_C				*See "Employees" Sheet*
EP_S_DFD				*See "Deliveries" Sheet*
EP_S_D_C				*See "Deliveries" Sheet*
2_EP_S_D	*Non-Emergency Surface Diesel Fleet*			
EP_S_F_C				*See "EP_Fleet" Sheet*
EP_S_D_DOZ				*See "EP_Fleet" Sheet*
EP_S_D_FUG				*See "EP_Fleet" Sheet*

EAST PLANT - UNDERGROUND - CONTROLS

Source ID	Control Technology		Control Efficiency	Notes
2_EP_UG_DB				
EP_UG_DRILL			*0%*	
EP_UG_BLAST			*0%*	
2_EP_UG_EXTRACT				
EP_UG_OVER			*0%*	
2_EP_UG_OREPASS				
EP_UG_GRIZ	*moisture*		*0%*	*Control accounted for in EF*
2_EP_UG_RAIL				
EP_UG_TRAIN	*moisture*		*0%*	*Control accounted for in EF*
EP_UG_COARSE	*3*	*dust collectors*		*Control accounted for in emission calculation*
2_EP_UG_1CRUSH				
EP_UG_FINE				*Emissions accounted for in EP_UG_COARSE*
2_EP_UG_LOW_ORE				
EP_UG_CV103				*Emissions accounted for in EP_UG_COARSE*
EP_UG_CV104	*3*	*dust collectors*		*Control accounted for in emission calculation*
EP_UG_CV105	*moisture*		*0%*	*Control accounted for in EF*
EP_UG_SILO	*3*	*dust collectors*		*Control accounted for in emission calculation*
EP_UG_FEED				*Emissions accounted for in EP_UG_SILO*
EP_UG_CV106_111				*Emissions accounted for in EP_UG_SILO*
EP_UG_Chute	*moisture*		*0%*	*Control accounted for in EF*
EP_UG_FLASK	*6*	*dust collectors*		*Control accounted for in emission calculation*
2_EP_UG_HOIST				
EP_UG_SKIP				*Emissions accounted for in EP_UG_FLASK*
EP_UG_BIN			*0%*	
2_EP_UG_UP_ORE				
EP_UG_FEED112_115	*4*	*dust collectors*		*Control accounted for in emission calculation*
EP_UG_CV102_105				*Emissions accounted for in EP_UG_FEED112_115*
EP_UG_INC_CONV115	*moisture*		*0%*	*Control accounted for in EF*
2_EP_UG_D				
EP_UG_D_C			*0%*	
EP_UG_D_DOZ	*water suppression*		*95%*	
EP_UG_D_FUG	*water suppression*		*95%*	*AP-42, Figure 13.2.2-2, Rev. 11/06*
2_EP_UG_REF				
EP_UG_COOL	*drift eliminators*			*Control accounted for in EF*
2_EP_UG_FUEL				
EP_UG_FUEL1			*0%*	

EAST PLANT - SURFACE - CONTROLS

Source ID	Control Technology	Control Efficiency	Notes
2_EP_S_EGEN			
E_GEN1		*0%*	
E_GEN2		*0%*	
E_GEN3		*0%*	
E_GEN4		*0%*	
E_GEN5		*0%*	
E_GEN6		*0%*	
E_GEN7		*0%*	
E_GEN8		*0%*	
E_GEN9		*0%*	
E_GEN10		*0%*	
E_GEN11		*0%*	
E_GEN12		*0%*	
E_GEN13		*0%*	
E_GEN14		*0%*	
E_GEN15		*0%*	
E_GEN16		*0%*	
2_EP_S_REF			
E_COOL1	*drift eliminators*	*0%*	
E_COOL2	*drift eliminators*	*0%*	
E_COOL3	*drift eliminators*	*0%*	
E_COOL4	*drift eliminators*	*0%*	
E_COOL5	*drift eliminators*	*0%*	
E_COOL6	*drift eliminators*	*0%*	
2_EP_S_CBP			
B_AGDEL		*0%*	*See "BatchPlant" Sheet*
B_SNDEL		*0%*	*See "BatchPlant" Sheet*
B_AGCHUT		*0%*	*See "BatchPlant" Sheet*
B_SNCHUT		*0%*	*See "BatchPlant" Sheet*
B_AGSTOR		*0%*	*See "BatchPlant" Sheet*
B_SNSTOR		*0%*	*See "BatchPlant" Sheet*
B_WHOPLD		*0%*	*See "BatchPlant" Sheet*
B_WHOPAG		*0%*	*See "BatchPlant" Sheet*
B_WHOPSN		*0%*	*See "BatchPlant" Sheet*
B_CEMSLO		*0%*	*See "BatchPlant" Sheet*
B_FLYSLO		*0%*	*See "BatchPlant" Sheet*
B_SILSLO		*0%*	*See "BatchPlant" Sheet*
B_SLOHOP		*0%*	*See "BatchPlant" Sheet*
B_SLOCNY		*0%*	*See "BatchPlant" Sheet*
B_SLOTRK		*0%*	*See "BatchPlant" Sheet*
2_EP_S_FUEL			
EP_S_FUEL1		*0%*	
2_EP_S_WE			
E_WE_RD	*chemical suppression*	*90%*	*AP-42, Figure 13.2.2-2, Rev. 11/06*
E_WE_EXP	*chemical suppression*	*90%*	*AP-42, Figure 13.2.2-2, Rev. 11/06*
E_WE_SUB	*precipitation*	*18%*	
EP_S_EFD	*chemical suppression*	*90%*	*AP-42, Figure 13.2.2-2, Rev. 11/06*
EP_S_E_C		*0%*	*AP-42, Figure 13.2.2-2, Rev. 11/06*
EP_S_DFD	*chemical suppression*	*90%*	
EP_S_D_C		*0%*	
2_EP_S_D			
EP_S_F_C		*0%*	
EP_S_D_DOZ		*0%*	
EP_S_D_FUG	*chemical suppression*	*90%*	*AP-42, Figure 13.2.2-2, Rev. 11/06*

EAST PLANT - UNDERGROUND - SOURCE IDENTIFICATION

Source ID	Source Identification
2_EP_UG_DB	***Drilling & Blasting***
EP_UG_DRILL	*Drilling*
EP_UG_BLAST	*Blasting*
2_EP_UG_EXTRACT	***Extraction Level Ore Flow***
EP_UG_OVER	*Oversize Rock Drill Rig*
2_EP_UG_OREPASS	***LHD/Ore Pass/Grizzly***
EP_UG_GRIZ	*Grizzly with Rock Breaker and associated transfers in (LHD) & out (Chute via Ore Pass)*
2_EP_UG_RAIL	***Haulage Ore Flow***
EP_UG_TRAIN	*Chute to Haul Truck*
EP_UG_COARSE	*Haul Truck to Coarse Ore Bin*
2_EP_UG_1CRUSH	***Primary Crushing Ore Flow***
EP_UG_FINE	*Gyratory Crushers (3) and associated transfers in (Coarse Ore Bin) and out (Feeders)*
2_EP_UG_LOW_ORE	***Lower Level Conveyor Ore Flow***
EP_UG_CV103	*Feeders (FE-101 - 103) to Conveyors (CV-101 - 103) and Spillage Chute*
EP_UG_CV104	*Conveyors (CV-101 - 103) to Conveyor (CV-104)*
EP_UG_CV105	*Conveyor (CV-104) to Tilt Conveyor (CV-105)*
EP_UG_SILO	*Tilt Conveyor (CV-105) to Silos (S1-101 - 103)*
EP_UG_FEED	*Silos S1-101 thru S1-103 to Feeders FE-106 thru FE-111*
EP_UG_CV106_111	*Feeders (FE-106 - 111) to Conveyors (CV-106 - 111)*
EP_UG_Chute	*Conveyors (CV-106 - 111) to Shuttle Chutes (A - F)*
EP_UG_FLASK	*Shuttle Chutes (A - F) to Flasks (101 - 112)*
2_EP_UG_HOIST	***Hoisting System Ore Flow***
EP_UG_SKIP	*Flasks (101 - 112) to Skips (SS-101 - 112)*
EP_UG_BIN	*Skips (SS-101 - 112) to Bins (1 - 4) and Spillage Chute*
2_EP_UG_UP_ORE	***Upper Level Conveyor System Ore Flow***
EP_UG_FEED112_115	*Bins (1 - 4) to Discharge Feeders (12)*
EP_UG_CV102_105	*Discharge Feeders (12) to Conveyors (CV-112 - 115)*
EP_UG_INC_CONV115	*Conveyors (CV-112 - 115) to Incline Conveyor (CV-201)*
2_EP_UG_D	***Non-Emergency Underground Diesel Fleet***
EP_UG_D_C	*Underground Combustion*
EP_UG_D_DOZ	*Underground Fugitive Dust (Dozing)*
EP_UG_D_FUG	*Underground Fugitive Dust (Grading, Vehicle Travel)*
2_EP_UG_REF	***Underground Refrigeration Plant***
EP_UG_COOL	*Underground Cooling Towers*
2_EP_UG_FUEL	***Diesel Storage Tanks***
EP_UG_FUEL1	*Underground Usage and Volume Estimated (Estimated Quantity: 6)*
3_EP_UG_TOTAL	***EP UG Subtotal***

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EAST PLANT - SURFACE - SOURCE IDENTIFICATION

Source ID	Source Identification
2_EP_S_EGEN	***Emergency Generators (Total)***
E_GEN1	*Cat 516B - Diesel*
E_GEN2	*Cat 3046C - Diesel*
E_GEN3	*Caterpillar C175-16*
E_GEN4	*Caterpillar C175-16*
E_GEN5	*Caterpillar C175-16*
E_GEN6	*Caterpillar C175-16*
E_GEN7	*Caterpillar C175-16*
E_GEN8	*Caterpillar C175-16*
E_GEN9	*Caterpillar C175-16*
E_GEN10	*Caterpillar C175-16*
E_GEN11	*Caterpillar C175-16*
E_GEN12	*Caterpillar C175-16*
E_GEN13	*Caterpillar C175-16*
E_GEN14	*Caterpillar C175-16*
E_GEN15	*Caterpillar C175-16*
E_GEN16	*Caterpillar C175-16*
2_EP_S_REF	***Surface Refrigeration Plant***
E_COOL1	*Surface Cooling Towers*
E_COOL2	*Surface Cooling Towers*
E_COOL3	*Surface Cooling Towers*
E_COOL4	*Surface Cooling Towers*
E_COOL5	*Surface Cooling Towers*
E_COOL6	*Surface Cooling Towers*
2_EP_S_CBP	***Cement Batch Plant***
B_AGDEL	*Batch Plant Aggregate Delivery to Ground Storage*
B_SNDEL	*Batch Plant Sand Delivery to Ground Storage*
B_AGCHUT	*Batch Plant Aggregate Transfer to Conveyor Belt via Chute*
B_SNCHUT	*Batch Plant Sand Transfer to Conveyor Belt via Chute*
B_AGSTOR	*Batch Plant Aggregate Transfer to Elevated Storage*
B_SNSTOR	*Batch Plant Sand Transfer to Elevated Storage*
B_WHOPLD	*Batch Plant Weigh Hopper Loading (Aggregate & Sand)*
B_WHOPAG	*Batch Plant Weigh Hopper Discharge to Truck Loading Conveyor (Agg)*
B_WHOPSN	*Batch Plant Weigh Hopper Discharge to Truck Loading Conveyor (Sand)*
B_CEMSLO	*Batch Plant Cement Unloading to Silo*
B_FLYSLO	*Batch Plant Flyash Unloading to Silo*
B_SILSLO	*Batch Plant Silica Fume Unloading to Silo*
B_SLOHOP	*Batch Plant Cement & Flyash Discharge to Silo Weigh Hopper*
B_SLOCNY	*Batch Plant Silo Weigh Hopper Discharge to Truck Loading Conveyor*
B_SLOTRK	*Batch Plant Truck Loading*
2_EP_S_FUEL	***Diesel Storage Tanks***
EP_S_FUEL1	*Surface Usage and Volume Estimated (Estimated Quantity: 1)*
2_EP_S_WE	***Miscellaneous Fugitives***
E_WE_RD	*EPS Secondary Sources from Access Roads (Wind Erosion)*
E_WE_EXP	*EPS Exposed Areas*
E_WE_SUB	*EPS Exposed Subsidence Area*
EP_S_EFD	*EPS Employee Fugitives*
EP_S_E_C	*EPS Employee Combustion*
EP_S_DFD	*EPS Delivery Fugitives*
EP_S_D_C	*EPS Delivery Combustion*
2_EP_S_D	***Non-Emergency Surface Diesel Fleet***
EP_S_F_C	*Surface Combustion*
EP_S_D_DOZ	*Surface Fugitive Dust (Dozing)*
EP_S_D_FUG	*Surface Fugitive Dust (Grading, Vehicle Travel)*
3_EP_S_TOTAL	***EP Surface Subtotal***

EAST PLANT - CONTROLLED UNDERGROUND - EF REFERENCE

Source ID	Emission Factor Reference
2_EP_UG_DB	
EP_UG_DRILL	*See "Drill & Blast" Sheet*
EP_UG_BLAST	*See "Drill & Blast" Sheet*
2_EP_UG_EXTRACT	
EP_UG_OVER	*AP-42, Table 11.19.2-2, Wet Drilling, Rev. 8/04*
2_EP_UG_OREPASS	
EP_UG_GRIZ	*AP-42, Table 11.19.2-2, Screening (controlled), Rev. 8/04*
2_EP_UG_RAIL	
EP_UG_TRAIN	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.2 mph)*
EP_UG_COARSE	*Assumed Grain Loading (0.002 gr/dscf)*
2_EP_UG_1CRUSH	
EP_UG_FINE	*Emissions accounted for in EP_UG_COARSE*
2_EP_UG_LOW_ORE	
EP_UG_CV103	*Emissions accounted for in EP_UG_COARSE*
EP_UG_CV104	*Assumed Grain Loading (0.002 gr/dscf)*
EP_UG_CV105	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.4 mph)*
EP_UG_SILO	*Assumed Grain Loading (0.002 gr/dscf)*
EP_UG_FEED	*Emissions accounted for in EP_UG_SILO*
EP_UG_CV106_111	*Emissions accounted for in EP_UG_SILO*
EP_UG_Chute	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.4 mph)*
EP_UG_FLASK	*Assumed Grain Loading (0.002 gr/dscf)*
2_EP_UG_HOIST	
EP_UG_SKIP	*Emissions accounted for in EP_UG_FLASK*
EP_UG_BIN	
2_EP_UG_UP_ORE	
EP_UG_FEED112_115	*Assumed Grain Loading (0.002 gr/dscf)*
EP_UG_CV102_105	*Emissions accounted for in EP_UG_FEED112_115*
EP_UG_INC_CONV115	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 4.5 mph)*
2_EP_UG_D	
EP_UG_D_C	*See "EP_Fleet" Sheet*
EP_UG_D_DOZ	*See "EP_Fleet" Sheet*
EP_UG_D_FUG	*See "EP_Fleet" Sheet*
2_EP_UG_REF	
EP_UG_COOL	*See "EP Cooling" Sheet*
2_EP_UG_FUEL	
EP_UG_FUEL1	*See "Fuel Tanks" Sheet*

EAST PLANT - CONTROLLED SURFACE - EF REFERENCE

Source ID	Emission Factor Reference
2_EP_S_EGEN	
E_GEN1	*See "E_Gen" Sheet*
E_GEN2	*See "E_Gen" Sheet*
E_GEN3	*See "E_Gen" Sheet*
E_GEN4	*See "E_Gen" Sheet*
E_GEN5	*See "E_Gen" Sheet*
E_GEN6	*See "E_Gen" Sheet*
E_GEN7	*See "E_Gen" Sheet*
E_GEN8	*See "E_Gen" Sheet*
E_GEN9	*See "E_Gen" Sheet*
E_GEN10	*See "E_Gen" Sheet*
E_GEN11	*See "E_Gen" Sheet*
E_GEN12	*See "E_Gen" Sheet*
E_GEN13	*See "E_Gen" Sheet*
E_GEN14	*See "E_Gen" Sheet*
E_GEN15	*See "E_Gen" Sheet*
E_GEN16	*See "E_Gen" Sheet*
2_EP_S_REF	
E_COOL1	*See "Cooling" Sheet*
E_COOL2	*See "Cooling" Sheet*
E_COOL3	*See "Cooling" Sheet*
E_COOL4	*See "Cooling" Sheet*
E_COOL5	*See "Cooling" Sheet*
E_COOL6	*See "Cooling" Sheet*
2_EP_S_CBP	
B_AGDEL	*See "BatchPlant" Sheet*
B_SNDEL	*See "BatchPlant" Sheet*
B_AGCHUT	*See "BatchPlant" Sheet*
B_SNCHUT	*See "BatchPlant" Sheet*
B_AGSTOR	*See "BatchPlant" Sheet*
B_SNSTOR	*See "BatchPlant" Sheet*
B_WHOPLD	*See "BatchPlant" Sheet*
B_WHOPAG	*See "BatchPlant" Sheet*
B_WHOPSN	*See "BatchPlant" Sheet*
B_CEMSLO	*See "BatchPlant" Sheet*
B_FLYSLO	*See "BatchPlant" Sheet*
B_SILSLO	*See "BatchPlant" Sheet*
B_SLOHOP	*See "BatchPlant" Sheet*
B_SLOCNY	*See "BatchPlant" Sheet*
B_SLOTRK	*See "BatchPlant" Sheet*
2_EP_S_FUEL	
EP_S_FUEL1	*See "Fuel Tanks" Sheet*
2_EP_S_WE	
E_WE_RD	*AP-42, Table 11.9-4, Wind Erosion, Rev. 7/98*
E_WE_EXP	*AP-42, Chapter 13.2.5, Industrial Wind Erosion, Rev. 11/06*
E_WE_SUB	*AP-42, Chapter 13.2.5, Industrial Wind Erosion, Rev. 11/06*
EP_S_EFD	*See "Employees" Sheet*
EP_S_E_C	*See "Employees" Sheet*
EP_S_DFD	*See "Deliveries" Sheet*
EP_S_D_C	*See "Deliveries" Sheet*
2_EP_S_D	
EP_S_F_C	*See "EP_Fleet" Sheet*
EP_S_D_DOZ	*See "EP_Fleet" Sheet*
EP_S_D_FUG	*See "EP_Fleet" Sheet*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: D. Steen		
	PROJECT NO: 262	PAGE: 17	OF: 18	SHEET: EPS_DISP
AIR EMISSION CALCULATIONS	SUBJECT: East Plant	DATE: January 11, 2019		

EAST PLANT - UNCONTROLLED UNDERGROUND - EF REFERENCE

Source ID	Emission Factor Reference
2_EP_UG_DB	
EP_UG_DRILL	*See "Drill & Blast" Sheet*
EP_UG_BLAST	*See "Drill & Blast" Sheet*
2_EP_UG_EXTRACT	
EP_UG_OVER	*AP-42, 11.19.2, Wet Drilling, Rev. 8/04*
2_EP_UG_OREPASS	
EP_UG_GRIZ	*AP-42, Table 11.19.2-2, Screening (uncontrolled), Rev. 8/04*
2_EP_UG_RAIL	
EP_UG_TRAIN	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.2 mph)*
EP_UG_COARSE	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.2 mph)*
2_EP_UG_1CRUSH	
EP_UG_FINE	*AP-42, Table 11.19.2-2, Tertiary Crushing (uncontrolled), Rev. 8/04*
2_EP_UG_LOW_ORE	
EP_UG_CV103	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.4 mph)*
EP_UG_CV104	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.4 mph)*
EP_UG_CV105	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.4 mph)*
EP_UG_SILO	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.4 mph)*
EP_UG_FEED	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.4 mph)*
EP_UG_CV106_111	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.4 mph)*
EP_UG_Chute	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.4 mph)*
EP_UG_FLASK	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 2.4 mph)*
2_EP_UG_HOIST	
EP_UG_SKIP	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 1.3 mph)*
EP_UG_BIN	
2_EP_UG_UP_ORE	
EP_UG_FEED112_115	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 4.5 mph)*
EP_UG_CV102_105	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 4.5 mph)*
EP_UG_INC_CONV115	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 4.5 mph)*
2_EP_UG_D	
EP_UG_D_C	*See "EP_Fleet" Sheet*
EP_UG_D_DOZ	*See "EP_Fleet" Sheet*
EP_UG_D_FUG	*See "EP_Fleet" Sheet*
2_EP_UG_REF	
EP_UG_COOL	*See "EP Cooling" Sheet*
2_EP_UG_FUEL	
EP_UG_FUEL1	*See "Fuel Tanks" Sheet*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: D. Steen		
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AIR EMISSION CALCULATIONS	SUBJECT: East Plant	DATE: January 11, 2019		

EAST PLANT - UNCONTROLLED SURFACE - EF REFERENCE

Source ID	Emission Factor Reference
2_EP_S_EGEN	
E_GEN1	*See "E_Gen" Sheet*
E_GEN2	*See "E_Gen" Sheet*
E_GEN3	*See "E_Gen" Sheet*
E_GEN4	*See "E_Gen" Sheet*
E_GEN5	*See "E_Gen" Sheet*
E_GEN6	*See "E_Gen" Sheet*
E_GEN7	*See "E_Gen" Sheet*
E_GEN8	*See "E_Gen" Sheet*
E_GEN9	*See "E_Gen" Sheet*
E_GEN10	*See "E_Gen" Sheet*
E_GEN11	*See "E_Gen" Sheet*
E_GEN12	*See "E_Gen" Sheet*
E_GEN13	*See "E_Gen" Sheet*
E_GEN14	*See "E_Gen" Sheet*
E_GEN15	*See "E_Gen" Sheet*
E_GEN16	*See "E_Gen" Sheet*
2_EP_S_REF	
E_COOL1	*See "Cooling" Sheet*
E_COOL2	*See "Cooling" Sheet*
E_COOL3	*See "Cooling" Sheet*
E_COOL4	*See "Cooling" Sheet*
E_COOL5	*See "Cooling" Sheet*
E_COOL6	*See "Cooling" Sheet*
2_EP_S_CBP	
B_AGDEL	*See "BatchPlant" Sheet*
B_SNDEL	*See "BatchPlant" Sheet*
B_AGCHUT	*See "BatchPlant" Sheet*
B_SNCHUT	*See "BatchPlant" Sheet*
B_AGSTOR	*See "BatchPlant" Sheet*
B_SNSTOR	*See "BatchPlant" Sheet*
B_WHOPLD	*See "BatchPlant" Sheet*
B_WHOPAG	*See "BatchPlant" Sheet*
B_WHOPSN	*See "BatchPlant" Sheet*
B_CEMSLO	*See "BatchPlant" Sheet*
B_FLYSLO	*See "BatchPlant" Sheet*
B_SILSLO	*See "BatchPlant" Sheet*
B_SLOHOP	*See "BatchPlant" Sheet*
B_SLOCNY	*See "BatchPlant" Sheet*
B_SLOTRK	*See "BatchPlant" Sheet*
2_EP_S_FUEL	
EP_S_FUEL1	*See "Fuel Tanks" Sheet*
2_EP_S_WE	
E_WE_EXP	*AP-42, Chapter 13.2.5, Industrial Wind Erosion, Rev. 11/06*
E_WE_SUB	*AP-42, Chapter 13.2.5, Industrial Wind Erosion, Rev. 11/06*
EP_S_EFD	*See "Employees" Sheet*
EP_S_E_C	*See "Employees" Sheet*
EP_S_DFD	*See "Deliveries" Sheet*
EP_S_D_C	*See "Deliveries" Sheet*
2_EP_S_D	
EP_S_F_C	*See "EP_Fleet" Sheet*
EP_S_D_DOZ	*See "EP_Fleet" Sheet*
EP_S_D_FUG	*See "EP_Fleet" Sheet*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: D. Steen		
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AIR EMISSION CALCULATIONS	SUBJECT: West Plant	DATE: January 11, 2019		

WEST PLANT - CONTROLLED - EMISSIONS SUMMARY

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Source ID	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
2_M_DRLBST	*Drilling & Blasting*											
WPS_DRILL							*0.12*	*7.2E-3*	*0.12*	*7.2E-3*		
WPS_BLAST	*0.67*	*2.1*	*2.1*	*0.40*	*0.67*	*0.13*	*0.13*	*2.5E-2*	*7.4E-3*	*1.4E-3*		
2_M_MAT	*Material Handling - Stockpile & SAG*											
W_CVYXF1							*0.73*	*1.9*	*0.11*	*0.28*		
W_CVYXF2							*0.73*	*1.9*	*0.11*	*0.28*		
M_TRIPPR							*0.73*	*1.9*	*0.11*	*0.28*		
M_STOCKP							*6.8E-3*	*1.7E-2*	*1.0E-3*	*2.6E-3*		
M1_FEED												
M1_XFER							*0.29*	*1.3*	*0.29*	*1.3*		
M2_FEED												
M2_XFER							*0.29*	*1.3*	*0.29*	*1.3*		
2_M_SAG1	*SAG Line 1*											
M1_LOAD							*0.27*	*0.95*	*4.1E-2*	*0.14*		
M1_SAG												
M1_TROML												
M1_VIBRT												
M1_BALLA												
M1_BALLB												
2_M_SAG2	*SAG Line 2*											
M2_LOAD							*0.27*	*0.95*	*4.1E-2*	*0.14*		
M2_SAG												
M2_TROML												
M2_VIBRT												
M2_BALLA												
M2_BALLB												
2_M_PEBB	*Pebble Recycle*											
M_SCREEN							*0.42*	*1.5*	*2.9E-2*	*0.10*		
M_PEBREC							*6.6E-2*	*0.23*	*9.9E-3*	*3.5E-2*		
M_PEBBIN							*6.6E-2*	*0.23*	*9.9E-3*	*3.5E-2*		
M1_PEBFD							*6.6E-2*	*0.23*	*9.9E-3*	*3.5E-2*		
M2_PEBFD							*6.6E-2*	*0.23*	*9.9E-3*	*3.5E-2*		
M1_PEBCV							*6.6E-2*	*0.23*	*9.9E-3*	*3.5E-2*		
M2_PEBCV							*6.6E-2*	*0.23*	*9.9E-3*	*3.5E-2*		

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AIR EMISSION CALCULATIONS	SUBJECT: West Plant	DATE: January 11, 2019		

WEST PLANT - CONTROLLED - EMISSIONS SUMMARY CONT.

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Source ID	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
2_M_MOLY_FL	*Moly Flotation*											
M_MLYFLT							*6.3E-4*	*1.3E-3*	*9.5E-5*	*2.0E-4*		
M_MLYBIN							*5.6E-4*	*1.2E-3*	*8.5E-5*	*1.8E-4*		
M_MLYBAG							*5.6E-4*	*1.2E-3*	*8.5E-5*	*1.8E-4*		
2_M_LIME	*Lime System*											
M1_LIMBN							*1.4E-3*	*4.6E-3*	*1.4E-3*	*4.6E-3*		
M1_LIMVM							*1.2E-2*	*3.8E-2*	*1.2E-2*	*3.8E-2*		
M1_LIMTK							*1.2E-2*	*3.8E-2*	*1.2E-2*	*3.8E-2*		
M2_LIMBN							*1.4E-3*	*4.6E-3*	*1.4E-3*	*4.6E-3*		
M2_LIMVM							*1.2E-2*	*3.8E-2*	*1.2E-2*	*3.8E-2*		
M2_LIMTK							*1.2E-2*	*3.8E-2*	*1.2E-2*	*3.8E-2*		
2_M_TALC	*Moly/Talc Heat Treatment Process*											
M_MLYHTR					*4.2*	*13.6*					*20.2*	*65.1*
M_KILN_P							*1.1*	*3.4*	*0.90*	*2.9*		
M_KILN_C	*1.3*	*5.9*	*2.3*	*10.2*	*0.29*	*1.3*	*0.13*	*0.55*	*0.13*	*0.55*	*0.14*	*0.63*
2_M_EGEN	*Emergency Generators*											
W_GEN1	*3.9*	*0.96*	*0.35*	*8.7E-2*	*9.0E-3*	*2.2E-3*	*7.7E-3*	*1.9E-3*	*7.7E-3*	*1.9E-3*	*1.7E-2*	*4.3E-3*
W_GEN2	*3.9*	*0.96*	*0.35*	*8.7E-2*	*9.0E-3*	*2.2E-3*	*7.7E-3*	*1.9E-3*	*7.7E-3*	*1.9E-3*	*1.7E-2*	*4.3E-3*
W_GEN3	*3.9*	*0.96*	*0.35*	*8.7E-2*	*9.0E-3*	*2.2E-3*	*7.7E-3*	*1.9E-3*	*7.7E-3*	*1.9E-3*	*1.7E-2*	*4.3E-3*
2_M_FUEL	*Diesel Storage Tanks*											
M_FUEL1											*4.0E-3*	*1.7E-2*
2_M_REAG	*Reagent Storage, Handling, and Use*											
M_SIPX							*4.9E-3*	*1.9E-2*	*4.9E-3*	*1.9E-2*		
M_MIBC											*1.5E-2*	*6.7E-2*
M_NAHS												
M_FLOC1							*9.3E-4*	*3.6E-3*	*9.3E-4*	*3.6E-3*		
M_FLOC2							*2.4E-4*	*8.6E-4*	*2.4E-4*	*8.6E-4*		
M_CYTEC											*1.1E-5*	*5.0E-5*
M_MCO											*1.1E-3*	*4.8E-3*
2_M_D	*Non-Emergency Diesel Fleet (mobile and stationary)*											
M_CMBSTN	*3.2*	*1.7*	*0.36*	*0.20*	*6.9E-3*	*3.8E-3*	*1.8E-2*	*1.0E-2*	*1.8E-2*	*1.0E-2*	*0.17*	*9.5E-2*
M_D_C_MOB	*25.1*	*30.3*	*4.0*	*4.5*	*4.7E-2*	*5.5E-2*	*0.15*	*0.19*	*0.15*	*0.19*	*2.7*	*2.9*
M_D_DOZ							*0.56*	*2.0*	*0.37*	*1.3*		
M_D_FUG							*19.9*	*16.6*	*2.0*	*1.7*		
2_M_HEAT	*Propane Building Heaters*											
W_HEAT1	*3.7E-3*	*1.6E-2*	*6.5E-3*	*2.8E-2*	*7.9E-4*	*3.5E-3*	*3.5E-4*	*1.5E-3*	*3.5E-4*	*1.5E-3*	*4.0E-4*	*1.7E-3*
W_HEAT2	*5.4E-3*	*2.4E-2*	*9.3E-3*	*4.1E-2*	*1.1E-3*	*5.0E-3*	*5.0E-4*	*2.2E-3*	*5.0E-4*	*2.2E-3*	*5.7E-4*	*2.5E-3*
2_M_WE	*Miscellaneous Fugitives*											
W_WE_EXP							*9.3E-3*	*4.1E-2*	*1.4E-3*	*6.1E-3*		
M_S_EFD							*1.8E-3*	*7.5E-2*	*4.4E-4*	*1.8E-2*		
M_S_E_C	*5.4E-2*	*0.24*	*2.5E-3*	*1.1E-2*	*1.3E-4*	*5.9E-4*	*1.4E-3*	*6.1E-3*	*2.5E-4*	*1.1E-3*	*5.9E-4*	*2.6E-3*
M_S_DFD							*0.15*	*0.45*	*3.7E-2*	*0.11*		
M_S_D_C	*0.10*	*3.2E-2*	*0.30*	*9.5E-2*	*9.4E-4*	*3.0E-4*	*7.7E-2*	*2.4E-2*	*2.2E-2*	*6.9E-3*	*2.3E-2*	*7.2E-3*
3_M_TOTAL	***42.0***	***43.3***	***10.1***	***15.8***	***5.2***	***15.0***	***26.5***	***36.4***	***4.9***	***10.9***	***23.3***	***68.9***

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI		BY: D. Steen	
	PROJECT NO: 262	PAGE: 3	OF: 18	SHEET: WPS_DISP
AIR EMISSION CALCULATIONS	SUBJECT: West Plant		DATE: January 11, 2019	

W E S T P L A N T - U N C O N T R O L L E D - E M I S S I O N S S U M M A R Y

	Potential Emissions											
	CO		**NO_X**		**SO_2**		**PM_{10}**		**$PM_{2.5}$**		**VOC**	
Source ID	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
2_M_DRLBST	*Drilling & Blasting*											
WPS_DRILL							*0.12*	*7.2E-3*	*0.12*	*7.2E-3*		
WPS_BLAST	*0.67*	*2.1*	*2.1*	*0.40*	*0.67*	*0.13*	*0.13*	*2.5E-2*	*7.4E-3*	*1.4E-3*		
2_M_MAT	*Material Handling - Stockpile & SAG*											
W_CVYXF1							*5.4*	*13.9*	*0.11*	*0.28*		
W_CVYXF2							*5.4*	*13.9*	*0.11*	*0.28*		
M_TRIPPR							*5.4*	*13.9*	*0.11*	*0.28*		
M_STOCKP							*5.4*	*13.9*	*0.10*	*0.26*		
M1_FEED							*0.33*	*1.1*	*4.9E-2*	*0.17*		
M1_XFER							*0.33*	*1.1*	*4.9E-2*	*0.17*		
M2_FEED							*0.33*	*1.1*	*4.9E-2*	*0.17*		
M2_XFER							*0.33*	*1.1*	*4.9E-2*	*0.17*		
2_M_SAG1	*SAG Line 1*											
M1_LOAD							*0.27*	*0.95*	*4.1E-2*	*0.14*		
M1_SAG												
M1_TROML												
M1_VIBRT												
M1_BALLA												
M1_BALLB												
2_M_SAG2	*SAG Line 2*											
M2_LOAD							*0.27*	*0.95*	*4.1E-2*	*0.14*		
M2_SAG												
M2_TROML												
M2_VIBRT												
M2_BALLA												
M2_BALLB												
2_M_PEBB	*Pebble Recycle*											
M_SCREEN							*10.0*	*35.0*	*10.0*	*35.0*		
M_PEBREC							*6.6E-2*	*0.23*	*9.9E-3*	*3.5E-2*		
M_PEBBIN							*6.6E-2*	*0.23*	*9.9E-3*	*3.5E-2*		
M1_PEBFD							*6.6E-2*	*0.23*	*9.9E-3*	*3.5E-2*		
M2_PEBFD							*6.6E-2*	*0.23*	*9.9E-3*	*3.5E-2*		
M1_PEBCV							*6.6E-2*	*0.23*	*9.9E-3*	*3.5E-2*		
M2_PEBCV							*6.6E-2*	*0.23*	*9.9E-3*	*3.5E-2*		

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AIR EMISSION CALCULATIONS	SUBJECT: West Plant		DATE: January 11, 2019	

WEST PLANT - UNCONTROLLED - EMISSIONS SUMMARY CONT.

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Source ID	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
2_M_MOLY_FL	*Moly Flotation*											
M_MLYFLT							*6.3E-4*	*1.3E-3*	*9.5E-5*	*2.0E-4*		
M_MLYBIN							*5.6E-4*	*1.2E-3*	*8.5E-5*	*1.8E-4*		
M_MLYBAG							*5.6E-4*	*1.2E-3*	*8.5E-5*	*1.8E-4*		
2_M_LIME	*Lime System*											
M1_LIMBN							*1.9*	*6.4*	*1.9*	*6.4*		
M1_LIMVM							*1.2E-2*	*3.8E-2*	*1.2E-2*	*3.8E-2*		
M1_LIMTK							*1.2E-2*	*3.8E-2*	*1.2E-2*	*3.8E-2*		
M2_LIMBN							*1.9*	*6.4*	*1.9*	*6.4*		
M2_LIMVM							*1.2E-2*	*3.8E-2*	*1.2E-2*	*3.8E-2*		
M2_LIMTK							*1.2E-2*	*3.8E-2*	*1.2E-2*	*3.8E-2*		
2_M_TALC	*Moly/Talc Heat Treatment Process*											
M_MLYHTR					*83.9*	*270*					*172*	*554*
M_KILN_P							*106*	*341*	*90.0*	*291*		
M_KILN_C	*1.3*	*5.9*	*2.3*	*10.2*	*0.29*	*1.3*	*0.13*	*0.55*	*0.13*	*0.55*	*0.14*	*0.63*
2_M_EGEN	*Emergency Generators*											
W_GEN1	*3.9*	*0.96*	*0.35*	*8.7E-2*	*9.0E-3*	*2.2E-3*	*7.7E-3*	*1.9E-3*	*7.7E-3*	*1.9E-3*	*1.7E-2*	*4.3E-3*
W_GEN2	*3.9*	*0.96*	*0.35*	*8.7E-2*	*9.0E-3*	*2.2E-3*	*7.7E-3*	*1.9E-3*	*7.7E-3*	*1.9E-3*	*1.7E-2*	*4.3E-3*
W_GEN3	*3.9*	*0.96*	*0.35*	*8.7E-2*	*9.0E-3*	*2.2E-3*	*7.7E-3*	*1.9E-3*	*7.7E-3*	*1.9E-3*	*1.7E-2*	*4.3E-3*
2_M_FUEL	*Diesel Storage Tanks*											
M_FUEL1											*4.0E-3*	*1.7E-2*
2_M_REAG	*Reagent Storage, Handling, and Use*											
M_SIPX							*4.9E-3*	*1.9E-2*	*4.9E-3*	*1.9E-2*		
M_MIBC											*1.5E-2*	*6.7E-2*
M_NAHS												
M_FLOC1							*2.7E-2*	*0.10*	*2.7E-2*	*0.10*		
M_FLOC2							*6.9E-3*	*2.4E-2*	*6.9E-3*	*2.4E-2*		
M_CYTEC											*1.1E-5*	*5.0E-5*
M_MCO											*1.1E-3*	*4.8E-3*
2_M_D	*Non-Emergency Diesel Fleet (mobile and stationary)*											
M_CMBSTN	*3.2*	*1.7*	*0.36*	*0.20*	*6.9E-3*	*3.8E-3*	*1.8E-2*	*1.0E-2*	*1.8E-2*	*1.0E-2*	*0.17*	*9.5E-2*
M_D_C_MOB	*25.1*	*30.3*	*4.0*	*4.5*	*4.7E-2*	*5.5E-2*	*0.15*	*0.19*	*0.15*	*0.19*	*2.7*	*2.9*
M_D_DOZ							*0.56*	*2.0*	*0.37*	*1.3*		
M_D_FUG							*199*	*166*	*19.8*	*16.5*		
2_M_HEAT	*Propane Building Heaters*											
W_HEAT1	*3.7E-3*	*1.6E-2*	*6.5E-3*	*2.8E-2*	*7.9E-4*	*3.5E-3*	*3.5E-4*	*1.5E-3*	*3.5E-4*	*1.5E-3*	*4.0E-4*	*1.7E-3*
W_HEAT2	*5.4E-3*	*2.4E-2*	*9.3E-3*	*4.1E-2*	*1.1E-3*	*5.0E-3*	*5.0E-4*	*2.2E-3*	*5.0E-4*	*2.2E-3*	*5.7E-4*	*2.5E-3*
2_M_WE	*Miscellaneous Fugitives*											
W_WE_EXP							*9.3E-2*	*0.41*	*1.4E-2*	*6.1E-2*		
M_S_EFD							*1.8E-2*	*7.5E-2*	*4.4E-3*	*1.8E-2*		
M_S_E_C	*5.4E-2*	*0.24*	*2.5E-3*	*1.1E-2*	*1.3E-4*	*5.9E-4*	*1.4E-3*	*6.1E-3*	*2.5E-4*	*1.1E-3*	*5.9E-4*	*2.6E-3*
M_S_DFD							*1.5*	*0.45*	*0.37*	*0.11*		
M_S_D_C	*0.10*	*3.2E-2*	*0.30*	*9.5E-2*	*9.4E-4*	*3.0E-4*	*7.7E-2*	*2.4E-2*	*2.2E-2*	*6.9E-3*	*2.3E-2*	*7.2E-3*
3_M_TOTAL	***42.0***	***43.3***	***10.1***	***15.8***	***84.9***	***272***	***345***	***622***	***126***	***360***	***175***	***558***

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AIR EMISSION CALCULATIONS	SUBJECT: West Plant	DATE: January 11, 2019		

WEST PLANT - CONTROLLED - EMISSION FACTORS

Source ID		Emission Factors						
		CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$	VOC	Units & Notes
2_M_DRLBST	*Drilling & Blasting*							
WPS_DRILL								*See "Drill & Blast" Sheet*
WPS_BLAST								*See "Drill & Blast" Sheet*
2_M_MAT	*Material Handling - Stockpile & SAG*							
W_CVYXF1					*7.4E-5*	*1.1E-5*		*lb/ton*
W_CVYXF2					*7.4E-5*	*1.1E-5*		*lb/ton*
M_TRIPPR					*7.4E-5*	*1.1E-5*		*lb/ton*
M_STOCKP					*6.9E-5*	*1.0E-5*		*lb/ton*
M1_FEED								*Emissions accounted for in M1_XFER*
M1_XFER								*Dust Collector (1017014 dscf/hr, 0.002 gr/dscf)*
M2_FEED								*Emissions accounted for in M2_XFER*
M2_XFER								*Dust Collector (1017014 dscf/hr, 0.002 gr/dscf)*
2_M_SAG1	*SAG Line 1*							
M1_LOAD					*5.7E-5*	*8.6E-6*		*lb/ton*
M1_SAG								*wet process*
M1_TROML								*wet process*
M1_VIBRT								*wet process*
M1_BALLA								*wet process*
M1_BALLB								*wet process*
2_M_SAG2	*SAG Line 2*							
M2_LOAD					*5.7E-5*	*8.6E-6*		*lb/ton*
M2_SAG								*wet process*
M2_TROML								*wet process*
M2_VIBRT								*wet process*
M2_BALLA								*wet process*
M2_BALLB								*wet process*
2_M_PEBB	*Pebble Recycle*							
M_SCREEN					*7.4E-4*	*5.0E-5*		*lb/ton*
M_PEBREC					*5.7E-5*	*8.6E-6*		*lb/ton*
M_PEBBIN					*5.7E-5*	*8.6E-6*		*lb/ton*
M1_PEBFD					*5.7E-5*	*8.6E-6*		*lb/ton*
M2_PEBFD					*5.7E-5*	*8.6E-6*		*lb/ton*
M1_PEBCV					*5.7E-5*	*8.6E-6*		*lb/ton*
M2_PEBCV					*5.7E-5*	*8.6E-6*		*lb/ton*

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AIR EMISSION CALCULATIONS	SUBJECT: West Plant	DATE: January 11, 2019		

WEST PLANT - CONTROLLED - EMISSION FACTORS CONT.

		Emission Factors					
Source ID		CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$	VOC	Units & Notes
2_M_MOLY_Fl	*Moly Flotation*							
M_MLYFLT					*5.7E-5*	*8.6E-6*		*lb/ton*
M_MLYBIN					*5.7E-5*	*8.6E-6*		*lb/ton*
M_MLYBAG					*5.7E-5*	*8.6E-6*		*lb/ton*
2_M_LIME	*Lime System*							
M1_LIMBN					*3.4E-4*	*3.4E-4*		*lb/ton*
M1_LIMVM					*2.8E-3*	*2.8E-3*		*lb/ton*
M1_LIMTK					*2.8E-3*	*2.8E-3*		*lb/ton*
M2_LIMBN					*3.4E-4*	*3.4E-4*		*lb/ton*
M2_LIMVM					*2.8E-3*	*2.8E-3*		*lb/ton*
M2_LIMTK					*2.8E-3*	*2.8E-3*		*lb/ton*
2_M_TALC	*Moly/Talc Heat Treatment Process*							
M_MLYHTR								*See "MolyTalc" Sheet*
M_KILN_P								*See "MolyTalc" Sheet*
M_KILN_C								*See "MolyTalc" Sheet*
2_M_EGEN	*Emergency Generators*							
W_GEN1								*See "E_Gen" Sheet*
W_GEN2								*See "E_Gen" Sheet*
W_GEN3								*See "E_Gen" Sheet*
2_M_FUEL	*Diesel Storage Tanks*							
M_FUEL1								*See "Fuel Tanks" Sheet*
2_M_REAG	*Reagent Storage, Handling, and Use*							
M_SIPX					*0.16*	*0.16*		*lb/ton*
M_MIBC								*See "Reagents" Sheet*
M_NAHS								*See "Reagents" Sheet*
M_FLOC1					*5.5E-3*	*5.5E-3*		*lb/ton*
M_FLOC2					*5.5E-3*	*5.5E-3*		*lb/ton*
M_CYTEC								*See "Reagents" Sheet*
M_MCO								*See "Reagents" Sheet*
2_M_D	*Non-Emergency Diesel Fleet (mobile and stationary)*							
M_CMBSTN								*See "WPS_Fleet" Sheet*
M_D_C_MOB								*See "WPS_Fleet" Sheet*
M_D_DOZ								*See "WPS_Fleet" Sheet*
M_D_FUG								*See "WPS_Fleet" Sheet*
2_M_HEAT	*Propane Building Heaters*							
W_HEAT1		*7.5*	*13.0*	*1.6*	*0.70*	*0.70*	*0.80*	*lb/k-gal*
W_HEAT2		*7.5*	*13.0*	*1.6*	*0.70*	*0.70*	*0.80*	*lb/k-gal*
2_M_WE	*Miscellaneous Fugitives*							
W_WE_EXP								*See Wind Workbook*
M_S_EFD								*See "Employees" Sheet*
M_S_E_C								*See "Employees" Sheet*
M_S_DFD								*See "Deliveries" Sheet*
M_S_D_C								*See "Deliveries" Sheet*

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WEST PLANT - UNCONTROLLED - EMISSION FACTORS

Source ID		Emission Factors						
		CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$	VOC	Units & Notes
2_M_DRLBST	*Drilling & Blasting*							
WPS_DRILL								*See "Drill & Blast" Sheet*
WPS_BLAST								*See "Drill & Blast" Sheet*
2_M_MAT	*Material Handling - Stockpile & SAG*							
W_CVYXF1					*5.5E-4*	*1.1E-5*		*lb/ton*
W_CVYXF2					*5.5E-4*	*1.1E-5*		*lb/ton*
M_TRIPPR					*5.5E-4*	*1.1E-5*		*lb/ton*
M_STOCKP					*5.5E-4*	*1.0E-5*		*lb/ton*
M1_FEED					*6.9E-5*	*1.0E-5*		*lb/ton*
M1_XFER					*6.9E-5*	*1.0E-5*		*lb/ton*
M2_FEED					*6.9E-5*	*1.0E-5*		*lb/ton*
M2_XFER					*6.9E-5*	*1.0E-5*		*lb/ton*
2_M_SAG1	*SAG Line 1*							
M1_LOAD					*5.7E-5*	*8.6E-6*		*lb/ton*
M1_SAG								*No emissions - Wet Process*
M1_TROML								*No emissions - Wet Process*
M1_VIBRT								*No emissions - Wet Process*
M1_BALLA								*No emissions - Wet Process*
M1_BALLB								*No emissions - Wet Process*
2_M_SAG2	*SAG Line 2*							
M2_LOAD					*5.7E-5*	*8.6E-6*		*lb/ton*
M2_SAG								*No emissions - Wet Process*
M2_TROML								*No emissions - Wet Process*
M2_VIBRT								*No emissions - Wet Process*
M2_BALLA								*No emissions - Wet Process*
M2_BALLB								*No emissions - Wet Process*
2_M_PEBB	*Pebble Recycle*							
M_SCREEN					*8.7E-3*	*8.7E-3*		*lb/ton*
M_PEBREC					*5.7E-5*	*8.6E-6*		*lb/ton*
M_PEBBIN					*5.7E-5*	*8.6E-6*		*lb/ton*
M1_PEBFD					*5.7E-5*	*8.6E-6*		*lb/ton*
M2_PEBFD					*5.7E-5*	*8.6E-6*		*lb/ton*
M1_PEBCV					*5.7E-5*	*8.6E-6*		*lb/ton*
M2_PEBCV					*5.7E-5*	*8.6E-6*		*lb/ton*

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WEST PLANT - UNCONTROLLED - EMISSION FACTORS CONT.

	Emission Factors						
Source ID	**CO**	**NO_X**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**VOC**	**Units & Notes**
2_M_MOLY_Fl *Moly Flotation*							
M_MLYFLT				*5.7E-5*	*8.6E-6*		*lb/ton*
M_MLYBIN				*5.7E-5*	*8.6E-6*		*lb/ton*
M_MLYBAG				*5.7E-5*	*8.6E-6*		*lb/ton*
2_M_LIME *Lime System*							
M1_LIMBN				*0.47*	*0.47*		*lb/ton*
M1_LIMVM				*2.8E-3*	*2.8E-3*		*lb/ton*
M1_LIMTK				*2.8E-3*	*2.8E-3*		*lb/ton*
M2_LIMBN				*0.47*	*0.47*		*lb/ton*
M2_LIMVM				*2.8E-3*	*2.8E-3*		*lb/ton*
M2_LIMTK				*2.8E-3*	*2.8E-3*		*lb/ton*
2_M_TALC *Moly/Talc Heat Treatment Process*							
M_MLYHTR							*See "MolyTalc" Sheet*
M_KILN_P							*See "MolyTalc" Sheet*
M_KILN_C							*See "MolyTalc" Sheet*
2_M_EGEN *Emergency Generators*							
W_GEN1							*See "E_Gen" Sheet*
W_GEN2							*See "E_Gen" Sheet*
W_GEN3							*See "E_Gen" Sheet*
2_M_FUEL *Diesel Storage Tanks*							
M_FUEL1							*See "Fuel Tanks" Sheet*
2_M_REAG *Reagent Storage, Handling, and Use*							
M_SIPX				*0.16*	*0.16*		*lb/ton*
M_MIBC							*See "Reagents" Sheet*
M_NAHS							*See "Reagents" Sheet*
M_FLOC1				*0.16*	*0.16*		*lb/ton*
M_FLOC2				*0.16*	*0.16*		*lb/ton*
M_CYTEC							*See "Reagents" Sheet*
M_MCO							*See "Reagents" Sheet*
2_M_D *Non-Emergency Diesel Fleet (mobile and stationary)*							
M_CMBSTN							*See "WP_Fleet" Sheet*
M_D_C_MOB							*See "WP_Fleet" Sheet*
M_D_DOZ							*See "WP_Fleet" Sheet*
M_D_FUG							*See "WP_Fleet" Sheet*
2_M_HEAT *Propane Building Heaters*							
W_HEAT1	*7.5*	*13.0*	*1.6*	*0.70*	*0.70*	*0.80*	*lb/k-gal*
W_HEAT2	*7.5*	*13.0*	*1.6*	*0.70*	*0.70*	*0.80*	*lb/k-gal*
2_M_WE *Miscellaneous Fugitives*							
W_WE_EXP							*See Wind Workbook*
M_S_EFD							*See "Employees" Sheet*
M_S_E_C							*See "Employees" Sheet*
M_S_DFD							*See "Deliveries" Sheet*
M_S_D_C							*See "Deliveries" Sheet*

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WEST PLANT - PROCESS RATES

	Process Rates		
Source ID	**Unit/Hr**	**Unit/Yr**	**Units & Notes**
2_M_DRLBST *Drilling & Blasting*			
WPS_DRILL			*See "Drill & Blast" Sheet*
WPS_BLAST			*See "Drill & Blast" Sheet*
2_M_MAT *Material Handling - Stockpile & SAG*			
W_CVYXF1	*9,855*	*50,292,894*	*ton*
W_CVYXF2	*9,855*	*50,292,894*	*ton*
M_TRIPPR	*9,855*	*50,292,894*	*ton*
M_STOCKP	*9,855*	*50,292,894*	*ton*
M1_FEED	*4,736*	*33,193,310*	*ton*
M1_XFER	*4,736*	*33,193,310*	*ton*
M2_FEED	*4,736*	*33,193,310*	*ton*
M2_XFER	*4,736*	*33,193,310*	*ton*
2_M_SAG1 *SAG Line 1*			
M1_LOAD	*4,736*	*33,193,310*	*ton*
M1_SAG	*4,736*	*33,193,310*	*ton*
M1_TROML	*4,736*	*33,193,310*	*ton*
M1_VIBRT	*4,736*	*33,193,310*	*ton*
M1_BALLA	*7,728*	*54,161,579*	*ton*
M1_BALLB	*7,728*	*54,161,579*	*ton*
2_M_SAG2 *SAG Line 2*			
M2_LOAD	*4,736*	*33,193,310*	*ton*
M2_SAG	*4,736*	*33,193,310*	*ton*
M2_TROML	*4,736*	*33,193,310*	*ton*
M2_VIBRT	*4,736*	*33,193,310*	*ton*
M2_BALLA	*7,728*	*54,161,579*	*ton*
M2_BALLB	*7,728*	*54,161,579*	*ton*
2_M_PEBB *Pebble Recycle*			
M_SCREEN	*1,149*	*8,046,863*	*ton*
M_PEBREC	*1,149*	*8,046,863*	*ton*
M_PEBBIN	*1,149*	*8,046,863*	*ton*
M1_PEBFD	*1,149*	*8,046,863*	*ton*
M2_PEBFD	*1,149*	*8,046,863*	*ton*
M1_PEBCV	*1,149*	*8,046,863*	*ton*
M2_PEBCV	*1,149*	*8,046,863*	*ton*

WEST PLANT - PROCESS RATES CONT.

Source ID		Process Rates		
		Unit/Hr	Unit/Yr	Units & Notes
2_M_MOLY_FI	*Moly Flotation*			
M_MLYFLT		*11.0*	*45,389*	*ton*
M_MLYBIN		*9.9*	*40,611*	*ton*
M_MLYBAG		*9.9*	*40,611*	*ton*
2_M_LIME	*Lime System*			
M1_LIMBN		*4.1*	*27,279*	*ton*
M1_LIMVM		*4.1*	*27,279*	*ton*
M1_LIMTK		*4.1*	*27,279*	*ton*
M2_LIMBN		*4.1*	*27,279*	*ton*
M2_LIMVM		*4.1*	*27,279*	*ton*
M2_LIMTK		*4.1*	*27,279*	*ton*
2_M_TALC	*Moly/Talc Heat Treatment Process*			
M_MLYHTR				*See "MolyTalc" Sheet*
M_KILN_P				*See "MolyTalc" Sheet*
M_KILN_C				*See "MolyTalc" Sheet*
2_M_EGEN	*Emergency Generators*			
W_GEN1				*See "E_Gen" Sheet*
W_GEN2				*See "E_Gen" Sheet*
W_GEN3				*See "E_Gen" Sheet*
2_M_FUEL	*Diesel Storage Tanks*			
M_FUEL1		*318*	*741,883*	*gal*
2_M_REAG	*Reagent Storage, Handling, and Use*			
M_SIPX		*3.2E-2*	*241*	*ton*
M_MIBC		*1,392*	*441,713*	*gal*
M_NAHS		*8,749*	*2,776,973*	*gal*
M_FLOC1		*0.17*	*1,296*	*ton*
M_FLOC2		*4.4E-2*	*314*	*ton*
M_CYTEC		*240*	*76,078*	*gal*
M_MCO		*422*	*133,835*	*gal*
2_M_D	*Non-Emergency Diesel Fleet (mobile and stationary)*			
M_CMBSTN				*See "WP_Fleet" Sheet*
M_D_C_MOB				*See "WP_Fleet" Sheet*
M_D_DOZ				*See "WP_Fleet" Sheet*
M_D_FUG				*See "WP_Fleet" Sheet*
2_M_HEAT	*Propane Building Heaters*			
W_HEAT1		*5.0E-4*	*4.4*	*k-gal*
W_HEAT2		*7.2E-4*	*6.3*	*k-gal*
2_M_WE	*Miscellaneous Fugitives*			
W_WE_EXP			*70.0*	*acre*
M_S_EFD				*See "Employees" Sheet*
M_S_E_C				*See "Employees" Sheet*
M_S_DFD				*See "Deliveries" Sheet*
M_S_D_C				*See "Deliveries" Sheet*

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WEST PLANT - CONTROLS

Source ID	Control Technology	Control Efficiency	Notes
2_M_DRLBST	*Drilling & Blasting*		
WPS_DRILL		*0%*	
WPS_BLAST		*0%*	
2_M_MAT	*Material Handling - Stockpile & SAG*		
W_CVYXF1	*moisture, enclosure*	*0%*	*Control accounted for in EF*
W_CVYXF2	*moisture, enclosure*	*0%*	*Control accounted for in EF*
M_TRIPPR	*moisture, enclosure*	*0%*	*Moist. & Enc. accounted for in EF*
M_STOCKP	*moisture, enclosure with filter vents*	*99%*	*Moist. & Enc. accounted for in EF*
M1_FEED		*0%*	*Emissions accounted for in M1_XFER*
M1_XFER	*1 dust collector*	*0%*	*Control accounted for in emission calculation*
M2_FEED		*0%*	*Emissions accounted for in M2_XFER*
M2_XFER	*1 dust collector*	*0%*	*Control accounted for in emission calculation*
2_M_SAG1	*SAG Line 1*		
M1_LOAD	*moisture, enclosure*	*0%*	*Control accounted for in EF*
M1_SAG	*wet process*	*100%*	
M1_TROML	*wet process*	*100%*	
M1_VIBRT	*wet process*	*100%*	
M1_BALLA	*wet process*	*100%*	
M1_BALLB	*wet process*	*100%*	
2_M_SAG2	*SAG Line 2*		
M2_LOAD	*moisture, enclosure*	*0%*	*Control accounted for in EF*
M2_SAG	*wet process*	*100%*	
M2_TROML	*wet process*	*100%*	
M2_VIBRT	*wet process*	*100%*	
M2_BALLA	*wet process*	*100%*	
M2_BALLB	*wet process*	*100%*	
2_M_PEBB	*Pebble Recycle*		
M_SCREEN	*moisture, enclosure*	*50%*	*Control accounted for in EF*
M_PEBREC	*moisture, enclosure*	*0%*	*Control accounted for in EF*
M_PEBBIN	*moisture, enclosure*	*0%*	*Control accounted for in EF*
M1_PEBFD	*moisture, enclosure*	*0%*	*Control accounted for in EF*
M2_PEBFD	*moisture, enclosure*	*0%*	*Control accounted for in EF*
M1_PEBCV	*moisture, enclosure*	*0%*	*Control accounted for in EF*
M2_PEBCV	*moisture, enclosure*	*0%*	*Control accounted for in EF*

WEST PLANT - CONTROLS CONT.

Source ID	Control Technology	Control Efficiency	Notes
2_M_MOLY_FL	*Moly Flotation*		
M_MLYFLT	*moisture, enclosure*	*0%*	*Control accounted for in EF*
M_MLYBIN	*moisture, enclosure*	*0%*	*Control accounted for in EF*
M_MLYBAG	*moisture, enclosure*	*0%*	*Control accounted for in EF*
2_M_LIME	*Lime System*		
M1_LIMBN	*bin vent*	*0%*	*Control accounted for in EF*
M1_LIMVM		*0%*	
M1_LIMTK		*0%*	
M2_LIMBN	*bin vent*	*0%*	*Control accounted for in EF*
M2_LIMVM		*0%*	
M2_LIMTK		*0%*	
2_M_TALC	*Moly/Talc Heat Treatment Process*		
M_MLYHTR		*SO2: 95%, VOC: 88%*	
M_KILN_P		*99%*	
M_KILN_C		*0%*	
2_M_EGEN	*Emergency Generators*		
W_GEN1		*0%*	
W_GEN2		*0%*	
W_GEN3		*0%*	
2_M_FUEL	*Diesel Storage Tanks*		
M_FUEL1		*0%*	
2_M_REAG	*Reagent Storage, Handling, and Use*		
M_SIPX		*0%*	
M_MIBC		*0%*	
M_NAHS		*0%*	
M_FLOC1		*0%*	
M_FLOC2		*0%*	
M_CYTEC		*0%*	
M_MCO		*0%*	
2_M_D	*Non-Emergency Diesel Fleet (mobile and stationary)*		
M_CMBSTN		*0%*	
M_D_C_MOB		*0%*	
M_D_DOZ	*enclosure with filter vents*	*0%*	
M_D_FUG	*chemical suppression*	*90%*	*AP-42, Figure 13.2.2-2, Rev. 11/06*
2_M_HEAT	*Propane Building Heaters*		
W_HEAT1		*0%*	
W_HEAT2		*0%*	
2_M_WE	*Miscellaneous Fugitives*		
W_WE_EXP	*chemical suppression*	*90%*	*AP-42, Figure 13.2.2-2, Rev. 11/06*
M_S_EFD	*chemical suppression*	*90%*	*AP-42, Figure 13.2.2-2, Rev. 11/06*
M_S_E_C		*0%*	*AP-42, Figure 13.2.2-2, Rev. 11/06*
M_S_DFD	*chemical suppression*	*90%*	*AP-42, Figure 13.2.2-2, Rev. 11/06*
M_S_D_C		*0%*	*AP-42, Figure 13.2.2-2, Rev. 11/06*

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WEST PLANT - SOURCE IDENTIFICATION

Source ID	Source Identification
2_M_DRLBST	***Drilling & Blasting***
WPS_DRILL	*Drilling*
WPS_BLAST	*Blasting*
2_M_MAT	***Material Handling - Stockpile & SAG***
W_CVYXF1	*Incline Conveyor to Mine Conveyor*
W_CVYXF2	*Mine Conveyor to Mine Transfer Conveyor (CV-002)*
M_TRIPPR	*Mine Transfer Conveyor (CV-002) to Stockpile Tripper Conveyor (CV-003)*
M_STOCKP	*Stockpile Tripper Conveyor (CV-003) to Covered SAG Mill Stockpile*
M1_FEED	*SAG Mill Stockpile to Reclaim Tunnel Feeders (FE-001 - 004) - SAG 1*
M1_XFER	*Reclaim Tunnel Feeders (FE001 - 004) to SAG 1 Conveyor (CV-004)*
M2_FEED	*SAG Mill Stockpile to Reclaim Tunnel Feeders (FE-005 - 008) - SAG 2*
M2_XFER	*Reclaim Tunnel Feeders (FE005 - 008) to SAG 2 Conveyor (CV-104)*
2_M_SAG1	***SAG Line 1***
M1_LOAD	*SAG 1 Conveyor (CV-004) to SAG Mill 1 (ML-001)*
M1_SAG	*SAG Mill 1 (ML-001)*
M1_TROML	*Trommel Screen 1 (SR-001) and associated transfer out (SR-002)*
M1_VIBRT	*Vibrating Screen (SR-002) and associated transfer out (oversize to CV-012)*
M1_BALLA	*Ball Mill 1A (ML-002) and associated transfers in and out*
M1_BALLB	*Ball Mill 1B (ML-003) and associated transfers in and out*
2_M_SAG2	***SAG Line 2***
M2_LOAD	*SAG 2 Conveyor (CV-104) to SAG Mill 2 (ML-001)*
M2_SAG	*SAG Mill 2 (ML-101)*
M2_TROML	*Trommel Screen 2 (SR-101) and associated transfer out (SR-003)*
M2_VIBRT	*Vibrating Screen (SR-003) and associated transfer out (oversize to CV-012)*
M2_BALLA	*Ball Mill 2A (ML-102) and associated transfers in and out*
M2_BALLB	*Ball Mill 2B (ML-103) and associated transfers in and out*
2_M_PEBB	***Pebble Recycle***
M_SCREEN	*SAG Mill Discharge Screens (SR-002 - 003) and associated transfers in (CV-012) and out (CV-013)*
M_PEBREC	*Recycle Conveyor 2 (CV-013) to Recycle Conveyor 3 (CV-014)*
M_PEBBIN	*Recycle Conveyor 3 (CV-014) to Pebble Bin (BN-002)*
M1_PEBFD	*Pebble Bin (BN-002) to Pebble Feeder 1 (FE-009)*
M2_PEBFD	*Pebble Bin (BN-002) to Pebble Feeder 2 (FE-109)*
M1_PEBCV	*Pebble Feeder 1 (FE-009) to SAG 1 Conveyor (CV-004)*
M2_PEBCV	*Pebble Feeder 2 (FE-109) to SAG 2 Conveyor (CV-104)*

WEST PLANT - SOURCE IDENTIFICATION CONT.

Source ID	Source Identification
2_M_MOLY_FL	***Moly Flotation***
M_MLYFLT	*Moly Concentrate Filter (FL-001) to Holoflite Dryers (DR001 - 002)*
M_MLYBIN	*Holoflite Dryers (DR-001 - 002) to Moly Concentrate Day Bins (BN001 - 003)*
M_MLYBAG	*Moly Concentrate Day Bins (BN001 - 003) to Moly Bagging System (MS-001)*
2_M_LIME	***Lime System***
M1_LIMBN	*Lime Bin 1 (BN-801) Loading (Discharge to Enclosed Screw Feeder)*
M1_LIMVM	*Screw Feeder 1 (CV-801) to Vertimill 1 (ML-801)*
M1_LIMTK	*Vertimill 1 (ML-801) to Milk of Lime Tank (TK-156)*
M2_LIMBN	*Lime Bin 2 (BN-802) Loading (Discharge to Enclosed Screw Feeder)*
M2_LIMVM	*Screw Feeder 2 (CV-802) to Vertimill 2 (ML-802)*
M2_LIMTK	*Vertimill 2 (ML-802) to Milk of Lime Tank (TK-156)*
2_M_TALC	***Moly/Talc Heat Treatment Process***
M_MLYHTR	*Moly/Talc Heat Treatment Process*
M_KILN_P	*Moly/Talc Rotary Dryer Process*
M_KILN_C	*Moly/Talc Rotary Dryer Combustion*
2_M_EGEN	***Emergency Generators***
W_GEN1	*Caterpillar C18 Generator Set*
W_GEN2	*Caterpillar C18 Generator Set*
W_GEN3	*Caterpillar C18 Generator Set*
2_M_FUEL	***Diesel Storage Tanks***
M_FUEL1	*Mill Usage and Volume Estimated (Estimated Quantity: 5)*
2_M_REAG	***Reagent Storage, Handling, and Use***
M_SIPX	*SIPX (Sodium Isopropyl Xanthate)*
M_MIBC	*MIBC (Methyl isobutyl carbonal)*
M_NAHS	*NaHS (Sodium hydrosulfide solution)*
M_FLOC1	*Flocculent (CIBA Magnafloc 155)*
M_FLOC2	*Flocculent (CIBA Magnafloc 10)*
M_CYTEC	*CYTEC 8989*
M_MCO	*MCO (Non-polar flotation oil)*
2_M_D	***Non-Emergency Diesel Fleet (mobile and stationary)***
M_CMBSTN	*Mill Combustion (Stationary)*
M_D_C_MOB	*Mill Combustion (Mobile)*
M_D_DOZ	*Mill Fugitive Dust (Dozing)*
M_D_FUG	*Mill Fugitive Dust (Grading, Vehicle Travel)*
2_M_HEAT	***Propane Building Heaters***
W_HEAT1	*Hydro House Propane Heater (0.045 MMBtu/hr)*
W_HEAT2	*Hydro House Propane Heater (0.065 MMBtu/hr)*
2_M_WE	***Miscellaneous Fugitives***
W_WE_EXP	*WPS Exposed Areas*
M_S_EFD	*WPS Employee Fugitives*
M_S_E_C	*WPS Employee Combustion*
M_S_DFD	*WPS Delivery Fugitives*
M_S_D_C	*WPS Delivery Combustion*
3_M_TOTAL	***West Plant Subtotal***

WEST PLANT - CONTROLLED - EF REFERENCE

Source ID	Emission Factor Reference
2_M_DRLBST	*Drilling & Blasting*
WPS_DRILL	*See "Drill & Blast" Sheet*
WPS_BLAST	*See "Drill & Blast" Sheet*
2_M_MAT	*Material Handling - Stockpile & SAG*
W_CVYXF1	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 1.3 mph)*
W_CVYXF2	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 1.3 mph)*
M_TRIPPR	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 1.3 mph)*
M_STOCKP	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.2% moist, 1.3 mph)*
M1_FEED	*Emissions accounted for in M1_XFER*
M1_XFER	*Manufacturer (Donaldson Torit) Specified Grain Loading*
M2_FEED	*Emissions accounted for in M2_XFER*
M2_XFER	*Manufacturer (Donaldson Torit) Specified Grain Loading*
2_M_SAG1	*SAG Line 1*
M1_LOAD	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
M1_SAG	*No emissions - Wet Process*
M1_TROML	*No emissions - Wet Process*
M1_VIBRT	*No emissions - Wet Process*
M1_BALLA	*No emissions - Wet Process*
M1_BALLB	*No emissions - Wet Process*
2_M_SAG2	*SAG Line 2*
M2_LOAD	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
M2_SAG	*No emissions - Wet Process*
M2_TROML	*No emissions - Wet Process*
M2_VIBRT	*No emissions - Wet Process*
M2_BALLA	*No emissions - Wet Process*
M2_BALLB	*No emissions - Wet Process*
2_M_PEBB	*Pebble Recycle*
M_SCREEN	*AP-42, Table 11.19.2-2, Screening (controlled), Rev. 8/04*
M_PEBREC	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
M_PEBBIN	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
M1_PEBFD	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
M2_PEBFD	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
M1_PEBCV	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
M2_PEBCV	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*

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WEST PLANT - CONTROLLED - EF REFERENCE CONT.

Source ID	Emission Factor Reference
2_M_MOLY_FL	*Moly Flotation*
M_MLYFLT	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
M_MLYBIN	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
M_MLYBAG	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
2_M_LIME	*Lime System*
M1_LIMBN	*AP-42, Table 11.12-2, Cement Unloading to Elevated Storage Silo (pneumatic, controlled), Rev. 6/06*
M1_LIMVM	*AP-42, Table 11.12-2, Weigh Hopper Loading (uncontrolled), Rev. 6/06*
M1_LIMTK	*AP-42, Table 11.12-2, Weigh Hopper Loading (uncontrolled), Rev. 6/06*
M2_LIMBN	*AP-42, Table 11.12-2, Cement Unloading to Elevated Storage Silo (pneumatic, controlled), Rev. 6/06*
M2_LIMVM	*AP-42, Table 11.12-2, Weigh Hopper Loading (uncontrolled), Rev. 6/06*
M2_LIMTK	*AP-42, Table 11.12-2, Weigh Hopper Loading (uncontrolled), Rev. 6/06*
2_M_TALC	*Moly/Talc Heat Treatment Process*
M_MLYHTR	*See "MolyTalc" Sheet*
M_KILN_P	*See "MolyTalc" Sheet*
M_KILN_C	*See "MolyTalc" Sheet*
2_M_EGEN	*Emergency Generators*
W_GEN1	*See "E_Gen" Sheet*
W_GEN2	*See "E_Gen" Sheet*
W_GEN3	*See "E_Gen" Sheet*
2_M_FUEL	*Diesel Storage Tanks*
M_FUEL1	*See "Fuel Tanks" Sheet*
2_M_REAG	*Reagent Storage, Handling, and Use*
M_SIPX	*AP-42, Table 11.12-2, Mixer Loading (uncontrolled), Rev. 6/06*
M_MIBC	*See "Reagents" Sheet*
M_NAHS	*See "Reagents" Sheet*
M_FLOC1	*AP-42, Table 11.12-2, Mixer Loading (controlled), Rev. 6/06*
M_FLOC2	*AP-42, Table 11.12-2, Mixer Loading (controlled), Rev. 6/06*
M_CYTEC	*See "Reagents" Sheet*
M_MCO	*See "Reagents" Sheet*
2_M_D	*Non-Emergency Diesel Fleet (mobile and stationary)*
M_CMBSTN	*See "WP_Fleet" Sheet*
M_D_C_MOB	*See "WP_Fleet" Sheet*
M_D_DOZ	*See "WP_Fleet" Sheet*
M_D_FUG	*See "WP_Fleet" Sheet*
2_M_HEAT	*Propane Building Heaters*
W_HEAT1	*AP-42, Table 1.5-1 (industrial, propane boilers), Rev. 7/08*
W_HEAT2	*AP-42, Table 1.5-1 (industrial, propane boilers), Rev. 7/08*
2_M_WE	*Miscellaneous Fugitives*
W_WE_EXP	*AP-42, Chapter 13.2.5, Industrial Wind Erosion, Rev. 11/06*
M_S_EFD	*See "Employees" Sheet*
M_S_E_C	*See "Employees" Sheet*
M_S_DFD	*See "Deliveries" Sheet*
M_S_D_C	*See "Deliveries" Sheet*

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WEST PLANT - UNCONTROLLED - EF REFERENCE

Source ID	Emission Factor Reference
2_M_DRLBST	*Drilling & Blasting*
WPS_DRILL	*See "Drill & Blast" Sheet*
WPS_BLAST	*See "Drill & Blast" Sheet*
2_M_MAT	*Material Handling - Stockpile & SAG*
W_CVYXF1	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 6.1 mph)*
W_CVYXF2	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 6.1 mph)*
M_TRIPPR	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 6.1 mph)*
M_STOCKP	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4% moist, 6.1 mph)*
M1_FEED	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.2% moist, 1.3 mph)*
M1_XFER	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.2% moist, 1.3 mph)*
M2_FEED	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.2% moist, 1.3 mph)*
M2_XFER	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.2% moist, 1.3 mph)*
2_M_SAG1	*SAG Line 1*
M1_LOAD	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
M1_SAG	*No emissions - Wet Process*
M1_TROML	*No emissions - Wet Process*
M1_VIBRT	*No emissions - Wet Process*
M1_BALLA	*No emissions - Wet Process*
M1_BALLB	*No emissions - Wet Process*
2_M_SAG2	*SAG Line 2*
M2_LOAD	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
M2_SAG	*No emissions - Wet Process*
M2_TROML	*No emissions - Wet Process*
M2_VIBRT	*No emissions - Wet Process*
M2_BALLA	*No emissions - Wet Process*
M2_BALLB	*No emissions - Wet Process*
2_M_PEBB	*Pebble Recycle*
M_SCREEN	*AP-42, Table 11.19.2-2, Screening (uncontrolled), Rev. 8/04*
M_PEBREC	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
M_PEBBIN	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
M1_PEBFD	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
M2_PEBFD	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
M1_PEBCV	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
M2_PEBCV	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*

WEST PLANT - UNCONTROLLED - EF REFERENCE CONT.

Source ID	Emission Factor Reference
2_M_MOLY_FL	*Moly Flotation*
M_MLYFLT	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
M_MLYBIN	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
M_MLYBAG	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
2_M_LIME	*Lime System*
M1_LIMBN	*AP-42, Table 11.12-2, Cement Unloading to Elevated Storage Silo (pneumatic, uncontrolled), Rev. 6/06*
M1_LIMVM	*AP-42, Table 11.12-2, Weigh Hopper Loading (uncontrolled), Rev. 6/06*
M1_LIMTK	*AP-42, Table 11.12-2, Weigh Hopper Loading (uncontrolled), Rev. 6/06*
M2_LIMBN	*AP-42, Table 11.12-2, Cement Unloading to Elevated Storage Silo (pneumatic, uncontrolled), Rev. 6/06*
M2_LIMVM	*AP-42, Table 11.12-2, Weigh Hopper Loading (uncontrolled), Rev. 6/06*
M2_LIMTK	*AP-42, Table 11.12-2, Weigh Hopper Loading (uncontrolled), Rev. 6/06*
2_M_TALC	*Moly/Talc Heat Treatment Process*
M_MLYHTR	*See "MolyTalc" Sheet*
M_KILN_P	*See "MolyTalc" Sheet*
M_KILN_C	*See "MolyTalc" Sheet*
2_M_EGEN	*Emergency Generators*
W_GEN1	*See "E_Gen" Sheet*
W_GEN2	*See "E_Gen" Sheet*
W_GEN3	*See "E_Gen" Sheet*
2_M_FUEL	*Diesel Storage Tanks*
M_FUEL1	*See "Fuel Tanks" Sheet*
2_M_REAG	*Reagent Storage, Handling, and Use*
M_SIPX	*AP-42, Table 11.12-2, Mixer Loading (uncontrolled), Rev. 6/06*
M_MIBC	*See "Reagents" Sheet*
M_NAHS	*See "Reagents" Sheet*
M_FLOC1	*AP-42, Table 11.12-2, Mixer Loading (uncontrolled), Rev. 6/06*
M_FLOC2	*AP-42, Table 11.12-2, Mixer Loading (uncontrolled), Rev. 6/06*
M_CYTEC	*See "Reagents" Sheet*
M_MCO	*See "Reagents" Sheet*
2_M_D	*Non-Emergency Diesel Fleet (mobile and stationary)*
M_CMBSTN	*See "WP_Fleet" Sheet*
M_D_C_MOB	*See "WP_Fleet" Sheet*
M_D_DOZ	*See "WP_Fleet" Sheet*
M_D_FUG	*See "WP_Fleet" Sheet*
2_M_HEAT	*Propane Building Heaters*
W_HEAT1	*AP-42, Table 1.5-1 (industrial, propane boilers), Rev. 7/08*
W_HEAT2	*AP-42, Table 1.5-1 (industrial, propane boilers), Rev. 7/08*
2_M_WE	*Miscellaneous Fugitives*
W_WE_EXP	*AP-42, Chapter 13.2.5, Industrial Wind Erosion, Rev. 11/06*
M_S_EFD	*See "Employees" Sheet*
M_S_E_C	*See "Employees" Sheet*
M_S_DFD	*See "Deliveries" Sheet*
M_S_D_C	*See "Deliveries" Sheet*

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L O A D O U T - C O N T R O L L E D - E M I S S I O N S S U M M A R Y

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Source ID	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
2_L_CU_CONC	*Copper Concentrate Loadout*											
F_LDSTL							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_STLBLD							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_STLCOL							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_COLBLT							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_LDGHOP							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_HOPFED							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_FEDBLT							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_BLTTRP							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_TRPSTO							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_LDRHOP							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_HOPBLT							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_BLTCNV							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_CNVTRN							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
2_L_FUEL	*Diesel Storage Tanks*											
L_FUEL1											*3.1E-3*	*1.3E-2*
2_L_GEN	*Emergency Generators*											
F_GEN1	*3.9*	*0.96*	*0.35*	*8.7E-2*	*9.0E-3*	*2.2E-3*	*7.7E-3*	*1.9E-3*	*7.7E-3*	*1.9E-3*	*1.7E-2*	*4.3E-3*
2_L_D	*Non-Emergency Diesel Fleet (mobile and stationary)*											
F_CMBSTN												
L_D_C_MOB	*8.3*	*20.4*	*0.94*	*2.3*	*1.9E-2*	*4.4E-2*	*4.7E-2*	*0.12*	*4.7E-2*	*0.12*	*0.44*	*1.1*
L_RR_LOAD	*0.99*	*2.6*	*0.86*	*2.2*	*1.9E-3*	*8.2E-3*	*2.0E-2*	*5.1E-2*	*2.0E-2*	*5.1E-2*	*9.3E-2*	*0.24*
RR_OFF	*5.4*	*1.2*	*4.6*	*1.0*	*3.6E-4*	*3.8E-3*	*0.11*	*2.4E-2*	*0.11*	*2.4E-2*	*0.50*	*0.11*
RR_ON												
2_L_S_WE	*Miscellaneous Fugitives*											
L_WE_RD							*0.10*	*0.44*	*1.5E-2*	*6.7E-2*		
L_S_EFD							*0.14*	*0.53*	*1.4E-2*	*5.3E-2*		
L_S_E_C	*4.9E-2*	*0.21*	*2.3E-3*	*1.0E-2*	*1.2E-4*	*5.3E-4*	*1.3E-3*	*5.5E-3*	*2.2E-4*	*9.7E-4*	*5.3E-4*	*2.3E-3*
L_S_DFD												
L_S_D_C												
3_L_TOTAL	***18.6***	***25.3***	***6.8***	***5.7***	***3.0E-2***	***5.9E-2***	***0.77***	***2.5***	***0.26***	***0.52***	***1.1***	***1.5***

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L O A D O U T - U N C O N T R O L L E D - E M I S S I O N S S U M M A R Y

	Potential Emissions											
	CO		**NO_X**		**SO_2**		**PM_{10}**		**$PM_{2.5}$**		**VOC**	
Source ID	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
2_L_CU_CONC	*Copper Concentrate Loadout*											
F_LDSTL							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_STLBLD							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_STLCOL							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_COLBLT							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_LDGHOP							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_HOPFED							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_FEDBLT							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_BLTTRP							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_TRPSTO							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_LDRHOP							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_HOPBLT							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_BLTCNV							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
F_CNVTRN							*2.6E-2*	*0.11*	*3.9E-3*	*1.6E-2*		
2_L_FUEL	*Diesel Storage Tanks*											
L_FUEL1											*3.1E-3*	*1.3E-2*
2_L_GEN	*Emergency Generators*											
F_GEN1	*3.9*	*0.96*	*0.35*	*8.7E-2*	*9.0E-3*	*2.2E-3*	*7.7E-3*	*1.9E-3*	*7.7E-3*	*1.9E-3*	*1.7E-2*	*4.3E-3*
2_L_D	*Non-Emergency Diesel Fleet (mobile and stationary)*											
F_CMBSTN												
L_D_C_MOB	*8.3*	*20.4*	*0.94*	*2.3*	*1.9E-2*	*4.4E-2*	*4.7E-2*	*0.12*	*4.7E-2*	*0.12*	*0.44*	*1.1*
L_RR_LOAD	*0.99*	*2.6*	*0.86*	*2.2*	*1.9E-3*	*8.2E-3*	*2.0E-2*	*5.1E-2*	*2.0E-2*	*5.1E-2*	*9.3E-2*	*0.24*
RR_OFF	*5.4*	*1.2*	*4.6*	*1.0*	*3.6E-4*	*3.8E-3*	*0.11*	*2.4E-2*	*0.11*	*2.4E-2*	*0.50*	*0.11*
RR_ON												
2_L_S_WE	*Miscellaneous Fugitives*											
L_WE_RD							*1.0*	*4.4*	*0.15*	*0.67*		
L_S_EFD							*1.4*	*5.3*	*0.14*	*0.53*		
L_S_E_C	*4.9E-2*	*0.21*	*2.3E-3*	*1.0E-2*	*1.2E-4*	*5.3E-4*	*1.3E-3*	*5.5E-3*	*2.2E-4*	*9.7E-4*	*5.3E-4*	*2.3E-3*
L_S_DFD												
L_S_D_C												
3_L_TOTAL	***18.6***	***25.3***	***6.8***	***5.7***	***3.0E-2***	***5.9E-2***	***3.0***	***11.3***	***0.53***	***1.6***	***1.1***	***1.5***

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L O A D O U T - C O N T R O L L E D - E M I S S I O N F A C T O R S

	Emission Factors						
Source ID	**CO**	**NO_X**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**VOC**	**Units & Notes**
2_L_CU_CONC	*Copper Concentrate Loadout*						
F_LDSTL				*5.7E-5*	*8.6E-6*		*lb/ton*
F_STLBLD				*5.7E-5*	*8.6E-6*		*lb/ton*
F_STLCOL				*5.7E-5*	*8.6E-6*		*lb/ton*
F_COLBLT				*5.7E-5*	*8.6E-6*		*lb/ton*
F_LDGHOP				*5.7E-5*	*8.6E-6*		*lb/ton*
F_HOPFED				*5.7E-5*	*8.6E-6*		*lb/ton*
F_FEDBLT				*5.7E-5*	*8.6E-6*		*lb/ton*
F_BLTTRP				*5.7E-5*	*8.6E-6*		*lb/ton*
F_TRPSTO				*5.7E-5*	*8.6E-6*		*lb/ton*
F_LDRHOP				*5.7E-5*	*8.6E-6*		*lb/ton*
F_HOPBLT				*5.7E-5*	*8.6E-6*		*lb/ton*
F_BLTCNV				*5.7E-5*	*8.6E-6*		*lb/ton*
F_CNVTRN				*5.7E-5*	*8.6E-6*		*lb/ton*
2_L_FUEL	*Diesel Storage Tanks*						
L_FUEL1							*See "Fuel Tanks" Sheet*
2_L_GEN	*Emergency Generators*						
F_GEN1							*See "E_Gen" Sheet*
2_L_D	*Non-Emergency Diesel Fleet (mobile and stationary)*						
F_CMBSTN							*See "Loadout_Fleet" Sheet*
L_D_C_MOB							*See "Loadout_Fleet" Sheet*
L_RR_LOAD							*See "RailRoad" Sheet*
RR_OFF							*See "RailRoad" Sheet*
RR_ON							*See "RailRoad" Sheet*
2_L_S_WE	*Miscellaneous Fugitives*						
L_WE_RD				*0.2*	*0.0*		*ton/acre-yr*
L_S_EFD							*See "Employees" Sheet*
L_S_E_C							*See "Employees" Sheet*
L_S_DFD							*See "Deliveries" Sheet*
L_S_D_C							*See "Deliveries" Sheet*

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LOADOUT - UNCONTROLLED - EMISSION FACTORS

	Emission Factors						
Source ID	**CO**	**NO_X**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**VOC**	**Units & Notes**
2_L_CU_CONC	*Copper Concentrate Loadout*						
F_LDSTL				*5.7E-5*	*8.6E-6*		*lb/ton*
F_STLBLD				*5.7E-5*	*8.6E-6*		*lb/ton*
F_STLCOL				*5.7E-5*	*8.6E-6*		*lb/ton*
F_COLBLT				*5.7E-5*	*8.6E-6*		*lb/ton*
F_LDGHOP				*5.7E-5*	*8.6E-6*		*lb/ton*
F_HOPFED				*5.7E-5*	*8.6E-6*		*lb/ton*
F_FEDBLT				*5.7E-5*	*8.6E-6*		*lb/ton*
F_BLTTRP				*5.7E-5*	*8.6E-6*		*lb/ton*
F_TRPSTO				*5.7E-5*	*8.6E-6*		*lb/ton*
F_LDRHOP				*5.7E-5*	*8.6E-6*		*lb/ton*
F_HOPBLT				*5.7E-5*	*8.6E-6*		*lb/ton*
F_BLTCNV				*5.7E-5*	*8.6E-6*		*lb/ton*
F_CNVTRN				*5.7E-5*	*8.6E-6*		*lb/ton*
2_L_FUEL	*Diesel Storage Tanks*						
L_FUEL1							*See "Fuel Tanks" Sheet*
2_L_GEN	*Emergency Generators*						
F_GEN1							*See "E_Gen" Sheet*
2_L_D	*Non-Emergency Diesel Fleet (mobile and stationary)*						
F_CMBSTN							*See "Loadout_Fleet" Sheet*
L_D_C_MOB							*See "Loadout_Fleet" Sheet*
L_RR_LOAD							*See "RailRoad" Sheet*
RR_OFF							*See "RailRoad" Sheet*
RR_ON							*See "RailRoad" Sheet*
2_L_S_WE	*Miscellaneous Fugitives*						
L_WE_RD				*0.2*	*0.0*		*ton/acre-yr*
L_S_EFD							*See "Employees" Sheet*
L_S_E_C							*See "Employees" Sheet*
L_S_DFD							*See "Deliveries" Sheet*
L_S_D_C							*See "Deliveries" Sheet*

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L O A D O U T - P R O C E S S R A T E S

	Process Rates		
Source ID	**Unit/Hr**	**Unit/Yr**	**Units & Notes**
2_L_CU_CONC	*Copper Concentrate Loadout*		
F_LDSTL	*456*	*3,680,491*	*ton*
F_STLBLD	*456*	*3,680,491*	*ton*
F_STLCOL	*456*	*3,680,491*	*ton*
F_COLBLT	*456*	*3,680,491*	*ton*
F_LDGHOP	*456*	*3,680,491*	*ton*
F_HOPFED	*456*	*3,680,491*	*ton*
F_FEDBLT	*456*	*3,680,491*	*ton*
F_BLTTRP	*456*	*3,680,491*	*ton*
F_TRPSTO	*456*	*3,680,491*	*ton*
F_LDRHOP	*456*	*3,680,491*	*ton*
F_HOPBLT	*456*	*3,680,491*	*ton*
F_BLTCNV	*456*	*3,680,491*	*ton*
F_CNVTRN	*456*	*3,680,491*	*ton*
2_L_FUEL	*Diesel Storage Tanks*		
L_FUEL1	*119*	*555,866*	*gal*
2_L_GEN	*Emergency Generators*		
F_GEN1			*See "E_Gen" Sheet*
2_L_D	*Non-Emergency Diesel Fleet (mobile and stationary)*		
F_CMBSTN			*See "Loadout_Fleet" Sheet*
L_D_C_MOB			*See "Loadout_Fleet" Sheet*
L_RR_LOAD			*See "RailRoad" Sheet*
RR_OFF			*See "RailRoad" Sheet*
RR_ON			*See "RailRoad" Sheet*
2_L_S_WE	*Miscellaneous Fugitives*		
L_WE_RD		*23.4*	*acre*
L_S_EFD			*See "Employees" Sheet*
L_S_E_C			*See "Employees" Sheet*
L_S_DFD			*See "Deliveries" Sheet*
L_S_D_C			*See "Deliveries" Sheet*

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L O A D O U T - C O N T R O L S

Source ID	Control Technology	Control Efficiency	Notes
2_L_CU_CONC	*Copper Concentrate Loadout*		
F_LDSTL	*moisture, enclosure*	*0%*	*Control accounted for in EF*
F_STLBLD	*moisture, enclosure*	*0%*	*Control accounted for in EF*
F_STLCOL	*moisture, enclosure*	*0%*	*Control accounted for in EF*
F_COLBLT	*moisture, enclosure*	*0%*	*Control accounted for in EF*
F_LDGHOP	*moisture, enclosure*	*0%*	*Control accounted for in EF*
F_HOPFED	*moisture, enclosure*	*0%*	*Control accounted for in EF*
F_FEDBLT	*moisture, enclosure*	*0%*	*Control accounted for in EF*
F_BLTTRP	*moisture, enclosure*	*0%*	*Control accounted for in EF*
F_TRPSTO	*moisture, enclosure*	*0%*	*Control accounted for in EF*
F_LDRHOP	*moisture, enclosure*	*0%*	*Control accounted for in EF*
F_HOPBLT	*moisture, enclosure*	*0%*	*Control accounted for in EF*
F_BLTCNV	*moisture, enclosure*	*0%*	*Control accounted for in EF*
F_CNVTRN	*moisture, enclosure*	*0%*	*Control accounted for in EF*
2_L_FUEL	*Diesel Storage Tanks*		
L_FUEL1		*0%*	
2_L_GEN	*Emergency Generators*		
F_GEN1		*0%*	
2_L_D	*Non-Emergency Diesel Fleet (mobile and stationary)*		
F_CMBSTN		*0%*	
L_D_C_MOB		*0%*	
L_RR_LOAD		*0%*	
RR_OFF		*0%*	
RR_ON		*0%*	
2_L_S_WE	*Miscellaneous Fugitives*		
L_WE_RD	*chemical suppression*	*90%*	
L_S_EFD	*chemical suppression*	*90%*	
L_S_E_C		*0%*	
L_S_DFD	*chemical suppression*	*90%*	
L_S_D_C		*0%*	

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LOADOUT - SOURCE IDENTIFICATION

Source ID	Source Identification
2_L_CU_CONC	***Copper Concentrate Loadout***
F_LDSTL	*Concentrate Filters (FL-001 - 006) to Shuttle Conveyors (CV-001 - CV-006)*
F_STLBLD	*Shuttle Conveyors (CV-001 - CV-006) to Filter Building (BG-011)*
F_STLCOL	*Shuttle Conveyors (CV-001 - CV-006) to Collecting Conveyor (CV-010)*
F_COLBLT	*Collecting Conveyor (CV-010) to Belt Conveyor (CV-020)*
F_LDGHOP	*Concentrate Hopper (HP-011) Loading*
F_HOPFED	*Concentrate Hopper (HP-011) to Concentrate Feeder (FE-011)*
F_FEDBLT	*Concentrate Feeder (FE-011) to Belt Conveyor (CV-020)*
F_BLTTRP	*Belt Conveyor (CV-020) to Tripper Conveyor (CV-030)*
F_TRPSTO	*Tripper Conveyor (CV-030) to Storage and Loadout Shed (BG-012)*
F_LDRHOP	*Front End Loader (MS-002) to Load Out Hoppers (HP-012 - 015)*
F_HOPBLT	*Load Out Hoppers (HP-012 - 015) to Weigh Belt Feeders (FE-012 -015)*
F_BLTCNV	*Weigh Belt Feeders (FE-012 -015) to Load Out Conveyors (CV-031 - 034)*
F_CNVTRN	*Load Out Conveyors (CV-031 - 034) to Rail Cars*
2_L_FUEL	***Diesel Storage Tanks***
L_FUEL1	*Loadout Usage and Volume Estimated (Estimated Quantity: 4)*
2_L_GEN	***Emergency Generators***
F_GEN1	*Caterpillar C18 Generator Set*
2_L_D	***Non-Emergency Diesel Fleet (mobile and stationary)***
F_CMBSTN	*Loadout Combustion (Stationary)*
L_D_C_MOB	*Loadout Combustion (Mobile)*
L_RR_LOAD	*Rail line loading idle emissions (at loadout facility)*
RR_OFF	*Rail line hauling concentrate offsite (Far West to Magma Junction)*
RR_ON	*Rail line to onsite tailings facility (WPS to Far West) - Alt4 Only*
2_L_S_WE	***Miscellaneous Fugitives***
L_WE_RD	*Loadout Secondary Sources from Access Roads (Wind Erosion)*
L_S_EFD	*Loadout Employee Fugitives*
L_S_E_C	*Loadout Employee Combustion*
L_S_DFD	*Loadout Delivery Fugitives*
L_S_D_C	*Loadout Delivery Combustion*
3_L_TOTAL	***Loadout Subtotal***

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AIR EMISSION CALCULATIONS	SUBJECT: Loadout	DATE: January 11, 2019		

LOADOUT - CONTROLLED - EF REFERENCE

Source ID	Emission Factor Reference
2_L_CU_CONC	*Copper Concentrate Loadout*
F_LDSTL	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_STLBLD	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_STLCOL	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_COLBLT	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_LDGHOP	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_HOPFED	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_FEDBLT	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_BLTTRP	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_TRPSTO	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_LDRHOP	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_HOPBLT	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_BLTCNV	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_CNVTRN	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
2_L_FUEL	*Diesel Storage Tanks*
L_FUEL1	*See "Fuel Tanks" Sheet*
2_L_GEN	*Emergency Generators*
F_GEN1	*See "E_Gen" Sheet*
2_L_D	*Non-Emergency Diesel Fleet (mobile and stationary)*
F_CMBSTN	*See "Loadout_Fleet" Sheet*
L_D_C_MOB	*See "Loadout_Fleet" Sheet*
L_RR_LOAD	*See "RailRoad" Sheet*
RR_OFF	*See "RailRoad" Sheet*
RR_ON	*See "RailRoad" Sheet*
2_L_S_WE	*Miscellaneous Fugitives*
L_WE_RD	*AP-42, Table 11.9-4, Wind Erosion, Rev. 7/98*
L_S_EFD	*See "Employees" Sheet*
L_S_E_C	*See "Employees" Sheet*
L_S_DFD	*See "Deliveries" Sheet*
L_S_D_C	*See "Deliveries" Sheet*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: D. Steen		
AIR EMISSION CALCULATIONS	PROJECT NO: 262	PAGE: 9	OF: 9	SHEET: FPLF_DISP
	SUBJECT: Loadout	DATE: January 11, 2019		

LOADOUT - UNCONTROLLED - EF REFERENCE

Source ID	Emission Factor Reference
2_L_CU_CONC	*Copper Concentrate Loadout*
F_LDSTL	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_STLBLD	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_STLCOL	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_COLBLT	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_LDGHOP	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_HOPFED	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_FEDBLT	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_BLTTRP	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_TRPSTO	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_LDRHOP	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_HOPBLT	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_BLTCNV	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
F_CNVTRN	*AP-42, Equation 13.2.4 (1), Rev. 11/06 (4.8% moist, 1.3 mph)*
2_L_FUEL	*Diesel Storage Tanks*
L_FUEL1	*See "Fuel Tanks" Sheet*
2_L_GEN	*Emergency Generators*
F_GEN1	*See "E_Gen" Sheet*
2_L_D	*Non-Emergency Diesel Fleet (mobile and stationary)*
F_CMBSTN	*See "Loadout_Fleet" Sheet*
L_D_C_MOB	*See "Loadout_Fleet" Sheet*
L_RR_LOAD	*See "RailRoad" Sheet*
RR_OFF	*See "RailRoad" Sheet*
RR_ON	*See "RailRoad" Sheet*
2_L_S_WE	*Miscellaneous Fugitives*
L_WE_RD	*AP-42, Table 11.9-4, Wind Erosion, Rev. 7/98*
L_S_EFD	*See "Employees" Sheet*
L_S_E_C	*See "Employees" Sheet*
L_S_DFD	*See "Deliveries" Sheet*
L_S_D_C	*See "Deliveries" Sheet*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI		BY: D. Steen	
	PROJECT NO: 262	PAGE: 1	OF: 9	SHEET: TSF_DISP
AIR EMISSION CALCULATIONS	SUBJECT: Tailings		DATE: January 11, 2019	

TAILINGS - CONTROLLED - EMISSIONS SUMMARY

ALTERNATIVE 2 - NEAR WEST - OOM Design, wet, centerline, subaqueous PAG, partial lining

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Source ID	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
2_T_FUEL	*Diesel Storage Tanks*											
T_FUEL1											*3.1E-2*	*0.13*
2_T_D	*Non-Emergency Diesel Fleet (mobile and stationary)*											
T_CMBSTN												
T_D_C_MOB	*115*	*341*	*14.4*	*40.6*	*0.24*	*0.72*	*0.71*	*2.0*	*0.71*	*2.0*	*7.7*	*20.5*
T_D_DOZ							*3.9*	*10.1*	*2.6*	*6.7*		
T_D_FUG							*79.1*	*194*	*10.1*	*25.1*		
2_T_GEN	*Emergency Generators*											
T_GEN1	*3.9*	*0.96*	*0.35*	*8.7E-2*	*9.0E-3*	*2.2E-3*	*7.7E-3*	*1.9E-3*	*7.7E-3*	*1.9E-3*	*1.7E-2*	*4.3E-3*
2_T_WE	*Miscellaneous Fugitives*											
T_WE_RD							*9.2E-2*	*0.40*	*1.4E-2*	*6.1E-2*		
T_WE_EX							*0.17*	*0.76*	*2.6E-2*	*0.11*		
T_WE_EX2												
T_S_EFD							*0.93*	*3.3*	*9.3E-2*	*0.33*		
T_S_E_C	*0.22*	*0.92*	*1.0E-2*	*4.3E-2*	*5.5E-4*	*2.3E-3*	*5.6E-3*	*2.3E-2*	*1.0E-3*	*4.2E-3*	*2.4E-3*	*1.0E-2*
T_S_DFD												
T_S_D_C												
3_T_TOTAL	***119***	***343***	***14.7***	***40.7***	***0.25***	***0.73***	***84.9***	***211***	***13.5***	***34.3***	***7.7***	***20.6***

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TAILINGS - UNCONTROLLED - EMISSIONS SUMMARY

ALTERNATIVE 2 - NEAR WEST - OOM Design, wet, centerline, subaqueous PAG, partial lining

	Potential Emissions											
	CO		NO_X		SO_2		PM_{10}		$PM_{2.5}$		VOC	
Source ID	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
2_T_FUEL	*Diesel Storage Tanks*											
T_FUEL1											*3.1E-2*	*0.13*
2_T_D	*Non-Emergency Diesel Fleet (mobile and stationary)*											
T_CMBSTN												
T_D_C_MOB	*115*	*341*	*14.4*	*40.6*	*0.24*	*0.72*	*0.71*	*2.0*	*0.71*	*2.0*	*7.7*	*20.5*
T_D_DOZ							*3.9*	*10.1*	*2.6*	*6.7*		
T_D_FUG							*791*	*1,942*	*101*	*251*		
2_T_GEN	*Emergency Generators*											
T_GEN1	*3.9*	*0.96*	*0.35*	*8.7E-2*	*9.0E-3*	*2.2E-3*	*7.7E-3*	*1.9E-3*	*7.7E-3*	*1.9E-3*	*1.7E-2*	*4.3E-3*
2_T_WE	*Miscellaneous Fugitives*											
T_WE_RD							*0.92*	*4.0*	*0.14*	*0.61*		
T_WE_EX							*1.7*	*7.6*	*0.26*	*1.1*		
T_WE_EX2												
T_S_EFD							*9.3*	*32.5*	*0.93*	*3.3*		
T_S_E_C	*0.22*	*0.92*	*1.0E-2*	*4.3E-2*	*5.5E-4*	*2.3E-3*	*5.6E-3*	*2.3E-2*	*1.0E-3*	*4.2E-3*	*2.4E-3*	*1.0E-2*
T_S_DFD												
T_S_D_C												
3_T_TOTAL	***119***	***343***	***14.7***	***40.7***	***0.25***	***0.73***	***807***	***1,999***	***106***	***265***	***7.7***	***20.6***

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TAILINGS - CONTROLLED - EMISSION FACTORS

ALTERNATIVE 2 - NEAR WEST - OOM Design, wet, centerline, subaqueous PAG, partial lining

	Emission Factors						
Source ID	**CO**	**NO_X**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**VOC**	**Units & Notes**
2_T_FUEL	*Diesel Storage Tanks*						
T_FUEL1							*See "Fuel Tanks" Sheet*
2_T_D	*Non-Emergency Diesel Fleet (mobile and stationary)*						
T_CMBSTN							
T_D_C_MOB							*See "ALT EI" Sheet*
T_D_DOZ							*See "ALT EI" Sheet*
T_D_FUG							*See "ALT EI" Sheet*
2_T_GEN	*Emergency Generators*						
T_GEN1							*See "E_Gen" Sheet*
2_T_WE	*Miscellaneous Fugitives*						
T_WE_RD				*2E-01*	*3E-02*		*ton/acre-yr*
T_WE_EX				*5E-03*	*8E-04*		*ton/acre-yr*
T_WE_EX2				*5E-03*	*8E-04*		*ton/acre-yr*
T_S_EFD							*See "ALT EI" Sheet*
T_S_E_C							*See "ALT EI" Sheet*
T_S_DFD							*See "Deliveries" Sheet*
T_S_D_C							*See "Deliveries" Sheet*

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T A I L I N G S - U N C O N T R O L L E D - E M I S S I O N F A C T O R S

ALTERNATIVE 2 - NEAR WEST - OOM Design, wet, centerline, subaqueous PAG, partial lining

	Emission Factors						
Source ID	**CO**	**NO_X**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**VOC**	**Units & Notes**
2_T_FUEL	*Diesel Storage Tanks*						
T_FUEL1							*See "Fuel Tanks" Sheet*
2_T_D	*Non-Emergency Diesel Fleet (mobile and stationary)*						
T_CMBSTN							
T_D_C_MOB							*See "ALT EI" Sheet*
T_D_DOZ							*See "ALT EI" Sheet*
T_D_FUG							*See "ALT EI" Sheet*
2_T_GEN	*Emergency Generators*						
T_GEN1							*See "E_Gen" Sheet*
2_T_WE	*Miscellaneous Fugitives*						
T_WE_RD				*2E-01*	*3E-02*		*ton/acre-yr*
T_WE_EX							*ton/acre-yr*
T_WE_EX2							*ton/acre-yr*
T_S_EFD							*See "ALT EI" Sheet*
T_S_E_C							*See "ALT EI" Sheet*
T_S_DFD							*See "Deliveries" Sheet*
T_S_D_C							*See "Deliveries" Sheet*

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AIR EMISSION CALCULATIONS	SUBJECT: Tailings			DATE: January 11, 2019

T A I L I N G S - P R O C E S S R A T E S

ALTERNATIVE 2 - NEAR WEST - OOM Design, wet, centerline, subaqueous PAG, partial lining

	Process Rates		
Source ID	**Unit/Hr**	**Unit/Yr**	**Units & Notes**
2_T_FUEL	*Diesel Storage Tanks*		
T_FUEL1	*1,568*	*9,322,392*	*gal*
2_T_D	*Non-Emergency Diesel Fleet (mobile and stationary)*		
T_CMBSTN	*THIS SOURCE IS NOT USED DURING PRODUCTION PHASE*		
T_D_C_MOB			
T_D_DOZ			
T_D_FUG			
2_T_GEN	*Emergency Generators*		
T_GEN1			*See "E_Gen" Sheet*
2_T_WE	*Miscellaneous Fugitives*		
T_WE_RD		*21.3*	*acre*
T_WE_EX		*1,439*	*dry acre*
T_WE_EX2			*dry acre*
T_S_EFD			*See "ALT EI" Sheet*
T_S_E_C			*See "ALT EI" Sheet*
T_S_DFD			*See "Deliveries" Sheet*
T_S_D_C			*See "Deliveries" Sheet*

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TAILINGS - CONTROLS

ALTERNATIVE 2 - NEAR WEST - OOM Design, wet, centerline, subaqueous PAG, partial lining

Source ID	Control Technology	Control Efficiency	Notes
2_T_FUEL	*Diesel Storage Tanks*		
T_FUEL1		*0%*	
2_T_D	*Non-Emergency Diesel Fleet (mobile and stationary)*		
T_CMBSTN		*0%*	
T_D_C_MOB		*0%*	
T_D_DOZ		*0%*	
T_D_FUG	*chemical suppression*	*90%*	*AP-42, Figure 13.2.2-2, Rev. 11/06*
2_T_GEN	*Emergency Generators*		
T_GEN1		*0%*	*AP-42, Figure 13.2.2-2, Rev. 11/06*
2_T_WE	*Miscellaneous Fugitives*		
T_WE_RD	*chemical suppression*	*90%*	*AP-42, Figure 13.2.2-2, Rev. 11/06*
T_WE_EX	*sprinklers*	*90%*	*AP-42, Figure 13.2.2-2, Rev. 11/06*
T_WE_EX2	*sprinklers*	*90%*	*AP-42, Figure 13.2.2-2, Rev. 11/06*
T_S_EFD	*chemical suppression*	*90%*	*AP-42, Figure 13.2.2-2, Rev. 11/06*
T_S_E_C		*0%*	*AP-42, Figure 13.2.2-2, Rev. 11/06*
T_S_DFD	*chemical suppression*	*90%*	*AP-42, Figure 13.2.2-2, Rev. 11/06*
T_S_D_C		*0%*	*AP-42, Figure 13.2.2-2, Rev. 11/06*

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	SUBJECT: Tailings	DATE: January 11, 2019		

TAILINGS - SOURCE IDENTIFICATION

ALTERNATIVE 2 - NEAR WEST - OOM Design, wet, centerline, subaqueous PAG, partial lining

Source ID	Source Identification
2_T_FUEL	***Diesel Storage Tanks***
T_FUEL1	*Tailings Usage and Volume Estimated (Estimated Quantity: 12)*
2_T_D	***Non-Emergency Diesel Fleet (mobile and stationary)***
T_CMBSTN	*Tailings Combustion (Stationary)*
T_D_C_MOB	*Tailings Combustion (Mobile)*
T_D_DOZ	*Tailings Fugitive Dust (Dozing)*
T_D_FUG	*Tailings Fugitive Dust (Grading, Vehicle Travel)*
2_T_GEN	***Emergency Generators***
T_GEN1	*Caterpillar C18 Generator Set*
2_T_WE	***Miscellaneous Fugitives***
T_WE_RD	*TSF Secondary Sources from Access Roads (Wind Erosion)*
T_WE_EX	*TSF Exposed Areas*
T_WE_EX2	*TSF Exposed Areas*
T_S_EFD	*TSF Employee Fugitives*
T_S_E_C	*TSF Employee Combustion*
T_S_DFD	*TSF Delivery Fugitives*
T_S_D_C	*TSF Delivery Combustion*
3_T_TOTAL	***Tailings Subtotal***

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI		BY: D. Steen	
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AIR EMISSION CALCULATIONS	SUBJECT: Tailings		DATE: January 11, 2019	

T A I L I N G S - C O N T R O L L E D - E F R E F E R E N C E

ALTERNATIVE 2 - NEAR WEST - OOM Design, wet, centerline, subaqueous PAG, partial lining

Source ID	Emission Factor Reference
2_T_FUEL	*Diesel Storage Tanks*
T_FUEL1	*See "Fuel Tanks" Sheet*
2_T_D	*Non-Emergency Diesel Fleet (mobile and stationary)*
T_CMBSTN	
T_D_C_MOB	*Calculated from Uncontrolled Emissions in this sheet*
T_D_DOZ	*Calculated from Uncontrolled Emissions in this sheet*
T_D_FUG	*Calculated from Uncontrolled Emissions in this sheet*
2_T_GEN	*Emergency Generators*
T_GEN1	*See "E_Gen" Sheet*
2_T_WE	*Miscellaneous Fugitives*
T_WE_RD	*AP-42, Table 11.9-4, Wind Erosion, Rev. 7/98*
T_WE_EX	*AP-42, Chapter 13.2.5, Industrial Wind Erosion, Rev. 11/06*
T_WE_EX2	*AP-42, Chapter 13.2.5, Industrial Wind Erosion, Rev. 11/06*
T_S_EFD	*See "ALT EI" Sheet*
T_S_E_C	*See "ALT EI" Sheet*
T_S_DFD	*See "Deliveries" Sheet*
T_S_D_C	*See "Deliveries" Sheet*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI		BY: D. Steen	
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TAILINGS - UNCONTROLLED - EF REFERENCE

ALTERNATIVE 2 - NEAR WEST - OOM Design, wet, centerline, subaqueous PAG, partial lining

Source ID	Emission Factor Reference
2_T_FUEL	*Diesel Storage Tanks*
T_FUEL1	*See "Fuel Tanks" Sheet*
2_T_D	*Non-Emergency Diesel Fleet (mobile and stationary)*
T_CMBSTN	
T_D_C_MOB	*See "ALT EI" Sheet*
T_D_DOZ	*See "ALT EI" Sheet*
T_D_FUG	*See "ALT EI" Sheet*
2_T_GEN	*Emergency Generators*
T_GEN1	*See "E_Gen" Sheet*
2_T_WE	*Miscellaneous Fugitives*
T_WE_RD	*AP-42, Table 11.9-4, Wind Erosion, Rev. 7/98*
T_WE_EX	*AP-42, Table 11.9-4, Wind Erosion, Rev. 7/98*
T_WE_EX2	*AP-42, Table 11.9-4, Wind Erosion, Rev. 7/98*
T_S_EFD	*See "ALT EI" Sheet*
T_S_E_C	*See "ALT EI" Sheet*
T_S_DFD	*See "Deliveries" Sheet*
T_S_D_C	*See "Deliveries" Sheet*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: D. Steen		
	PROJECT NO: 262	PAGE: 1	OF: 1	SHEET: ALT Summary
AIR EMISSION CALCULATIONS	SUBJECT: Alternatives Emissions Summary	DATE: January 11, 2019		

TSF Alt2 Controlled Emissions Summary - Annual (ton/yr)

	PM	PM10	PM2.5	CO	NOX	SO2	VOC
Mobile Equipment - Combustion	2.0	2.0	2.0	341	40.6	0.7	20.5
Mobile Equipment - Fugitives	926	215	21.5				
Dozing/Grading	85.6	15.3	8.2				
Employee Traffic - Combustion	2.3E-2	2.3E-2	4.2E-3	0.9	4.3E-2	2.3E-3	1.0E-2
Employee Traffic - Fugitives	16.6	3.9	0.4				
Wind Erosion	1.5	0.8	0.1				
Conveyor Transfers (Alt4 ONLY)	--	--	--				
TOTAL	1,032	**237**	**32.2**	**342**	**40.6**	**0.7**	**20.5**

TSF Alt3 Controlled Emissions Summary - Annual (ton/yr)

	PM	PM10	PM2.5	CO	NOX	SO2	VOC
Mobile Equipment - Combustion	2.0	2.0	2.0	335	40.0	0.7	20.2
Mobile Equipment - Fugitives	900	209	20.9				
Dozing/Grading	85.6	15.3	8.2				
Employee Traffic - Combustion	2.3E-2	2.3E-2	4.2E-3	0.9	4.3E-2	2.3E-3	1.0E-2
Employee Traffic - Fugitives	16.6	3.9	0.4				
Wind Erosion	1.9	0.9	0.1				
Conveyor Transfers (Alt4 ONLY)	--	--	--				
TOTAL	1,006	**231**	**31.6**	**336**	**40.0**	**0.7**	**20.2**

TSF Alt4 Controlled Emissions Summary - Annual (ton/yr)

	PM	PM10	PM2.5	CO	NOX	SO2	VOC
Mobile Equipment - Combustion	2.2	2.2	2.2	385	44.3	0.8	21.7
Mobile Equipment - Fugitives	786	182	18.2				
Dozing/Grading	172	29.0	17.3				
Employee Traffic - Combustion	2.8E-2	2.8E-2	4.9E-3	1.1	5.1E-2	2.7E-3	1.2E-2
Employee Traffic - Fugitives	19.8	4.6	0.5				
Wind Erosion	1.6	0.8	0.1				
Conveyor Transfers (Alt4 ONLY)	20.1	9.5	1.4				
TOTAL	1,001	**228**	**39.8**	**386**	**44.4**	**0.8**	**21.7**

TSF Alt5 Controlled Emissions Summary - Annual (ton/yr)

	PM	PM10	PM2.5	CO	NOX	SO2	VOC
Mobile Equipment - Combustion	2.6	2.6	2.6	442	52.2	0.9	25.9
Mobile Equipment - Fugitives	1,509	350	35.0				
Dozing/Grading	26.6	5.1	2.4				
Employee Traffic - Combustion	2.3E-3	2.3E-3	4.1E-4	9.0E-2	4.2E-3	2.2E-4	9.8E-4
Employee Traffic - Fugitives	1.6	0.4	3.8E-2				
Wind Erosion	1.9	1.0	0.1				
Conveyor Transfers (Alt4 ONLY)	--	--	--				
TOTAL	1,542	**359**	**40.2**	**442**	**52.2**	**0.9**	**25.9**

TSF Alt6 Controlled Emissions Summary - Annual (ton/yr)

	PM	PM10	PM2.5	CO	NOX	SO2	VOC
Mobile Equipment - Combustion	2.0	2.0	2.0	335	40.0	0.7	20.2
Mobile Equipment - Fugitives	900	209	20.9				
Dozing/Grading	85.6	15.3	8.2				
Employee Traffic - Combustion	6.6E-2	6.6E-2	1.2E-2	2.6	0.1	6.4E-3	2.8E-2
Employee Traffic - Fugitives	46.6	10.8	1.1				
Wind Erosion	1.8	0.9	0.1				
Conveyor Transfers (Alt4 ONLY)	--	--	--				
TOTAL	1,036	**238**	**32.3**	**338**	**40.1**	**0.7**	**20.2**

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI			BY: D. Steen
AIR EMISSION CALCULATIONS	PROJECT NO: 262	PAGE: 1	OF: 1	SHEET: PLUVUE
	SUBJECT: Emissions Calculations for PLUVUE II			DATE: January 14, 2019

Short-term (24-hour) maximum allowable emissions (tons/day)

Location	NO_X *lb/hr*	SO_2 *lb/hr*	PM_{10} *lb/hr*	NO_X *ton/day*	SO_2 *ton/day*	PM_{10} *ton/day*
East Plant	35.75	6.87	55.41	0.43	0.08	0.66
West Plant	9.08	5.21	26.43	0.11	0.06	0.32
Tailings Storage Facility (Alt2)	14.38	0.24	84.63	0.17	0.00	1.02
Filter Plant & Loadout Facility	6.43	0.02	0.76	0.08	0.00	0.01

Facility Total Emissions excluding Emergency Generators and Wind Erosion

Location	Source ID	Source Description	NO_X *lb/hr*	SO2 *lb/hr*	PM10 *lb/hr*
EPS	3_EP_UG_TOTAL	EP UG Subtotal	35.42	6.87	50.40
	3_EP_S_TOTAL	EP Surface Subtotal	134.14	0.80	9.93
	2_EP_S_EGEN	Emergency Generators (Total)	-133.82	-0.80	-4.54
	E_WE_RD	EPS Secondary Sources from Access Roads (Wind Erosion)			-0.03
	E_WE_EXP	EPS Exposed Areas			-0.003
	E_WE_SUB	EPS Exposed Subsidence Area			-0.35
EPS	**PLUVUE Total**		**35.75**	**6.87**	**55.41**
WPS	3_M_TOTAL	West Plant Subtotal	10.13	5.24	26.46
	2_M_EGEN	Emergency Generators	-1.05	-0.03	-0.02
	W_WE_EXP	WPS Exposed Areas			-0.01
WPS	**PLUVUE Total**		**9.08**	**5.21**	**26.43**
TSF (Alt2)	3_T_TOTAL	Tailings Subtotal	14.73	0.25	84.90
	2_T_GEN	Emergency Generators	-0.35	-0.01	-0.01
	T_WE_RD	TSF Secondary Sources from Access Roads (Wind Erosion)			-0.09
	T_WE_EX	TSF Exposed Areas			-0.17
	T_WE_EX2	TSF Exposed Areas			0.00
TSF (Alt2)	**PLUVUE Total**		**14.38**	**0.24**	**84.63**
FPLF	3_L_TOTAL	Loadout Subtotal	6.78	0.03	0.77
	F_GEN1	Caterpillar C18 Generator Set	-0.35	-0.01	-0.01
FPLF	**PLUVUE Total**		**6.43**	**0.02**	**0.76**

Conversions	
2000	*lb/ton*
24	*hrs/day*

Blue values are input; black values are calculated or linked.

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI		BY: D. Steen	
	PROJECT NO: 262	PAGE: 1	OF: 8	SHEET: EP_Fleet
AIR EMISSION CALCULATIONS	SUBJECT: Diesel Fleet Calculations - East Plant	DATE: January 11, 2019		

East Plant Diesel Machinery (Non-Emergency) Year 14

Equipment*	Rating kW	Rating hp	Quantity	EPA Tier**	Fuel gal/hr	Ann. Op. Hours***	Load Factor (%)*
Surface Loader - CAT 962K	165	221	2	4	6	1,862	60%
Surface Shotcrete Truck - Highway Legal	128	172	0	4	1	0	60%
Development LHD - Sandvik LH514	256	343	9	4	12	2,182	60%
Development Drill - Atlas Copco M2C	120	161	6	4	7	741	10%
Production Drill - Simba M6C	112	150	17	4	7	3,454	10%
Blind Bore Machine - Redbore 50 MDUR	0	0	1	X	0	2,443	0%
Powder Truck - Normet Charmec MF 605 DA	110	148	13	4	6	612	90%
Bolter - Atlas Copco Boltec MC	120	161	6	4	7	2,780	10%
Mechanized Shotcrete Sprayers - Normet Spraymec 6050 WP	96	129	6	4	7	860	60%
Transmixer Trucks - Normet Utimec LF 600	155	208	4	4	11	2,275	90%
UG Haul Trucks (40T)	375	503	4	4	20	3,115	90%
Scissor Trucks - Getman A64	129	173	5	4	6	1,225	90%
Cable Bolters - Atlas Copco Cabletec LC	120	161	10	4	7	1,704	10%
Production LHD - Sandvik LH514e	132	177	30	X	0	4,768	60%
2.3 yd LHD - Atlas Copco ST2G	86	115	3	4	2	701	60%
3.5 yd LHD - Atlas Copco ST3.5	136	182	4	4	3	701	60%
Mobile Rock Breaker - Sandvik LH514	256	343	5	4	12	0	90%
Medium Reach Rig - MacLean BH-3 Blockholer	147	197	2	4	7	372	10%
Water Cannon - Getman A64	120	161	3	4	6	745	90%
Fuel/Lube Truck - Normet Utimec	120	161	4	4	6	745	90%
Crane Truck - Getman A64	129	173	4	4	6	1,489	50%
Man Haul Vans - Miller Toyota	128	172	19	4	1	1,117	90%
Flat Deck Truck - Getman A64	129	173	4	4	6	701	90%
Crane Truck - Miller Toyota	128	172	4	4	1	1,117	50%
Generator Truck (LHD) - GETMAN A64	120	161	2	4	6	701	60%
UG Grader - CAT 140M2	144	193	3	4	6	1,402	60%
Forklift - CAT P36000	110	148	4	4	3	1,402	60%
UG Water Trucks - Getman A64	129	173	3	4	6	1,402	60%
Conveyor Maint Vehicle - Miller Crane Truck	128	172	2	4	1	1,730	90%
Scissor Lift - Miller Toyota	128	172	9	4	1	1,117	50%
Skid Steer Loader - CAT272D	71	95	2	4	3	745	60%
Raise Bore - Redbore 60	0	0	5	X	0	0	0%
UG Dozer - 2.9m Blade - CAT D6N	112	150	2	4	3	745	60%
Ore Haul Trucks - Powertrans T954 *	388	520	18	4	8	5,061	60%

* *Resolution*

** *Minimum Tier 4 assumed. X denotes a unit with 0 kW rating, electric assumed*

*** *Per unit, including availability and utilization factors*

Conversions	
453.592	*g/lb*
2,000	*lb/ton*
0.0015%	*ppm S in ULSD (GPA 2140)*
7.05	*lb/gal*
1.00E+06	*Btu/MMBtu*
1.998	*SO_2/S*
1.341	*hp/kw*
8,760	*hrs/yr*

Blue values are input; black values are calculated or linked.

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI		BY: D. Steen
	PROJECT NO: 262	PAGE: 2 OF: 8	SHEET: EP_Fleet
AIR EMISSION CALCULATIONS	SUBJECT: Diesel Fleet Calculations - East Plant		DATE: January 11, 2019

East Plant Diesel Machinery (Non-Emergency) - Emission Factors **Year 14**

Equipment	Rating kW	Quantity	CO* g/kW-hr	NO_X* g/kW-hr	SO_2** g/kW-hr	PM* g/kW-hr	VOC* g/kW-hr
Surface Loader - CAT 962K	165	2	3.5	0.40	-	2.0E-2	0.19
Surface Shotcrete Truck - Highway Legal	128	0	5.0	0.40	-	2.0E-2	0.19
Development LHD - Sandvik LH514	256	9	3.5	0.40	-	2.0E-2	0.19
Development Drill - Atlas Copco M2C	120	6	5.0	0.40	-	2.0E-2	0.19
Production Drill - Simba M6C	112	17	5.0	0.40	-	2.0E-2	0.19
Blind Bore Machine - Redbore 50 MDUR	0	1	electric	electric	electric	electric	electric
Powder Truck - Normet Charmec MF 605 DA	110	13	5.0	0.40	-	2.0E-2	0.19
Bolter - Atlas Copco Boltec MC	120	6	5.0	0.40	-	2.0E-2	0.19
Mechanized Shotcrete Sprayers - Normet Spraymec 6050 WP	96	6	5.0	0.40	-	2.0E-2	0.19
Transmixer Trucks - Normet Utimec LF 600	155	4	3.5	0.40	-	2.0E-2	0.19
UG Haul Trucks (40T)	375	4	3.5	0.40	-	2.0E-2	0.19
Scissor Trucks - Getman A64	129	5	5.0	0.40	-	2.0E-2	0.19
Cable Bolters - Atlas Copco Cabletec LC	120	10	5.0	0.40	-	2.0E-2	0.19
Production LHD - Sandvik LH514e	132	30	electric	electric	electric	electric	electric
2.3 yd LHD - Atlas Copco ST2G	86	3	5.0	0.40	-	2.0E-2	0.19
3.5 yd LHD - Atlas Copco ST3.5	136	4	3.5	0.40	-	2.0E-2	0.19
Mobile Rock Breaker - Sandvik LH514	256	5	3.5	0.40	-	2.0E-2	0.19
Medium Reach Rig - MacLean BH-3 Blockholer	147	2	3.5	0.40	-	2.0E-2	0.19
Water Cannon - Getman A64	120	3	5.0	0.40	-	2.0E-2	0.19
Fuel/Lube Truck - Normet Utimec	120	4	5.0	0.40	-	2.0E-2	0.19
Crane Truck - Getman A64	129	4	5.0	0.40	-	2.0E-2	0.19
Man Haul Vans - Miller Toyota	128	19	5.0	0.40	-	2.0E-2	0.19
Flat Deck Truck - Getman A64	129	4	5.0	0.40	-	2.0E-2	0.19
Crane Truck - Miller Toyota	128	4	5.0	0.40	-	2.0E-2	0.19
Generator Truck (LHD) - GETMAN A64	120	2	5.0	0.40	-	2.0E-2	0.19
UG Grader - CAT 140M2	144	3	3.5	0.40	-	2.0E-2	0.19
Forklift - CAT P36000	110	4	5.0	0.40	-	2.0E-2	0.19
UG Water Trucks - Getman A64	129	3	5.0	0.40	-	2.0E-2	0.19
Conveyor Maint Vehicle - Miller Crane Truck	128	2	5.0	0.40	-	2.0E-2	0.19
Scissor Lift - Miller Toyota	128	9	5.0	0.40	-	2.0E-2	0.19
Skid Steer Loader - CAT272D	71	2	5.0	0.40	-	2.0E-2	0.19
Raise Bore - Redbore 60	0	5	electric	electric	electric	electric	electric
UG Dozer - 2.9m Blade - CAT D6N	112	2	5.0	0.40	-	2.0E-2	0.19
Ore Haul Trucks - Powertrans T954	388	18	3.5	0.40	-	2.0E-2	0.19

* *40 CFR §1039.101, Table 1; 40 CFR § 89.112, Table 1*

** *SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: D. Steen		
	PROJECT NO: 262	PAGE: 3	OF: 8	SHEET: EP_Fleet
AIR EMISSION CALCULATIONS	SUBJECT: Diesel Fleet Calculations - East Plant	DATE: January 11, 2019		

East Plant Diesel Machinery (Non-Emergency) - Short-Term Emission **Year 14**

Equipment	CO *lb/hr*	NO_X *lb/hr*	SO_2* *lb/hr*	PM *lb/hr*	VOC *lb/hr*
Surface Loader - CAT 962K	1.5	0.17	1.8E-3	8.7E-3	8.3E-2
Surface Shotcrete Truck - Highway Legal					
Development LHD - Sandvik LH514	10.7	1.2	1.6E-2	6.1E-2	0.58
Development Drill - Atlas Copco M2C	0.79	6.3E-2	1.0E-3	3.2E-3	3.0E-2
Production Drill - Simba M6C	2.1	0.17	2.9E-3	8.4E-3	8.0E-2
Blind Bore Machine - Redbore 50 MDUR					
Powder Truck - Normet Charmec MF 605 DA	14.2	1.1	1.7E-2	5.7E-2	0.54
Bolter - Atlas Copco Boltec MC	0.79	6.3E-2	1.0E-3	3.2E-3	3.0E-2
Mechanized Shotcrete Sprayers - Normet Spraymec 6050 WP	3.8	0.30	6.2E-3	1.5E-2	0.14
Transmixer Trucks - Normet Utimec LF 600	4.3	0.49	9.2E-3	2.5E-2	0.23
UG Haul Trucks (40T)	10.4	1.2	1.7E-2	6.0E-2	0.57
Scissor Trucks - Getman A64	6.4	0.51	6.6E-3	2.6E-2	0.24
Cable Bolters - Atlas Copco Cabletec LC	1.3	0.11	1.7E-3	5.3E-3	5.0E-2
Production LHD - Sandvik LH514e					
2.3 yd LHD - Atlas Copco ST2G	1.7	0.14	9.2E-4	6.8E-3	6.5E-2
3.5 yd LHD - Atlas Copco ST3.5	2.5	0.29	1.8E-3	1.4E-2	0.14
Mobile Rock Breaker - Sandvik LH514					
Medium Reach Rig - MacLean BH-3 Blockholer	0.23	2.6E-2	3.5E-4	1.3E-3	1.2E-2
Water Cannon - Getman A64	3.6	0.29	4.0E-3	1.4E-2	0.14
Fuel/Lube Truck - Normet Utimec	4.8	0.38	5.3E-3	1.9E-2	0.18
Crane Truck - Getman A64	2.8	0.23	3.0E-3	1.1E-2	0.11
Man Haul Vans - Miller Toyota	24.1	1.9	4.4E-3	9.7E-2	0.92
Flat Deck Truck - Getman A64	5.1	0.41	5.3E-3	2.0E-2	0.19
Crane Truck - Miller Toyota	2.8	0.23	5.1E-4	1.1E-2	0.11
Generator Truck (LHD) - GETMAN A64	1.6	0.13	1.8E-3	6.3E-3	6.0E-2
UG Grader - CAT 140M2	2.0	0.23	2.7E-3	1.1E-2	0.11
Forklift - CAT P36000	2.9	0.23	1.5E-3	1.2E-2	0.11
UG Water Trucks - Getman A64	2.6	0.20	2.7E-3	1.0E-2	9.7E-2
Conveyor Maint Vehicle - Miller Crane Truck	2.5	0.20	4.6E-4	1.0E-2	9.7E-2
Scissor Lift - Miller Toyota	6.3	0.51	1.2E-3	2.5E-2	0.24
Skid Steer Loader - CAT272D	0.94	7.5E-2	8.5E-4	3.8E-3	3.6E-2
Raise Bore - Redbore 60					
UG Dozer - 2.9m Blade - CAT D6N	1.5	0.12	7.7E-4	5.9E-3	5.6E-2
Ore Haul Trucks - Powertrans T954	32.3	3.7	2.1E-2	0.18	1.8
East Plant Underground	**155**	**14.6**	**0.14**	**0.73**	**6.9**
East Plant Surface	**1.5**	**0.17**	**1.8E-3**	**8.7E-3**	**8.3E-2**
East Plant Total	**157**	**14.7**	**0.14**	**0.74**	**7.0**

* *Calculated by mass balance using a 15% fuel contingency*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: D. Steen		
	PROJECT NO: 262	PAGE: 4	OF: 8	SHEET: EP_Fleet
AIR EMISSION CALCULATIONS	SUBJECT: Diesel Fleet Calculations - East Plant	DATE: January 11, 2019		

East Plant Diesel Machinery (Non-Emergency) - Long-Term Emission **Year 14**

Equipment	CO ton/yr	NO_X ton/yr	SO_2* ton/yr	PM ton/yr	VOC ton/yr
Surface Loader - CAT 962K	1.4	0.16	1.6E-3	8.1E-3	7.7E-2
Surface Shotcrete Truck - Highway Legal					
Development LHD - Sandvik LH514	11.6	1.3	1.7E-2	6.6E-2	0.63
Development Drill - Atlas Copco M2C	0.29	2.4E-2	3.9E-4	1.2E-3	1.1E-2
Production Drill - Simba M6C	3.6	0.29	5.1E-3	1.4E-2	0.14
Blind Bore Machine - Redbore 50 MDUR					
Powder Truck - Normet Charmec MF 605 DA	4.3	0.35	5.3E-3	1.7E-2	0.16
Bolter - Atlas Copco Boltec MC	1.1	8.8E-2	1.4E-3	4.4E-3	4.2E-2
Mechanized Shotcrete Sprayers - Normet Spraymec 6050 WP	1.6	0.13	2.7E-3	6.6E-3	6.2E-2
Transmixer Trucks - Normet Utimec LF 600	4.9	0.56	1.1E-2	2.8E-2	0.27
UG Haul Trucks (40T)	16.2	1.9	2.7E-2	9.3E-2	0.88
Scissor Trucks - Getman A64	3.9	0.31	4.1E-3	1.6E-2	0.15
Cable Bolters - Atlas Copco Cabletec LC	1.1	9.0E-2	1.5E-3	4.5E-3	4.3E-2
Production LHD - Sandvik LH514e					
2.3 yd LHD - Atlas Copco ST2G	0.60	4.8E-2	3.2E-4	2.4E-3	2.3E-2
3.5 yd LHD - Atlas Copco ST3.5	0.88	0.10	6.5E-4	5.0E-3	4.8E-2
Mobile Rock Breaker - Sandvik LH514					
Medium Reach Rig - MacLean BH-3 Blockholer	4.2E-2	4.8E-3	6.5E-5	2.4E-4	2.3E-3
Water Cannon - Getman A64	1.3	0.11	1.5E-3	5.3E-3	5.1E-2
Fuel/Lube Truck - Normet Utimec	1.8	0.14	2.0E-3	7.1E-3	6.7E-2
Crane Truck - Getman A64	2.1	0.17	2.2E-3	8.5E-3	8.0E-2
Man Haul Vans - Miller Toyota	13.5	1.1	2.5E-3	5.4E-2	0.51
Flat Deck Truck - Getman A64	1.8	0.14	1.9E-3	7.2E-3	6.8E-2
Crane Truck - Miller Toyota	1.6	0.13	2.9E-4	6.3E-3	6.0E-2
Generator Truck (LHD) - GETMAN A64	0.56	4.4E-2	6.2E-4	2.2E-3	2.1E-2
UG Grader - CAT 140M2	1.4	0.16	1.9E-3	8.0E-3	7.6E-2
Forklift - CAT P36000	2.0	0.16	1.1E-3	8.2E-3	7.7E-2
UG Water Trucks - Getman A64	1.8	0.14	1.9E-3	7.2E-3	6.8E-2
Conveyor Maint Vehicle - Miller Crane Truck	2.2	0.18	4.0E-4	8.8E-3	8.3E-2
Scissor Lift - Miller Toyota	3.5	0.28	6.5E-4	1.4E-2	0.13
Skid Steer Loader - CAT272D	0.35	2.8E-2	3.2E-4	1.4E-3	1.3E-2
Raise Bore - Redbore 60					
UG Dozer - 2.9m Blade - CAT D6N	0.55	4.4E-2	2.9E-4	2.2E-3	2.1E-2
Ore Haul Trucks - Powertrans T954	81.8	9.3	5.3E-2	0.47	4.4
East Plant Underground	**167**	**17.3**	**0.15**	**0.87**	**8.2**
East Plant Surface	**1.4**	**0.16**	**1.6E-3**	**8.1E-3**	**7.7E-2**
East Plant Total	**168**	**17.5**	**0.15**	**0.87**	**8.3**

* *Calculated by mass balance using a 15% fuel contingency*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: D. Steen		
	PROJECT NO: 262	PAGE: 5	OF: 8	SHEET: EP_Fleet
AIR EMISSION CALCULATIONS	SUBJECT: Diesel Fleet Calculations - East Plant	DATE: January 11, 2019		

East Plant Diesel Machinery (Non-Emergency) - Fugitive Emissions from Vehicle Travel - Vehicle Specifications **Year 14**

Equipment	Quantity	Ann. Op. Hours[a]	Speed[b] *mph*	Silt[c] *%*	Weight[b] *ton*
Surface Loader - CAT 962K	2	1,862	5.0	3.0	29.4
Surface Shotcrete Truck - Highway Legal	0	0	5.0	3.0	4.0
Development LHD - Sandvik LH514	9	2,182	8.3	3.0	49.7
Development Drill - Atlas Copco M2C	6	741	5.0	3.0	29.8
Production Drill - Simba M6C	17	3,454	5.0	3.0	23.0
Blind Bore Machine - Redbore 50 MDUR	1	2,443	0.0	3.0	34.2
Powder Truck - Normet Charmec MF 605 DA	13	612	5.0	3.0	19.8
Bolter - Atlas Copco Boltec MC	6	2,780	5.0	3.0	23.8
Mechanized Shotcrete Sprayers - Normet Spraymec 6050 WP	6	860	5.0	3.0	14.9
Transmixer Trucks - Normet Utimec LF 600	4	2,275	10.0	3.0	23.5
UG Haul Trucks (40T)	4	3,115	8.3	3.0	58.3
Scissor Trucks - Getman A64	5	1,225	5.0	3.0	12.5
Cable Bolters - Atlas Copco Cabletec LC	10	1,704	5.0	3.0	33.1
Production LHD - Sandvik LH514e	30	4,768	4.6	3.0	50.2
2.3 yd LHD - Atlas Copco ST2G	3	701	8.3	3.0	16.5
3.5 yd LHD - Atlas Copco ST3.5	4	701	8.3	3.0	22.2
Mobile Rock Breaker - Sandvik LH514	5	0	5.0	3.0	16.0
Medium Reach Rig - MacLean BH-3 Blockholer	2	372	5.0	3.0	21.5
Water Cannon - Getman A64	3	745	5.0	3.0	20.0
Fuel/Lube Truck - Normet Utimec	4	745	5.0	3.0	12.5
Crane Truck - Getman A64	4	1,489	5.0	3.0	16.5
Man Haul Vans - Miller Toyota	19	1,117	10.0	3.0	4.0
Flat Deck Truck - Getman A64	4	701	10.0	3.0	12.0
Crane Truck - Miller Toyota	4	1,117	5.0	3.0	17.0
Generator Truck (LHD) - GETMAN A64	2	701	5.0	3.0	17.0
UG Grader - CAT 140M2		*grader-specific fugitive emissions on p. 8*			
Forklift - CAT P36000	4	1,402	5.0	3.0	30.2
UG Water Trucks - Getman A64	3	1,402	10.0	3.0	17.0
Conveyor Maint Vehicle - Miller Crane Truck	2	1,730	5.0	3.0	17.0
Scissor Lift - Miller Toyota	9	1,117	5.0	3.0	4.4
Skid Steer Loader - CAT272D	2	745	5.0	3.0	5.1
Raise Bore - Redbore 60	5	0	0.0	3.0	13.5
UG Dozer - 2.9m Blade - CAT D6N		*dozer-specific fugitive emissions on p. 8*			
Ore Haul Trucks - Powertrans T954	18	5,061	6.7	3.0	211.1
Surface Mean Fleet Weight					29.4
Underground Mean Fleet Weight					41.1

[a] *Per unit, including availability and utilization factors*

[b] *Resolution*

[c] *AP-42, Chapter 13.2.2 and 13.2.1 (SL in g/m^2)*

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East Plant Diesel Machinery (Non-Emergency) - Fugitive Emissions from Vehicle Travel - Emission Factors **Year 14**

Equipment	PM* *lb/VMT*	PM_{10}* *lb/VMT*	$PM_{2.5}$* *lb/VMT*
Surface Loader - CAT 962K	5.2	1.2	0.12
Surface Shotcrete Truck - Highway Legal	5.2	1.2	0.12
Development LHD - Sandvik LH514	6.0	1.4	0.14
Development Drill - Atlas Copco M2C	6.0	1.4	0.14
Production Drill - Simba M6C	6.0	1.4	0.14
Blind Bore Machine - Redbore 50 MDUR	6.0	1.4	0.14
Powder Truck - Normet Charmec MF 605 DA	6.0	1.4	0.14
Bolter - Atlas Copco Boltec MC	6.0	1.4	0.14
Mechanized Shotcrete Sprayers - Normet Spraymec 6050 WP	6.0	1.4	0.14
Transmixer Trucks - Normet Utimec LF 600	6.0	1.4	0.14
UG Haul Trucks (40T)	6.0	1.4	0.14
Scissor Trucks - Getman A64	6.0	1.4	0.14
Cable Bolters - Atlas Copco Cabletec LC	6.0	1.4	0.14
Production LHD - Sandvik LH514e	6.0	1.4	0.14
2.3 yd LHD - Atlas Copco ST2G	6.0	1.4	0.14
3.5 yd LHD - Atlas Copco ST3.5	6.0	1.4	0.14
Mobile Rock Breaker - Sandvik LH514	6.0	1.4	0.14
Medium Reach Rig - MacLean BH-3 Blockholer	6.0	1.4	0.14
Water Cannon - Getman A64	6.0	1.4	0.14
Fuel/Lube Truck - Normet Utimec	6.0	1.4	0.14
Crane Truck - Getman A64	6.0	1.4	0.14
Man Haul Vans - Miller Toyota	6.0	1.4	0.14
Flat Deck Truck - Getman A64	6.0	1.4	0.14
Crane Truck - Miller Toyota	6.0	1.4	0.14
Generator Truck (LHD) - GETMAN A64	6.0	1.4	0.14
UG Grader - CAT 140M2			
Forklift - CAT P36000	6.0	1.4	0.14
UG Water Trucks - Getman A64	6.0	1.4	0.14
Conveyor Maint Vehicle - Miller Crane Truck	6.0	1.4	0.14
Scissor Lift - Miller Toyota	6.0	1.4	0.14
Skid Steer Loader - CAT272D	6.0	1.4	0.14
Raise Bore - Redbore 60	6.0	1.4	0.14
UG Dozer - 2.9m Blade - CAT D6N			
Ore Haul Trucks - Powertrans T954	6.0	1.4	0.14

* *Control from precip and water & chemical dust suppressant applied to emission factors*

Unpaved Roads - Predictive Emission Factor Equation & Constants*

	Empirical Constants for Industrial Roads			
$E = k \times (s / 12)^a \times (W / 3)^b \times (365 - P) / 365$	**Constan**	**PM**	**PM_{10}**	**$PM_{2.5}$**
k, a, b - empirical constants	k	4.9	1.5	0.15
s - surface material silt content %	a	0.7	0.9	0.9
W - mean vehicle wt ton	b	0.45	0.45	0.45
P - Days of >0.01" Precip				

* *AP-42, 13.2.2, Equation 1a & 2, Table 13.2.2-2, Industrial Roads, Rev. 8/04*

East Plant Diesel Machinery (Non-Emergency) - Fugitive Emissions from Vehicle Travel - Emissions (Short-Term & Long-Term) AAQS **Year 14**

Equipment	PM lb/hr	PM_{10} lb/hr	$PM_{2.5}$ lb/hr	PM ton/yr	PM_{10} ton/yr	$PM_{2.5}$ ton/yr
Surface Loader - CAT 962K	51.9	12.0	1.2	39.8	9.2	0.92
Surface Shotcrete Truck - Highway Legal						
Development LHD - Sandvik LH514	452	105	10.5	493	114	11.4
Development Drill - Atlas Copco M2C	181	42.0	4.2	67.0	15.6	1.6
Production Drill - Simba M6C	513	119	11.9	885	205	20.5
Blind Bore Machine - Redbore 50 MDUR						
Powder Truck - Normet Charmec MF 605 DA	392	90.9	9.1	120	27.8	2.8
Bolter - Atlas Copco Boltec MC	181	42.0	4.2	251	58.3	5.8
Mechanized Shotcrete Sprayers - Normet Spraymec 6050 WP	181	42.0	4.2	77.8	18.0	1.8
Transmixer Trucks - Normet Utimec LF 600	241	56.0	5.6	274	63.7	6.4
UG Haul Trucks (40T)	201	46.6	4.7	313	72.6	7.3
Scissor Trucks - Getman A64	151	35.0	3.5	92.3	21.4	2.1
Cable Bolters - Atlas Copco Cabletec LC	302	70.0	7.0	257	59.6	6.0
Production LHD - Sandvik LH514e	833	193	19.3	1,987	461	46.1
2.3 yd LHD - Atlas Copco ST2G	151	35.0	3.5	52.8	12.3	1.2
3.5 yd LHD - Atlas Copco ST3.5	201	46.6	4.7	70.4	16.3	1.6
Mobile Rock Breaker - Sandvik LH514						
Medium Reach Rig - MacLean BH-3 Blockholer	60.3	14.0	1.4	11.2	2.6	0.26
Water Cannon - Getman A64	90.5	21.0	2.1	33.7	7.8	0.78
Fuel/Lube Truck - Normet Utimec	121	28.0	2.8	44.9	10.4	1.0
Crane Truck - Getman A64	121	28.0	2.8	89.8	20.8	2.1
Man Haul Vans - Miller Toyota	1,146	266	26.6	640	148	14.8
Flat Deck Truck - Getman A64	241	56.0	5.6	84.5	19.6	2.0
Crane Truck - Miller Toyota	121	28.0	2.8	67.4	15.6	1.6
Generator Truck (LHD) - GETMAN A64	60.3	14.0	1.4	21.1	4.9	0.49
UG Grader - CAT 140M2						
Forklift - CAT P36000	121	28.0	2.8	84.5	19.6	2.0
UG Water Trucks - Getman A64	181	42.0	4.2	127	29.4	2.9
Conveyor Maint Vehicle - Miller Crane Truck	60.3	14.0	1.4	52.2	12.1	1.2
Scissor Lift - Miller Toyota	271	63.0	6.3	152	35.2	3.5
Skid Steer Loader - CAT272D	60.3	14.0	1.4	22.5	5.2	0.52
Raise Bore - Redbore 60						
UG Dozer - 2.9m Blade - CAT D6N						
Ore Haul Trucks - Powertrans T954	728	169	16.9	1,842	427	42.7
Vehicle Travel - East Plant Underground	**7,361**	**1,708**	**171**	**8,214**	**1,906**	**191**
Vehicle Travel - East Plant Surface	**51.9**	**12.0**	**1.2**	**39.8**	**9.2**	**0.92**
Vehicle Travel - East Plant Total	**7,413**	**1,720**	**172**	**8,254**	**1,915**	**191**

Annual Unpaved Road Controls

	Surface	UG	Reference
Days of >0.01" Precip	64	0**	*EPS Precip Data (days >0.01'')*
Water & Chemical Suppression*	90%*	95%	*AP-42, Figure 13.2.2-2, Rev. 11/06*

* *Control efficiency is based on AP-42 Chapter 13.2.2, Unpaved Roads. Figure 13.2.2-2 provides the control efficiencies achievable with watering.*

** *Control efficiency is based on AP-42 Chapter 13.2.2, Unpaved Roads. Underground will be constantly watered due to wet conditions.*

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East Plant Diesel Machinery (Non-Emergency) - Fugitive Emissions from Grading/Dozing - Emissions (Short-Term & Long-Term) **Year 14**

Emission Factors

Grading	**PM**	**PM_{10}**	**$PM_{2.5}$**	**EF Unit**
UG Grader - CAT 140M2	3.0	0.96	9.2E-2	*lb/VMT*
Dozing				
UG Dozer - 2.9m Blade - CAT D6N	3.5	0.56	0.37	*lb/hr*

Emissions

	Quantit	**Operatio** *hr/yr*	**PM** *lb/hr*	**PM_{10}** *lb/hr*	**$PM_{2.5}$** *lb/hr*	**PM** *ton/yr*	**PM_{10}** *ton/yr*	**$PM_{2.5}$** *ton/yr*
Grading								
UG Grader - CAT 140M2	3	1,612	49.6	16.1	1.5	40.0	12.9	1.2
Dozing								
UG Dozer - 2.9m Blade - CAT D6N	2	856	7.0	1.1	0.74	3.0	0.48	0.32
Grading - East Plant Underground			**49.6**	**16.1**	**1.5**	**40.0**	**12.9**	**1.2**
Grading - East Plant Surface								
Dozing - East Plant Underground			**7.0**	**1.1**	**0.74**	**3.0**	**0.48**	**0.32**
Dozing - East Plant Surface								
Grading/Dozing - East Plant Total			**56.7**	**17.2**	**2.3**	**43.0**	**13.4**	**1.6**

East Plant Underground Fleet - Uncontrolled Fugitive Dust Emissions

	PM *lb/hr*	**PM_{10}** *lb/hr*	**$PM_{2.5}$** *lb/hr*	**PM** *ton/yr*	**PM_{10}** *ton/yr*	**$PM_{2.5}$** *ton/yr*
Vehicle Travel & Grading - East Plant Underground	**7,411**	**1,724**	**172**	**8,254**	**1,919**	**192**
Dozing - East Plant Underground	**7.0**	**1.1**	**0.74**	**3.0**	**0.48**	**0.32**
Fugitive Dust - East Plant Underground Total	**7,418**	**1,725**	**173**	**8,257**	**1,919**	**192**

East Plant Surface Fleet - Uncontrolled Fugitive Dust Emissions

	PM *lb/hr*	**PM_{10}** *lb/hr*	**$PM_{2.5}$** *lb/hr*	**PM** *ton/yr*	**PM_{10}** *ton/yr*	**$PM_{2.5}$** *ton/yr*
Vehicle Travel & Grading - East Plant Surface	**51.9**	**12.0**	**1.2**	**39.8**	**9.2**	**0.92**
Dozing - East Plant Surface						
Fugitive Dust - East Plant Surface Total	**51.9**	**12.0**	**1.2**	**39.8**	**9.2**	**0.92**

Dozing and Grading Emission Factor Equations *AP-42, 11.9, Table 11.9-1 (overburden), Rev. 7/98*

		Scaling Factor PM_{10}	Scaling Factor $PM_{2.5}$	
Dozing (PM)	$E = (5.7 * s^{1.2}) / (M^{1.3})$		0.105	
Dozing (PM_{15})	$E = (1.0 * s^{1.5}) / (M^{1.4})$	0.75		
Grading (PM)	$E = 0.040 * S^{2.5}$		0.031	
Grading (PM_{15})	$E = 0.051 * S^{2.0}$	0.6		
s = material silt content %			3.0	*AP-42, Chapter 13.2.2, Related Information, r13s0202_dec03.xls*
M = material moisture content %			4.0	*Resolution Copper*
S = mean vehicle speed mph			5.59	*Phone Meeting with C. Pascoe 10/11/12 (9 km/hr)*
Fuel Contingency			15%	*RCM Mine Data for Ari Modelling 2012.xlsx*

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West Plant Diesel Machinery (Non-Emergency)

Mobile Equipment	Rating *kW*	Rating *hp*	Quantity	EPA Tier	Fuel *gal/hr*	Ann. Op. Hours	Load Factor (%)**
Dozer (Coarse Ore Stockpile)	219	294	1	4	15	6,132	60%
Boom Truck (Pebble Crusher)	219	294	1	4	15	2,190	60%
Wheel Loader (2 yrs) - 992 class	189	254	2	4	13	6,130	60%
Forklift (Maintenance)	58	78	1	4	4	2,190	60%
Bobcat	58	78	2	4	4	2,920	60%
Flatbed Truck	146	196	1	4	10*	2,190	90%
Forklift (Moly Plant-Lg)	146	196	1	4	10*	2,920	60%
Stormwater Mgmt. Pump	153	205	3	4	10	1,095	90%
Stormwater Mgmt. Pump	388	520	0	4	27	1,095	90%
Flatbed Truck (1 ton, nonroad)	287	385	2	4	20	1,095	90%
Grader	117	157	1	4	8	2,190	60%
Backhoe	112	150	1	4	4	2,190	60%
Water Truck	219	294	2	4	15	2,190	60%
Boom Truck	117	157	1	4	8	2,190	60%
Fuel Lube Truck	224	300	1	4	3	4,380	90%
20T Crane	75	100	1	4	8	1,752	50%
60T Crane	117	157	1	4	8	876	50%
Mobile Air Compressor	44	59	2	4	3	1,095	90%
Light Tower	7	10	2	4	1	4,380	90%
Fusion Machine	44	59	1	4	3	2,190	90%
Lg Forklift (Warehouse)	146	196	1	4	10*	2,190	60%
Sm Forklift (Warehouse)	146	196	1	4	10*	2,190	60%
Highrail Maintenance Vehicle	146	196	1	4	10*	876	80%
Bucket Truck (Electrical)	146	196	1	4	10*	876	90%
Vacuum Truck	146	196	1	4	10*	876	90%
Man/Boom Lifts	146	196	2	4	10*	2,190	50%
Loader (Clean-up)-972 Class	146	196	1	4	10*	2,190	60%

* *Conservative Assumption*
** *Resolution*

Conversions

453.592	*g/lb*	
2,000	*lb/ton*	
0.0015%	*ppm S in ULSD (GPA 2140)*	
7.05	*lb/gal*	
1.00E+06	*Btu/MMBtu*	
1.998	*SO_2/S*	
1.341	*hp/kw*	
7,000	*Btu/hp-hr*	*AP-42, Table 3.4-1, Footnote e, Diesel, Rev. 10/96*
137,000	*Btu/gal*	*AP-42, Appendix A, Diesel, Rev. 9/85*
8,760	*hr/yr*	

Blue values are input; black values are calculated or linked.

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West Plant Diesel Machinery (Non-Emergency) - Emission Factors

Equipment	Rating *kW*	Quantity	CO* *g/kW-hr*	NO_X* *g/kW-hr*	SO_2** *g/kW-hr*	PM* *g/kW-hr*	VOC* *g/kW-hr*
Dozer (Coarse Ore Stockpile)	219	1	3.5	0.40	-	2.0E-2	0.19
Boom Truck (Pebble Crusher)	219	1	3.5	0.40	-	2.0E-2	0.19
Wheel Loader (2 yrs) - 992 class	189	2	3.5	0.40	-	2.0E-2	0.19
Forklift (Maintenance)	58	1	5.0	0.40	-	2.0E-2	0.19
Bobcat	58	2	5.0	0.40	-	2.0E-2	0.19
Flatbed Truck	146	1	3.5	0.40	-	2.0E-2	0.19
Forklift (Moly Plant-Lg)	146	1	3.5	0.40	-	2.0E-2	0.19
Stormwater Mgmt. Pump	153	3	3.5	0.40	-	2.0E-2	0.19
Stormwater Mgmt. Pump	388	0	3.5	0.40	-	2.0E-2	0.19
Flatbed Truck (1 ton, nonroad)	287	2	3.5	0.40	-	2.0E-2	0.19
Grader	117	1	5.0	0.40	-	2.0E-2	0.19
Backhoe	112	1	5.0	0.40	-	2.0E-2	0.19
Water Truck	219	2	3.5	0.40	-	2.0E-2	0.19
Boom Truck	117	1	5.0	0.40	-	2.0E-2	0.19
Fuel Lube Truck	224	1	3.5	0.40	-	2.0E-2	0.19
20T Crane	75	1	5.0	0.40	-	2.0E-2	0.19
60T Crane	117	1	5.0	0.40	-	2.0E-2	0.19
Mobile Air Compressor	44	2	5.0	4.7	-	3.0E-2	4.7
Light Tower	7	2	6.6	7.5	-	0.40	7.5
Fusion Machine	44	1	5.0	4.7	-	3.0E-2	4.7
Lg Forklift (Warehouse)	146	1	3.5	0.40	-	2.0E-2	0.19
Sm Forklift (Warehouse)	146	1	3.5	0.40	-	2.0E-2	0.19
Highrail Maintenance Vehicle	146	1	3.5	0.40	-	2.0E-2	0.19
Bucket Truck (Electrical)	146	1	3.5	0.40	-	2.0E-2	0.19
Vacuum Truck	146	1	3.5	0.40	-	2.0E-2	0.19
Man/Boom Lifts	146	2	3.5	0.40	-	2.0E-2	0.19
Loader (Clean-up)-972 Class	146	1	3.5	0.40	-	2.0E-2	0.19

* *40 CFR §1039.101, Table 1*

** *SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

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West Plant Diesel Machinery (Non-Emergency) - Short-Term Emission

Equipment	CO lb/hr	NO_X lb/hr	SO_2* lb/hr	PM lb/hr	VOC lb/hr
Dozer (Coarse Ore Stockpile)	1.0	0.12	2.2E-3	5.8E-3	5.5E-2
Boom Truck (Pebble Crusher)	1.0	0.12	2.2E-3	5.8E-3	5.5E-2
Wheel Loader (2 yrs) - 992 class	1.8	0.20	3.8E-3	1.0E-2	9.5E-2
Forklift (Maintenance)	0.39	3.1E-2	5.8E-4	1.5E-3	1.5E-2
Bobcat	0.77	6.2E-2	1.2E-3	3.1E-3	2.9E-2
Flatbed Truck	1.0	0.12	2.2E-3	5.8E-3	5.5E-2
Forklift (Moly Plant-Lg)	0.68	7.7E-2	1.5E-3	3.9E-3	3.7E-2
Stormwater Mgmt. Pump	3.2	0.36	6.9E-3	1.8E-2	0.17
Stormwater Mgmt. Pump					
Flatbed Truck (1 ton, nonroad)	4.0	0.46	8.6E-3	2.3E-2	0.22
Grader	0.77	6.2E-2	1.2E-3	3.1E-3	2.9E-2
Backhoe	0.74	5.9E-2	5.8E-4	3.0E-3	2.8E-2
Water Truck	2.0	0.23	4.4E-3	1.2E-2	0.11
Boom Truck	0.77	6.2E-2	1.2E-3	3.1E-3	2.9E-2
Fuel Lube Truck	1.6	0.18	6.6E-4	8.9E-3	8.4E-2
20T Crane	0.41	3.3E-2	9.7E-4	1.6E-3	1.6E-2
60T Crane	0.64	5.1E-2	9.7E-4	2.6E-3	2.4E-2
Mobile Air Compressor	0.87	0.82	1.3E-3	5.2E-3	0.82
Light Tower	0.19	0.22	2.2E-4	1.2E-2	0.22
Fusion Machine	0.43	0.41	6.6E-4	2.6E-3	0.41
Lg Forklift (Warehouse)	0.68	7.7E-2	1.5E-3	3.9E-3	3.7E-2
Sm Forklift (Warehouse)	0.68	7.7E-2	1.5E-3	3.9E-3	3.7E-2
Highrail Maintenance Vehicle	0.90	0.10	1.9E-3	5.1E-3	4.9E-2
Bucket Truck (Electrical)	1.0	0.12	2.2E-3	5.8E-3	5.5E-2
Vacuum Truck	1.0	0.12	2.2E-3	5.8E-3	5.5E-2
Man/Boom Lifts	1.1	0.13	2.4E-3	6.4E-3	6.1E-2
Loader (Clean-up)-972 Class	0.68	7.7E-2	1.5E-3	3.9E-3	3.7E-2
West Plant Stationary	**3.2**	**0.36**	**6.9E-3**	**1.8E-2**	**0.17**
West Plant Mobile	**25.1**	**4.0**	**4.7E-2**	**0.15**	**2.7**
West Plant Total	**28.3**	**4.4**	**5.4E-2**	**0.16**	**2.8**

* *Calculated by mass balance using a 15% fuel contingency*

West Plant Diesel Machinery (Non-Emergency) - Long-Term Emission

Equipment	CO *ton/yr*	NO_X *ton/yr*	SO_2* *ton/yr*	PM *ton/yr*	VOC *ton/yr*
Dozer (Coarse Ore Stockpile)	3.1	0.36	6.7E-3	1.8E-2	0.17
Boom Truck (Pebble Crusher)	1.1	0.13	2.4E-3	6.3E-3	6.0E-2
Wheel Loader (2 yrs) - 992 class	5.4	0.61	1.2E-2	3.1E-2	0.29
Forklift (Maintenance)	0.42	3.4E-2	6.4E-4	1.7E-3	1.6E-2
Bobcat	1.1	9.0E-2	1.7E-3	4.5E-3	4.3E-2
Flatbed Truck	1.1	0.13	2.4E-3	6.3E-3	6.0E-2
Forklift (Moly Plant-Lg)	0.99	0.11	2.1E-3	5.6E-3	5.4E-2
Stormwater Mgmt. Pump	1.7	0.20	3.8E-3	1.0E-2	9.5E-2
Stormwater Mgmt. Pump					
Flatbed Truck (1 ton, nonroad)	2.2	0.25	4.7E-3	1.2E-2	0.12
Grader	0.85	6.8E-2	1.3E-3	3.4E-3	3.2E-2
Backhoe	0.81	6.5E-2	6.4E-4	3.2E-3	3.1E-2
Water Truck	2.2	0.25	4.8E-3	1.3E-2	0.12
Boom Truck	0.85	6.8E-2	1.3E-3	3.4E-3	3.2E-2
Fuel Lube Truck	3.4	0.39	1.4E-3	1.9E-2	0.18
20T Crane	0.36	2.9E-2	8.5E-4	1.4E-3	1.4E-2
60T Crane	0.28	2.3E-2	4.3E-4	1.1E-3	1.1E-2
Mobile Air Compressor	0.48	0.45	7.2E-4	2.9E-3	0.45
Light Tower	0.42	0.48	4.8E-4	2.5E-2	0.48
Fusion Machine	0.48	0.45	7.2E-4	2.9E-3	0.45
Lg Forklift (Warehouse)	0.74	8.5E-2	1.6E-3	4.2E-3	4.0E-2
Sm Forklift (Warehouse)	0.74	8.5E-2	1.6E-3	4.2E-3	4.0E-2
Highrail Maintenance Vehicle	0.39	4.5E-2	8.5E-4	2.3E-3	2.1E-2
Bucket Truck (Electrical)	0.44	5.1E-2	9.6E-4	2.5E-3	2.4E-2
Vacuum Truck	0.44	5.1E-2	9.6E-4	2.5E-3	2.4E-2
Man/Boom Lifts	1.2	0.14	2.7E-3	7.0E-3	6.7E-2
Loader (Clean-up)-972 Class	0.74	8.5E-2	1.6E-3	4.2E-3	4.0E-2
West Plant Stationary	**1.7**	**0.20**	**3.8E-3**	**1.0E-2**	**9.5E-2**
West Plant Mobile	**30.3**	**4.5**	**5.5E-2**	**0.19**	**2.9**
West Plant Total	**32.0**	**4.7**	**5.9E-2**	**0.20**	**3.0**

* *Calculated by mass balance using a 15% fuel contingency*

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West Plant Diesel Machinery (Non-Emergency) - Fugitive Emissions from Vehicle Travel - Vehicle Specifications

Equipment	Quantity	Ann. Op. Hours[a]	Speed[b] *mph*	Silt[c] *%*	Weight[b] *ton*
Dozer (Coarse Ore Stockpile)		*dozer-specific fugitive emissions on p. 8*			
Boom Truck (Pebble Crusher)	1	2,190	15	3.0	27
Wheel Loader (2 yrs) - 992 class			*paved surface*		
Forklift (Maintenance)			*paved surface*		
Bobcat			*paved surface*		
Flatbed Truck	1	2,190	25	3.0	27
Forklift (Moly Plant-Lg)			*paved surface*		
Stormwater Mgmt. Pump			*stationary*		
Stormwater Mgmt. Pump			*stationary*		
Flatbed Truck (1 ton, nonroad)	2	1,095	15	3.0	2
Grader		*grader-specific fugitive emissions on p. 8*			
Backhoe	1	2,190	5	3.0	12
Water Truck	2	2,190	15	3.0	10
Boom Truck	1	2,190	15	3.0	17
Fuel Lube Truck	1	4,380	15	3.0	50
20T Crane	1	1,752	10	3.0	27
60T Crane	1	876	10	3.0	45
Mobile Air Compressor	2	1,095	5	3.0	4
Light Tower	2	4,380	5	3.0	1
Fusion Machine	1	2,190	1	3.0	2
Lg Forklift (Warehouse)			*paved surface*		
Sm Forklift (Warehouse)			*paved surface*		
Highrail Maintenance Vehicle	1	876	5	3.0	2
Bucket Truck (Electrical)	1	876	15	3.0	12
Vacuum Truck	1	876	15	3.0	2
Man/Boom Lifts	2	2,190	5	3.0	12
Loader (Clean-up)-972 Class	1	2,190	5	3.0	23
Mean Vehicle Weight					13.8

[a] *Per unit, including availability and utilization factors*
[b] *Resolution*
[c] *AP-42, Chaр*

West Plant Diesel Machinery (Non-Emergency) - Fugitive Emissions from Vehicle Travel - Emission Factors

Equipment	PM *lb/VMT*	PM_{10} *lb/VMT*	$PM_{2.5}$ *lb/VMT*
Dozer (Coarse Ore Stockpile)			
Boom Truck (Pebble Crusher)	3.7	0.85	8.5E-2
Wheel Loader (2 yrs) - 992 class			
Forklift (Maintenance)			
Bobcat			
Flatbed Truck	3.7	0.85	8.5E-2
Forklift (Moly Plant-Lg)			
Stormwater Mgmt. Pump			
Stormwater Mgmt. Pump			
Flatbed Truck (1 ton, nonroad)	3.7	0.85	8.5E-2
Grader			
Backhoe	3.7	0.85	8.5E-2
Water Truck	3.7	0.85	8.5E-2
Boom Truck	3.7	0.85	8.5E-2
Fuel Lube Truck	3.7	0.85	8.5E-2
20T Crane	3.7	0.85	8.5E-2
60T Crane	3.7	0.85	8.5E-2
Mobile Air Compressor	3.7	0.85	8.5E-2
Light Tower	3.7	0.85	8.5E-2
Fusion Machine	3.7	0.85	8.5E-2
Lg Forklift (Warehouse)			
Sm Forklift (Warehouse)			
Highrail Maintenance Vehicle	3.7	0.85	8.5E-2
Bucket Truck (Electrical)	3.7	0.85	8.5E-2
Vacuum Truck	3.7	0.85	8.5E-2
Man/Boom Lifts	3.7	0.85	8.5E-2
Loader (Clean-up)-972 Class	3.7	0.85	8.5E-2

Unpaved Roads - Predictive Emission Factor Equation & Constants*

$E = k \times (s / 12)^a \times (W / 3)^b \times (365 - P) / 365$

	Empirical Constants for Industrial Roads			
	Constan	PM	PM_{10}	$PM_{2.5}$
k, a, b - empirical constants	k	4.9	1.5	0.15
s - surface material silt content %	a	0.7	0.9	0.9
W - mean vehicle wt ton	b	0.45	0.45	0.45
P - Days of >0.01" Precip				

* *AP-42, 13.2.2, Equation 1a & 2, Table 13.2.2-2, Industrial Roads, Rev. 8/04*

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West Plant Diesel Machinery (Non-Emergency) - Fugitive Emissions from Vehicle Travel - Emissions (Short-Term & Long-Term)

Equipment	PM *lb/hr*	PM_{10} *lb/hr*	$PM_{2.5}$ *lb/hr*	PM *ton/yr*	PM_{10} *ton/yr*	$PM_{2.5}$ *ton/yr*
Dozer (Coarse Ore Stockpile)						
Boom Truck (Pebble Crusher)	55.3	12.8	1.3	50.9	11.8	1.2
Wheel Loader (2 yrs) - 992 class						
Forklift (Maintenance)						
Bobcat						
Flatbed Truck	92.1	21.4	2.1	84.8	19.7	2.0
Forklift (Moly Plant-Lg)						
Stormwater Mgmt. Pump						
Stormwater Mgmt. Pump						
Flatbed Truck (1 ton, nonroad)	111	25.6	2.6	50.9	11.8	1.2
Grader						
Backhoe	18.4	4.3	0.43	17.0	3.9	0.39
Water Truck	111	25.6	2.6	102	23.6	2.4
Boom Truck	55.3	12.8	1.3	50.9	11.8	1.2
Fuel Lube Truck	55.3	12.8	1.3	102	23.6	2.4
20T Crane	36.8	8.5	0.85	27.1	6.3	0.63
60T Crane	36.8	8.5	0.85	13.6	3.1	0.31
Mobile Air Compressor	36.8	8.5	0.85	17.0	3.9	0.39
Light Tower	36.8	8.5	0.85	67.9	15.7	1.6
Fusion Machine	3.7	0.85	8.5E-2	3.4	0.79	7.9E-2
Lg Forklift (Warehouse)						
Sm Forklift (Warehouse)						
Highrail Maintenance Vehicle	18.4	4.3	0.43	6.8	1.6	0.16
Bucket Truck (Electrical)	55.3	12.8	1.3	20.4	4.7	0.47
Vacuum Truck	55.3	12.8	1.3	20.4	4.7	0.47
Man/Boom Lifts	36.8	8.5	0.85	33.9	7.9	0.79
Loader (Clean-up)-972 Class	18.4	4.3	0.43	17.0	3.9	0.39
Vehicle Travel - Mill Total	**833**	**193**	**19.3**	**685**	**159**	**15.9**

Daily Unpaved Road Controls

	Surface
days of <0.01" Precip	307

Daily Unpaved Road EF Multiplier

	Surface
days of <0.01" Precip	1

Annual Unpaved Road Controls

	Surface	Reference
Days of >0.01" Precip	58	*WPS Precip Data (days >0.01'')*
Water & Chemical Suppression*	90%	*AP-42, Figure 13.2.2-2, Rev. 11/06*

* *Control efficiency is based on AP-42 Chapter 13.2.2, Unpaved Roads. Figure 13.2.2-2 provides the control efficiencies achievable with watering*

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West Plant Diesel Machinery (Non-Emergency) - Fugitive Emissions from Grading/Dozing - Emissions (Short-Term & Long-Term)

Emission Factors

Grading	**PM**	**PM_{10}**	**$PM_{2.5}$**	**EF Unit**
Grader	3.0	0.96	9.2E-2	*lb/VMT*
Dozing				
Dozer (Coarse Ore Stockpile)	3.5	0.56	0.37	*lb/hr*

Emissions

	Quantit	**Operatio** *hr/yr*	**PM** *lb/hr*	**PM_{10}** *lb/hr*	**$PM_{2.5}$** *lb/hr*	**PM** *ton/yr*	**PM_{10}** *ton/yr*	**$PM_{2.5}$** *ton/yr*
Grading								
Grader	1.0	2,519	16.5	5.4	0.51	20.8	6.7	0.65
Dozing								
Dozer (Coarse Ore Stockpile)*	1.0	7,052	3.5	0.56	0.37	12.4	2.0	1.3
Grading - West Plant			**16.5**	**5.4**	**0.51**	**20.8**	**6.7**	**0.65**
Dozing - West Plant			**3.5**	**0.56**	**0.37**	**12.4**	**2.0**	**1.3**
Grading/Dozing - West Plant Total			**20.1**	**5.9**	**0.88**	**33.2**	**8.7**	**1.9**

West Plant Fleet - Uncontrolled Fugitive Dust Emissions

	PM *lb/hr*	**PM_{10}** *lb/hr*	**$PM_{2.5}$** *lb/hr*	**PM** *ton/yr*	**PM_{10}** *ton/yr*	**$PM_{2.5}$** *ton/yr*
Vehicle Travel & Grading - West Plant	**849**	**199**	**19.8**	**706**	**166**	**16.5**
Dozing - West Plant	**3.5**	**0.56**	**0.37**	**12.4**	**2.0**	**1.3**
Fugitive Dust - West Plant Total	**853**	**199**	**20.2**	**719**	**168**	**17.8**

Dozing and Grading Emission Factor Equations *AP-42, 11.9, Table 11.9-1 (overburden), Rev. 7/98*

		Scaling Factor PM_{10}	Scaling Factor $PM_{2.5}$	
Dozing (PM)	$E = (5.7 * s^{1.2}) / (M^{1.3})$		0.105	
Dozing (PM_{15})	$E = (1.0 * s^{1.5}) / (M^{1.4})$	0.75		
Grading (PM)	$E = 0.040 * S^{2.5}$		0.031	
Grading (PM_{15})	$E = 0.051 * S^{2.0}$	0.6		
s = material silt content %			3.0	*AP-42, Chapter 13.2.2, Related Information, r13s0202_dec03.xls*
M = material moisture content %			4.0	*Resolution Copper*
S = mean vehicle speed mph			5.59	*Phone Meeting with C. Pascoe 10/11/12 (9 km/hr)*
Fuel Contingency			15%	*RCM Mine Data for Ari Modelling 2012.xlsx*

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Loadout Diesel Machinery (Non-Emergency)

Mobile Equipment	References & Notes	Rating *kW*	Rating *hp*	Quantity	EPA Tier	Fuel *gal/hr*	Ann. Op. Hours	Load Factor (%)**
Loader	a	248	333	3	4	17	5,913	60%
Switch Engine	a	438	587	1	4	30	5,203	80%
Track Mobile	a	219	294	1	4	15	5,203	60%
Wheel Loader	a	75	100	1	4	13	876	60%
Sweeper	b	146	196	1	4	10*	876	60%

* *Conservative Assumption*

** *Resolution*

Conversions		
453.592	*g/lb*	
2,000	*lb/ton*	
0.0015%	*ppm S in ULSD (GPA 2140)*	
7.05	*lb/gal*	
1.00E+06	*Btu/MMBtu*	
1.998	*SO_2/S*	
1.341	*hp/kw*	
7,000	*Btu/hp-hr*	*AP-42, Table 3.4-1, Footnote e, Diesel, Rev. 10/96*
137,000	*Btu/gal*	*AP-42, Appendix A, Diesel, Rev. 9/85*

References & Notes	
a, b	*Resolution*

Blue values are input; *black values are calculated or linked.*

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Loadout Diesel Machinery (Non-Emergency) - Emission Factors

Equipment	Rating *kW*	Quantity	CO* *g/kW-hr*	NO_X* *g/kW-hr*	SO_2** *g/kW-hr*	PM* *g/kW-hr*	VOC* *g/kW-hr*
Loader	248	3	3.5	0.40	-	2.0E-2	0.19
Switch Engine	438	1	3.5	0.40	-	2.0E-2	0.19
Track Mobile	219	1	3.5	0.40	-	2.0E-2	0.19
Wheel Loader	75	1	5.0	0.40	-	2.0E-2	0.19
Sweeper	146	1	3.5	0.40	-	2.0E-2	0.19

* *40 CFR §1039.101, Table 1*

** *SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

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Loadout Diesel Machinery (Non-Emergency) - Short-Term Emission

Equipment	CO *lb/hr*	NO_X *lb/hr*	SO_2* *lb/hr*	PM *lb/hr*	VOC *lb/hr*
Loader	3.4	0.39	7.4E-3	2.0E-2	0.19
Switch Engine	2.7	0.31	5.8E-3	1.5E-2	0.15
Track Mobile	1.0	0.12	2.2E-3	5.8E-3	5.5E-2
Wheel Loader	0.49	3.9E-2	1.9E-3	2.0E-3	1.9E-2
Sweeper	0.68	7.7E-2	1.5E-3	3.9E-3	3.7E-2
Loadout Stationary					
Loadout Mobile	**8.3**	**0.94**	**1.9E-2**	**4.7E-2**	**0.44**
Loadout Total	**8.3**	**0.94**	**1.9E-2**	**4.7E-2**	**0.44**

* *Calculated by mass balance using a 15% fuel contingency*

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Loadout Diesel Machinery (Non-Emergency) - Long-Term Emission

Equipment	CO *ton/yr*	NO_X *ton/yr*	SO_2* *ton/yr*	PM *ton/yr*	VOC *ton/yr*
Loader	10.2	1.2	2.2E-2	5.8E-2	0.55
Switch Engine	7.0	0.80	1.5E-2	4.0E-2	0.38
Track Mobile	2.6	0.30	5.7E-3	1.5E-2	0.14
Wheel Loader	0.22	1.7E-2	8.3E-4	8.6E-4	8.2E-3
Sweeper	0.30	3.4E-2	6.4E-4	1.7E-3	1.6E-2
Loadout Stationary					
Loadout Mobile	**20.4**	**2.3**	**4.4E-2**	**0.12**	**1.1**
Loadout Total	**20.4**	**2.3**	**4.4E-2**	**0.12**	**1.1**

* *Calculated by mass balance using a 15% fuel contingency*

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Alt2 Production

ALTERNATIVE 2

TSF Alt2 Controlled Emissions Summary - Annual (ton/yr)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Mobile Equipment - Combustion	2.0	2.0	2.0	341	40.6	0.7	20.5
Mobile Equipment - Fugitives	782	181	18.1				
Dozing/Grading	72.2	12.9	6.9				
Employee Traffic - Combustion	2.3E-2	2.3E-2	4.2E-3	0.9	4.3E-2	2.3E-3	1.0E-2
Employee Traffic - Fugitives	14.0	3.3	0.3				
Wind Erosion	1.5	0.8	0.1				
Conveyor Transfers (Alt4 ONLY)	--	--	--				
TOTAL	871	**200**	**27.5**	**342**	**40.6**	**0.7**	**20.5**

TSF Alt2 Controlled Emissions Summary - Hourly (lb/hr)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Mobile Equipment - Combustion	0.7	0.7	0.7	115	14.4	0.2	7.7
Mobile Equipment - Fugitives	319	74.1	7.4				
Dozing/Grading	27.9	5.0	2.7				
Employee Traffic - Combustion	5.6E-3	5.6E-3	1.0E-3	0.2	1.0E-2	5.5E-4	2.4E-3
Employee Traffic - Fugitives	4.0	0.9	9.3E-2				
Wind Erosion	0.3	0.2	2.6E-2				
Conveyor Transfers (Alt4 ONLY)	--	--	--				
TOTAL	352	**80.9**	**10.9**	**115**	**14.4**	**0.2**	**7.7**

Direct CO_2e Emissions

94,783	*tonne/yr*

Blue entries are entered values , black entries are calculated or linked

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Fuel Burning Equipment Combustion

Operational Parameters — **Emission Factors****

Mobile Equipment	Engine *kW*	Equip. Util.	Load Factor (%)	Quantity	EPA Tier	Fuel* *gal/hr*	Hours Per Unit	Hours per Yr	PM *g/kW-hr*	CO *g/kW-hr*	NO_X *g/kW-hr*	VOC *g/kW-hr*
Excavator 65t	362	70%	60%	2	4	29	24	6,132	0.02	3.5	0.4	0.2
Excavator 45t	322	70%	60%	1	4	25	24	6,132	0.02	3.5	0.4	0.2
Dozer (D8 Class)	268	70%	60%	2	4	21	24	6,132	0.02	3.5	0.4	0.2
Dozer (D9 Class)	325	70%	60%	3	4	26	24	6,132	0.02	3.5	0.4	0.2
D10 Dozer	538	70%	60%	2	4	42	24	6,132	0.02	3.5	0.4	0.2
Tractors	186	70%	60%	6	4	15	24	6,132	0.02	3.5	0.4	0.2
Scrapers (631K)	425	70%	60%	2	4	33	24	6,132	0.02	3.5	0.4	0.2
Grader (120 Class)	103	70%	60%	2	4	8	24	6,132	0.02	5.0	0.4	0.2
Grader (14 Class)	178	70%	60%	0	4				0.02	3.5	0.4	0.2
Compactor (825 Class)	324	70%	60%	1	4	26	24	6,132	0.02	3.5	0.4	0.2
Compactor (S74 Class)	130	70%	60%	2	4	10	24	6,132	0.02	5.0	0.4	0.2
Compactor (CS56 Class)	117	70%	60%	0	4				0.02	5.0	0.4	0.2
Skid Steer 246 class	71	30%	60%	2	4	6	24	2,628	0.02	5.0	0.4	0.2
Boom Winch Truck 10t	179	30%	60%	2	4	14	24	2,628	0.02	3.5	0.4	0.2
Pipe welder - McElroy 1648	19	30%	90%	1	4	1	24	2,628	0.40	6.6	7.5	7.5
Pipe welder - McElroy 618	13	30%	90%	1	4	1	24	2,628	0.40	6.6	7.5	7.5
Water Truck/Dust Polymer Trucl	294	70%	60%	4	4	23	24	6,132	0.02	3.5	0.4	0.2
Forklift	110	30%	60%	2	4	9	24	2,628	0.02	5.0	0.4	0.2
Telehandler	83	30%	60%	1	4	7	24	2,628	0.02	5.0	0.4	0.2
Fuel Truck	224	70%	60%	1	4	18	24	6,132	0.02	3.5	0.4	0.2
Service Truck - 1 ton	308	70%	90%	8	4	24	24	6,132	0.02	3.5	0.4	0.2
Small Truck (3/4t)	308	70%	90%	20	4	24	24	6,132	0.02	3.5	0.4	0.2
Boats	56	30%	60%	1	4	4	24	2,628	0.03	5.0	4.7	4.7
Air compressor	75	30%	60%	1	4	6	24	2,628	0.02	5.0	0.4	0.2
Portable diesel pumps (Godwin)	19	30%	60%	2	4	1	24	2,628	0.40	6.6	7.5	7.5
Light plants	7	40%	60%	6	4	1	24	3,504	0.40	6.6	7.5	7.5
40 ton haulage truck	350	70%	60%	7	4	28	24	6,132	0.02	3.5	0.4	0.2

**Per unit. Including 15% fuel contingency.*

***Table 1 of §1039.101 – Tier 4 Exhaust Emission Standards After the 2014 Model Year, g/kW-hr*

****Blue EFs from manufacturer specifications*

Conversions

1.998	*SO_2/S*	7,000	*Btu/hp-hr*	*AP-42, Table 3.4-1, Footnote e, Diesel, Rev. 10/96*
1.341	*hp/kw*	137,000	*Btu/gal*	*AP-42, Appendix A, Diesel, Rev. 9/85*
0.0015%	*ppm S in ULSD (GPA 2140)*	453.592	*g/lb*	
7.05	*lb/gal*	2,000	*lb/ton*	

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Fuel Burning Equipment Combustion - Continued

Fleet Emissions

	PM		CO		NO_X		SO_2 *		VOC	
Equipment	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
Excavator 65t	1.9E-2	5.9E-2	3.4	10.3	0.38	1.2	7.4E-3	2.3E-2	0.18	0.56
Excavator 45t	8.5E-3	2.6E-2	1.5	4.6	0.17	0.52	3.2E-3	9.7E-3	8.1E-2	0.25
Dozer (D8 Class)	1.4E-2	4.3E-2	2.5	7.6	0.28	0.87	5.3E-3	1.6E-2	0.13	0.41
Dozer (D9 Class)	2.6E-2	7.9E-2	4.5	13.8	0.52	1.6	9.9E-3	3.0E-2	0.25	0.75
D10 Dozer	2.8E-2	8.7E-2	5.0	15.3	0.57	1.7	1.1E-2	3.3E-2	0.27	0.83
Tractors	3.0E-2	9.1E-2	5.2	15.9	0.59	1.8	1.1E-2	3.5E-2	0.28	0.86
Scrapers (631K)	2.2E-2	6.9E-2	3.9	12.1	0.45	1.4	8.4E-3	2.6E-2	0.21	0.65
Grader (120 Class)	5.4E-3	1.7E-2	1.4	4.2	0.11	0.33	2.0E-3	6.2E-3	5.2E-2	0.16
Grader (14 Class)										
Compactor (825 Class)	8.6E-3	2.6E-2	1.5	4.6	0.17	0.53	3.3E-3	1.0E-2	8.1E-2	0.25
Compactor (S74 Class)	6.9E-3	2.1E-2	1.7	5.3	0.14	0.42	2.5E-3	7.8E-3	6.5E-2	0.20
Compactor (CS56 Class)										
Skid Steer 246 class	3.7E-3	4.9E-3	0.94	1.2	7.5E-2	9.9E-2	1.5E-3	2.0E-3	3.6E-2	4.7E-2
Boom Winch Truck 10t	9.5E-3	1.2E-2	1.7	2.2	0.19	0.25	3.5E-3	4.7E-3	9.0E-2	0.12
Pipe welder - McElroy 1648	1.5E-2	1.9E-2	0.24	0.32	0.28	0.36	1.9E-4	2.5E-4	0.28	0.36
Pipe welder - McElroy 618	1.1E-2	1.4E-2	0.18	0.23	0.20	0.26	1.9E-4	2.5E-4	0.20	0.26
Water Truck/Dust Polymer Truck	3.1E-2	9.5E-2	5.4	16.7	0.62	1.9	1.2E-2	3.6E-2	0.30	0.91
Forklift	5.8E-3	7.6E-3	1.5	1.9	0.12	0.15	2.3E-3	3.0E-3	5.5E-2	7.3E-2
Telehandler	2.2E-3	2.9E-3	0.55	0.72	4.4E-2	5.8E-2	8.9E-4	1.2E-3	2.1E-2	2.7E-2
Fuel Truck	5.9E-3	1.8E-2	1.0	3.2	0.12	0.36	2.3E-3	7.0E-3	5.6E-2	0.17
Service Truck - 1 ton	9.8E-2	0.30	17.1	52.5	2.0	6.0	3.7E-2	0.11	0.93	2.8
Small Truck (3/4t)	0.24	0.75	42.8	131	4.9	15.0	9.1E-2	0.28	2.3	7.1
Boats	2.2E-3	2.9E-3	0.37	0.49	0.35	0.46	5.1E-4	6.7E-4	0.35	0.46
Air compressor	2.0E-3	2.6E-3	0.49	0.65	3.9E-2	5.2E-2	7.6E-4	1.0E-3	1.9E-2	2.5E-2
Portable diesel pumps (Godwin)	2.0E-2	2.6E-2	0.33	0.43	0.37	0.49	2.5E-4	3.3E-4	0.37	0.49
Light plants	2.4E-2	4.1E-2	0.39	0.68	0.44	0.78	7.6E-4	1.3E-3	0.44	0.78
40 ton haulage truck	6.5E-2	0.20	11.3	34.8	1.3	4.0	2.5E-2	7.6E-2	0.62	1.9
Total Fleet Emissions	**0.7**	**2.01**	**114.8**	**340.6**	**14.4**	**40.6**	**0.2**	**0.7**	**7.7**	**20.5**

** SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

Mobile Equipment - Fugitives

Mobile Equipment	Quantity	Hours Per Unit	Annual Hours	Speed * *mph*	Weight ** *ton*	Silt *** *%*
Excavator 65t	2	24	6,132	5.0	83	3.0
Excavator 45t	1	24	6,132	5.0	54	3.0
Dozer (D8 Class)		Dozer-Specific Emissions on p. 6				
Dozer (D9 Class)		Dozer-Specific Emissions on p. 6				
D10 Dozer		Dozer-Specific Emissions on p. 6				
Tractors	6	24	6,132	5.0	13	3.0
Scrapers (631K)	2	24	6,132	5.0	72	3.0
Grader (120 Class)		Grader-Specific Emissions on p. 6				
Grader (14 Class)		Grader-Specific Emissions on p. 6				
Compactor (825 Class)	1	24	6,132	2.0	39	3.0
Compactor (S74 Class)	2	24	6,132	2.0	18	3.0
Compactor (CS56 Class)	0			2.0	13	3.0
Skid Steer 246 class	2	24	2,628	5.0	5	3.0
Boom Winch Truck 10t	2	24	2,628	15.0	12	3.0
Pipe welder - McElroy 1648	1	24	2,628	1.0	6	3.0
Pipe welder - McElroy 618	1	24	2,628	1.0	1	3.0
Water Truck/Dust Polymer Truck	4	24	6,132	15.0	50	3.0
Forklift	2	24	2,628	5.0	22	3.0
Telehandler	1	24	2,628	15.0	15	3.0
Fuel Truck	1	24	6,132	15.0	13	3.0
Service Truck - 1 ton	8	24	6,132	15.0	4	3.0
Small Truck (3/4t)	20	24	6,132	15.0	4	3.0
Boats		No Regular Travel on Unpaved Roads				
Air compressor		No Regular Travel on Unpaved Roads				
Portable diesel pumps (Godwin)		No Regular Travel on Unpaved Roads				
Light plants		No Regular Travel on Unpaved Roads				
40 ton haulage truck	7	24	6,132	12.5	58	3.0
Mean Vehicle Weight					**21.4**	

** Resolution Copper*

*** Equipment Specification Sheets*

**** Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)* 3.0 %

Unpaved Roads - Predictive Emission Factor Equation & Constants*

	Empirical Constants for Industrial Roads			
$E = k \times (s / 12)^a \times (W / 3)^b$	**Constant**	**PM**	**PM_{10}**	**$PM_{2.5}$**
k, a, b - empirical constants	k	4.9	1.5	0.15
s - surface material silt content %	a	0.7	0.9	0.9
W - mean vehicle wt ton	b	0.45	0.45	0.45
P - Days of >0.01" Precip				

**AP-42, 13.2.2, Equation 1a & 2, Table 13.2.2-2, Industrial Roads, Rev. 11/06*

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Mobile Equipment - Fugitives, Continued

	Emission Factors			Estimated Emissions (Controlled)					
	PM	PM_{10}	$PM_{2.5}$	PM		PM_{10}		$PM_{2.5}$	
Mobile Equipment		*lb/VMT*		*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
Excavator 65t	4.5	1.0427	0.10	4.5	11.6	1.0	2.7	0.10	0.27
Excavator 45t	4.5	1.0	0.10	2.2	5.8	0.52	1.3	5.2E-2	0.13
Dozer (D8 Class)				Dozer-Specific Emissions on p. 6					
Dozer (D9 Class)				Dozer-Specific Emissions on p. 6					
D10 Dozer				Dozer-Specific Emissions on p. 6					
Tractors	4.5	1.0	0.10	13.5	34.9	3.1	8.1	0.31	0.81
Scrapers (631K)	4.5	1.0	0.10	4.5	11.6	1.0	2.7	0.10	0.27
Grader (120 Class)				Grader-Specific Emissions on p. 6					
Grader (14 Class)				Grader-Specific Emissions on p. 6					
Compactor (825 Class)	4.5	1.0	0.10	0.90	2.3	0.21	0.54	2.1E-2	5.4E-2 `
Compactor (S74 Class)	4.5	1.0	0.10	1.8	4.7	0.42	1.1	4.2E-2	0.11
Compactor (CS56 Class)	4.5	1.0	0.10						
Skid Steer 246 class	4.5	1.0	0.10	4.5	5.0	1.0	1.2	0.10	0.12
Boom Winch Truck 10t	4.5	1.0	0.10	13.5	15.0	3.1	3.5	0.31	0.35
Pipe welder - McElroy 1648	4.5	1.0	0.10	0.45	0.50	0.10	0.12	1.0E-2	1.2E-2
Pipe welder - McElroy 618	4.5	1.0	0.10	0.45	0.50	0.10	0.12	1.0E-2	1.2E-2
Water Truck/Dust Polymer Trucl	4.5	1.0	0.10	27.0	69.8	6.3	16.2	0.63	1.6
Forklift	4.5	1.0	0.10	4.5	5.0	1.0	1.2	0.10	0.12
Telehandler	4.5	1.0	0.10	6.7	7.5	1.6	1.7	0.16	0.17
Fuel Truck	4.5	1.0	0.10	6.7	17.4	1.6	4.0	0.16	0.40
Service Truck - 1 ton	4.5	1.0	0.10	53.9	140	12.5	32.4	1.3	3.2
Small Truck (3/4t)	4.5	1.0	0.10	135	349	31.3	80.9	3.1	8.1
Boats					Stationary				
Air compressor					Stationary				
Portable diesel pumps (Godwin)					Stationary				
Light plants					Stationary				
40 ton haulage truck	4.5	1.0	0.10	39.3	102	9.1	23.6	0.91	2.4
Total				**319**	**782**	**74**	**181**	**7**	**18**

annual

Unpaved Road Controls

	Surface	Reference
$E = EF_{uncontrolled} \times (365 - P) / 365$		
Days of >0.01" Precip	57	*TSF met data 2015-2016 (long-term emissions only)*
Water & Chemical Suppression *	90%	*AP-42, Figure 13.2.2-2, Rev. 11/06*

** Control efficiency is based on AP-42 Chapter 13.2.2, Unpaved Roads. Figure 13.2.2-2 provides the control efficiencies achievable.*

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Dozing Emissions

Dozing Emission Factor Equations			*AP-42, 11.9, Table 11.9-1 (overburden), Rev. 7/98*	Scaling Factors	
				PM_{10}	$PM_{2.5}$
Dozing (PM)	$E_{lb/hr} = 5.7 * s^{1.2} / M^{1.3}$		*lb/hr*		0.105
Dozing (PM_{15})	$E_{lb/hr} = 1.0 * s^{1.5} / M^{1.4}$		*lb/hr*	0.75	
s = material silt content %		3.0	*Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)*		
M = material moisture content %		4.0	*Resolution Copper*		

Grading Emission Factor Equations			*AP-42, 11.9, Table 11.9-1, Rev. 7/98*	Scaling Factors	
				PM_{10}	$PM_{2.5}$
Grading (PM)	$E_{lb/hr} = 0.04 * S^{2.5}$		*lb/VMT*		0.031
Grading (PM_{15})	$E_{lb/hr} = 0.051 * S^{2.0}$		*lb/VMT*	0.6	
S = mean vehicle speed (mph)		5.6	*Phone Meeting with C. Pascoe 10/11/12 (9 km/hr)*		

Emission Factors

Mobile Equipment	Quantity	Operation *hr/yr*	Emission Factors, Per Unit (lb/hr) PM	PM_{10}	$PM_{2.5}$	Unit
Dozer (D8 Class)	2	6,132	3.5	0.56	0.37	*lb/hr*
Dozer (D9 Class)	3	6,132	3.5	0.56	0.37	*lb/hr*
D10 Dozer	2	6,132	3.5	0.56	0.37	*lb/hr*
Grader (120 Class)	2	6,132	16.5	5.4	0.51	*lb/hr*
Grader (14 Class)	0		16.5	5.4	0.51	*lb/hr*

Total Dozing/Grading Emissions

	Estimated Emissions					
	PM		PM_{10}		$PM_{2.5}$	
Mobile Equipment	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
Dozer (D8 Class)	7.0	18.2	1.1	2.9	0.74	1.9
Dozer (D9 Class)	10.5	27.3	1.7	4.3	1.1	2.9
D10 Dozer	7.0	18.2	1.1	2.9	0.74	1.9
Grader (120 Class)	3.3	8.6	1.1	2.8	0.10	0.27
Grader (14 Class)						
Dozing - TSF	24.6	63.6	3.9	10.1	2.6	6.7
Grading - TSF	3.3	8.6	1.1	2.8	0.10	0.27
Grading/Dozing - TSF Total	**27.9**	**72.2**	**5.0**	**12.9**	**2.7**	**6.9**

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Employee Traffic Emissions

Employee Traffic

	Max Hourly		Average Annual		
		Distance (*mi/hr*)		Distance (*mi/yr*)	
	No. Trips	One Way	No. Trips	One Way	RT
Employee	58	5.4	20,066	5.4	10.7

Combustion Emission Factors *

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
	g/VMT	*g/VMT*	*g/VMT*	*g/VMT*	*g/VMT*	*g/VMT*	*g/VMT*
Employee	9.9E-2	9.9E-2	1.8E-2	3.9E+0	1.8E-1	9.6E-3	4.2E-2

** MOVES 2014a*

Mean Vehicle Weight*

Employee	2	*ton*

**Estimate*

Unpaved Roads - Equation, Constants, & Emission Factors *

$E = k \times (s / 12)^a \times (W / 3)^b$

		Empirical Constants for Industrial Roads				Emission Factors (*lb/VMT*)		
		Constant	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
k, a, b - empirical constants		k	4.9	1.5	0.15	1.5	0.36	3.6E-2
s - surface material silt content (%) **	3.0	a	0.7	0.9	0.9			
W - mean vehicle wt (*ton*)	2.0	b	0.45	0.45	0.45			

**AP-42, 13.2.2, Equations 1a & 2, Table 13.2.2-2, Unpaved Roads, Rev. 11/06*

***Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)*

Unpaved Road Controls

	Surface	Reference
$E = EF_{uncontrolled} \times (365 - P) / 365$		
Days of >0.01" Precip	57	*TSF met data 2015-2016 (long-term emissions only)*
Water & Chemical Suppression *	90%	*AP-42, Figure 13.2.2-2, Rev. 11/06*

**Control efficiency is based on AP-42 Chapter 13.2.2, Unpaved Roads. Figure 13.2.2-2 provides the control efficiencies achievable.*

Employee Traffic Emissions (lb/hr)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Employee (Combustion)	5.6E-3	5.6E-3	1.0E-3	0.22	1.0E-2	5.5E-4	2.4E-3
Employee (Unpaved Road)	4.0	0.93	9.3E-2				
Total	**4.0**	**0.93**	**9.4E-2**	**0.22**	**1.0E-2**	**5.5E-4**	**2.4E-3**

Employee Traffic Emissions (ton/yr)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Employee (Combustion)	2.3E-2	2.3E-2	4.2E-3	0.92	4.3E-2	2.3E-3	1.0E-2
Employee (Unpaved Road)	14.0	3.3	0.33				
Total	**14.0**	**3.3**	**0.33**	**0.92**	**4.3E-2**	**2.3E-3**	**1.0E-2**

Conversions

2	one-way/RT
24	hr/day

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Wind Erosion from Exposed Areas

1,439	Maximum Erodible Area (acres)
water/chemical tackifiers	Control Technology
90%	Control Efficiency

Wind Erosion Emissions

	PM		PM_{10}		$PM_{2.5}$	
	lb/hr	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
TSF & Support Areas	0.35	1.5	0.17	0.76	2.6E-2	0.11

AP-42, Sec. 13.2.5

Flat, u/u10+* 0.053 *AP-42, Sec. 13.2.5, p. 5*

(A) u10+ = 1.2 u10 *Fastest mile wind speed at 10m, with a 1.2 factor to convert hourly wind speed to fastest mile.*

(B, piles) u = (Us/Ur) × 0.1 × u10+*

(B, flat) u = 0.053 × u10+*

(C) P = 58 (u - ut*)2 + 25 (u* - ut*); P = 0 for u* ≤ ut*; where ut* =* 0.172 *m/s* *Threshold Friction Velocity, AZ Cu Mine Tailings*

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Conveyor Transfers (Alt4 ONLY)

Operational Parameters

Filtered Scavenger Tails			
Average	31,535,410	*ton/yr*	*Resolution, 4/19/18*
Maximum	44,569,359	*ton/yr*	*Resolution, 4/19/18*
Maximum	5,088	*ton/hr*	
Number of Transfers	16		*Resolution, 4/19/18*
Number of Controlled Transfers	14	*assumption*	
Filtered Pyrite Tails			
Average	6,238,913	*ton/yr*	*Resolution, 4/19/18*
Maximum	10,224,314	*ton/yr*	*Resolution, 4/19/18*
Maximum	1,167	*ton/hr*	
Number of Transfers	10		*Resolution, 4/19/18*
Number of Controlled Transfers	8	*assumption*	

Emission Factor Equation*

$E\ [lb/ton] = K * 0.0032\ (U/5)^{1.3}/(M/2)^{1.4}$

K_{PM}	0.74	U (wind speed, controlled)	1.3	*mph*
K_{PM10}	0.35	U (wind speed, uncontrolled)	6.17	*mph***
$K_{PM2.5}$	0.053	M (moisture content)	11	%***

**AP-42 Chapter 13.2.4, Equation 1*

***Average of 2015-2016 from WPS met station*

****Worst case of scavenger (11%) and pyrite (14%), A. Marks, 4/20/18*

Emission Factors (*lb/ton*)

	Controlled*	Uncontrolled
PM	3.8E-5	2.9E-4
PM_{10}	1.8E-5	1.4E-4
$PM_{2.5}$	2.7E-6	2.0E-5

**Controlled using enclosure*

Emissions (per Single Scavenger Transfer)

	lb/hr		*ton/yr*	
	Controlled	**Uncontrolled**	**Controlled**	**Uncontrolled**
PM	0.19	1.5	0.60	4.5
PM_{10}	9.1E-2	0.69	0.28	2.1
$PM_{2.5}$	1.4E-2	0.10	4.3E-2	0.32

Emissions (per Single Pyrite Transfer)

	lb/hr		*ton/yr*	
	Controlled	**Uncontrolled**	**Controlled**	**Uncontrolled**
PM	4.4E-2	0.33	0.12	0.89
PM_{10}	2.1E-2	0.16	5.6E-2	0.42
$PM_{2.5}$	3.2E-3	2.4E-2	8.4E-3	6.4E-2

Total Emissions

	lb/hr	*ton/yr*
PM		
PM_{10}		
$PM_{2.5}$		

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Direct Greenhouse Gas Emissions

Greenhouse Gas Emission Factors

Pollutant	Fuel Source	Emission Factor		Reference
CO_2	Diesel	73.96	*kg/MMBtu*	*40 CFR Part 98, Table C-1 to Subpart C (11/13) Distillate Fuel Oil #2*
CH_4	Diesel	0.003	*kg/MMBtu*	*40 CFR Part 98, Table C-2 to Subpart C (11/13) Petroleum*
N_2O	Diesel	0.0006	*kg/MMBtu*	*40 CFR Part 98, Table C-2 to Subpart C (11/13) Petroleum*

Total Fuel Use	9,322,392	*gal/yr*
	1,277,168	*MMBtu/yr*

Direct Greenhouse Gas (CO_2e) Emissions

Greenhouse Gas	Emissions *tonne/yr**	Global Warming Potential**	CO_2e *tonne/yr**
Carbon Dioxide (CO_2)	94,459	1	94,459
Methane (CH_4)	3.8	25	95.8
Nitrous Oxide (N_2O)	0.77	298	228
Total			**94,783**

**metric tons per year*

***40 CFR Part 98, Table A-1 to Subpart A (11/13) Chemical-Specific GWPs*

Conversions

1,000	*kg/tonne*
1,000,000	*Btu/MMBtu*

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Emergency Generator - Emissions Summary

Emergency Power Generation Emissions Summary - Short-Term

Source	**CO** *lb/hr*	**NO_X** *lb/hr*	**PM** *lb/hr*	**SO_2** *lb/hr*	**VOC** *lb/hr*
East Plant - Existing Generators	17.7	32.5	1.0	3.8E-2	6.6
East Plant - New Generators	14.9	101	3.5	0.76	6.8
West Plant Generators	11.6	1.0	2.3E-2	2.7E-2	5.1E-2
Tailings Generator	3.9	0.35	7.7E-3	9.0E-3	1.7E-2
Filter Plant (Loadout) Generator	3.9	0.35	7.7E-3	9.0E-3	1.7E-2
Emergency Power Generation Total	**51.9**	**136**	**4.6**	**0.84**	**13.4**

Emergency Power Generation Emissions Summary - Long-Term

Source	**CO** *ton/yr*	**NO_X** *ton/yr*	**PM** *ton/yr*	**SO_2** *ton/yr*	**VOC** *ton/yr*
East Plant - Existing Generators	4.4	8.1	0.25	9.6E-3	1.6
East Plant - New Generators	3.7	25.3	0.88	0.19	1.7
West Plant Generators	2.9	0.26	5.7E-3	6.7E-3	1.3E-2
Tailings Generator	0.96	8.7E-2	1.9E-3	2.2E-3	4.3E-3
Filter Plant (Loadout) Generator	0.96	8.7E-2	1.9E-3	2.2E-3	4.3E-3
Emergency Power Generation Total	**13.0**	**33.9**	**1.1**	**0.21**	**3.4**

Conversions

1.341	*hp/kW*	
453.592	*g/lb*	
2,000	*lb/ton*	
15	*ppm S in ULSD (GPA 2140)*	
7.05	*lb/gal*	*AP-42, Appendix A (Distillate Oil), Rev. 9/85*
1.00E+06	*Btu/MMBtu*	

Blue values are input; black values are calculated or linked.

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple
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Emergency Power Generation

East Plant - Existing Generators

Cat 516B - Diesel	2,628	*hp*	*Resolution*
	1,960	*kW*	
Model Year	2006		*Assuming Tier II*
Cat 3046C - Diesel	449	*hp*	*Resolution*
	335	*kW*	
Model Year	2001		*Assuming Tier II*
Break-Specific Fuel Consumption	7,000	*Btu/hp-hr*	*AP-42, Table 3.4-1, Footnote e, Rev. 10/96*
Diesel Heat Value	137,000	*Btu/gal*	*AP-42, Appendix A, Rev. 9/85*
Operation	500	*hr/yr*	*Resolution*
Power (All Engines)	21.5	*MMBtu/hr*	

Total Diesel Fuel Consumption	*gal/hr*	*gal/yr*
Cat 516B - Diesel	134	67,139
Cat 3046C - Diesel	23	11,471

Emission Factors	Cat 516B - Diesel	Cat 3046C - Diesel	Reference
CO	3.50 *g/kW-h*	3.50 *g/kW-h*	*40 CFR § 89.112, Table 1, Tier II*
NO_X	6.40 *g/kW-h*	6.60 *g/kW-h*	*40 CFR § 89.112, Table 1, Tier II*
PM	0.20 *g/kW-h*	0.20 *g/kW-h*	*40 CFR § 89.112, Table 1, Tier II*
VOC	1.30 *g/kW-h*	1.30 *g/kW-h*	*40 CFR § 89.112, Table 1, Tier II*
SO_2	-	-	*Mass balance based on 15 ppm S content (below)*

Emissions	Cat 516B - Diesel		Cat 3046C - Diesel		Total	
	lb/hr	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
CO	15.1	3.8	2.6	0.65	17.7	4.4
NO_X	27.7	6.9	4.9	1.2	32.5	8.1
PM	0.86	0.22	0.15	3.7E-2	1.0	0.25
VOC	5.6	1.4	0.96	0.24	6.6	1.6
SO_2 *	3.3E-2	8.2E-3	5.6E-3	1.4E-3	3.8E-2	9.6E-3

* *Calculated by mass balance using a 15% fuel contingency*

SO2 Mass Balance (Single Cat 516B - Diesel)

$$\frac{134\ gal}{hr} \times \frac{7.05\ lb}{gal} \times 0.0015\%\ S \times \frac{64.06\ lb\ SO_2}{32.07\ lb\ S} \times (1 + 15\%) = \frac{0.03\ lb\ SO_2}{hr}$$

$$\frac{0.03\ lb\ SO_2}{hr} \times \frac{500\ hr}{yr} \times \frac{ton}{2{,}000\ lb} = \frac{0.008\ ton\ SO_2}{yr}$$

SO2 Mass Balance (Single Cat 3046C - Diesel)

$$\frac{23\ gal}{hr} \times \frac{7.05\ lb}{gal} \times 0.0015\%\ S \times \frac{64.06\ lb\ SO_2}{32.07\ lb\ S} \times (1 + 15\%) = \frac{0.006\ lb\ SO_2}{hr}$$

$$\frac{0.01\ lb\ SO_2}{hr} \times \frac{500\ hr}{yr} \times \frac{ton}{2{,}000\ lb} = \frac{0.0014\ ton\ SO_2}{yr}$$

Emergency Power Generation - Continued

East Plant - New Generators

Engine Make and Model	Caterpillar C175-16		*Caterpillar Standby 3100 kW Tier 4i Performance Data*
Engine Output	3,263	*kW*	
	4,376	*hp*	*Resolution*
Break-Specific Fuel Consumption	7,000	*Btu/hp-hr*	*AP-42, Table 3.4-1, Footnote e, Rev. 10/96*
Diesel Heat Value	137,000	*Btu/gal*	*AP-42, Appendix A, Rev. 9/85*
Quantity	14		*Resolution*
Operation	500	*hr/yr*	*Resolution*
Power (All Engines)	428.8	*MMBtu/hr*	

Total Diesel Fuel Consumption	*gal/hr*	*gal/yr*
Single Generator	224	111,796
14 Generators	3,130	1,565,139

Emission Factors	**Performance Data***		**Reference**
CO	0.11	*g/hp-h*	*Caterpillar Standby 3100 kW Tier 4i Performance Data (worst case)*
NO_X	0.75	*g/hp-h*	*Caterpillar Standby 3100 kW Tier 4i Performance Data (worst case)*
PM**	0.05	*g/hp-h*	*Caterpillar Standby 3100 kW Tier 4i Performance Data (worst case)*
VOC	0.05	*g/hp-h*	*Caterpillar Standby 3100 kW Tier 4i Performance Data (worst case)*
SO_2	-		*Mass balance based on 15 ppm S content (below)*

**Performance data: Rated Speed Potential Site Variation: 1800 RPM*

***Worst case emissions at 50% power (2,284 hp)*

Emissions	**Single Generator**		**14 Generators**	
	lb/hr	***ton/yr***	***lb/hr***	***ton/yr***
CO	1.1	0.27	14.9	3.7
NO_X	7.2	1.8	101	25.3
PM	0.25	6.3E-2	3.5	0.88
VOC	0.48	0.12	6.8	1.7
SO_2 *	5.4E-2	1.4E-2	0.76	0.19

* *Calculated by mass balance using a 15% fuel contingency*

SO2 Mass Balance (Single Caterpillar C175-16)

$$\frac{224\ gal}{hr} \times \frac{7.05\ lb}{gal} \times 0.0015\%\ S \times \frac{64.06\ lb\ SO_2}{32.07\ lb\ S} \times (1+15\%) = \frac{0.05\ lb\ SO_2}{hr}$$

$$\frac{0.05\ lb\ SO_2}{hr} \times \frac{500\ hr}{yr} \times \frac{ton}{2{,}000\ lb} = \frac{0.014\ ton\ SO_2}{yr}$$

Emergency Power Generation - Continued

West Plant Generators

Engine Make and Model	*Caterpillar C18 Generator Set*		*Resolution*
Diesel Generator	671	*hp*	
	500	*kW*	*Cat Specs*
Model Year	2016		
Quantity	3		*Resolution*
Break-Specific Fuel Consumption	7,000	*Btu/hp-hr*	*AP-42, Table 3.4-1, Footnote e, Rev. 10/96*
Diesel Heat Value	137,000	*Btu/gal*	*AP-42, Appendix A, Rev. 9/85*
Operation	500	*hr/yr*	*Resolution*
Power (All Engines)	14.1	*MMBtu/hr*	
Fuel Consumption (Single Generator)	37	*gal/hr*	*Cat Specs*
	18,500	*gal/yr*	
Fuel Consumption (3 Generators)	55,500	*gal/yr*	

Emission Factors	Emission Factor		Reference
CO	3.5	*g/kW-h*	*40 CFR § 1039.101, Table 1*
NO_X	0.2	*g/hp-hr*	*Cat Specs*
PM	0.005	*g/hp-hr*	*Cat Specs*
VOC	0.01	*g/hp-hr*	*Cat Specs*
SO_2	-		*Mass balance based on 15 ppm S content (below)*

Emissions	Diesel Generators (3)	
	lb/hr	*ton/yr*
CO	11.6	2.9
NO_X	1.0	0.26
PM	2.3E-2	5.7E-3
VOC	5.1E-2	1.3E-2
SO_2*	2.7E-2	6.7E-3

* *Calculated by mass balance using a 15% fuel contingency*

SO2 Mass Balance (Single Diesel Generator)

$$\frac{37\ \text{gal}}{\text{hr}} \times \frac{7.05\ \text{lb}}{\text{gal}} \times 0.0015\%\ S \times \frac{64.06\ \text{lb } SO_2}{32.07\ \text{lb } S} \times (1 + 15\%) = \frac{0.009\ \text{lb } SO_2}{\text{hr}}$$

$$\frac{0.009\ \text{lb } SO_2}{\text{hr}} \times \frac{500\ \text{hr}}{\text{yr}} \times \frac{\text{ton}}{2{,}000\ \text{lb}} = \frac{0.0022\ \text{ton } SO_2}{\text{yr}}$$

Emergency Power Generation - Continued

Tailings Generator

Engine Make and Model	*Caterpillar C18 Generator Set*		*Resolution*
Diesel Generator	671	*hp*	
	500	*kW*	*Cat Specs*
Model Year	2016		
Quantity	1		*Resolution*
Break-Specific Fuel Consumption	7,000	*Btu/hp-hr*	*AP-42, Table 3.4-1, Footnote e, Rev. 10/96*
Diesel Heat Value	137,000	*Btu/gal*	*AP-42, Appendix A, Rev. 9/85*
Operation	500	*hr/yr*	*Resolution*
Power (All Engines)	4.7	*MMBtu/hr*	
Fuel Consumption (Single Generator)	37	*gal/hr*	*Cat Specs*
	18,500	*gal/yr*	

Emission Factors	Emission Factor		Reference
CO	3.5	*g/kW-h*	*40 CFR § 1039.101, Table 1*
NO_X	0.2	*g/hp-hr*	*Cat Specs*
PM	0.005	*g/hp-hr*	*Cat Specs*
VOC	0.01	*g/hp-hr*	*Cat Specs*
SO_2	-		*Mass balance based on 15 ppm S content (below)*

Emissions	Diesel Generator	
	lb/hr	*ton/yr*
CO	3.9	0.96
NO_X	0.35	8.7E-2
PM	7.7E-3	1.9E-3
VOC	1.7E-2	4.3E-3
SO_2*	9.0E-3	2.2E-3

* *Calculated by mass balance using a 15% fuel contingency*

SO2 Mass Balance (Single Diesel Generator)

$$\frac{37\ \text{gal}}{\text{hr}} \times \frac{7.05\ \text{lb}}{\text{gal}} \times 0.0015\%\ S \times \frac{64.06\ \text{lb}\ SO_2}{32.07\ \text{lb}\ S} \times (1 + 15\%) = \frac{0.009\ \text{lb}\ SO_2}{\text{hr}}$$

$$\frac{0.009\ \text{lb}\ SO_2}{\text{hr}} \times \frac{500\ \text{hr}}{\text{yr}} \times \frac{\text{ton}}{2{,}000\ \text{lb}} = \frac{0.0022\ \text{ton}\ SO_2}{\text{yr}}$$

Emergency Power Generation - Continued

Filter Plant (Loadout) Generator

Engine Make and Model	*Caterpillar C18 Generator Set*		*Resolution*
Diesel Generator	671	*hp*	
	500	*kW*	*Cat Specs*
Model Year	2016		
Quantity	1		*Resolution*
Break-Specific Fuel Consumption	7,000	*Btu/hp-hr*	*AP-42, Table 3.4-1, Footnote e, Rev. 10/96*
Diesel Heat Value	137,000	*Btu/gal*	*AP-42, Appendix A, Rev. 9/85*
Operation	500	*hr/yr*	*Resolution*
Power (All Engines)	4.7	*MMBtu/hr*	
Fuel Consumption (Single Generator)	37	*gal/hr*	*Cat Specs*
	18,500	*gal/yr*	

Emission Factors	Emission Factor		Reference
CO	3.5	*g/kW-h*	*40 CFR § 1039.101, Table 1*
NO_X	0.2	*g/hp-hr*	*Cat Specs*
PM	0.005	*g/hp-hr*	*Cat Specs*
VOC	0.01	*g/hp-hr*	*Cat Specs*
SO_2	-		*Mass balance based on 15 ppm S content (below)*

Emissions	Diesel Generator	
	lb/hr	*ton/yr*
CO	3.9	0.96
NO_X	0.35	8.7E-2
PM	7.7E-3	1.9E-3
VOC	1.7E-2	4.3E-3
SO_2*	9.0E-3	2.2E-3

* *Calculated by mass balance using a 15% fuel contingency*

SO2 Mass Balance (Single Diesel Generator)

$$\frac{37\ gal}{hr} \times \frac{7.05\ lb}{gal} \times 0.0015\%\ S \times \frac{64.06\ lb\ SO_2}{32.07\ lb\ S} \times (1 + 15\%) = \frac{0.009\ lb\ SO_2}{hr}$$

$$\frac{0.009\ lb\ SO_2}{hr} \times \frac{500\ hr}{yr} \times \frac{ton}{2{,}000\ lb} = \frac{0.0022\ ton\ SO_2}{yr}$$

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CONTROLLED EMISSIONS

Source Description	PM *lb/hr*	PM *ton/yr*	PM_{10} *lb/hr*	PM_{10} *ton/yr*	$PM_{2.5}$ *lb/hr*	$PM_{2.5}$ *ton/yr*
Aggregate Delivery to Ground Storage	0.45	0.25	0.21	0.12	0.03	0.02
Sand Delivery to Ground Storage	0.23	0.13	0.11	0.06	0.02	9.3E-3
Aggregate Transfer to Conveyor Belt via Chute	0.03	0.02	0.02	0.01	2.5E-3	1.6E-3
Sand Transfer to Conveyor Belt via Chute	0.03	0.01	0.01	5.3E-3	2.0E-3	8.5E-4
Aggregate Transfer to Elevated Storage	0.03	0.02	0.02	0.01	2.5E-3	1.6E-3
Sand Transfer to Elevated Storage	0.03	0.01	0.01	5.3E-3	2.0E-3	8.5E-4
Weigh Hopper Loading (Aggregate & Sand)	0.31	0.15	0.18	0.09	0.03	0.01
Weigh Hopper Discharge to Truck Loading Conveyor (Agg)	0.03	0.02	0.02	0.01	2.5E-3	1.6E-3
Weigh Hopper Discharge to Truck Loading Conveyor (Sand)	0.03	0.01	0.01	5.3E-3	2.0E-3	8.5E-4
Cement Unloading to Silo	0.08	0.03	0.03	0.01	3.9E-3	1.6E-3
Flyash Unloading to Silo	0.09	0.04	0.05	0.02	7.2E-3	3.7E-3
Silica Fume Unloading to Silo	0.03	9.5E-3	0.02	5.2E-3	2.9E-3	7.9E-4
Cement & Flyash Discharge to Silo Weigh Hopper	4.3E-3	1.8E-3	2.5E-3	1.0E-3	3.8E-4	1.6E-4
Silo Weigh Hopper Discharge to Truck Loading Conveyor	4.3E-3	1.8E-3	2.5E-3	1.0E-3	3.8E-4	1.6E-4
Truck Loading*	8.8	3.7	2.4	0.98	0.36	0.15
Total	**10.2**	**4.4**	**3.0**	**1.3**	**0.46**	**0.20**

**Emissions for truck loading are based on quantity of cement and cement supplement, per AP-42 Chapter 11.12.*

UNCONTROLLED EMISSIONS

Source Description	PM *lb/hr*	PM *ton/yr*	PM_{10} *lb/hr*	PM_{10} *ton/yr*	$PM_{2.5}$ *lb/hr*	$PM_{2.5}$ *ton/yr*
Aggregate Delivery to Ground Storage	0.56	0.32	0.27	0.15	0.04	0.02
Sand Delivery to Ground Storage	0.28	0.16	0.13	0.08	0.02	0.01
Aggregate Transfer to Conveyor Belt via Chute	0.49	0.32	0.23	0.15	0.04	0.02
Sand Transfer to Conveyor Belt via Chute	0.39	0.16	0.18	0.08	0.03	0.01
Aggregate Transfer to Elevated Storage	0.49	0.32	0.23	0.15	0.04	0.02
Sand Transfer to Elevated Storage	0.39	0.16	0.18	0.08	0.03	0.01
Weigh Hopper Loading (Aggregate & Sand)	1.2	0.59	0.72	0.34	0.11	0.05
Weigh Hopper Discharge to Truck Loading Conveyor (Agg)	0.49	0.32	0.23	0.15	0.04	0.02
Weigh Hopper Discharge to Truck Loading Conveyor (Sand)	0.39	0.16	0.18	0.08	0.03	0.01
Cement Unloading to Silo	55.6	22.8	35.8	14.7	5.4	2.2
Flyash Unloading to Silo	30.7	15.6	10.7	5.5	1.6	0.83
Silica Fume Unloading to Silo	12.3	3.3	4.3	1.2	0.65	0.18
Cement & Flyash Discharge to Silo Weigh Hopper	0.43	0.18	0.25	0.10	0.04	0.02
Silo Weigh Hopper Discharge to Truck Loading Conveyor	0.43	0.18	0.25	0.10	0.04	0.02
Truck Loading*	100	41.7	27.9	11.6	4.2	1.7
Total	**205**	**86.3**	**81.6**	**34.3**	**12.4**	**5.2**

**Emissions for truck loading are based on quantity of cement and cement supplement, per AP-42 Chapter 11.12.*

Conversions	
2,000	*lb/ton*

Blue values are input; black values are calculated or linked.

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Max Emission Scenario: Shotcrete

ACTIVITY RATES

Source Description	Capacity[1] ton/hr	ton/yr	Control Description		Reference
Aggregate Delivery to Ground Storage	81.0	91,386	*Water Sprays*	20%	2
Sand Delivery to Ground Storage	135	154,412	*Water Sprays*	20%	2
Aggregate Transfer to Conveyor Belt via Chute	70.8	91,386	*Wind Break*		
Sand Transfer to Conveyor Belt via Chute	185	154,412	*Wind Break*		
Aggregate Transfer to Elevated Storage	70.8	91,386	*Wind Break*		
Sand Transfer to Elevated Storage	185	154,412	*Wind Break*		
Weigh Hopper Loading (Aggregate & Sand)	255	245,797	*Enclosure*	75%	3
Weigh Hopper Discharge to Truck Loading Conveyor (Agg)	70.8	91,386	*Enclosure*		
Weigh Hopper Discharge to Truck Loading Conveyor (Sand)	185	154,412	*Enclosure*		
Cement Unloading to Silo	76.2	62,467	*Dust Collector*		
Flyash Unloading to Silo	9.8	9,947	*Dust Collector*		
Silica Fume Unloading to Silo	3.9	2,130	*Dust Collector*		
Cement & Flyash Discharge to Silo Weigh Hopper	89.8	74,544	*Vent Filter*	99%	4
Silo Weigh Hopper Discharge to Truck Loading Conveyor	89.8	74,544			
Truck Loading	345	320,341	*Dust Collector*		

1 *Resolution Copper*
2 *AP-42, Table B2.-3, Spray Tower ($PM_{2.5}$), Rev. 9/90*
3 *Stationary Source Control Techniques Document for Fine Particulate Matter (EPA 1998), Table 6.1, Telescoping Chute*
4 *Stationary Source Control Techniques Document for Fine Particulate Matter (EPA 1998), Figure 5.3-2*

EMISSION FACTORS

Source Description	Uncontrolled PM lb/ton	Uncontrolled PM_{10} lb/ton	Uncontrolled $PM_{2.5}$ lb/ton	Controlled PM lb/ton	Controlled PM_{10} lb/ton	Controlled $PM_{2.5}$ lb/ton	Reference
Aggregate Delivery to Ground Storage	6.9E-03	3.3E-03	5.0E-04	5.5E-03	2.6E-03	4.0E-04	1
Sand Delivery to Ground Storage	2.1E-03	9.9E-04	1.5E-04	1.7E-03	7.9E-04	1.2E-04	2
Aggregate Transfer to Conveyor Belt via Chute	6.9E-03	3.3E-03	5.0E-04	4.9E-04	2.3E-04	3.5E-05	3
Sand Transfer to Conveyor Belt via Chute	2.1E-03	9.9E-04	1.5E-04	1.5E-04	6.9E-05	1.1E-05	4
Aggregate Transfer to Elevated Storage	6.9E-03	3.3E-03	5.0E-04	4.9E-04	2.3E-04	3.5E-05	3
Sand Transfer to Elevated Storage	2.1E-03	9.9E-04	1.5E-04	1.5E-04	6.9E-05	1.1E-05	4
Weigh Hopper Loading (Aggregate & Sand)	4.8E-03	2.8E-03	4.2E-04	1.2E-03	7.0E-04	1.1E-04	5
Weigh Hopper Discharge to Truck Loading Conveyor (Agg)	6.9E-03	3.3E-03	5.0E-04	4.9E-04	2.3E-04	3.5E-05	3
Weigh Hopper Discharge to Truck Loading Conveyor (Sand)	2.1E-03	9.9E-04	1.5E-04	1.5E-04	6.9E-05	1.1E-05	4
Cement Unloading to Silo	0.73	0.47	0.07	9.9E-04	3.4E-04	5.1E-05	6
Flyash Unloading to Silo	3.14	1.1	0.2	8.9E-03	4.9E-03	7.4E-04	7
Silica Fume Unloading to Silo	3.14	1.1	0.2	8.9E-03	4.9E-03	7.4E-04	7
Cement & Flyash Discharge to Silo Weigh Hopper	4.8E-03	2.8E-03	4.2E-04	4.8E-05	2.8E-05	4.2E-06	5
Silo Weigh Hopper Discharge to Truck Loading Conveyor	4.8E-03	2.8E-03	4.2E-04	4.8E-05	2.8E-05	4.2E-06	5
Truck Loading	1.118	0.31	0.0469	0.0980	0.0263	4.0E-03	8

1 *AP-42 Table 11.12-2 based on section 13.2.4 equation 1 (Aggregate Transfers); Controlled 20% with water sprays*
2 *AP-42 Table 11.12-2 based on section 13.2.4 equation 1 (Sand Transfers); Controlled 20% with water sprays*
3 *AP-42 Table 11.12-2 based on section 13.2.4 equation 1 (Aggregate Transfers); Controlled wind speed (1.3 mph)*
4 *AP-42 Table 11.12-2 based on section 13.2.4 equation 1 (Sand Transfers); Controlled wind speed (1.3 mph)*
5 *AP-42 Table 11.12-2 (weigh hopper loading); $PM_{2.5}$ factors based on Chapter 13.2.4 particle size multipliers*
6 *AP-42 Table 11.12-2 (cement unloading to elevated storage silo); $PM_{2.5}$ factors based on Chapter 13.2.4 particle size multipliers*
7 *AP-42 Table 11.12-2 (cement supplement unloading to elevated storage silo); $PM_{2.5}$ factors based on Chapter 13.2.4 particle size multipliers*
8 *AP-42 Table 11.12-2 (Truck Loading - truck mix); $PM_{2.5}$ factors based on Chapter 13.2.4 particle size multipliers*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple	
	PROJECT NO: 262	PAGE: 1	OF: 4	SHEET: Drill & Blast
AIR EMISSION CALCULATIONS	SUBJECT: Drilling and Blasting		DATE: January 11, 2019	

East Plant Drilling

Emission Factors			Reference
PM_{10}	8.0E-5	*lb/ton*	*AP-42, Table 11.19.2-2 (wet drilling), Rev. 8/04*
PM Scaling Factors			
PM	2.1		*Ratio calculated based on particle size multiplier from AP-42, 13.2.4*
PM_{10}	1		
$PM_{2.5}$	1		

Production Drilling - Activity Information		
Ore Quantity	2,065,200	*tonne/yr*
	1,414	*tonne/hr*
	2,276,491	*ton/yr*
	1,559	*ton/hr*

Production Drilling - Emissions	*lb/hr*	*ton/yr*
PM	0.26	0.19
PM_{10}	0.12	9.1E-2
$PM_{2.5}$	0.12	9.1E-2

Conversions	
1.10231	*ton/tonne*
907.185	*kg/ton*
3.28084	*ft/m*
10.7639	*ft^2/m^2*
8,760	*hr/yr*
2,000	*lb/ton*

Blue values are input; black values are calculated or linked.

West Plant Drilling

Emission Factors			**Reference**
PM_{10}	8.0E-5	*lb/ton*	*AP-42, Table 11.19.2-2 (wet drilling), Rev. 8/04*
PM Scaling Factors			
PM	2.1		*Ratio calculated based on particle size multiplier from AP-42, 13.2.4*
PM_{10}	1		
$PM_{2.5}$	1		

Production Drilling - Activity Information		
Ore Quantity	164,300	*tonne/yr*
	1,414	*tonne/hr*
	181,110	*ton/yr*
	1,559	*ton/hr*

Production Drilling - Emissions	*lb/hr*	*ton/yr*
PM	0.26	1.5E-2
PM_{10}	0.12	7.2E-3
$PM_{2.5}$	0.12	7.2E-3

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple	
	PROJECT NO: 262	PAGE: 3	OF: 4	SHEET: Drill & Blast
AIR EMISSION CALCULATIONS	SUBJECT: Drilling and Blasting		DATE: January 11, 2019	

East Plant Blasting			**Reference**
Activity Information			
Blasting Agent Use	1,487,000	*kg/yr*	*Resolution*
	1,639	*ton/yr*	
No. of Blasts	487	*blasts/yr*	*Resolution*
	2	*max blasts/day*	*Resolution*
Operation	365	*days/yr*	
	24	*hr/day*	

Emission Factors			**Reference**
Emission Factor Equation	$TSP = 0.000014 \times A^{1.5}$	*lb/blast*	*AP-42, Table 11.9-1 (blasting, overburden), Rev. 7/98*
Where, A = Area per Blast	580	*m^2 (max per blast)*	*Resolution*
	6,243	*ft^2 (max per blast)*	*Based on maximum blasts per day*
TSP	6.91	*lb/blast*	
Where, A = Area per Blast	141,200	*m^2 (annual)*	*Resolution*
	1,519,863	*ft^2 (annual)*	
TSP	3,363	*lb/yr*	
CO	32.53	*lb/ton*	*Resolution*
NO_X	6.20	*lb/ton*	*Resolution*
SO_2	2	*lb/ton*	*AP-42, Table 13.3-1 (ANFO), Rev. 2/80*

PM Scaling Factors		**Reference**
PM	1	*AP-42, Table 11.9-1 (blasting, overburden), Rev. 7/98*
PM_{10}	0.52	*AP-42, Table 11.9-1 (blasting, overburden), Rev. 7/98*
$PM_{2.5}$	0.03	*AP-42, Table 11.9-1 (blasting, overburden), Rev. 7/98*

Emissions	*(lb/blast)**	*lb/hr**	*(lb/day)**	*ton/yr*
PM	6.9	6.9	13.8	1.7
PM_{10}	3.6	3.6	7.2	0.87
$PM_{2.5}$	0.21	0.21	0.41	5.0E-2
CO	109	109	219	26.7
NO_X	20.9	20.9	41.7	5.1
SO_2	6.7	6.7	13.5	1.6

* *Based on maximum of 2 blasts per day*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI			BY: N. Tipple
AIR EMISSION CALCULATIONS	PROJECT NO: 262	PAGE: 4	OF: 4	SHEET: Drill & Blast
	SUBJECT: Drilling and Blasting	DATE: January 11, 2019		

West Plant Blasting			Reference
Activity Information			
Blasting Agent Use	118,300	*kg/yr*	*Resolution*
	130	*ton/yr*	
No. of Blasts	390	*blasts/yr*	*Resolution*
	2	*max blasts/day*	*Resolution*
Operation	365	*days/yr*	
	24	*hr/day*	

Emission Factors			Reference
Emission Factor Equation	$TSP = 0.000014 \times A^{1.5}$	*lb/blast*	*AP-42, Table 11.9-1 (blasting, overburden), Rev. 7/98*
Where, A = Area per Blast	63	*m^2 (max per blast)*	*Resolution*
	678	*ft^2 (max per blast)*	*Based on maximum blasts per day*
TSP	0.25	*lb/blast*	
Where, A = Area per Blast	14,400	*m^2 (annual)*	*Resolution*
	155,000	*ft^2 (annual)*	
TSP	96	*lb/yr*	
CO	32.53	*lb/ton*	*Resolution*
NO_X	6.20	*lb/ton*	*Resolution*
SO_2	2	*lb/ton*	*AP-42, Table 13.3-1 (ANFO), Rev. 2/80*

PM Scaling Factors		Reference
PM	1	*AP-42, Table 11.9-1 (blasting, overburden), Rev. 7/98*
PM_{10}	0.52	*AP-42, Table 11.9-1 (blasting, overburden), Rev. 7/98*
$PM_{2.5}$	0.03	*AP-42, Table 11.9-1 (blasting, overburden), Rev. 7/98*

Emissions	*(lb/blast)**	*lb/hr**	*(lb/day)**	*ton/yr*
PM	0.25	0.25	0.49	4.8E-2
PM_{10}	0.13	0.13	0.26	2.5E-2
$PM_{2.5}$	7.4E-3	7.4E-3	1.5E-2	1.4E-3
CO	10.9	10.9	21.8	2.1
NO_X	2.1	2.1	4.1	0.40
SO_2	0.67	0.67	1.3	0.13

* *Based on maximum of 2 blasts per day*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI			BY: N. Tipple
	PROJECT NO: 262	PAGE: 1	OF: 1	SHEET: Reagents
AIR EMISSION CALCULATIONS	SUBJECT: Liquid Reagent Tanks & Solid Reagent Usage	DATE: January 11, 2019		

LIQUID REAGENT STORAGE TANK CHARACTERISTICS AND EMISSIONS

TANK EMISSIONS	VOC* (lb/yr)	VOC lb/hr	VOC ton/yr
MIBC (Methyl isobutyl carbonal)	134.9	1.5E-02	6.7E-02
MCO (Non-polar flotation oil)	9.5	1.1E-03	4.8E-03
CYTEC 8989	0.1	1.1E-05	5.0E-05
NaHS (Sodium hydrosulfide solution)			

* *Calculated using EPA Tanks 4.0.9d*

MIBC (Methyl isobutyl carbonal)			Notes 1
Design Throughput	5,268	*l/day*	2
	1,392	*gal/day*	
Average Throughput	4,581	*l/day*	2
	441,713	*gal/yr*	
Tank Diameter	4.4	*m*	2
	14.4	*ft*	
Tank Height	5.4	*m*	2
	17.7	*ft*	
Tank Volume	67.3	m^3	2
	17,779	*gal*	

1 *Assuming 100% $(CH_3)_2CHCH_2CH(OH)CH_3$*
2 *Resolution*

CYTEC 8989			Notes 1
Design Throughput	908	*l/day*	2
	240	*gal/day*	
Average Throughput	789	*l/day*	2
	76,078	*gal/yr*	
Tank Diameter	3.7	*m*	2
	12.1	*ft*	
Tank Height	4.7	*m*	2
	15.4	*ft*	
Tank Volume	39.8	m^3	2
	10,514	*gal*	

1 *Dithiophosphate, Cresol -p, & Non-Organic Components*
2 *Resolution*

MCO (Non-polar flotation oil)			Notes 1
Design Throughput	1,597	*l/day*	2
	422	*gal/day*	
Average Throughput	1,388	*l/day*	2
	133,835	*gal/yr*	
Tank Diameter	3.9	*m*	2
	12.8	*ft*	
Tank Height	4.9	*m*	2
	16.1	*ft*	
Tank Volume	45.6	m^3	2
	12,046	*gal*	

1 *Emissions calculated based on 100% Distillate fuel oil no. 2*
2 *Resolution*

NaHS (Sodium hydrosulfide solution)			Notes 1
Design Throughput	41.4	*tonnes/day*	2, 3
	8,749	*gal/day*	
Average Throughput	36.0	*tonnes/day*	2, 3
	2,776,973	*gal/yr*	
Tank Diameter	7.5	*m*	1, 2
	24.6	*ft*	
Tank Height	8.5	*m*	1, 2
	27.9	*ft*	
Tank Volume	334.4	m^3	1, 2
	88,339	*gal*	
Specific Gravity	1.25		2

1 *Stainless Steel Heated and Insulated Tank*
2 *Resolution*
3 *As shipped concentration 40% - 45% NaHS*

Solid Reagent Use *(Resolution)*

	(tonne/day) (design)	*(tonne/day) (average)*	*(ton/hr)*	*(ton/yr)*
Lime	89.7	67.8	4.1	27,279
SIPX*	690*	600*	0.03	241
CIBA 155	3.70	3.22	0.17	1,296
CIBA 10	0.96	0.78	0.04	314

* *Units: kg/day*

Conversions

3.78541	*l/gal*	24	*hr/day*
264.172	*gal/m*^{3}	365	*days/yr*
8.35	*lb/gal water*	2,204.62	*lb/tonne*
3.28084	*ft/m*	907.185	*kg/ton*
1.10231	*ton/tonne*	2,000	*lb/ton*
8,760	*hr/yr*		

Blue values are input; *black values are calculated or linked.*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
	PROJECT NO: 262	PAGE: 1	OF: 1	SHEET: MolyTalc
AIR EMISSION CALCULATIONS	SUBJECT: Moly/Talc Heat Treatment	DATE: January 11, 2019		

Molybdenite / Talc Concentrate Heat Treatment Emissions

	Long-Term Emissions*				Short-Term Emissions*	
SO_2 Emissions						
Uncontrolled SO_2 Emissions	245	*tonne/yr*	270	*ton/yr*	83.9	*lb/hr*
SO_2 Control Efficiency	95%				95%	
Controlled SO_2 Emissions	12.3	*tonne/yr*	13.6	*ton/yr*	4.2	*lb/hr*
VOC Emissions						
Uncontrolled VOC Emissions	503	*tonne/yr*	554	*ton/yr*	172	*lb/hr*
VOC Control Efficiency	88%				88%	
Controlled VOC Emissions	59.1	*tonne/yr*	65.1	*ton/yr*	20.2	*lb/hr*

* *Resolution*

Molybdenite / Talc Rotary Dryer - Throughput Rates and Process Emission Factors

Dryer Throughput		62,603	*tonne/yr*	*Resolution*
		69,008	*ton/yr*	
		9.7	*tonne/hr*	*Resolution*
		10.7	*ton/hr*	
Dryer Heat Capacity		16.25	*MMBtu/hr*	*Resolution*
Dryer Propane Usage		180	*gal/hr*	
		1,572,928	*gal/yr*	
Emission Factors	PM	10	*lb/ton*	*AP-42, Table 12.3-3, Rev. 10/86*
	PM_{10}	9.9	*lb/ton*	*AP-42, Table 12.3-3, Rev. 10/86, With Particle Size Ratio*
	$PM_{2.5}$	8.4	*lb/ton*	*AP-42, Table 12.3-3, Rev. 10/86, With Particle Size Ratio*
PM Control Efficiency		99.0%		*EPA Air Pollution Control Technology Fact Sheet, Wet Electrostatic Precipitator*

Molybdenite / Talc Rotary Dryer - Process Emissions

		lb/hr	*ton/yr*
Uncontrolled	PM	107	345
	PM_{10}	106	341
	$PM_{2.5}$	90.0	291
Controlled	PM	1.1	3.5
	PM_{10}	1.1	3.4
	$PM_{2.5}$	0.90	2.9

Molybdenite / Talc Rotary Dryer - Combustion Emissions

Pollutant	*lb/k-gal **	*lb/hr*	*ton/yr*
PM	0.7	0.13	0.55
SO_2	1.6	0.29	1.3
NO_X	13	2.3	10.2
CO	7.5	1.3	5.9
VOC	0.8	0.14	0.63

AP-42, Table 1.5-1, Rev. 07/08

Conversions

90.5	*MMBtu/k-gal (AP-42, Appendix A)*
7,000	*gr/lb*
0.0185%	*S in Propane (GPA 2140-97)*
44.08	*lb/mol* C_3H_8
359.05	*SCF/lb-mol (0° F)*
100	*SCF/100 SCF*
1.10231	*ton/tonne*
2.20462	*lb/kg*
2,000	*lb/ton*

Blue values are input; black values are calculated or linked.

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI			BY: N. Tipple
	PROJECT NO: 262	PAGE: 1	OF: 2	SHEET: Cooling
AIR EMISSION CALCULATIONS	SUBJECT: Cooling Tower Emissions	DATE: January 11, 2019		

COOLING TOWERS - PM/PM_{10}/$PM_{2.5}$ EMISSION RATES

Operation					Reference
Surface Cooling Circulation	4,200	*l/s*	1,110	*gal/s*	*Resolution*
Surface Drift Loss	0.005%				*Resolution*
Cooling Capacity	135.0	*MW*			*Resolution*
Underground Cooling Circulation	1,250	*l/s*	330	*gal/s*	*Resolution*
Underground Drift Loss	0.005%				*Resolution*

Cooling Tower Water Quality			Reference
Total Dissolved Solids (TDS)	3,000	*ppm*	*Resolution*

Drift		Reference
Drift Mass Governed by		*EPA Document: Effects of Pathogenic and Toxic Material Transport*
Atmospheric Dispersion	31.3%	*Via Cooling Device Drift - Vol. 1 Technical Report*
		EPA 600 7-79-251a, 11/1979

Surface Towers

$$\frac{1{,}110\ \text{gal}}{\text{sec}} \times \frac{8.33\ \text{lb}}{\text{gal water}} \times \frac{3{,}600\ \text{sec}}{\text{hr}} \times 0.005\%\ \text{(drift)} = \frac{1663.62\ \text{lb water}}{\text{hr}}$$

Underground Towers

$$\frac{330\ \text{gal}}{\text{sec}} \times \frac{8.33\ \text{lb}}{\text{gal water}} \times \frac{3{,}600\ \text{sec}}{\text{hr}} \times 0.005\%\ \text{(drift)} = \frac{495.12\ \text{lb water}}{\text{hr}}$$

PM Emissions

Surface Towers

$$\frac{1663.62\ \text{lb water}}{\text{hr}} \times \frac{31.3\%}{\text{(dispersion factor)*}} \times \frac{3{,}000\ \text{lb PM}}{1.0\text{E}+06\ \text{lb water}} = \frac{1.56\ \text{lb PM}}{\text{hr}} = \frac{6.84\ \text{ton PM}}{\text{yr}}$$

Underground Towers

$$\frac{495.12\ \text{lb water}}{\text{hr}} \times \frac{31.3\%}{\text{(dispersion factor)*}} \times \frac{3{,}000\ \text{lb PM}}{1.0\text{E}+06\ \text{lb water}} = \frac{0.47\ \text{lb PM}}{\text{hr}} = \frac{2.04\ \text{ton PM}}{\text{yr}}$$

PM_{10} Emissions

Surface Towers

$$\frac{1.56\ \text{lb PM}}{\text{hr}} \times \frac{0.403\ \text{lb PM}_{10}\text{*}}{\text{lb PM}} = \frac{0.63\ \text{lb PM}_{10}}{\text{hr}} = \frac{2.76\ \text{ton PM}_{10}}{\text{yr}}$$

Underground Towers

$$\frac{0.47\ \text{lb PM}}{\text{hr}} \times \frac{0.403\ \text{lb PM}_{10}\text{*}}{\text{lb PM}} = \frac{0.19\ \text{lb PM}_{10}}{\text{hr}} = \frac{0.82\ \text{ton PM}_{10}}{\text{yr}}$$

$PM_{2.5}$ Emissions

Surface Towers

$$\frac{1.56\ \text{lb PM}}{\text{hr}} \times \frac{0.061\ \text{lb PM}_{2.5}\text{*}}{\text{lb PM}} = \frac{0.096\ \text{lb PM}_{2.5}}{\text{hr}} = \frac{0.420\ \text{ton PM}_{2.5}}{\text{yr}}$$

Underground Towers

$$\frac{0.47\ \text{lb PM}}{\text{hr}} \times \frac{0.061\ \text{lb PM}_{2.5}\text{*}}{\text{lb PM}} = \frac{0.029\ \text{lb PM}_{2.5}}{\text{hr}} = \frac{0.125\ \text{ton PM}_{2.5}}{\text{yr}}$$

**See size fraction calculation on Page 2.*

Blue values are input; black values are calculated or linked.

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI			BY: N. Tipple
AIR EMISSION CALCULATIONS	PROJECT NO: 262	PAGE: 2	OF: 2	SHEET: Cooling
	SUBJECT: Cooling Tower Emissions	DATE: January 11, 2019		

COOLING TOWERS - PM/PM_{10}/$PM_{2.5}$ EMISSION RATES - Continued

PM_{10}, $PM_{2.5}$ Multiplier Calculation

Operation		**Reference**
Water TDS	3,000 *ppm*	*Resolution*
Calcium Carbonate Density	2.7 *g/cc*	*Perry's Chemical Engineer's Handbook, Sixth Edition, p. 3-10.*
Volume of a Sphere	$V = 4 / 3 * \pi * r^3$	

Water Drop Size and Mass Distribution*

Droplet Dia. *(micron)*	*(% mass)*	Water Droplet Vol. *(cc)*	Water Droplet Mass *(g)*	Solids Mass *(g)*	Solids Vol. *(cc)*	Solids Dia. *(micron)*	% mass <10, <2.5 *(microns)*
22	0.4	5.6E-09	5.6E-09	1.7E-11	6.2E-12	2.3	
29	1.5	1.3E-08	1.3E-08	3.8E-11	1.4E-11	3.0	1.9
44	3.8	4.5E-08	4.5E-08	1.3E-10	5.0E-11	4.6	
58	2.1	1.0E-07	1.0E-07	3.1E-10	1.1E-10	6.0	
65	1.9	1.4E-07	1.4E-07	4.3E-10	1.6E-10	6.7	
87	1.6	3.4E-07	3.4E-07	1.0E-09	3.8E-10	9.0	
108	1.4	6.6E-07	6.6E-07	2.0E-09	7.3E-10	11.2	12.6
120	1.3	9.0E-07	9.0E-07	2.7E-09	1.0E-09	12.4	
132	1.1	1.2E-06	1.2E-06	3.6E-09	1.3E-09	13.7	
144	1.3	1.6E-06	1.6E-06	4.7E-09	1.7E-09	14.9	
174	5.8	2.8E-06	2.8E-06	8.3E-09	3.1E-09	18.0	
300	5.0	1.4E-05	1.4E-05	4.2E-08	1.6E-08	31.1	
450**	4.2	4.8E-05	4.8E-05	1.4E-07	5.3E-08	46.6	
Total	31.3						

* *Effects of Pathogenic and Toxic Material Transport Via Cooling Device Drift - Vol. 1 Technical Report. EPA 600 7-79-251a, Nov. 1979.*

** *Maximum droplet size governed by atmospheric dispersion.*

PM_{10}/PM multiplier	=	**0.40**
$PM_{2.5}$/PM multiplier	=	**0.06**

Conversions	
8,760	*hr/yr*
60	*min/hr*
2,000	*lb/ton*
3.78541	*l/gal*
8.33	*lb/gal water*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI			BY: D. Steen
	PROJECT NO: 262	PAGE: 1	OF: 3	SHEET: Employees
AIR EMISSION CALCULATIONS	SUBJECT: Employee Fugitives	DATE: January 11, 2019		

Summary of Fugitive Emissions from Employee Commuting

CONTROLLED EMISSIONS (SHORT-TERM)

Location	**PM** *lb/hr*	**PM_{10}** *lb/hr*	**$PM_{2.5}$** *lb/hr*	**NO_X** *lb/hr*	**SO_2** *lb/hr*	**CO** *lb/hr*	**VOC** *lb/hr*
East Plant	8.5E-2	2.6E-2	5.6E-3	2.1E-2	1.1E-3	0.45	4.9E-3
West Plant	1.0E-2	3.2E-3	6.8E-4	2.5E-3	1.3E-4	5.4E-2	5.9E-4
Tailings Storage Facility	4.0	0.93	9.4E-2	1.0E-2	5.5E-4	0.22	2.4E-3
Filter Plant and Loadout Facility	0.67	0.14	1.4E-2	2.3E-3	1.2E-4	4.9E-2	5.3E-4

CONTROLLED EMISSIONS (LONG-TERM)

Location	**PM** *ton/yr*	**PM_{10}** *ton/yr*	**$PM_{2.5}$** *ton/yr*	**NO_X** *ton/yr*	**SO_2** *ton/yr*	**CO** *ton/yr*	**VOC** *ton/yr*
East Plant	3.1	0.67	0.16	9.2E-2	4.9E-3	2.0	2.1E-2
West Plant	0.38	8.1E-2	1.9E-2	1.1E-2	5.9E-4	0.24	2.6E-3
Tailings Storage Facility	14.0	3.3	0.33	4.3E-2	2.3E-3	0.92	1.0E-2
Filter Plant and Loadout Facility	2.5	0.53	5.4E-2	1.0E-2	5.3E-4	0.21	2.3E-3

UNCONTROLLED EMISSIONS (SHORT-TERM)

Location	**PM** *lb/hr*	**PM_{10}** *lb/hr*	**$PM_{2.5}$** *lb/hr*	**NO_X** *lb/hr*	**SO_2** *lb/hr*	**CO** *lb/hr*	**VOC** *lb/hr*
East Plant	0.75	0.16	3.8E-2	2.1E-2	1.1E-3	0.45	4.9E-3
West Plant	9.1E-2	1.9E-2	4.6E-3	2.5E-3	1.3E-4	5.4E-2	5.9E-4
Tailings Storage Facility	40.0	9.3	0.93	1.0E-2	5.5E-4	0.22	2.4E-3
Filter Plant and Loadout Facility	6.7	1.4	0.14	2.3E-3	1.2E-4	4.9E-2	5.3E-4

UNCONTROLLED EMISSIONS (LONG-TERM)

Location	**PM** *ton/yr*	**PM_{10}** *ton/yr*	**$PM_{2.5}$** *ton/yr*	**NO_X** *ton/yr*	**SO_2** *ton/yr*	**CO** *ton/yr*	**VOC** *ton/yr*
East Plant	3.1	0.67	0.16	9.2E-2	4.9E-3	2.0	2.1E-2
West Plant	0.38	8.1E-2	1.9E-2	1.1E-2	5.9E-4	0.24	2.6E-3
Tailings Storage Facility	140	32.6	3.3	4.3E-2	2.3E-3	0.92	1.0E-2
Filter Plant and Loadout Facility	24.7	5.3	0.53	1.0E-2	5.3E-4	0.21	2.3E-3

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI		BY: D. Steen
	PROJECT NO: 262	PAGE: 2 OF: 3	SHEET: Employees
AIR EMISSION CALCULATIONS	SUBJECT: Employee Fugitives		DATE: January 11, 2019

Fugitive Dust from Employee Commuting

	Daily Number of	Average Distance Travelled		
Location	**Vehicles***	*one way VMT, ea**	*RT VMT/day*	*RT VMT/yr*
East Plant	332	1.9	1,262	460,484
West Plant	318	0.2	153	55,714
Tailings Storage Facility	58	5.4	621	214,814
Filter Plant and Loadout Fa	18	3.8	138	50,195

* *Resolution*

Unpaved Roads - Equation & Constants*

$E = k \times (s / 12)^a \times (W / 3)^b \times (365 - P) / 365$

	Empirical Constants for Industrial Roads			
	Constan	**PM**	**PM_{10}**	**$PM_{2.5}$**
k, a, b - empirical constants	k	4.9	1.5	0.15
s - surface material silt content %	a	0.7	0.9	0.9
W - mean vehicle wt ton	b	0.45	0.45	0.45

* *AP-42, 13.2.2, Equation 1a & 2, Table 13.2.2-2, Unpaved Roads, Rev. 11/06*

EMISSION FACTORS

		Silt	Vehicle Weight	PM	PM_{10}	$PM_{2.5}$
Location	**Paved/Unpaved**	**%***	***ton****	*lb/VMT*	*lb/VMT*	*lb/VMT*
East Plant	Paved***	SL: 0.6	2.0	1.4E-2	2.8E-3	6.9E-4
West Plant	Paved***	SL: 0.6	2.0	1.4E-2	2.8E-3	6.9E-4
Tailings Storage Facility	Unpaved	3.0	2.0	1.5	0.36	3.6E-2
Filter Plant and Loadout Fa	Unpaved	2.0	2.0	1.2	0.25	2.5E-2

* *AP-42, Chapter 13.2.2 and 13.2.1 (SL in g/m*

** *Estimate*

*** *AP-42, Chapter 13.2.1*

CONTROLLED EMISSIONS

	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Location	*lb/hr*	*lb/hr*	*lb/hr*	*ton/yr*	*ton/yr*	*ton/yr*
East Plant	7.4E-2	1.5E-2	3.6E-3	3.1	0.62	0.15
West Plant	8.9E-3	1.8E-3	4.4E-4	0.37	7.5E-2	1.8E-2
Tailings Storage Facility	4.0	0.93	9.3E-2	14.0	3.3	0.33
Filter Plant and Loadout Facility	0.67	0.14	1.4E-2	2.5	0.53	5.3E-2

UNCONTROLLED EMISSIONS

	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Location	*lb/hr*	*lb/hr*	*lb/hr*	*ton/yr*	*ton/yr*	*ton/yr*
East Plant	0.74	0.15	3.6E-2	3.1	0.62	0.15
West Plant	8.9E-2	1.8E-2	4.4E-3	0.37	7.5E-2	1.8E-2
Tailings Storage Facility	40.0	9.3	0.93	140	32.5	3.3
Filter Plant and Loadout Facility	6.7	1.4	0.14	24.7	5.3	0.53

Conversions & Assumptions	
365	*days of operation/yr*
2,000	*lb/ton*
24	*hr/day*
90%	*Control (Chemical Suppressant)*

	Days of >0.01" Precip	
EP	64	*EPS Precip Data (days >0.01'')*
West Plant	58	*WPS Precip Data (days >0.01'')*
TSF	57	*TSF Precip Data (days >0.01'')*
FPLF	57	*TSF Precip Data (days >0.01'')*

Blue values are input; black values are calculated or linked.

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI		BY: D. Steen	
	PROJECT NO: 262	PAGE: 3	OF: 3	SHEET: Employees
AIR EMISSION CALCULATIONS	SUBJECT: Employee Fugitives		DATE: January 11, 2019	

Combustion Emissions from Employee Commuting

		PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	VOC
Location	*VMT/day*	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*
East Plant	1,262	1.1E-2	1.1E-2	2.0E-3	2.1E-2	1.1E-3	0.45	4.9E-3
West Plant	153	1.4E-3	1.4E-3	2.5E-4	2.5E-3	1.3E-4	5.4E-2	5.9E-4
Tailings Storage Facility	621	5.6E-3	5.6E-3	1.0E-3	1.0E-2	5.5E-4	0.22	2.4E-3
Filter Plant and Loadout Facility	138	1.3E-3	1.3E-3	2.2E-4	2.3E-3	1.2E-4	4.9E-2	5.3E-4

		PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	VOC
Location	*VMT/yr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*
East Plant	460,484	5.0E-2	5.0E-2	8.9E-3	9.2E-2	4.9E-3	2.0	2.1E-2
West Plant	55,714	6.1E-3	6.1E-3	1.1E-3	1.1E-2	5.9E-4	0.24	2.6E-3
Tailings Storage Facility	214,814	2.3E-2	2.3E-2	4.2E-3	4.3E-2	2.3E-3	0.92	1.0E-2
Filter Plant and Loadout Facility	50,195	5.5E-3	5.5E-3	9.7E-4	1.0E-2	5.3E-4	0.21	2.3E-3

	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	VOC
Emission Factor*	*g/VMT*	*g/VMT*	*g/VMT*	*g/VMT*	*g/VMT*	*g/VMT*	*g/VMT*
	9.9E-2	9.9E-2	1.8E-2	0.18	9.6E-3	3.9	4.2E-2

* *MOVES 20*

Conversions & Assumptions	
453.592	*g/lb*
2,000	*lb/ton*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple	
	PROJECT NO: 262	PAGE: 1	OF: 3	SHEET: Deliveries
AIR EMISSION CALCULATIONS	SUBJECT: Delivery Fugitives		DATE: January 11, 2019	

Summary of Material and Equipment Deliveries

CONTROLLED EMISSIONS (SHORT-TERM)

	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	VOC
Location	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*
East Plant	0.3	9.6E-2	2.5E-2	0.1	4.0E-4	4.3E-2	9.6E-3
West Plant	0.8	0.2	5.9E-2	0.3	9.4E-4	0.1	2.3E-2
Tailings Storage Facility*							
Filter Plant and Loadout Facility*							

* *Regular deliveries not scheduled for production phase.*

CONTROLLED EMISSIONS (LONG-TERM)

	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	VOC
Location	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*
East Plant	2.4	0.5	0.1	9.9E-2	3.1E-4	3.3E-2	7.4E-3
West Plant	2.3	0.5	0.1	9.5E-2	3.0E-4	3.2E-2	7.2E-3
Tailings Storage Facility*							
Filter Plant and Loadout Facility*							

* *Regular deliveries not scheduled for production phase.*

UNCONTROLLED EMISSIONS (SHORT-TERM)

	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	VOC
Location	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*
East Plant	3.2	0.7	0.2	0.1	4.0E-4	4.3E-2	9.6E-3
West Plant	7.6	1.6	0.4	0.3	9.4E-4	0.1	2.3E-2
Tailings Storage Facility*							
Filter Plant and Loadout Facility*							

* *Regular deliveries not scheduled for production phase.*

UNCONTROLLED EMISSIONS (LONG-TERM)

	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	VOC
Location	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*
East Plant	2.4	0.5	0.1	9.9E-2	3.1E-4	3.3E-2	7.4E-3
West Plant	2.3	0.5	0.1	9.5E-2	3.0E-4	3.2E-2	7.2E-3
Tailings Storage Facility*							
Filter Plant and Loadout Facility*							

* *Regular deliveries not scheduled for production phase.*

Fugitive Dust from Material and Equipment Deliveries

Deliveries by Location	*trips/yr*	*trips/day*	*trips/hr*	*one way VMT, ea***	*VMT/yr*	*VMT/hr*
East Plant	6,166	20	4	1.9	23,431	15
West Plant	6,935	19	11	1.6	22,608	36
Tailings Storage Facility*	0	0		5.4	0	0
Filter Plant and Loadout Facility*	0	0		1.3	0	0

* *Regular deliveries not scheduled for production phase.*
** *Resolution*

Unpaved Roads - Equation & Constants*

$E = k \times (s / 12)^a \times (W / 3)^b \times (365 - P) / 365$

Empirical Constants for Industrial Roads

	Constant	PM	PM_{10}	$PM_{2.5}$
k, a, b - empirical constants	k	4.9	1.5	0.15
s - surface material silt content %	a	0.7	0.9	0.9
W - mean vehicle wt ton	b	0.45	0.45	0.45

* *AP-42, 13.2.2, Equations 1a & 2, Table 13.2.2-2, Unpaved Roads, Rev. 11/06*

EMISSION FACTORS

Location	Paved/Unpaved	Silt %*	Vehicle Weight ton**	PM lb/VMT	PM_{10} lb/VMT	$PM_{2.5}$ lb/VMT
East Plant	Paved***	SL: 0.6	28.3	0.21	4.2E-2	1.0E-2
West Plant	Paved***	SL: 0.6	28.3	0.21	4.2E-2	1.0E-2
Tailings Storage Facility	Unpaved	3.0	28.3	5.1	1.2	0.12
Filter Plant and Loadout Facility	Unpaved	2.0	28.3	3.8	0.82	8.2E-2

* *AP-42, Chapter 13.2.2 and 13.2.1 (SL in g/m^2)*
** *Representative 18-Wheeler Weight (16.5 ton) and 40-ton Highway Limit*
*** *AP-42, Chapter 13.2.1*

CONTROLLED EMISSIONS

Location	PM lb/hr	PM_{10} lb/hr	$PM_{2.5}$ lb/hr	PM ton/yr	PM_{10} ton/yr	$PM_{2.5}$ ton/yr
East Plant	0.32	6.3E-2	1.6E-2	2.3	0.47	0.11
West Plant	0.75	0.15	3.7E-2	2.3	0.45	0.11
Tailings Storage Facility*						
Filter Plant and Loadout Facility*						

* *Regular deliveries not scheduled for production phase.*

UNCONTROLLED EMISSIONS

Location	PM lb/hr	PM_{10} lb/hr	$PM_{2.5}$ lb/hr	PM ton/yr	PM_{10} ton/yr	$PM_{2.5}$ ton/yr
East Plant	3.2	0.63	0.16	2.3	0.47	0.11
West Plant	7.5	1.5	0.37	2.3	0.45	0.11
Tailings Storage Facility*						
Filter Plant and Loadout Facility*						

* *Regular deliveries not scheduled for production phase.*

Conversions & Assumptions

453.592	*g/lb*
2,000	*lb/ton*
24	*hr/day*
90%	*Control (Chemical Suppressant)*

Days of >0.01" Precip		
EP	64	*EPS Precip Data (days >0.01'')*
WP	58	*WPS Precip Data (days >0.01'')*
TSF	57	*TSF Precip Data (days >0.01'')*
FPLF	57	*TSF Precip Data (days >0.01'')*

Blue values are input; black values are calculated or linked.

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple	
	PROJECT NO: 262	PAGE: 3	OF: 3	SHEET: Deliveries
AIR EMISSION CALCULATIONS	SUBJECT: Delivery Fugitives		DATE: January 11, 2019	

Combustion Emissions from Deliveries

Location	VMT/hr	PM lb/hr	PM_{10} lb/hr	$PM_{2.5}$ lb/hr	NO_X lb/hr	SO_2 lb/hr	CO lb/hr	VOC lb/hr
East Plant	15	3.2E-2	3.2E-2	9.3E-3	0.1	4.0E-4	4.3E-2	9.6E-3
West Plant	36	7.7E-2	7.7E-2	2.2E-2	0.3	9.4E-4	0.1	2.3E-2
Tailings Storage Facility*	0							
Filter Plant and Loadout Facility*	0							

* *Regular deliveries not scheduled for production phase.*

Location	VMT/yr	PM ton/yr	PM_{10} ton/yr	$PM_{2.5}$ ton/yr	NO_X ton/yr	SO_2 ton/yr	CO ton/yr	VOC ton/yr
East Plant	23,431	2.5E-2	2.5E-2	7.1E-3	9.9E-2	3.1E-4	3.3E-2	7.4E-3
West Plant	22,608	2.4E-2	2.4E-2	6.9E-3	9.5E-2	3.0E-4	3.2E-2	7.2E-3
Tailings Storage Facility*	0							
Filter Plant and Loadout Facility*	0							

* *Regular deliveries not scheduled for production phase.*

Combustion Emission Factor*	PM g/VMT	PM_{10} g/VMT	$PM_{2.5}$ g/VMT	NO_X g/VMT	SO_2 g/VMT	CO g/VMT	VOC g/VMT
	1.0	1.0	0.3	3.8	1.2E-2	1.3	0.3

* *MOVES 2014a*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: D. Steen		
	PROJECT NO: 262	PAGE: 1	OF: 2	SHEET: RailRoad
AIR EMISSION CALCULATIONS	SUBJECT: Rail Line Combustion	DATE: July 27, 2018		

Locomotives

2,000	hp	Locomotive engine capacity (estimated)	
2		locomotives per trip	

Rail distance

20.9	mi	one-way	WPS to Far West (Onsite)
6.7	mi	one-way	Far West to MJ (Offsite)

Train Speed

10	mph	max	North of Rte 60
25	mph	max	South of Rte. 60
6.67	mph	average	North of Rte 60
16.67	mph	average	South of Rte. 60

2.4	hours	average	time from WPS to Far West
0.4	hours	average	time from Far West to Magma Junction

locomotive assumptions

Tier 4	engine rated emission
average	speed based on terrain

Alt2	Activity Scenario (Alternative)

Annual assumptions

Hauling (loaded)

2	locomotive operating	
100%	engine load	
0.4	hrs/day	(Offsite)
2.4	hrs/day	(Onsite)

Hauling (empty)

1	locomotive operating	
100%	engine load	
0.4	hrs/day	(Offsite)
2.4	hrs/day	(Onsite)

loading (idling)

1	locomotive operating	
15%	engine load	
17.3	hrs/day	

Emission Factors

	PM *g/bhp-hr*	NOX *g/bhp-hr*	CO *g/bhp-hr*	VOC *g/bhp-hr*	
2005-2011	0.1	5.5	1.5	0.3	Tier 2
2012-2014	0.1	5.5	1.5	0.3	Tier 3
2015+	0.03	1.3	1.5	0.14	Tier 4

TABLE 1 TO §1033.101 – LINE-HAUL LOCOMOTIVE EMISSION STANDARDS

dist (mi)	dist (m)	
13.25	21,329	WPS to hwy 60
7.63	12,287	hwy 60 to FPLF
6.74	10,850	FPLF to MJ

Uncontrolled annual emissions

	PM *(ton/yr)*	PM10 *(ton/yr)*	PM2.5 *(ton/yr)*	NOX *(ton/yr)*	CO *(ton/yr)*	VOC *(ton/yr)*	SO2 *(ton/yr)*
loading	0.05	0.05	0.05	2.23	2.57	0.24	0.01
Offsite	0.02	0.02	0.02	1.04	1.20	0.11	0.00
Onsite	0.15	0.15	0.15	6.31	7.28	0.68	0.02
TOTAL	0.22	0.22	0.22	9.58	11.06	1.03	0.04

Uncontrolled hourly emissions

	PM *(lb/hr)*	PM10 *(lb/hr)*	PM2.5 *(lb/hr)*	NOX *(lb/hr)*	CO *(lb/hr)*	VOC *(lb/hr)*	SO2 *(lb/hr)*	
loading	0.020	0.020	0.020	0.860	0.992	0.093	0.002	
Offsite	0.107	0.107	0.107	4.637	5.351	0.499	0.000	max hourly scaled to max time on off-site track
Onsite	0.265	0.265	0.265	11.464	13.228	1.235	0.005	
TOTAL	0.391	0.391	0.391	16.961	19.570	1.827	0.008	

Conversions			
1,609	m/mi	365	days/yr
3.28084	ft/m	24	hr/day
2,000	lb/ton	3,600	s/h
453.592	g/lb	8,760	hr/yr

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: D. Steen
	PROJECT NO: 262	PAGE: 2 OF: 2 SHEET: RailRoad
AIR EMISSION CALCULATIONS	SUBJECT: Rail Line Combustion	DATE: July 27, 2018

assumptions

	100	cars per train	*GPO*
	15	ppm S (ULSD)	
trips	1	RT/day	*GPO*

Loadout from FP&LF

456	ton/hour	*GPO*
3,300,000	ton/year	*GPO*
300	opeating days per year	*GPO*

110	ton/car	
17.3	hours	loading time/ day

0.0048 g/hp-hr SO2 = 15 parts S / 1,000,000 | 7.05 lb / gal diesel | 64.06 SO2 / 32.07 S | gal diesel / 0.14 MMBtu | 0.007 MMBtu / hp-hr | 453.592 g / lb

					train W			
16	ft	locomotive height	4.9	m				
50	ft	typical RR ROW	7	m	rail bed	3	m	one way guidance (RoadW-VW+6m)

	UTM1_E (m)	UTM1_N (m)	Elev1 (m)	UTM2_E (m)	UTM2_N (m)	Elev2 (m)	distance (m)	Elev (m)	% total %	width m	SigZ init (m)
Rail line hauling concentrate offsite (Far West to Magma Junction)											
RR_Offsite	453,418	3,666,075	463	462,062	3,672,632	511	10,850	487	40.4%	10.0	3.86
Rail line to onsite tailings facility (WPS to Far West) - Alt4 Only											
RR_Onsite1	462,062	3,672,632	511	472,780	3,680,551	616	13,326	563	42.1%	10	3.86
RR_Onsite2	472,780	3,680,551	616	473,827	3,681,797	634	1,628	625	5.1%	10	3.86
RR_Onsite3	473,827	3,681,797	634	475,468	3,682,792	659	1,919	646	6.1%	10	3.86
RR_Onsite4	475,468	3,682,792	659	475,817	3,683,276	668	597	663	1.9%	10	3.86
RR_Onsite5	475,817	3,683,276	668	476,357	3,683,229	671	542	670	1.7%	10	3.86
RR_Onsite6	476,357	3,683,229	671	476,388	3,683,695	670	467	671	1.5%	10	3.86
RR_Onsite7	476,388	3,683,695	670	478,018	3,685,033	674	2,109	672	6.7%	10	3.86
RR_Onsite8	478,018	3,685,033	674	480,183	3,684,192	680	2,322	677	7.3%	10	3.86
RR_Onsite9	480,183	3,684,192	680	481,147	3,684,158	690	965	685	3.0%	10	3.86
RR_Onsite10	481,147	3,684,158	690	481,638	3,683,430	710	879	700	2.8%	10	3.86
RR_Onsite11	481,638	3,683,430	710	482,998	3,683,091	720	1,401	715	4.4%	10	3.86
RR_Onsite12	482,998	3,683,091	720	483,522	3,682,631	726	697	723	2.2%	10	3.86
RR_Onsite13	483,522	3,682,631	726	484,294	3,682,996	739	855	732	2.7%	10	3.86
RR_Onsite14	484,294	3,682,996	739	487,104	3,682,964	793	2,810	766	8.9%	10	3.86
RR_Onsite15	487,104	3,682,964	793	488,221	3,683,276	816	1,159	804	3.7%	10	3.86

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
	PROJECT NO: 262	PAGE: 1	OF: 1	SHEET: Fuel Tanks
AIR EMISSION CALCULATIONS	SUBJECT: Diesel Fuel Storage	DATE: January 11, 2019		

Diesel Storage Tanks

		EP Surface	EP UG[a]	WP	Loadout	Tailings
Per Tank Fuel Usage[b]	*gal/hr*	12	156	64	30	131
Per Tank Fuel Usage[b]	*gal/mo*	1,885	22,151	12,365	11,581	64,739
Per Tank Fuel Usage[b]	*gal/yr*	22,621	265,817	148,377	138,966	776,866
Total Fuel Usage[b]	*gal/hr*	12	937	318	119	1,568
Total Fuel Usage[b]	*gal/mo*	1,885	132,909	61,824	46,322	776,866
Total Fuel Usage[b]	*gal/yr*	22,621	1,594,904	741,883	555,866	9,322,392
Fuel Tank Quantity		1	6	5	4	12
Fuel Tank Volume	*gal*	5,000	20,000	10,000	10,000	20,000
Fills Per Tank, Per Year		5	14	15	14	39
Diameter	*ft*	8	13	8	12	12
Length	*ft*	13	20	27	12	24
Orientation		Horizontal	Horizontal	Horizontal	Horizontal	Horizontal
Tank Contents		Diesel	Diesel	Diesel	Diesel	Diesel
Location		Superior, Arizona				
Per Tank VOC Emissions	*lb/hr*	3.3E-4	8.0E-4	7.9E-4	7.7E-4	2.5E-3
Per Tank VOC Emissions	*lb/yr*	2.87	7.03	6.94	6.72	22.31
Per Tank VOC Emissions	*ton/yr*	1.4E-3	3.5E-3	3.5E-3	3.4E-3	1.1E-2
Total VOC Emissions	*lb/hr*	3.3E-4	4.8E-3	4.0E-3	3.1E-3	3.1E-2
Total VOC Emissions	*ton/yr*	1.4E-3	2.1E-2	1.7E-2	1.3E-2	0.13

[a] *Resolution 6562 (2,000 m)*
[b] *Including 15% contingency*

Conversions	
7.48052	*ft³/gal*
2,000	*lb/ton*
8,760	*hr/yr*
12	*mo/yr*

Blue values are input; black values are calculated or linked.

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI			BY: N. Tipple
	PROJECT NO: 262	PAGE: 1	OF: 1	SHEET: Flow
AIR EMISSION CALCULATIONS	SUBJECT: Flow Calculations (EPA Method 19)			DATE: January 11, 2019

Stockpile Reclaim Dust Collectors *(Donaldson Torit DFO 4-32)*

Linear Interpolation (Barometric Pressure Based on Elevation)

Elevation	Pressure	Pressure	
ft	*kPa*	*atm*	
2,500*	92.5*	0.91	
2,888**	91.2	0.90	*West Plant Elevation/Pressure*
3,000*	90.8*	0.90	

* *www.engineeringtoolbox.com/air-altitude-pressure-d_462.html*
** *Google Earth*

71.20	F (WP Met Data; 2015-2016)
0.90	atm
68.0	F, standard temp.
18,950	acfm*
16,950	scfm
1,017,014	

* Resolution

Underground Reclaim Dust Collectors

Linear Interpolation (Pressure Based on Elevation)

Elevation	*Pressure*	*Pressure*	
ft	kPa	atm	
-2,000*	109*	1.08	
-2,386	110.5	1.09	Mine Elevation/Pres
-2,500*	111*	1.10	

* www.engineeringtoolbox.com/air-altitude-pressure-d_462.html

Elevation Calculation

4,176	ft AMSL	EP Elevation*
6,562	ft	Mine Depth**
-2,386	ft AMSL	Mine Elevation

* *Google Earth*
** Resolution

40.0	*°C*	Resolution
1.09	*atm*	UG BP
68	*F, standard temp.*	
22,500	*a m³/hr*	Resolution
794,581	*acfh*	for crushers
915,420	*scfh*	
5,100	*a m³/hr*	Resolution
180,105	*acfh*	for conveyor transfer
207,495	*scfh*	
22,500	*a m³/hr*	Resolution
794,581	*acfh*	for silos
915,420	*scfh*	
17,000	*a m³/hr*	Resolution
600,350	*acfh*	for skip loading
691,651	*scfh*	
17,000	*a m³/hr*	Resolution
600,350	*acfh*	for bin unloading
691,651	*scfh*	

Conversions

101.3	*kPa/atm*
60	min/hr
35.31	ft^3/m^3

Blue values are input; black values are calculated or linked.

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI	BY: N. Tipple		
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AIR EMISSION CALCULATIONS	SUBJECT: Hazardous Air Pollutants	DATE: January 11, 2019		

Hazardous Air Pollutants Emissions Summary

CAS No.	Pollutant	ULSD Engines *ton/yr*	Process & Fug. Dust *ton/yr*	Reagents *ton/yr*	Diesel Tanks *ton/yr*	Propane Combustion *ton/yr*	Total *ton/yr*	POM
106990	1,3-Butadiene	4.0E-2					**4.0E-2**	
83329	Acenaphthene	2.1E-3					**2.1E-3**	POM
208968	Acenaphthylene	6.5E-3					**6.5E-3**	POM
75070	Acetaldehyde	7.9E-1					**7.9E-1**	
107028	Acrolein	9.6E-2					**9.6E-2**	
120127	Anthracene	2.1E-3					**2.1E-3**	POM
7440382	Arsenic	4.7E-3	5.3E-3			9.4E-8	**9.9E-3**	
56553	Benzo(a)anthracene	1.8E-3					**1.8E-3**	POM
71432	Benzene	1.1E+0			1.5E-6	9.9E-7	**1.1E+0**	
50328	Benzo(a)pyrene	2.3E-4					**2.3E-4**	POM
205992	Benzo(b)fluoranthene	2.6E-4					**2.6E-4**	POM
191242	Benzo(g,h,l)perylene	5.8E-4					**5.8E-4**	POM
207089	Benzo(k)fluoranthene	1.9E-4					**1.9E-4**	POM
7440417	Beryllium	3.5E-3	3.1E-4			5.7E-9	**3.8E-3**	
92524	Biphenyl				1.9E-4		**1.9E-4**	POM
7440439	Cadmium	3.5E-3	2.3E-4			5.2E-7	**3.7E-3**	
7440473	Chromium	3.5E-3	3.4E-2			6.6E-7	**3.8E-2**	
218019	Chrysene	5.8E-4					**5.8E-4**	POM
7440484	Cobalt		3.4E-3			4.0E-8	**3.4E-3**	
53703	Dibenzo(a,h)anthracene	6.5E-4					**6.5E-4**	POM
100414	Ethylbenzene				2.4E-5		**2.4E-5**	
206440	Fluoranthene	8.4E-3					**8.4E-3**	POM
86737	Fluorene	3.2E-2					**3.2E-2**	POM
50000	Formaldehyde	1.2E+0				3.5E-5	**1.2E+0**	
110543	Hexane				1.9E-3	8.5E-4	**2.7E-3**	
193395	Indeno(1,2,3-c,d)pyrene	4.4E-4					**4.4E-4**	POM
7439921	Lead	1.1E-2	1.3E-2				**2.3E-2**	
7439965	Manganese	7.0E-3	2.6E-2			1.8E-7	**3.3E-2**	
7439976	Mercury	3.5E-3	6.7E-5			1.2E-7	**3.6E-3**	
91203	Naphthalene	1.1E-1			1.0E-3	2.9E-7	**1.1E-1**	POM
7440020	Nickel	3.5E-3	4.3E-3			9.9E-7	**7.8E-3**	
85018	Phenanthrene	3.6E-2			2.3E-4		**3.6E-2**	POM
108952	Phenol				1.2E-4		**1.2E-4**	
129000	Pyrene	5.4E-3					**5.4E-3**	POM
7782492	Selenium	1.8E-2	1.2E-3			1.1E-8	**1.9E-2**	
100425	Styrene				6.0E-5		**6.0E-5**	
108883	Toluene	4.6E-1			6.0E-5	1.6E-6	**4.6E-1**	
1330207	Xylene	3.2E-1					**3.2E-1**	
95636	1,2,4-trimethylbenzene							
7783064	Hydrogen sulfide			2.6E-2			**2.6E-2**	
106445	p-Cresol			2.5E-5			**2.5E-5**	
79061	Acrylamide			1.5E-2			**1.5E-2**	
106467	Dichlorobenzene					5.7E-7	**5.7E-7**	
7440360	Antimony		1.3E-4				**1.3E-4**	
POM	POM (aggregated)					4.2E-8	**4.2E-8**	POM
POM	*Polycylic Organic Matter Subtotal*	*2.0E-1*	*0.0E+0*	*0.0E+0*	*1.5E-3*	*3.3E-7*	*2.0E-1*	
HAPs	All HAPs	4.2E+0	8.7E-2	4.1E-2	3.6E-3	8.9E-4	4.4E+0	

Conversions

137,000	*Btu/gal*	*AP-42, Appendix A, Diesel, Rev. 9/85*
1,000,000	*Btu/MMBtu*	
2,000	*lb/ton*	

Blue values are input; black values are calculated or linked

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI			BY: N. Tipple
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AIR EMISSION CALCULATIONS	SUBJECT: Hazardous Air Pollutants	DATE: January 11, 2019		

HAPs Emissions for ULSD Engines (Small & Large)

			Small ULSD Engines* 2,044,591 MMBtu/yr***		Large ULSD Engines** 290,124 MMBtu/yr***	
CAS No.	**Pollutant**	**POM**	*lb/MMBtu*	*ton/yr*	*lb/MMBtu*	*ton/yr*
106990	1,3-Butadiene		3.9E-5	4.0E-2		
83329	Acenaphthene	POM	1.4E-6	1.5E-3	4.7E-6	6.8E-4
208968	Acenaphthylene	POM	5.1E-6	5.2E-3	9.2E-6	1.3E-3
75070	Acetaldehyde		7.7E-4	7.8E-1	2.5E-5	3.7E-3
107028	Acrolein		9.3E-5	9.5E-2	7.9E-6	1.1E-3
120127	Anthracene	POM	1.9E-6	1.9E-3	1.2E-6	1.8E-4
56553	Benzo(a)anthracene	POM	1.7E-6	1.7E-3	6.2E-7	9.0E-5
71432	Benzene		9.3E-4	9.5E-1	7.8E-4	1.1E-1
50328	Benzo(a)pyrene	POM	1.9E-7	1.9E-4	2.6E-7	3.7E-5
205992	Benzo(b)fluoranthene	POM	9.9E-8	1.0E-4	1.1E-6	1.6E-4
191242	Benzo(g,h,l)perylene	POM	4.9E-7	5.0E-4	5.6E-7	8.1E-5
207089	Benzo(k)fluoranthene	POM	1.6E-7	1.6E-4	2.2E-7	3.2E-5
218019	Chrysene	POM	3.5E-7	3.6E-4	1.5E-6	2.2E-4
53703	Dibenzo(a,h)anthracene	POM	5.8E-7	6.0E-4	3.5E-7	5.0E-5
206440	Fluoranthene	POM	7.6E-6	7.8E-3	4.0E-6	5.8E-4
86737	Fluorene	POM	2.9E-5	3.0E-2	1.3E-5	1.9E-3
50000	Formaldehyde		1.2E-3	1.2E+0	7.9E-5	1.1E-2
193395	Indeno(1,2,3-c,d)pyrene	POM	3.8E-7	3.8E-4	4.1E-7	6.0E-5
91203	Naphthalene	POM	8.5E-5	8.7E-2	1.3E-4	1.9E-2
85018	Phenanthrene	POM	2.9E-5	3.0E-2	4.1E-5	5.9E-3
129000	Pyrene	POM	4.8E-6	4.9E-3	3.7E-6	5.4E-4
108883	Toluene		4.1E-4	4.2E-1	2.8E-4	4.1E-2
1330207	Xylene		2.9E-4	2.9E-1	1.9E-4	2.8E-2
POM	*Polycylic Organic Matter Subtotal*			*1.72E-01*		*3.07E-02*
HAPs	**All HAPs**			**3.96E+00**		**2.28E-01**

* *AP-42, Table 3.3-2, Rev. 10/96, diesel engines (≤ 600 hp)*

** *AP-42, Tables 3.4-3 & 3.4-4, Rev. 10/96, large diesel engines (> 600 hp)*

*** *Calculated using a 15% fuel contingency*

Diesel Combustion Metal Emissions

CAS No.	**Pollutant**	**HAP**	*lb/10^{12} Btu**	*lb/MMBtu*	*ton/yr*
7440382	Arsenic	HAP	4	4.0E-6	4.7E-3
7440417	Beryllium	HAP	3	3.0E-6	3.5E-3
7440439	Cadmium	HAP	3	3.0E-6	3.5E-3
7440473	Chromium	HAP	3	3.0E-6	3.5E-3
	Copper		6	6.0E-6	7.0E-3
7439921	Lead	HAP	9	9.0E-6	1.1E-2
7439976	Mercury	HAP	3	3.0E-6	3.5E-3
7439965	Manganese	HAP	6	6.0E-6	7.0E-3
7440020	Nickel	HAP	3	3.0E-6	3.5E-3
7782492	Selenium	HAP	15	1.5E-5	1.8E-2
	Zinc		4	4.0E-6	4.7E-3
Total Diesel Combustion Metal Emissions					**6.9E-2**

* *AP-42, Table 1.3-10, Rev. 5/10*

HAPs Emissions for Propane Combustion

Propane Sources

Source	Operation *hr/yr*	Throughput *MMBtu/hr*	Throughput *MMBtu/yr*
Hydro House Propane Heater (0.045 MMBtu/hr)	8,760	0.045	394.2
Hydro House Propane Heater (0.065 MMBtu/hr)	8,760	0.065	569.4
Total		**0.11**	**963.6**

Propane HAP & Metal Emissions

CAS No.	Pollutant	Emission Factor* *lb/MMScf*	Emission Factor* *lb/MMBtu***	Emissions *ton/yr*
71432	Benzene	2.1E-3	2.1E-6	9.9E-7
106467	Dichlorobenzene	1.2E-3	1.2E-6	5.7E-7
50000	Formaldehyde	7.5E-2	7.4E-5	3.5E-5
110543	Hexane	1.8E+0	1.8E-3	8.5E-4
91203	Naphthalene	6.1E-4	6.0E-7	2.9E-7
108883	Toluene	3.4E-3	3.3E-6	1.6E-6
POM	POM (aggregated)	8.8E-5	8.6E-8	4.2E-8
7440382	Arsenic	2.0E-4	2.0E-7	9.4E-8
7440417	Beryllium	1.2E-5	1.2E-8	5.7E-9
7440439	Cadmium	1.1E-3	1.1E-6	5.2E-7
7440473	Chromium	1.4E-3	1.4E-6	6.6E-7
7440484	Cobalt	8.4E-5	8.2E-8	4.0E-8
7439965	Manganese	3.8E-4	3.7E-7	1.8E-7
7439976	Mercury	2.6E-4	2.5E-7	1.2E-7
7440020	Nickel	2.1E-3	2.1E-6	9.9E-7
7782492	Selenium	2.4E-5	2.4E-8	1.1E-8
	Total HAPs			**8.9E-4**

**AP-42, Table 1.4-3 & 1.4-4 (7/98) Natural Gas Combustion*

***Natural Gas Higher Heating Value* 1,020 *Btu/scf*

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HAPs Emissions from Process & Fugitive Dust

Ore HAPs Concentrations & Emissions

CAS No.		Pollutant	Concentration* %	Emissions *ton/yr*
7440360	Sb	Antimony	0.0001%	1.3E-4
7440382	As	Arsenic	0.0044%	5.3E-3
7440417	Be	Beryllium	0.0003%	3.1E-4
7440439	Cd	Cadmium	0.0002%	2.3E-4
7440473	Cr	Chromium	0.0283%	3.4E-2
7440484	Co	Cobalt	0.0028%	3.4E-3
7439921	Pb	Lead	0.0104%	1.3E-2
7439965	Mn	Manganese	0.0213%	2.6E-2
7439976	Hg	Mercury	0.0001%	6.7E-5
7440020	Ni	Nickel	0.0036%	4.3E-3
7782492	Se	Selenium	0.0010%	1.2E-3

* *Resolution*

PM Emissions

	PM *ton/yr*
East Plant	19.8
West Plant	21.8
Loadout	0.0
Tailings	79.2
Total	**120.8**

HAPs Emissions from Reagent Handling & Storage

CAS No.	Pollutant	*lb/yr*	*ton/yr*	Source
7783064	Hydrogen sulfide*	51.4	2.6E-2	NaHS (Sodium hydrosulfide solution)
106445	p-Cresol*	0.05	2.5E-5	CYTEC 8989
79061	Acrylamide**		1.5E-2	Flocculent (CIBA Magnafloc 10 & 155)

* *Calculated using EPA Tanks 4.0.9d*

** *Assuming all PM emitted from material transfer is Acrylamide*

HAPs Emissions from Diesel Storage Tanks

CAS No.	Pollutant	Weight Percent*	Emissions *ton/yr*	POM
71432	Benzene	0.001%	1.5E-6	
92524	Biphenyl	0.100%	1.9E-4	POM
100414	Ethyl benzene	0.013%	2.4E-5	
110543	Hexane	1.000%	1.9E-3	
91203	Naphthalene	0.550%	1.0E-3	POM
108952	Phenol	0.064%	1.2E-4	
100425	Styrene	0.032%	6.0E-5	
108883	Toluene	0.032%	6.0E-5	
85018	Phenanthrene	0.125%	2.3E-4	POM
POM	*Polycylic Organic Matter Subtotal*	7.8E-3	1.5E-3	

* *Resolution*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper EI		BY: N. Tipple
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AIR EMISSION CALCULATIONS	SUBJECT: Direct Greenhouse Gases & CO_2e		DATE: January 11, 2019

DIRECT GREENHOUSE GAS & CO_2 EQUIVALENT CALCULATIONS - PRELIMINARY

GHG Emission Factors

Pollutant	Fuel	EF *kg/MMBtu*	Reference
CO_2	Propane	61.71	*40 CFR Part 98, Table C-1 to Subpart C (11/13) LPG*
CH_4	Propane	3.0E-3	*40 CFR Part 98, Table C-2 to Subpart C (11/13) Petroleum*
N_2O	Propane	6.0E-4	*40 CFR Part 98, Table C-2 to Subpart C (11/13) Petroleum*
CO_2	Diesel	73.96	*40 CFR Part 98, Table C-1 to Subpart C (11/13) Distillate Fuel Oil #2*
CH_4	Diesel	3.0E-3	*40 CFR Part 98, Table C-2 to Subpart C (11/13) Petroleum*
N_2O	Diesel	6.0E-4	*40 CFR Part 98, Table C-2 to Subpart C (11/13) Petroleum*

Propane Fuel Use & Direct GHG Emissions

Contributor	*MMBtu/hr*	*hr/yr*	*MMBtu/yr*	CO_2 *tonne/yr**	CH_4 *tonne/yr**	N_2O *tonne/yr**
Hydro House Heaters	0.11	8,760	964	59.5	2.9E-3	5.8E-4
Total			**964**	**59.5**	**2.9E-3**	**5.8E-4**

**metric tons per year*

Diesel Fuel Use & Direct GHG Emissions

Contributor	Diesel Cons. *gal/yr*	+15% *gal/yr*	*MMBtu/yr*	CO_2 *tonne/yr***	CH_4 *tonne/yr***	N_2O *tonne/yr***
East Plant Fleet	2,345,797	2,697,666	369,580	27,334	1.1	0.22
West Plant Fleet	741,883	853,166	116,884	8,645	0.35	7.0E-2
Loadout Fleet	555,866	639,246	87,577	6,477	0.26	5.3E-2
Tailings Fleet	9,322,392	10,720,751	1,468,743	108,628	4.4	0.88
East Plant Emergency Generators	1,643,748	1,890,310	258,973	19,154	0.78	0.16
Mil Emergency Generators	55,500	63,825	8,744	647	2.6E-2	5.2E-3
Tailings Emergency Generators	18,500	21,275	2,915	216	8.7E-3	1.7E-3
Filter Plant Emergency Generators	18,500	21,275	2,915	216	8.7E-3	1.7E-3
Railroad	116,693	134,197	18,385	1,360	5.5E-2	1.1E-2
Total	**14,818,879**	**17,041,711**	**2,334,714**	**172,675**	**7.0**	**1.4**

**Calculated by mass balance using a 15% fuel contingency*
***metric tons per year*

Direct CO_2e Emissions

Greenhouse Gas	Emissions *tonne/yr**	Global Warming Potential**	CO_2e *tonne/yr**
Carbon Dioxide (CO_2)	172,735	1	172,735
Methane (CH_4)	7.0	25	175
Nitrous Oxide (N_2O)	1.4	298	418
Total			**173,328**

direct emissions > 25,000 metric tons per year

** metric tons per year*
*** 40 CFR Part 98, Table A-1 to Subpart A (11/13) Chemical-Specific GWPs*

The revised draft guidance sets forth a reference point of 25,000 metric tons CO2-equivalent GHG emissions on an annual basis below which a quantitative analysis of GHG emissions is not recommended unless quantification is easily accomplished, in light of the availability of quantification tools and appropriate input data.

Conversions

1,000	*kg/metric ton*	
7,000	*MMBtu/hp-hr**	
137,000	*Btu/gal*	*AP42, Appendix A*
1,000,000	*Btu/MMBtu*	

** AP-42 Table 3.3-1, Footnote a & AP-42 Table 3.4-1, Footnote e*

Blue values contain input, *black values are calculated or linked*

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AIR EMISSION CALCULATIONS	SUBJECT: Underground Scrubbing	DATE: January 11, 2019		

Underground Control Summary - Control Efficiencies (MODELING ONLY)

Combined Underground Scrubbing Efficiency for Particulate Pollutants

	PM	PM_{10}	$PM_{2.5}$
Water Droplets in Shafts	30.7%	30.7%	4.5%
Heat Rejection Sprays	30.0%	30.0%	2.5%
Gravitational Settlement	60.4%	6.7%	0.4%
Effective Control	**80.8%**	**54.7%**	**7.2%**

Underground Control Summary - Emissions

Emissions for Particulate Pollutants (*lb/hr*)

	PM	PM_{10}	$PM_{2.5}$
Controlled UG Emissions	82.4	50.4	14.8
Vented to Atmosphere	15.8	22.8	13.8

Emissions for Particulate Pollutants (*ton/yr*)

	PM	PM_{10}	$PM_{2.5}$
Controlled UG Emissions	103.2	70.3	29.7
Vented to Atmosphere	19.8	31.8	27.5

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Exhaust Shaft Dust Scrubbing Efficiency for PM_{10} and $PM_{2.5}$

Water droplets in the shaft will remove at least:

90% Particulate matter greater than 10 µm*
40% Particulate matter between 4 and 10 µm*
10% Particulate matter less than 4 µm*
** Resolution (Moreby 2008)*

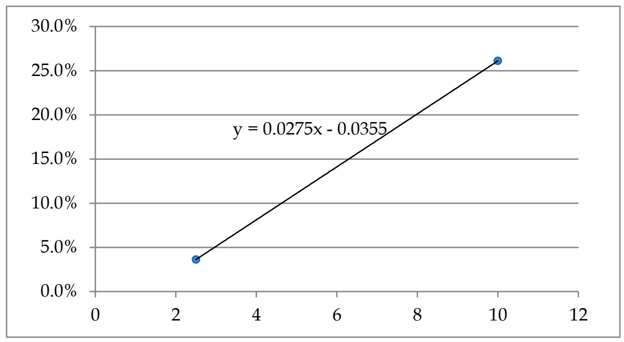
PM_4 Scrubbing Efficiency: 10%
PM_{10} Scrubbing Efficiency: Between 10% and 40%

To find PM_{10} scrubbing efficiency, solve for particulate distribution:

PM_{10} *lb/hr*	$PM_{2.5}$ *lb/hr*	PM *lb/hr*
110	15.3	422

** RESO EI 20140404.xlsx*

	Maximum particle size (µm)		
	2.5	10	30
Distribution:	3.6%	26.1%	100.0%



Fraction of particles with max size of 4 µm (x = 4) is 8.1%

PM_4/PM_{10} Ratio	31.1%
$PM_{2.5}/PM_4$ Ratio	44.6%

Exhaust Shaft Dust Scrubbing Efficiency	
PM_{10}	30.7%
$PM_{2.5}$	4.5%

Air Sciences Inc.	PROJECT TITLE: Resolution Copper	BY: N. Tipple		
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AIR EMISSION CALCULATIONS	SUBJECT: Underground Scrubbing	DATE: January 11, 2019		

Heat Rejection Sprays Scrubbing Efficiency for Particulate and Gaseous Pollutants

Pollutant	Scrubbing Efficiency*	Overall Efficiency**
$PM_{2.5}$	5.0%	2.5%
PM_7	45.0%	22.5%
PM_{10}	60.0%	30.0%

* *Resolution (Moreby 2008)*
** *Efficiency assuming* 50% *of air passes through heat rejection sprays*

Gravitational Settlement

Terminal Settling Velocity

$$\mu_t = \frac{d^2\, g\,(\rho_s - \rho_a)}{18\,\mu_a}$$

Stokes' Law

$$\eta = \frac{W_n L u_t}{Q_n}$$

Air Pollution Control Theory, p. 240

Where		Value	Unit	Reference
g =	gravitational constant	9.81	m/s^2	
ρ_s =	particle density (ore)	3,463	kg/m^3	*McPherson, Ch. 20*
ρ_a =	air density	1,000	kg/m^3	
μ_a =	air viscosity	1.8E-5	Ns/m^2	*McPherson, Ch. 20*
W_9 =	width of shaft 9	6.7	*m*	*Resolution*
W_{10} =	width of shaft 10	8.5	*m*	*Resolution*
W_{14} =	width of shaft 14	10	*m*	*Resolution*
L =	length of chamber	> 2,000	*m*	*Resolution*
Q_n =	chamber air flow rate	622	m^3/s	*Resolution*

Particle Size (d_p)			u_t	Efficiency, η (Settlement in Shafts)			
	μm	*m*	*m/s*	Shaft 9	Shaft 10	Shaft 14	Avg
$PM_{2.5}$	≤ 2.5	2.5E-6	4.66E-4	0.3%	0.4%	0.5%	0.4%
PM_{10}	≤ 10	1.0E-5	7.46E-3	5.4%	6.8%	8.0%	6.7%
PM	≤ 30	3.0E-5	6.71E-2	48.2%	61.1%	71.9%	60.4%

List of References

Value	Unit	Description	Location in EI	Reference
0.63	*m/s*	LHD/Ore Pass/Grizzly Wind Speed	Gen Info L26	EI Info Request, Resolution Copper
1.00	*m/s*	Rail Haulage Ore Flow Wind Speed	Gen Info L27	EI Info Request, Resolution Copper
1.79	*m/s*	Primary Crushing Ore Flow Wind Speed	Gen Info L28	EI Info Request, Resolution Copper
1.07	*m/s*	Lower Level Conveyor Ore Flow Wind Speed	Gen Info L29	EI Info Request, Resolution Copper
0.60	*m/s*	Hoisting System Ore Flow Wind Speed	Gen Info L30	EI Info Request, Resolution Copper
2.00	*m/s*	Upper Level Conveyor System Ore Flow Wind Speed	Gen Info L31	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, Pg. 25
4	%	UG Ore Moisture Content	Gen Info I26 - I31	General Plan of Operations, Section 4.4.4
96	%	Incline Conveyor to Mine Transfer Conveyor Solids Content	Gen Info G33	Mill Flowcharts (40000-FS-601 through 623)
95.8	%	Enclosed Stockpile Solids Content	Gen Info G34	Mill Flowcharts (40000-FS-601 through 623)
95.8	%	Stockpile Reclaim Solids Content	Gen Info G35	Mill Flowcharts (40000-FS-601 through 623)
4.8	%	Mill Moisture Content	Gen Info I36 - I39	Largest moisture content listed in AP-42, Ch. 13.2.4
4.8	%	Loadout Moisture Content	Gen Info I41	Largest moisture content listed in AP-42, Ch. 13.2.4
1.3	*mph*	Incline Conveyor to Mine Transfer Conveyor Wind Speed	Gen Info K33	Enclosure, Lowest wind speed listed in AP-42, Ch. 13.2.4
1.3	*mph*	General Enclosed Transfer Wind Speed	Gen Info K34 - K41	Enclosure, Lowest Wind Speed listed in AP-42, Ch. 13.2.4
8,940	*tonne/hr*	Coarse Ore Stockpile Throughput	Gen Info V17	Technical Memo: Process Plant Mass Balance Calculations for EI
143,750	*tonne/day*	Coarse Ore Stockpile Throughput	Gen Info V18	Technical Memo: Process Plant Mass Balance Calculations for EI
45,625,000	*tonne/yr*	Coarse Ore Stockpile Throughput	Gen Info V19	Technical Memo: Process Plant Mass Balance Calculations for EI
4,296	*tonne/hr*	Sag Mill Throughput	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
94,875	*tonne/day*	Sag Mill Throughput	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
30,112,500	*tonne/yr*	Sag Mill Throughput	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
10	*tonne/hr*	Moly Cake Throughput (WET)	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
238	*tonne/day*	Moly Cake Throughput (WET)	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
41,176	*tonne/yr*	Moly Cake Throughput (WET)	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
8.95	*tonne/hr*	Moly Cake Throughput (DRIED)	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
213	*tonne/day*	Moly Cake Throughput (DRIED)	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
36,842	*tonne/yr*	Moly Cake Throughput (DRIED)	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
multiple parameters		Batch Plant Info	BatchPlant	Tech Memo - Batch Plant Data
0.002	*grain/dscf*	Baghouse grain loading	East Plant_CALC, Column J	Manufacturer (Donaldson Torit) Specifications
0.0185	%	S in Propane	Mill_CALC B97	Standard: GPA 2140-97
0.002	*grain/dscf*	Baghouse grain loading	Mill_CALC, Column J	Manufacturer (Donaldson Torit) Specifications
0.045	*MMBtu/hr*	Hydro House Heater Rating	Mill_CALC BH75	EI Info Request, Resolution Copper
0.065	*MMBtu/hr*	Hydro House Heater Rating	Mill_CALC BH76	EI Info Request, Resolution Copper
10	*[quantity]*	Quantity of Cable Bolters	EP_Fleet K24	EI Info Request, Resolution Copper

List of References

Value	Unit	Description	Location in EI	Reference
multiple parameters		East Plant Equipment List	EP_Fleet	RCM Mine Data for Ari Modelling 2012.xlsx
4	*[tier]*	Minimum Engine Tier Rating	EP_Fleet, Column L	EI Info Request, Resolution Copper
15%	%	Fuel Contingency	Fleet & Egen SO2, Tank VOC, GHG, HAPs	mobile equipment estimate mpo for all alternatives.xlsx
multiple parameters		Vehicle Speeds	EP_Fleet, Column CA	EI Info Request, Resolution Copper Best Management Practices
3	%	Road Silt Content	EP_Fleet, Column CB	AP-42, Chapter 13.2.2, Related Information, r13s0202_dec03.xls
multiple parameters		Vehicle Weights	All Fleets	Meeting with C. Pascoe 5/7/14, Phone Meeting K. Ballard 5/14/14, Spec Sheets
90	%	Control of Unpaved Roads with Chemical Suppressant	Loadout Fleet	Chem_Suppressant_Memo_20150225.pdf
4	*[tier]*	Minimum Engine Tier Rating	Mill_Fleet, Column L	EI Info Request, Resolution Copper
multiple parameters		Miscellaneous Mill Fleet Updates/Edits (ratings, hours, etc.)	Mill_Fleet	EquipmentHREst1252013.xlsx, Updated based on feedback from K. Ballard and R. Heig 4/16/14.
multiple parameters		Vehicle Speeds	Mill_Fleet, Column CA	EI Info Request, Resolution Copper Best Management Practices
3	%	Road Silt Content	Mill_Fleet, Column CB	AP-42, Chapter 13.2.2, Related Information, r13s0202_dec03.xls
90	%	Control of Unpaved Roads	EP Fleet, Mill Fleet	Chem_Suppressant_Memo_20150225.pdf
4	*[tier]*	Minimum Engine Tier Rating	Loadout_Fleet, Column L	EI Info, Request, Resolution Copper
multiple parameters		Miscellaneous Mill Fleet Updates/Edits (ratings, hours, etc.)	Loadout_Fleet	Per RCM Mine Data for Ari Modelling 2012.xlsx, Updated based on feedback from K. Ballard and R. Heig 4/16/14.
4	*[tier]*	Minimum Engine Tier Rating	Tailings_Fleet, Column L	EI Info Request, Resolution Copper
multiple parameters		Miscellaneous Tailings Fleet Updates/Edits (ratings, hours, etc.)	Tailings_Fleet	Per mobile equipment estimate mpo.xlsx, and EquipmentHREst1252013.xlsx and phone call with K. Ballard 4/25/14., Updated based on feedback from K. Ballard and R. Heig 4/16/14
multiple parameters		Vehicle Speeds	Tailings_Fleet, Column CA	EI Info Request, Resolution Copper Best Management Practices
3	%	Road Silt Content	Tailings_Fleet, Column CB	AP-42, Chapter 13.2.2, Related Information, r13s0202_dec03.xls
90	%	Control of Unpaved Roads	Tailings Fleet	Chem_Suppressant_Memo_20150225.pdf
332	*[quantity]*	Number of Employees at East Plant	Employees E12	General Plan of Operations, Section 3.7.2
318	*[quantity]*	Number of Employees at Mill	Employees E13	General Plan of Operations, Section 3.7.2
17	*[quantity]*	Number of Employees at Loadout	Employees E14	General Plan of Operations, Section 3.7.2
18	*[quantity]*	Number of Employees at Tailings	Employees E15	General Plan of Operations, Section 3.7.2
3	%	Road Silt Content	Employees G32 - G35	AP-42, Chapter 13.2.2, Related Information, r13s0202_dec03.xls
2	*ton*	Average Vehicle Weight	Employees I32 - I35	Average Vehicle Weight in 2010, Time Magazine
90	%	Control of Unpaved Roads	Employees C62	AP-42, Figure 13.2.2-5, Rev. 11/06
14	*[quantity]*	East Plant Emergency Generator Quantity	E_Gen AN16	EI Info Request, Resolution Copper
500	*hr/yr*	East Plant Emergency Generator Hours of Operation	E_Gen W19, AN17, BE18, BV18, CM18	Email from K. Walch, 4/14/2014
6,562	*ft*	Depth of Mine	Fuel Tanks C30	2000 m, RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 9
4,200	*l/s*	Surface Cooling Tower Circulation Rate	Cooling G11	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, Section 8.3
0.005%	%	Drift Loss	Cooling G12, G16	Hatch. Condenser Cooling Tower Blowdown and Make-Up Water Requirement Review
1,250	*l/s*	UG Cooling Tower Circulation Rate	Cooling G15	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012; 2 towers @ 625 l/s, each
3,000	*ppm*	Total Dissolved Solids Content	Cooling G20	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, Section 11.2

List of References

Value	Unit	Description	Location in EI	Reference
		Reagent Tank Volumes	Reagents	Design Criteria 2013 08 6.pdf (pg 25-27)
487	*blasts/yr*	East Plant Number of Blasts	Drill & Blast AN12	Tech Memo: Underground Blasting Face Area for Emissions Calculation
2	*max blasts/day*	East Plant Number of Blasts	Drill & Blast AN13	Tech Memo: Underground Blasting Face Area for Emissions Calculation
580	*m^2 (max daily)*	East Plant Blast Area	Drill & Blast AN20	Tech Memo: Underground Blasting Face Area for Emissions Calculation
141,200	*m^2 (annual)*	East Plant Blast Area	Drill & Blast AN23	Tech Memo: Underground Blasting Face Area for Emissions Calculation
32.53	*lb/ton*	CO EF	Drill & Blast AN26, BE26	NIOSH - Fumes Studies - Richard Mainiero, Emulsion
6.2	*lb/ton*	NOX EF	Drill & Blast AN27, BE27	NIOSH - Fumes Studies - Richard Mainiero, Emulsion
40	°C	Underground Temp	Flow C47	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 12
6,562	*ft*	Depth of Mine	Flow I39	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 9
18,950	*acfm*	Stockpile Reclaim Dust Collector Flow	Flow C27	Email from Eric Pedersen (M3) 3/27/14
22,500	*a m^3/hr*	Crusher Dust Collector Flow	Flow C51	UG Flowsheet 0000
5,100	*a m^3/hr*	Conveyor Transfer Dust Collector Flow	Flow C55	UG Flowsheet 0000
22,500	*a m^3/hr*	Silos Dust Collector Flow	Flow C59	UG Flowsheet 0000
17,000	*a m^3/hr*	Skip Loading Dust Collector Flow	Flow C63	UG Flowsheet 0000
17,000	*a m^3/hr*	Bin Unloading Dust Collector Flow	Flow C67	UG Flowsheet 0000
64	*days/year*	EPS Precip Data (days >0.01")	Precip	2015-2016 Processed AERMET Precip Data (EP)
58	*days/year*	WPS Precip Data (days >0.01")	Precip	2015-2016 Processed AERMET Precip Data (WP)
57	*days/year*	TSF Precip Data (days >0.01")	Precip	2015-2016 Processed AERMET Precip Data (Hewitt)
57	*days/year*	TSF Precip Data (days >0.01")	Precip	2015-2016 Processed AERMET Precip Data (Hewitt)
21.3	*acre*	Exposed area at East Plant	WindblownDust B2	GIS Analysis with K. Ballard
279	*acre*	Exposed area at Subsidence Area	WindblownDust D15	RCML GTC 2017_09 GPO Estimated Areas of Caved Zones Based on Itasca July 2017 Report.pdf
70	*acre*	Exposed area at Mill	WindblownDust I2	GIS Analysis with K. Ballard
1,380	*acre*	Dry Beach	WindblownDust W5	180302R-Alt3A-TM-DustMgmt Rev B.pdf
59	*acre*	Dam Slope	WindblownDust W6	180302R-Alt3A-TM-DustMgmt Rev B.pdf
90	%	PM>10 Control (Water Droplet Scrubbing)	UG Control S12	RCM Exhaust Shaft Scrubbing Efficiency.pdf
40	%	PM4-10 Control (Water Droplet Scrubbing)	UG Control S13	RCM Exhaust Shaft Scrubbing Efficiency.pdf
10	%	PM<4 Control (Water Droplet Scrubbing)	UG Control S14	RCM Exhaust Shaft Scrubbing Efficiency.pdf
60	%	PM7 Control (Heat Rejection Sprays)	UG Control AN14	RCM Exhaust Shaft Scrubbing Efficiency.pdf
45	%	PM7 Control (Heat Rejection Sprays)	UG Control AN13	RCM Exhaust Shaft Scrubbing Efficiency.pdf
5	%	PM7 Control (Heat Rejection Sprays)	UG Control AN12	RCM Exhaust Shaft Scrubbing Efficiency.pdf
1.8E-5	*Ns/m^2*	Dynamic Viscosity of Air	UG Control AO45	The Aerodynamics, Sources, and Control of Airborne Dust Chapter 20.pdf
50	%	Air that Flows Through the Heat Rejection Sprays	UG Control AN16	RCM Exhaust Shaft Scrubbing Efficiency.pdf
6.7	*m*	width of shaft 9	UG Control AN46	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 9
8.5	*m*	width of shaft 10	UG Control AN47	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 9
10	*m*	width of shaft 14	UG Control AN48	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 9

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Value	Unit	Description	Location in EI	Reference
2,000	*m*	length of chamber	UG Control AN49	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 9
622	*m^3/s*	chamber air flowrate (all vents)	UG Control AN50	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, p. 49
multiple parameters		Concentration of HAPs/Metals in Ore	HAPs, Column BF	Average of 6 ore body samples (RES-009A, 017L, 017M, 023D, 025D, 002B).
multiple parameters		HAP emissions Weight Percent	HAPs, Column BF	Default data - EPCRA Section 313 Industry Guidance - Metal Mining Facilities, January 1999 (EPA 745-B-99-001), Table 3-8
multiple parameters		Ore Haul Trucks - Powertrans T954	EP_Fleet J45-N45	160T Powertrans Double RT Concept Underground.xlsx, units converted
multiple parameters		Average Distance Travelled, one way VMT, ea	Employees & Deliveries	GIS estimation with K. Ballard
2,628	*hp*	HP of Egen	E_Gen W11	Pinal County Air Quality, Permit Number B30993.0000
449	*hp*	HP of Egen	E_Gen W14	Pinal County Air Quality, Permit Number B30993.0000
4,376	*hp*	HP of Egens	E_Gen AN13	Caterpillar Standby 3100 kW Tier 4i Performance Data
multiple parameters		VOC Emission Calculations	Fuel Tanks G26 through K26	Calculated using by EPA Tanks 4.0.9d, 05/02/2014
135	*MW*	Cooling capacity	Cooling G13	RCM Pre-feasibility Refrigeration and Ventilation Study, 2012, Section 8.3
multiple parameters		MOVES Results (Deliveries & Employees)	Deliveries & Employees	MOVES 2014a
134.91	*lb/yr*	MIBC (Methyl isobutyl carbonal) - VOC Emissions	Reagents G13	MIBC (Methyl isobutyl carbonal) - EPA Tank 4.0.9d calculations
9.53	*lb/yr*	MCO (Non-polar flotation oil) - VOC Emissions	Reagents G14	MCO (Non-polar flotation oil) - EPA Tank 4.0.9d calculations
0.10	*lb/yr*	CYTEC 8989 - VOC Emissions	Reagents G15	CYTEC 8989 - EPA Tank 4.0.9d calculations
multiple parameters		Load Factors	All Fleets	Resolution, engine factor.xlsx
multiple parameters		West Plant and Filter Plant Mobile Equipment Specs	Mill_Fleet and Loadout_Fleet	West Plant & Filter Plant Mobile Eq.xlsx (R. Heig 2/16/13)
multiple parameters		West Plant, Filter Plant, Tailings Mobile Equipment Specs	Mill_Fleet Loadout_Fleet Tailings_Fleet	RCM Mine Data for Ari Modelling 2012.xlsx
1,500	*kW*	West Plant Egen demand	E_Gen Pg 4	9/30/2016, M3 Tech. Memo & CAT C18 Specs
500	*kW*	Filter Plant Egen demand	E_Gen Pg 6	9/30/2016, M3 Tech. Memo & CAT C18 Specs
500	*kW*	TSF Egen demand	E_Gen Pg 5	9/30/2016, M3 Tech. Memo & CAT C18 Specs
390	*blasts/yr*	West Plant Number of Blasts	Drill & Blast BE12	Tech Memo: Underground Blasting Face Area for Emissions Calculation
2	*max blasts/day*	West Plant Number of Blasts	Drill & Blast BE13	Tech Memo: Underground Blasting Face Area for Emissions Calculation
63	*m^2 (max daily)*	West Plant Blast Area	Drill & Blast BE20	Tech Memo: Underground Blasting Face Area for Emissions Calculation
14,400	*m^2 (annual)*	West Plant Blast Area	Drill & Blast BE23	Tech Memo: Underground Blasting Face Area for Emissions Calculation
164,300	*tonne/yr*	WP development rock drill and blast	Drill & Blast V21	Tech Memo: Underground Blasting Face Area for Emissions Calculation
1,414	*tonne/hr*	WP development rock drill and blast	Drill & Blast E22	Tech Memo: Underground Blasting Face Area for Emissions Calculation
118,300	*kg/yr*	WP blasting agent usage	Drill & Blast V22	Tech Memo: Underground Blasting Face Area for Emissions Calculation
2,065,200	*tonne/yr*	EP development rock drill and blast	Drill & Blast V22	Tech Memo: Underground Blasting Face Area for Emissions Calculation
1,414	*tonne/hr*	EP development rock drill and blast	Drill & Blast V22	Tech Memo: Underground Blasting Face Area for Emissions Calculation
1,487,000	*kg/yr*	EP blasting agent usage	Drill & Blast V22	Tech Memo: Underground Blasting Face Area for Emissions Calculation

List of References

Value	Unit	Description	Location in EI	Reference
502.6	*tonne/yr*	Long-Term uncontrolled fuel oil vapor	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
59.1	*tonne/yr*	Long-Term controlled fuel oil vapor	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
171.9	*lb/hr*	Short-Term uncontrolled fuel oil vapor	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
20.2	*lb/hr*	Short-Term controlled fuel oil vapor	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
245.3	*tonne/yr*	Long-Term uncontrolled SO2	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
12.3	*tonne/yr*	Long-Term controlled SO2	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
83.9	*lb/hr*	Short-Term uncontrolled SO2	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
4.2	*lb/hr*	Short-Term controlled SO2	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
62,603	*tonne/yr*	Long-Term filter cake throughput (through rotary dryer)	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
9.7	*tonne/hr*	Short-Term filter cake throughput (through rotary dryer)	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
99%		wet ESP control efficiency	MolyTalc	EPA Air Pollution Control Technology Fact Sheet, Wet Electrostatic Precipitator
10	*lb/ton*	Emission Factor for Concentrate Dryer	MolyTalc	AP-42 Chapter 12.3
1,042	*tonne/hr*	Pebble Recycle	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
23,000	*tonne/day*	Pebble Recycle	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
7,300,000	*tonne/yr*	Pebble Recycle	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
414	*tonne/hr*	Copper Concentrate Throughput	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
9,942	*tonne/day*	Copper Concentrate Throughput	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
3,338,889	*tonne/yr*	Copper Concentrate Throughput	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
1,060	*tonne/hr*	SAG Trommel Oversize	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
23,390	*tonne/day*	SAG Trommel Oversize	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
7,424,100	*tonne/yr*	SAG Trommel Oversize	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
7,011	*tonne/hr*	Ball Mill Feed	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
154,808	*tonne/day*	Ball Mill Feed	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
49,134,616	*tonne/yr*	Ball Mill Feed	Gen Info	Technical Memo: Process Plant Mass Balance Calculations for EI
6,166	*trip/yr*	EP Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
20	*trips/day*	EP Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
6,935	*trip/yr*	WP Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
19	*trips/day*	WP Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
0	*trip/yr*	TSF Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
0	*trips/day*	TSF Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
0	*trip/yr*	FPLF Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
0	*trips/day*	FPLF Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2

List of References

Value	Unit	Description	Location in EI	Reference
11	*trips/hr*	WP Materials/Equipment Deliveries	Deliveries	GPO Section 3.4.2
16.25	*MMBtu*	Heat Capacity of Moly/Talc Rotary Dryer	MolyTalc	Tech Memo: Molybdenite / Talc Concentrate Heat Treatment Emissions
0.20	*mi/RT*	Distance of UG RT LHD	EP_Fleet	TruckandLoaderHaulageDistances.pptx
2.34	*mi/RT*	Distance of UG RT Haul	EP_Fleet	TruckandLoaderHaulageDistances.pptx

POINT Source Release Parameters

Model ID	Description	Facility	UTM X (m, Zone 12)	UTM Y (m, Zone 12)	Elevation (m)	Release Height (m)	Temperature (°C)	Exit Velocity (m/s)	Stack Dia (m)
E_VENT1	EPS Exhaust Vent 1	EPS	493,683	3,685,100	1,272	21.1	24.0	19.1	7.4
E_VENT2	EPS Exhaust Vent 2	EPS	493,701	3,685,089	1,269	21.1	24.0	19.1	7.4
E_VENT3	EPS Exhaust Vent 3	EPS	493,718	3,685,078	1,268	21.1	24.0	19.1	7.4
E_VENT4	EPS Exhaust Vent 4	EPS	493,736	3,685,066	1,267	21.1	24.0	19.1	7.4
E_GEN1	EPS Cat 516B - Diesel	EPS	493,790	3,684,824	1,261	5.0	490.0	64.5	0.30
E_GEN2	EPS Cat 3046C - Diesel	EPS	493,820	3,684,824	1,255	5.0	490.0	11.0	0.30
E_GEN3	EPS Caterpillar C175-16 1	EPS	493,790	3,684,834	1,263	5.0	472.3	112.0	0.36
E_GEN4	EPS Caterpillar C175-16 2	EPS	493,790	3,684,843	1,267	5.0	472.3	112.0	0.36
E_GEN5	EPS Caterpillar C175-16 3	EPS	493,790	3,684,853	1,270	5.0	472.3	112.0	0.36
E_GEN6	EPS Caterpillar C175-16 4	EPS	493,790	3,684,862	1,272	5.0	472.3	112.0	0.36
E_GEN7	EPS Caterpillar C175-16 5	EPS	493,790	3,684,872	1,273	5.0	472.3	112.0	0.36
E_GEN8	EPS Caterpillar C175-16 6	EPS	493,790	3,684,882	1,274	5.0	472.3	112.0	0.36
E_GEN9	EPS Caterpillar C175-16 7	EPS	493,790	3,684,891	1,274	5.0	472.3	112.0	0.36
E_GEN10	EPS Caterpillar C175-16 8	EPS	493,820	3,684,834	1,255	5.0	472.3	112.0	0.36
E_GEN11	EPS Caterpillar C175-16 9	EPS	493,820	3,684,843	1,256	5.0	472.3	112.0	0.36
E_GEN12	EPS Caterpillar C175-16 10	EPS	493,820	3,684,853	1,257	5.0	472.3	112.0	0.36
E_GEN13	EPS Caterpillar C175-16 11	EPS	493,820	3,684,862	1,260	5.0	472.3	112.0	0.36
E_GEN14	EPS Caterpillar C175-16 12	EPS	493,820	3,684,872	1,264	5.0	472.3	112.0	0.36
E_GEN15	EPS Caterpillar C175-16 13	EPS	493,820	3,684,882	1,268	5.0	472.3	112.0	0.36
E_GEN16	EPS Caterpillar C175-16 14	EPS	493,820	3,684,891	1,269	5.0	472.3	112.0	0.36
E_COOL1	EPS Surface Cooling Towers 1	EPS	493,613	3,684,698	1,268	11.7	100.0	12.2	9.7
E_COOL2	EPS Surface Cooling Towers 2	EPS	493,613	3,684,716	1,268	11.7	100.0	12.2	9.7
E_COOL3	EPS Surface Cooling Towers 3	EPS	493,613	3,684,734	1,268	11.7	100.0	12.2	9.7
E_COOL4	EPS Surface Cooling Towers 4	EPS	493,647	3,684,698	1,268	11.7	100.0	12.2	9.7
E_COOL5	EPS Surface Cooling Towers 5	EPS	493,647	3,684,716	1,268	11.7	100.0	12.2	9.7
E_COOL6	EPS Surface Cooling Towers 6	EPS	493,647	3,684,734	1,268	11.7	100.0	12.2	9.7
M1_FEED	SAG Mill Stockpile to Reclaim Tunnel Feeders (FE-001 - 004) - SAG 1	WPS	490,184	3,686,096	960	46.4	Ambient	27.4	0.61
M1_XFER	Mill Reclaim Tunnel Feeders (FE001 - 004) to SAG 1 Conveyor (CV-004)	WPS	490,147	3,685,992	958	46.4	Ambient	27.4	0.61
M2_FEED	SAG Mill Stockpile to Reclaim Tunnel Feeders (FE-005 - 008) - SAG 2	WPS	490,228	3,686,080	973	46.4	Ambient	27.4	0.61
M2_XFER	Mill Reclaim Tunnel Feeders (FE005 - 008) to SAG 2 Conveyor (CV-104)	WPS	490,191	3,685,977	957	46.4	Ambient	27.4	0.61
M1_LOAD	Mill SAG 1 Conveyor (CV-004) to SAG Mill 1 (ML-001)	WPS	490,100	3,685,862	951	22.2	Ambient	0.001	0.001
M1_SAG	SAG Mill 1 (ML-001)	WPS	490,089	3,685,834	947	22.2	Ambient	0.001	0.001
M1_TROML	Mill Trommel Screen 1 (SR-001) and associated transfer out (SR-002)	WPS	490,089	3,685,834	947	22.2	Ambient	0.001	0.001
M1_VIBRT	Mill Vibrating Screen (SR-002) and associated transfer out (oversize to CV-012)	WPS	490,089	3,685,834	947	22.2	Ambient	0.001	0.001
M1_BALLA	Ball Mill 1A (ML-002) and associated transfers in and out	WPS	490,089	3,685,834	947	22.2	Ambient	0.001	0.001
M1_BALLB	Ball Mill 1B (ML-003) and associated transfers in and out	WPS	490,089	3,685,834	947	22.2	Ambient	0.001	0.001
M2_LOAD	Mill SAG 2 Conveyor (CV-104) to SAG Mill 2 (ML-001)	WPS	490,143	3,685,846	961	22.2	Ambient	0.001	0.001
M2_SAG	SAG Mill 2 (ML-101)	WPS	490,133	3,685,818	954	22.2	Ambient	0.001	0.001
M2_TROML	Mill Trommel Screen 2 (SR-101) and associated transfer out (SR-003)	WPS	490,133	3,685,818	954	22.2	Ambient	0.001	0.001
M2_VIBRT	Mill Vibrating Screen (SR-003) and associated transfer out (oversize to CV-012)	WPS	490,133	3,685,818	954	22.2	Ambient	0.001	0.001
M2_BALLA	WPS Fugitive Surface Emissions	WPS	490,133	3,685,818	954	22.2	Ambient	0.001	0.001
M2_BALLB	WPS Fugitive Surface Emissions	WPS	490,133	3,685,818	954	22.2	Ambient	0.001	0.001
M_SCREEN	WPS Fugitive Surface Emissions	WPS	490,116	3,685,839	952	22.2	Ambient	0.001	0.001
M_PEBREC	Mill Recycle Conveyor 2 (CV-013) to Recycle Conveyor 3 (CV-014)	WPS	490,116	3,685,839	952	22.2	Ambient	0.001	0.001

POINT Source Release Parameters

Model ID	Description	Facility	UTM X (m, Zone 12)	UTM Y (m, Zone 12)	Elevation (m)	Release Height (m)	Temperature (°C)	Exit Velocity (m/s)	Stack Dia (m)
M_PEBBIN	Mill Recycle Conveyor 3 (CV-014) to Pebble Bin (BN-002)	WPS	490,116	3,685,839	952	22.2	Ambient	0.001	0.001
M1_PEBFD	Mill Pebble Bin (BN-002) to Pebble Feeder 1 (FE-009)	WPS	490,116	3,685,839	952	22.2	Ambient	0.001	0.001
M2_PEBFD	Mill Pebble Bin (BN-002) to Pebble Feeder 2 (FE-109)	WPS	490,116	3,685,839	952	22.2	Ambient	0.001	0.001
M1_PEBCV	Mill Pebble Feeder 1 (FE-009) to SAG 1 Conveyor (CV-004)	WPS	490,116	3,685,839	952	22.2	Ambient	0.001	0.001
M2_PEBCV	Mill Pebble Feeder 2 (FE-109) to SAG 2 Conveyor (CV-104)	WPS	490,116	3,685,839	952	22.2	Ambient	0.001	0.001
M_MLYFLT	Mill Moly Concentrate Filter (FL-001) to Holoflite Dryers (DR001 - 002)	WPS	489,931	3,685,743	927	22.2	Ambient	0.001	0.001
M_MLYBIN	Mill Holoflite Dryers (DR-001 - 002) to Moly Concentrate Day Bins (BN001 - 003)	WPS	489,929	3,685,730	928	1.8	Ambient	0.001	0.001
M_MLYBAG	Mill Moly Concentrate Day Bins (BN001 - 003) to Moly Bagging System (MS-001)	WPS	489,929	3,685,730	928	1.8	Ambient	0.001	0.001
M1_LIMBN	Mill Lime Bin 1 (BN-801) Loading (Discharge to Enclosed Screw Feeder)	WPS	490,147	3,685,653	963	9.0	Ambient	0.001	0.001
M1_LIMVM	Mill Screw Feeder 1 (CV-801) to Vertimill 1 (ML-801)	WPS	490,133	3,685,658	959	9.0	Ambient	0.001	0.001
M1_LIMTK	Mill Vertimill 1 (ML-801) to Milk of Lime Tank (TK-156)	WPS	490,147	3,685,676	959	9.0	Ambient	0.001	0.001
M2_LIMBN	Mill Lime Bin 2 (BN-802) Loading (Discharge to Enclosed Screw Feeder)	WPS	490,151	3,685,665	961	9.0	Ambient	0.001	0.001
M2_LIMVM	Mill Screw Feeder 2 (CV-802) to Vertimill 2 (ML-802)	WPS	490,137	3,685,669	960	9.0	Ambient	0.001	0.001
M2_LIMTK	Mill Vertimill 2 (ML-802) to Milk of Lime Tank (TK-156)	WPS	490,147	3,685,676	959	9.0	Ambient	0.001	0.001
M_MLYHTR	Mill Moly/Talc Heat Treatment Process	WPS	489,945	3,685,729	928	22.3	10.0	0.3	0.30
M_KILN_P	Moly/Talc Rotary Dryer Process	WPS	489,944	3,685,720	929	22.3	10.0	0.3	0.30
M_KILN_C	Moly/Talc Rotary Dryer Combustion	WPS	489,944	3,685,720	929	22.3	10.0	0.3	0.30
W_GEN1	WPS Caterpillar C18 Generator Set 1	WPS	490,175	3,685,798	963	2.8	447.1	35.9	0.20
W_GEN2	WPS Caterpillar C18 Generator Set 2	WPS	490,173	3,685,792	962	2.8	447.1	35.9	0.20
W_GEN3	WPS Caterpillar C18 Generator Set 3	WPS	490,170	3,685,785	962	2.8	447.1	35.9	0.20
M_CMBSTN	Mill Combustion (Stationary)	WPS	490,036	3,685,487	955	3.8	204.0	135.9	0.10
W_HEAT1	WPS Hydro House Propane Heater (0.045 MMBtu/hr)	WPS	490,929	3,684,596	912	3.8	204.0	0.9	0.10
W_HEAT2	WPS Hydro House Propane Heater (0.065 MMBtu/hr)	WPS	490,948	3,684,599	913	3.8	204.0	1.3	0.10
F_LDSTL	FPLF Concentrate Filters (FL-001 - 006) to Shuttle Conveyors (CV-001 - CV-006)	FPLF	461,713	3,673,879	512	1.8	Ambient	0.001	0.001
F_STLBLD	FPLF Shuttle Conveyors (CV-001 - CV-006) to Filter Building (BG-011)	FPLF	461,687	3,673,854	512	1.8	Ambient	0.001	0.001
F_STLCOL	FPLF Shuttle Conveyors (CV-001 - CV-006) to Collecting Conveyor (CV-010)	FPLF	461,660	3,673,854	512	1.8	Ambient	0.001	0.001
F_COLBLT	FPLF Collecting Conveyor (CV-010) to Belt Conveyor (CV-020)	FPLF	461,649	3,673,865	512	1.8	Ambient	0.001	0.001
F_LDGHOP	FPLF Concentrate Hopper (HP-011) Loading	FPLF	461,647	3,673,868	512	1.8	Ambient	0.001	0.001
F_HOPFED	FPLF Concentrate Hopper (HP-011) to Concentrate Feeder (FE-011)	FPLF	461,647	3,673,868	512	1.8	Ambient	0.001	0.001
F_FEDBLT	FPLF Concentrate Feeder (FE-011) to Belt Conveyor (CV-020)	FPLF	461,647	3,673,868	512	1.8	Ambient	0.001	0.001
F_BLTTRP	FPLF Belt Conveyor (CV-020) to Tripper Conveyor (CV-030)	FPLF	461,569	3,673,876	511	1.8	Ambient	0.001	0.001
F_TRPSTO	FPLF Tripper Conveyor (CV-030) to Storage and Loadout Shed (BG-012)	FPLF	461,563	3,673,876	511	1.8	Ambient	0.001	0.001
F_LDRHOP	FPLF Front End Loader (MS-002) to Load Out Hoppers (HP-012 - 015)	FPLF	461,437	3,673,851	510	1.8	Ambient	0.001	0.001
F_HOPBLT	FPLF Load Out Hoppers (HP-012 - 015) to Weigh Belt Feeders (FE-012 -015)	FPLF	461,437	3,673,851	510	1.8	Ambient	0.001	0.001
F_BLTCNV	FPLF Weigh Belt Feeders (FE-012 -015) to Load Out Conveyors (CV-031 - 034)	FPLF	461,437	3,673,851	510	1.8	Ambient	0.001	0.001
F_CNVTRN	FPLF Load Out Conveyors (CV-031 - 034) to Rail Cars	FPLF	461,437	3,673,832	510	1.8	Ambient	0.001	0.001
F_GEN1	FPLF Caterpillar C18 Generator Set 4	FPLF	461,749	3,673,868	512	2.8	447.1	35.9	0.20
T_GEN1	TSF Caterpillar C18 Generator Set 5	TSF	485,241	3,687,293	805	2.8	447.1	35.9	0.20

VOLUME Source Release Parameters

Model ID	Description	Facility	UTM X (m, Zone 12)	UTM Y (m, Zone 12)	Elevation (m)	Release Height (m)	σ_{yo} (m)	σ_{zo} (m)
B_AGDEL	Batch Plant Aggregate Delivery to Ground Storage	EPS	493,671	3,684,924	1,272	1.8	1.0	1.6
B_SNDEL	Batch Plant Sand Delivery to Ground Storage	EPS	493,673	3,684,924	1,272	1.8	1.0	1.6
B_AGCHUT	Batch Plant Aggregate Transfer to Conveyor Belt via Chute	EPS	493,665	3,684,928	1,274	1.8	1.1	1.6
B_SNCHUT	Batch Plant Sand Transfer to Conveyor Belt via Chute	EPS	493,665	3,684,928	1,274	1.8	1.1	1.6
B_AGSTOR	Batch Plant Aggregate Transfer to Elevated Storage	EPS	493,651	3,684,923	1,275	1.8	1.1	1.6
B_SNSTOR	Batch Plant Sand Transfer to Elevated Storage	EPS	493,651	3,684,928	1,275	1.8	0.2	1.6
B_WHOPLD	Batch Plant Weigh Hopper Loading (Aggregate & Sand)	EPS	493,650	3,684,926	1,275	1.8	0.3	1.6
B_WHOPAG	Batch Plant Weigh Hopper Discharge to Truck Loading Conveyor (Agg)	EPS	493,650	3,684,929	1,275	1.8	1.1	1.6
B_WHOPSN	Batch Plant Weigh Hopper Discharge to Truck Loading Conveyor (Sand)	EPS	493,650	3,684,929	1,275	1.8	1.1	1.6
B_CEMSLO	Batch Plant Cement Unloading to Silo	EPS	493,645	3,684,929	1,277	1.8	3.3	1.6
B_FLYSLO	Batch Plant Flyash Unloading to Silo	EPS	493,645	3,684,926	1,277	1.8	5.8	1.6
B_SILSLO	Batch Plant Silica Fume Unloading to Silo	EPS	493,650	3,684,935	1,275	1.8	3.3	1.6
B_SLOHOP	Batch Plant Cement & Flyash Discharge to Silo Weigh Hopper	EPS	493,650	3,684,938	1,275	1.8	5.8	1.6
B_SLOCNY	Batch Plant Silo Weigh Hopper Discharge to Truck Loading Conveyor	EPS	493,649	3,684,941	1,275	1.8	1.2	1.6
B_SLOTRK	Batch Plant Truck Loading	EPS	493,650	3,684,945	1,276	1.8	1.1	1.6
W_CVYXF1	Incline Conveyor to Mine Conveyor	WPS	0	0	0	0.0	0.0	0.0
W_CVYXF2	WPS Mine Conveyor to Mine Transfer Conveyor (CV-002)	WPS	490,136	3,685,328	957	3.5	3.3	1.6
M_TRIPPR	Mill Mine Transfer Conveyor (CV-002) to Stockpile Tripper Conveyor (CV-003)	WPS	490,279	3,686,002	975	44.4	24.6	20.7
M_STOCKP	Mill Stockpile Tripper Conveyor (CV-003) to Covered SAG Mill Stockpile	WPS	490,184	3,686,036	969	44.4	24.6	20.7
M_SIPX	Mill SIPX (Sodium Isopropyl Xanthate)	WPS	490,131	3,685,752	951	15.0	1.1	7.0
M_MIBC	Mill MIBC (Methyl isobutyl carbonal)	WPS	490,132	3,685,754	951	15.0	1.1	7.0
M_NAHS	Mill NaHS (Sodium hydrosulfide solution)	WPS	490,135	3,685,753	951	15.0	1.1	7.0
M_FLOC1	Mill Flocculent (CIBA Magnafloc 155)	WPS	490,134	3,685,751	951	15.0	1.1	7.0
M_FLOC2	Mill Flocculent (CIBA Magnafloc 10)	WPS	490,138	3,685,749	952	15.0	1.1	7.0
M_CYTEC	Mill CYTEC 8989	WPS	490,139	3,685,752	952	15.0	1.1	7.0
M_MCO	Mill MCO (Non-polar flotation oil)	WPS	490,142	3,685,749	952	15.0	1.1	7.0
E_FUGS	EPS Fugitive Surface Emissions	EPS	493,633	3,684,853	1,281	5.0	98.8	4.7
W_FUGS	WPS Fugitive Surface Emissions	WPS	490,000	3,685,229	936	5.0	197.7	4.7
F_FUGS	FPLF Fugitive Surface Emissions	FPLF	461,606	3,673,866	512	5.0	58.1	4.7
T_FUGS	TSF Fugitive Surface Emissions	TSF	481,673	3,686,150	746	5.0	348.8	4.7

AREA Source Release Parameters													
Model ID	**Description**	**Facility**	**UTM X (m, Zone 12)**	**UTM Y (m, Zone 12)**	**UTM X (m, Zone 12)***	**UTM Y (m, Zone 12)***	**Elevation (m)**	**Release Height (m)**	**σ_{xo} (m)**	**σ_{yo} (m)**	**σ_{zo} (m)****	**Rotation (°)****
E_WE_EXP	EPS Exposed Areas	EPS	493,738	3,684,781			1,231	1.0	262.4	399.6	0.9	-54.0
E_WE_SUB	EPS Exposed Subsidence Area	EPS	494,354	3,683,028			1,278	1.0	1290.1	1,440.8	0.9	-27.5
W_WE_EXP	WPS Exposed Areas	WPS	489,301	3,683,810			899	1.0	838.4	1,669.0	0.9	0.5
T_WE_EX	TSF Exposed Areas	TSF	480,674	3,687,648			757	1.0	15.0	0.9		
E_RD01	EPS Delivery & Employee road emissions	EPS	495,456	3,685,978	495,355	3,685,835	1,220	2.6	16.0	2.4		
E_RD02	EPS Delivery & Employee road emissions	EPS	495,355	3,685,835	495,333	3,685,614	1,214	2.6	16.0	2.4		
E_RD03	EPS Delivery & Employee road emissions	EPS	495,333	3,685,614	495,101	3,685,520	1,202	2.6	16.0	2.4		
E_RD04	EPS Delivery & Employee road emissions	EPS	495,101	3,685,520	494,863	3,685,575	1,197	2.6	16.0	2.4		
E_RD05	EPS Delivery & Employee road emissions	EPS	494,863	3,685,575	494,647	3,685,550	1,190	2.6	16.0	2.4		
E_RD06	EPS Delivery & Employee road emissions	EPS	494,647	3,685,550	494,444	3,685,584	1,183	2.6	16.0	2.4		
E_RD07	EPS Delivery & Employee road emissions	EPS	494,444	3,685,584	494,310	3,685,542	1,184	2.6	16.0	2.4		
E_RD08	EPS Delivery & Employee road emissions	EPS	494,310	3,685,542	494,195	3,685,430	1,181	2.6	16.0	2.4		
E_RD09	EPS Delivery & Employee road emissions	EPS	494,195	3,685,430	493,906	3,684,591	1,224	2.6	16.0	2.4		
E_RD10	EPS Delivery & Employee road emissions	EPS	493,906	3,684,591	493,788	3,684,554	1,270	2.6	16.0	2.4		
E_RD11	EPS Delivery road emissions	EPS	493,788	3,684,554	493,659	3,684,558	1,270	2.6	16.0	2.4		
E_RD12	EPS Delivery road emissions	EPS	493,659	3,684,558	493,554	3,684,560	1,277	2.6	16.0	2.4		
E_RD13	EPS Delivery road emissions	EPS	493,554	3,684,560	493,553	3,684,587	1,286	2.6	16.0	2.4		
E_RD14	EPS Delivery road emissions	EPS	493,553	3,684,587	493,626	3,684,585	1,276	2.6	16.0	2.4		
E_RD15	EPS Delivery road emissions	EPS	493,626	3,684,585	493,659	3,684,558	1,268	2.6	16.0	2.4		
E_RD16	EPS Employee road emissions	EPS	493,788	3,684,554	493,711	3,684,668	1,266	2.6	16.0	2.4		
E_TP01	EPS Delivery & Employee road tailpipe emissions	EPS	495,456	3,685,978	495,355	3,685,835	1,220	2.6	16.0	2.4		
E_TP02	EPS Delivery & Employee road tailpipe emissions	EPS	495,355	3,685,835	495,333	3,685,614	1,214	2.6	16.0	2.4		
E_TP03	EPS Delivery & Employee road tailpipe emissions	EPS	495,333	3,685,614	495,101	3,685,520	1,202	2.6	16.0	2.4		
E_TP04	EPS Delivery & Employee road tailpipe emissions	EPS	495,101	3,685,520	494,863	3,685,575	1,197	2.6	16.0	2.4		
E_TP05	EPS Delivery & Employee road tailpipe emissions	EPS	494,863	3,685,575	494,647	3,685,550	1,190	2.6	16.0	2.4		
E_TP06	EPS Delivery & Employee road tailpipe emissions	EPS	494,647	3,685,550	494,444	3,685,584	1,183	2.6	16.0	2.4		
E_TP07	EPS Delivery & Employee road tailpipe emissions	EPS	494,444	3,685,584	494,310	3,685,542	1,184	2.6	16.0	2.4		
E_TP08	EPS Delivery & Employee road tailpipe emissions	EPS	494,310	3,685,542	494,195	3,685,430	1,181	2.6	16.0	2.4		
E_TP09	EPS Delivery & Employee road tailpipe emissions	EPS	494,195	3,685,430	493,906	3,684,591	1,224	2.6	16.0	2.4		
E_TP10	EPS Delivery & Employee road tailpipe emissions	EPS	493,906	3,684,591	493,788	3,684,554	1,270	2.6	16.0	2.4		
E_TP11	EPS Delivery road tailpipe emissions	EPS	493,788	3,684,554	493,659	3,684,558	1,270	2.6	16.0	2.4		
E_TP12	EPS Delivery road tailpipe emissions	EPS	493,659	3,684,558	493,554	3,684,560	1,277	2.6	16.0	2.4		
E_TP13	EPS Delivery road tailpipe emissions	EPS	493,554	3,684,560	493,553	3,684,587	1,286	2.6	16.0	2.4		
E_TP14	EPS Delivery road tailpipe emissions	EPS	493,553	3,684,587	493,626	3,684,585	1,276	2.6	16.0	2.4		
E_TP15	EPS Delivery road tailpipe emissions	EPS	493,626	3,684,585	493,659	3,684,558	1,268	2.6	16.0	2.4		
E_TP16	EPS Employee road tailpipe emissions	EPS	493,788	3,684,554	493,711	3,684,668	1,266	2.6	16.0	2.4		
W_RD01	WPS Employee road emissions	WPS	489,852	3,683,414	489,840	3,683,476	832	2.6	16.0	2.4		
W_RD02	WPS Employee road emissions	WPS	489,840	3,683,476	489,931	3,683,519	834	2.6	16.0	2.4		
W_RD03	WPS Employee road emissions	WPS	489,931	3,683,519	489,974	3,683,619	837	2.6	16.0	2.4		
W_RD04	WPS Employee road emissions	WPS	489,974	3,683,619	490,058	3,683,730	841	2.6	16.0	2.4		
W_RD05	WPS Employee road emissions	WPS	490,058	3,683,730	490,010	3,683,826	843	2.6	16.0	2.4		
W_RD06	WPS Delivery road emissions	WPS	488,859	3,684,639	488,912	3,684,810	887	2.6	16.0	2.4		
W_RD07	WPS Delivery road emissions	WPS	488,912	3,684,810	489,081	3,684,939	906	2.6	16.0	2.4		
W_RD08	WPS Delivery road emissions	WPS	489,081	3,684,939	488,952	3,685,077	910	2.6	16.0	2.4		
W_RD09	WPS Delivery road emissions	WPS	488,952	3,685,077	488,987	3,685,168	893	2.6	16.0	2.4		

AREA Source Release Parameters

Model ID	Description	Facility	UTM X (m, Zone 12)	UTM Y (m, Zone 12)	UTM X (m, Zone 12)*	UTM Y (m, Zone 12)*	Elevation (m)	Release Height (m)	σ_{xo} (m)	σ_{yo} (m)	σ_{zo} (m)**	Rotation (°)**
W_RD10	WPS Delivery road emissions	WPS	488,987	3,685,168	489,588	3,685,693	922	2.6	16.0	2.4		
W_RD11	WPS Delivery road emissions	WPS	489,588	3,685,693	489,751	3,685,646	944	2.6	16.0	2.4		
W_RD12	WPS Delivery road emissions	WPS	489,751	3,685,646	490,047	3,685,523	940	2.6	16.0	2.4		
W_TP01	WPS Employee road tailpipe emissions	WPS	489,852	3,683,414	489,840	3,683,476	832	2.6	16.0	2.4		
W_TP02	WPS Employee road tailpipe emissions	WPS	489,840	3,683,476	489,931	3,683,519	834	2.6	16.0	2.4		
W_TP03	WPS Employee road tailpipe emissions	WPS	489,931	3,683,519	489,974	3,683,619	837	2.6	16.0	2.4		
W_TP04	WPS Employee road tailpipe emissions	WPS	489,974	3,683,619	490,058	3,683,730	841	2.6	16.0	2.4		
W_TP05	WPS Employee road tailpipe emissions	WPS	490,058	3,683,730	490,010	3,683,826	843	2.6	16.0	2.4		
W_TP06	WPS Delivery road tailpipe emissions	WPS	488,859	3,684,639	488,912	3,684,810	887	2.6	16.0	2.4		
W_TP07	WPS Delivery road tailpipe emissions	WPS	488,912	3,684,810	489,081	3,684,939	906	2.6	16.0	2.4		
W_TP08	WPS Delivery road tailpipe emissions	WPS	489,081	3,684,939	488,952	3,685,077	910	2.6	16.0	2.4		
W_TP09	WPS Delivery road tailpipe emissions	WPS	488,952	3,685,077	488,987	3,685,168	893	2.6	16.0	2.4		
W_TP10	WPS Delivery road tailpipe emissions	WPS	488,987	3,685,168	489,588	3,685,693	922	2.6	16.0	2.4		
W_TP11	WPS Delivery road tailpipe emissions	WPS	489,588	3,685,693	489,751	3,685,646	944	2.6	16.0	2.4		
W_TP12	WPS Delivery road tailpipe emissions	WPS	489,751	3,685,646	490,047	3,685,523	940	2.6	16.0	2.4		
F_RD01	FPLF Delivery & Employee road emissions	FPLF	460,966	3,672,584	460,965	3,673,840	506	2.6	16.0	2.4		
F_RD02	FPLF Delivery & Employee road emissions	FPLF	460,965	3,673,840	460,991	3,673,902	507	2.6	16.0	2.4		
F_RD03	FPLF Delivery & Employee road emissions	FPLF	460,991	3,673,902	461,055	3,673,935	508	2.6	16.0	2.4		
F_RD04	FPLF Delivery & Employee road emissions	FPLF	461,055	3,673,935	461,578	3,673,935	510	2.6	16.0	2.4		
F_RD05	FPLF Employee road emissions	FPLF	461,578	3,673,935	461,579	3,673,973	511	2.6	16.0	2.4		
F_RD06	FPLF Delivery road emissions	FPLF	461,578	3,673,935	461,739	3,673,935	512	2.6	16.0	2.4		
F_TP01	FPLF Delivery & Employee road tailpipe emissions	FPLF	460,966	3,672,584	460,965	3,673,840	506	2.6	16.0	2.4		
F_TP02	FPLF Delivery & Employee road tailpipe emissions	FPLF	460,965	3,673,840	460,991	3,673,902	507	2.6	16.0	2.4		
F_TP03	FPLF Delivery & Employee road tailpipe emissions	FPLF	460,991	3,673,902	461,055	3,673,935	508	2.6	16.0	2.4		
F_TP04	FPLF Delivery & Employee road tailpipe emissions	FPLF	461,055	3,673,935	461,578	3,673,935	510	2.6	16.0	2.4		
F_TP05	FPLF Employee road tailpipe emissions	FPLF	461,578	3,673,935	461,579	3,673,973	511	2.6	16.0	2.4		
F_TP06	FPLF Delivery road tailpipe emissions	FPLF	461,578	3,673,935	461,739	3,673,935	512	2.6	16.0	2.4		
T_RD01	TSF Delivery & Employee road emissions	TSF	484,717	3,687,597	484,868	3,687,372	817	2.6	16.0	2.4		
T_RD02	TSF Delivery & Employee road emissions	TSF	484,868	3,687,372	484,840	3,687,614	816	2.6	16.0	2.4		
T_RD03	TSF Delivery & Employee road emissions	TSF	484,840	3,687,614	484,902	3,687,734	829	2.6	16.0	2.4		
T_RD04	TSF Delivery & Employee road emissions	TSF	484,902	3,687,734	485,140	3,687,737	830	2.6	16.0	2.4		
T_RD05	TSF Delivery & Employee road emissions	TSF	485,140	3,687,737	485,396	3,687,556	831	2.6	16.0	2.4		
T_RD06	TSF Delivery & Employee road emissions	TSF	485,396	3,687,556	485,483	3,687,201	838	2.6	16.0	2.4		
T_RD07	TSF Delivery & Employee road emissions	TSF	485,483	3,687,201	485,206	3,686,859	819	2.6	16.0	2.4		
T_RD08	TSF Delivery & Employee road emissions	TSF	485,206	3,686,859	485,244	3,686,713	793	2.6	16.0	2.4		
T_RD09	TSF Delivery & Employee road emissions	TSF	485,244	3,686,713	485,485	3,686,648	787	2.6	16.0	2.4		
T_RD10	TSF Delivery & Employee road emissions	TSF	485,485	3,686,648	485,743	3,686,373	795	2.6	16.0	2.4		
T_RD11	TSF Delivery & Employee road emissions	TSF	485,743	3,686,373	485,968	3,686,371	825	2.6	16.0	2.4		
T_RD12	TSF Delivery & Employee road emissions	TSF	485,968	3,686,371	485,978	3,686,468	847	2.6	16.0	2.4		
T_RD13	TSF Delivery & Employee road emissions	TSF	485,978	3,686,468	486,225	3,686,574	852	2.6	16.0	2.4		
T_RD14	TSF Delivery & Employee road emissions	TSF	486,225	3,686,574	486,374	3,686,722	857	2.6	16.0	2.4		
T_RD15	TSF Delivery & Employee road emissions	TSF	486,374	3,686,722	486,667	3,686,628	864	2.6	16.0	2.4		

AREA Source Release Parameters

Model ID	Description	Facility	UTM X (m, Zone 12)	UTM Y (m, Zone 12)	UTM X (m, Zone 12)*	UTM Y (m, Zone 12)*	Elevation (m)	Release Height (m)	σ_{xo} (m)	σ_{yo} (m)	σ_{zo} (m)**	Rotation (°)**
T_RD16	TSF Delivery & Employee road emissions	TSF	486,667	3,686,628	486,848	3,686,719	866	2.6	16.0	2.4		
T_RD17	TSF Delivery & Employee road emissions	TSF	486,848	3,686,719	487,055	3,686,754	869	2.6	16.0	2.4		
T_RD18	TSF Delivery & Employee road emissions	TSF	487,055	3,686,754	487,322	3,687,277	878	2.6	16.0	2.4		
T_RD19	TSF Delivery & Employee road emissions	TSF	487,322	3,687,277	487,577	3,687,026	886	2.6	16.0	2.4		
T_RD20	TSF Delivery & Employee road emissions	TSF	487,577	3,687,026	487,776	3,686,967	887	2.6	16.0	2.4		
T_RD21	TSF Delivery & Employee road emissions	WPS	487,776	3,686,967	488,477	3,686,584	899	2.6	16.0	2.4		
T_RD22	TSF Delivery & Employee road emissions	WPS	488,477	3,686,584	488,646	3,686,733	921	2.6	16.0	2.4		
T_RD23	TSF Delivery & Employee road emissions	WPS	488,646	3,686,733	488,817	3,686,734	922	2.6	16.0	2.4		
T_RD24	TSF Delivery & Employee road emissions	WPS	488,817	3,686,734	488,992	3,686,591	929	2.6	16.0	2.4		
T_RD25	TSF Delivery & Employee road emissions	WPS	488,992	3,686,591	489,270	3,686,573	936	2.6	16.0	2.4		
T_RD26	TSF Delivery & Employee road emissions	WPS	489,270	3,686,573	489,554	3,686,278	938	2.6	16.0	2.4		
T_RD27	TSF Delivery & Employee road emissions	WPS	489,554	3,686,278	489,758	3,685,821	942	2.6	16.0	2.4		
T_RD28	TSF Delivery & Employee road emissions	WPS	489,758	3,685,821	489,722	3,685,660	939	2.6	16.0	2.4		
T_RD29	TSF Delivery & Employee road emissions	WPS	489,722	3,685,660	489,860	3,685,620	936	2.6	16.0	2.4		
T_TP01	TSF Delivery & Employee road tailpipe emissions	TSF	484,717	3,687,597	484,868	3,687,372	817	2.6	16.0	2.4		
T_TP02	TSF Delivery & Employee road tailpipe emissions	TSF	484,868	3,687,372	484,840	3,687,614	816	2.6	16.0	2.4		
T_TP03	TSF Delivery & Employee road tailpipe emissions	TSF	484,840	3,687,614	484,902	3,687,734	829	2.6	16.0	2.4		
T_TP04	TSF Delivery & Employee road tailpipe emissions	TSF	484,902	3,687,734	485,140	3,687,737	830	2.6	16.0	2.4		
T_TP05	TSF Delivery & Employee road tailpipe emissions	TSF	485,140	3,687,737	485,396	3,687,556	831	2.6	16.0	2.4		
T_TP06	TSF Delivery & Employee road tailpipe emissions	TSF	485,396	3,687,556	485,483	3,687,201	838	2.6	16.0	2.4		
T_TP07	TSF Delivery & Employee road tailpipe emissions	TSF	485,483	3,687,201	485,206	3,686,859	819	2.6	16.0	2.4		
T_TP08	TSF Delivery & Employee road tailpipe emissions	TSF	485,206	3,686,859	485,244	3,686,713	793	2.6	16.0	2.4		
T_TP09	TSF Delivery & Employee road tailpipe emissions	TSF	485,244	3,686,713	485,485	3,686,648	787	2.6	16.0	2.4		
T_TP10	TSF Delivery & Employee road tailpipe emissions	TSF	485,485	3,686,648	485,743	3,686,373	795	2.6	16.0	2.4		
T_TP11	TSF Delivery & Employee road tailpipe emissions	TSF	485,743	3,686,373	485,968	3,686,371	825	2.6	16.0	2.4		
T_TP12	TSF Delivery & Employee road tailpipe emissions	TSF	485,968	3,686,371	485,978	3,686,468	847	2.6	16.0	2.4		
T_TP13	TSF Delivery & Employee road tailpipe emissions	TSF	485,978	3,686,468	486,225	3,686,574	852	2.6	16.0	2.4		
T_TP14	TSF Delivery & Employee road tailpipe emissions	TSF	486,225	3,686,574	486,374	3,686,722	857	2.6	16.0	2.4		
T_TP15	TSF Delivery & Employee road tailpipe emissions	TSF	486,374	3,686,722	486,667	3,686,628	864	2.6	16.0	2.4		
T_TP16	TSF Delivery & Employee road tailpipe emissions	TSF	486,667	3,686,628	486,848	3,686,719	866	2.6	16.0	2.4		
T_TP17	TSF Delivery & Employee road tailpipe emissions	TSF	486,848	3,686,719	487,055	3,686,754	869	2.6	16.0	2.4		
T_TP18	TSF Delivery & Employee road tailpipe emissions	TSF	487,055	3,686,754	487,322	3,687,277	878	2.6	16.0	2.4		
T_TP19	TSF Delivery & Employee road tailpipe emissions	TSF	487,322	3,687,277	487,577	3,687,026	886	2.6	16.0	2.4		
T_TP20	TSF Delivery & Employee road tailpipe emissions	TSF	487,577	3,687,026	487,776	3,686,967	887	2.6	16.0	2.4		
T_TP21	TSF Delivery & Employee road tailpipe emissions	WPS	487,776	3,686,967	488,477	3,686,584	899	2.6	16.0	2.4		
T_TP22	TSF Delivery & Employee road tailpipe emissions	WPS	488,477	3,686,584	488,646	3,686,733	921	2.6	16.0	2.4		
T_TP23	TSF Delivery & Employee road tailpipe emissions	WPS	488,646	3,686,733	488,817	3,686,734	922	2.6	16.0	2.4		
T_TP24	TSF Delivery & Employee road tailpipe emissions	WPS	488,817	3,686,734	488,992	3,686,591	929	2.6	16.0	2.4		
T_TP25	TSF Delivery & Employee road tailpipe emissions	WPS	488,992	3,686,591	489,270	3,686,573	936	2.6	16.0	2.4		
T_TP26	TSF Delivery & Employee road tailpipe emissions	WPS	489,270	3,686,573	489,554	3,686,278	938	2.6	16.0	2.4		
T_TP27	TSF Delivery & Employee road tailpipe emissions	WPS	489,554	3,686,278	489,758	3,685,821	942	2.6	16.0	2.4		
T_TP28	TSF Delivery & Employee road tailpipe emissions	WPS	489,758	3,685,821	489,722	3,685,660	939	2.6	16.0	2.4		
T_TP29	TSF Delivery & Employee road tailpipe emissions	WPS	489,722	3,685,660	489,860	3,685,620	936	2.6	16.0	2.4		
RR_OFF	Rail line hauling concentrate offsite (Far West to Magma Junction)	FPLF	453,418	3,666,075	462,062	3,672,632	487	3.9	10.0	3.6		

** A second coordinate indicates a LINE source, a subtype of the AREA source.*

*** Presence of these parameters indicate an AREA source that is not a LINE source.*

Air Sciences Inc.	PROJECT TITLE: Resolution Copper Project	BY: D. Steen
	PROJECT NO: 262-32	PAGE: 1 OF: 3 SHEET: Wind
AIR EMISSION CALCULATIONS	SUBJECT: Wind Erosion Emissions	DATE: October 12, 2018

EAST PLANT FUGITIVE WIND EROSION EMISSIONS
Based on EPS Station Meteorological Data

AP-42, Sec. 13.2.5
Flat, u^*/u_{10}^+ 0.053 AP-42, Sec. 13.2.5, p. 5
(A) $u_{10}^+ = 1.2\ u_{10}$ Fastest mile wind speed at 10m, with a 1.2 factor to convert hourly wind speed to fastest mile.
(B, piles) $u^* = (U_s/U_r) \times 0.1 \times u_{10}^+$
(B, flat) $u^* = 0.053 \times u_{10}^+$ AZ Cu Mine Tailings
(C) $P = 58\ (u^* - u_t^*)^2 + 25\ (u^* - u_t^*)$; $P = 0$ for $u^* \le u_t^*$; where u_t^* = 0.172 m/s Threshold Friction Velocity AZ Cu. Mine Tailings

	Flat Areas, Uncontrolled		Pollutant	Scaling Factor
PM Emissions	72.2	(ton/acre-yr)	PM	1
PM10 Emissions	36.1	(ton/acre-yr)	PM10	0.5
PM2.5 Emissions	5.4	(ton/acre-yr)	PM2.5	0.075

17,544 Total hours (2015-2016)
7,084 Total hours in 2015-2016 with wind erosion emissions > 0

East Plant Wind Erosion

21 Maximum Erodible Area (acres) — Water Controlled, Control Eff. **90%**
0.002 Disturbance Created Every Hour (acre/hr)

	Controlled	Uncontrolled	
PM Emissions	0.023	0.23	tpy
PM_{10} Emissions	0.012	0.12	tpy
$PM_{2.5}$ Emissions	0.002	0.017	tpy

East Plant Subsidence

279 Maximum Erodible Area (acres) — Controlled by Precip; Per Year. Control Eff. **18%**
0.032 Disturbance Created Every Hour (acre/hr)

PM Emissions	1.31	1.59	tpy
PM_{10} Emissions	0.65	0.79	tpy
$PM_{2.5}$ Emissions	0.10	0.12	tpy

Conversions:
453.6 g/lb
4,046.9 m^2/acre

Air Sciences Inc.	PROJECT TITLE: Resolution Copper Project	BY: D. Steen		
	PROJECT NO: 262-32	PAGE: 2	OF: 3	SHEET: Wind
AIR EMISSION CALCULATIONS	SUBJECT: Wind Erosion Emissions	DATE: October 12, 2018		

WEST PLANT FUGITIVE WIND EROSION EMISSIONS
Based on WPS Meteorological Data

AP-42, Sec. 13.2.5
Flat, u^*/u_{10}^+ 0.053 AP-42, Sec. 13.2.5, p. 5
(A) $u_{10}^+ = 1.2\ u_{10}$ Fastest mile wind speed at 10m, with a 1.2 factor to convert hourly wind speed to fastest mile.
(B, piles) $u^* = (U_s/U_r) \times 0.1 \times u_{10}^+$
(B, flat) $u^* = 0.053 \times u_{10}^+$ AZ Cu Mine Tailings
(C) $P = 58\ (u^* - u_t^*)^2 + 25\ (u^* - u_t^*)$; $P = 0$ for $u^* \le u_t^*$; where u_t^* = 0.172 m/s Threshold Friction Velocity AZ Cu. Mine Tailings

	Flat Areas, Uncontrolled		Pollutant	Scaling Factor
PM Emissions	72.2	(ton/acre-yr)	PM	1
PM10 Emissions	36.1	(ton/acre-yr)	PM10	0.5
PM2.5 Emissions	5.4	(ton/acre-yr)	PM2.5	0.075

17,544 Total hours (2015-2016)
7,671 Number of Emissable hours in 2015-2016

<u>**West Plant**</u>

70 Maximum Erodible Area (acres)
0.008 Disturbance Created Every Hour (acre/hr)

Water Controlled
Control Eff. **90%**

	Controlled	Uncontrolled	
PM Emissions	0.08	0.81	tpy
PM_{10} Emissions	0.04	0.41	tpy
$PM_{2.5}$ Emissions	0.01	0.06	tpy

Air Sciences Inc.	PROJECT TITLE: Resolution Copper Project	BY: D. Steen
	PROJECT NO: 262-32	PAGE: 3 OF: 3 SHEET: Wind
AIR EMISSION CALCULATIONS	SUBJECT: Wind Erosion Emissions	DATE: October 12, 2018

TAILINGS STORAGE FACILITY FUGITIVE WIND EROSION EMISSIONS
Based on Hewitt Station Meteorological Data

AP-42, Sec. 13.2.5
Flat, u^*/u_{10}^+ 0.053 AP-42, Sec. 13.2.5, p. 5

(A) $u_{10}^+ = 1.2\ u_{10}$ Fastest mile wind speed at 10m, with a 1.2 factor to convert hourly wind speed to fastest mile.

(B, piles) $u^* = (U_s/U_r) \times 0.1 \times u_{10}^+$

(B, flat) $u^* = 0.053 \times u_{10}^+$ AZ Cu Mine Tailings

(C) $P = 58\ (u^* - u_t^*)^2 + 25\ (u^* - u_t^*)$; $P = 0$ for $u^* \le u_t^*$; where u_t^* = 0.172 m/s Threshold Friction Velocity AZ Cu. Mine Tailings

	Flat Areas, Uncontrolled	
PM Emissions	65.4	(ton/acre-yr)
PM10 Emissions	32.7	(ton/acre-yr)
PM2.5 Emissions	4.9	(ton/acre-yr)

Pollutant	Scaling Factor
PM	1
PM10	0.5
PM2.5	0.075

17,544 Total hours (2015-2016)
8,401 Number of Emissable hours in 2015-2016

<u>**Year 41 Tailings Exposed Area**</u>

1,439 Maximum Erodible Area (acres)
0.164 Disturbance Created Every Hour (acre/hr)

Water Controlled
Control Eff. **90%**

	Controlled	Uncontrolled	
PM Emissions	1.52	15.16	tpy
PM_{10} Emissions	0.76	7.58	tpy
$PM_{2.5}$ Emissions	0.11	1.14	tpy

Air Sciences Inc.	PROJECT TITLE: Resolution Copper Project	BY: D. Steen
	PROJECT NO: 262-32-05	PAGE: 1 OF: 1 SHEET: Summary
AIR EMISSION CALCULATIONS	SUBJECT: Contsruction EI	DATE: November 1, 2018

Controlled Emissions Summary - Project Total (*ton/proj*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC	Duration (mo)
West Plant Construction Emissions	470	206	20	202	110	4	76	18
East Plant Construction Emissions	257	108	11	129	62	4	38	12
Alt2&3 Corridor Construction Emissions	249	110	10	30	26	0	24	18
Alt2 TSF Construction Emissions	1,190	390	62	667	421	13	317	36
Filter Plant Construction Emissions	104	37	4	21	23	1	23	18
TOTAL	**2,271**	**852**	**108**	**1,049**	**642**	**22**	**479**	**-**

Controlled Emissions Summary - Annual (*ton/yr*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
West Plant Construction Emissions	311	136	14	135	73	3	51
East Plant Construction Emissions	257	108	11	129	62	4	38
Alt2&3 Corridor Construction Emissions	166	74	7	20	17	0	16
Alt2 TSF Construction Emissions	389	126	20	222	140	4	106
Filter Plant Construction Emissions	70	25	3	14	15	1	15
TOTAL	**1,193**	**468**	**54**	**520**	**309**	**12**	**226**

Controlled Emissions Summary - Hourly (*lb/hr*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
West Plant Construction Emissions	325	126	13	755	228	24	48
East Plant Construction Emissions	401	131	14	797	235	30	42
Alt2&3 Corridor Construction Emissions	166	67	7	64	36	1	25
Alt2 TSF Construction Emissions	265	77	12	1,054	330	29	80
Filter Plant Construction Emissions	116	34	4	18	20	2	20
TOTAL	**1,273**	**435**	**51**	**2,688**	**849**	**86**	**215**

Air Sciences Inc.	PROJECT TITLE: Resolution Copper Project	BY: D. Steen
	PROJECT NO: 262-32-05	1 OF: 1 SHEET: Summary
AIR EMISSION CALCULATIONS	SUBJECT: Contsruction EI	DATE: November 1, 2018

Controlled Emissions Summary - Project Total (ton/proj) - Alternatives

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Alternative 2	1,439	500	72.1	697	447	12.9	341
Alternative 3	1,436	499	71.7	691	440	12.9	335
Alternative 4	558	178	27.0	639	279	15.3	151
Alternative 5	1,101	392	55.6	460	373	6.2	324
Alternative 6	1,018	347	49.7	509	412	6.9	359
Maximum	**1,439**	**500**	**72.1**	**697**	**447**	**15.3**	**359**

Controlled Emissions Summary - Annual (ton/yr) - Alternatives

Alternative 2	555	199	27.1	242	157	4.4	122
Alternative 3	553	198	25.8	240	155	4.4	120
Alternative 4	178	55.1	8.8	213	93.0	5.1	50.2
Alternative 5	476	171	23.9	177	143	2.4	124
Alternative 6	448	156	21.9	196	156	2.7	135
Maximum	**555**	**199**	**27.1**	**242**	**157**	**5.1**	**135**

Controlled Emissions Summary - Hourly (lb/hr) - Alternatives

Alternative 2	**431**	144	19.5	1,118	366	30.8	105
Alternative 3	430	143	18.9	1,116	364	30.8	103
Alternative 4	170	49.0	7.9	1,263	356	36.5	45.4
Alternative 5	379	130	17.7	635	241	16.4	103
Alternative 6	398	132	18.0	713	267	18.5	110
Maximum	**431**	**144**	**19.5**	**1,263**	**366**	**36.5**	**110**

Air Sciences Inc.	PROJECT TITLE: Resolution Copper Project	BY: D. Steen
	PROJECT NO: 262-32-05	PAGE: 1 OF: 9 SHEET: West Plant
AIR EMISSION CALCULATIONS	SUBJECT: West Plant Construction Emissions	DATE: November 1, 2018

West Plant Controlled Emissions Summary - Project Total (*ton/proj*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Drilling	0.45	0.21	3.2E-2	--	--	--	--
Blasting	20.1	10.4	0.60	133	33.9	4.0	--
Mobile Equipment Combustion	3.9	3.9	3.9	68.5	76.4	0.13	76.4
Mobile Equipment - Fugitives	70.1	16.3	1.6	--	--	--	--
Dozing	38.5	6.1	4.0	--	--	--	--
Grading	20.9	6.0	0.65	--	--	--	--
Scraping	308	160	9.2	--	--	--	--
Employee and Delivery - Combustion	3.7E-2	3.7E-2	1.0E-2	0.14	8.3E-4	0.22	1.2E-2
Employee and Delivery - Fugitives	6.7	1.6	0.16	--	--	--	--
Wind Erosion	1.6	0.82	0.12	--	--	--	--
TOTAL	**470**	**206**	**20.4**	**202**	**110**	**4.3**	**76.4**

West Plant Controlled Emissions Summary - Annual (*ton/yr*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Drilling	0.30	0.14	2.1E-2	--	--	--	--
Blasting	10.9	5.7	0.33	89.0	22.6	2.7	--
Mobile Equipment Combustion	2.6	2.6	2.6	45.6	50.9	8.4E-2	50.9
Mobile Equipment - Fugitives	46.8	10.8	1.1	--	--	--	--
Dozing	25.7	4.1	2.7	--	--	--	--
Grading	13.9	4.0	0.43	--	--	--	--
Scraping	205	107	6.2	--	--	--	--
Employee and Delivery - Combustion	2.5E-2	2.5E-2	6.8E-3	9.1E-2	5.6E-4	0.14	7.7E-3
Employee and Delivery - Fugitives	4.5	1.0	0.10	--	--	--	--
Wind Erosion	1.1	0.55	8.2E-2	--	--	--	--
TOTAL	**311**	**136**	**13.5**	**135**	**73.5**	**2.9**	**50.9**

West Plant Controlled Emissions Summary - Hourly (*lb/hr*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Drilling	0.24	0.11	1.7E-2	--	--	--	--
Blasting	5.5	2.9	0.17	712	181	21.2	--
Mobile Equipment Combustion	2.4	2.4	2.4	42.7	47.6	5.1E-2	47.6
Mobile Equipment - Fugitives	56.1	13.0	1.3	--	--	--	--
Dozing	21.1	3.4	2.2	--	--	--	--
Grading	11.4	3.3	0.35	--	--	--	--
Scraping	164	85.4	4.9	--	--	--	--
Employee and Delivery - Combustion	0.13	0.13	3.1E-2	0.40	6.2E-3	2.2	4.6E-2
Employee and Delivery - Fugitives	63.5	14.7	1.5	--	--	--	--
Wind Erosion	0.25	0.13	1.9E-2	--	--	--	--
TOTAL	**325**	**126**	**12.9**	**755**	**228**	**23.5**	**47.7**

Blue entries are entered values, *black entries are calculated or linked*

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Drilling

Project Duration	18	*months*	*Email from Resolution (4/13/2018)*
Material Quantity	3,211,740	*tonne/yr*	
	4,817,610	*tonne/proj*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	3,540,333	*ton/yr*	
	5,310,500	*ton/proj*	
	1,416	*ton/hr*	
Operation	250	*days/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	10	*hr/day*	*Resolution Copper Project Technical Memorandum – Construction Emissions*

Emission Factors			**References**
PM_{10}	8.0E-5	*lb/ton*	*AP-42, Table 11.19.2-2 (wet drilling), Rev. 8/04*
PM Scaling Factors			
PM	0.74		*AP-42, Chapter 13.2.4-4, 11/06*
PM_{10}	0.35		*AP-42, Chapter 13.2.4-4, 11/06*
$PM_{2.5}$	0.053		*AP-42, Chapter 13.2.4-4, 11/06*

Emissions	***lb/hr***	***ton/yr***	***ton/proj***
PM	0.24	0.30	0.45
PM_{10}	0.11	0.14	0.21
$PM_{2.5}$	1.7E-2	2.1E-2	3.2E-2

Conversions	
2,000	*lb/ton*
1.1023	*ton/tonne*
3.2808	*ft/m*
100	*cm/m*
453.592	*g/lb*

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Blasting

Material Moved	4,817,610	*tonne/proj*	
	5,310,500	*ton/proj*	
	3,540,333	*ton/yr*	
Blasting Agent Use	2,409	*tonne/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	2,655	*ton/yr*	
	3,983	*ton/proj*	
Number of Blasts	250	*blasts/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	375	*blasts/proj*	
	1	*max blasts/day*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
Operation	250	*days/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	10	*hr/day*	*Resolution Copper Project Technical Memorandum – Construction Emissions*

Emission Factors			**References**				
Emission Factor Equation	$TSP = 0.000014 \times A^{1.5}$	*lb/blast*	*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*				
Where, A = Area per Blast	5,382	*ft²*	Where, A = Area per Year	2,018,233	*ft²*	1,345,489	*ft²*
TSP	5.5	*lb/blast*	TSP	40,141	*lb/proj*	21,850	*lb/year*
CO	67	*lb/ton-ANFO*	*AP-42, Table 13.3-1 (ANFO), Rev. 2/80*				
NO_X	17	*lb/ton-ANFO*	*AP-42, Table 13.3-1 (ANFO), Rev. 2/80*				
SO_2	2	*lb/ton-ANFO*	*AP-42, Table 13.3-1 (ANFO), Rev. 2/80*				
PM Scaling Factors							
PM	1						
PM_{10}	0.52		*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*				
$PM_{2.5}$	0.03		*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*				

Emissions	*lb/blast*	*lb/hr **	*ton/yr*	*ton/proj*
PM	5.5	5.5	10.9	20.1
PM_{10}	2.9	2.9	5.7	10.4
$PM_{2.5}$	0.17	0.17	0.33	0.60
CO	712	712	89.0	133
NO_X	181	181	22.6	33.9
SO_2	21.2	21.2	2.7	4.0

** Based on maximum of 1 blasts per day*

Mobile Equipment Combustion

Operational Parameters

Mobile Equipment	Engine Rating kW	Engine Rating hp	Quantity	EPA Tier	Fuel gal/hr	Project Hours	Annual Hours *	Hours Per Unit	
D-9T Dozer	325	436	6	3	22	21,917	14,611	3,653	5T3
Grader Cat 160M (16')	159	213	3	3	11	10,958	7,305	3,653	4T3
Cat 623G Scraper 18-23CY	294	394	3	3	20	10,958	7,305	3,653	5T3
Compactor Vib Cat CB-54C 67"	102	137	2	3	7	5,479	3,653	2,740	3T3
Water Truck (8,000 gallons)	294	394	2	3	20	4,870	3,247	2,435	5T3
Fuel/Lube Truck	224	300	1	3	15	3,456	2,304	3,456	4T3
Cat 336DL 1.56 CY Excavator	200	268	2	3	14	5,479	3,653	2,740	4T3
Cat 980 Loader 7.5 CY	325	436	1	3	22	2,740	1,827	2,740	5T3
Haul Truck 740 CAT	350	469	1	3	24	1,370	913	1,370	5T3
4x4 3/4T Pickup Gas	308	413	3	3	21	11,250	7,500	3,750	5T3

** Scalled down from 18 months to 12 months*

Diesel Emission Factors *

Equipment	PM g/kW-hr	CO g/kW-hr	NO_X g/kW-hr	VOC g/kW-hr
D-9T Dozer	0.2	3.5	4.0	4.0
Grader Cat 160M (16')	0.2	3.5	4.0	4.0
Cat 623G Scraper 18-23CY	0.2	3.5	4.0	4.0
Compactor Vib Cat CB-54C 67"	0.3	5.0	4.0	4.0
Water Truck (8,000 gallons)	0.2	3.5	4.0	4.0
Fuel/Lube Truck	0.2	3.5	4.0	4.0
Cat 336DL 1.56 CY Excavator	0.2	3.5	4.0	4.0
Cat 980 Loader 7.5 CY	0.2	3.5	4.0	4.0
Haul Truck 740 CAT	0.2	3.5	4.0	4.0

** 40 CFR §1039.101, Table 1*

Gasoline Emission Factors *

Equipment	PM g/mi	CO g/mi	NO_X g/mi	SO_2 g/mi	VOC g/mi
4x4 3/4T Pickup Gas	0.099	3.88	0.18	0.01	0.04

** MOVES 2014a*

Fuel Conversions

1.998	SO_2/S	7,000	Btu/hp-hr	AP-42, Table 3.4-1, Footnote e, Diesel, Rev. 10/96
1.341	hp/kw	137,000	Btu/gal	AP-42, Appendix A, Diesel, Rev. 9/85
0.0015%	ppm S in ULSD (GPA 2140)			
7.05	lb/gal			

Mobile Equipment Combustion - Continued

Fleet Emissions

	PM		CO		NO_X		SO_2*		VOC	
Equipment	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
D-9T Dozer	0.86	1.0	15.0	18.3	17.2	20.9	4.6E-3	3.4E-2	17.2	20.9
Grader Cat 160M (16')	0.21	0.26	3.7	4.5	4.2	5.1	2.3E-3	8.5E-3	4.2	5.1
Cat 623G Scraper 18-23CY	0.39	0.47	6.8	8.3	7.8	9.5	4.2E-3	1.5E-2	7.8	9.5
Compactor Vib Cat CB-54C 67"	0.13	0.12	2.2	2.1	1.8	1.6	1.5E-3	2.7E-3	1.8	1.6
Water Truck (8,000 gallons)	0.26	0.21	4.5	3.7	5.2	4.2	4.2E-3	6.9E-3	5.2	4.2
Fuel/Lube Truck	9.9E-2	0.11	1.7	2.0	2.0	2.3	3.2E-3	3.7E-3	2.0	2.3
Cat 336DL 1.56 CY Excavator	0.18	0.16	3.1	2.8	3.5	3.2	3.0E-3	5.4E-3	3.5	3.2
Cat 980 Loader 7.5 CY	0.14	0.13	2.5	2.3	2.9	2.6	4.6E-3	4.2E-3	2.9	2.6
Haul Truck 740 CAT	0.15	7.0E-2	2.7	1.2	3.1	1.4	5.1E-3	2.3E-3	3.1	1.4
4x4 3/4T Pickup Gas	9.8E-3	1.2E-2	0.38	0.48	1.8E-2	2.2E-2	1.8E-2	1.2E-3	4.2E-3	5.2E-3
TOTAL	**2.4**	**2.6**	**42.7**	**45.6**	**47.6**	**50.9**	**5.1E-2**	**8.4E-2**	**47.6**	**50.9**

** SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

Fleet Emissions (18-Month Project)

	PM	CO	NO_X	SO_2*	VOC
Equipment	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*
D-9T Dozer	1.6	27.5	31.4	5.1E-2	31.4
Grader Cat 160M (16')	0.38	6.7	7.7	1.3E-2	7.7
Cat 623G Scraper 18-23CY	0.71	12.4	14.2	2.3E-2	14.2
Compactor Vib Cat CB-54C 67"	0.18	3.1	2.5	4.1E-3	2.5
Water Truck (8,000 gallons)	0.32	5.5	6.3	1.0E-2	6.3
Fuel/Lube Truck	0.17	3.0	3.4	5.5E-3	3.4
Cat 336DL 1.56 CY Excavator	0.24	4.2	4.8	8.1E-3	4.8
Cat 980 Loader 7.5 CY	0.20	3.4	3.9	6.4E-3	3.9
Haul Truck 740 CAT	0.11	1.8	2.1	3.5E-3	2.1
4x4 3/4T Pickup Gas	1.8E-2	0.72	3.3E-2	1.8E-3	7.8E-3
TOTAL	**3.9**	**68.5**	**76.4**	**0.13**	**76.4**

** SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

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Mobile Equipment - Fugitives

Mobile Equipment	Quantity	Project Hours	Annual Hours	Hours Per Unit	Speed * *mph*	Weight ** *ton*	Silt *** *%*
D-9T Dozer	6	21,917	14,611	3,653	*Dozer specs on page 7*		
Grader Cat 160M (16')	3	10,958	7,305	3,653	*Grader specs on page 7*		
Cat 623G Scraper 18-23CY	3	10,958	7,305	3,653	*Scraper specs on page 7*		
Compactor Vib Cat CB-54C 67"	2	5,479	3,653	2,740	2	14.3	3.0
Water Truck (8,000 gallons)	2	4,870	3,247	2,435	15	50.2	3.0
Fuel/Lube Truck	1	3,456	2,304	3,456	15	12.5	3.0
Cat 336DL 1.56 CY Excavator	2	5,479	3,653	2,740	2	38.6	3.0
Cat 980 Loader 7.5 CY	1	2,740	1,827	2,740	2	19.6	3.0
Haul Truck 740 CAT	1	1,370	913	1,370	15	58.3	3.0
4x4 3/4T Pickup Gas	3	11,250	7,500	3,750	15	4.0	3.0
Mean Vehicle Weight						25.7	

** Resolution Copper*

*** Equipment Specification Sheets*

**** Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)* 3 %

Unpaved Roads - Predictive Emission Factor Equation & Constants*

	Empirical Constants for Industrial Roads			
$E = k \times (s / 12)^a \times (W / 3)^b$	Constant	PM	PM_{10}	$PM_{2.5}$
k, a, b - empirical constants	k	4.9	1.5	0.15
s - surface material silt content %	a	0.7	0.9	0.9
W - mean vehicle wt ton	b	0.45	0.45	0.45
P - Days of >0.01" Precip				

**AP-42, 13.2.2, Equation 1a & 2, Table 13.2.2-2, Industrial Roads, Rev. 11/06*

Unpaved Road Controls

	Surface	Reference
E = EF(unctl) x (365 - P) / 365		
Days of >0.01" Precip	58	*West Plant met data 2015-2016 (long-term emissions only)*
Water & Chemical Suppression *	90%	*AP-42, Figure 13.2.2-2, Rev. 11/06*

** Control efficiency is based on AP-42 Chapter 13.2.2, Unpaved Roads. Figure 13.2.2-2 provides the control efficiencies achievable.*

	Emission Factors *(lb/VMT)*			Estimated Emissions (Controlled)								
	PM	PM_{10}	$PM_{2.5}$		PM			PM_{10}			$PM_{2.5}$	
Mobile Equipment				*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*
Compactor Vib Cat CB-54C 67"	4.9	1.1	0.11	2.0	1.5	2.2	0.45	0.35	0.52	4.5E-2	3.5E-2	5.2E-2
Water Truck (8,000 gallons)	4.9	1.1	0.11	14.6	10.0	15.0	3.4	2.3	3.5	0.34	0.23	0.35
Fuel/Lube Truck	4.9	1.1	0.11	7.3	7.1	10.6	1.7	1.6	2.5	0.17	0.16	0.25
Cat 336DL 1.56 CY Excavator	4.9	1.1	0.11	2.0	1.5	2.2	0.45	0.35	0.52	4.5E-2	3.5E-2	5.2E-2
Cat 980 Loader 7.5 CY	4.9	1.1	0.11	0.98	0.75	1.1	0.23	0.17	0.26	2.3E-2	1.7E-2	2.6E-2
Haul Truck 740 CAT	4.9	1.1	0.11	7.3	2.8	4.2	1.7	0.65	0.98	0.17	6.5E-2	9.8E-2
4x4 3/4T Pickup Gas	4.9	1.1	0.11	22.0	23.1	34.6	5.1	5.4	8.0	0.51	0.54	0.80
TOTAL				**56.1**	**46.8**	**70.1**	**13.0**	**10.8**	**16.3**	**1.3**	**1.1**	**1.6**

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Dozing/Grading/Scraping Emissions

Dozing and Grading Emission Factor Equations	*AP-42, 11.9, Table 11.9-1 (overburden), Rev. 7/98.*	Scaling Factors	
		PM_{10}	$PM_{2.5}$
Dozing (PM)	E lb/hr = (5.7 *(s) 1.2) / (M 1.3)		0.105
Dozing (PM_{15})	E lb/hr = (1.0 * (s) 1.5) / (M 1.4)	0.75	
Grading (PM)	E (lb/VMT) = 0.040 * $S^{2.5}$		0.031
Grading (PM_{15})	E (lb/VMT) = 0.051 * $S^{2.0}$	0.6	
s = material silt content %	3.0	*Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)*	
M = material moisture content %	4.0	*Resolution Copper*	
S = mean vehicle speed mph	7.1	*AP-42, Table 11.9-3 (mph)*	

Scraping Emission Factor		*AP-42, 11.9, Table 11.9-4 (topsoil), Rev. 7/98.*	
Topsoil removal by scraper		Scaling Factor	*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*
PM	0.058 *lb/ton*	PM_{10}	$PM_{2.5}$
		0.52	0.03

Scraping Operational Parameters			
Cut Volume	3,503,716	*m^3*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
Specific Gravity	2.75	*g/cm^3*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	10,621,020	*ton/proj*	
	7,080,680	*ton/yr*	
	2,832	*ton/hr*	

Emission Factors

Mobile Equipment	**Unit**	**Emission Factors PM**	**PM_{10}**	**$PM_{2.5}$**
D-9T Dozer	*lb/hr*	3.5	0.56	0.37
Grader Cat 160M (16')*	*lb/VMT*	5.4	1.5	0.17
Cat 623G Scraper 18-23CY	*lb/ton*	5.8E-2	3.0E-2	1.7E-3

Total Emissions

	Estimated Emissions								
	PM			**PM_{10}**			**$PM_{2.5}$**		
Mobile Equipment	***lb/hr***	***ton/yr***	***ton/proj***	***lb/hr***	***ton/yr***	***ton/proj***	***lb/hr***	***ton/yr***	***ton/proj***
D-9T Dozer	21.1	25.7	38.5	3.4	4.1	6.1	2.2	2.7	4.0
Grader Cat 160M (16')	11.4	13.9	20.9	3.3	4.0	6.0	0.35	0.43	0.65
Cat 623G Scraper 18-23CY	164	205	308	85.4	107	160	4.9	6.2	9.2
TOTAL	**197**	**245**	**367**	**92.1**	**115**	**172**	**7.5**	**9.3**	**13.9**

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Employee and Delivery Emissions

Employees and Deliveries

	Max Hourly*			Average Annual**			Average Project		
		Distance (*mi/hr*)			Distance (*mi/yr*)			Distance (*mi/proj*)	
	No. Trips	One Way	RT	No. Trips	One Way	RT	No. Trips	One Way	RT
Employee	519	0.2	0.5	56,500	0.2	0.5	84,750	0.2	0.5
Delivery	11	1.6	3.3	6,269	1.6	3.3	9,404	1.6	3.3

** Traffic Impact Analysis*
*** Resolution Copper MPO*

Combustion Emission Factors *

	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	VOC
	g/VMT	*g/VMT*	*g/VMT*	*g/VMT*	*g/VMT*	*g/VMT*	*g/VMT*
Employee	9.9E-2	9.9E-2	1.8E-2	1.8E-1	9.6E-3	3.9E+0	4.2E-2
Delivery	9.7E-1	9.7E-1	2.8E-1	3.8E+0	1.2E-2	1.3E+0	2.9E-1

** MOVES 2014a*

Mean Vehicle Weight

				Quantity **
Employee		2	*ton*	135,000
Delivery *	Empty	16.5	*ton*	14,237
	Payload	23.5	*ton*	
	Average	28.3	*ton*	
Mean Vehicle Wt		4.5	*ton*	

** Based on typical 18-wheeler and 80,000 lb highway limit*
*** Total number of trips expected for construction fleet*

Unpaved Roads - Equation, Constants, & Emission Factors *

$E = k \times (s / 12)^a \times (W / 3)^b$

		Empirical Constants for Industrial Roads				Emission Factors (*lb/VMT*)		
		Constant	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
k, a, b - empirical constants		k	4.9	1.5	0.15	2.2	0.52	5.2E-2
s - surface material silt content (%) **	3.0	a	0.7	0.9	0.9			
W - mean vehicle wt (*ton*) ***	4.5	b	0.45	0.45	0.45			

** AP-42, 13.2.2, Equations 1a & 2, Table 13.2.2-2, Unpaved Roads, Rev. 11/06*
*** Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)*
**** AP-42, 13.2.2, Equations 1a & 2, Table 13.2.2-2, Unpaved Roads, Rev. 11/08*

Unpaved Road Controls

	Surface	Reference
E = EF(unctl) x (365 - P) / 365		
Days of >0.01" Precip	58	*West Plant met data 2015-2016 (long-term emissions only)*
Water & Chemical Suppression *	90%	*AP-42, Figure 13.2.2-2, Rev. 11/06*

** Control efficiency is based on AP-42 Chapter 13.2.2, Unpaved Roads. Figure 13.2.2-2 provides the control efficiencies achievable.*

Combustion Emissions

	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	VOC
	lb/hr	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*
Employee	5.4E-2	5.4E-2	9.6E-3	9.9E-2	5.3E-3	2.1	2.3E-2
Delivery	7.7E-2	7.7E-2	2.2E-2	0.30	9.4E-4	0.10	2.3E-2
	ton/yr	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*
Employee	3.0E-3	3.0E-3	5.2E-4	5.4E-3	2.9E-4	0.12	1.3E-3
Delivery	2.2E-2	2.2E-2	6.2E-3	8.6E-2	2.7E-4	2.9E-2	6.5E-3
	ton/proj	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*
Employee	4.4E-3	4.4E-3	7.9E-4	8.1E-3	4.3E-4	0.17	1.9E-3
Delivery	3.3E-2	3.3E-2	9.3E-3	0.13	4.0E-4	4.3E-2	9.7E-3

Unpaved Road Emissions (Controlled)

	PM	PM_{10}	$PM_{2.5}$
	lb/hr	*lb/hr*	*lb/hr*
Employee	55.5	12.9	1.3
Delivery	8.0	1.9	0.19
	ton/yr	*ton/yr*	*ton/yr*
Employee	2.5	0.59	5.9E-2
Delivery	1.9	0.44	4.4E-2
	ton/proj	*ton/proj*	*ton/proj*
Employee	3.8	0.88	8.8E-2
Delivery	2.9	0.67	6.7E-2

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Wind Erosion from Exposed Areas

269.4	Maximum Erodible Area (acres)			
2,500	number of disturbance hours (per year)	50	wk/yr	*140023 Construction Emissions 07-26-2017.doc*
0.11	Disturbance Created Every Hour (acre/hr)	5	days/wk	*140023 Construction Emissions 07-26-2017.doc*
Water Sprays & Tactifiers	Control Technology	10	hr/day	*140023 Construction Emissions 07-26-2017.doc*
90%	Control Efficiency			

Emissions (Uncontrolled)

PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
lb/hr	*lb/hr*	*lb/hr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/proj*	*ton/proj*	*ton/proj*
2.5	1.3	0.19	11.0	5.5	0.82	16.4	8.2	1.2

Emissions (Controlled)

PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
lb/hr	*lb/hr*	*lb/hr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/proj*	*ton/proj*	*ton/proj*
0.25	0.13	1.9E-2	1.1	0.55	8.2E-2	1.6	0.82	0.12

AP-42, Sec. 13.2.5

Flat, u/u10+* 0.053 *AP-42, Sec. 13.2.5, p. 5*

(A) u10+ = 1.2 u10 *Fastest mile wind speed at 10m, with a 1.2 factor to convert hourly wind speed to fastest mile.*

(B, piles) u = (Us/Ur) × 0.1 × u10+*

(B, flat) u = 0.053 × u10+* *Threshold Friction Velocity, AZ Cu Mine Tailings*

(C) P = 58 (u - ut*)2 + 25 (u* - ut*); P = 0 for u* ≤ ut*; where ut* =* 0.172 *m/s*

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East Plant Controlled Emissions Summary - Project Total (*ton/proj*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Drilling	0.48	0.23	3.4E-2	--	--	--	--
Blasting	20.1	10.4	0.60	94.8	24.1	2.8	--
Mobile Equipment Combustion	1.9	1.9	1.9	34.2	38.2	6.3E-2	38.2
Mobile Equipment - Fugitives	33.0	7.7	0.77	--	--	--	--
Dozing	19.3	3.1	2.0	--	--	--	--
Grading	10.5	3.0	0.32	--	--	--	--
Scraping	146	76.0	4.4	--	--	--	--
Employee and Delivery - Combustion	5.9E-2	5.9E-2	1.4E-2	0.18	3.0E-3	1.1	2.1E-2
Employee and Delivery - Fugitives	25.1	5.8	0.58	--	--	--	--
Wind Erosion	0.46	0.23	3.5E-2	--	--	--	--
TOTAL	**257**	**108**	**10.7**	**129**	**62.3**	**4.0**	**38.2**

East Plant Controlled Emissions Summary - Annual (*ton/yr*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Drilling	0.48	0.23	3.4E-2	--	--	--	--
Blasting	20.1	10.4	0.60	94.8	24.1	2.8	--
Mobile Equipment Combustion	1.9	1.9	1.9	34.2	38.2	6.3E-2	38.2
Mobile Equipment - Fugitives	33.0	7.7	0.77	--	--	--	--
Dozing	19.3	3.1	2.0	--	--	--	--
Grading	10.5	3.0	0.32	--	--	--	--
Scraping	146	76.0	4.4	--	--	--	--
Employee and Delivery - Combustion	5.9E-2	5.9E-2	1.4E-2	0.18	3.0E-3	1.1	2.1E-2
Employee and Delivery - Fugitives	25.1	5.8	0.58	--	--	--	--
Wind Erosion	0.46	0.23	3.5E-2	--	--	--	--
TOTAL	**257**	**108**	**10.7**	**129**	**62.3**	**4.0**	**38.2**

East Plant Controlled Emissions Summary - Hourly (*lb/hr*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Drilling	0.38	0.18	2.7E-2	--	--	--	--
Blasting	10.2	5.3	0.30	758	192	22.6	--
Mobile Equipment Combustion	2.2	2.2	2.2	37.9	42.2	5.1E-2	42.2
Mobile Equipment - Fugitives	46.9	10.9	1.1	--	--	--	--
Dozing	17.6	2.8	1.8	--	--	--	--
Grading	11.4	3.3	0.35	--	--	--	--
Scraping	117	60.8	3.5	--	--	--	--
Employee and Delivery - Combustion	0.27	0.27	5.8E-2	0.68	1.9E-2	7.2	0.10
Employee and Delivery - Fugitives	195	45.2	4.5	--	--	--	--
Wind Erosion	0.11	5.3E-2	7.9E-3	--	--	--	--
TOTAL	**401**	**131**	**13.9**	**797**	**235**	**29.9**	**42.3**

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Drilling

Project Duration	12	*months*	*Email from K. Ballard (4/13/2018)*
Material Quantity	5,134,891	*tonne/yr*	
	5,134,891	*tonne/proj*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	5,660,242	*ton/yr*	
	5,660,242	*ton/proj*	
	2,264	*ton/hr*	
Operation	250	*days/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	10	*hr/day*	*Resolution Copper Project Technical Memorandum – Construction Emissions*

Emission Factors			**References**
PM_{10}	8.0E-5	*lb/ton*	*AP-42, Table 11.19.2-2 (wet drilling), Rev. 8/04*
PM Scaling Factors			
PM	0.74		*AP-42, Chapter 13.2.4-4, 11/06*
PM_{10}	0.35		*AP-42, Chapter 13.2.4-4, 11/06*
$PM_{2.5}$	0.053		*AP-42, Chapter 13.2.4-4, 11/06*

Emissions	***lb/hr***	***ton/yr***	***ton/proj***
PM	0.38	0.48	0.48
PM_{10}	0.18	0.23	0.23
$PM_{2.5}$	2.7E-2	3.4E-2	3.4E-2

Conversions	
2,000	*lb/ton*
1.1023	*ton/tonne*
3.2808	*ft/m*
100	*cm/m*
453.592	*g/lb*

Blasting

Material Moved	5,134,891	*tonne/proj*	
	5,660,242	*ton/proj*	
	5,660,242	*ton/yr*	
Blasting Agent Use	2,567	*tonne/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	2,830	*ton/yr*	
	2,830	*ton/proj*	
Number of Blasts	250	*blasts/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	250	*blasts/proj*	
	1	*max blasts/day*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
Operation	250	*days/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	10	*hr/day*	*Resolution Copper Project Technical Memorandum – Construction Emissions*

Emission Factors			**References**				
Emission Factor Equation	$TSP = 0.000014 \times A^{1.5}$	*lb/blast*	*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*				
Where, A = Area per Blast	8,073	*ft²*	Where, A = Area per Year	2,018,233	*ft²*	2,018,233	*ft²*
TSP	10.2	*lb/blast*	TSP	40,141	*lb/proj*	40,141	*lb/year*
CO	67	*lb/ton-ANFO*	*AP-42, Table 13.3-1 (ANFO), Rev. 2/80*				
NO_X	17	*lb/ton-ANFO*	*AP-42, Table 13.3-1 (ANFO), Rev. 2/80*				
SO_2	2	*lb/ton-ANFO*	*AP-42, Table 13.3-1 (ANFO), Rev. 2/80*				
PM Scaling Factors							
PM	1						
PM_{10}	0.52		*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*				
$PM_{2.5}$	0.03		*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*				

Emissions	***lb/blast***	***lb/hr ****	***ton/yr***	***ton/proj***
PM	10.2	10.2	20.1	20.1
PM_{10}	5.3	5.3	10.4	10.4
$PM_{2.5}$	0.30	0.30	0.60	0.60
CO	758	758	94.8	94.8
NO_X	192	192	24.1	24.1
SO_2	22.6	22.6	2.8	2.8

** Based on maximum of 1 blasts per day*

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Mobile Equipment Combustion

Operational Parameters

	Engine Rating			EPA	Fuel	Project	Annual	Hours	
Mobile Equipment	*kW*	*hp*	**Quantity**	**Tier**	*gal/hr*	**Hours ***	**Hours**	**Per Unit**	
D-9T Dozer	325	436	5	3	22	10,958	10,958	2,192	5T3
Grader Cat 160M (16')	159	213	3	3	11	5,479	5,479	1,826	4T3
Cat 623G Scraper 18-23CY	294	394	3	3	20	5,479	5,479	1,826	5T3
Compactor Vib Cat CB-54C 67"	102	137	2	3	7	2,740	2,740	1,370	3T3
Water Truck (8,000 gallons)	294	394	1	3	20	2,435	2,435	2,435	5T3
Fuel/Lube Truck	224	300	1	3	15	1,728	1,728	1,728	4T3
Cat 336DL 1.56 CY Excavator	200	268	2	3	14	2,740	2,740	1,370	4T3
Cat 980 Loader 7.5 CY	325	436	1	3	22	1,370	1,370	1,370	5T3
Haul Truck 740 CAT	350	469	1	3	24	685	685	685	5T3
4x4 3/4T Pickup Gas	308	413	3	3	21	5,625	5,625	1,875	5T3

** Project duration is expected to be 12 months*

Diesel Emission Factors *

	PM	CO	NO_X	VOC
Equipment	*g/kW-hr*	*g/kW-hr*	*g/kW-hr*	*g/kW-hr*
D-9T Dozer	0.2	3.5	4.0	4.0
Grader Cat 160M (16')	0.2	3.5	4.0	4.0
Cat 623G Scraper 18-23CY	0.2	3.5	4.0	4.0
Compactor Vib Cat CB-54C 67"	0.3	5.0	4.0	4.0
Water Truck (8,000 gallons)	0.2	3.5	4.0	4.0
Fuel/Lube Truck	0.2	3.5	4.0	4.0
Cat 336DL 1.56 CY Excavator	0.2	3.5	4.0	4.0
Cat 980 Loader 7.5 CY	0.2	3.5	4.0	4.0
Haul Truck 740 CAT	0.2	3.5	4.0	4.0

** 40 CFR §1039.101, Table 1*

Gasoline Emission Factors *

	PM	CO	NO_X	SO_2	VOC
Equipment	*g/mi*	*g/mi*	*g/mi*	*g/mi*	*g/mi*
4x4 3/4T Pickup Gas	0.099	3.88	0.18	0.01	0.04

** MOVES 2014a*

Fuel Conversions

1.998	SO_2/S	7,000	*Btu/hp-hr*	*AP-42, Table 3.4-1, Footnote e, Diesel, Rev. 10/96*
1.341	*hp/kw*	137,000	*Btu/gal*	*AP-42, Appendix A, Diesel, Rev. 9/85*
0.0015%	*ppm S in ULSD (GPA 2140)*			
7.05	*lb/gal*			

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Mobile Equipment Combustion - Continued

Fleet Emissions

	PM		CO		NO_X		SO_2 *		VOC	
Equipment	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
D-9T Dozer	0.72	0.79	12.5	13.7	14.3	15.7	4.6E-3	2.5E-2	14.3	15.7
Grader Cat 160M (16')	0.21	0.19	3.7	3.4	4.2	3.8	2.3E-3	6.4E-3	4.2	3.8
Cat 623G Scraper 18-23CY	0.39	0.36	6.8	6.2	7.8	7.1	4.2E-3	1.2E-2	7.8	7.1
Compactor Vib Cat CB-54C 67"	0.13	9.2E-2	2.2	1.5	1.8	1.2	1.5E-3	2.0E-3	1.8	1.2
Water Truck (8,000 gallons)	0.13	0.16	2.3	2.8	2.6	3.2	4.2E-3	5.1E-3	2.6	3.2
Fuel/Lube Truck	9.9E-2	8.5E-2	1.7	1.5	2.0	1.7	3.2E-3	2.7E-3	2.0	1.7
Cat 336DL 1.56 CY Excavator	0.18	0.12	3.1	2.1	3.5	2.4	3.0E-3	4.1E-3	3.5	2.4
Cat 980 Loader 7.5 CY	0.14	9.8E-2	2.5	1.7	2.9	2.0	4.6E-3	3.2E-3	2.9	2.0
Haul Truck 740 CAT	0.15	5.3E-2	2.7	0.92	3.1	1.1	5.1E-3	1.7E-3	3.1	1.1
4x4 3/4T Pickup Gas	9.8E-3	9.2E-3	0.38	0.36	1.8E-2	1.7E-2	1.8E-2	8.9E-4	4.2E-3	3.9E-3
TOTAL	**2.2**	**1.9**	**37.9**	**34.2**	**42.2**	**38.2**	**5.1E-2**	**6.3E-2**	**42.2**	**38.2**

** SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

Fleet Emissions (12-Month Project)

	PM	CO	NO_X	SO_2 *	VOC
Equipment	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*
D-9T Dozer	0.79	13.7	15.7	2.5E-2	15.7
Grader Cat 160M (16')	0.19	3.4	3.8	6.4E-3	3.8
Cat 623G Scraper 18-23CY	0.36	6.2	7.1	1.2E-2	7.1
Compactor Vib Cat CB-54C 67"	9.2E-2	1.5	1.2	2.0E-3	1.2
Water Truck (8,000 gallons)	0.16	2.8	3.2	5.1E-3	3.2
Fuel/Lube Truck	8.5E-2	1.5	1.7	2.7E-3	1.7
Cat 336DL 1.56 CY Excavator	0.12	2.1	2.4	4.1E-3	2.4
Cat 980 Loader 7.5 CY	9.8E-2	1.7	2.0	3.2E-3	2.0
Haul Truck 740 CAT	5.3E-2	0.92	1.1	1.7E-3	1.1
4x4 3/4T Pickup Gas	9.2E-3	0.36	1.7E-2	8.9E-4	3.9E-3
TOTAL	**1.9**	**34.2**	**38.2**	**6.3E-2**	**38.2**

** SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

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Mobile Equipment - Fugitives

Mobile Equipment	Quantity	Project Hours	Annual Hours	Hours Per Unit	Speed * *mph*	Weight ** *ton*	Silt *** *%*
D-9T Dozer	5	10,958	10,958	2,192	*Dozer specs on page 7*		
Grader Cat 160M (16')	3	5,479	5,479	1,826	*Grader specs on page 7*		
Cat 623G Scraper 18-23CY	3	5,479	5,479	1,826	*Scraper specs on page 7*		
Compactor Vib Cat CB-54C 67"	2	2,740	2,740	1,370	2	14.3	3.0
Water Truck (8,000 gallons)	1	2,435	2,435	2,435	15	50.2	3.0
Fuel/Lube Truck	1	1,728	1,728	1,728	15	12.5	3.0
Cat 336DL 1.56 CY Excavator	2	2,740	2,740	1,370	2	38.6	3.0
Cat 980 Loader 7.5 CY	1	1,370	1,370	1,370	2	19.6	3.0
Haul Truck 740 CAT	1	685	685	685	15	58.3	3.0
4x4 3/4T Pickup Gas	3	5,625	5,625	1,875	15	4.0	3.0
Mean Vehicle Weight						23.5	

** Resolution Copper*

*** Equipment Specification Sheets*

**** Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)* 3 %

Unpaved Roads - Predictive Emission Factor Equation & Constants*

	Empirical Constants for Industrial Roads			
$E = k \times (s / 12)^a \times (W / 3)^b$	Constant	PM	PM_{10}	$PM_{2.5}$
k, a, b - empirical constants	k	4.9	1.5	0.15
s - surface material silt content %	a	0.7	0.9	0.9
W - mean vehicle wt ton	b	0.45	0.45	0.45
P - Days of >0.01" Precip				

**AP-42, 13.2.2, Equation 1a & 2, Table 13.2.2-2, Industrial Roads, Rev. 11/06*

Unpaved Road Controls

	Surface	Reference
E = EF(unctl) x (365 - P) / 365		
Days of >0.01" Precip	64	*East Plant met data 2015-2016 (long-term emissions only)*
Water & Chemical Suppression *	90%	*AP-42, Figure 13.2.2-2, Rev. 11/06*

** Control efficiency is based on AP-42 Chapter 13.2.2, Unpaved Roads. Figure 13.2.2-2 provides the control efficiencies achievable.*

	Emission Factors *(lb/VMT)*			Estimated Emissions (Controlled)								
	PM	PM_{10}	$PM_{2.5}$	PM			PM_{10}			$PM_{2.5}$		
Mobile Equipment				*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*
Compactor Vib Cat CB-54C 67"	4.7	1.1	0.11	1.9	1.1	1.1	0.43	0.25	0.25	4.3E-2	2.5E-2	2.5E-2
Water Truck (8,000 gallons)	4.7	1.1	0.11	7.0	7.1	7.1	1.6	1.6	1.6	0.16	0.16	0.16
Fuel/Lube Truck	4.7	1.1	0.11	7.0	5.0	5.0	1.6	1.2	1.2	0.16	0.12	0.12
Cat 336DL 1.56 CY Excavator	4.7	1.1	0.11	1.9	1.1	1.1	0.43	0.25	0.25	4.3E-2	2.5E-2	2.5E-2
Cat 980 Loader 7.5 CY	4.7	1.1	0.11	0.94	0.53	0.53	0.22	0.12	0.12	2.2E-2	1.2E-2	1.2E-2
Haul Truck 740 CAT	4.7	1.1	0.11	7.0	2.0	2.0	1.6	0.46	0.46	0.16	4.6E-2	4.6E-2
4x4 3/4T Pickup Gas	4.7	1.1	0.11	21.1	16.3	16.3	4.9	3.8	3.8	0.49	0.38	0.38
TOTAL				**46.9**	**33.0**	**33.0**	**10.9**	**7.7**	**7.7**	**1.1**	**0.77**	**0.77**

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Dozing/Grading/Scraping Emissions

Dozing and Grading Emission Factor Equations *AP-42, 11.9, Table 11.9-1 (overburden), Rev. 7/98.*

		Scaling Factors PM_{10}	Scaling Factors $PM_{2.5}$
Dozing (PM)	E lb/hr = (5.7 *(s) 1.2) / (M 1.3)		0.105
Dozing (PM_{15})	E lb/hr = (1.0 * (s) 1.5) / (M 1.4)	0.75	
Grading (PM)	E (lb/VMT) = 0.040 * $S^{2.5}$		0.031
Grading (PM_{15})	E (lb/VMT) = 0.051 * $S^{2.0}$	0.6	

s = material silt content %	3.0	*Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)*
M = material moisture content %	4.0	*Resolution Copper*
S = mean vehicle speed mph	7.1	*AP-42, Table 11.9-3 (mph)*

Scraping Emission Factor *AP-42, 11.9, Table 11.9-4 (topsoil), Rev. 7/98.*

Topsoil removal by scraper — Scaling Factor — *AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*

		Scaling Factor PM_{10}	Scaling Factor $PM_{2.5}$
PM	0.058 *lb/ton*	0.52	0.03

Scraping Operational Parameters

Cut Volume	1,867,233	*m^3*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
Specific Gravity	2.45	*g/cm^3*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	5,042,771	*ton/proj*	
	5,042,771	*ton/yr*	
	2,017	*ton/hr*	

Emission Factors

Mobile Equipment	**Unit**	**Emission Factors PM**	**PM_{10}**	**$PM_{2.5}$**
D-9T Dozer	*lb/hr*	3.5	0.56	0.37
Grader Cat 160M (16')*	*lb/VMT*	5.4	1.5	0.17
Cat 623G Scraper 18-23CY	*lb/ton*	5.8E-2	3.0E-2	1.7E-3

Total Emissions

	Estimated Emissions								
	PM			**PM_{10}**			**$PM_{2.5}$**		
Mobile Equipment	***lb/hr***	***ton/yr***	***ton/proj***	***lb/hr***	***ton/yr***	***ton/proj***	***lb/hr***	***ton/yr***	***ton/proj***
D-9T Dozer	17.6	19.3	19.3	2.8	3.1	3.1	1.8	2.0	2.0
Grader Cat 160M (16')	11.4	10.5	10.5	3.3	3.0	3.0	0.35	0.32	0.32
Cat 623G Scraper 18-23CY	117	146	146	60.8	76.0	76.0	3.5	4.4	4.4
TOTAL	**146**	**176**	**176**	**66.9**	**82.1**	**82.1**	**5.7**	**6.7**	**6.7**

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Employee and Delivery Emissions

Employees and Deliveries

	Max Hourly*			Average Annual**			Average Project		
		Distance (*mi/hr*)			Distance (*mi/yr*)			Distance (*mi/proj*)	
	No. Trips	One Way	RT	No. Trips	One Way	RT	No. Trips	One Way	RT
Employee	219	1.9	3.8	63,750	1.9	3.8	63,750	1.9	3.8
Delivery	11	1.9	3.8	7,968	1.9	3.8	7,968	1.9	3.8

** Traffic Impact Analysis*
*** Resolution Copper MPO*

Combustion Emission Factors *

	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	VOC
	g/VMT	*g/VMT*	*g/VMT*	*g/VMT*	*g/VMT*	*g/VMT*	*g/VMT*
Employee	9.9E-2	9.9E-2	1.8E-2	1.8E-1	9.6E-3	3.9E+0	4.2E-2
Delivery	9.7E-1	9.7E-1	2.8E-1	3.8E+0	1.2E-2	1.3E+0	2.9E-1

** MOVES 2014a*

Mean Vehicle Weight				Quantity **
Employee		2	*ton*	135,000
Delivery *	Empty	16.5	*ton*	14,237
	Payload	23.5	*ton*	
	Average	28.3	*ton*	
Mean Vehicle Wt		4.5	*ton*	

** Based on typical 18-wheeler and 80,000 lb highway limit*
*** Total number of trips expected for construction fleet*

Unpaved Roads - Equation, Constants, & Emission Factors *

$E = k \times (s / 12)^a \times (W / 3)^b$

		Empirical Constants for Industrial Roads				Emission Factors (*lb/VMT*)		
		Constant	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
k, a, b - empirical constants		k	4.9	1.5	0.15	2.2	0.52	5.2E-2
s - surface material silt content (*%*) **	3.0	a	0.7	0.9	0.9			
W - mean vehicle wt (*ton*) ***	4.5	b	0.45	0.45	0.45			

** AP-42, 13.2.2, Equations 1a & 2, Table 13.2.2-2, Unpaved Roads, Rev. 11/06*
*** Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)*
**** AP-42, 13.2.2, Equations 1a & 2, Table 13.2.2-2, Unpaved Roads, Rev. 11/08*

Unpaved Road Controls

	Surface	Reference
E = EF(unctl) x (365 - P) / 365		
Days of >0.01'' Precip	64	*East Plant met data 2015-2016 (long-term emissions only)*
Water & Chemical Suppression *	90%	*AP-42, Figure 13.2.2-2, Rev. 11/06*

** Control efficiency is based on AP-42 Chapter 13.2.2, Unpaved Roads. Figure 13.2.2-2 provides the control efficiencies achievable.*

Combustion Emissions

	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	VOC
	lb/hr	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*
Employee	0.18	0.18	3.2E-2	0.33	1.8E-2	7.1	7.7E-2
Delivery	8.9E-2	8.9E-2	2.5E-2	0.35	1.1E-3	0.12	2.7E-2
	ton/yr	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*
Employee	2.6E-2	2.6E-2	4.7E-3	4.8E-2	2.6E-3	1.0	1.1E-2
Delivery	3.2E-2	3.2E-2	9.2E-3	0.13	4.0E-4	4.3E-2	9.6E-3
	ton/proj	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*
Employee	2.6E-2	2.6E-2	4.7E-3	4.8E-2	2.6E-3	1.0	1.1E-2
Delivery	3.2E-2	3.2E-2	9.2E-3	0.13	4.0E-4	4.3E-2	9.6E-3

Unpaved Road Emissions (Controlled)

	PM	PM_{10}	$PM_{2.5}$
	lb/hr	*lb/hr*	*lb/hr*
Employee	186	43.0	4.3
Delivery	9.3	2.2	0.22
	ton/yr	*ton/yr*	*ton/yr*
Employee	22.3	5.2	0.52
Delivery	2.8	0.65	6.5E-2
	ton/proj	*ton/proj*	*ton/proj*
Employee	22.3	5.2	0.52
Delivery	2.8	0.65	6.5E-2

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Wind Erosion from Exposed Areas

121.8	Maximum Erodible Area (acres)			
2,500	number of disturbance hours (per year)	50	wk/yr	*140023 Construction Emissions 07-26-2017.doc*
0.05	Disturbance Created Every Hour (acre/hr)	5	days/wk	*140023 Construction Emissions 07-26-2017.doc*
Water Sprays & Tactifiers	Control Technology	10	hr/day	*140023 Construction Emissions 07-26-2017.doc*
90%	Control Efficiency			

Emissions (Uncontrolled)

PM	**PM_{10}**	**$PM_{2.5}$**	**PM**	**PM_{10}**	**$PM_{2.5}$**	**PM**	**PM_{10}**	**$PM_{2.5}$**
lb/hr	***lb/hr***	***lb/hr***	***ton/yr***	***ton/yr***	***ton/yr***	***ton/proj***	***ton/proj***	***ton/proj***
1.1	0.53	7.9E-2	4.6	2.3	0.35	4.6	2.3	0.35

Emissions (Controlled)

PM	**PM_{10}**	**$PM_{2.5}$**	**PM**	**PM_{10}**	**$PM_{2.5}$**	**PM**	**PM_{10}**	**$PM_{2.5}$**
lb/hr	***lb/hr***	***lb/hr***	***ton/yr***	***ton/yr***	***ton/yr***	***ton/proj***	***ton/proj***	***ton/proj***
0.11	5.3E-2	7.9E-3	0.46	0.23	3.5E-2	0.46	0.23	3.5E-2

AP-42, Sec. 13.2.5

Flat, u/u10+* 0.053 *AP-42, Sec. 13.2.5, p. 5*

(A) u10+ = 1.2 u10 *Fastest mile wind speed at 10m, with a 1.2 factor to convert hourly wind speed to fastest mile.*

(B, piles) u = (Us/Ur) × 0.1 × u10+*

(B, flat) u = 0.053 × u10+* *Threshold Friction Velocity, AZ Cu Mine Tailings*

(C) P = 58 (u - ut*)2 + 25 (u* - ut*); P = 0 for u* ≤ ut*; where ut* =* 0.172 *m/s*

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Filter Plant Controlled Emissions Summary - Project Total (*ton/proj*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Drilling	--	--	--	--	--	--	--
Blasting	--	--	--	--	--	--	--
Mobile Equipment Combustion	1.2	1.2	1.2	20.8	23.0	3.8E-2	23.0
Mobile Equipment - Fugitives	35.1	8.1	0.81	--	--	--	--
Dozing	6.1	0.97	0.64	--	--	--	--
Grading	3.3	0.95	0.10	--	--	--	--
Scraping	42.6	22.1	1.3	--	--	--	--
Employee and Delivery - Combustion	1.8E-2	1.8E-2	3.3E-3	3.4E-2	1.8E-3	0.72	7.8E-3
Employee and Delivery - Fugitives	15.9	3.7	0.37	--	--	--	--
Wind Erosion	0.30	0.15	2.2E-2	--	--	--	--
TOTAL	**104**	**37.2**	**4.4**	**20.8**	**23.0**	**0.76**	**23.0**

Filter Plant Controlled Emissions Summary - Annual (*ton/yr*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Drilling	--	--	--	--	--	--	--
Blasting	--	--	--	--	--	--	--
Mobile Equipment Combustion	0.79	0.79	0.79	13.8	15.3	2.5E-2	15.3
Mobile Equipment - Fugitives	23.4	5.4	0.54	--	--	--	--
Dozing	4.1	0.65	0.43	--	--	--	--
Grading	2.2	0.63	6.8E-2	--	--	--	--
Scraping	28.4	14.8	0.85	--	--	--	--
Employee and Delivery - Combustion	1.2E-2	1.2E-2	2.2E-3	2.2E-2	1.2E-3	0.48	5.2E-3
Employee and Delivery - Fugitives	10.6	2.5	0.25	--	--	--	--
Wind Erosion	0.20	9.8E-2	1.5E-2	--	--	--	--
TOTAL	**69.7**	**24.8**	**2.9**	**13.9**	**15.3**	**0.51**	**15.3**

Filter Plant Controlled Emissions Summary - Hourly (*lb/hr*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Drilling	--	--	--	--	--	--	--
Blasting	--	--	--	--	--	--	--
Mobile Equipment Combustion	1.0	1.0	1.0	18.0	20.0	3.9E-2	20.0
Mobile Equipment - Fugitives	33.6	7.8	0.78	--	--	--	--
Dozing	3.5	0.56	0.37	--	--	--	--
Grading	3.8	1.1	0.12	--	--	--	--
Scraping	22.7	11.8	0.68	--	--	--	--
Employee and Delivery - Combustion	5.0E-2	5.0E-2	8.9E-3	9.1E-2	4.8E-3	2.0	2.1E-2
Employee and Delivery - Fugitives	51.1	11.9	1.2	--	--	--	--
Wind Erosion	4.5E-2	2.2E-2	3.4E-3	--	--	--	--
TOTAL	**116**	**34.2**	**4.2**	**18.1**	**20.1**	**2.0**	**20.1**

Blue entries are entered values, black entries are calculated or linked

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Drilling

Project Duration	18	*months*	*Email from K. Ballard (4/13/2018)*
Material Quantity	0	*tonne/yr*	
	0	*tonne/proj*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	0	*ton/yr*	
	0	*ton/proj*	
	0	*ton/hr*	
Operation	250	*days/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	10	*hr/day*	*Resolution Copper Project Technical Memorandum – Construction Emissions*

Emission Factors			**References**
PM_{10}	8.0E-5	*lb/ton*	*AP-42, Table 11.19.2-2 (wet drilling), Rev. 8/04*
PM Scaling Factors			
PM	0.74		*AP-42, Chapter 13.2.4-4, 11/06*
PM_{10}	0.35		*AP-42, Chapter 13.2.4-4, 11/06*
$PM_{2.5}$	0.053		*AP-42, Chapter 13.2.4-4, 11/06*

Emissions	*lb/hr*	*ton/yr*	*ton/proj*
PM	--	--	--
PM_{10}	--	--	--
$PM_{2.5}$	--	--	--

Conversions	
2,000	*lb/ton*
1.1023	*ton/tonne*
3.2808	*ft/m*
100	*cm/m*
453.592	*g/lb*

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Blasting

Material Moved	0	*tonne/proj*	
	0	*ton/proj*	
	0	*ton/yr*	
Blasting Agent Use	0	*tonne/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	0	*ton/yr*	
	0	*ton/proj*	
Number of Blasts	0	*blasts/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	0	*blasts/proj*	
	0	*max blasts/day*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
Operation	250	*days/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	10	*hr/day*	*Resolution Copper Project Technical Memorandum – Construction Emissions*

Emission Factors			**References**				
Emission Factor Equation	$TSP = 0.000014 \times A^{1.5}$	*lb/blast*	*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*				
Where, A = Area per Blast	0	*ft²*	Where, A = Area per Year	0	*ft²*	0	*ft²*
TSP	0.0	*lb/blast*	TSP	0	*lb/proj*	0	*lb/year*
CO	67	*lb/ton-ANFO*	*AP-42, Table 13.3-1 (ANFO), Rev. 2/80*				
NO_X	17	*lb/ton-ANFO*	*AP-42, Table 13.3-1 (ANFO), Rev. 2/80*				
SO_2	2	*lb/ton-ANFO*	*AP-42, Table 13.3-1 (ANFO), Rev. 2/80*				
PM Scaling Factors							
PM	1						
PM_{10}	0.52		*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*				
$PM_{2.5}$	0.03		*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*				

Emissions	*lb/blast*	*lb/hr **	*ton/yr*	*ton/proj*
PM	--	--	--	--
PM_{10}	--	--	--	--
$PM_{2.5}$	--	--	--	--
CO	--	--	--	--
NO_X	--	--	--	--
SO_2	--	--	--	--

** Based on maximum of 0 blasts per day*

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Mobile Equipment Combustion

Operational Parameters

Mobile Equipment	Engine Rating kW	Engine Rating hp	Quantity	EPA Tier	Fuel gal/hr	Project Hours	Annual Hours *	Hours Per Unit	
D-9T Dozer	325	436	1	3	22	3,466	2,311	3,466	5T3
Grader Cat 160M (16')	159	213	1	3	11	1,733	1,155	1,733	4T3
Cat 623G Scraper 18-23CY	294	394	1	3	20	1,899	1,266	1,899	5T3
Compactor Vib Cat CB-54C 67"	102	137	1	3	7	2,847	1,898	2,847	3T3
Water Truck (8,000 gallons)	294	394	1	3	20	3,466	2,311	3,466	5T3
Fuel/Lube Truck	224	300	1	3	15	2,880	1,920	2,880	4T3
Cat 336DL 1.56 CY Excavator	200	268	1	3	14	2,880	1,920	2,880	4T3
Cat 980 Loader 7.5 CY	325	436	1	3	22	1,440	960	1,440	5T3
Haul Truck 740 CAT	350	469	1	3	24	720	480	720	5T3
4x4 3/4T Pickup Gas	308	413	1	3	21	2,880	1,920	2,880	5T3

** Scalled down from 18 months to 12 months*

Diesel Emission Factors *

Equipment	PM g/kW-hr	CO g/kW-hr	NO_X g/kW-hr	VOC g/kW-hr
D-9T Dozer	0.2	3.5	4.0	4.0
Grader Cat 160M (16')	0.2	3.5	4.0	4.0
Cat 623G Scraper 18-23CY	0.2	3.5	4.0	4.0
Compactor Vib Cat CB-54C 67"	0.3	5.0	4.0	4.0
Water Truck (8,000 gallons)	0.2	3.5	4.0	4.0
Fuel/Lube Truck	0.2	3.5	4.0	4.0
Cat 336DL 1.56 CY Excavator	0.2	3.5	4.0	4.0
Cat 980 Loader 7.5 CY	0.2	3.5	4.0	4.0
Haul Truck 740 CAT	0.2	3.5	4.0	4.0

** 40 CFR §1039.101, Table 1*

Gasoline Emission Factors *

Equipment	PM g/mi	CO g/mi	NO_X g/mi	SO_2 g/mi	VOC g/mi
4x4 3/4T Pickup Gas	0.099	3.88	0.18	0.01	0.04

** MOVES 2014a*

Fuel Conversions

1.998	SO_2/S	7,000	Btu/hp-hr	AP-42, Table 3.4-1, Footnote e, Diesel, Rev. 10/96
1.341	hp/kw	137,000	Btu/gal	AP-42, Appendix A, Diesel, Rev. 9/85
0.0015%	ppm S in ULSD (GPA 2140)			
7.05	lb/gal			

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Mobile Equipment Combustion - Continued

Fleet Emissions

	PM		CO		NO_X		SO_2*		VOC	
Equipment	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
D-9T Dozer	0.14	0.17	2.5	2.9	2.9	3.3	4.6E-3	5.4E-3	2.9	3.3
Grader Cat 160M (16')	7.0E-2	4.0E-2	1.2	0.71	1.4	0.81	2.3E-3	1.3E-3	1.4	0.81
Cat 623G Scraper 18-23CY	0.13	8.2E-2	2.3	1.4	2.6	1.6	4.2E-3	2.7E-3	2.6	1.6
Compactor Vib Cat CB-54C 67"	6.7E-2	6.4E-2	1.1	1.1	0.90	0.85	1.5E-3	1.4E-3	0.90	0.85
Water Truck (8,000 gallons)	0.13	0.15	2.3	2.6	2.6	3.0	4.2E-3	4.9E-3	2.6	3.0
Fuel/Lube Truck	9.9E-2	9.5E-2	1.7	1.7	2.0	1.9	3.2E-3	3.0E-3	2.0	1.9
Cat 336DL 1.56 CY Excavator	8.8E-2	8.5E-2	1.5	1.5	1.8	1.7	3.0E-3	2.8E-3	1.8	1.7
Cat 980 Loader 7.5 CY	0.14	6.9E-2	2.5	1.2	2.9	1.4	4.6E-3	2.2E-3	2.9	1.4
Haul Truck 740 CAT	0.15	3.7E-2	2.7	0.65	3.1	0.74	5.1E-3	1.2E-3	3.1	0.74
4x4 3/4T Pickup Gas	3.3E-3	3.1E-3	0.13	0.12	6.0E-3	5.7E-3	6.0E-3	3.0E-4	1.4E-3	1.3E-3
TOTAL	**1.0**	**0.79**	**18.0**	**13.8**	**20.0**	**15.3**	**3.9E-2**	**2.5E-2**	**20.0**	**15.3**

** SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

Fleet Emissions (18-Month Project)

	PM	CO	NO_X	SO_2*	VOC
Equipment	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*
D-9T Dozer	0.25	4.3	5.0	8.1E-3	5.0
Grader Cat 160M (16')	6.1E-2	1.1	1.2	2.0E-3	1.2
Cat 623G Scraper 18-23CY	0.12	2.2	2.5	4.0E-3	2.5
Compactor Vib Cat CB-54C 67"	9.6E-2	1.6	1.3	2.1E-3	1.3
Water Truck (8,000 gallons)	0.22	3.9	4.5	7.3E-3	4.5
Fuel/Lube Truck	0.14	2.5	2.8	4.6E-3	2.8
Cat 336DL 1.56 CY Excavator	0.13	2.2	2.5	4.3E-3	2.5
Cat 980 Loader 7.5 CY	0.10	1.8	2.1	3.3E-3	2.1
Haul Truck 740 CAT	5.6E-2	0.97	1.1	1.8E-3	1.1
4x4 3/4T Pickup Gas	4.7E-3	0.18	8.6E-3	4.6E-4	2.0E-3
TOTAL	**1.2**	**20.8**	**23.0**	**3.8E-2**	**23.0**

** SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

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Mobile Equipment - Fugitives

Mobile Equipment	Quantity	Project Hours	Annual Hours	Hours Per Unit	Speed * *mph*	Weight ** *ton*	Silt *** *%*
D-9T Dozer	1	3,466	2,311	3,466	*Dozer specs on page 7*		
Grader Cat 160M (16')	1	1,733	1,155	1,733	*Grader specs on page 7*		
Cat 623G Scraper 18-23CY	1	1,899	1,266	1,899	*Grader specs on page 7*		
Compactor Vib Cat CB-54C 67"	1	2,847	1,898	2,847	2	14.3	3.0
Water Truck (8,000 gallons)	1	3,466	2,311	3,466	15	50.2	3.0
Fuel/Lube Truck	1	2,880	1,920	2,880	15	12.5	3.0
Cat 336DL 1.56 CY Excavator	1	2,880	1,920	2,880	2	38.6	3.0
Cat 980 Loader 7.5 CY	1	1,440	960	1,440	2	19.6	3.0
Haul Truck 740 CAT	1	720	480	720	15	58.3	3.0
4x4 3/4T Pickup Gas	1	2,880	1,920	2,880	15	4.0	3.0
Mean Vehicle Weight						28.2	

** Resolution Copper*

*** Equipment Specification Sheets*

**** Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)* 3 %

Unpaved Roads - Predictive Emission Factor Equation & Constants*

	Empirical Constants for Industrial Roads			
$E = k \times (s / 12)^a \times (W / 3)^b$	Constant	PM	PM_{10}	$PM_{2.5}$
k, a, b - empirical constants	k	4.9	1.5	0.15
s - surface material silt content %	a	0.7	0.9	0.9
W - mean vehicle wt ton	b	0.45	0.45	0.45
P - Days of >0.01" Precip				

**AP-42, 13.2.2, Equation 1a & 2, Table 13.2.2-2, Industrial Roads, Rev. 11/06*

Unpaved Road Controls

	Surface	Reference
E = EF(unctl) x (365 - P) / 365		
Days of >0.01" Precip	57	*Hewitt met data 2015-2016 (long-term emissions only)*
Water & Chemical Suppression *	90%	*AP-42, Figure 13.2.2-2, Rev. 11/06*

** Control efficiency is based on AP-42 Chapter 13.2.2, Unpaved Roads. Figure 13.2.2-2 provides the control efficiencies achievable.*

	Emission Factors *(lb/VMT)*			Estimated Emissions (Controlled)								
	PM	PM_{10}	$PM_{2.5}$	PM			PM_{10}			$PM_{2.5}$		
Mobile Equipment				*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*
Compactor Vib Cat CB-54C 67"	5.1	1.2	0.12	1.0	0.82	1.2	0.24	0.19	0.28	2.4E-2	1.9E-2	2.8E-2
Water Truck (8,000 gallons)	5.1	1.2	0.12	7.6	7.4	11.2	1.8	1.7	2.6	0.18	0.17	0.26
Fuel/Lube Truck	5.1	1.2	0.12	7.6	6.2	9.3	1.8	1.4	2.2	0.18	0.14	0.22
Cat 336DL 1.56 CY Excavator	5.1	1.2	0.12	1.0	0.82	1.2	0.24	0.19	0.29	2.4E-2	1.9E-2	2.9E-2
Cat 980 Loader 7.5 CY	5.1	1.2	0.12	1.0	0.41	0.62	0.24	9.6E-2	0.14	2.4E-2	9.6E-3	1.4E-2
Haul Truck 740 CAT	5.1	1.2	0.12	7.6	1.5	2.3	1.8	0.36	0.54	0.18	3.6E-2	5.4E-2
4x4 3/4T Pickup Gas	5.1	1.2	0.12	7.6	6.2	9.3	1.8	1.4	2.2	0.18	0.14	0.22
TOTAL				**33.6**	**23.4**	**35.1**	**7.8**	**5.4**	**8.1**	**0.78**	**0.54**	**0.81**

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Dozing/Grading/Scraping Emissions

Dozing and Grading Emission Factor Equations *AP-42, 11.9, Table 11.9-1 (overburden), Rev. 7/98.*

		Scaling Factors PM_{10}	Scaling Factors $PM_{2.5}$
Dozing (PM)	E lb/hr = (5.7 *(s) 1.2) / (M 1.3)		0.105
Dozing (PM_{15})	E lb/hr = (1.0 * (s) 1.5) / (M 1.4)	0.75	
Grading (PM)	E (lb/VMT) = 0.040 * $S^{2.5}$		0.031
Grading (PM_{15})	E (lb/VMT) = 0.051 * $S^{2.0}$	0.6	

s = material silt content %	3.0	*Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)*
M = material moisture content %	4.0	*Resolution Copper*
S = mean vehicle speed mph	7.1	*AP-42, Table 11.9-3 (mph)*

Scraping Emission Factor *AP-42, 11.9, Table 11.9-4 (topsoil), Rev. 7/98.*

Topsoil removal by scraper		Scaling Factor PM_{10}	Scaling Factor $PM_{2.5}$
PM	0.058 *lb/ton*	0.52	0.03

AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)

Scraping Operational Parameters

Cut Volume	484,240 *m^3*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
Specific Gravity	2.75 *g/cm^3*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	1,467,905 *ton/proj*	
	978,603 *ton/yr*	
	391 *ton/hr*	

Emission Factors

Mobile Equipment	Unit	PM	PM_{10}	$PM_{2.5}$
D-9T Dozer	*lb/hr*	3.5	0.56	0.37
Grader Cat 160M (16')*	*lb/VMT*	5.4	1.5	0.17
Cat 623G Scraper 18-23CY	*lb/ton*	5.8E-2	3.0E-2	1.7E-3

Total Emissions

	Estimated Emissions								
	PM			PM_{10}			$PM_{2.5}$		
Mobile Equipment	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*
D-9T Dozer	3.5	4.1	6.1	0.56	0.65	0.97	0.37	0.43	0.64
Grader Cat 160M (16')	3.8	2.2	3.3	1.1	0.63	0.95	0.12	6.8E-2	0.10
Cat 623G Scraper 18-23CY	22.7	28.4	42.6	11.8	14.8	22.1	0.68	0.85	1.3
TOTAL	**30.0**	**34.6**	**52.0**	**13.5**	**16.0**	**24.1**	**1.2**	**1.3**	**2.0**

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Employee and Delivery Emissions

Employees and Deliveries

	Max Hourly*			Average Annual**			Average Project		
		Distance (*mi/hr*)			Distance (*mi/yr*)			Distance (*mi/proj*)	
	No. Trips	One Way	RT	No. Trips	One Way	RT	No. Trips	One Way	RT
Employee	30	3.8	7.6	14,750	3.8	7.6	22,125	3.8	7.6
Delivery	8	1.3	2.6	Combined with WPS and TSF			Combined with WPS and TSF		

** Traffic Impact Analysis*
*** Resolution Copper MPO*

Combustion Emission Factors *

	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	VOC
	g/VMT	*g/VMT*	*g/VMT*	*g/VMT*	*g/VMT*	*g/VMT*	*g/VMT*
Employee	9.9E-2	9.9E-2	1.8E-2	1.8E-1	9.6E-3	3.9E+0	4.2E-2
Delivery	9.7E-1	9.7E-1	2.8E-1	3.8E+0	1.2E-2	1.3E+0	2.9E-1

** MOVES 2014a*

Mean Vehicle Weight

Mean Vehicle Weight				Quantity **
Employee		2	*ton*	135,000
Delivery *	Empty	16.5	*ton*	14,237
	Payload	23.5	*ton*	
	Average	28.3	*ton*	
Mean Vehicle Wt		4.5	*ton*	

** Based on typical 18-wheeler and 80,000 lb highway limit*
*** Total number of trips expected for construction fleet*

Unpaved Roads - Equation, Constants, & Emission Factors *

$E = k \times (s / 12)^a \times (W / 3)^b$

		Empirical Constants for Industrial Roads				Emission Factors (*lb/VMT*)		
		Constant	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
k, a, b - empirical constants		k	4.9	1.5	0.15	2.2	0.52	5.2E-2
s - surface material silt content (%) **	3.0	a	0.7	0.9	0.9			
W - mean vehicle wt (*ton*) ***	4.5	b	0.45	0.45	0.45			

** AP-42, 13.2.2, Equations 1a & 2, Table 13.2.2-2, Unpaved Roads, Rev. 11/06*
*** Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)*
**** AP-42, 13.2.2, Equations 1a & 2, Table 13.2.2-2, Unpaved Roads, Rev. 11/08*

Unpaved Road Controls

	Surface	Reference
E = EF(unctl) x (365 - P) / 365		
Days of >0.01" Precip	57	*Hewitt met data 2015-2016 (long-term emissions only)*
Water & Chemical Suppression *	90%	*AP-42, Figure 13.2.2-2, Rev. 11/06*

** Control efficiency is based on AP-42 Chapter 13.2.2, Unpaved Roads. Figure 13.2.2-2 provides the control efficiencies achievable.*

Combustion Emissions

	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	VOC
	lb/hr	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*
Employee	5.0E-2	5.0E-2	8.9E-3	9.1E-2	4.8E-3	2.0	2.1E-2
Delivery	--	--	--	--	--	--	--
	ton/yr	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*
Employee	1.2E-2	1.2E-2	2.2E-3	2.2E-2	1.2E-3	0.48	5.2E-3
Delivery	--	--	--	--	--	--	--
	ton/proj	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*
Employee	1.8E-2	1.8E-2	3.3E-3	3.4E-2	1.8E-3	0.72	7.8E-3
Delivery	--	--	--	--	--	--	--

Unpaved Road Emissions (Controlled)

	PM	PM_{10}	$PM_{2.5}$
	lb/hr	*lb/hr*	*lb/hr*
Employee	51.1	11.9	1.2
Delivery	--	--	--
	ton/yr	*ton/yr*	*ton/yr*
Employee	10.6	2.5	0.25
Delivery	--	--	--
	ton/proj	*ton/proj*	*ton/proj*
Employee	15.9	3.7	0.37
Delivery	--	--	--

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Wind Erosion from Exposed Areas

48.5	Maximum Erodible Area (acres)			
2,500	number of disturbance hours (per year)	50	wk/yr	*140023 Construction Emissions 07-26-2017.doc*
0.02	Disturbance Created Every Hour (acre/hr)	5	days/wk	*140023 Construction Emissions 07-26-2017.doc*
Water Sprays & Tactifiers	Control Technology	10	hr/day	*140023 Construction Emissions 07-26-2017.doc*
90%	Control Efficiency			

Emissions (Uncontrolled)

PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
lb/hr	*lb/hr*	*lb/hr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/proj*	*ton/proj*	*ton/proj*
0.45	0.22	3.4E-2	2.0	0.98	0.15	3.0	1.5	0.22

Emissions (Controlled)

PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
lb/hr	*lb/hr*	*lb/hr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/proj*	*ton/proj*	*ton/proj*
4.5E-2	2.2E-2	3.4E-3	0.20	9.8E-2	1.5E-2	0.30	0.15	2.2E-2

AP-42, Sec. 13.2.5

Flat, u/u10+* *0.053* *AP-42, Sec. 13.2.5, p. 5*

(A) u10+ = 1.2 u10 *Fastest mile wind speed at 10m, with a 1.2 factor to convert hourly wind speed to fastest mile.*

(B, piles) u = (Us/Ur) × 0.1 × u10+*

(B, flat) u = 0.053 × u10+* *Threshold Friction Velocity, AZ Cu Mine Tailings*

(C) P = 58 (u - ut*)2 + 25 (u* - ut*); P = 0 for u* ≤ ut*; where ut* =* *0.172* *m/s*

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Tailings Corridor Controlled Emissions Summary - Project Total (*ton/proj*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Drilling	0.026	0.012	0.002	--	--	--	--
Blasting	0.29	0.153	0.009	7.80	1.98	0.23	--
Mobile Equipment Combustion	1.26	1.26	1.26	22.07	23.87	0.04	23.86
Mobile Equipment - Fugitives	140	58.1	4.7	--	--	--	--
Dozing	9.4	1.5	0.99	--	--	--	--
Grading	8.2	2.3	0.25	--	--	--	--
Scraping	90.1	46.8	2.7	--	--	--	--
Employee and Delivery - Combustion							
Employee and Delivery - Fugitives				--	--	--	--
Wind Erosion	0.25	0.13	1.9E-2	--	--	--	--
TOTAL	**249**	**110**	**9.9**	**29.9**	**25.9**	**0.27**	**23.9**

Tailings Corridor Controlled Emissions Summary - Annual (*ton/yr*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Drilling	0.018	0.008	0.001	--	--	--	--
Blasting	0.16	0.08	0.005	5.20	1.32	0.16	--
Mobile Equipment Combustion	0.84	0.84	0.84	14.72	15.92	0.03	15.91
Mobile Equipment - Fugitives	93.2	38.8	3.1	--	--	--	--
Dozing	6.3	1.00	0.66	--	--	--	--
Grading	5.5	1.6	0.17	--	--	--	--
Scraping	60.0	31.2	1.8	--	--	--	--
Employee and Delivery - Combustion							
Employee and Delivery - Fugitives				--	--	--	--
Wind Erosion	0.17	8.4E-2	1.3E-2	--	--	--	--
TOTAL	**166**	**73.6**	**6.6**	**19.9**	**17.2**	**0.18**	**15.9**

Tailings Corridor Controlled Emissions Summary - Hourly (*lb/hr*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Drilling	0.01	0.01	0.00	--	--	--	--
Blasting	0.08	0.04	0.00	41.61	10.56	1.24	--
Mobile Equipment Combustion	1.31	1.31	1.31	22.86	25.22	0.04	25.21
Mobile Equipment - Fugitives	102	37.4	3.3	--	--	--	--
Dozing	7.0	1.1	0.74	--	--	--	--
Grading	7.6	2.2	0.24	--	--	--	--
Scraping	48.0	25.0	1.4	--	--	--	--
Employee and Delivery - Combustion							
Employee and Delivery - Fugitives				--	--	--	--
Wind Erosion	3.8E-2	1.9E-2	2.9E-3	--	--	--	--
TOTAL	**166**	**67.1**	**7.1**	**64.5**	**35.8**	**1.3**	**25.2**

Blue entries are entered values, black entries are calculated or linked

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Drilling

Project Duration	18	*months*	*Email from Resolution (4/13/2018)*
Material Quantity	187,803	*tonne/yr*	
	281,705	*tonne/proj*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	207,017	*ton/yr*	
	310,526	*ton/proj*	
	83	*ton/hr*	
Operation	250	*days/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	10	*hr/day*	*Resolution Copper Project Technical Memorandum – Construction Emissions*

Emission Factors			**References**
PM_{10}	8.0E-5	*lb/ton*	*AP-42, Table 11.19.2-2 (wet drilling), Rev. 8/04*
PM Scaling Factors			
PM	0.74		*AP-42, Chapter 13.2.4-4, 11/06*
PM_{10}	0.35		*AP-42, Chapter 13.2.4-4, 11/06*
$PM_{2.5}$	0.053		*AP-42, Chapter 13.2.4-4, 11/06*

Emissions	***lb/hr***	***ton/yr***	***ton/proj***
PM	0.014	0.018	0.026
PM_{10}	0.007	0.008	0.012
$PM_{2.5}$	0.001	0.001	0.002

Conversions	
2,000	*lb/ton*
1.1023	*ton/tonne*
3.2808	*ft/m*
100	*cm/m*
453.592	*g/lb*

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Blasting

Material Moved	281,705	*tonne/proj*	
	310,526	*ton/proj*	
	207,017	*ton/yr*	
Blasting Agent Use	140.9	*tonne/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	155	*ton/yr*	
	233	*ton/proj*	
Number of Blasts	250	*blasts/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	375	*blasts/proj*	
	1	*max blasts/day*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
Operation	250	*days/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	10	*hr/day*	*Resolution Copper Project Technical Memorandum – Construction Emissions*

Emission Factors			References				
Emission Factor Equation	$TSP = 0.000014 \times A^{1.5}$	*lb/blast*	*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*				
Where, A = Area per Blast	323	*ft²*	Where, A = Area per Year	121,094	*ft²*	80,729	*ft²*
TSP	0.1	*lb/blast*	TSP	590	*lb/proj*	321	*lb/year*
CO	67	*lb/ton-ANFO*	*AP-42, Table 13.3-1 (ANFO), Rev. 2/80*				
NO_X	17	*lb/ton-ANFO*	*AP-42, Table 13.3-1 (ANFO), Rev. 2/80*				
SO_2	2	*lb/ton-ANFO*	*AP-42, Table 13.3-1 (ANFO), Rev. 2/80*				
PM Scaling Factors							
PM	1						
PM_{10}	0.52		*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*				
$PM_{2.5}$	0.03		*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*				

Emissions	*lb/blast*	*lb/hr **	*ton/yr*	*ton/proj*
PM	8.1E-2	8.1E-2	0.16	0.29
PM_{10}	4.2E-2	4.2E-2	8.3E-2	0.15
$PM_{2.5}$	2.4E-3	2.4E-3	4.8E-3	8.8E-3
CO	41.6	41.6	5.2	7.8
NO_X	10.6	10.6	1.3	2.0
SO_2	1.2	1.2	0.16	0.23

** Based on maximum of 1 blasts per day*

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Mobile Equipment Combustion

Operational Parameters

	Engine Rating			EPA	Fuel	Project	Annual	Hours	
Mobile Equipment	*kW*	*hp*	**Quantity**	**Tier**	*gal/hr*	**Hours**	**Hours ***	**Per Unit**	
D-9T Dozer	325	436	2	3	22	5,359	3,573	2,680	5T3
Grader Cat 160M (16')	159	213	2	3	11	4,287	2,858	2,144	4T3
Cat 623G Scraper 18-23CY	294	394	1	3	20	1,308	872	1,308	5T3
Compactor Vib Cat CB-54C 67"	102	137	2	3	7	4,922	3,281	2,461	3T3
Water Truck (8,000 gallons)	294	394	1	3	20	1,786	1,191	1,786	5T3
Fuel/Lube Truck	224	300	1	3	15	1,250	833	1,250	4T3
Cat 336DL 1.56 CY Excavator	200	268	1	3	14	2,880	1,920	2,880	4T3
Cat 980 Loader 7.5 CY	325	436	1	3	22	1,440	960	1,440	5T3
Haul Truck 740 CAT	350	469	1	3	24	720	480	720	5T3
4x4 3/4T Pickup Gas	308	413	2	3	21	5,760	3,840	2,880	5T3

** Scalled down from 18 months to 12 months*

Diesel Emission Factors *

	PM	CO	NO_X	VOC
Equipment	*g/kW-hr*	*g/kW-hr*	*g/kW-hr*	*g/kW-hr*
D-9T Dozer	0.2	3.5	4.0	4.0
Grader Cat 160M (16')	0.2	3.5	4.0	4.0
Cat 623G Scraper 18-23CY	0.2	3.5	4.0	4.0
Compactor Vib Cat CB-54C 67"	0.3	5.0	4.0	4.0
Water Truck (8,000 gallons)	0.2	3.5	4.0	4.0
Fuel/Lube Truck	0.2	3.5	4.0	4.0
Cat 336DL 1.56 CY Excavator	0.2	3.5	4.0	4.0
Cat 980 Loader 7.5 CY	0.2	3.5	4.0	4.0
Haul Truck 740 CAT	0.2	3.5	4.0	4.0

** 40 CFR §1039.101, Table 1*

Gasoline Emission Factors *

	PM	CO	NO_X	SO_2	VOC
Equipment	*g/mi*	*g/mi*	*g/mi*	*g/mi*	*g/mi*
4x4 3/4T Pickup Gas	0.099	3.88	0.18	0.01	0.04

** MOVES 2014a*

Fuel Conversions

1.998	*SO_2/S*	7,000	*Btu/hp-hr*	*AP-42, Table 3.4-1, Footnote e, Diesel, Rev. 10/96*
1.341	*hp/kw*	137,000	*Btu/gal*	*AP-42, Appendix A, Diesel, Rev. 9/85*
0.0015%	*ppm S in ULSD (GPA 2140)*			
7.05	*lb/gal*			

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Mobile Equipment Combustion - Continued

Fleet Emissions

	PM		CO		NO_X		SO_2*		VOC	
Equipment	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
D-9T Dozer	0.29	0.26	5.0	4.5	5.7	5.1	4.6E-3	8.3E-3	5.7	5.1
Grader Cat 160M (16')	0.14	0.10	2.5	1.8	2.8	2.0	2.3E-3	3.3E-3	2.8	2.0
Cat 623G Scraper 18-23CY	0.13	5.7E-2	2.3	0.99	2.6	1.1	4.2E-3	1.8E-3	2.6	1.1
Compactor Vib Cat CB-54C 67"	0.13	0.11	2.2	1.8	1.8	1.5	1.5E-3	2.4E-3	1.8	1.5
Water Truck (8,000 gallons)	0.13	7.7E-2	2.3	1.4	2.6	1.5	4.2E-3	2.5E-3	2.6	1.5
Fuel/Lube Truck	9.9E-2	4.1E-2	1.7	0.72	2.0	0.82	3.2E-3	1.3E-3	2.0	0.82
Cat 336DL 1.56 CY Excavator	8.8E-2	8.5E-2	1.5	1.5	1.8	1.7	3.0E-3	2.8E-3	1.8	1.7
Cat 980 Loader 7.5 CY	0.14	6.9E-2	2.5	1.2	2.9	1.4	4.6E-3	2.2E-3	2.9	1.4
Haul Truck 740 CAT	0.15	3.7E-2	2.7	0.65	3.1	0.74	5.1E-3	1.2E-3	3.1	0.74
4x4 3/4T Pickup Gas	3.3E-3	6.3E-3	0.13	0.25	6.0E-3	1.1E-2	6.0E-3	6.1E-4	1.4E-3	2.7E-3
TOTAL	**1.3**	**0.84**	**22.9**	**14.7**	**25.2**	**15.9**	**3.9E-2**	**2.7E-2**	**25.2**	**15.9**

** SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

Fleet Emissions (18-Month Project)

	PM	CO	NO_X	SO_2*	VOC
Equipment	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*
D-9T Dozer	0.38	6.7	7.7	1.2E-2	7.7
Grader Cat 160M (16')	0.15	2.6	3.0	5.0E-3	3.0
Cat 623G Scraper 18-23CY	8.5E-2	1.5	1.7	2.8E-3	1.7
Compactor Vib Cat CB-54C 67"	0.17	2.8	2.2	3.6E-3	2.2
Water Truck (8,000 gallons)	0.12	2.0	2.3	3.8E-3	2.3
Fuel/Lube Truck	6.2E-2	1.1	1.2	2.0E-3	1.2
Cat 336DL 1.56 CY Excavator	0.13	2.2	2.5	4.3E-3	2.5
Cat 980 Loader 7.5 CY	0.10	1.8	2.1	3.3E-3	2.1
Haul Truck 740 CAT	5.6E-2	0.97	1.1	1.8E-3	1.1
4x4 3/4T Pickup Gas	9.4E-3	0.37	1.7E-2	9.1E-4	4.0E-3
TOTAL	**1.3**	**22.1**	**23.9**	**4.0E-2**	**23.9**

** SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

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Mobile Equipment - Fugitives

Mobile Equipment	Quantity	Project Hours	Annual Hours	Hours Per Unit	Speed * *mph*	Weight ** *ton*	Silt *** *%*
D-9T Dozer	2	5,359	3,573	2,680	*Dozer specs on page 7*		
Grader Cat 160M (16')	2	4,287	2,858	2,144	*Grader specs on page 7*		
Cat 623G Scraper 18-23CY	1	1,308	872	1,308	*Scraper specs on page 7*		
Compactor Vib Cat CB-54C 67"	2	4,922	3,281	2,461	2	14.3	3.0
Water Truck (8,000 gallons)	1	1,786	1,191	1,786	15	50.2	3.0
Fuel/Lube Truck	1	1,250	833	1,250	15	12.5	3.0
Cat 336DL 1.56 CY Excavator	1	2,880	1,920	2,880	2	38.6	3.0
Cat 980 Loader 7.5 CY	1	1,440	960	1,440	2	19.6	3.0
Haul Truck 740 CAT	1	720	480	720	15	58.3	3.0
4x4 3/4T Pickup Gas	2	5,760	3,840	2,880	15	4.0	3.0
Mean Vehicle Weight						24.0	

** Resolution Copper*

*** Equipment Specification Sheets*

**** Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)* 3 %

Unpaved Roads - Predictive Emission Factor Equation & Constants*

	Empirical Constants for Industrial Roads			
$E = k \times (s / 12)^a \times (W / 3)^b$	Constant	PM	PM_{10}	$PM_{2.5}$
k, a, b - empirical constants	k	4.9	1.5	0.15
s - surface material silt content %	a	0.7	0.9	0.9
W - mean vehicle wt ton	b	0.45	0.45	0.45
P - Days of >0.01" Precip				

**AP-42, 13.2.2, Equation 1a & 2, Table 13.2.2-2, Industrial Roads, Rev. 11/06*

Unpaved Road Controls

	Surface	Reference
E = EF(unctl) x (365 - P) / 365		
Days of >0.01" Precip	57	*Hewitt met data 2015-2016 (long-term emissions only)*
Water & Chemical Suppression *	90%	*AP-42, Figure 13.2.2-2, Rev. 11/06*

** Control efficiency is based on AP-42 Chapter 13.2.2, Unpaved Roads. Figure 13.2.2-2 provides the control efficiencies achievable.*

	Emission Factors *(lb/VMT)*			Estimated Emissions (Controlled)								
	PM	PM_{10}	$PM_{2.5}$	PM			PM_{10}			$PM_{2.5}$		
Mobile Equipment				*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*
Compactor Vib Cat CB-54C 67"	4.7	1.1	0.11	1.9	1.3	2.0	0.44	0.30	0.46	4.4E-2	3.0E-2	4.6E-2
Water Truck (8,000 gallons)	4.7	1.1	0.11	7.1	3.6	5.3	1.6	0.83	1.2	0.16	8.3E-2	0.12
Fuel/Lube Truck	4.7	1.1	0.11	7.1	2.5	3.7	1.6	0.58	0.87	0.16	5.8E-2	8.7E-2
Cat 336DL 1.56 CY Excavator	4.7	1.1	0.11	0.95	0.77	1.1	0.22	0.18	0.27	2.2E-2	1.8E-2	2.7E-2
Cat 980 Loader 7.5 CY	4.7	1.1	0.11	0.95	0.38	0.57	0.22	8.9E-2	0.13	2.2E-2	8.9E-3	1.3E-2
Haul Truck 740 CAT	4.7	1.1	0.11	7.1	1.4	2.2	1.6	0.33	0.50	0.16	3.3E-2	5.0E-2
4x4 3/4T Pickup Gas	4.7	1.1	0.11	14.2	11.5	17.2	3.3	2.7	4.0	0.33	0.27	0.40
TOTAL				**39.3**	**21.5**	**32.2**	**9.1**	**5.0**	**7.5**	**0.91**	**0.50**	**0.75**

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Dozing/Grading/Scraping Emissions

Dozing and Grading Emission Factor Equations *AP-42, 11.9, Table 11.9-1 (overburden), Rev. 7/98.*

		Scaling Factors	
		PM_{10}	$PM_{2.5}$
Dozing (PM)	E lb/hr = (5.7 *(s) 1.2) / (M 1.3)		0.105
Dozing (PM_{15})	E lb/hr = (1.0 * (s) 1.5) / (M 1.4)	0.75	
Grading (PM)	E (lb/VMT) = 0.040 * S $^{2.5}$		0.031
Grading (PM_{15})	E (lb/VMT) = 0.051 * S $^{2.0}$	0.6	

s = material silt content %	3.0	*Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)*
M = material moisture content %	4.0	*Resolution Copper*
S = mean vehicle speed mph	7.1	*AP-42, Table 11.9-3 (mph)*

Scraping Emission Factor *AP-42, 11.9, Table 11.9-4 (topsoil), Rev. 7/98.*

Topsoil removal by scraper — Scaling Factor *AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*

			PM_{10}	$PM_{2.5}$
PM	0.058	*lb/ton*	0.52	0.03

Scraping Operational Parameters

Cut Volume	1,024,380	*m^3*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
Specific Gravity	2.75	*g/cm^3*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	3,105,263	*ton/proj*	
	2,070,175	*ton/yr*	
	828	*ton/hr*	

Emission Factors

		Emission Factors		
Mobile Equipment	**Unit**	**PM**	**PM_{10}**	**$PM_{2.5}$**
D-9T Dozer	*lb/hr*	3.5	0.56	0.37
Grader Cat 160M (16')*	*lb/VMT*	5.4	1.5	0.17
Cat 623G Scraper 18-23CY	*lb/ton*	5.8E-2	3.0E-2	1.7E-3

Total Emissions

	Estimated Emissions								
		PM			**PM_{10}**			**$PM_{2.5}$**	
Mobile Equipment	***lb/hr***	***ton/yr***	***ton/proj***	***lb/hr***	***ton/yr***	***ton/proj***	***lb/hr***	***ton/yr***	***ton/proj***
D-9T Dozer	7.0	6.3	9.4	1.1	1.00	1.5	0.74	0.66	0.99
Grader Cat 160M (16')	7.6	5.5	8.2	2.2	1.6	2.3	0.24	0.17	0.25
Cat 623G Scraper 18-23CY	48.0	60.0	90.1	25.0	31.2	46.8	1.4	1.8	2.7
TOTAL	**62.7**	**71.8**	**108**	**28.3**	**33.8**	**50.7**	**2.4**	**2.6**	**3.9**

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Employee and Delivery Emissions

Employees and Deliveries*

	Max Hourly			**Average Annual**			**Average Project**		
		Distance (*mi/hr*)			Distance (*mi/yr*)			Distance (*mi/proj*)	
	No. Trips	One Way	RT	No. Trips	One Way	RT	No. Trips	One Way	RT
Employee	0			Combined with WPS			Combined with WPS		
Delivery	0			0	0.0	0.0	0	0.0	0.0

** No Additional Deliveries or Employees Expected for Corridor Construction*

Combustion Emission Factors *

	PM	**PM_{10}**	**$PM_{2.5}$**	**NO_X**	**SO_2**	**CO**	**VOC**
	g/VMT	***g/VMT***	***g/VMT***	***g/VMT***	***g/VMT***	***g/VMT***	***g/VMT***
Employee	9.9E-2	9.9E-2	1.8E-2	1.8E-1	9.6E-3	3.9E+0	4.2E-2
Delivery	9.7E-1	9.7E-1	2.8E-1	3.8E+0	1.2E-2	1.3E+0	2.9E-1

** MOVES 2014a*

Mean Vehicle Weight				**Quantity** **
Employee		2	*ton*	0
Delivery *	Empty	16.5	*ton*	0
	Payload	23.5	*ton*	
	Average	28.3	*ton*	
Mean Vehicle Wt			*ton*	

** Based on typical 18-wheeler and 80,000 lb highway limit*
*** Total number of trips expected for construction fleet*

Unpaved Roads - Equation, Constants, & Emission Factors *

$E = k \times (s / 12)^a \times (W / 3)^b$

		Empirical Constants for Industrial Roads				**Emission Factors (*lb/VMT*)**		
		Constant	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
k, a, b - empirical constants		k	4.9	1.5	0.15			
s - surface material silt content (*%*) **	3.0	a	0.7	0.9	0.9			
W - mean vehicle wt (*ton*) ***		b	0.45	0.45	0.45			

** AP-42, 13.2.2, Equations 1a & 2, Table 13.2.2-2, Unpaved Roads, Rev. 11/06*
*** Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)*
**** AP-42, 13.2.2, Equations 1a & 2, Table 13.2.2-2, Unpaved Roads, Rev. 11/08*

Unpaved Road Controls

	Surface	**Reference**
E = EF(unctl) x (365 - P) / 365		
Days of >0.01" Precip	57	*Hewitt met data 2015-2016 (long-term emissions only)*
Water & Chemical Suppression *	90%	*AP-42, Figure 13.2.2-2, Rev. 11/06*

** Control efficiency is based on AP-42 Chapter 13.2.2, Unpaved Roads. Figure 13.2.2-2 provides the control efficiencies achievable.*

Combustion Emissions

	PM	**PM_{10}**	**$PM_{2.5}$**	**NO_X**	**SO_2**	**CO**	**VOC**
	lb/hr	***lb/hr***	***lb/hr***	***lb/hr***	***lb/hr***	***lb/hr***	***lb/hr***
Employee	--	--	--	--	--	--	--
Delivery	--	--	--	--	--	--	--
	ton/yr	***ton/yr***	***ton/yr***	***ton/yr***	***ton/yr***	***ton/yr***	***ton/yr***
Employee	--	--	--	--	--	--	--
Delivery							
	ton/proj	***ton/proj***	***ton/proj***	***ton/proj***	***ton/proj***	***ton/proj***	***ton/proj***
Employee	--	--	--	--	--	--	--
Delivery							

Unpaved Road Emissions (Controlled)

	PM	**PM_{10}**	**$PM_{2.5}$**
	lb/hr	***lb/hr***	***lb/hr***
Employee	--	--	--
Delivery	--	--	--
	ton/yr	***ton/yr***	***ton/yr***
Employee			
Delivery			
	ton/proj	***ton/proj***	***ton/proj***
Employee	--	--	--
Delivery			

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Wind Erosion from Exposed Areas

45.4	Maximum Erodible Area (acres)			
2,500	number of disturbance hours (per year)	50	wk/yr	*140023 Construction Emissions 07-26-2017.doc*
0.02	Disturbance Created Every Hour (acre/hr)	5	days/wk	*140023 Construction Emissions 07-26-2017.doc*
Water Sprays & Tactifiers	Control Technology	10	hr/day	*140023 Construction Emissions 07-26-2017.doc*
90%	Control Efficiency			

Emissions (Uncontrolled)

PM	**PM_{10}**	**$PM_{2.5}$**	**PM**	**PM_{10}**	**$PM_{2.5}$**	**PM**	**PM_{10}**	**$PM_{2.5}$**
lb/hr	***lb/hr***	***lb/hr***	***ton/yr***	***ton/yr***	***ton/yr***	***ton/proj***	***ton/proj***	***ton/proj***
0.38	0.19	2.9E-2	1.7	0.84	0.13	2.5	1.3	0.19

Emissions (Controlled)

PM	**PM_{10}**	**$PM_{2.5}$**	**PM**	**PM_{10}**	**$PM_{2.5}$**	**PM**	**PM_{10}**	**$PM_{2.5}$**
lb/hr	***lb/hr***	***lb/hr***	***ton/yr***	***ton/yr***	***ton/yr***	***ton/proj***	***ton/proj***	***ton/proj***
3.8E-2	1.9E-2	2.9E-3	0.17	8.4E-2	1.3E-2	0.25	0.13	1.9E-2

AP-42, Sec. 13.2.5

Flat, u/u10+* 0.053 *AP-42, Sec. 13.2.5, p. 5*

(A) u10+ = 1.2 u10 *Fastest mile wind speed at 10m, with a 1.2 factor to convert hourly wind speed to fastest mile.*

(B, piles) u = (Us/Ur) × 0.1 × u10+*

(B, flat) u = 0.053 × u10+* *Threshold Friction Velocity, AZ Cu Mine Tailings*

(C) P = 58 (u - ut*)2 + 25 (u* - ut*); P = 0 for u* ≤ ut*; where ut* =* 0.172 *m/s*

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Tailings Storage Facility (Alternative 2) Controlled Emissions Summary - Project Total (*ton/proj*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Drilling	2.1	0.97	0.15	--	--	--	--
Blasting	56.8	29.5	1.7	408	103	12.2	--
Crushing and Screening	445.1	162.6	24.6	--	--	--	--
Combustion	14.9	14.9	14.9	259	317	0.48	317
Mobile Equipment - Fugitives	520	121	12.1	--	--	--	--
Dozing	47.3	7.5	5.0	--	--	--	--
Grading				--	--	--	--
Scraping	90.1	46.8	2.7	--	--	--	--
Employee and Delivery - Combustion	--	--	--	--	--	--	--
Employee and Delivery - Fugitives	--	--	--	--	--	--	--
Wind Erosion	14.0	7.0	1.1	--	--	--	--
TOTAL	**1,190**	**390**	**62.1**	**667**	**421**	**12.6**	**317**

Tailings Storage Facility (Alternative 2) Controlled Emissions Summary - Annual (*ton/yr*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Drilling	0.69	0.32	4.9E-2	--	--	--	--
Blasting	10.9	5.7	0.33	136	34.5	4.1	--
Crushing and Screening	148.4	54.2	8.2	--	--	--	--
Combustion	5.0	5.0	5.0	86.3	106	0.16	106
Mobile Equipment - Fugitives	173	40.2	4.0	--	--	--	--
Dozing	15.8	2.5	1.7	--	--	--	--
Grading				--	--	--	--
Scraping	30.0	15.6	0.90	--	--	--	--
Employee and Delivery - Combustion	--	--	--	--	--	--	--
Employee and Delivery - Fugitives	--	--	--	--	--	--	--
Wind Erosion	4.7	2.3	0.35	--	--	--	--
TOTAL	**389**	**126**	**20.5**	**222**	**140**	**4.2**	**106**

Tailings Storage Facility (Alternative 2) Controlled Emissions Summary - Hourly (*lb/hr*)

	PM	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2	VOC
Drilling	0.55	0.26	3.9E-2	--	--	--	--
Blasting	5.5	2.9	0.17	986	250	29.4	--
Crushing and Screening	33.9	12.4	1.9	--	--	--	--
Combustion	3.9	3.9	3.9	67.4	79.9	4.2E-2	79.9
Mobile Equipment - Fugitives	182	42.2	4.2	--	--	--	--
Dozing	14.1	2.2	1.5	--	--	--	--
Grading				--	--	--	--
Scraping	24.0	12.5	0.72	--	--	--	--
Employee and Delivery - Combustion	--	--	--	--	--	--	--
Employee and Delivery - Fugitives	--	--	--	--	--	--	--
Wind Erosion	1.3	0.63	9.5E-2	--	--	--	--
TOTAL	**265**	**76.9**	**12.5**	**1,054**	**330**	**29.5**	**79.9**

Blue entries are entered values, black entries are calculated or linked

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Drilling

Project Duration	36	*months*	*Email from K. Ballard (4/13/2018)*
Material Quantity	7,358,841	*tonne/yr*	
	22,076,523	*tonne/proj*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	8,111,724	*ton/yr*	
	24,335,172	*ton/proj*	
	3,245	*ton/hr*	
Operation	250	*days/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	10	*hr/day*	*Resolution Copper Project Technical Memorandum – Construction Emissions*

Emission Factors			**References**
PM_{10}	8.0E-5	*lb/ton*	*AP-42, Table 11.19.2-2 (wet drilling), Rev. 8/04*
PM Scaling Factors			
PM	0.74		*AP-42, Chapter 13.2.4-4, 11/06*
PM_{10}	0.35		*AP-42, Chapter 13.2.4-4, 11/06*
$PM_{2.5}$	0.053		*AP-42, Chapter 13.2.4-4, 11/06*

Emissions	***lb/hr***	***ton/yr***	***ton/proj***
PM	0.55	0.69	2.1
PM_{10}	0.26	0.32	0.97
$PM_{2.5}$	3.9E-2	4.9E-2	0.15

Conversions	
2,000	*lb/ton*
1.1023	*ton/tonne*
3.2808	*ft/m*
100	*cm/m*
453.592	*g/lb*

Blasting

Material Moved	22,076,523	*tonne/proj*	
	24,335,172	*ton/proj*	
	8,111,724	*ton/yr*	
Blasting Agent Use	11,038.3	*tonne/proj*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	12,168	*ton/proj*	
	4,056	*ton/yr*	
Number of Blasts	750	*blasts/proj*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	250	*blasts/yr*	
	1	*max blasts/day*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
Operation	250	*days/yr*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	10	*hr/day*	*Resolution Copper Project Technical Memorandum – Construction Emissions*

Emission Factors			**References**				
Emission Factor Equation	$TSP = 0.000014 \times A^{1.5}$	*lb/blast*	*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*				
Where, A = Area per Blast	5,382	*ft*^{2}	Where, A = Area per Year	4,036,467	*ft*^{2}	1,345,489	*ft*^{2}
TSP	5.5	*lb/blast*	TSP	113,535	*lb/proj*	21,850	*lb/year*
CO	67	*lb/ton-ANFO*	*AP-42, Table 13.3-1 (ANFO), Rev. 2/80*				
NO_X	17	*lb/ton-ANFO*	*AP-42, Table 13.3-1 (ANFO), Rev. 2/80*				
SO_2	2	*lb/ton-ANFO*	*AP-42, Table 13.3-1 (ANFO), Rev. 2/80*				
PM Scaling Factors							
PM	1						
PM_{10}	0.52		*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*				
$PM_{2.5}$	0.03		*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*				

Emissions	*lb/blast*	*lb/hr **	*ton/yr*	*ton/proj*
PM	5.5	5.5	10.9	56.8
PM_{10}	2.9	2.9	5.7	29.5
$PM_{2.5}$	0.17	0.17	0.33	1.7
CO	986	986	136	408
NO_X	250	250	34.5	103
SO_2	29.4	29.4	4.1	12.2

** Based on maximum of 1 blasts per day*

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Crushing and Screening

Ore Crushed	8,884,277	*ton/yr*
	1,014	*ton/hr*
Operation	365	*days/yr*
	24	*hr/day*
	8,760	*hr/yr*

Emission Factors	PM	PM_{10}	$PM_{2.5}$	Unit	References
Crusher	0.0054	0.0024	0.00036	*lb/ton*	*AP-42, Table 11.19.2-2 (08/04) Tert. Crush. - unctrl.; $PM_{2.5}$ = PM_{10} *(0.053/0.35)*
Screen	0.025	0.0087	0.00132	*lb/ton*	*AP-42, Table 11.19.2-2 (08/04) Screening - unctrl.; $PM_{2.5}$ = PM_{10} *(0.053/0.35)*
Conveyor Transfer	0.003	0.0011	0.00017	*lb/ton*	*AP-42, Table 11.19.2-2 (08/04) Conveyor Transfer - unctrl.; $PM_{2.5}$ = PM_{10} *(0.053/0.35)*

Control Equipment		
Crusher	0%	*Best Operating Practices*
Screen	0%	*Best Operating Practices*
Conveyor Transfer	0%	*Best Operating Practices*

Portable Crushing and Screening Emissions

	PM			PM_{10}			$PM_{2.5}$		
	lb/hr	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*
Crusher	5.48	23.99	71.96	2.43	10.66	31.98	0.37	1.61	4.84
Screen	25.35	111.05	333.16	8.82	38.65	115.94	1.34	5.85	17.56
Conveyor Transfer	3.04	13.33	39.98	1.12	4.89	14.66	0.17	0.74	2.22
Total	**33.87**	**148.37**	**445.10**	**12.37**	**54.19**	**162.58**	**1.87**	**8.21**	**24.62**

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Combustion

Operational Parameters

Mobile Equipment	Engine Rating kW	Engine Rating hp	Quantity	EPA Tier	Fuel gal/hr	Project Hours	Annual Hours *	Hours Per Unit	
D-9T Dozer	325	436	4	3	22	26,902	8,967	6,726	5T3
Grader Cat 160M (16')	159	213	0	3	11	0	0		4T3
Cat 623G Scraper 18-23CY	294	394	0	3	20	0	0		5T3
Compactor Vib Cat CB-54C 67"	102	137	2	3	7	11,801	3,934	5,901	3T3
Water Truck (8,000 gallons)	294	394	1	3	20	5,380	1,793	5,380	5T3
Fuel/Lube Truck	224	300	1	3	15	5,656	1,885	5,656	4T3
Cat 336DL 1.56 CY Excavator	200	268	3	3	14	21,210	7,070	7,070	4T3
Cat 980 Loader 7.5 CY	325	436	0	3	22	0	0		5T3
Haul Truck 740 CAT	350	469	14	3	24	98,981	32,994	7,070	5T3
4x4 3/4T Pickup Gas	308	413	3	3	21	18,854	6,285	6,285	5T3

** Scalled down from 36 months to 12 months*

Stationary Diesel Combustion Tier 3

Equipment	Mfr. Year	Engine Capacity hp	Engine Capacity kW	Utilization hr/yr	Fuel gal/hr	
Crusher Generator	>2006	1,000	745.7	4,380	51	7T3
Screen Generator	>2008	100	74.6	4,380	5	2T3
Conveyor Generator	>2006	350	261.0	4,380	18	5T3

Diesel Emission Factors *

Equipment	PM g/kW-hr	CO g/kW-hr	NO_X g/kW-hr	VOC g/kW-hr
D-9T Dozer	0.2	3.5	4.0	4.0
Grader Cat 160M (16')	0.2	3.5	4.0	4.0
Cat 623G Scraper 18-23CY	0.2	3.5	4.0	4.0
Compactor Vib Cat CB-54C 67"	0.3	5.0	4.0	4.0
Water Truck (8,000 gallons)	0.2	3.5	4.0	4.0
Fuel/Lube Truck	0.2	3.5	4.0	4.0
Cat 336DL 1.56 CY Excavator	0.2	3.5	4.0	4.0
Cat 980 Loader 7.5 CY	0.2	3.5	4.0	4.0
Haul Truck 740 CAT	0.2	3.5	4.0	4.0
Crusher Generator	0.2	3.5	6.4	6.4
Screen Generator	0.4	5.0	4.7	4.7
Conveyor Generator	0.2	3.5	4.0	4.0

** 40 CFR §1039.101, Table 1 and 40 CFR §89.112*

Gasoline Emission Factors *

Equipment	PM g/mi	CO g/mi	NO_X g/mi	SO_2 g/mi	VOC g/mi
4x4 3/4T Pickup Gas	0.099	3.88	0.18	0.01	0.04

** MOVES 2014a*

Fuel Conversions

1.998	*SO_2/S*	7,000	*Btu/hp-hr*	*AP-42, Table 3.4-1, Footnote e, Diesel, Rev. 10/96*
1.341	*hp/kw*	137,000	*Btu/gal*	*AP-42, Appendix A, Diesel, Rev. 9/85*
0.0015%	*ppm S in ULSD (GPA 2140)*			
7.05	*lb/gal*			

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Combustion - Continued

Fleet Emissions

	PM		CO		NO_X		SO_2*		VOC	
Equipment	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*	*lb/hr*	*ton/yr*
D-9T Dozer	0.57	0.64	10.0	11.2	11.5	12.9	4.6E-3	2.1E-2	11.5	12.9
Grader Cat 160M (16')										
Cat 623G Scraper 18-23CY										
Compactor Vib Cat CB-54C 67"	0.13	0.13	2.2	2.2	1.8	1.8	1.5E-3	2.9E-3	1.8	1.8
Water Truck (8,000 gallons)	0.13	0.12	2.3	2.0	2.6	2.3	4.2E-3	3.8E-3	2.6	2.3
Fuel/Lube Truck	9.9E-2	9.3E-2	1.7	1.6	2.0	1.9	3.2E-3	3.0E-3	2.0	1.9
Cat 336DL 1.56 CY Excavator	0.26	0.31	4.6	5.5	5.3	6.2	3.0E-3	1.0E-2	5.3	6.2
Cat 980 Loader 7.5 CY										
Haul Truck 740 CAT	2.2	2.5	37.8	44.6	43.2	50.9	5.1E-3	8.4E-2	43.2	50.9
4x4 3/4T Pickup Gas	3.3E-3	1.0E-2	0.13	0.40	6.0E-3	1.9E-2	4.4E-3	1.0E-3	1.4E-3	4.4E-3
Stationary Diesel Combustion										
Crusher Generator	0.33	0.72	5.8	12.6	10.5	23.0	1.1E-2	2.4E-2	10.5	23.0
Screen Generator	6.6E-2	0.14	0.82	1.8	0.77	1.7	1.1E-3	2.3E-3	0.77	1.7
Conveyor Generator	0.12	0.25	2.0	4.4	2.3	5.0	3.8E-3	8.3E-3	2.3	5.0
TOTAL	**3.9**	**5.0**	**67.4**	**86.3**	**79.9**	**106**	**4.2E-2**	**0.16**	**79.9**	**106**

** SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

Combustion Equipment (36-Month project)

	PM	CO	NO_X	SO_2*	VOC
Fleet Emissions	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*
D-9T Dozer	1.9	33.7	38.6	6.3E-2	38.6
Grader Cat 160M (16')					
Cat 623G Scraper 18-23CY					
Compactor Vib Cat CB-54C 67"	0.40	6.6	5.3	8.7E-3	5.3
Water Truck (8,000 gallons)	0.35	6.1	7.0	1.1E-2	7.0
Fuel/Lube Truck	0.28	4.9	5.6	9.0E-3	5.6
Cat 336DL 1.56 CY Excavator	0.94	16.4	18.7	3.1E-2	18.7
Cat 980 Loader 7.5 CY					
Haul Truck 740 CAT	7.6	134	153	0.25	153
4x4 3/4T Pickup Gas	3.1E-2	1.2	5.6E-2	3.0E-3	1.3E-2
Stationary Diesel Combustion					
Crusher Generator	2.16	37.80	69.13	0.07	69.13
Screen Generator	0.43	5.40	5.08	0.01	5.08
Conveyor Generator	0.76	13.23	15.12	0.02	15.12
TOTAL	**14.9**	**259**	**317**	**0.48**	**317**

** SO_2 emissions - mass balance based on 15 ppm S content (ULSD)*

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Mobile Equipment - Fugitives

Mobile Equipment	Quantity	Project Hours	Annual Hours	Hours Per Unit	Speed * *mph*	Weight ** *ton*	Silt *** %
D-9T Dozer	4	26,902	8,967	6,726	*Dozer specs on page 7*		
Grader Cat 160M (16')	0	0	0		*Grader specs on page 7*		
Cat 623G Scraper 18-23CY	0	0	0		*Scraper specs on page 7*		
Compactor Vib Cat CB-54C 67"	2	11,801	3,934	5,901	2	14.3	3.0
Water Truck (8,000 gallons)	1	5,380	1,793	5,380	15	50.2	3.0
Fuel/Lube Truck	1	5,656	1,885	5,656	15	12.5	3.0
Cat 336DL 1.56 CY Excavator	3	21,210	7,070	7,070	2	38.6	3.0
Cat 980 Loader 7.5 CY	0	0	0		2	19.6	3.0
Haul Truck 740 CAT	14	98,981	32,994	7,070	15	58.3	3.0
4x4 3/4T Pickup Gas	3	18,854	6,285	6,285	15	4.0	3.0
Mean Vehicle Weight						43.1	

** Resolution Copper*

*** Equipment Specification Sheets*

**** Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)* 3 %

Unpaved Roads - Predictive Emission Factor Equation & Constants*

	Empirical Constants for Industrial Roads			
$E = k \times (s / 12)^a \times (W / 3)^b$	Constant	PM	PM_{10}	$PM_{2.5}$
k, a, b - empirical constants	k	4.9	1.5	0.15
s - surface material silt content %	a	0.7	0.9	0.9
W - mean vehicle wt ton	b	0.45	0.45	0.45
P - Days of >0.01" Precip				

**AP-42, 13.2.2, Equation 1a & 2, Table 13.2.2-2, Industrial Roads, Rev. 11/06*

Unpaved Road Controls

	Surface	Reference
E = EF(unctl) x (365 - P) / 365		
Days of >0.01" Precip	57	*Hewitt met data 2015-2016 (long-term emissions only)*
Water & Chemical Suppression *	90%	*AP-42, Figure 13.2.2-2, Rev. 11/06*

** Control efficiency is based on AP-42 Chapter 13.2.2, Unpaved Roads. Figure 13.2.2-2 provides the control efficiencies achievable.*

	Emission Factors *(lb/VMT)*			Estimated Emissions (Controlled)								
	PM	PM_{10}	$PM_{2.5}$	PM			PM_{10}			$PM_{2.5}$		
Mobile Equipment				*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*
Compactor Vib Cat CB-54C 67"	6.2	1.4	0.14	2.5	2.0	6.1	0.57	0.47	1.4	5.7E-2	4.7E-2	0.14
Water Truck (8,000 gallons)	6.2	1.4	0.14	9.2	7.0	21.0	2.1	1.6	4.9	0.21	0.16	0.49
Fuel/Lube Truck	6.2	1.4	0.14	9.2	7.4	22.1	2.1	1.7	5.1	0.21	0.17	0.51
Cat 336DL 1.56 CY Excavator	6.2	1.4	0.14	3.7	3.7	11.0	0.86	0.85	2.6	8.6E-2	8.5E-2	0.26
Cat 980 Loader 7.5 CY	6.2	1.4	0.14									
Haul Truck 740 CAT	6.2	1.4	0.14	129	129	386	30.0	29.8	89.5	3.0	3.0	9.0
4x4 3/4T Pickup Gas	6.2	1.4	0.14	27.7	24.5	73.5	6.4	5.7	17.1	0.64	0.57	1.7
TOTAL				**182**	**173**	**520**	**42.2**	**40.2**	**121**	**4.2**	**4.0**	**12.1**

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Dozing/Grading/Scraping Emissions

Dozing and Grading Emission Factor Equations		*AP-42, 11.9, Table 11.9-1 (overburden), Rev. 7/98.*	
		Scaling Factors	
		PM_{10}	$PM_{2.5}$
Dozing (PM)	E lb/hr = (5.7 *(s) 1.2) / (M 1.3)		0.105
Dozing (PM_{15})	E lb/hr = (1.0 * (s) 1.5) / (M 1.4)	0.75	
Grading (PM)	E (lb/VMT) = 0.040 * S $^{2.5}$		0.031
Grading (PM_{15})	E (lb/VMT) = 0.051 * S $^{2.0}$	0.6	

s = material silt content %	3.0	*Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)*
M = material moisture content %	4.0	*Resolution Copper*
S = mean vehicle speed mph	7.1	*AP-42, Table 11.9-3 (mph)*

Scraping Emission Factor *AP-42, 11.9, Table 11.9-4 (topsoil), Rev. 7/98.*

Topsoil removal by scraper		Scaling Factor		*AP-42, Tab. 11.9-1, 7/98 (blasting, overburden)*
PM	0.058 *lb/ton*	PM_{10}	$PM_{2.5}$	
		0.52	0.03	

Scraping Operational Parameters

Cut Volume	1,024,380	*m^3*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
Specific Gravity	2.75	*g/cm^3*	*Resolution Copper Project Technical Memorandum – Construction Emissions*
	3,105,263	*ton/proj*	
	1,035,088	*ton/yr*	
	414	*ton/hr*	

Emission Factors

		Emission Factors		
Mobile Equipment	**Unit**	**PM**	**PM_{10}**	**$PM_{2.5}$**
D-9T Dozer	*lb/hr*	3.5	0.56	0.37
Grader Cat 160M (16')*	*lb/VMT*	5.4	1.5	0.17
Cat 623G Scraper 18-23CY	*lb/ton*	5.8E-2	3.0E-2	1.7E-3

Total Emissions

	Estimated Emissions								
		PM			**PM_{10}**			**$PM_{2.5}$**	
Mobile Equipment	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*	*lb/hr*	*ton/yr*	*ton/proj*
D-9T Dozer	14.1	15.8	47.3	2.2	2.5	7.5	1.5	1.7	5.0
Grader Cat 160M (16')									
Cat 623G Scraper 18-23CY	24.0	30.0	90.1	12.5	15.6	46.8	0.72	0.90	2.7
TOTAL	**38.1**	**45.8**	**137**	**14.7**	**18.1**	**54.4**	**2.2**	**2.6**	**7.7**

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Employee and Delivery Emissions

Employees and Deliveries*

	Max Hourly			Average Annual			Average Project		
		Distance (*mi/hr*)			Distance (*mi/yr*)			Distance (*mi/proj*)	
	No. Trips	One Way	RT	No. Trips	One Way	RT	No. Trips	One Way	RT
Employee	0			Combined with WPS			Combined with WPS		
Delivery	0			0	0.0	0.0	0	0.0	0.0

** No Additional Deliveries or Employees Expected for Corridor Construction*

Combustion Emission Factors *

	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	VOC
	g/VMT	*g/VMT*	*g/VMT*	*g/VMT*	*g/VMT*	*g/VMT*	*g/VMT*
Employee	9.9E-2	9.9E-2	1.8E-2	1.8E-1	9.6E-3	3.9E+0	4.2E-2
Delivery	9.7E-1	9.7E-1	2.8E-1	3.8E+0	1.2E-2	1.3E+0	2.9E-1

** MOVES 2014a*

Mean Vehicle Weight / **Quantity ****

				Quantity
Employee		2	*ton*	0
Delivery *	Empty	16.5	*ton*	0
	Payload	23.5	*ton*	
	Average	28.3	*ton*	
Mean Vehicle Wt			*ton*	

** Based on typical 18-wheeler and 80,000 lb highway limit*
*** Total number of trips expected for construction fleet*

Unpaved Roads - Equation, Constants, & Emission Factors *

$E = k \times (s / 12)^a \times (W / 3)^b$

		Constant	PM	PM_{10}	$PM_{2.5}$
k, a, b - empirical constants		k	4.9	1.5	0.15
s - surface material silt content (%) **	3.0	a	0.7	0.9	0.9
W - mean vehicle wt (*ton*) ***		b	0.45	0.45	0.45

Empirical Constants for Industrial Roads

Emission Factors (*lb/VMT*)

PM	PM_{10}	$PM_{2.5}$

** AP-42, 13.2.2, Equations 1a & 2, Table 13.2.2-2, Unpaved Roads, Rev. 11/06*
*** Related Information to AP-42, Chapter 13.2.2 (r13s0202_dec03.xls)*
**** AP-42, 13.2.2, Equations 1a & 2, Table 13.2.2-2, Unpaved Roads, Rev. 11/08*

Unpaved Road Controls

	Surface	Reference
E = EF(unctl) x (365 - P) / 365		
Days of >0.01" Precip	57	*Hewitt met data 2015-2016 (long-term emissions only)*
Water & Chemical Suppression *	90%	*AP-42, Figure 13.2.2-2, Rev. 11/06*

** Control efficiency is based on AP-42 Chapter 13.2.2, Unpaved Roads. Figure 13.2.2-2 provides the control efficiencies achievable.*

Combustion Emissions

	PM	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	VOC
	lb/hr	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*	*lb/hr*
Employee	--	--	--	--	--	--	--
Delivery	--	--	--	--	--	--	--
	ton/yr	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*	*ton/yr*
Employee	--	--	--	--	--	--	--
Delivery							
	ton/proj	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*	*ton/proj*
Employee	--	--	--	--	--	--	--
Delivery							

Unpaved Road Emissions (Controlled)

	PM	PM_{10}	$PM_{2.5}$
	lb/hr	*lb/hr*	*lb/hr*
Employee	--	--	--
Delivery	--	--	--
	ton/yr	*ton/yr*	*ton/yr*
Employee			
Delivery			
	ton/proj	*ton/proj*	*ton/proj*
Employee	--	--	--
Delivery			

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Wind Erosion from Exposed Areas

150.0	Maximum Erodible Area (acres)		
2,500	number of disturbance hours (per year)	50 wk/yr	*140023 Construction Emissions 07-26-2017.doc*
0.06	Disturbance Created Every Hour (acre/hr)	5 days/wk	*140023 Construction Emissions 07-26-2017.doc*
Precipitation	Control Technology (Hewitt Precip Data)	10 hr/day	*140023 Construction Emissions 07-26-2017.doc*
16%	Control Efficiency (Applied to Long-Term Emissions Only)		

Emissions (Uncontrolled)

PM	**PM_{10}**	**$PM_{2.5}$**	**PM**	**PM_{10}**	**$PM_{2.5}$**	**PM**	**PM_{10}**	**$PM_{2.5}$**
lb/hr	***lb/hr***	***lb/hr***	***ton/yr***	***ton/yr***	***ton/yr***	***ton/proj***	***ton/proj***	***ton/proj***
1.3	0.63	9.5E-2	5.5	2.8	0.42	16.6	8.3	1.2

Emissions (Controlled)

PM	**PM_{10}**	**$PM_{2.5}$**	**PM**	**PM_{10}**	**$PM_{2.5}$**	**PM**	**PM_{10}**	**$PM_{2.5}$**
lb/hr	***lb/hr***	***lb/hr***	***ton/yr***	***ton/yr***	***ton/yr***	***ton/proj***	***ton/proj***	***ton/proj***
1.3	0.63	9.5E-2	4.7	2.3	0.35	14.0	7.0	1.1

AP-42, Sec. 13.2.5

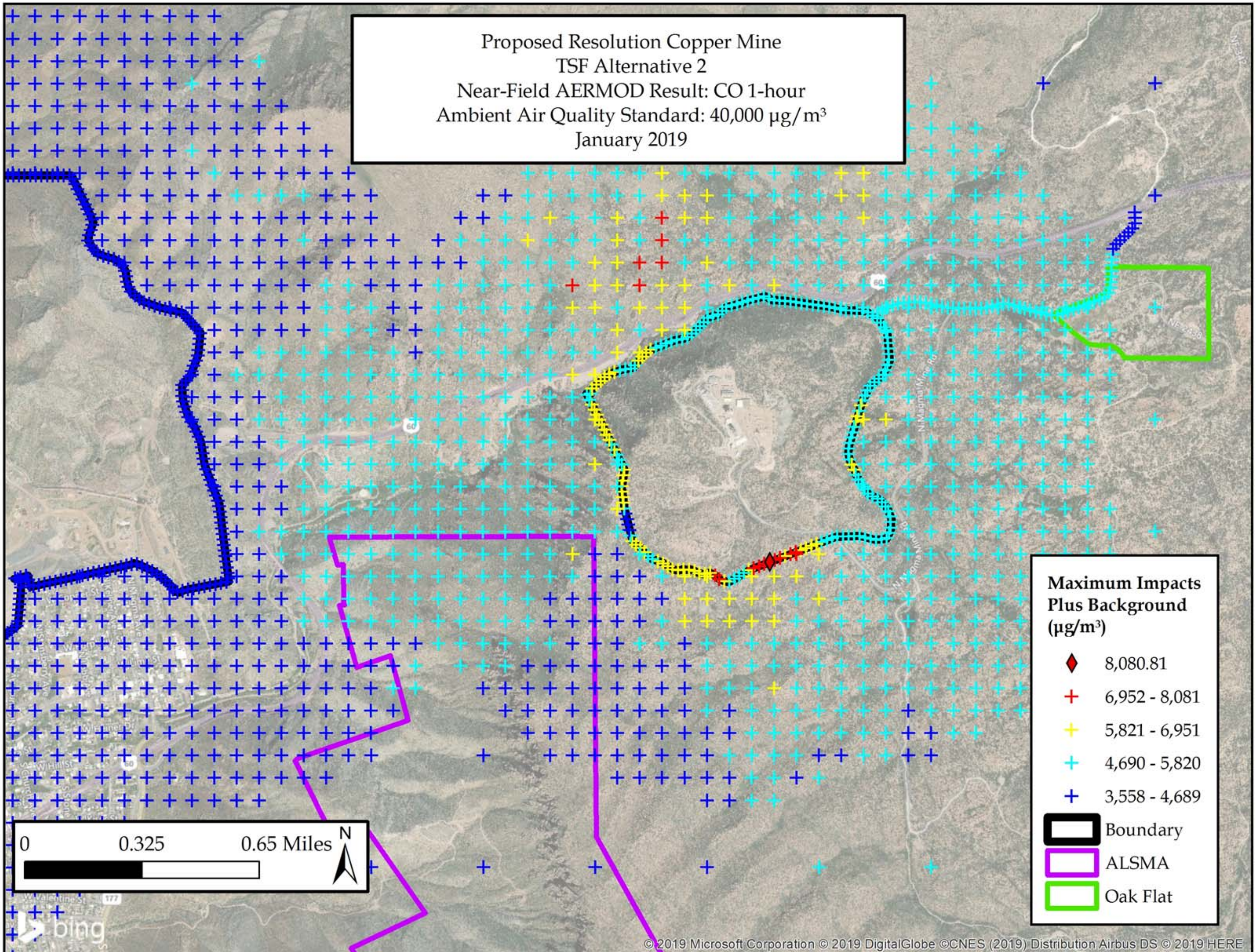
Flat, u/u10+* 0.053 *AP-42, Sec. 13.2.5, p. 5*

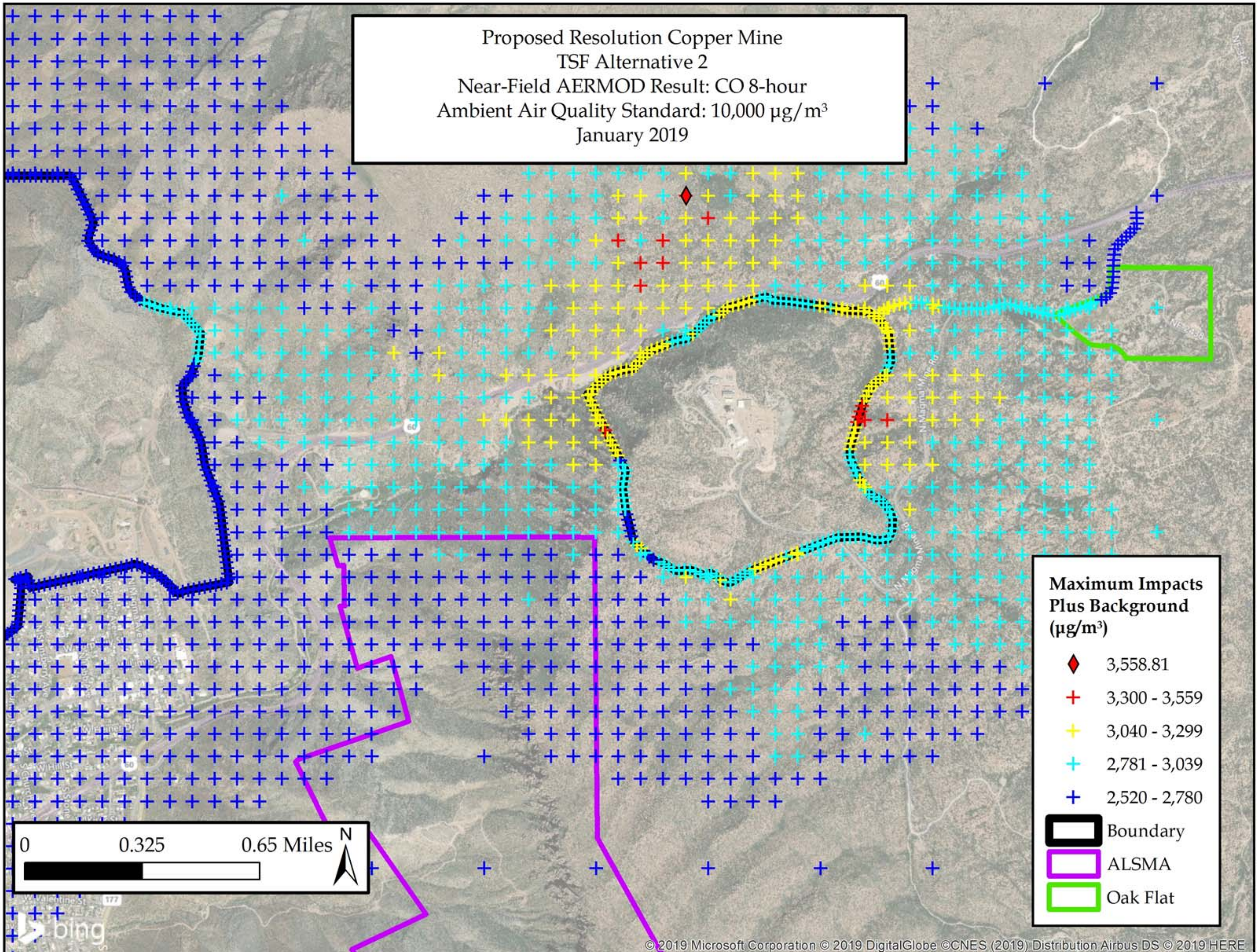
(A) u10+ = 1.2 u10 *Fastest mile wind speed at 10m, with a 1.2 factor to convert hourly wind speed to fastest mile.*

(B, piles) u = (Us/Ur) × 0.1 × u10+*

(B, flat) u = 0.053 × u10+* *Threshold Friction Velocity, AZ Cu Mine Tailings*

(C) P = 58 (u - ut*)2 + 25 (u* - ut*); P = 0 for u* ≤ ut*; where ut* =* 0.172 *m/s*


Proposed Resolution Copper Mine
TSF Alternative 2
Near-Field AERMOD Result: CO 1-hour
Ambient Air Quality Standard: 40,000 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
8,080.81
6,952 - 8,081
5,821 - 6,951
4,690 - 5,820
3,558 - 4,689
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
© 2019 Microsoft Corporation © 2019 DigitalGlobe ©CNES (2019) Distribution Airbus DS © 2019 HERE


Proposed Resolution Copper Mine
TSF Alternative 2
Near-Field AERMOD Result: CO 8-hour
Ambient Air Quality Standard: 10,000 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
3,558.81
3,300 - 3,559
3,040 - 3,299
2,781 - 3,039
2,520 - 2,780
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
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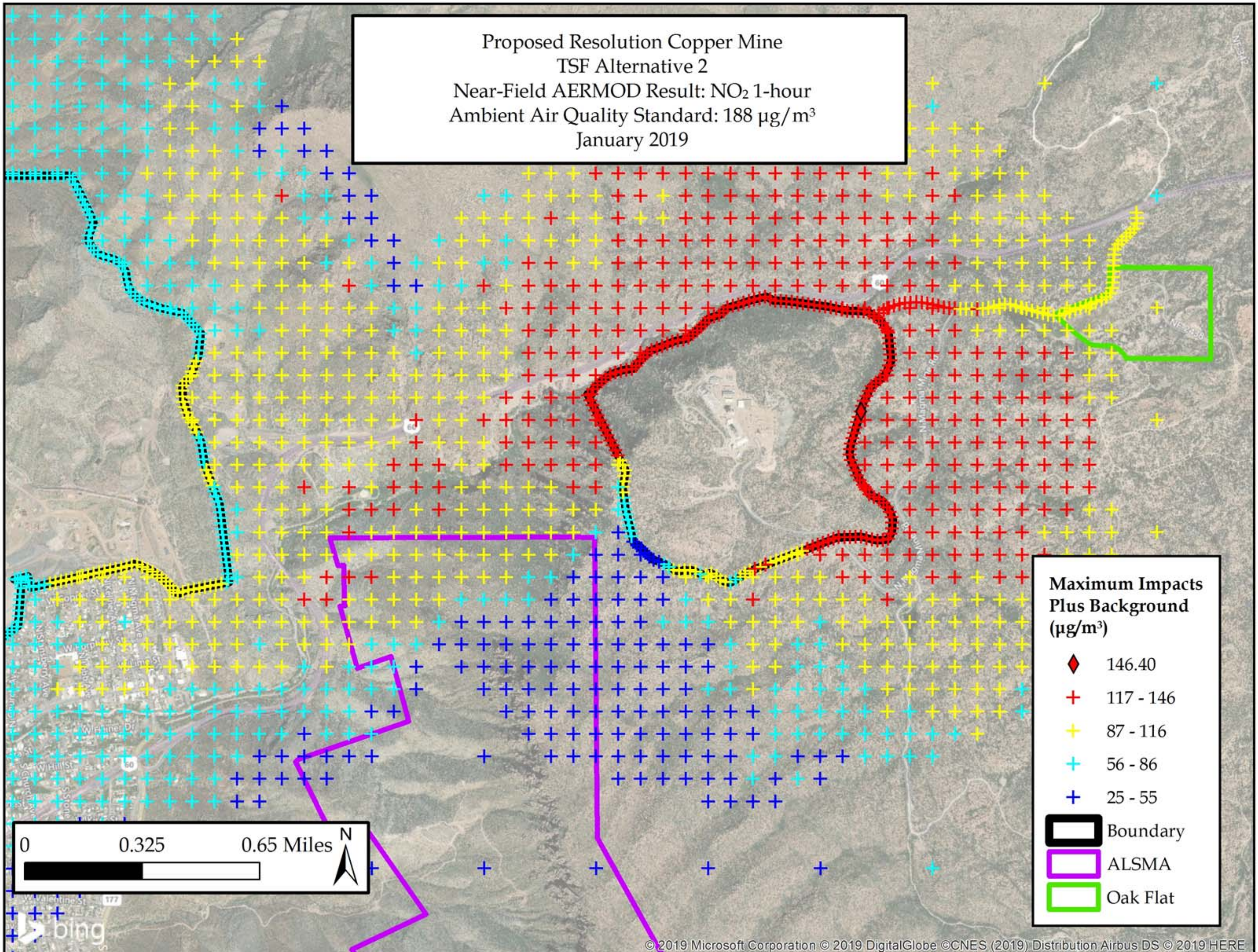
Proposed Resolution Copper Mine
TSF Alternative 2
Near-Field AERMOD Result: NO_2 1-hour
Ambient Air Quality Standard: 188 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
146.40
117 - 146
87 - 116
56 - 86
25 - 55
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
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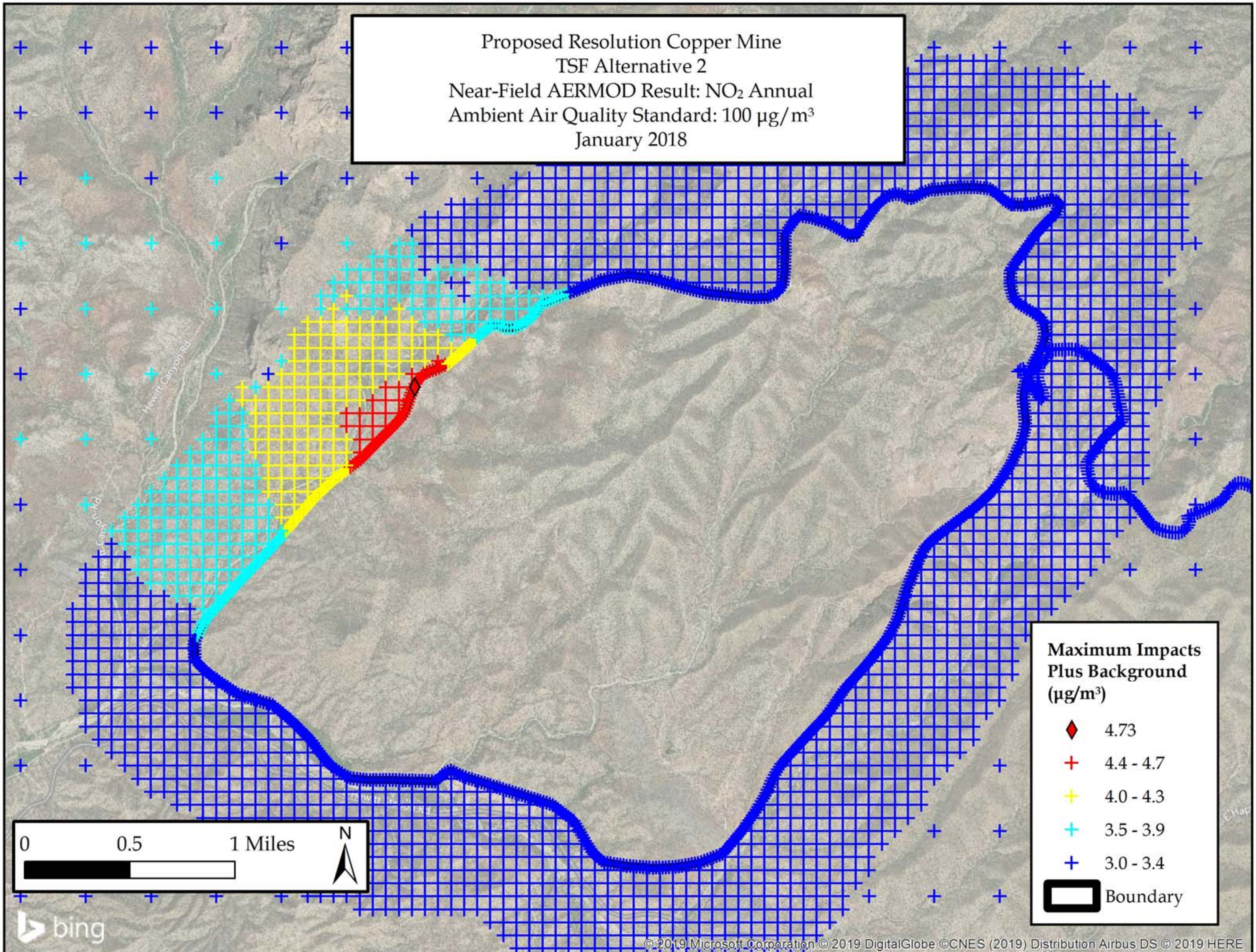
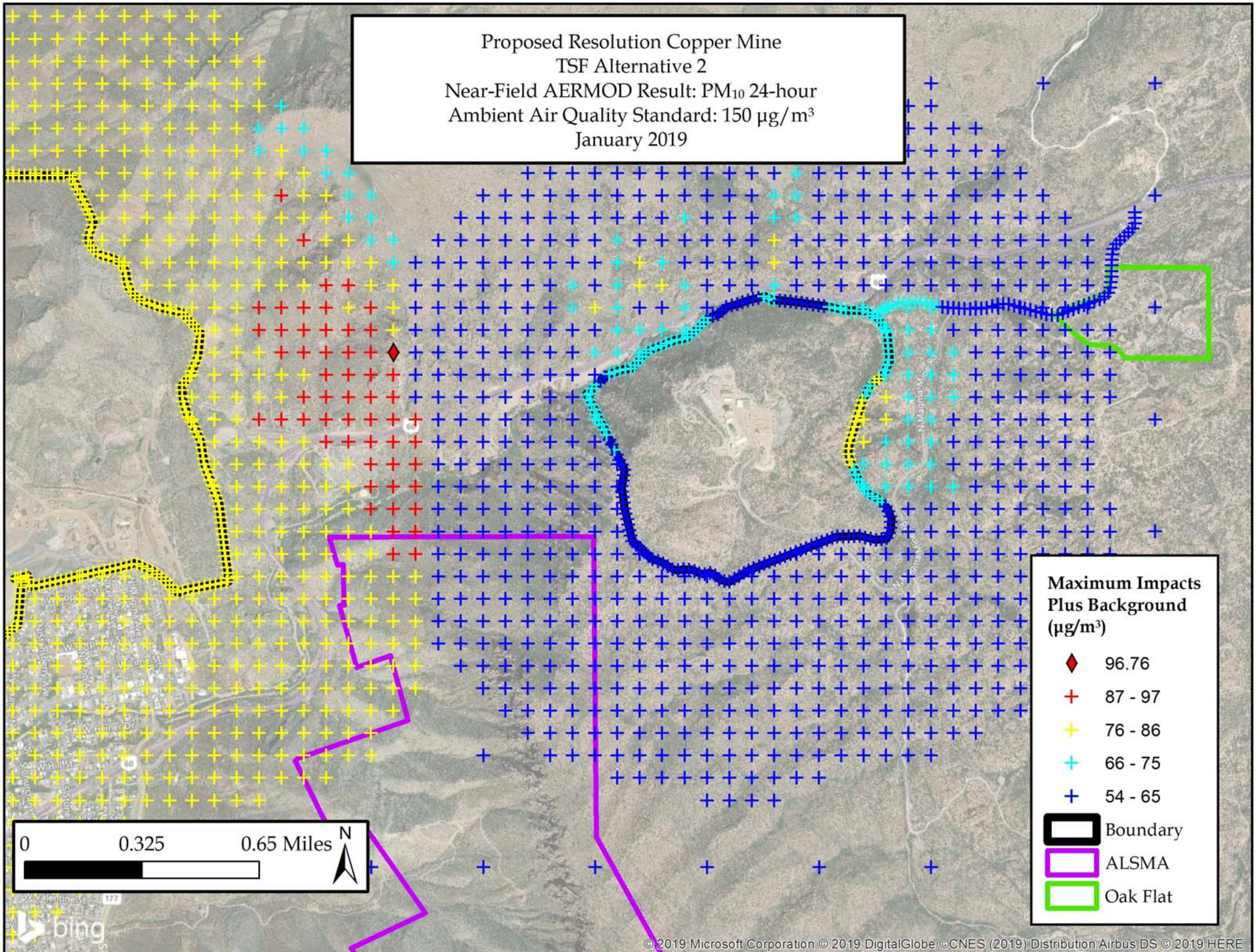
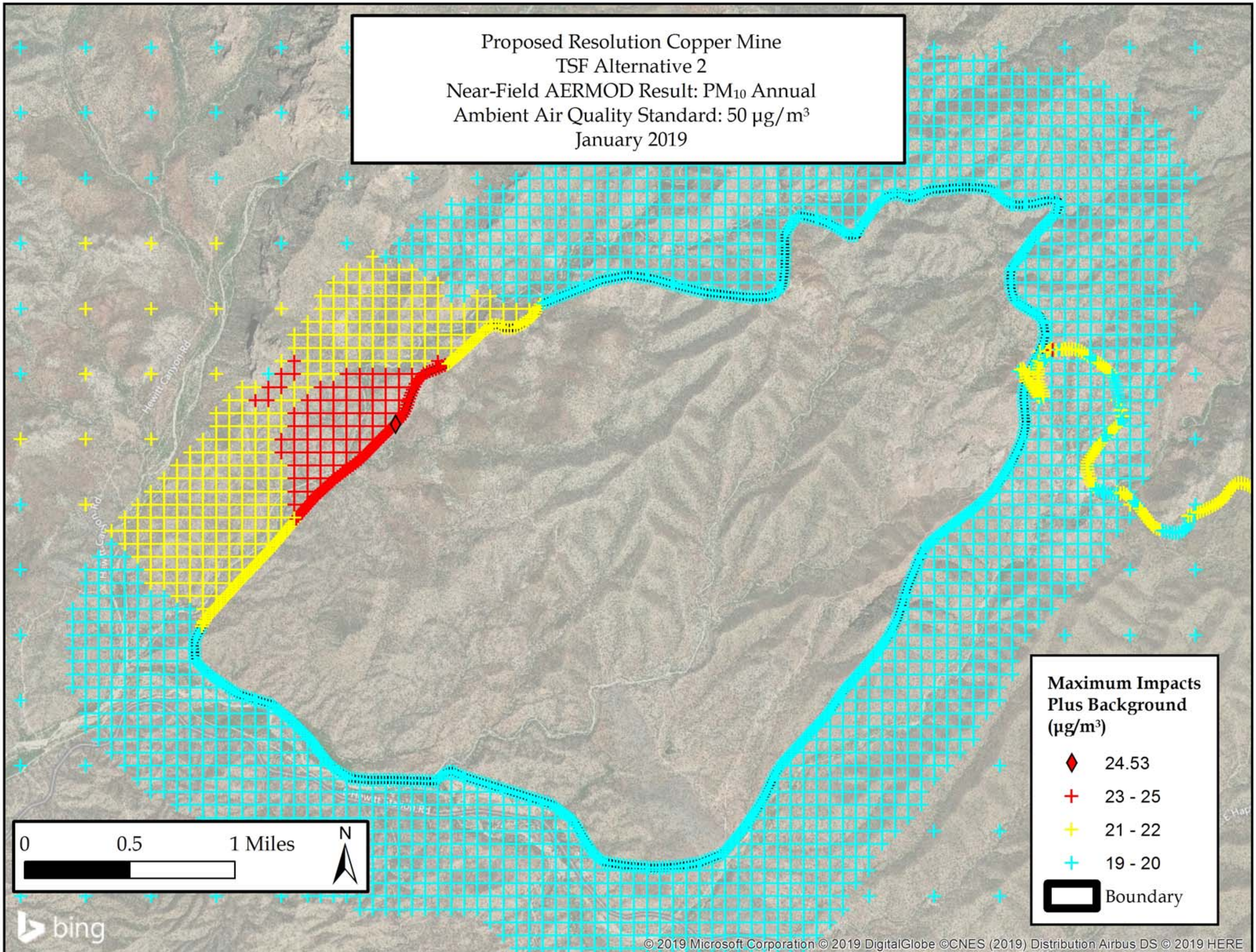


Proposed Resolution Copper Mine
TSF Alternative 2
Near-Field AERMOD Result: NO2 Annual
Ambient Air Quality Standard: 100 µg/m³
January 2018
Hewitt Canyon Rd
Maximum Impacts Plus Background (µg/m³)
4.73
4.4 - 4.7
4.0 - 4.3
3.5 - 3.9
3.0 - 3.4
Boundary
0
0.5
1 Miles
N
bing
© 2019 Microsoft Corporation © 2019 DigitalGlobe ©CNES (2019) Distribution Airbus DS © 2019 HERE


Proposed Resolution Copper Mine
TSF Alternative 2
Near-Field AERMOD Result: PM10 24-hour
Ambient Air Quality Standard: 150 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
96.76
87 - 97
76 - 86
66 - 75
54 - 65
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
bing
© 2019 Microsoft Corporation © 2019 DigitalGlobe ©CNES (2019) Distribution Airbus DS © 2019 HERE


Proposed Resolution Copper Mine
TSF Alternative 2
Near-Field AERMOD Result: PM10 Annual
Ambient Air Quality Standard: 50 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
24.53
23 - 25
21 - 22
19 - 20
Boundary
0
0.5
1 Miles
N
Hewitt Canyon Rd
bing
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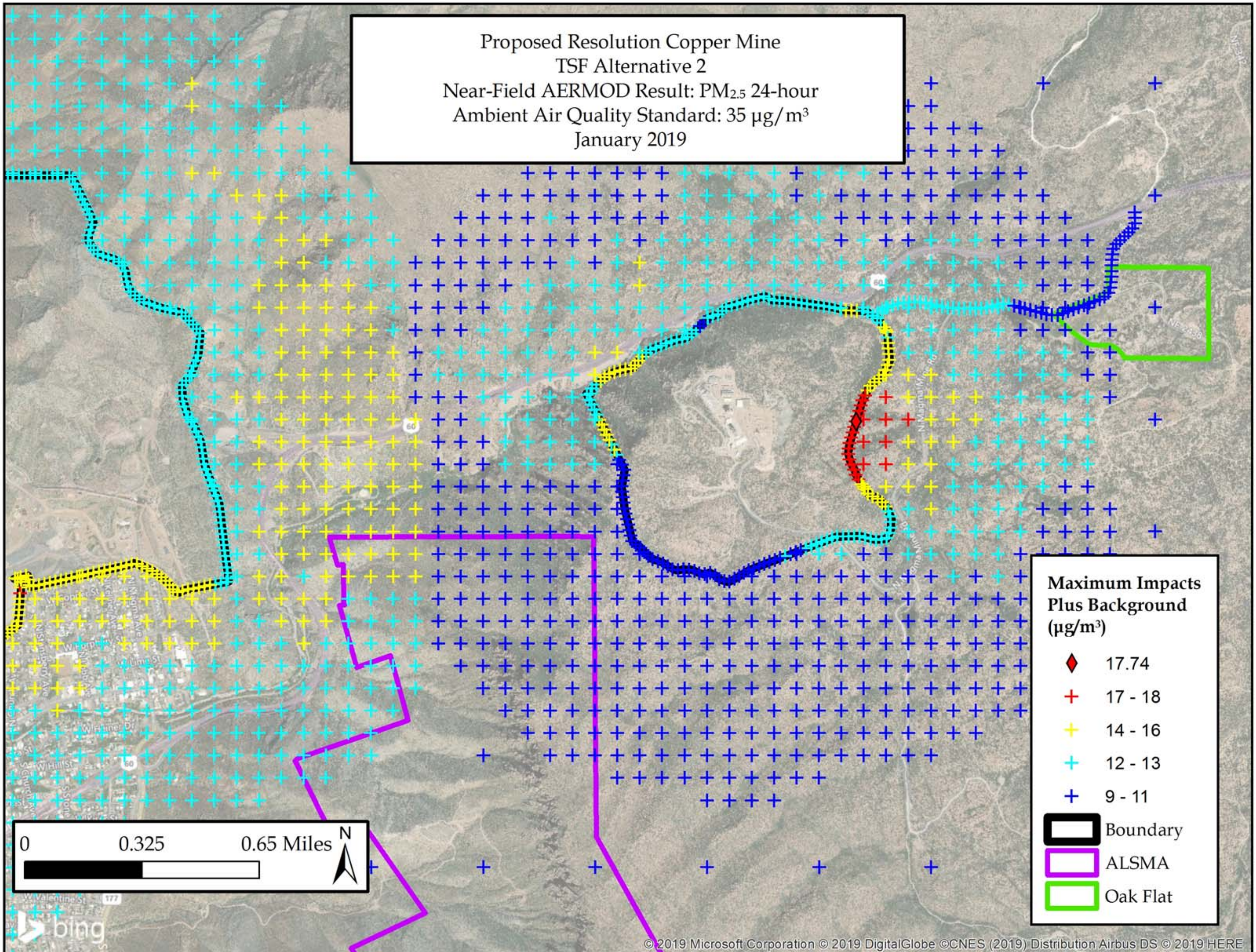
Proposed Resolution Copper Mine
TSF Alternative 2
Near-Field AERMOD Result: PM2.5 24-hour
Ambient Air Quality Standard: 35 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
17.74
17 - 18
14 - 16
12 - 13
9 - 11
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
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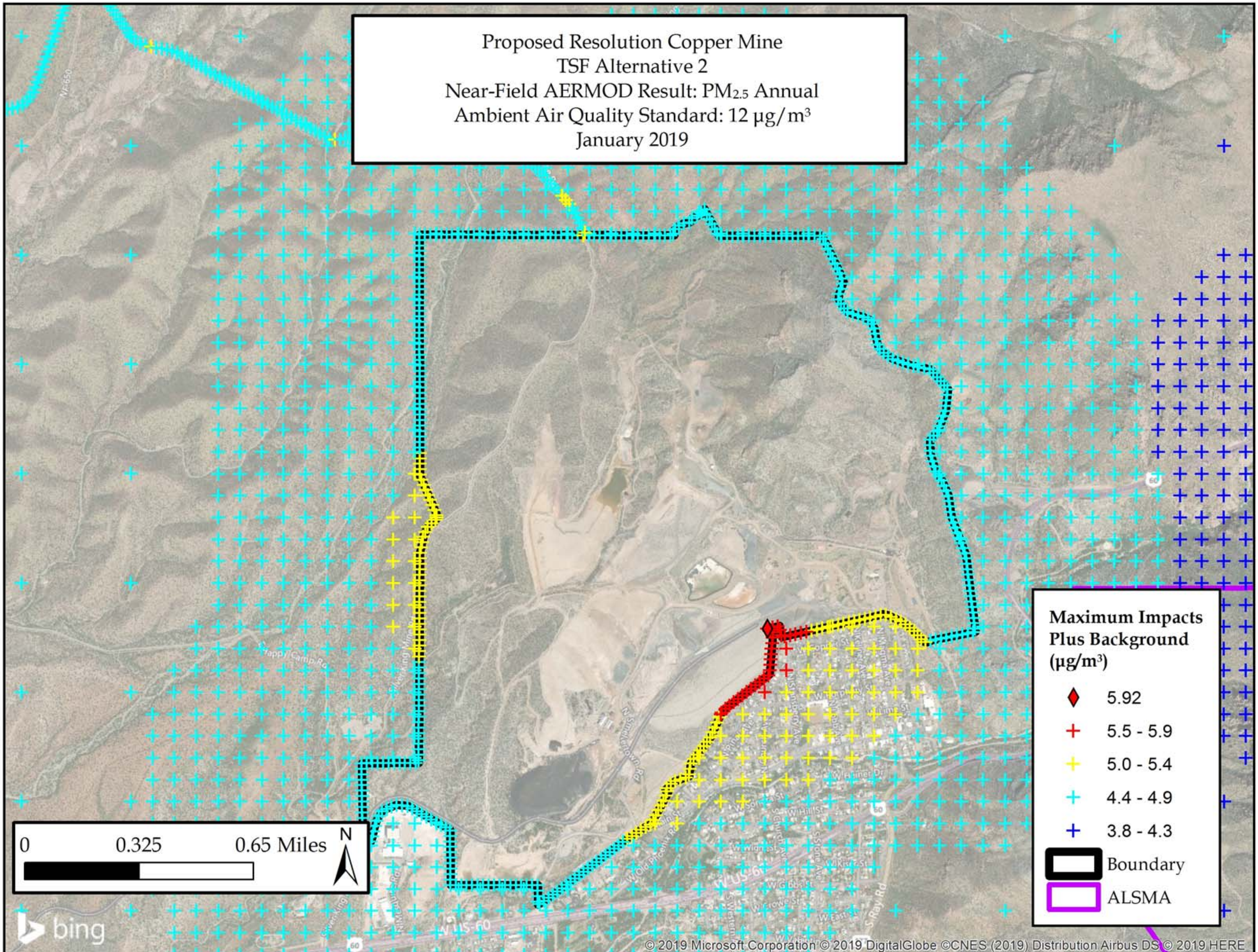
Proposed Resolution Copper Mine
TSF Alternative 2
Near-Field AERMOD Result: PM2.5 Annual
Ambient Air Quality Standard: 12 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
5.92
5.5 - 5.9
5.0 - 5.4
4.4 - 4.9
3.8 - 4.3
Boundary
ALSMA
0
0.325
0.65 Miles
N
bing
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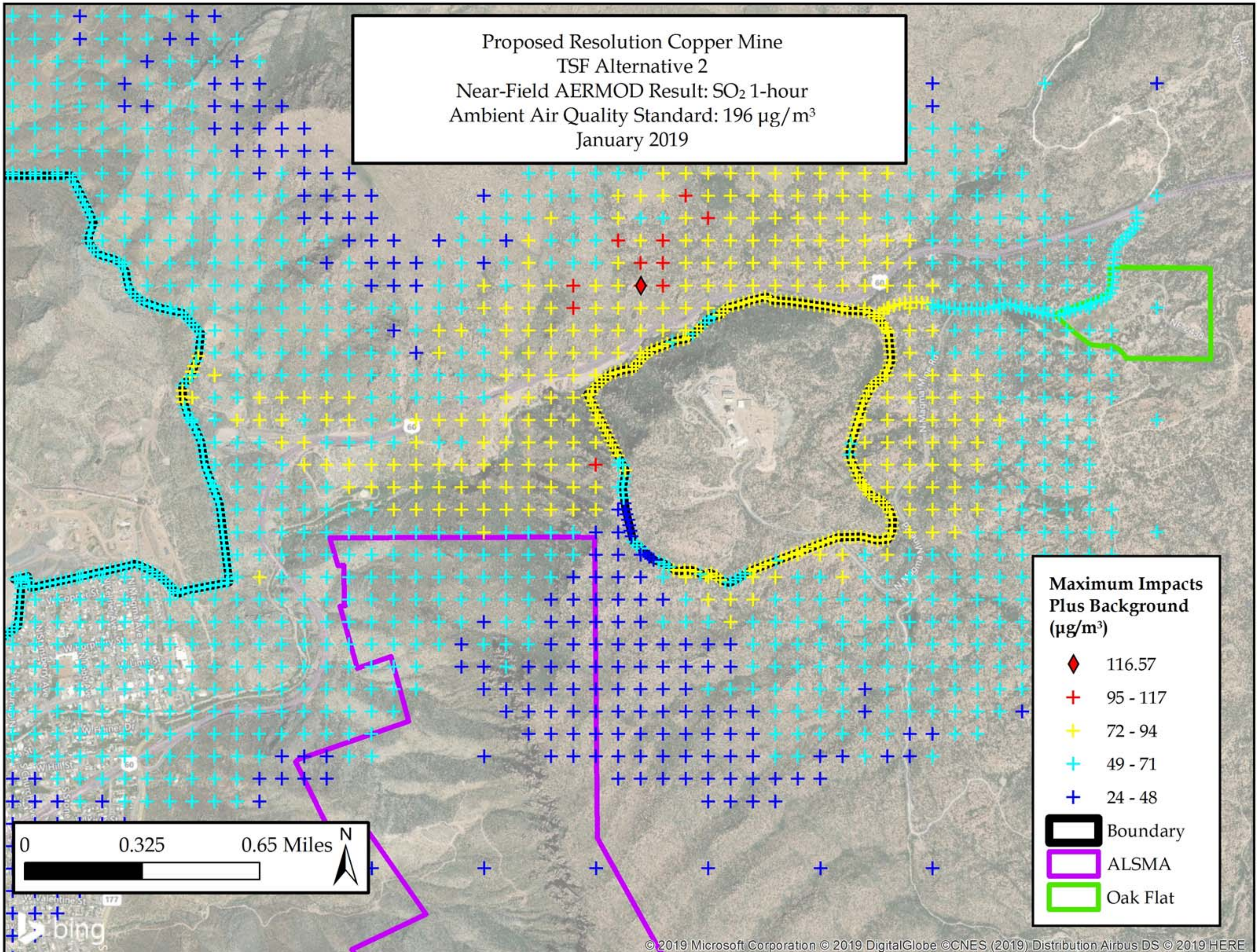

Proposed Resolution Copper Mine
TSF Alternative 2
Near-Field AERMOD Result: SO_2 1-hour
Ambient Air Quality Standard: 196 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
116.57
95 - 117
72 - 94
49 - 71
24 - 48
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
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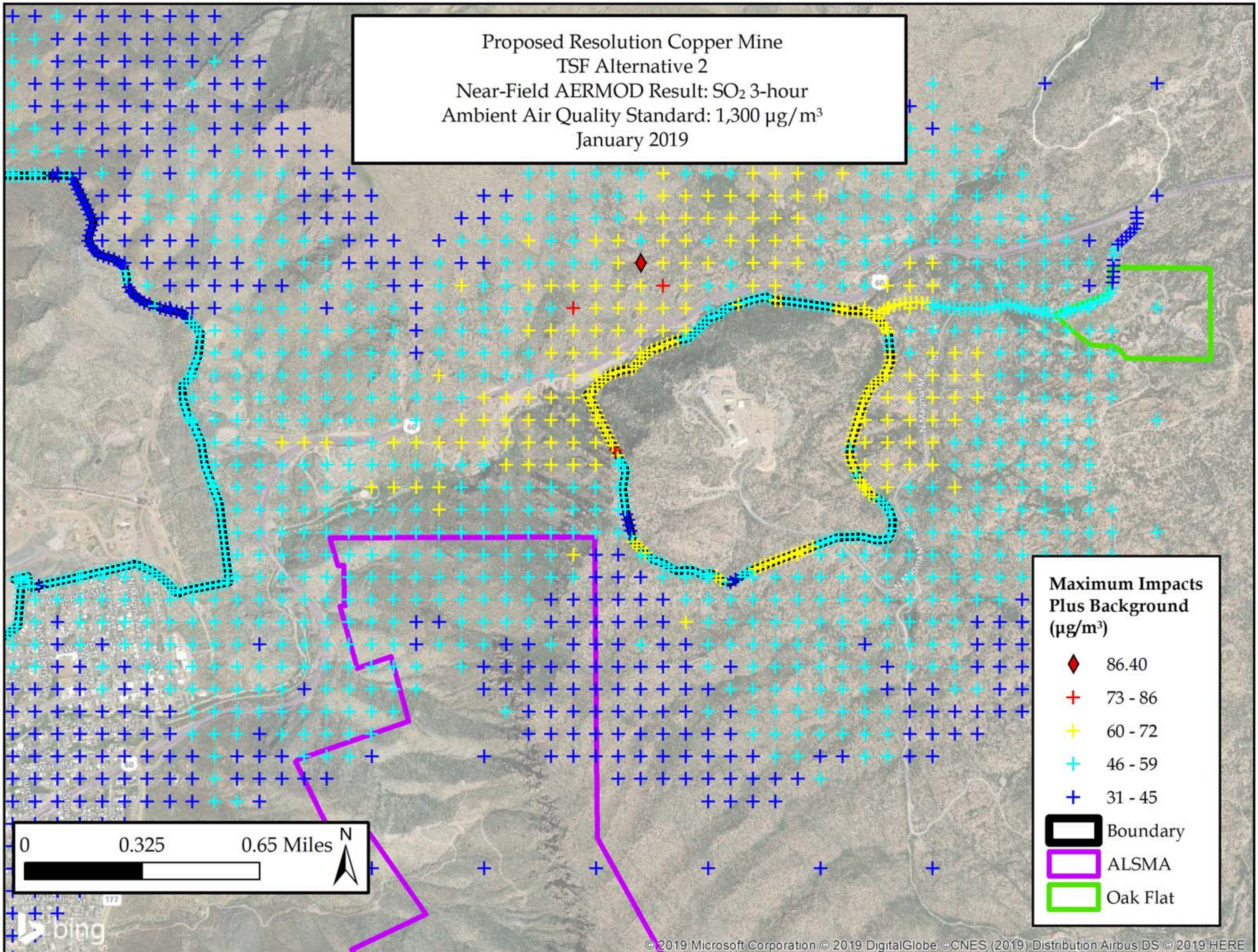
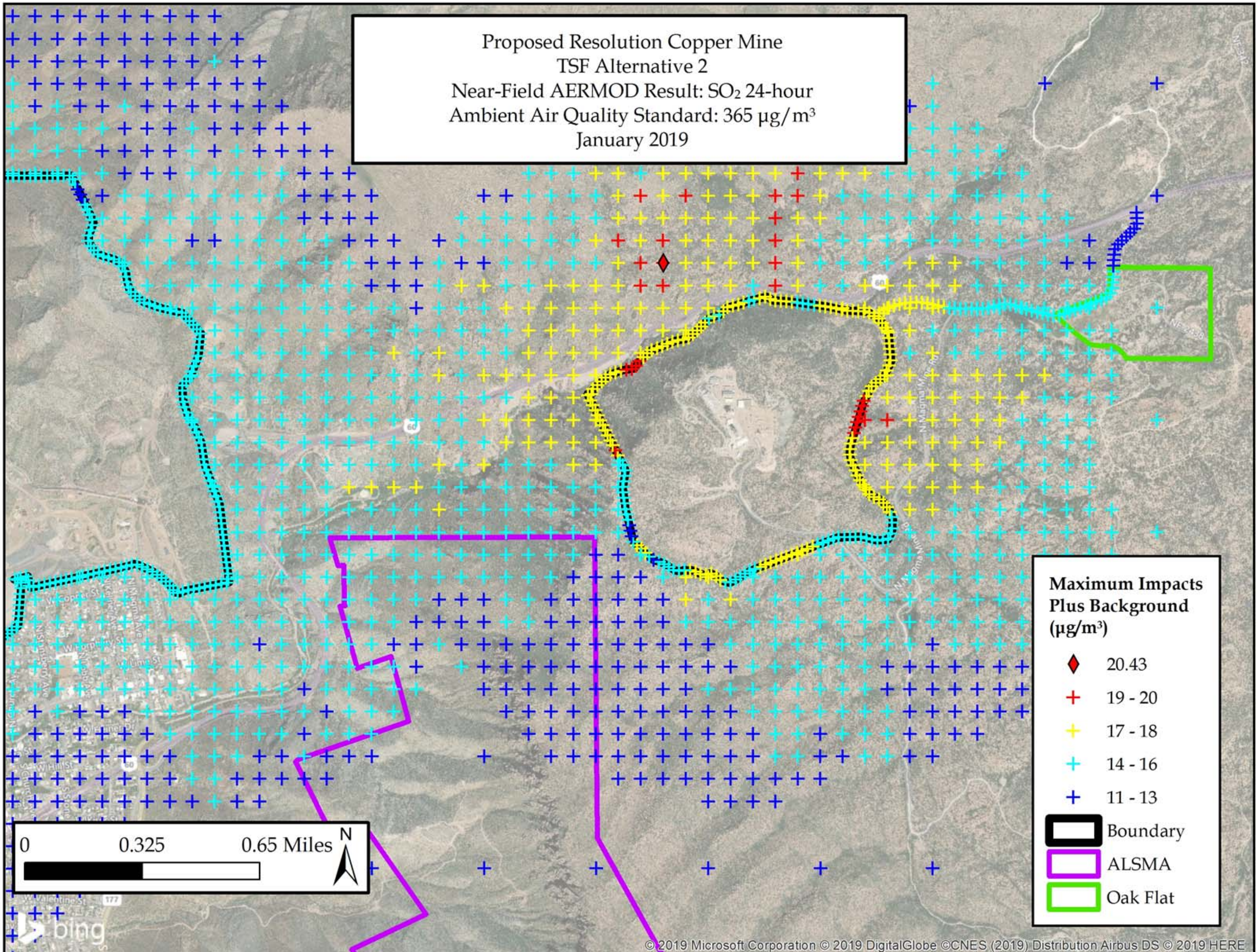

Proposed Resolution Copper Mine
TSF Alternative 2
Near-Field AERMOD Result: SO₂ 3-hour
Ambient Air Quality Standard: 1,300 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
86.40
73 - 86
60 - 72
46 - 59
31 - 45
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
© 2019 Microsoft Corporation © 2019 DigitalGlobe ©CNES (2019) Distribution Airbus DS © 2019 HERE


Proposed Resolution Copper Mine
TSF Alternative 2
Near-Field AERMOD Result: SO2 24-hour
Ambient Air Quality Standard: 365 µg/m3
January 2019
Maximum Impacts Plus Background (µg/m3)
20.43
19 - 20
17 - 18
14 - 16
11 - 13
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
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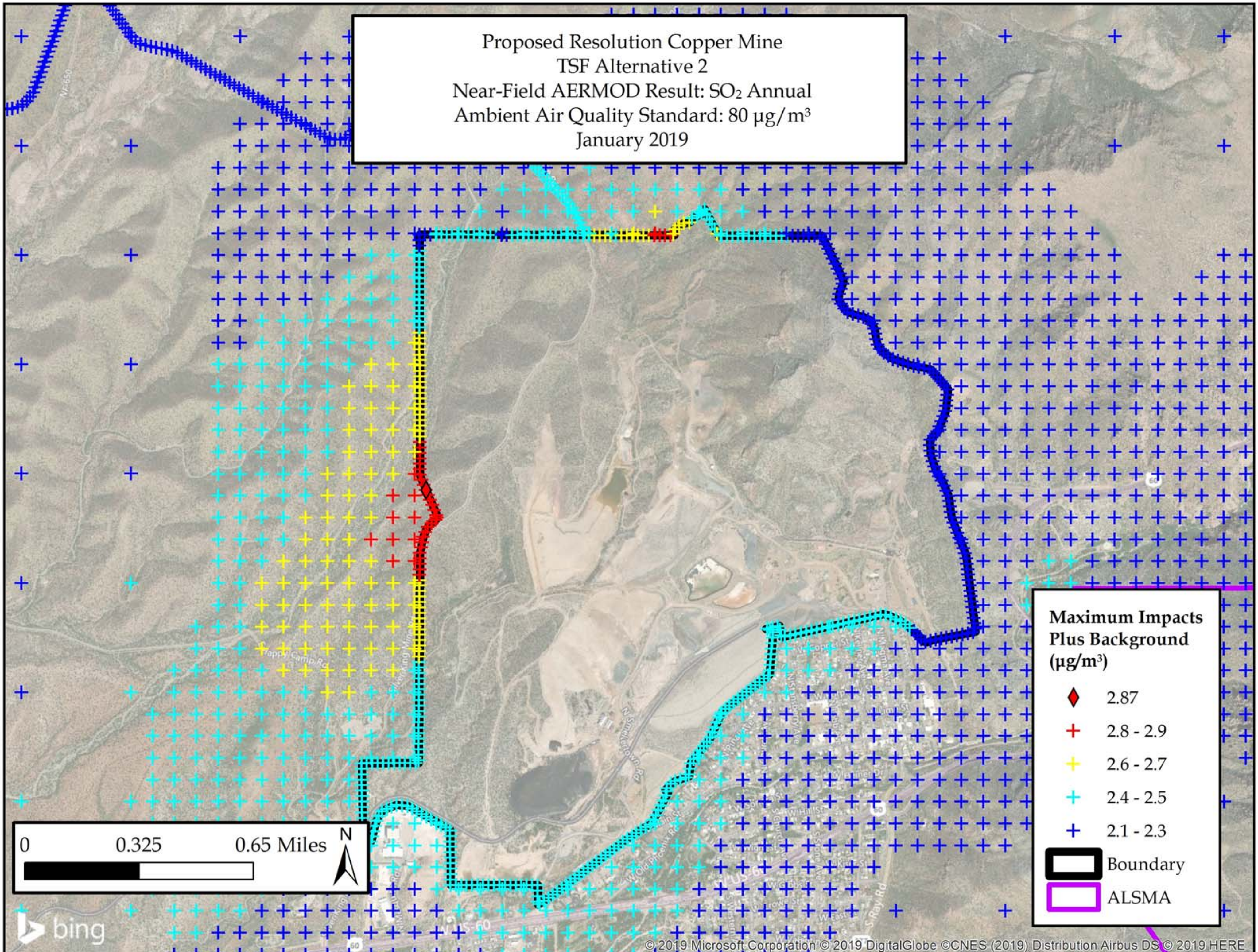
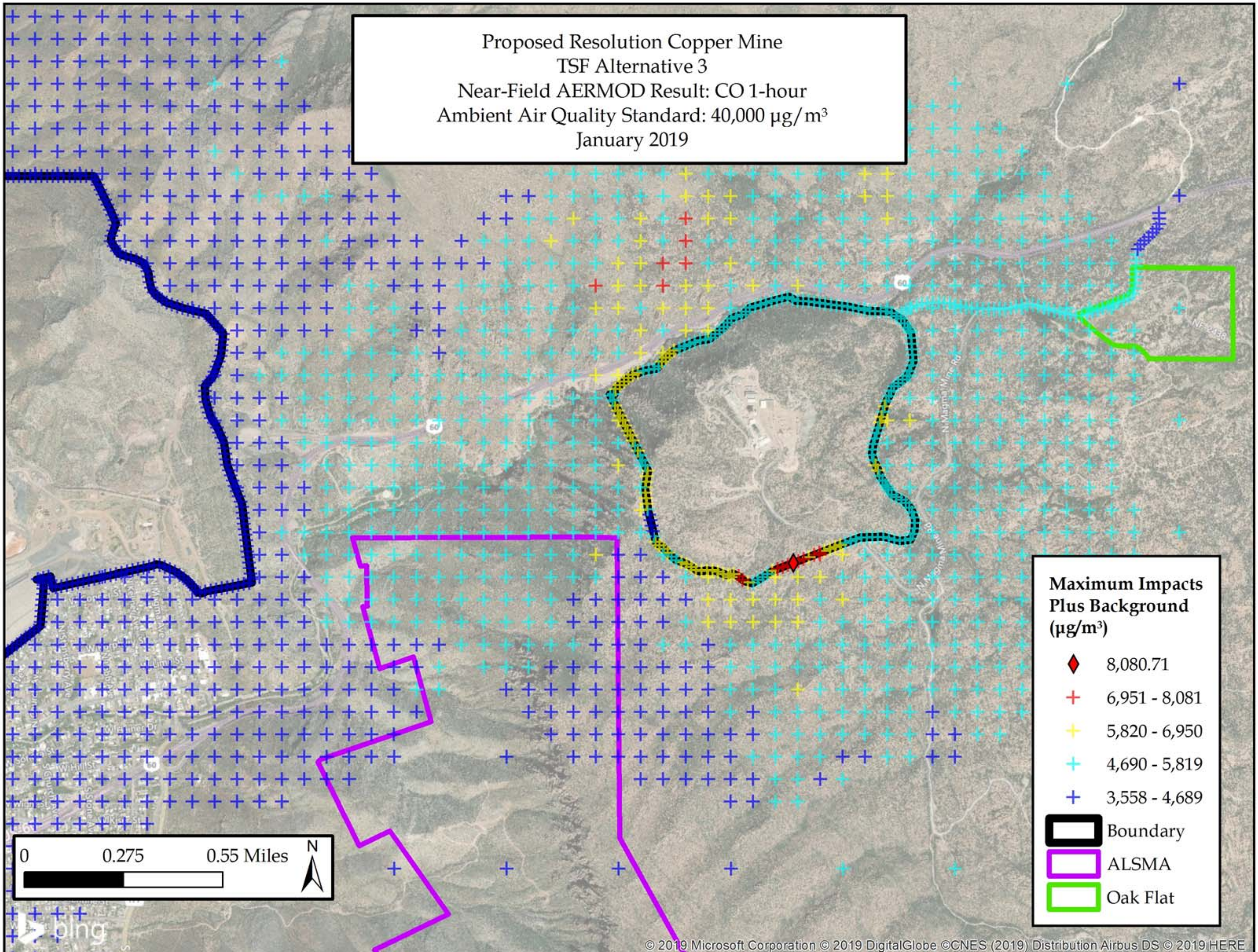

Proposed Resolution Copper Mine
TSF Alternative 2
Near-Field AERMOD Result: SO_2 Annual
Ambient Air Quality Standard: 80 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
2.87
2.8 - 2.9
2.6 - 2.7
2.4 - 2.5
2.1 - 2.3
Boundary
ALSMA
0
0.325
0.65 Miles
N
bing
© 2019 Microsoft Corporation © 2019 DigitalGlobe ©CNES (2019) Distribution Airbus DS © 2019 HERE


Proposed Resolution Copper Mine
TSF Alternative 3
Near-Field AERMOD Result: CO 1-hour
Ambient Air Quality Standard: 40,000 μg/m³
January 2019
Maximum Impacts Plus Background (μg/m³)
8,080.71
6,951 - 8,081
5,820 - 6,950
4,690 - 5,819
3,558 - 4,689
Boundary
ALSMA
Oak Flat
0
0.275
0.55 Miles
N
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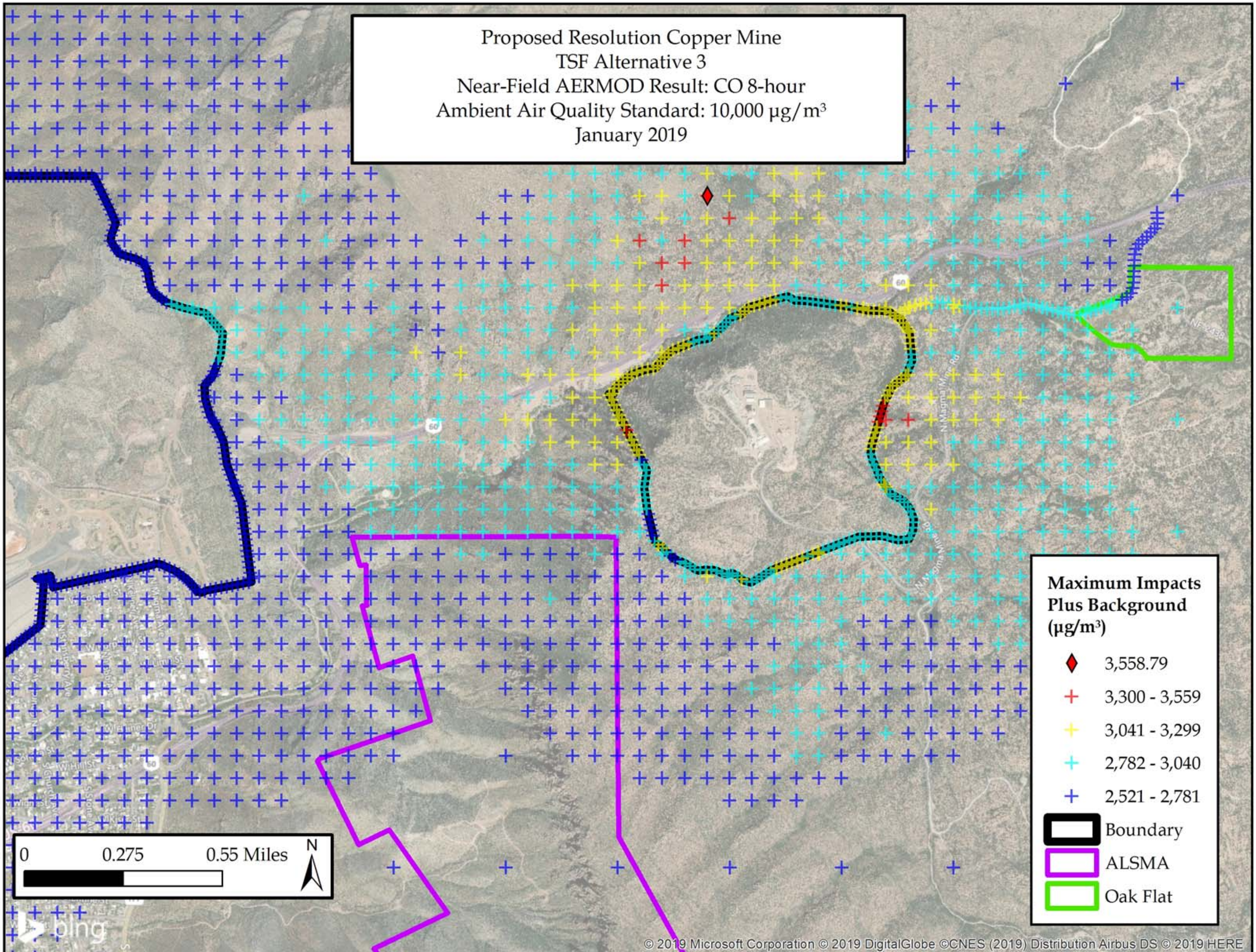
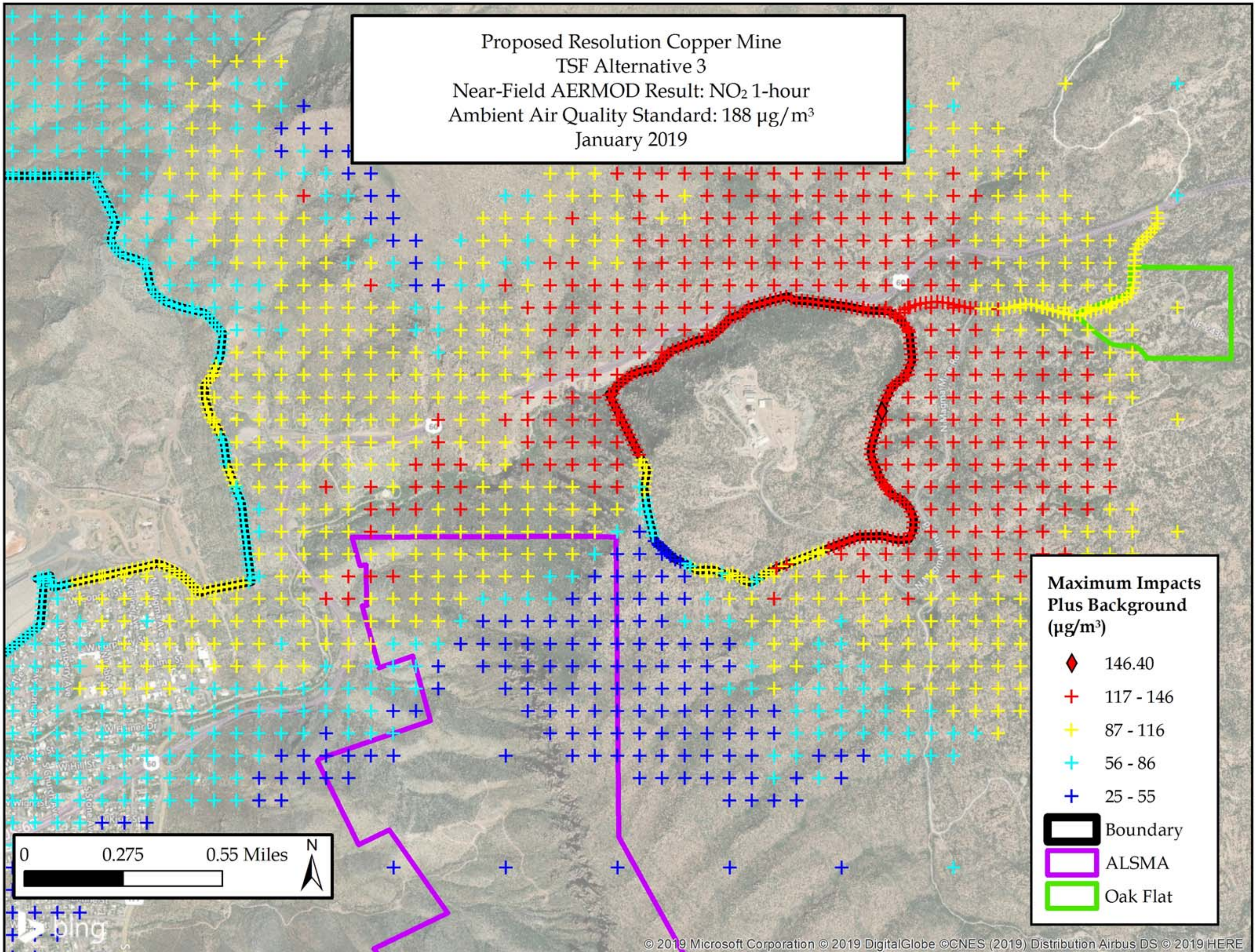


Proposed Resolution Copper Mine
TSF Alternative 3
Near-Field AERMOD Result: CO 8-hour
Ambient Air Quality Standard: 10,000 μg/m³
January 2019
Maximum Impacts Plus Background (μg/m³)
3,558.79
3,300 - 3,559
3,041 - 3,299
2,782 - 3,040
2,521 - 2,781
Boundary
ALSMA
Oak Flat
0
0.275
0.55 Miles
N
© 2019 Microsoft Corporation © 2019 DigitalGlobe ©CNES (2019) Distribution Airbus DS © 2019 HERE



Proposed Resolution Copper Mine
TSF Alternative 3
Near-Field AERMOD Result: NO2 1-hour
Ambient Air Quality Standard: 188 µg/m3
January 2019
Maximum Impacts Plus Background (µg/m3)
146.40
117 - 146
87 - 116
56 - 86
25 - 55
Boundary
ALSMA
Oak Flat
0
0.275
0.55 Miles
N
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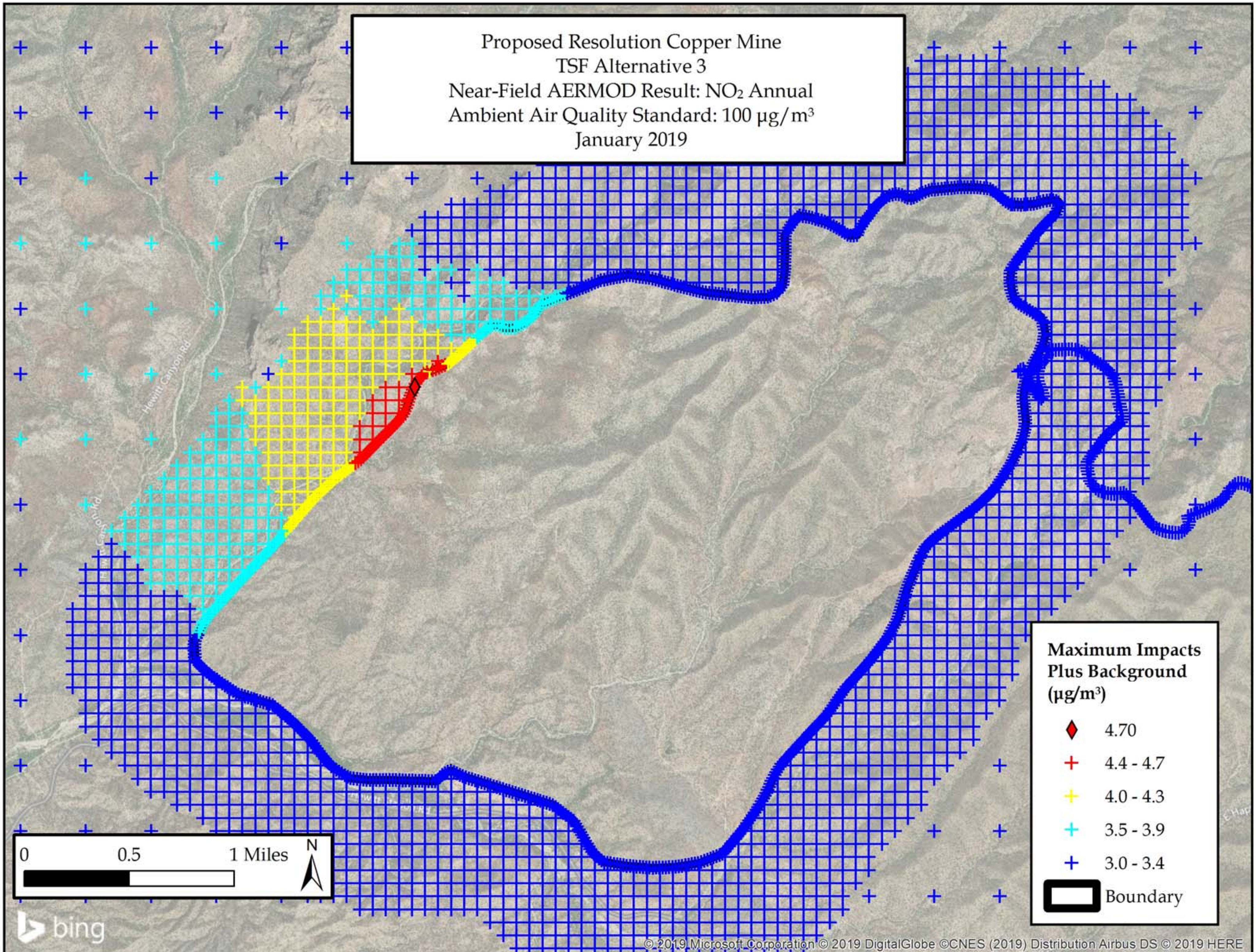
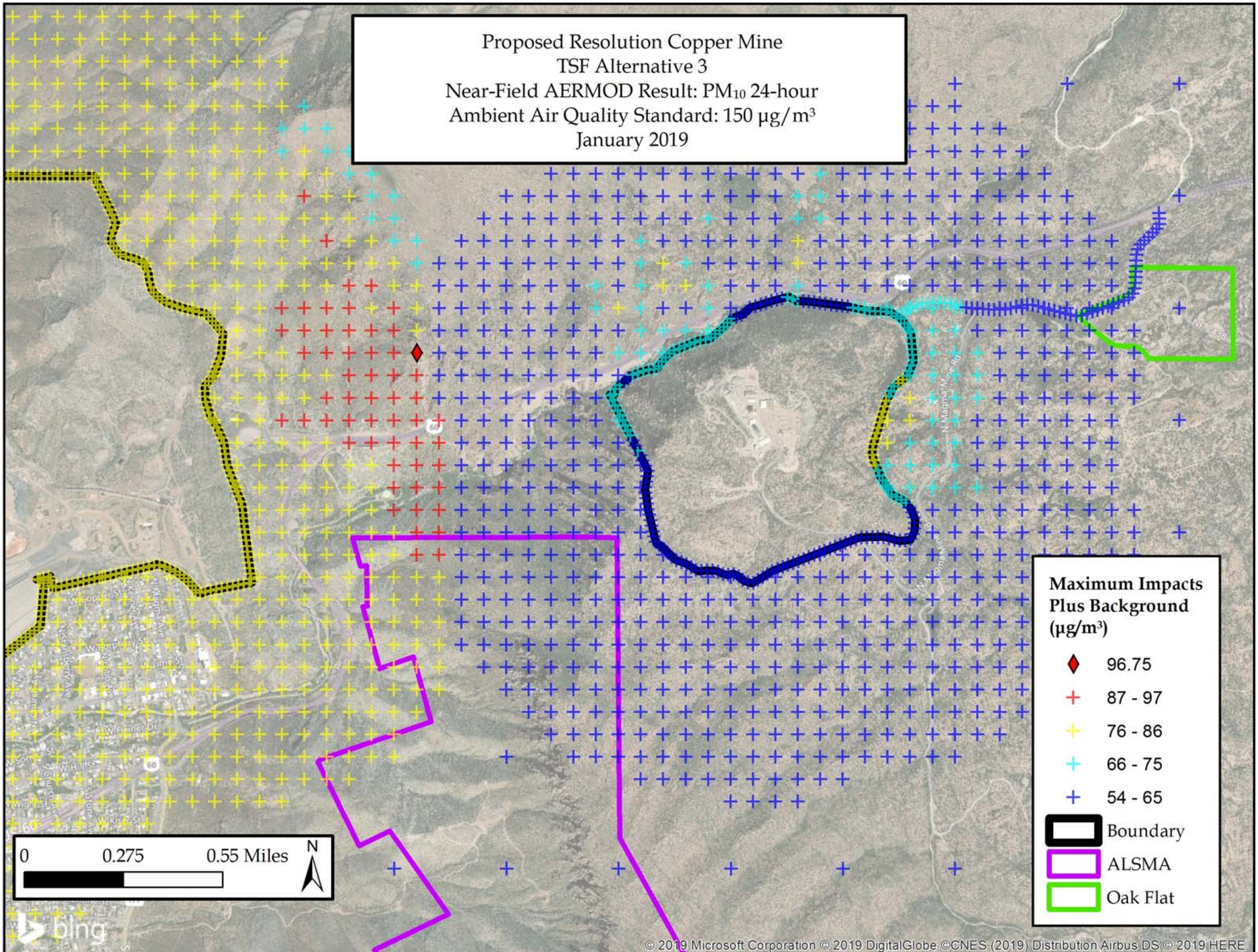
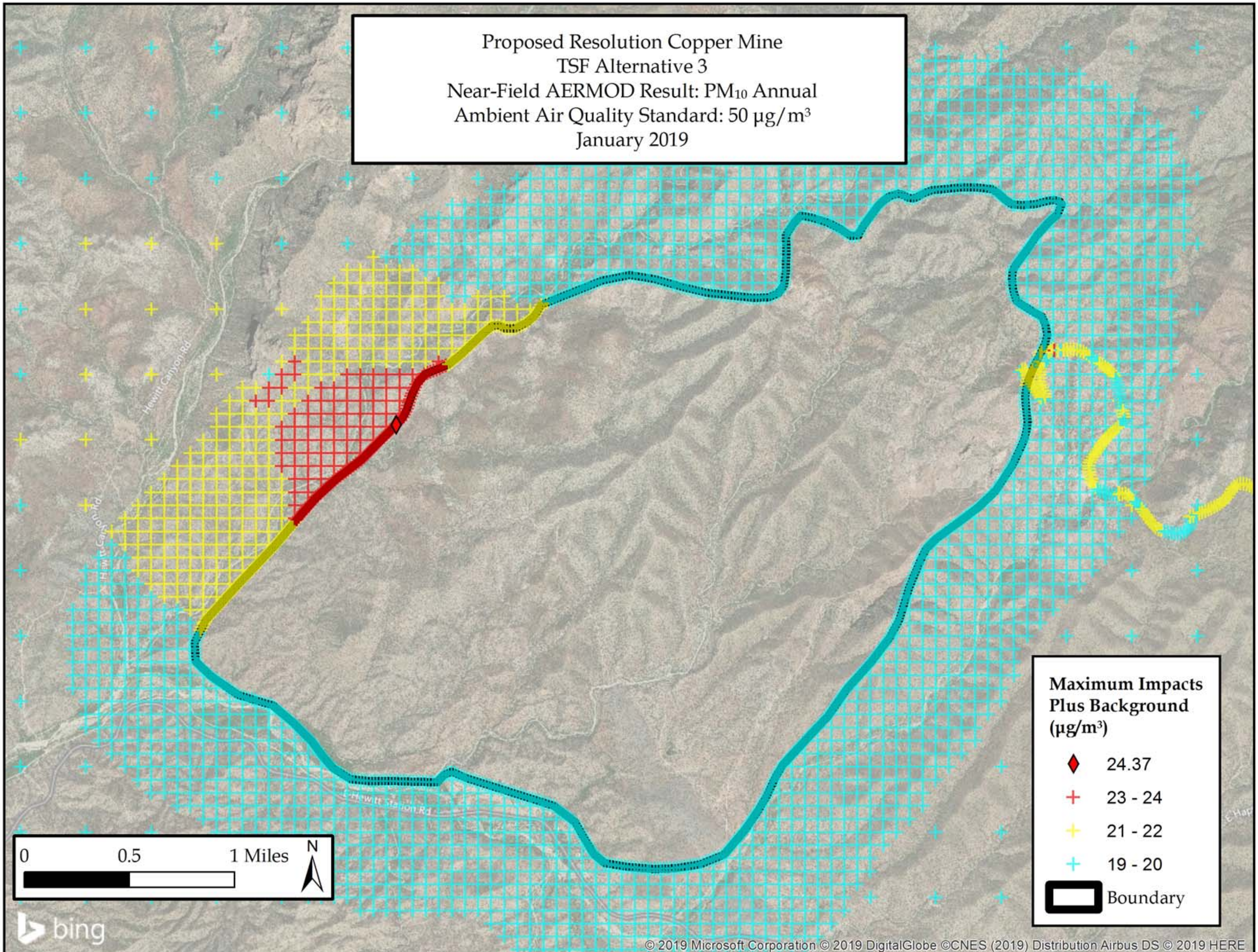


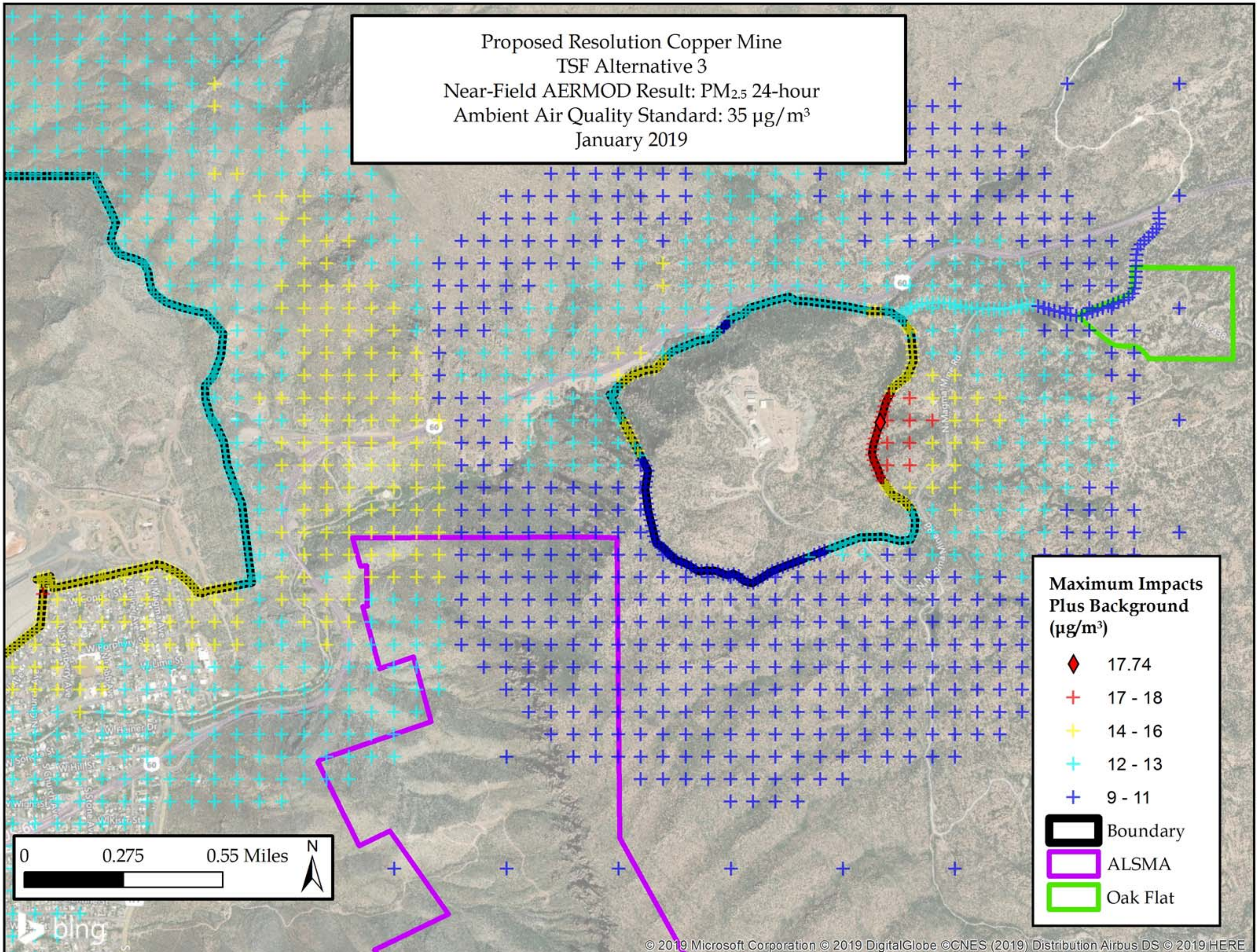
Proposed Resolution Copper Mine
TSF Alternative 3
Near-Field AERMOD Result: NO_2 Annual
Ambient Air Quality Standard: 100 µg/m³
January 2019
Hewitt Canyon Rd
Maximum Impacts Plus Background (µg/m³)
4.70
4.4 - 4.7
4.0 - 4.3
3.5 - 3.9
3.0 - 3.4
Boundary
0
0.5
1 Miles
N
bing
© 2019 Microsoft Corporation © 2019 DigitalGlobe ©CNES (2019) Distribution Airbus DS © 2019 HERE

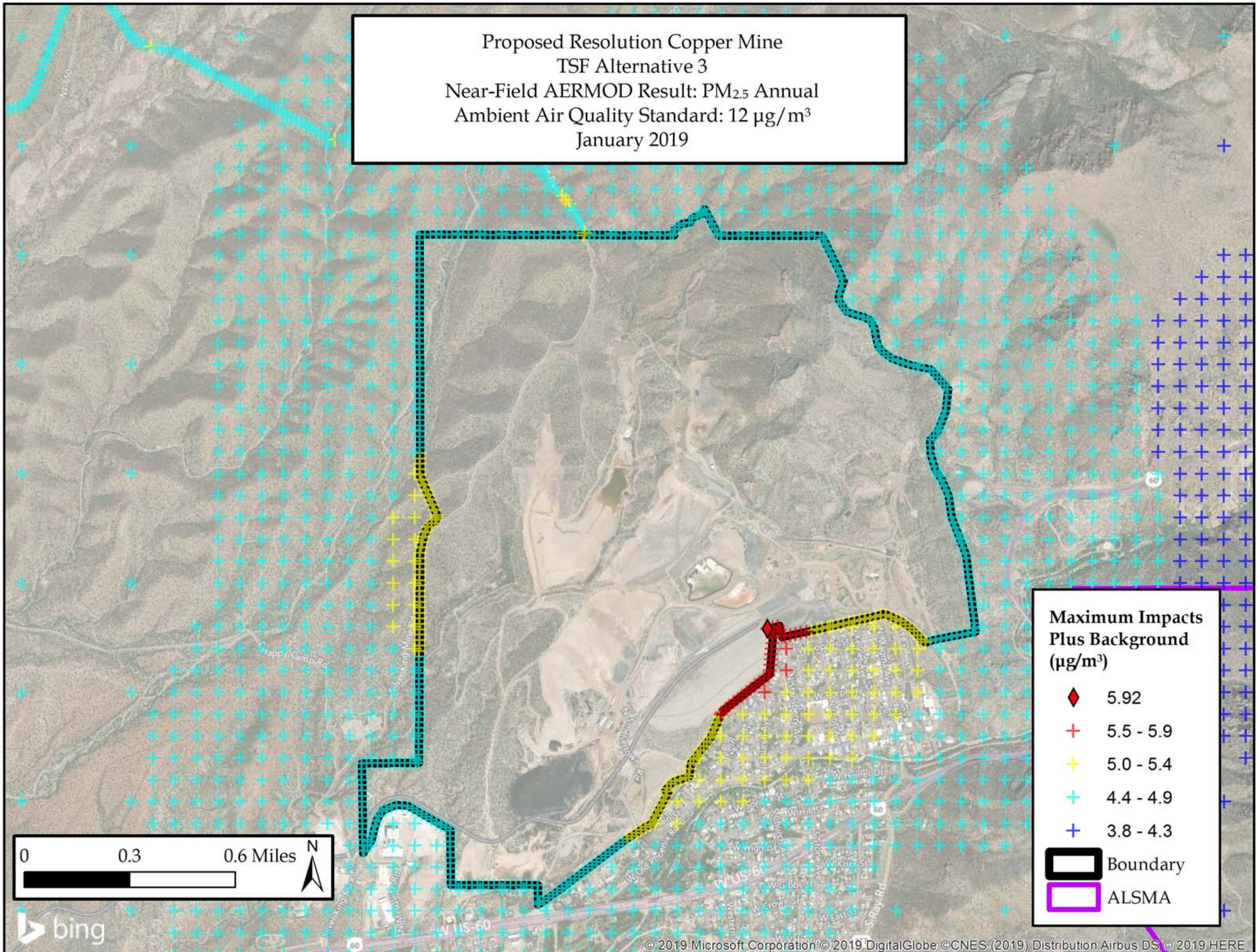


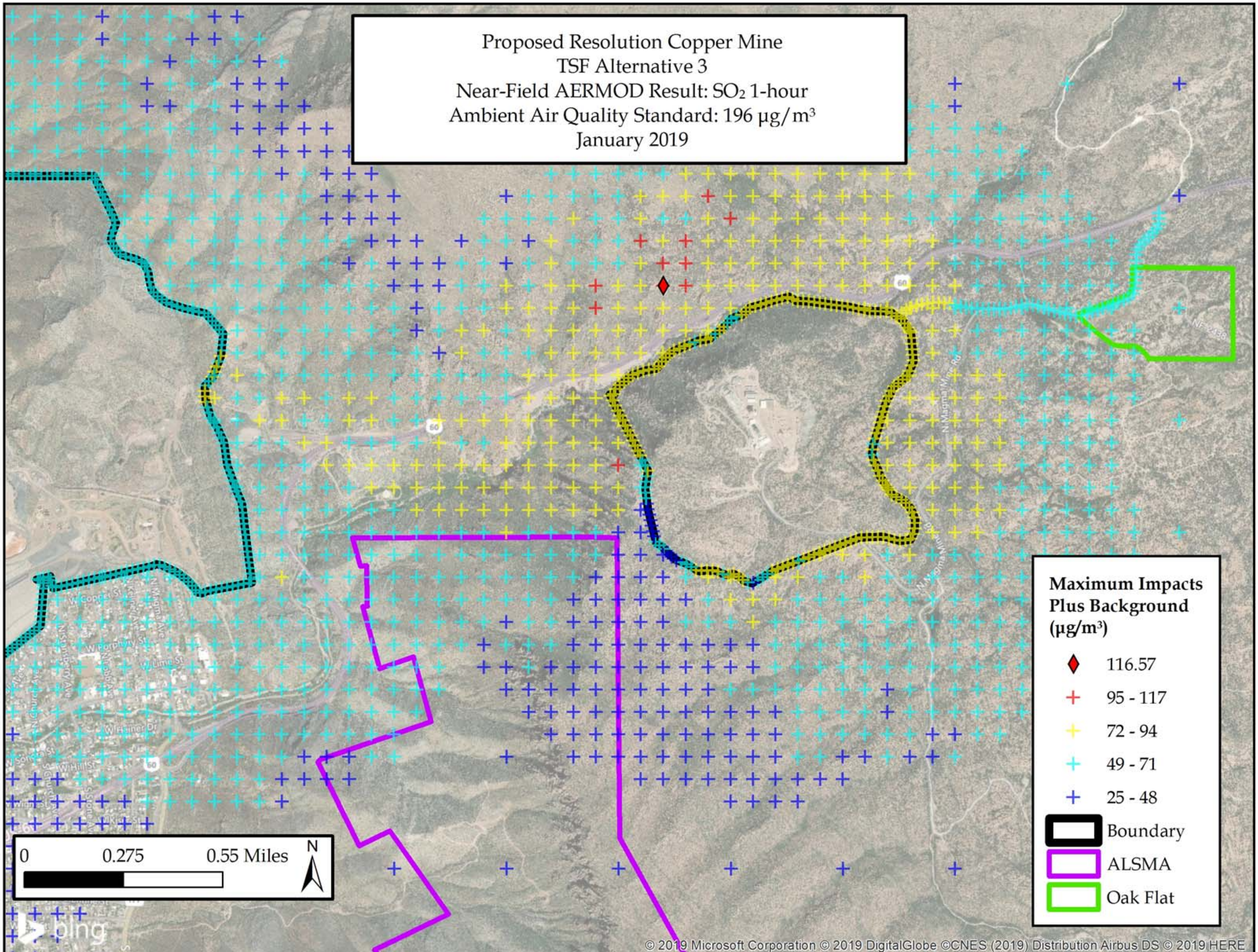
Proposed Resolution Copper Mine
TSF Alternative 3
Near-Field AERMOD Result: PM10 24-hour
Ambient Air Quality Standard: 150 µg/m3
January 2019
Maximum Impacts Plus Background (µg/m3)
96.75
87 - 97
76 - 86
66 - 75
54 - 65
Boundary
ALSMA
Oak Flat
0
0.275
0.55 Miles
N
© 2019 Microsoft Corporation © 2019 DigitalGlobe ©CNES (2019) Distribution Airbus DS © 2019 HERE



Proposed Resolution Copper Mine
TSF Alternative 3
Near-Field AERMOD Result: PM10 Annual
Ambient Air Quality Standard: 50 µg/m³
January 2019
Hewitt Canyon Rd
E Hewitt Station Rd
Maximum Impacts Plus Background (µg/m³)
24.37
23 - 24
21 - 22
19 - 20
Boundary
0
0.5
1 Miles
N
bing
© 2019 Microsoft Corporation © 2019 DigitalGlobe ©CNES (2019) Distribution Airbus DS © 2019 HERE


Proposed Resolution Copper Mine
TSF Alternative 3
Near-Field AERMOD Result: PM2.5 24-hour
Ambient Air Quality Standard: 35 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
17.74
17 - 18
14 - 16
12 - 13
9 - 11
Boundary
ALSMA
Oak Flat
0
0.275
0.55 Miles
N
bing
© 2019 Microsoft Corporation © 2019 DigitalGlobe ©CNES (2019) Distribution Airbus DS © 2019 HERE


Proposed Resolution Copper Mine
TSF Alternative 3
Near-Field AERMOD Result: PM2.5 Annual
Ambient Air Quality Standard: 12 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
5.92
5.5 - 5.9
5.0 - 5.4
4.4 - 4.9
3.8 - 4.3
Boundary
ALSMA
0
0.3
0.6 Miles
N
© 2019 Microsoft Corporation © 2019 DigitalGlobe ©CNES (2019) Distribution Airbus DS © 2019 HERE


Proposed Resolution Copper Mine
TSF Alternative 3
Near-Field AERMOD Result: SO_2 1-hour
Ambient Air Quality Standard: 196 μg/m³
January 2019
Maximum Impacts Plus Background (μg/m³)
116.57
95 - 117
72 - 94
49 - 71
25 - 48
Boundary
ALSMA
Oak Flat
0
0.275
0.55 Miles
N
bing
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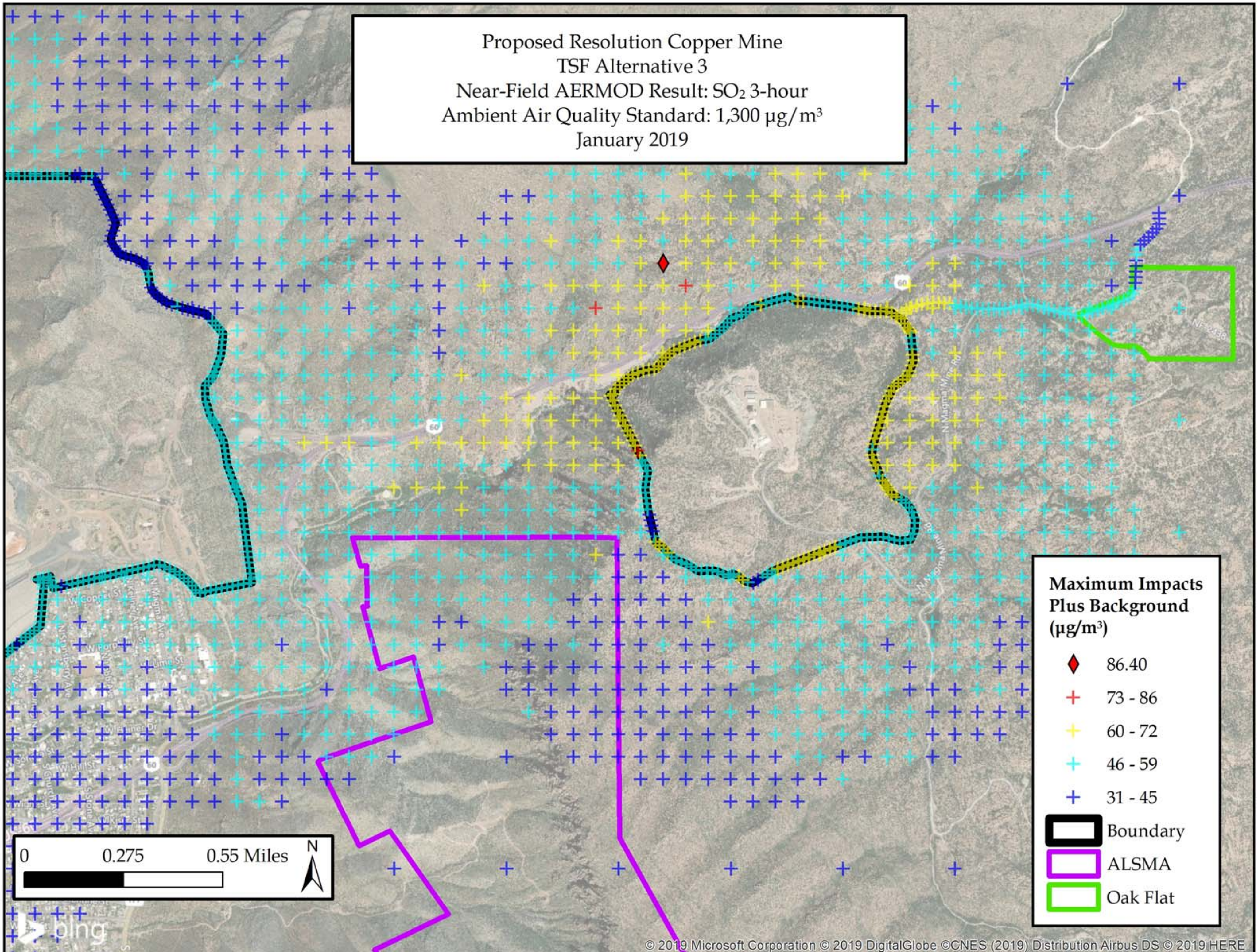
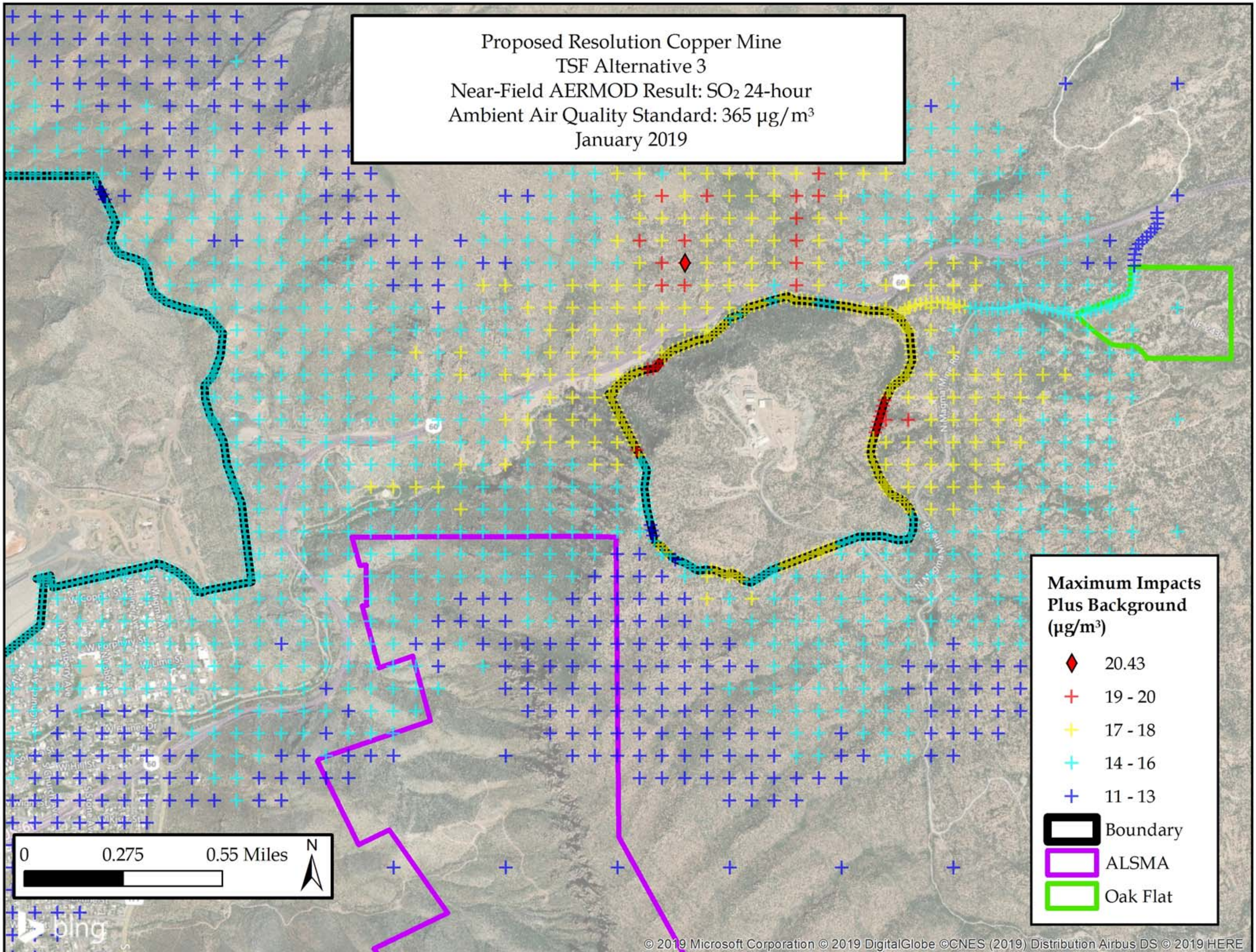


Proposed Resolution Copper Mine
TSF Alternative 3
Near-Field AERMOD Result: SO₂ 3-hour
Ambient Air Quality Standard: 1,300 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
86.40
73 - 86
60 - 72
46 - 59
31 - 45
Boundary
ALSMA
Oak Flat
0
0.275
0.55 Miles
N
© 2019 Microsoft Corporation © 2019 DigitalGlobe ©CNES (2019) Distribution Airbus DS © 2019 HERE


Proposed Resolution Copper Mine
TSF Alternative 3
Near-Field AERMOD Result: SO_2 24-hour
Ambient Air Quality Standard: 365 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
20.43
19 - 20
17 - 18
14 - 16
11 - 13
Boundary
ALSMA
Oak Flat
0
0.275
0.55 Miles
N
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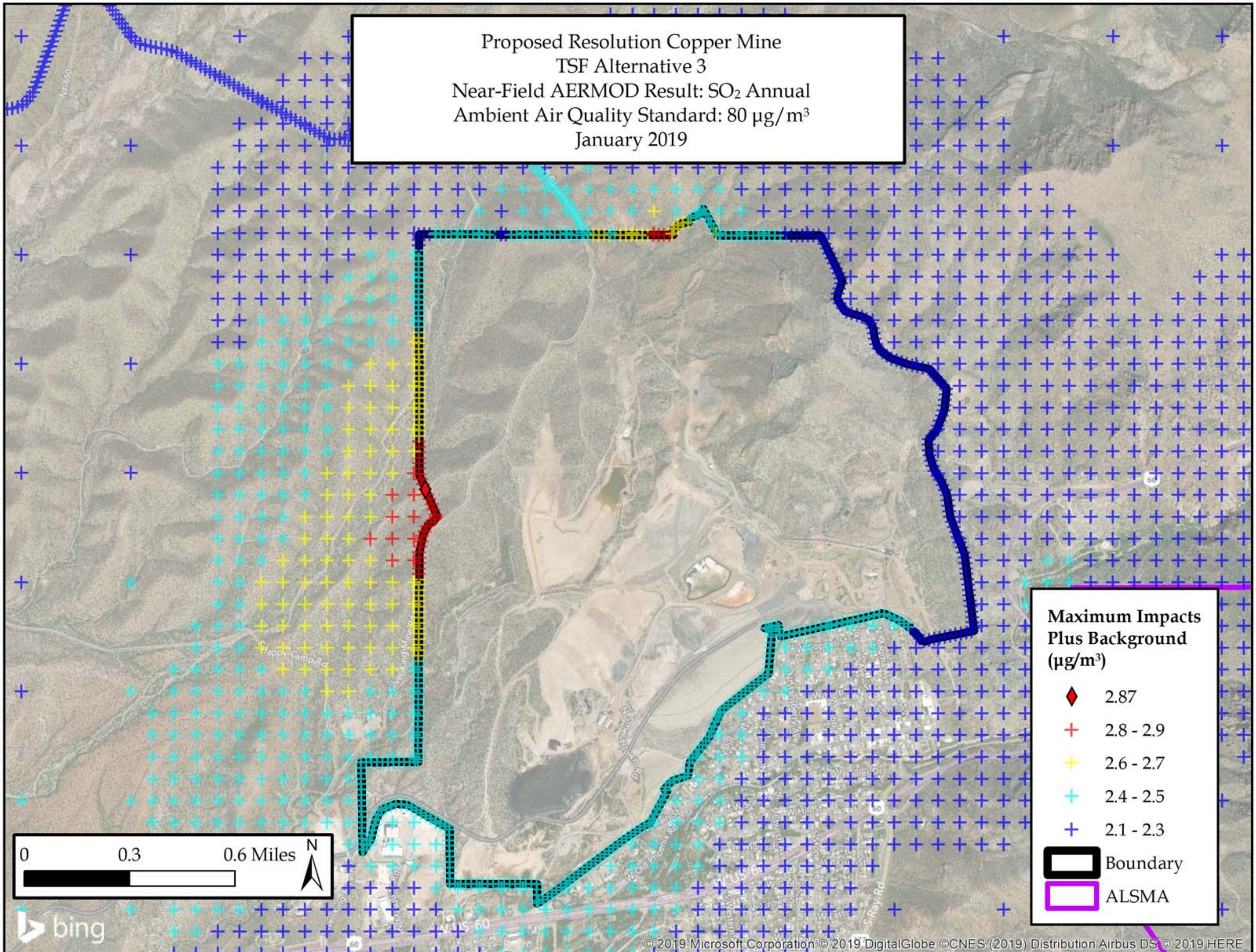
Proposed Resolution Copper Mine
TSF Alternative 3
Near-Field AERMOD Result: SO2 Annual
Ambient Air Quality Standard: 80 µg/m3
January 2019
Maximum Impacts Plus Background (µg/m3)
2.87
2.8 - 2.9
2.6 - 2.7
2.4 - 2.5
2.1 - 2.3
Boundary
ALSMA
0
0.3
0.6 Miles
N
Happy Camp Rd
US-60
bing
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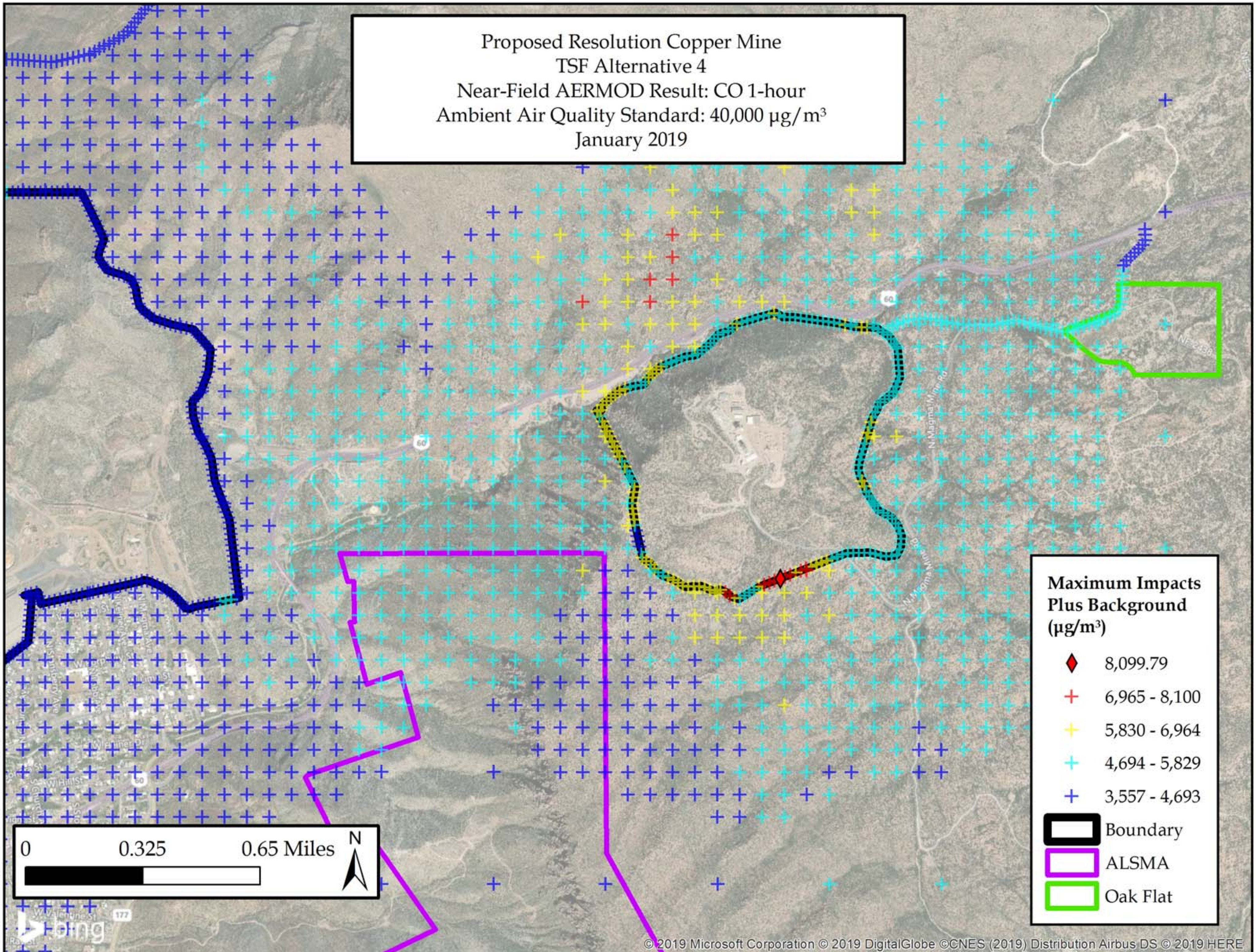

Proposed Resolution Copper Mine
TSF Alternative 4
Near-Field AERMOD Result: CO 1-hour
Ambient Air Quality Standard: 40,000 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
8,099.79
6,965 - 8,100
5,830 - 6,964
4,694 - 5,829
3,557 - 4,693
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
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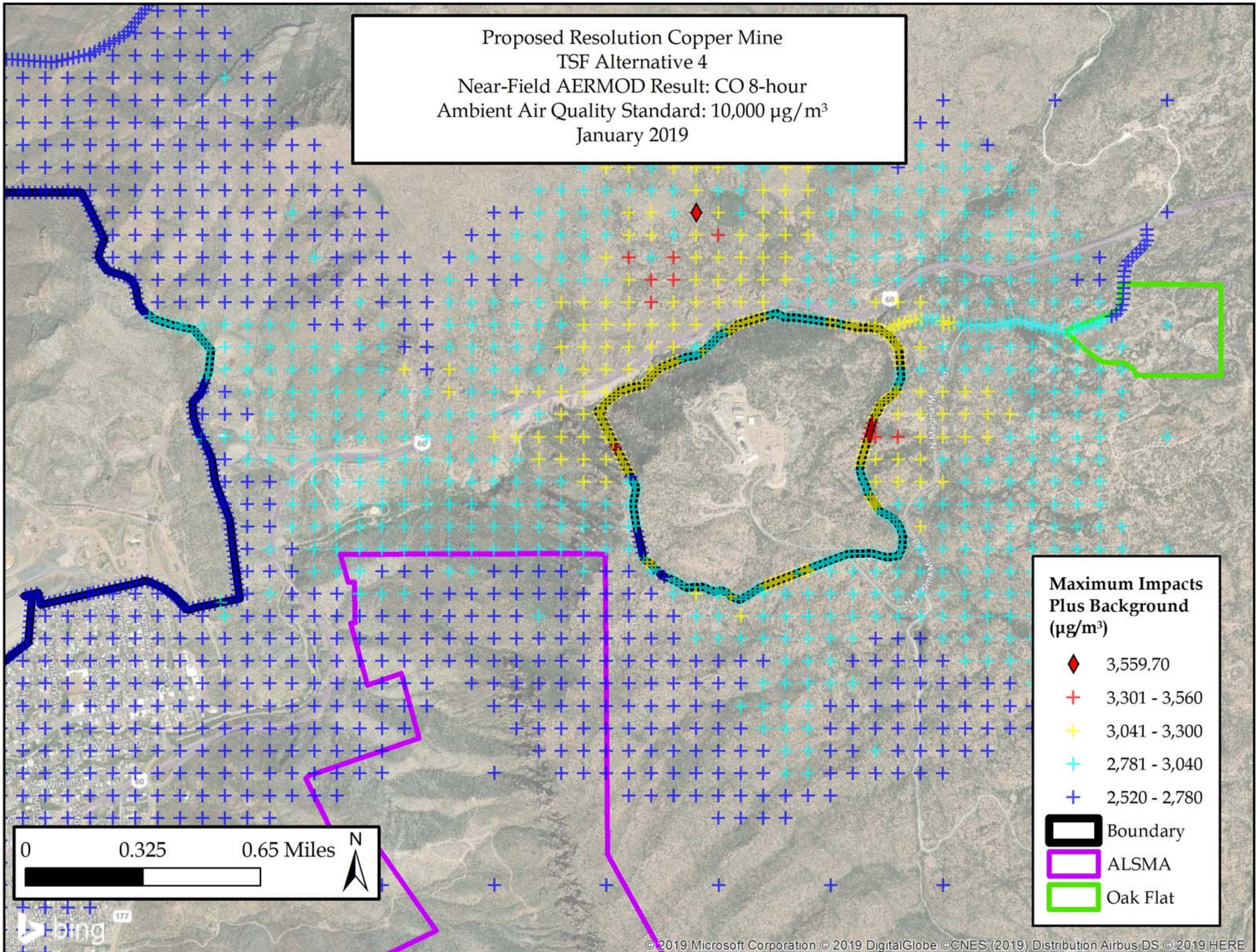

Proposed Resolution Copper Mine
TSF Alternative 4
Near-Field AERMOD Result: CO 8-hour
Ambient Air Quality Standard: 10,000 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
3,559.70
3,301 - 3,560
3,041 - 3,300
2,781 - 3,040
2,520 - 2,780
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
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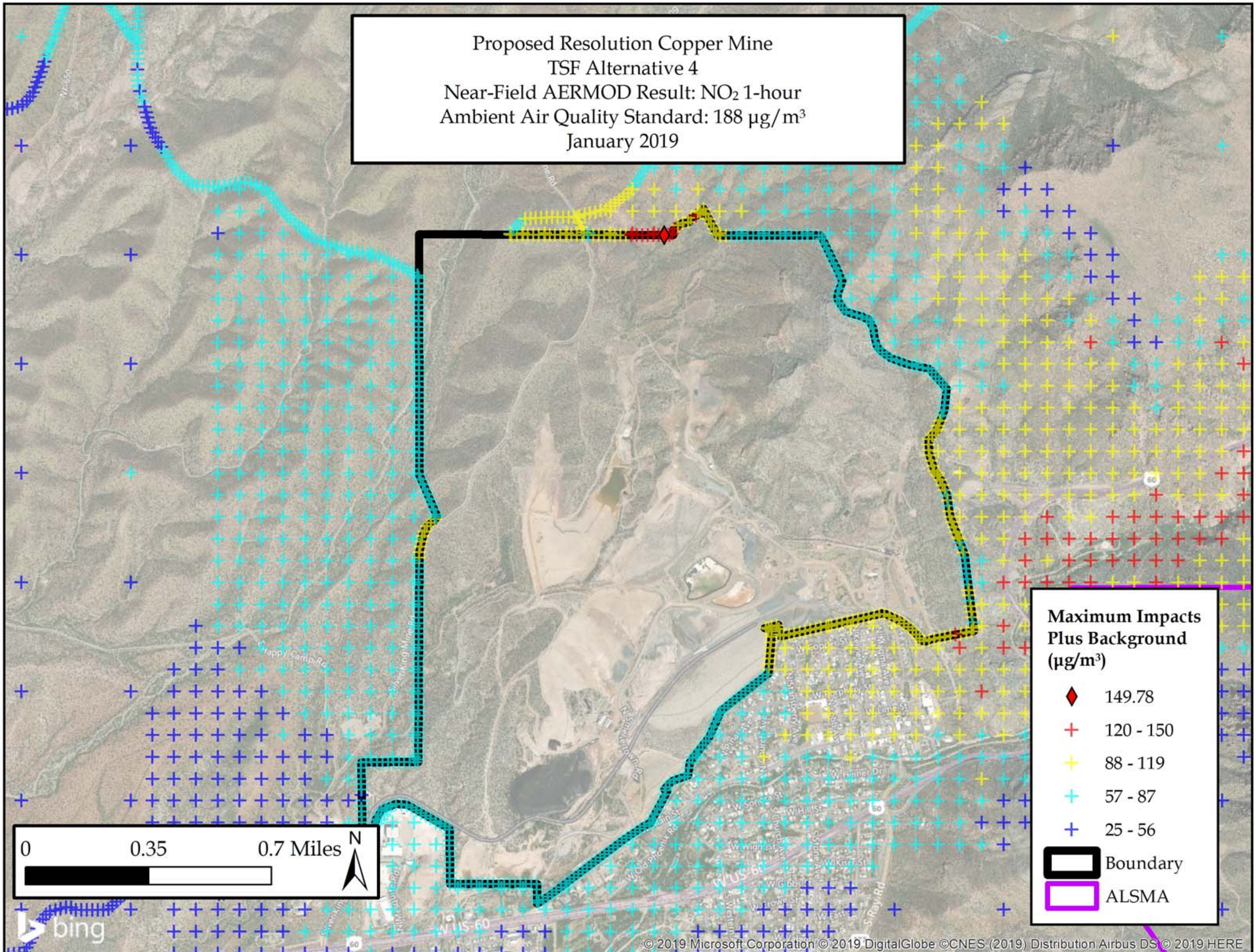

Proposed Resolution Copper Mine
TSF Alternative 4
Near-Field AERMOD Result: NO2 1-hour
Ambient Air Quality Standard: 188 µg/m3
January 2019
Maximum Impacts Plus Background (µg/m3)
149.78
120 - 150
88 - 119
57 - 87
25 - 56
Boundary
ALSMA
0
0.35
0.7 Miles
N
bing
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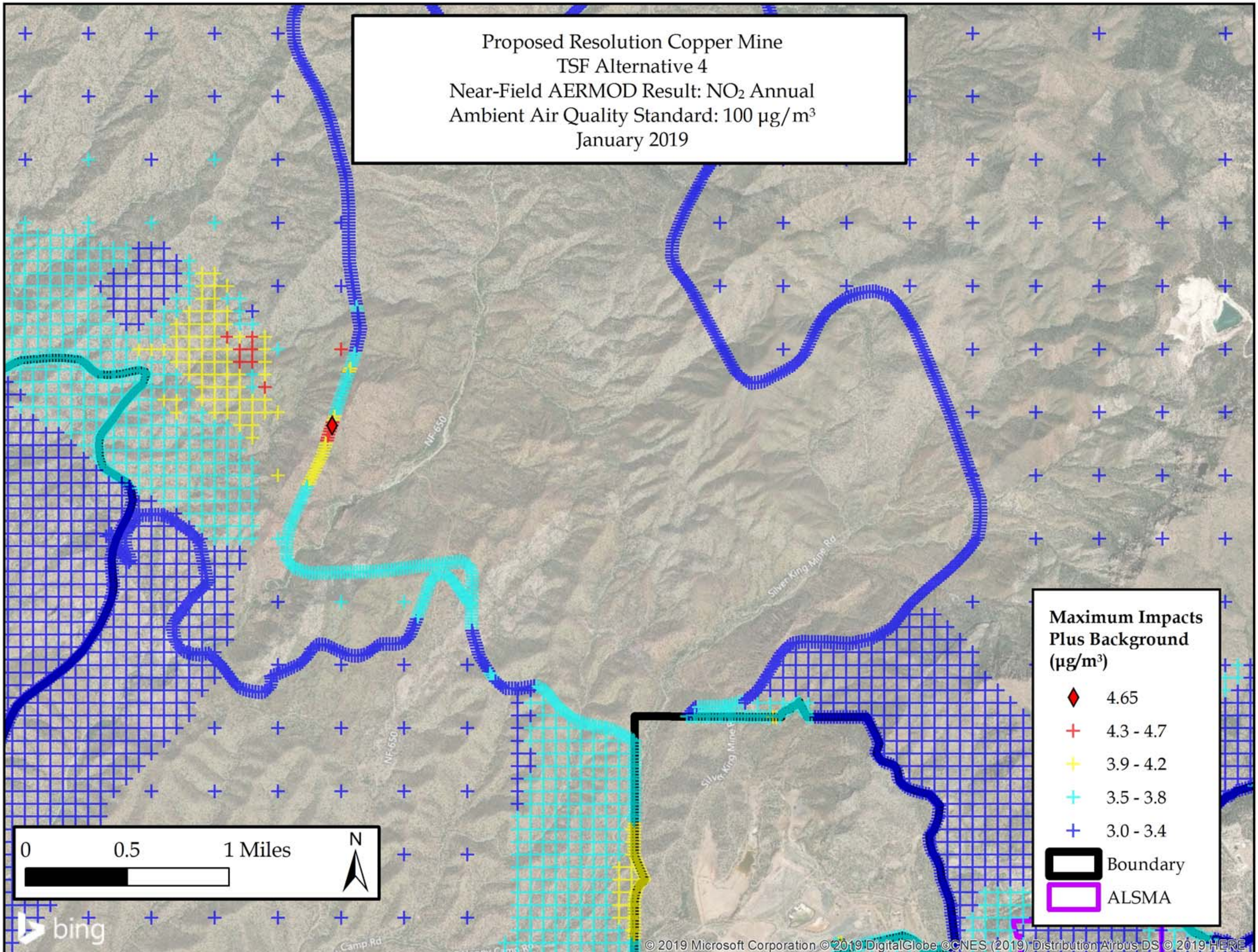
Proposed Resolution Copper Mine
TSF Alternative 4
Near-Field AERMOD Result: NO₂ Annual
Ambient Air Quality Standard: 100 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
4.65
4.3 - 4.7
3.9 - 4.2
3.5 - 3.8
3.0 - 3.4
Boundary
ALSMA
0
0.5
1 Miles
N
NF-650
Silver King Mine Rd
bing
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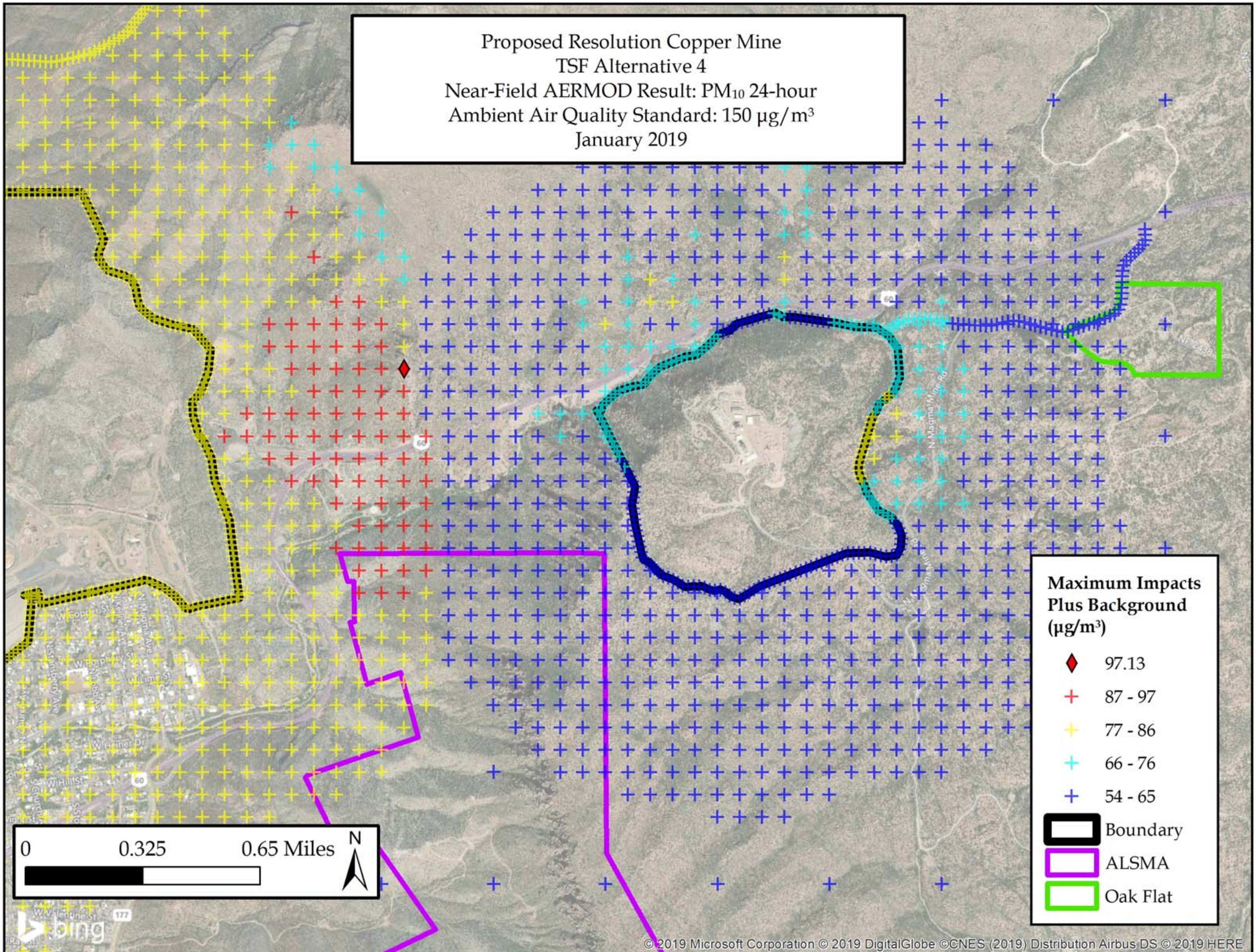
Proposed Resolution Copper Mine
TSF Alternative 4
Near-Field AERMOD Result: PM10 24-hour
Ambient Air Quality Standard: 150 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
97.13
87 - 97
77 - 86
66 - 76
54 - 65
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
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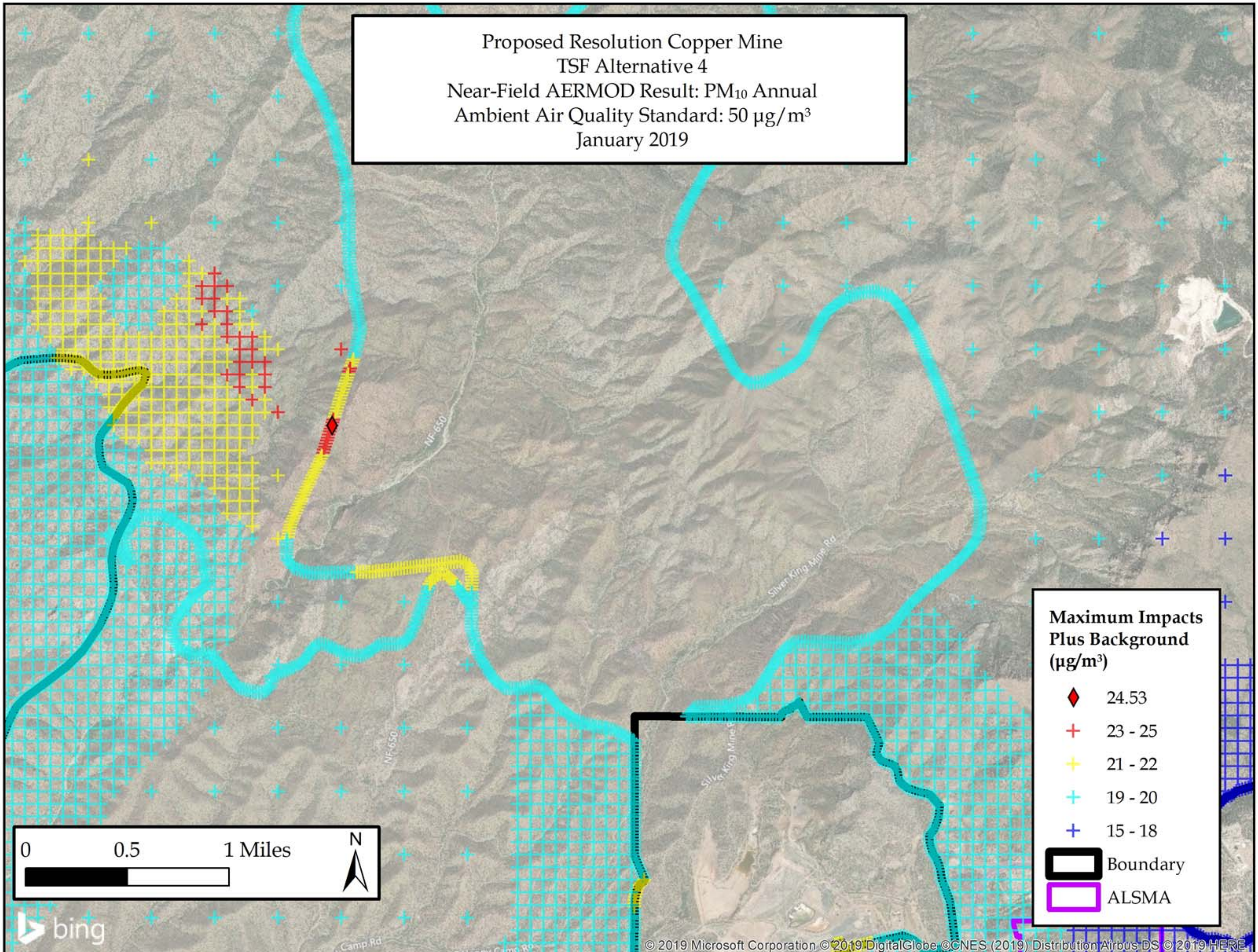
Proposed Resolution Copper Mine
TSF Alternative 4
Near-Field AERMOD Result: PM10 Annual
Ambient Air Quality Standard: 50 µg/m3
January 2019
Maximum Impacts Plus Background (µg/m3)
24.53
23 - 25
21 - 22
19 - 20
15 - 18
Boundary
ALSMA
0
0.5
1 Miles
N
NF-650
Silver King Mine Rd
bing
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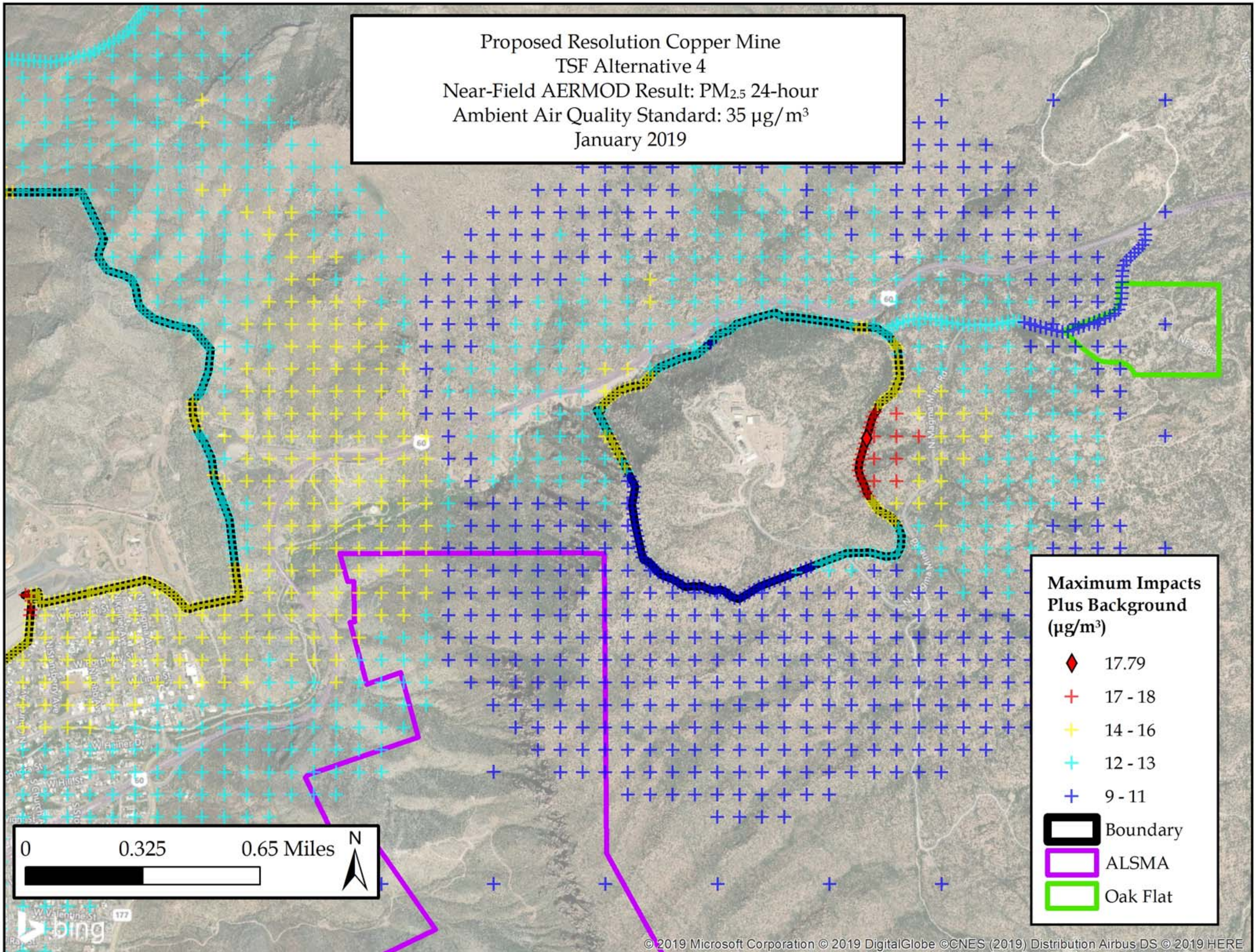
Proposed Resolution Copper Mine
TSF Alternative 4
Near-Field AERMOD Result: PM2.5 24-hour
Ambient Air Quality Standard: 35 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
17.79
17 - 18
14 - 16
12 - 13
9 - 11
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
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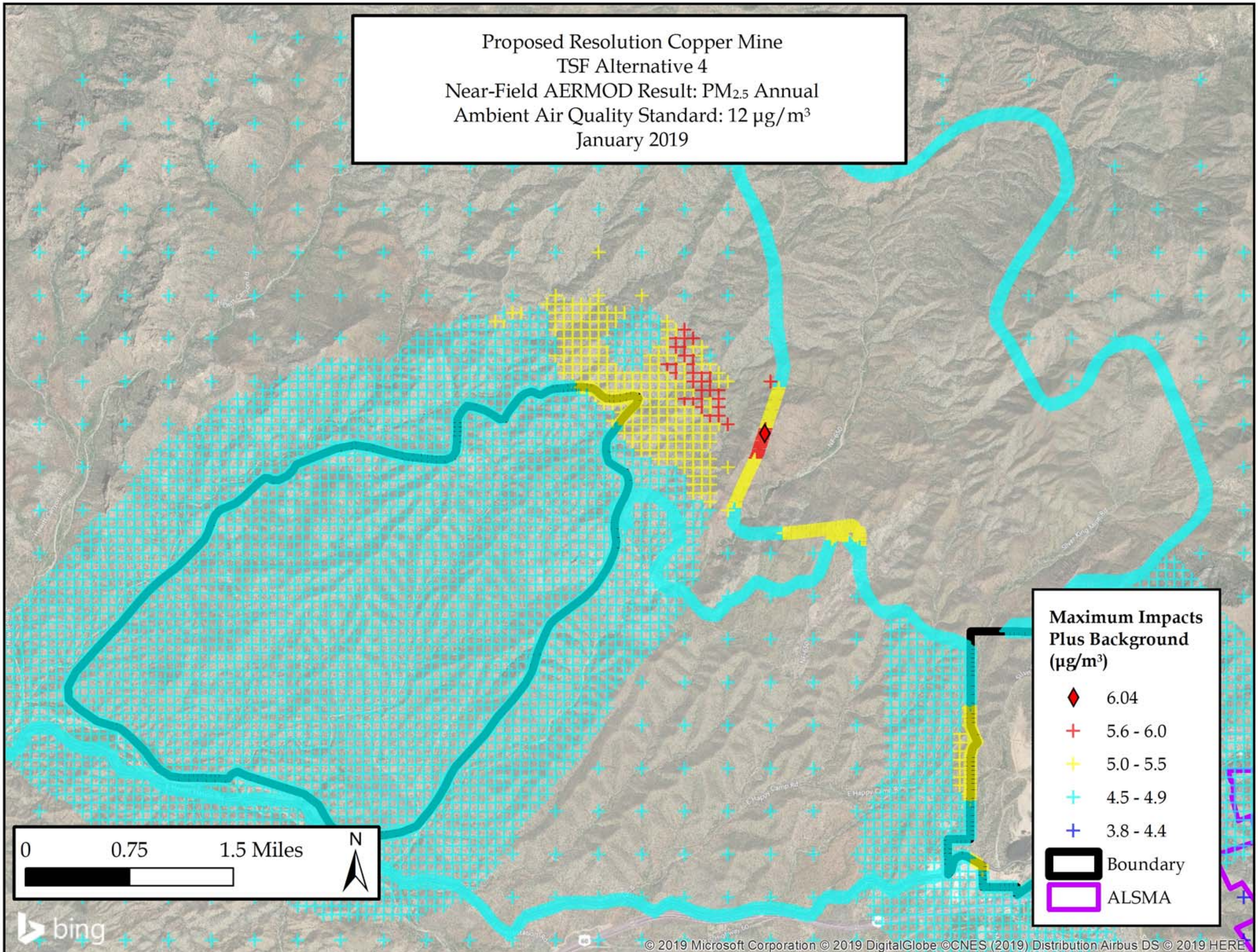

Proposed Resolution Copper Mine
TSF Alternative 4
Near-Field AERMOD Result: PM2.5 Annual
Ambient Air Quality Standard: 12 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
6.04
5.6 - 6.0
5.0 - 5.5
4.5 - 4.9
3.8 - 4.4
Boundary
ALSMA
0
0.75
1.5 Miles
N
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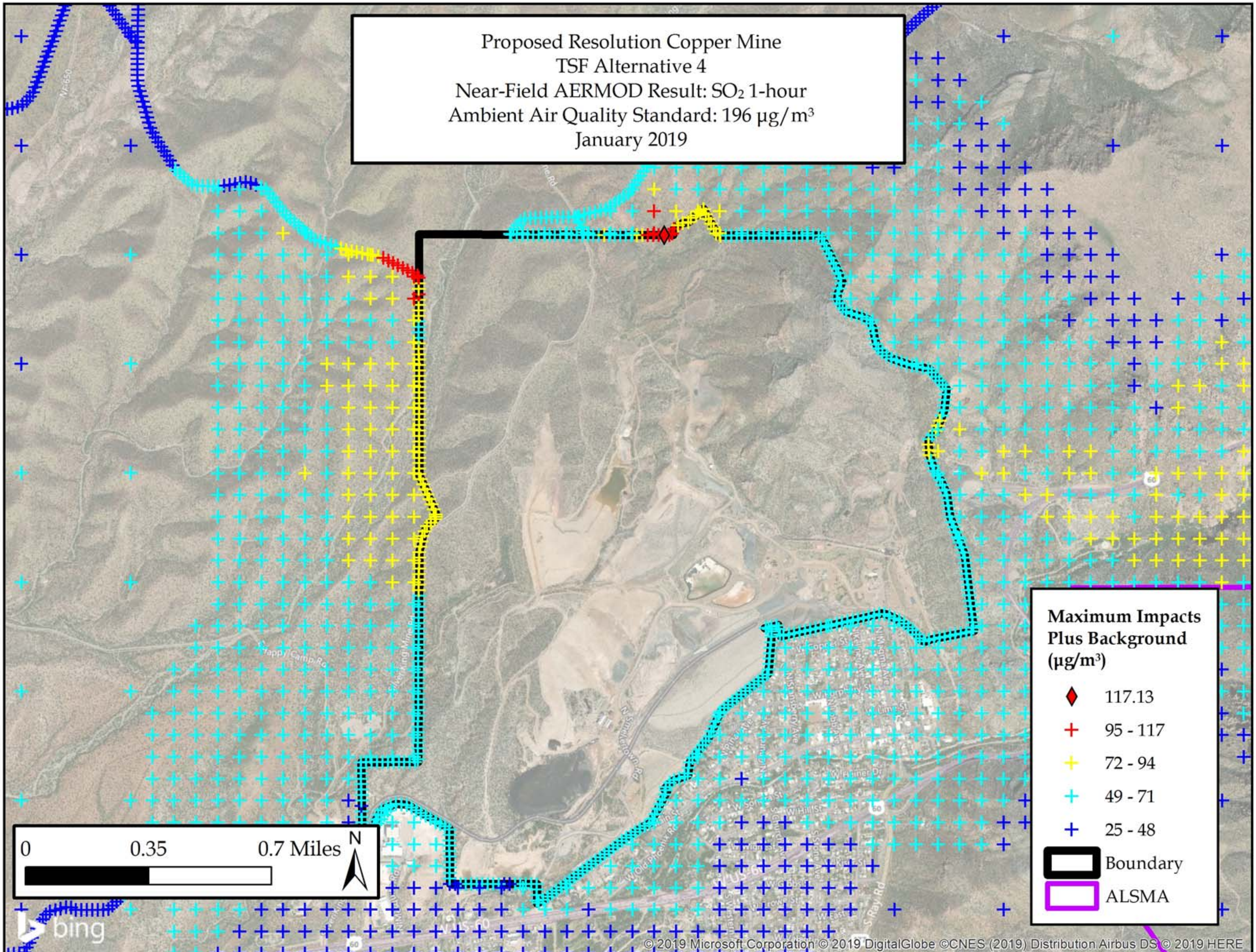

Proposed Resolution Copper Mine
TSF Alternative 4
Near-Field AERMOD Result: SO2 1-hour
Ambient Air Quality Standard: 196 µg/m3
January 2019
Maximum Impacts Plus Background (µg/m3)
117.13
95 - 117
72 - 94
49 - 71
25 - 48
Boundary
ALSMA
0
0.35
0.7 Miles
N
bing
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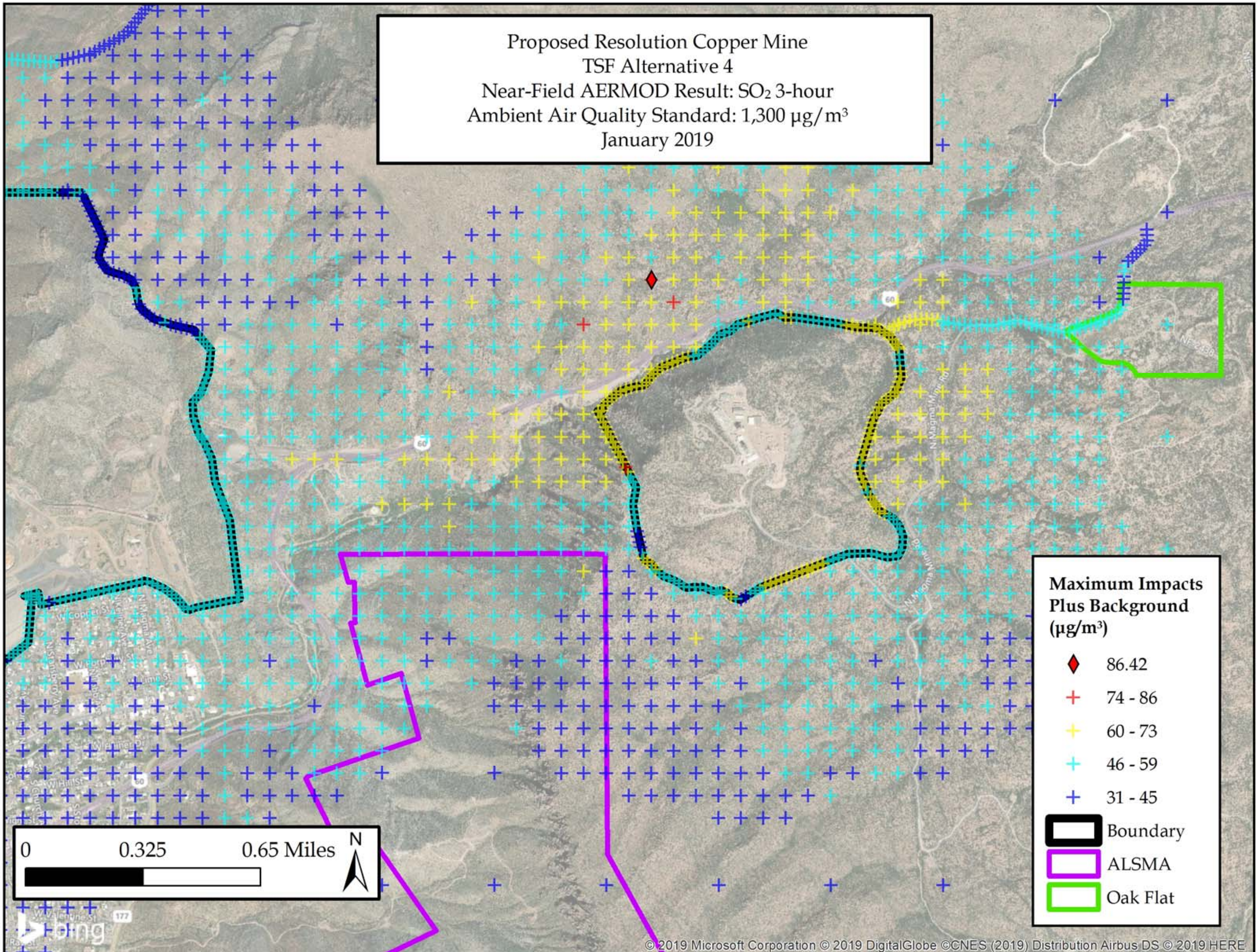
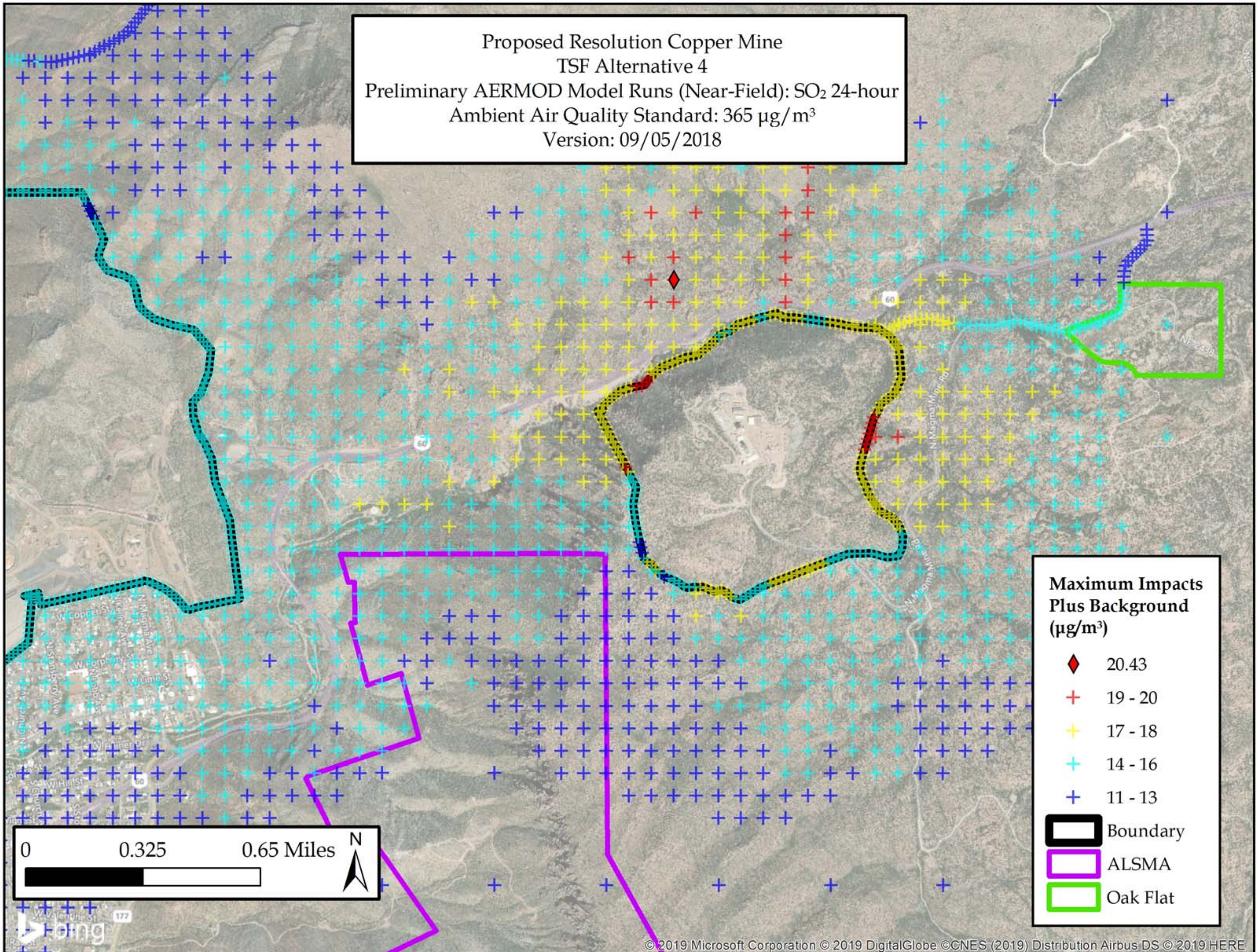
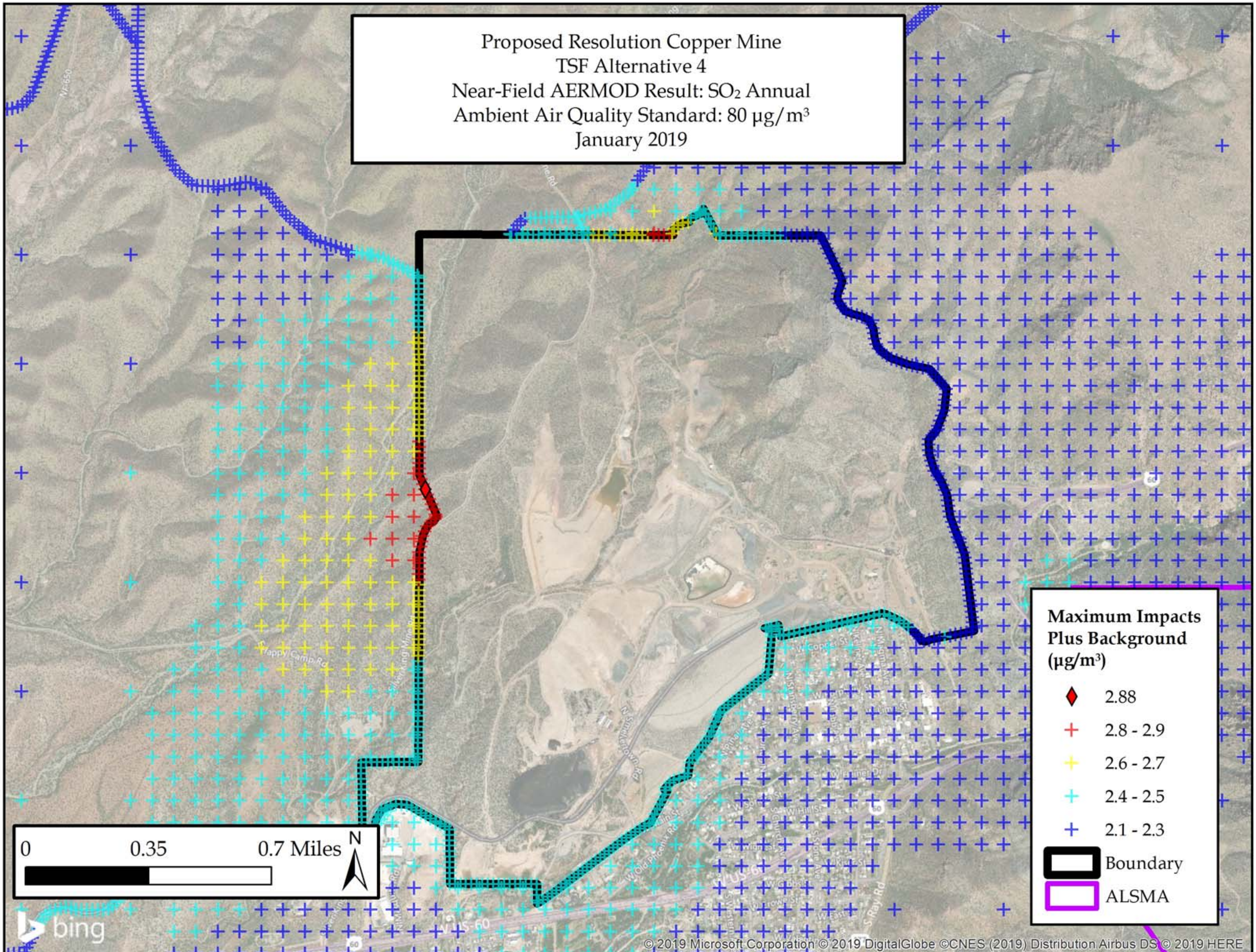
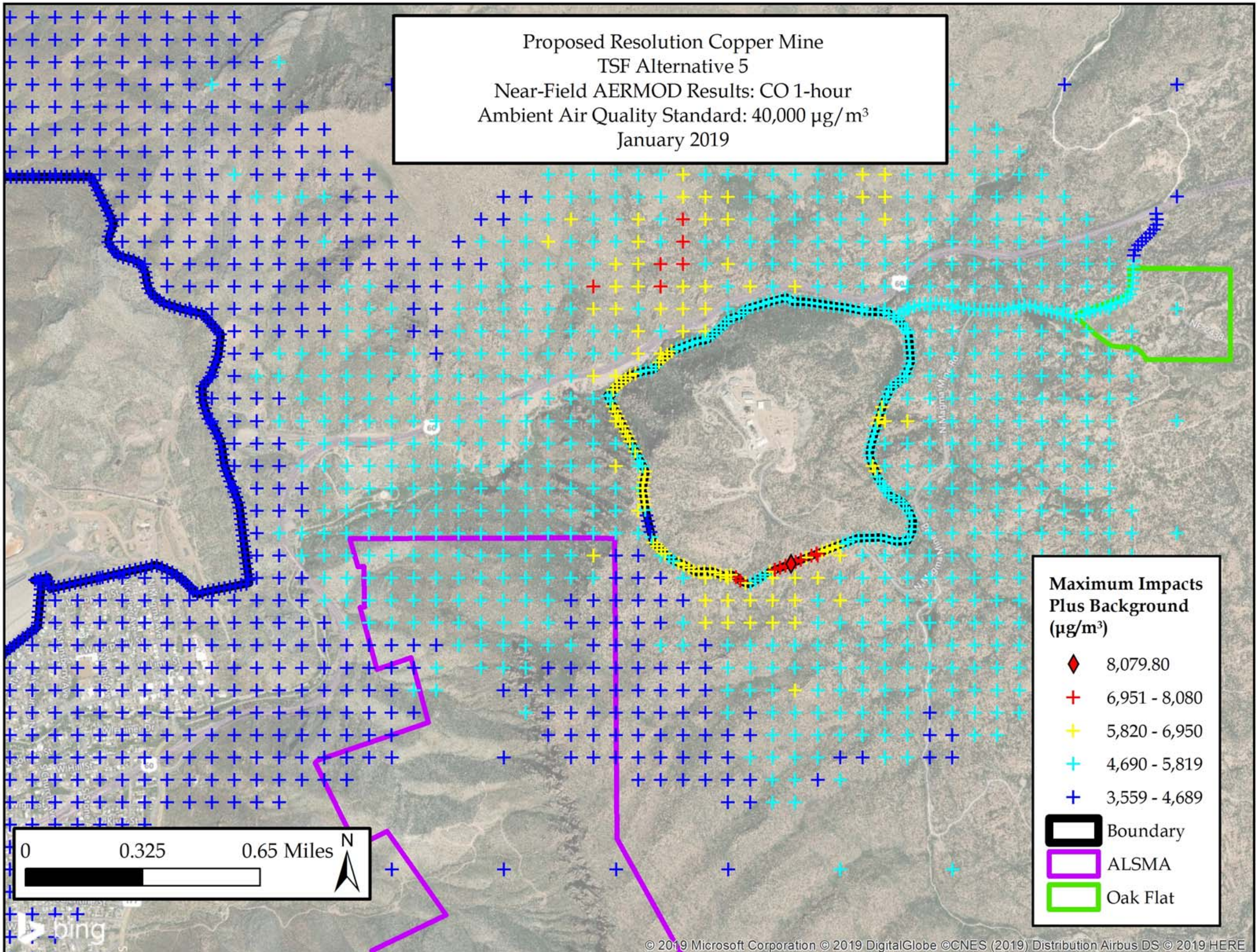


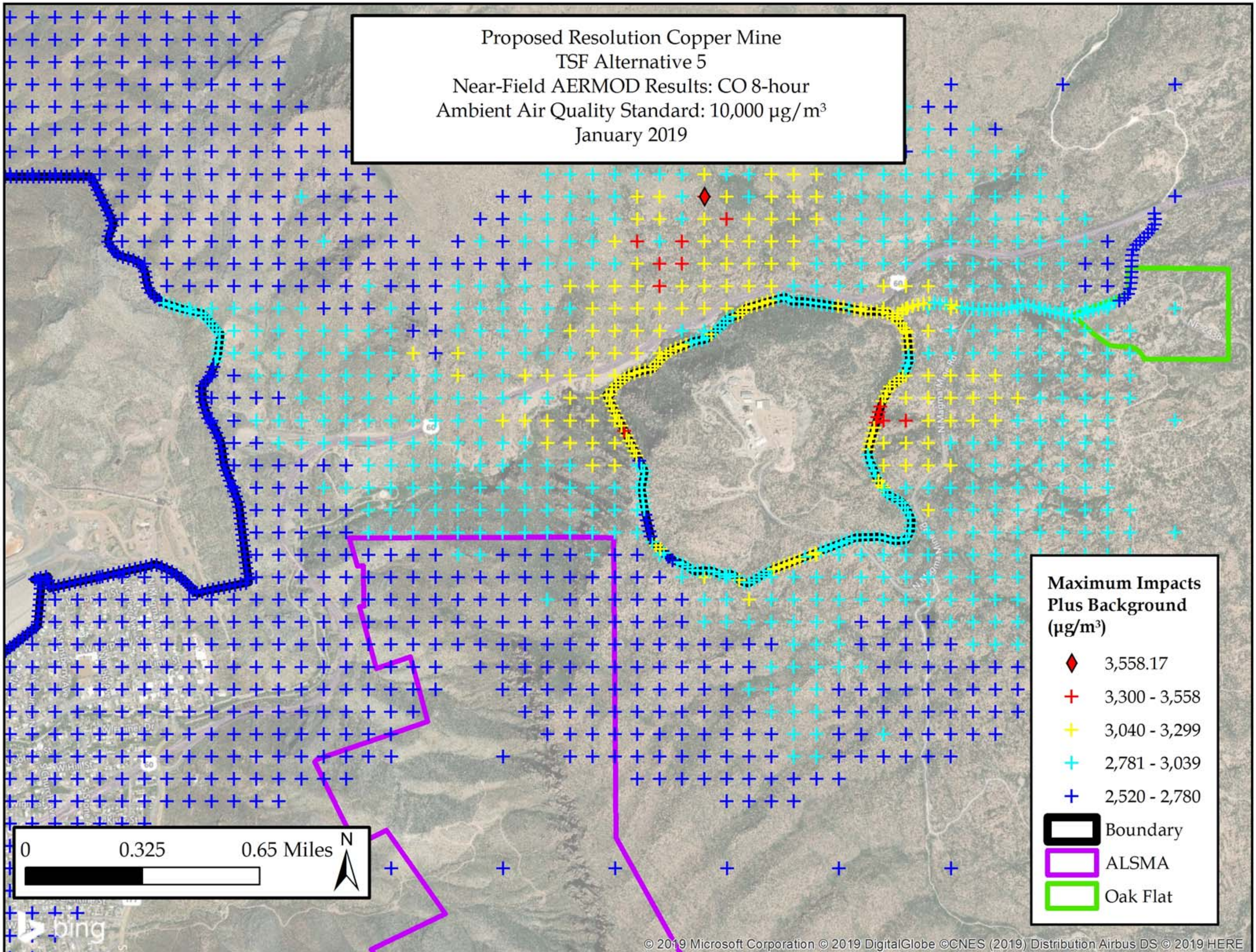
Proposed Resolution Copper Mine
TSF Alternative 4
Near-Field AERMOD Result: SO_2 3-hour
Ambient Air Quality Standard: 1,300 μg/m³
January 2019
Maximum Impacts Plus Background (μg/m³)
86.42
74 - 86
60 - 73
46 - 59
31 - 45
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
© 2019 Microsoft Corporation © 2019 DigitalGlobe ©CNES (2019) Distribution Airbus DS © 2019 HERE

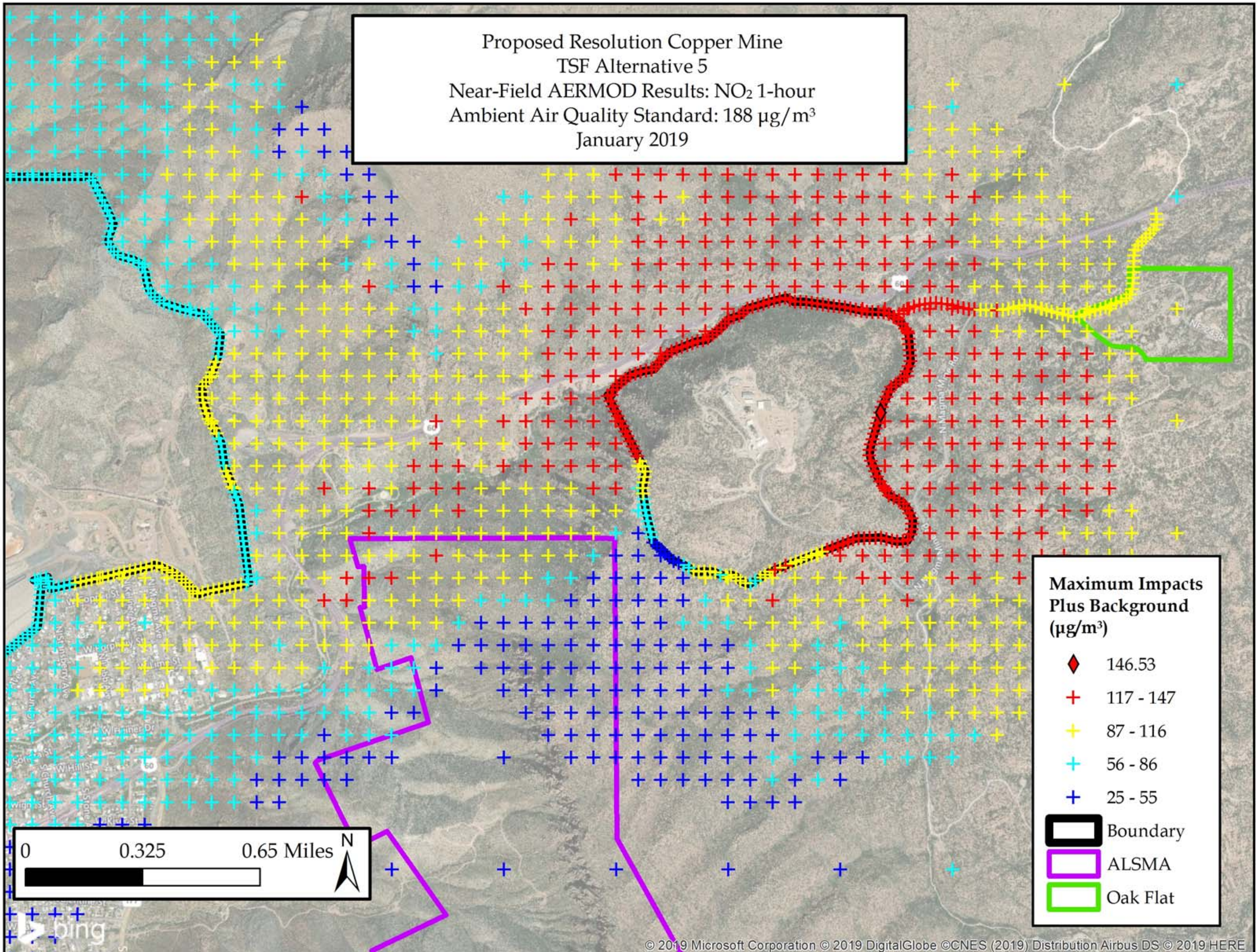

Proposed Resolution Copper Mine
TSF Alternative 4
Preliminary AERMOD Model Runs (Near-Field): SO₂ 24-hour
Ambient Air Quality Standard: 365 µg/m³
Version: 09/05/2018
Maximum Impacts Plus Background (µg/m³)
20.43
19 - 20
17 - 18
14 - 16
11 - 13
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
© 2019 Microsoft Corporation © 2019 DigitalGlobe ©CNES (2019) Distribution Airbus DS © 2019 HERE

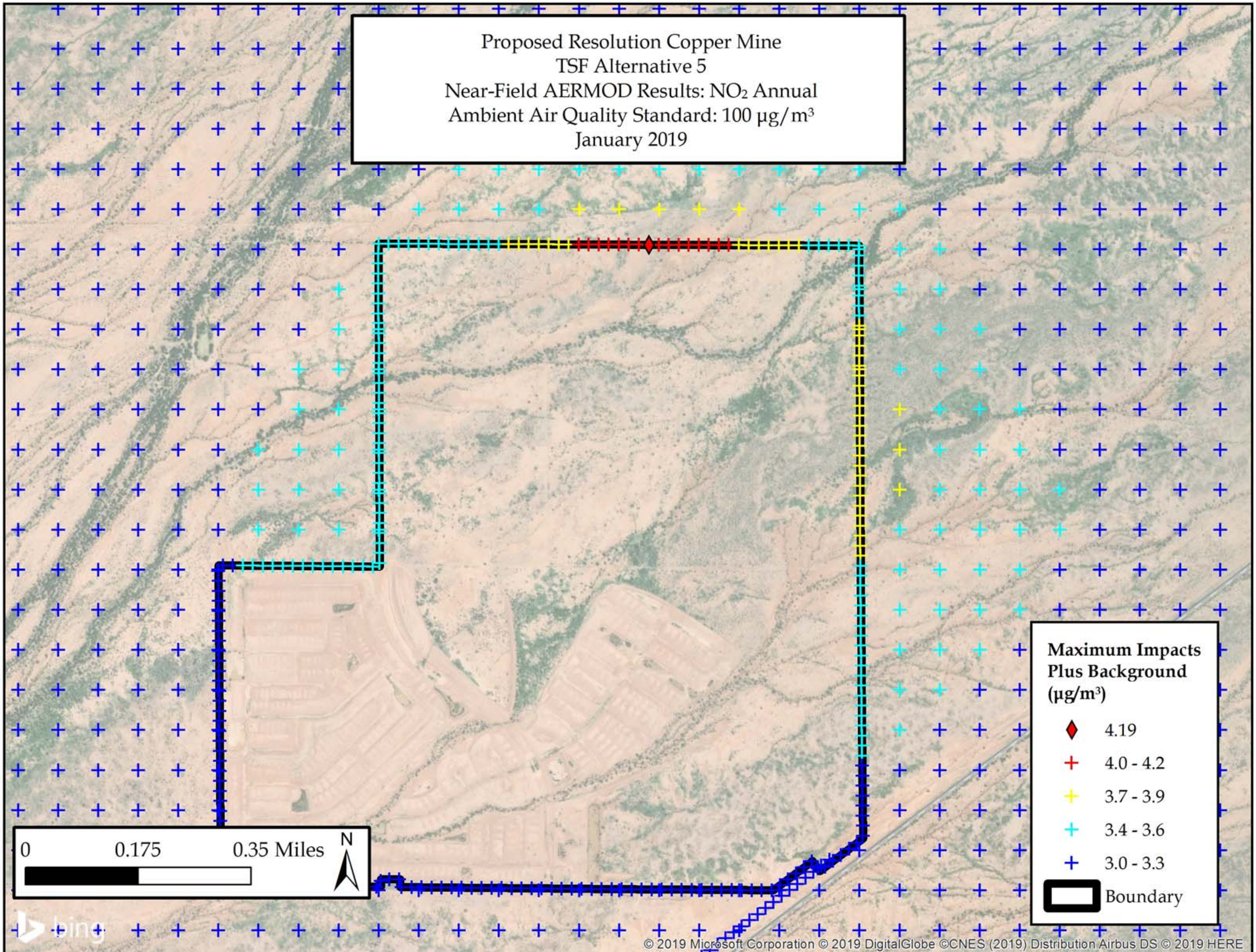


Proposed Resolution Copper Mine
TSF Alternative 4
Near-Field AERMOD Result: SO2 Annual
Ambient Air Quality Standard: 80 µg/m3
January 2019
Maximum Impacts Plus Background (µg/m3)
2.88
2.8 - 2.9
2.6 - 2.7
2.4 - 2.5
2.1 - 2.3
Boundary
ALSMA
0
0.35
0.7 Miles
N
© 2019 Microsoft Corporation © 2019 DigitalGlobe ©CNES (2019) Distribution Airbus DS © 2019 HERE


Proposed Resolution Copper Mine
TSF Alternative 5
Near-Field AERMOD Results: CO 1-hour
Ambient Air Quality Standard: 40,000 μg/m³
January 2019
Maximum Impacts Plus Background (μg/m³)
8,079.80
6,951 - 8,080
5,820 - 6,950
4,690 - 5,819
3,559 - 4,689
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
© 2019 Microsoft Corporation © 2019 DigitalGlobe ©CNES (2019) Distribution Airbus DS © 2019 HERE


Proposed Resolution Copper Mine
TSF Alternative 5
Near-Field AERMOD Results: CO 8-hour
Ambient Air Quality Standard: 10,000 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
3,558.17
3,300 - 3,558
3,040 - 3,299
2,781 - 3,039
2,520 - 2,780
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
© 2019 Microsoft Corporation © 2019 DigitalGlobe ©CNES (2019) Distribution Airbus DS © 2019 HERE


Proposed Resolution Copper Mine
TSF Alternative 5
Near-Field AERMOD Results: NO₂ 1-hour
Ambient Air Quality Standard: 188 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
146.53
117 - 147
87 - 116
56 - 86
25 - 55
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
bing
© 2019 Microsoft Corporation © 2019 DigitalGlobe ©CNES (2019) Distribution Airbus DS © 2019 HERE


Proposed Resolution Copper Mine
TSF Alternative 5
Near-Field AERMOD Results: NO_2 Annual
Ambient Air Quality Standard: 100 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
4.19
4.0 - 4.2
3.7 - 3.9
3.4 - 3.6
3.0 - 3.3
Boundary
0
0.175
0.35 Miles
N
bing
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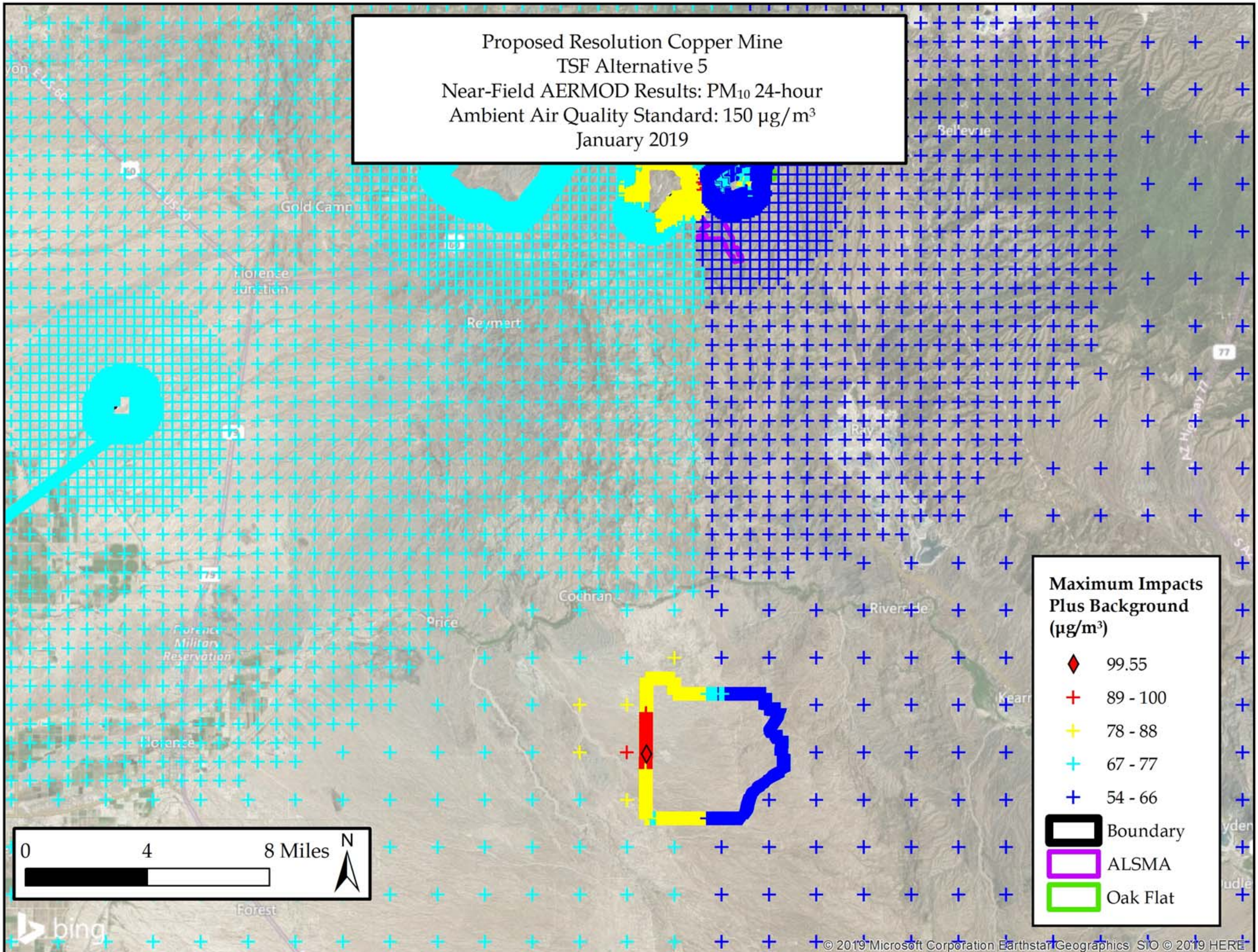
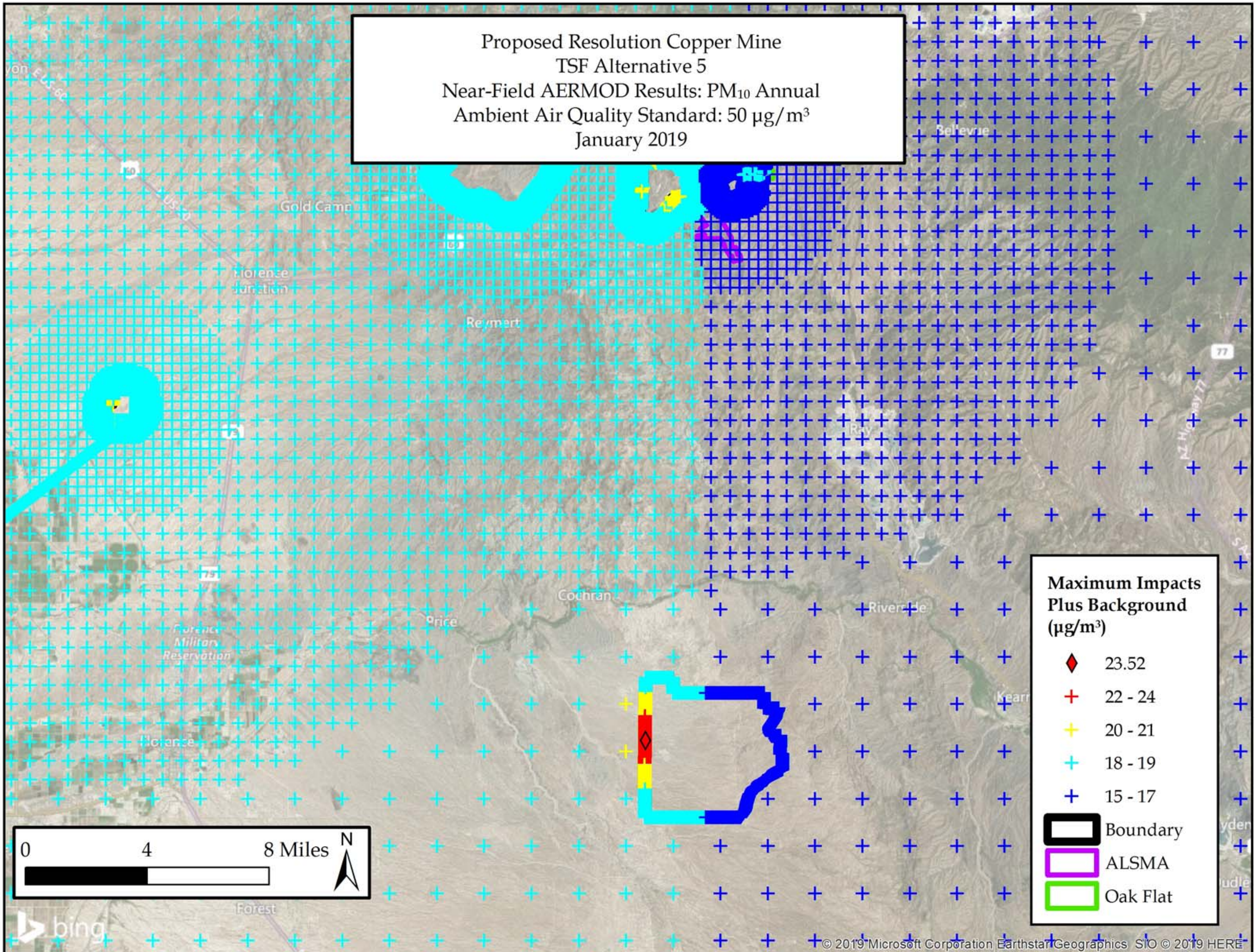
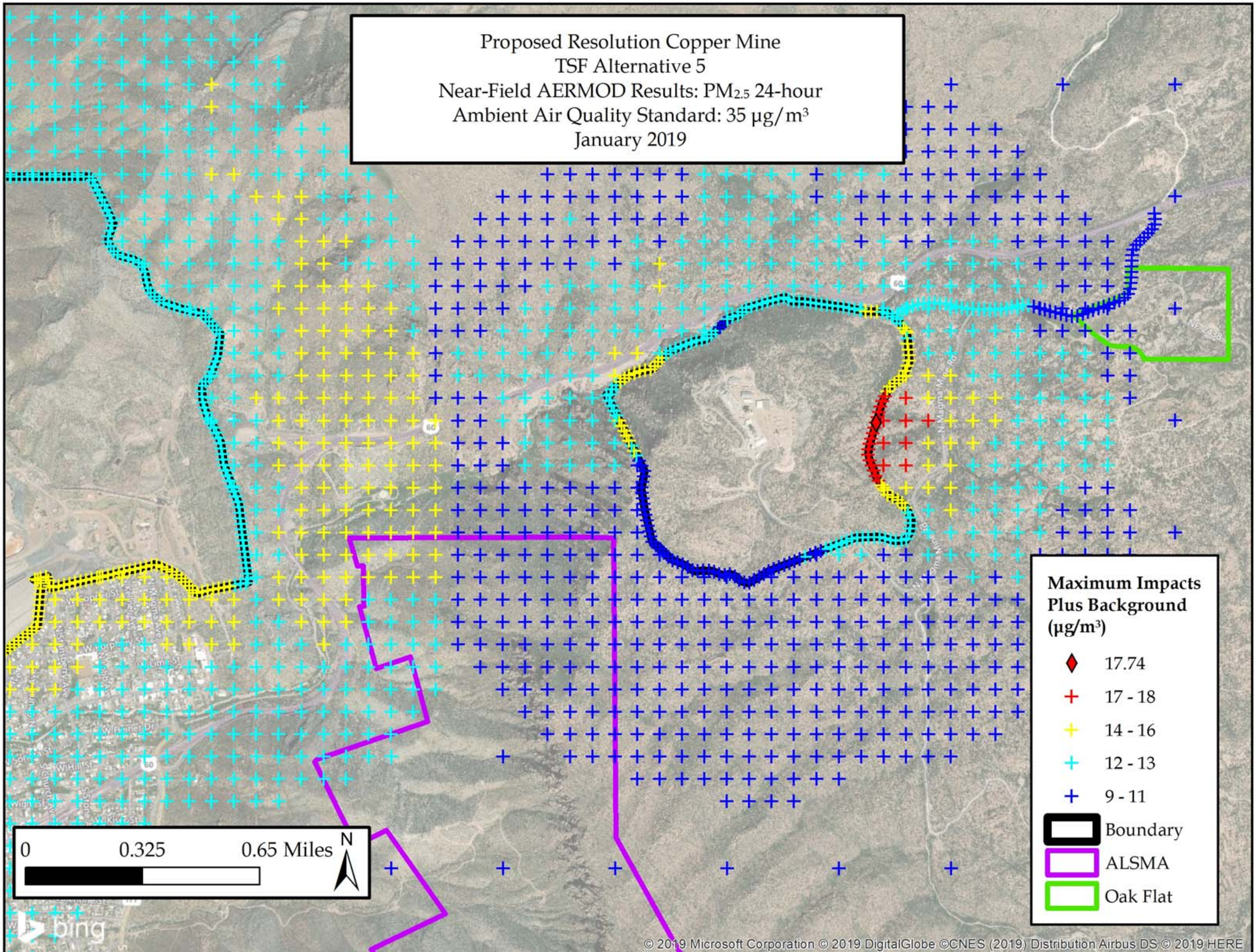


Proposed Resolution Copper Mine
TSF Alternative 5
Near-Field AERMOD Results: PM10 24-hour
Ambient Air Quality Standard: 150 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
99.55
89 - 100
78 - 88
67 - 77
54 - 66
Boundary
ALSMA
Oak Flat
0
4
8 Miles
N
Gold Camp
Florence Junction
Reymert
Bellevue
Ray
Cochran
Price
Riverside
Florence Military Reservation
Florence
Forest
© 2019 Microsoft Corporation Earthstar Geographics SIO © 2019 HERE



Proposed Resolution Copper Mine
TSF Alternative 5
Near-Field AERMOD Results: PM10 Annual
Ambient Air Quality Standard: 50 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
23.52
22 - 24
20 - 21
18 - 19
15 - 17
Boundary
ALSMA
Oak Flat
0
4
8 Miles
N
Gold Camp
Florence Junction
Reymert
Cochran
Price
Florence Military Reservation
Florence
Forest
Bellevue
Ray
Riverside
Kearny
AZ Highway 77
© 2019 Microsoft Corporation Earthstar Geographics SIO © 2019 HERE


Proposed Resolution Copper Mine
TSF Alternative 5
Near-Field AERMOD Results: PM2.5 24-hour
Ambient Air Quality Standard: 35 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
17.74
17 - 18
14 - 16
12 - 13
9 - 11
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
bing
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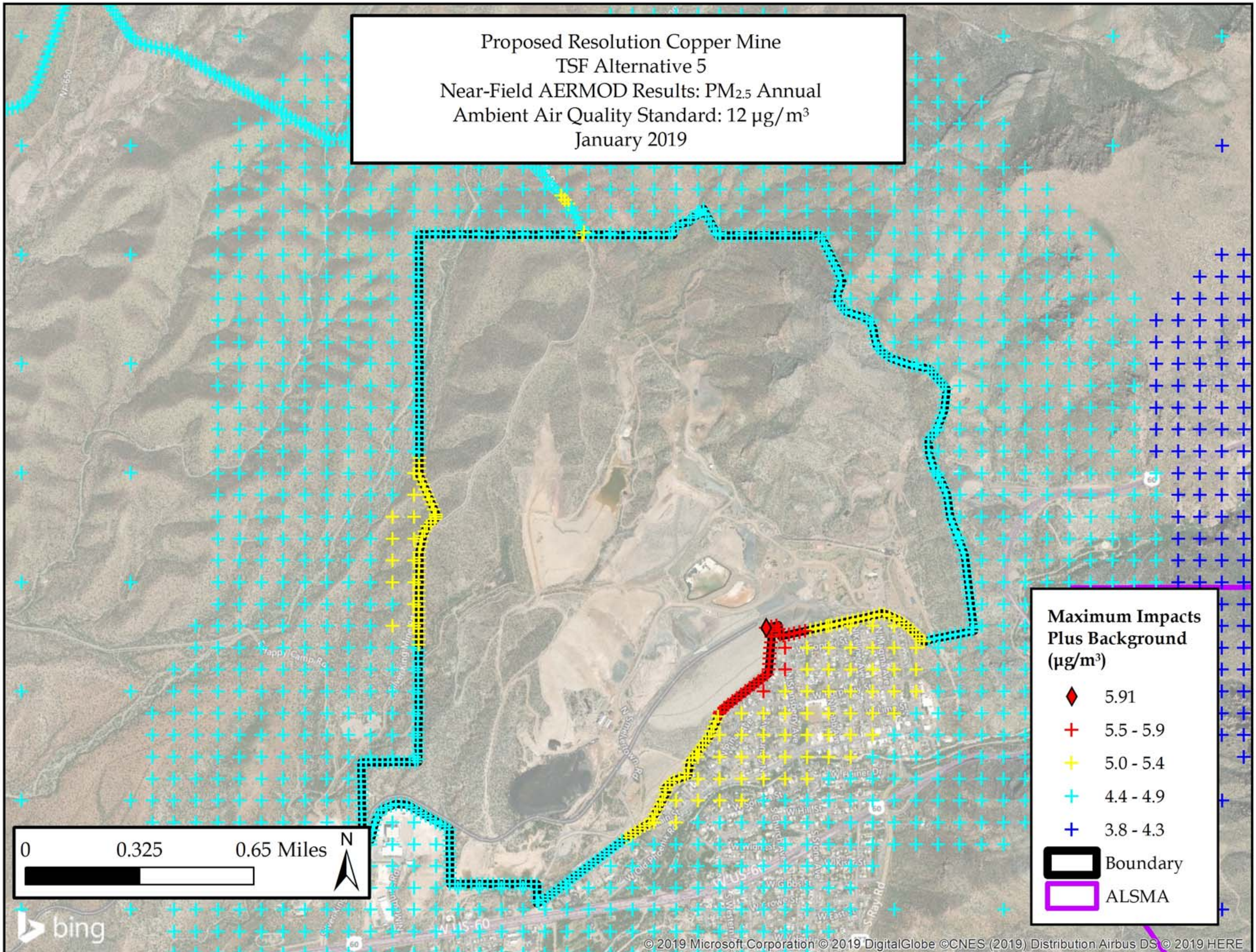
Proposed Resolution Copper Mine
TSF Alternative 5
Near-Field AERMOD Results: PM2.5 Annual
Ambient Air Quality Standard: 12 μg/m³
January 2019
Maximum Impacts Plus Background (μg/m³)
5.91
5.5 - 5.9
5.0 - 5.4
4.4 - 4.9
3.8 - 4.3
Boundary
ALSMA
0
0.325
0.65 Miles
N
bing
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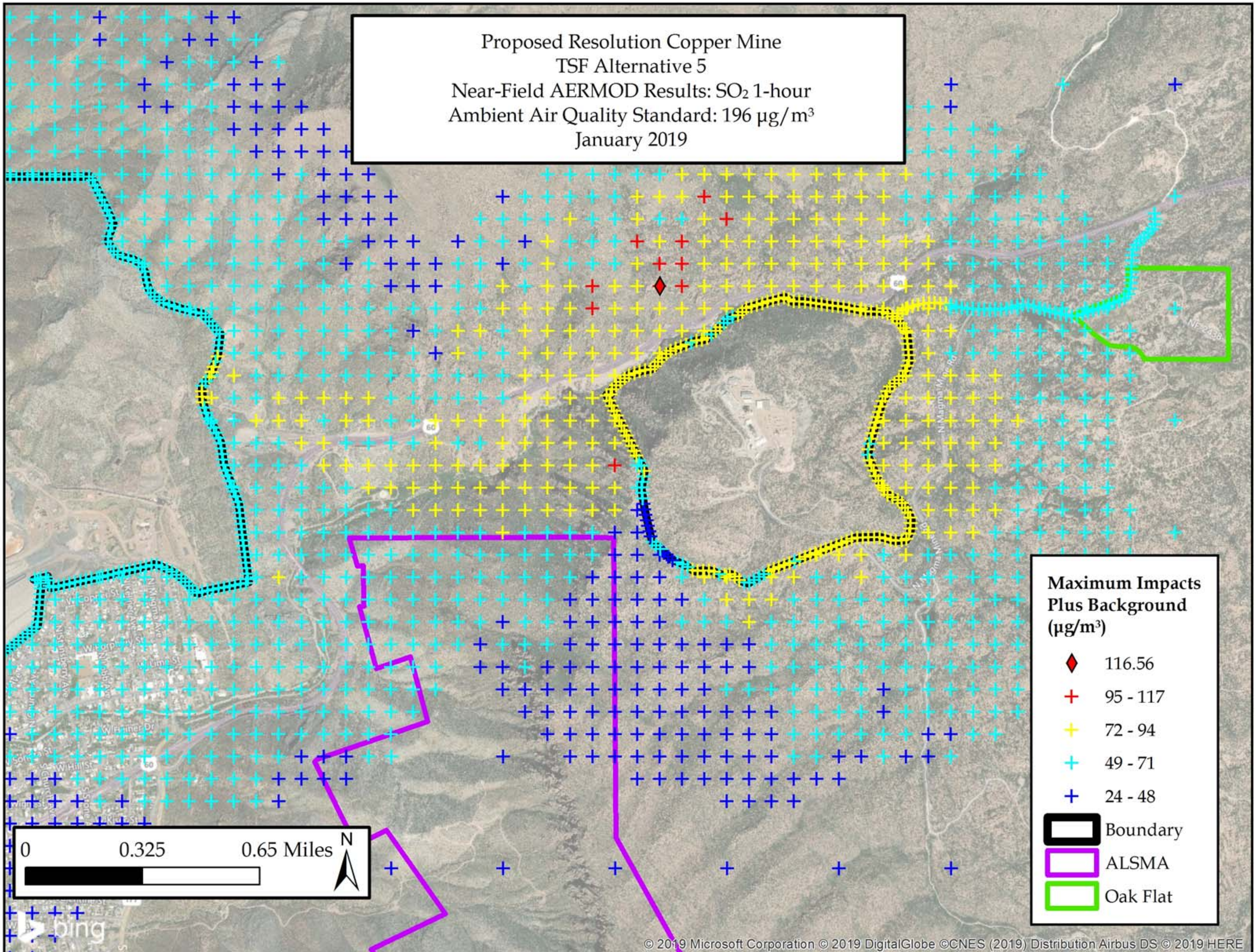

Proposed Resolution Copper Mine
TSF Alternative 5
Near-Field AERMOD Results: SO_2 1-hour
Ambient Air Quality Standard: 196 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
116.56
95 - 117
72 - 94
49 - 71
24 - 48
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
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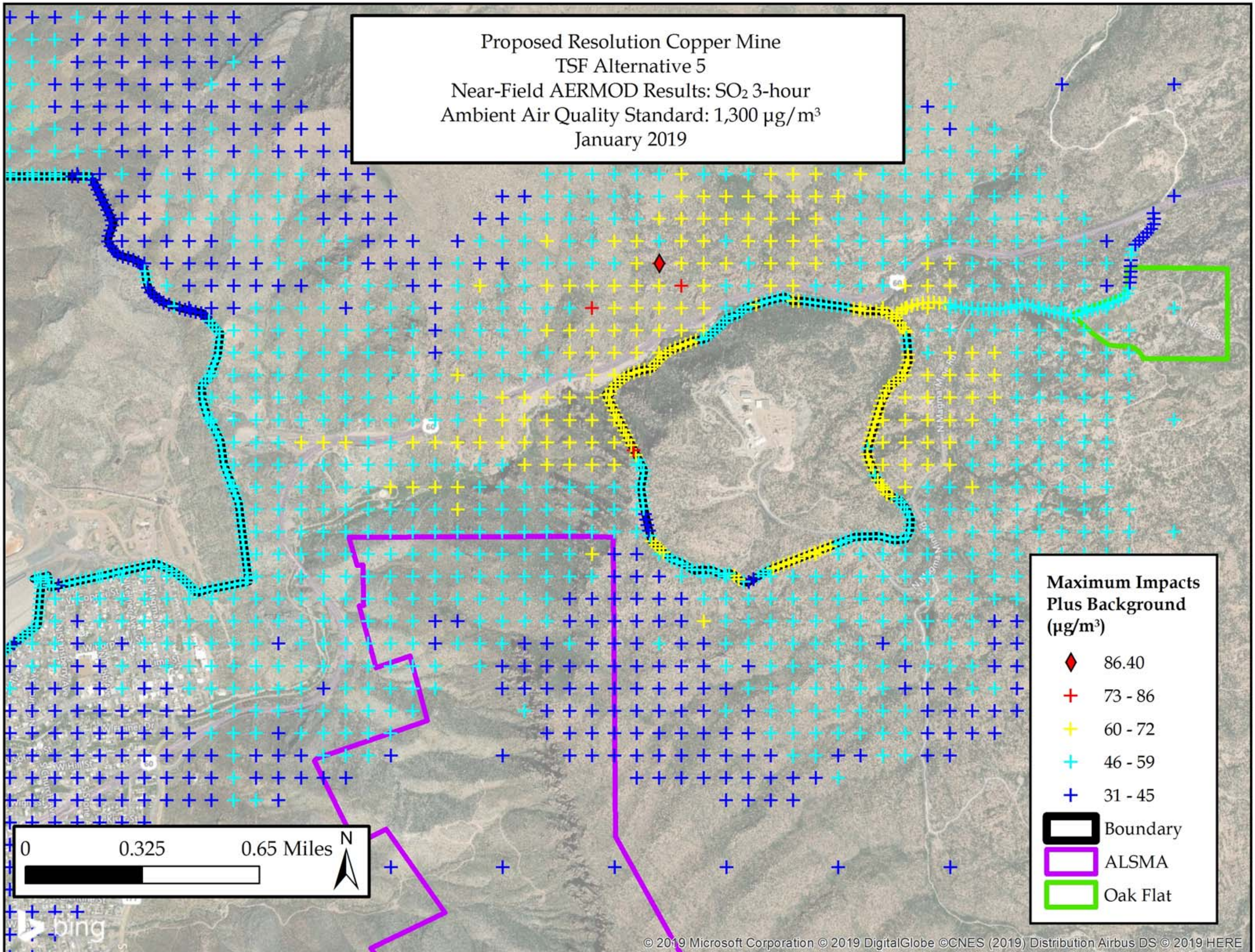
Proposed Resolution Copper Mine
TSF Alternative 5
Near-Field AERMOD Results: SO2 3-hour
Ambient Air Quality Standard: 1,300 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
86.40
73 - 86
60 - 72
46 - 59
31 - 45
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
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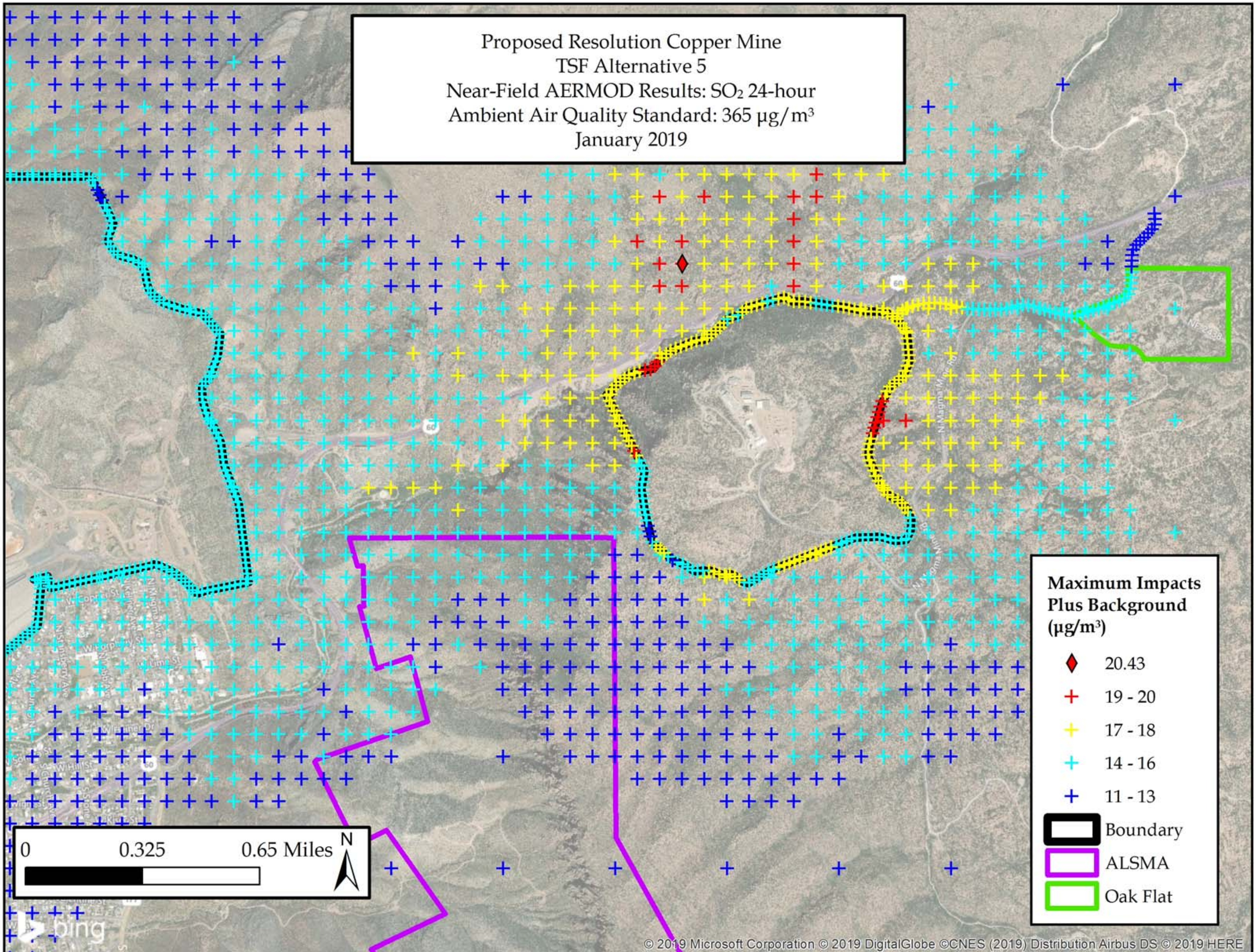
Proposed Resolution Copper Mine
TSF Alternative 5
Near-Field AERMOD Results: SO₂ 24-hour
Ambient Air Quality Standard: 365 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
20.43
19 - 20
17 - 18
14 - 16
11 - 13
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
bing
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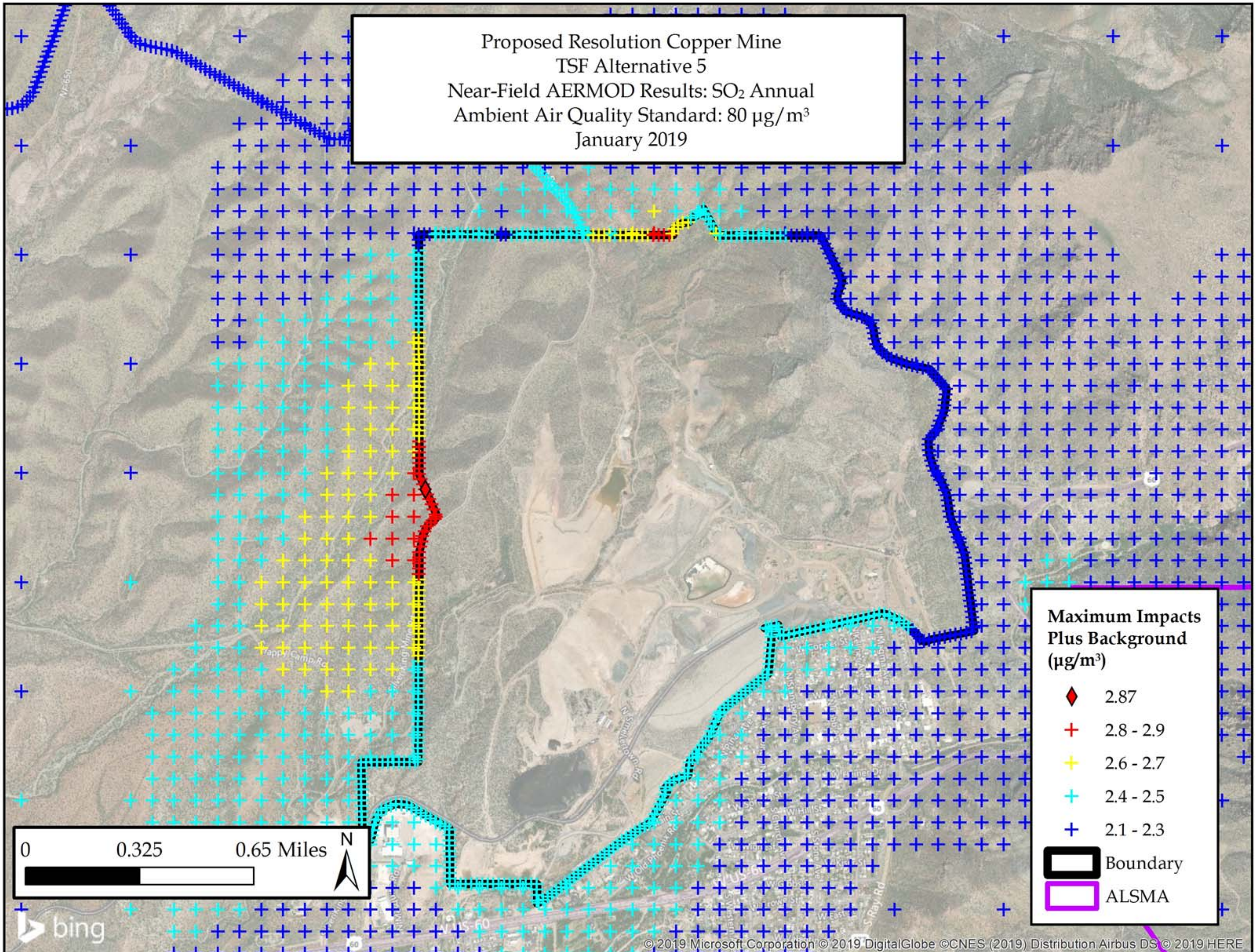

Proposed Resolution Copper Mine
TSF Alternative 5
Near-Field AERMOD Results: SO2 Annual
Ambient Air Quality Standard: 80 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
2.87
2.8 - 2.9
2.6 - 2.7
2.4 - 2.5
2.1 - 2.3
Boundary
ALSMA
0
0.325
0.65 Miles
N
bing
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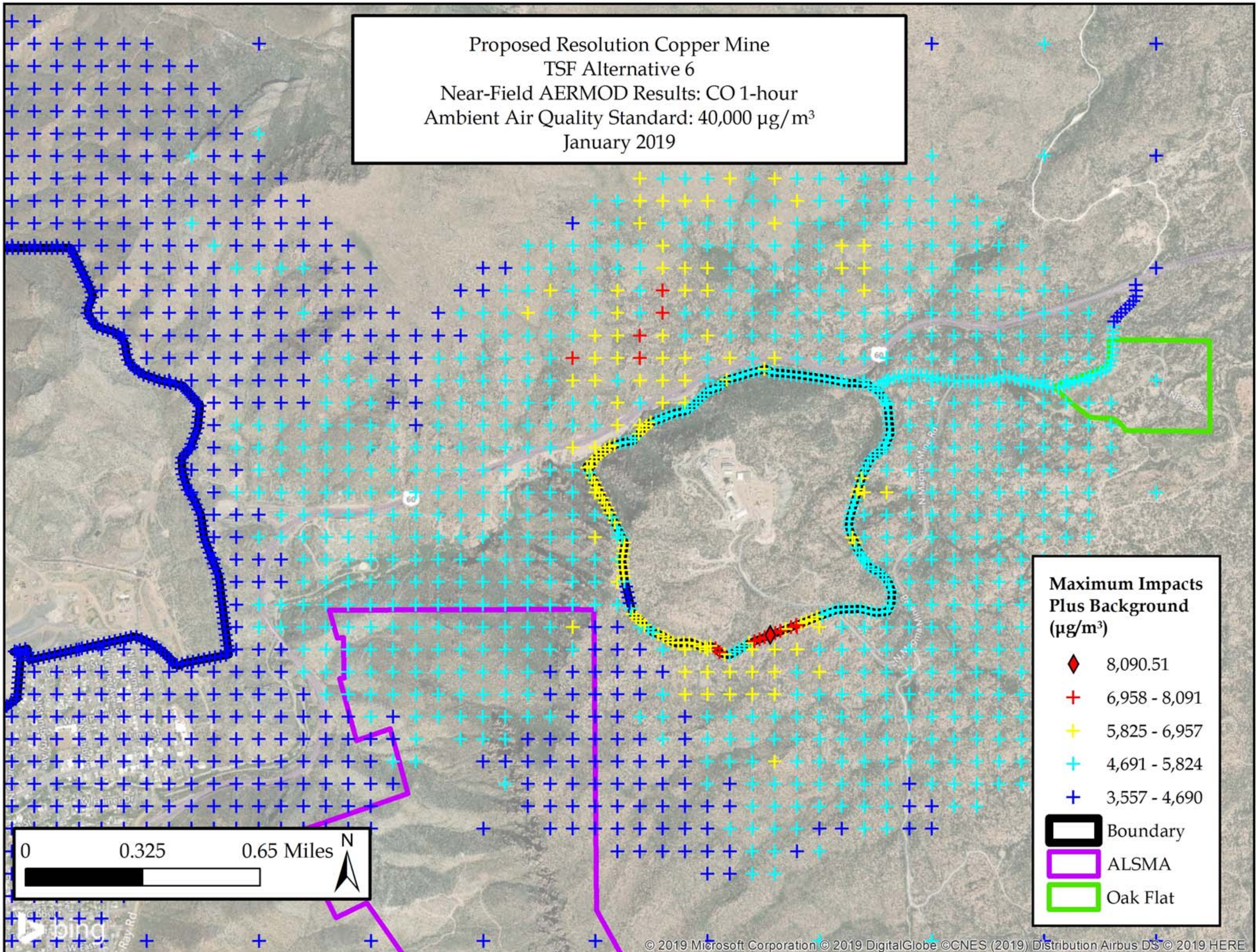

Proposed Resolution Copper Mine
TSF Alternative 6
Near-Field AERMOD Results: CO 1-hour
Ambient Air Quality Standard: 40,000 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
8,090.51
6,958 - 8,091
5,825 - 6,957
4,691 - 5,824
3,557 - 4,690
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
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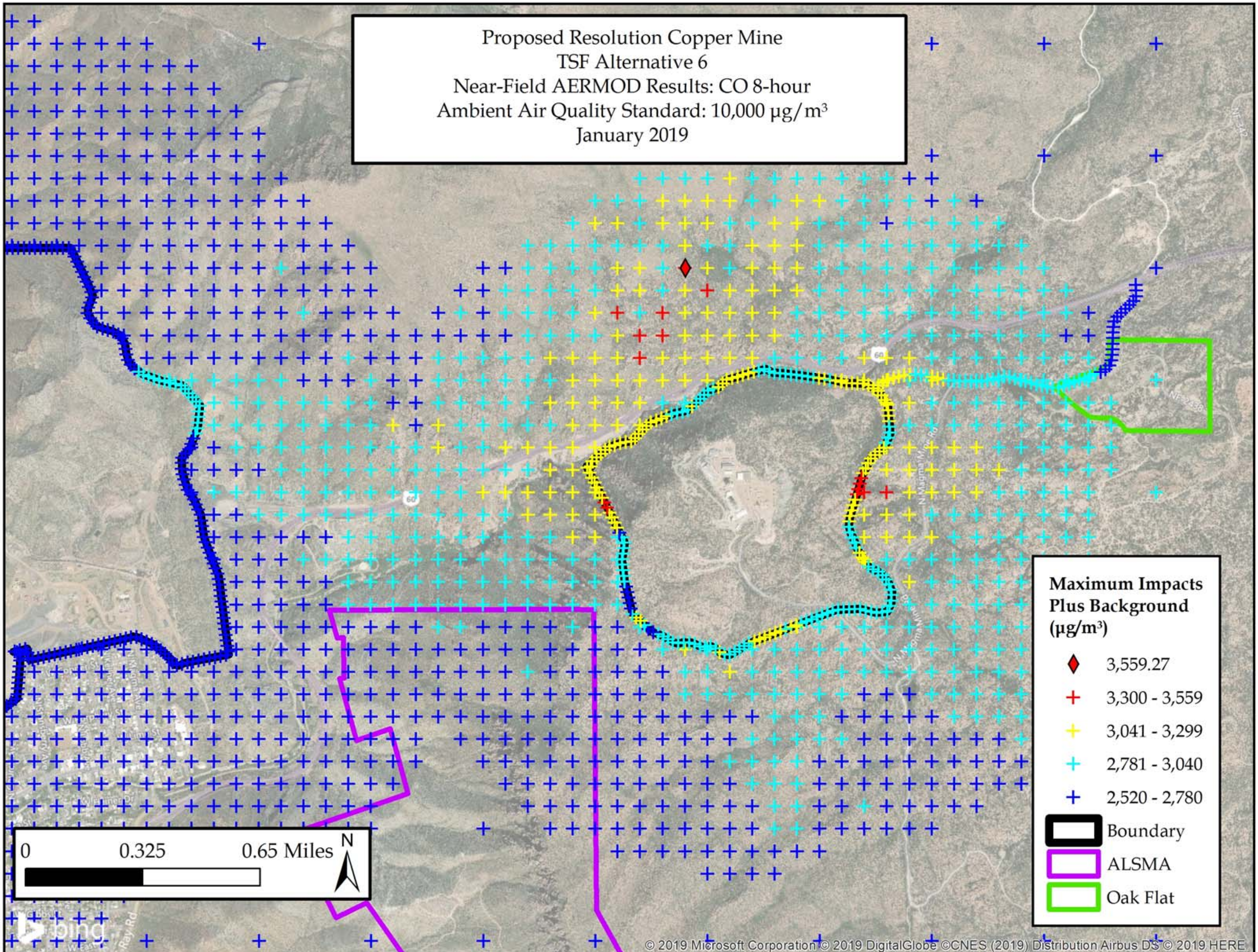
Proposed Resolution Copper Mine
TSF Alternative 6
Near-Field AERMOD Results: CO 8-hour
Ambient Air Quality Standard: 10,000 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
3,559.27
3,300 - 3,559
3,041 - 3,299
2,781 - 3,040
2,520 - 2,780
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
60
bing
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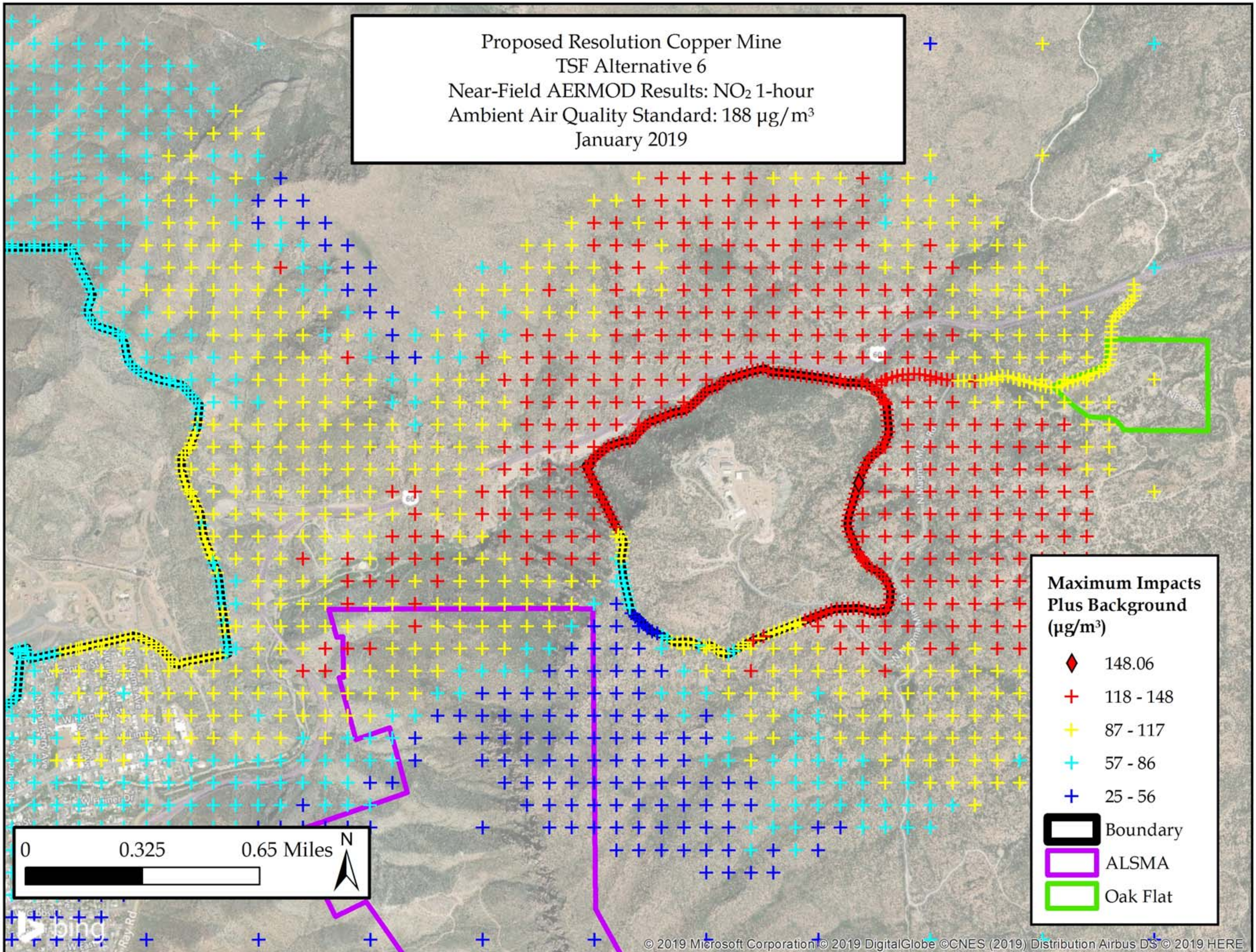

Proposed Resolution Copper Mine
TSF Alternative 6
Near-Field AERMOD Results: NO_2 1-hour
Ambient Air Quality Standard: 188 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
148.06
118 - 148
87 - 117
57 - 86
25 - 56
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
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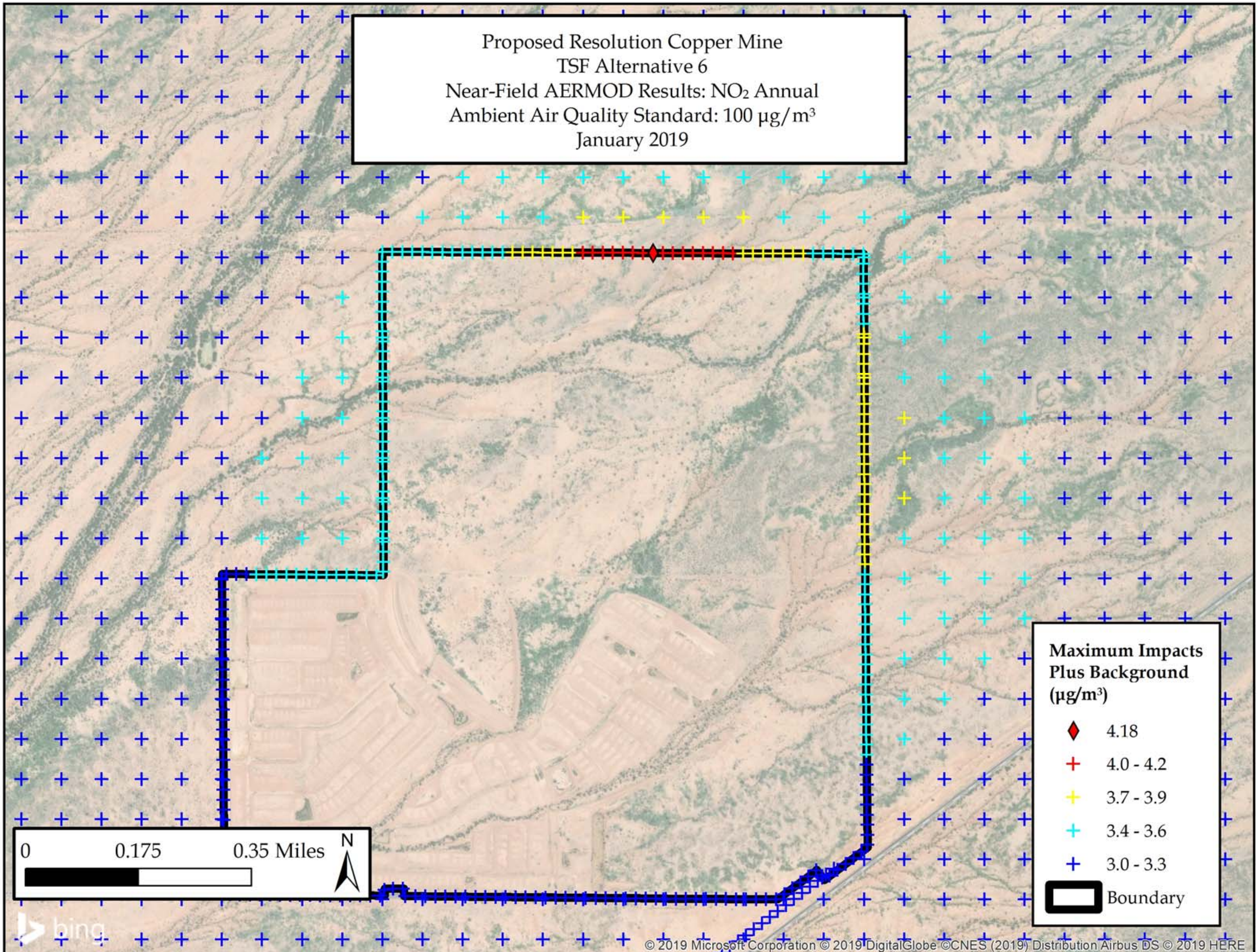
Proposed Resolution Copper Mine
TSF Alternative 6
Near-Field AERMOD Results: NO2 Annual
Ambient Air Quality Standard: 100 µg/m3
January 2019
Maximum Impacts Plus Background (µg/m3)
4.18
4.0 - 4.2
3.7 - 3.9
3.4 - 3.6
3.0 - 3.3
Boundary
0
0.175
0.35 Miles
N
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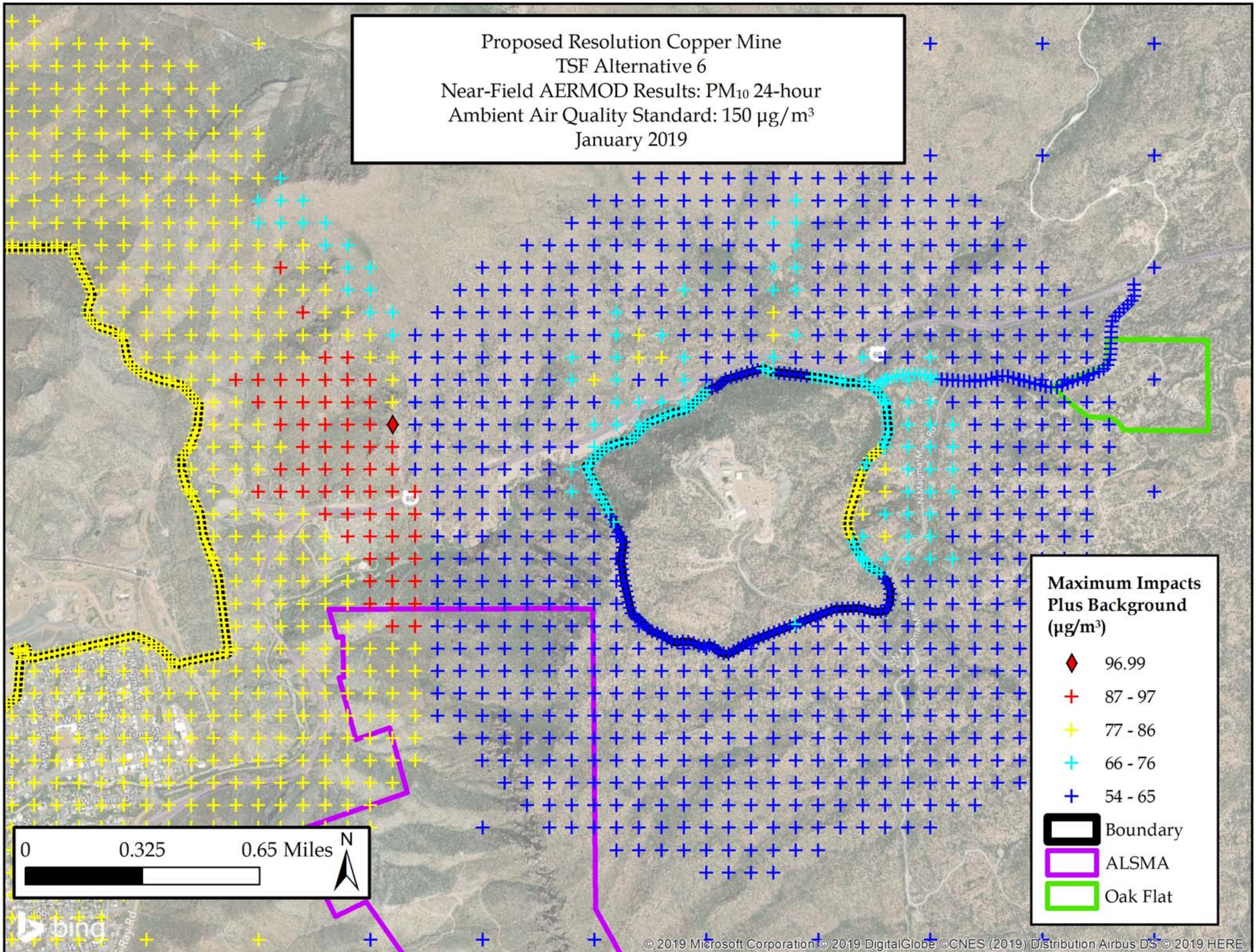

Proposed Resolution Copper Mine
TSF Alternative 6
Near-Field AERMOD Results: PM10 24-hour
Ambient Air Quality Standard: 150 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
96.99
87 - 97
77 - 86
66 - 76
54 - 65
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
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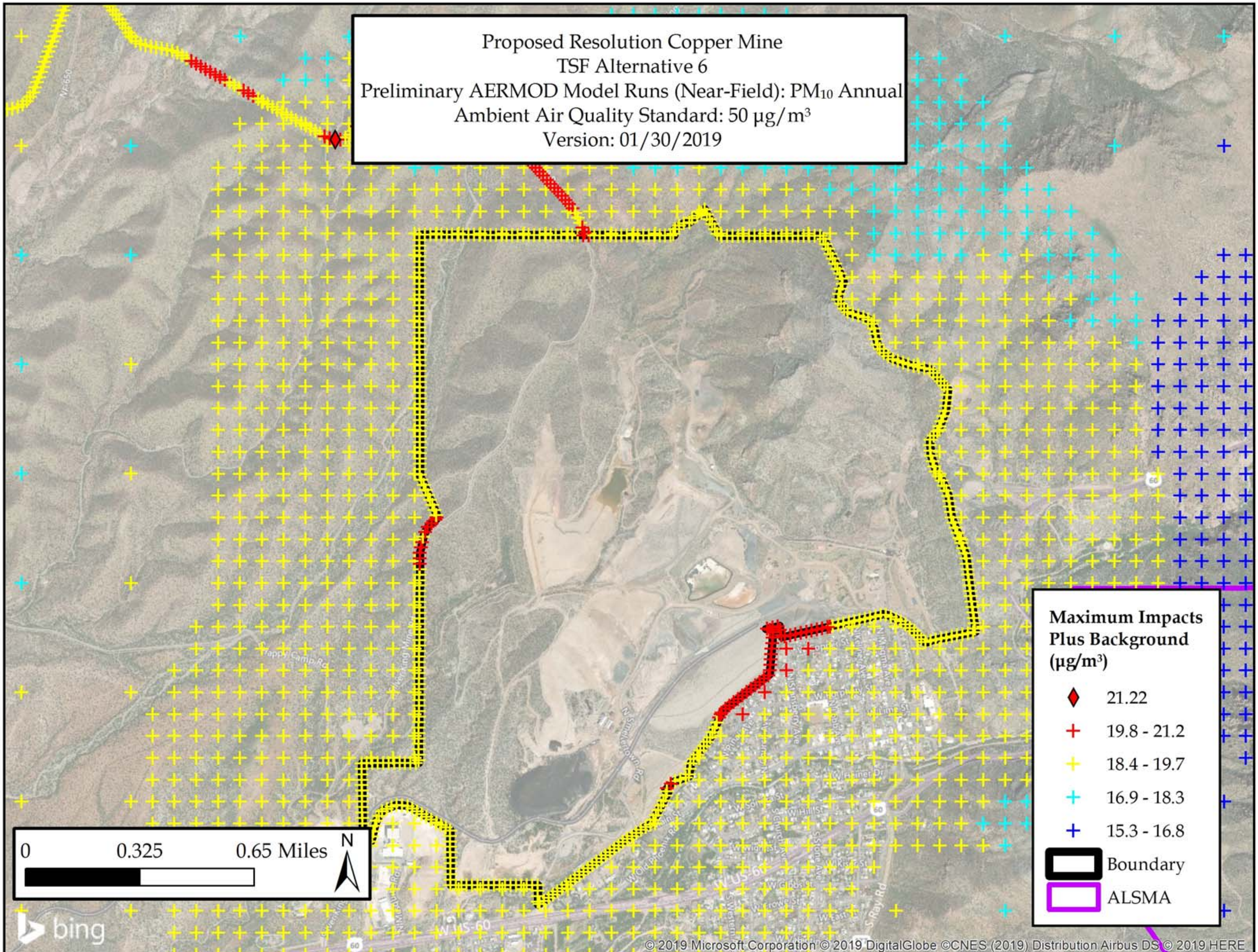
Proposed Resolution Copper Mine
TSF Alternative 6
Preliminary AERMOD Model Runs (Near-Field): PM10 Annual
Ambient Air Quality Standard: 50 µg/m³
Version: 01/30/2019
Maximum Impacts Plus Background (µg/m³)
21.22
19.8 - 21.2
18.4 - 19.7
16.9 - 18.3
15.3 - 16.8
Boundary
ALSMA
0
0.325
0.65 Miles
N
bing
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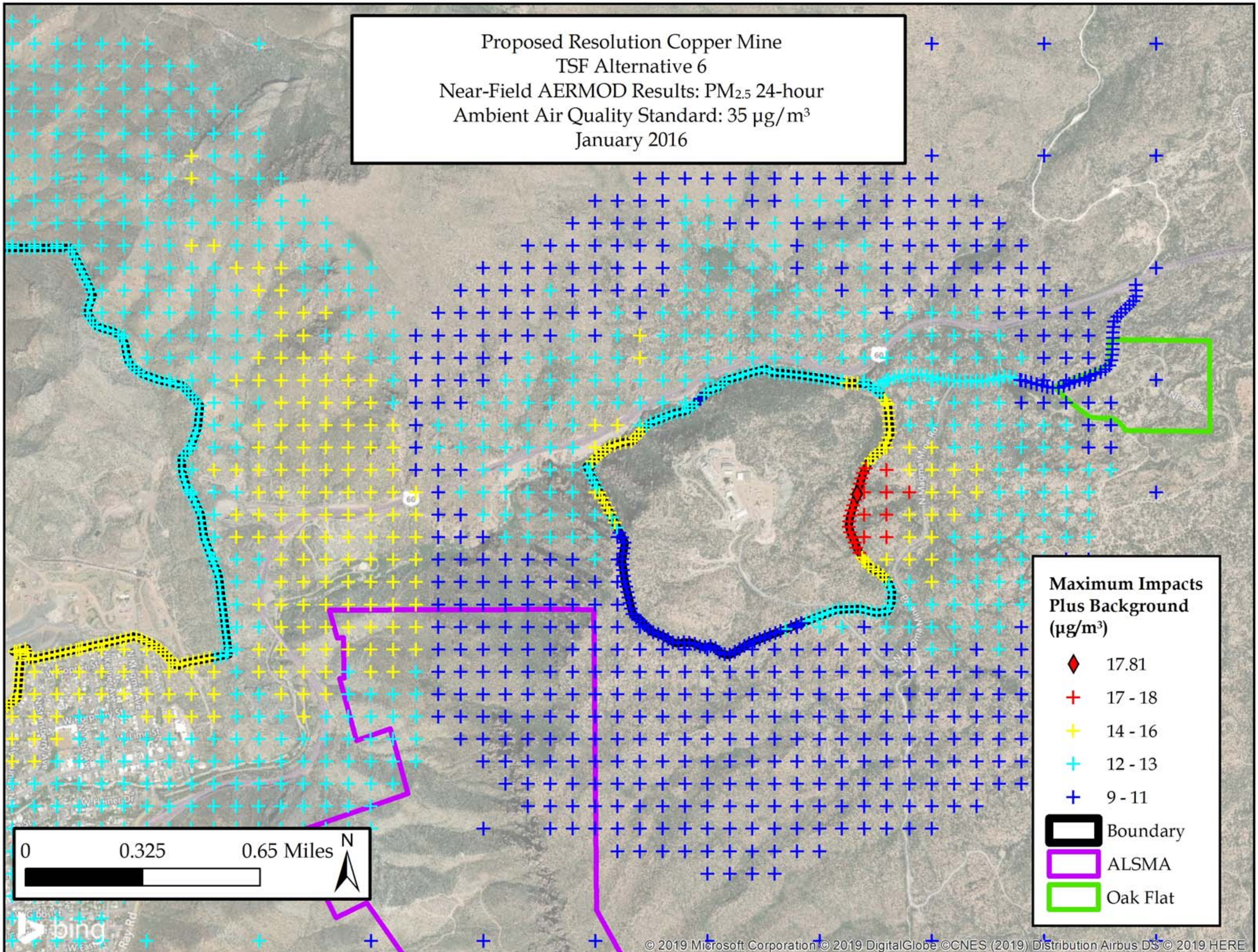
Proposed Resolution Copper Mine
TSF Alternative 6
Near-Field AERMOD Results: PM2.5 24-hour
Ambient Air Quality Standard: 35 µg/m³
January 2016
Maximum Impacts Plus Background (µg/m³)
17.81
17 - 18
14 - 16
12 - 13
9 - 11
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
bing
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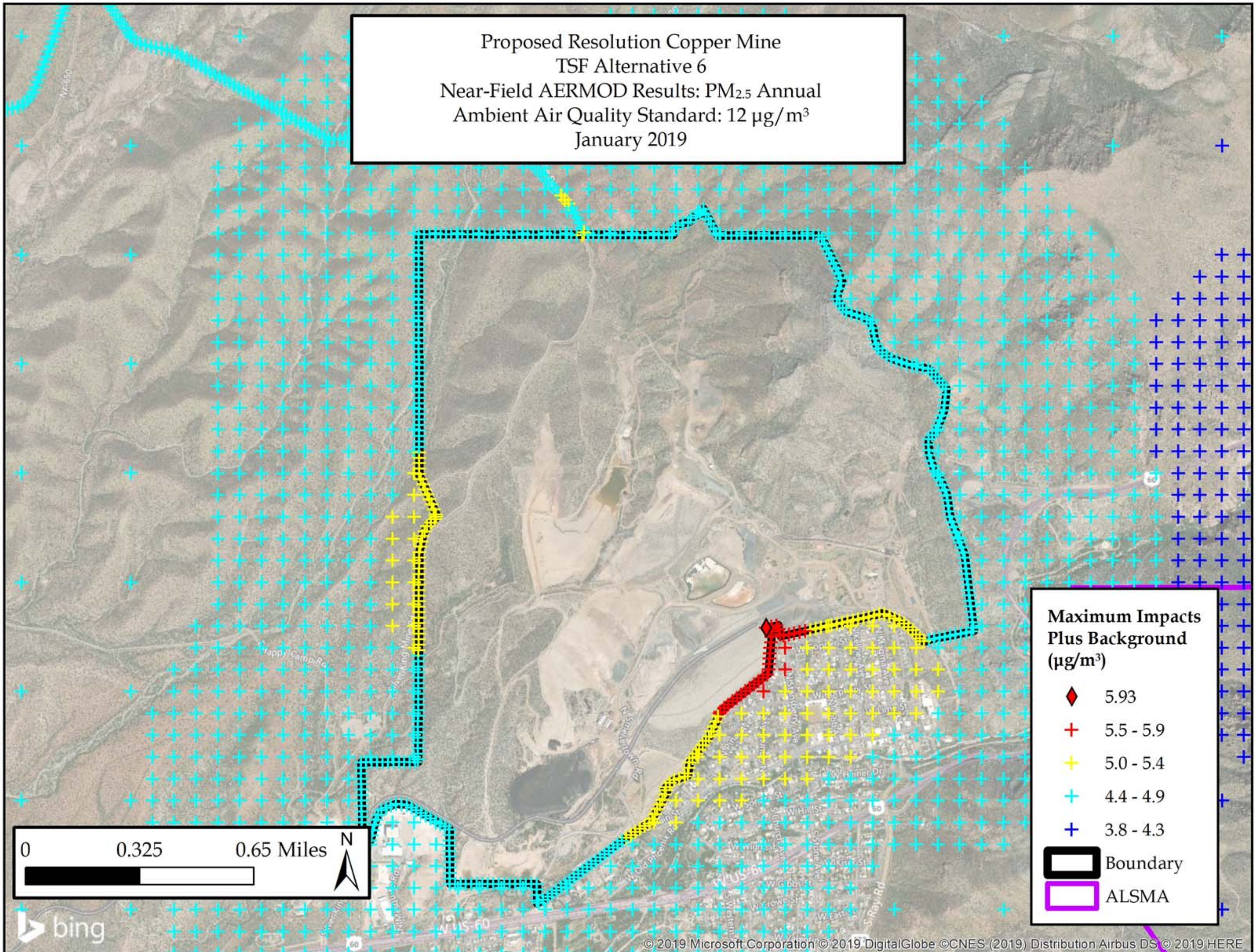
Proposed Resolution Copper Mine
TSF Alternative 6
Near-Field AERMOD Results: PM2.5 Annual
Ambient Air Quality Standard: 12 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
5.93
5.5 - 5.9
5.0 - 5.4
4.4 - 4.9
3.8 - 4.3
Boundary
ALSMA
0
0.325
0.65 Miles
N
bing
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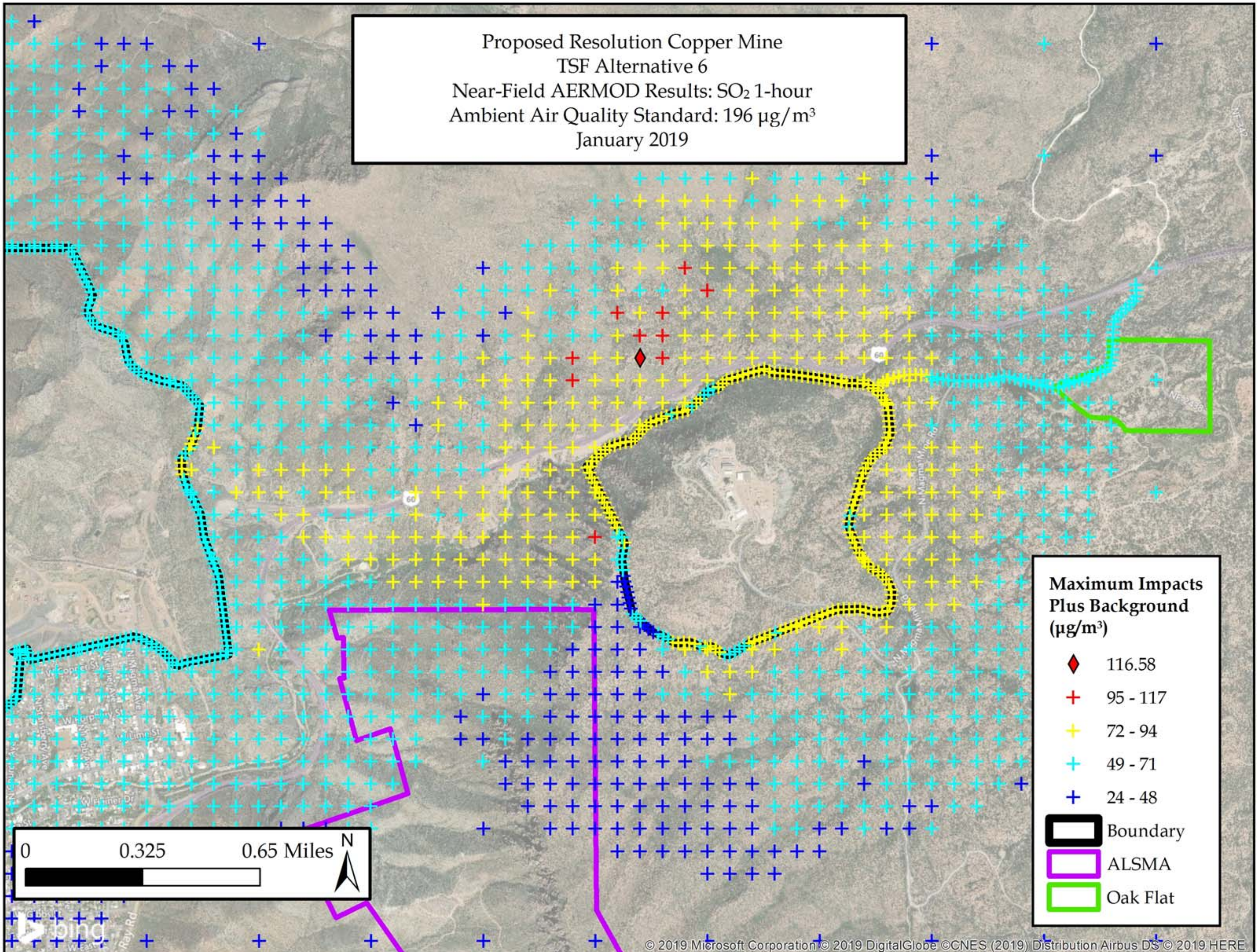
Proposed Resolution Copper Mine
TSF Alternative 6
Near-Field AERMOD Results: SO_2 1-hour
Ambient Air Quality Standard: 196 µg/m^3
January 2019
Maximum Impacts Plus Background (µg/m^3)
116.58
95 - 117
72 - 94
49 - 71
24 - 48
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
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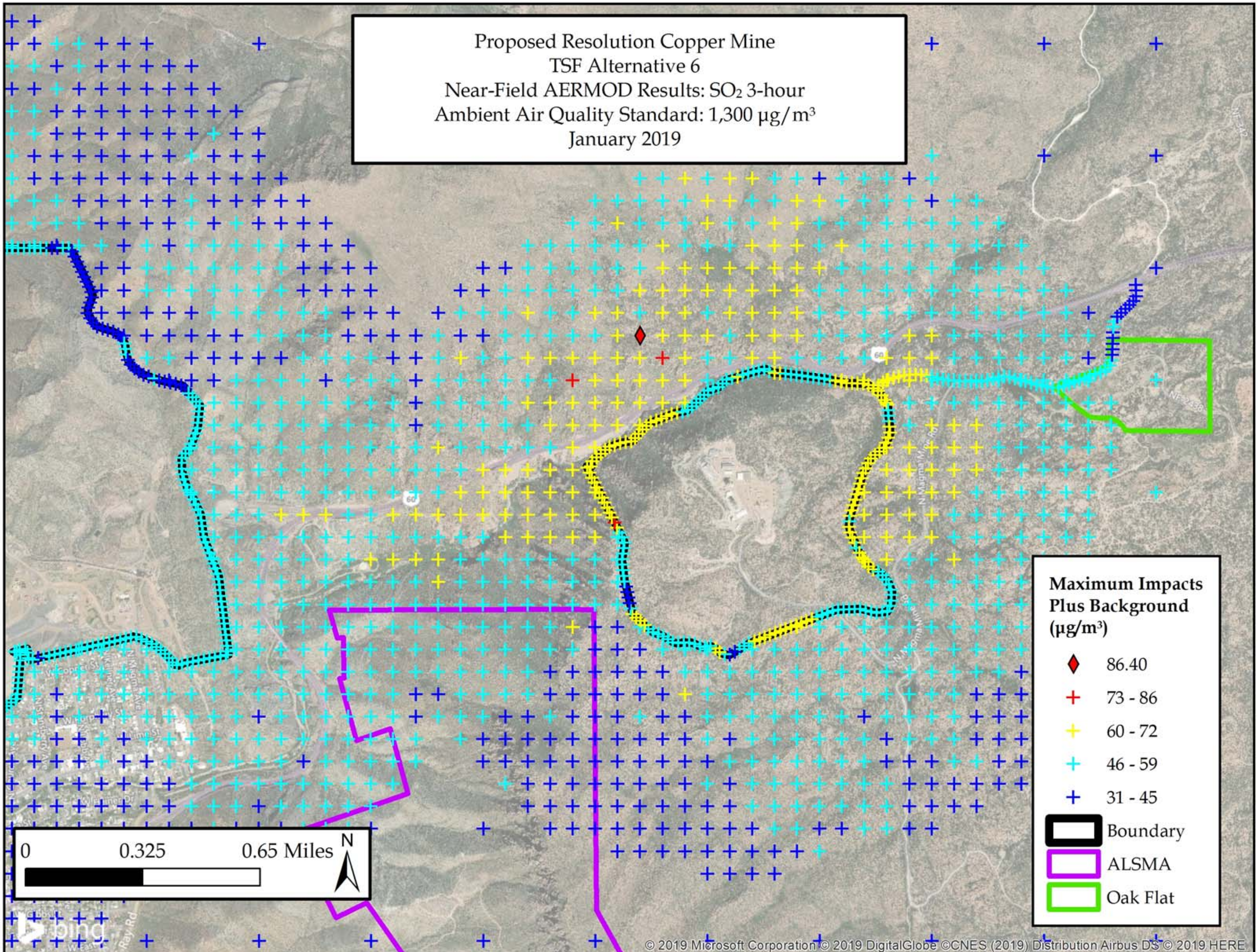
Proposed Resolution Copper Mine
TSF Alternative 6
Near-Field AERMOD Results: SO2 3-hour
Ambient Air Quality Standard: 1,300 µg/m3
January 2019
Maximum Impacts Plus Background (µg/m3)
86.40
73 - 86
60 - 72
46 - 59
31 - 45
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
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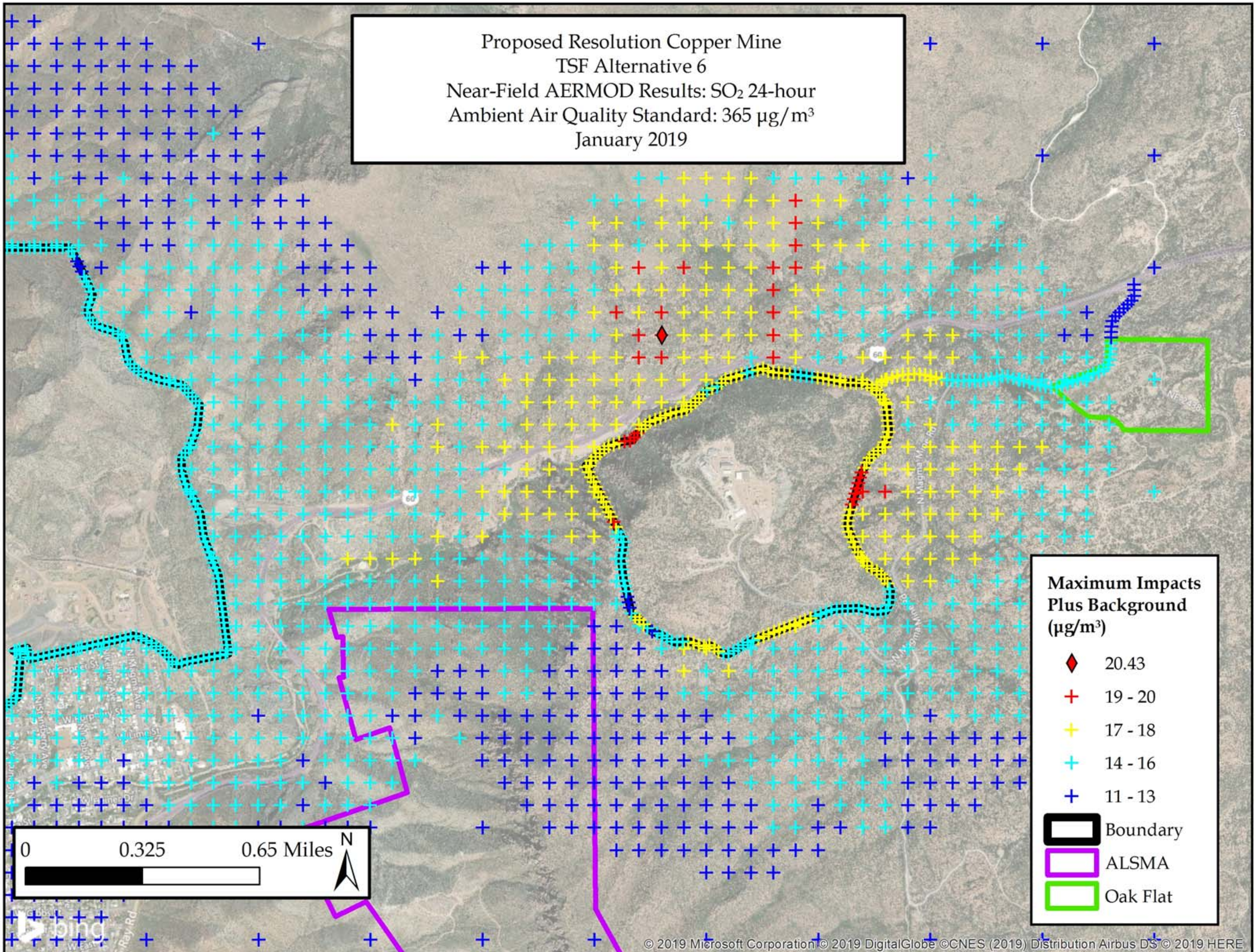
Proposed Resolution Copper Mine
TSF Alternative 6
Near-Field AERMOD Results: SO_2 24-hour
Ambient Air Quality Standard: 365 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
20.43
19 - 20
17 - 18
14 - 16
11 - 13
Boundary
ALSMA
Oak Flat
0
0.325
0.65 Miles
N
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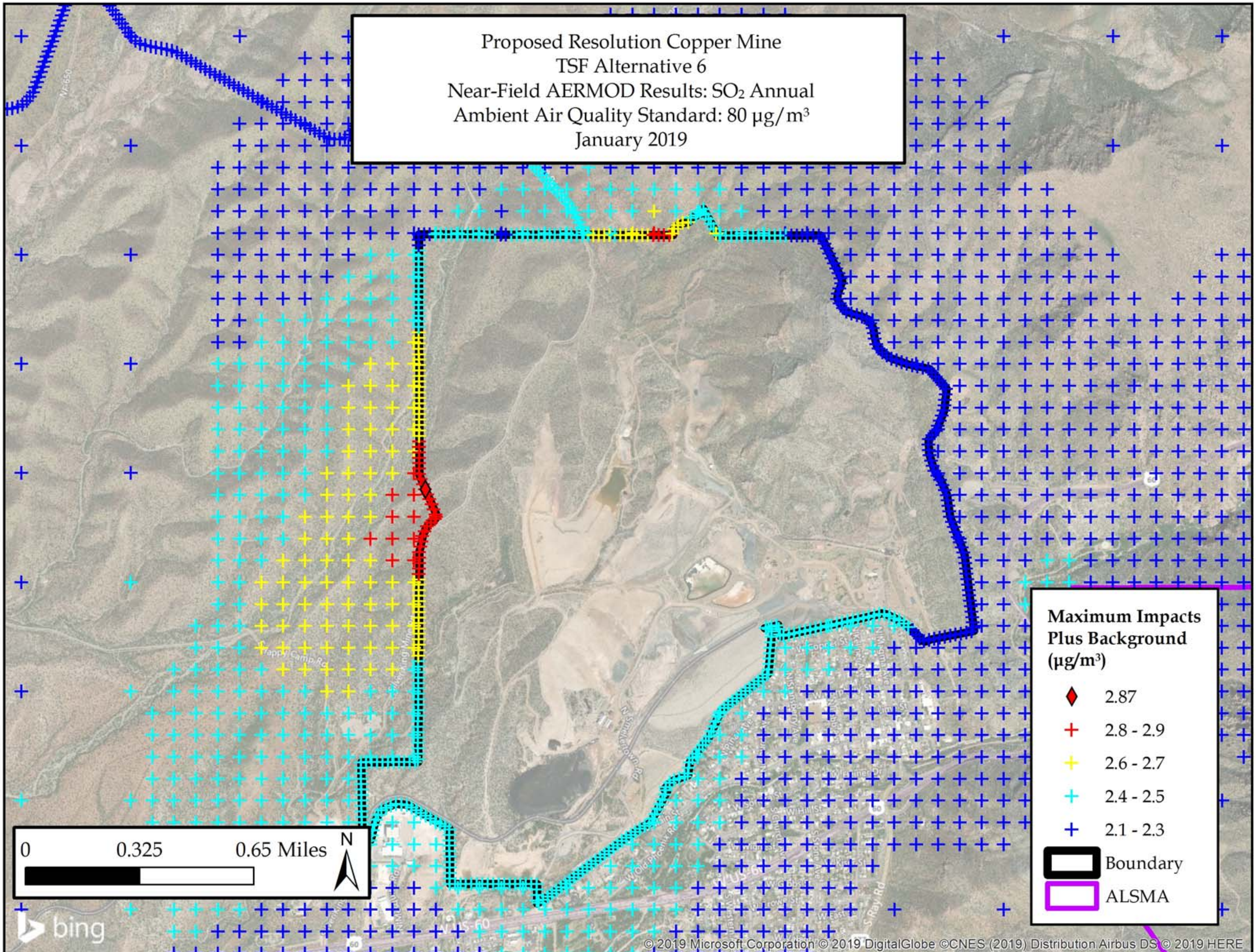
Proposed Resolution Copper Mine
TSF Alternative 6
Near-Field AERMOD Results: SO₂ Annual
Ambient Air Quality Standard: 80 µg/m³
January 2019
Maximum Impacts Plus Background (µg/m³)
2.87
2.8 - 2.9
2.6 - 2.7
2.4 - 2.5
2.1 - 2.3
Boundary
ALSMA
0
0.325
0.65 Miles
N
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Victoria Boyne

Subject: FW: EXTERNAL:RC Action Items - Air Quality

From: Peacey, Victoria (RC) <Victoria.Peacey@riotinto.com>
Sent: Sunday, February 24, 2019 9:21 AM
To: mcrasmussen@fs.fed.us
Cc: Donna Morey <dmorey@swca.com>; Chris Garrett <cgarrett@swca.com>; Ballard, Kami (RC) <Kami.Ballard@riotinto.com>; RCPermitting <RCPermitting@riotinto.com>
Subject: EXTERNAL:RC Action Items - Air Quality

Hello Mary,

As a follow-up to the air quality meeting on December 18, 2018, the documents following have been uploaded to the RC EIS Share Point per the link below, addressing the following requests:

Air Science NEPA Air modeling Report

- Backup emission calculations
- Figures and photos
- Report update to address clarifications
  - In the report, we highlighted/flagged the updated sections for ease of review. Once the USFS confirms the updates are acceptable, we can send a final version removing the highlighted sections.

https://swcacorp.sharepoint.com/[redacted]

Information on metals deposition will be submitted separately.

Thanks,

Vicky Peacey
Senior Manager – Environment, Permitting and Approvals

RESOLUTION COPPER
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Superior, AZ 85173, United States
T: +1 520.689.3313 M: +1 [redacted]
victoria.peacey@riotinto.com www.resolutioncopper.com