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REPORT

Viewshed Analysis - EMMA Expansion Project Closure/Closeout Plan

Freeport-McMoRan Tyrone, Inc.

Submitted to:

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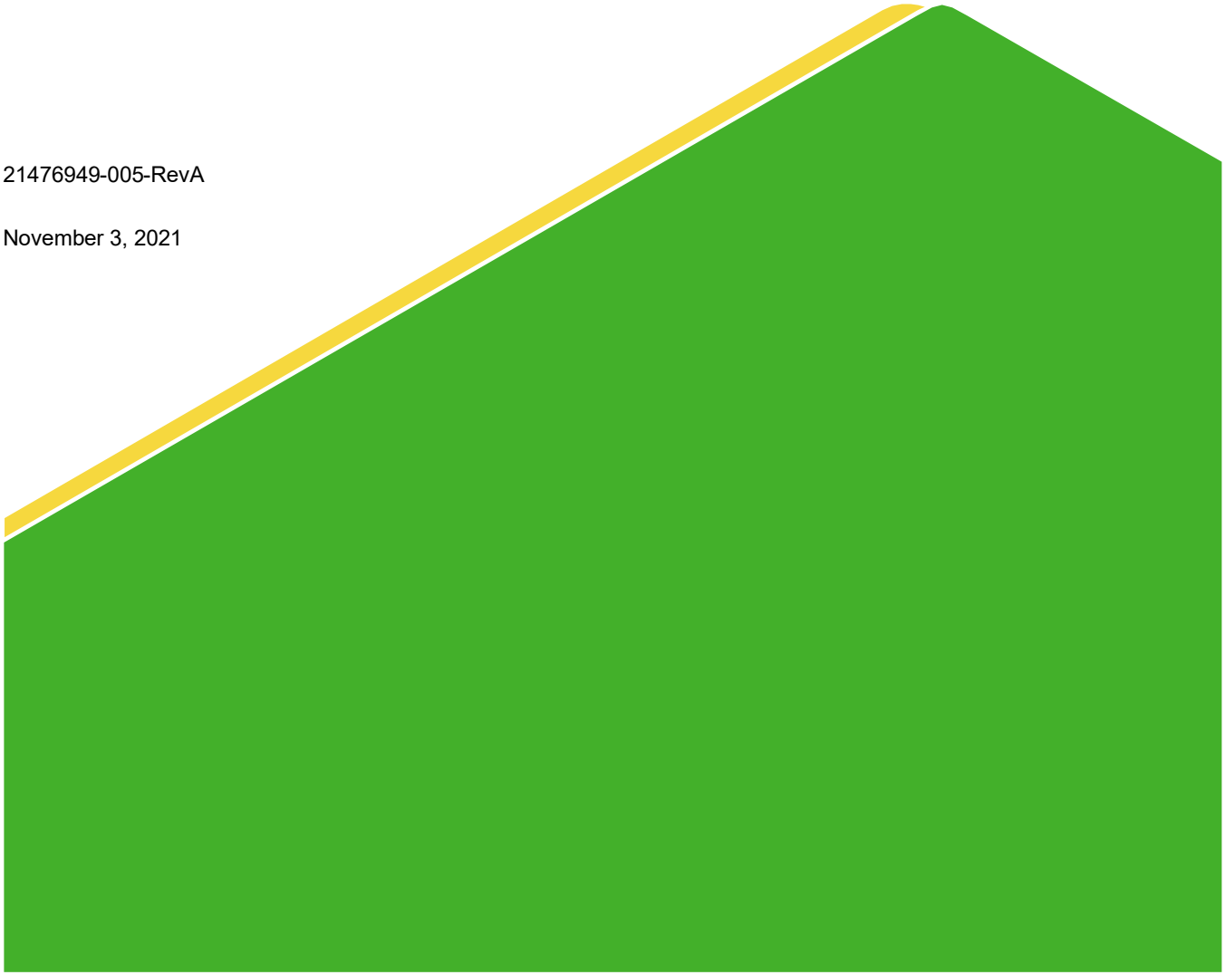
November 3, 2021



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FIGURES

List of Acronyms and Abbreviations

Baseline	existing conditions
CCP	Closure/Closeout Plan
CDT	Continental Divide Trail
DEM	Digital Elevation Model
Emma	Emma Expansion Project
EOY	End of Year
GIS	Geographic Information Systems
Golder	Golder Associates USA Inc.
SR 90	New Mexico State Road 90
Tyrone	Freeport-McMoRan Tyrone, Inc.

1.0 INTRODUCTION

Freeport-McMoRan Tyrone, Inc. (Tyrone) is an open pit copper mine located just off State Road 90, approximately 10 miles southwest of Silver City in Grant County, New Mexico (**Figure 1-1**). Tyrone is proposing to expand the existing Tyrone Mine to include the proposed Emma Expansion Project (Emma). The proposed Emma area is located along the southern boundary of the Tyrone Mine and will include the development of a new open pit and two non-discharging waste rock stockpiles, construction of new haul roads, and installation of various infrastructure to support the project. See **Figure 1-2** for existing conditions, and **Figure 1-3** for proposed changes.

Golder Associates USA Inc. (Golder) was contracted to perform an environmental viewshed analysis in support of the Emma project. The scope of the analysis included identifying key observer points within a 2-mile radius of the proposed permit boundary, and then developing a desktop viewshed model to simulate the line of sight from each observer point with regards to the proposed mine features, specifically the EMW Waste stockpile and the temporary Soil Stockpile.

This analysis is submitted as part of the overall visual resources analysis for Emma, which refers to the natural and cultural landscape features that comprise the landscape surrounding the project as well as their qualities and contribution to landscape character. Natural landscape features include landforms, water features, and vegetation. Cultural landscape features include buildings, roadways, structures, and artificial lighting related to human land uses. The quality of the visual environment has a value to individuals, society, and the economy of a region, particularly in an area where scenic landscapes provide the backdrop for tourism and recreation activities.

This analysis evaluates whether the development of the proposed mine features will impact the viewshed of residential structures and transportation corridors in the vicinity of the mine, and also investigates just how severe those impacts may be.

1.1 Affected Environment

Emma is located in unincorporated Grant County New Mexico, approximately seven miles southwest of the Tyrone townsite and five miles north of White Signal. The project is bordered by the Big Burro Mountains to the west and State Road 90 (SR 90) to the east. Closest residences are located approximately one mile south of the Emma site at the Apache Mound subdivision and others east of SR 90. The terrain to the south and east is characterized by flat and gently sloping terrain. The site lies near the foot of the Big Burro Mountains to the west close to the continental divide. Vegetation in the area is dominated by a mixture of grasses, cactus, pinyon pine and evergreen oaks with one-seed and alligator juniper subdominant, and desert shrub habitats at the project site and to the east and south, with mixed conifer in the Big Burro Mountains to the west.

Land use patterns in the region are primarily rural grazing, residential, mining, and large areas of open space. The area to the west of Emma is public land administered by the U.S. Department of the Interior, United States Forest Service. The region is traversed by paved and unpaved roads and experiences off-road vehicle use. Major transportation routes in the region include SR 90, a two-lane highway bordering to the east of the Emma area. No other major roadways are located within 8 miles of the project area. No eligible or designated scenic highways have been identified within the vicinity of the project.

The Continental Divide Trail (CDT) runs through the Gila National Forest approximately five miles to the west of Emma. The CDT is a designated national scenic trail.

1.2 Project Site

The proposed Emma area will increase the existing mine area by approximately 337 acres. This increase will allow for the construction of the proposed Emma Pit, EMW Waste stockpile, new Southern Emma Haul Roads, and supporting infrastructure **(Figure 1-3).** The 6HW Waste stockpile and a new Northern Emma Haul Road will also be constructed as part of this project but will be located entirely within the existing Tyrone Mine operations area.

Potential areas that can be affected by future development activities at Emma include the residences to the south of Emma starting at the intersection of SR 90 and a county road called Tyrone/Thompson Road (referred to as Tyrone Road herein). Surface lands in and adjacent to the mine have historically been used for mining, livestock grazing, timber and fuel wood harvesting, recreation, and wildlife habitat. Ponderosa pine was logged in the Big Burro Mountains south of the Tyrone Mine, and fuel wood has been cut from woodlands in this area for at least a century. Recreation in the area includes camping, picnicking, hunting, off-road vehicle use, hiking, horseback riding, and bicycling. Current surrounding land uses include private residences, grazing, mining, and recreation. Grazing is the predominant land use surrounding the Emma area.

2.0 VIEWSHED ANALYSIS

2.1 Viewshed Basics

The viewshed analysis described in this report was conducted using the latest tools within ESRI's ArcMap 10.8 and ArcGIS Pro 2.8 desktop software. ArcGIS's Spatial Analyst extension includes a suite of geoprocessing tools designed to model the visible terrain from pre-defined observer points, using a grid-based (raster) approach. The primary input variable in a desktop viewshed study is the topographic surface grid, and the eventual analysis output is heavily dependent on both the accuracy and precision of this dataset. Other optional variables can include potential visual obstruction features such as vegetation or man-made structures, a standard light-refraction co-efficient, an earth curvature factor, and observer offset parameters.

The specific process used on this study is known as the "Visibility" tool, which is used to determine the surface locations visible to one or more observer points. Using the primary surface topography input grid, the visibility of each cell center is determined by comparing the altitude angle to the cell center with the altitude angle to the local horizon. The local horizon is computed by considering the intervening terrain between the point of observation and the current cell center. If the point lies above the local horizon, it is considered visible (ESRI, 2021). The optional input variables described above can also be integrated into the model to influence the tool's output, which is a new raster (grid) surface where each cell contains one of two values – "visible", or "not visible". To produce the most accurate results for each observer point, the tool can be iterated using a new observer point each time, resulting in a unique visibility raster for each location.

It must be noted that a desktop viewshed analysis is merely an attempt to model current or future conditions, and its accuracy is dependent on the precision and accuracy of its input dataset, as well as the limitations of the technology. This analysis's outputs represent the modeler's best estimate of viewshed impact.

2.2 Discussion of Model

The primary input variable in this desktop viewshed analysis is the topography of the site and surrounding area. A comprehensive digital elevation model (DEM) was created using a combination of data sources, starting with the existing ground topography provided by Tyrone. This file provided the base topographic surface for the Tyrone Mine and its immediate vicinity. The next step was to expand the overall footprint of the DEM to encompass all areas within 2 miles of the proposed Emma site, so that all of the observation locations could be included in the model. To fill these outer data gaps, a LiDAR survey conducted in 2018 and published by the United States Geological Survey (USGS) in 2019 was incorporated into the DEM (USGS, 2019). Finally, the portion of the DEM in and around the proposed Emma permit boundary was cut out and replaced with Tyrone's final 2026 design topographic data, as provided to Golder on September 8, 2021 (**Figure 1-3**). Due to the relatively high resolution of each of the three source datasets, the model DEM was able to maintain 3-foot horizontal grid-spacing.

Observer locations within two miles of the proposed permit boundary were selected to represent a range of locations that that could potentially be impacted by the presence of various Emma features following their development. For the purposes of this study, these observer locations have been divided into 3 general categories: SR 90, the proposed country road re-alignment, and residential structures. While the analysis primarily focused on the houses in or around the Apache Mound subdivision, the study also included residential structures south and east of Apache Mound. To help track the various model runs and their results, each observer point in each of these 3 categories was assigned a number (**Figure 2-1**). Each residential structure was assigned an observer point roughly in the center of the building footprint, while observer points along the transportation corridors are evenly spaced along each road's centerline (every 500 feet along SR 90 and every 250 feet along the proposed county road alignment).

The only other input variables used in this viewshed analysis were the tool's default light refractivity coefficient of 0.13 (ESRI, 2021), and a six-foot vertical offset applied to each observer point, which is a common strategy for simulating the view of a human observer on foot or driving a vehicle. Golder ultimately deemed the sparse local vegetation inconsequential for the purposes of this study, so the lines of sight generated by the model do not take into account the location of bushes or trees.

Once all model elements were in place, the visibility tool was iterated 113 times – once for each observer point (33 structures, 42 locations along SR 90, and 38 locations along the proposed county road re-alignment). The output for each model iteration is a 3-foot x 3-foot visibility grid where each cell contains a value representing either "not visible from the observer point" or "visible from the observer point". These grids were then plotted on site maps for further analysis and for presentation purposes.

2.3 Model Results

Once initial modelling was complete, the 113 output grids were reviewed visually and were also intersected with the Emma proposed permit boundary to determine which observer points produced visibility grids that coincided with the proposed site topography. In addition to assessing each result grid for overlap with the Emma site, an additional level of scrutiny was applied to determine whether the visible features were in existence prior to Emma construction (natural features and existing Tyrone Mine features), or if the visibility was a direct result of the new Emma construction (primarily the proposed EMW Waste stockpile in the northeast portion of the proposed permit boundary). The results of this review process can be visualized spatially on **Figure 2-1**.

3.0 PROJECT IMPACTS

The proposed Emma permit boundary encompasses approximately 337 acres of private land controlled by Tyrone at the EOY 2026 (**Figure 1-3**). The majority of this area will either be unchanged or will have its elevation lowered (the proposed Emma Pit is approximately 116 acres). Those portions of the site will not experience any changes in visibility to the surrounding area. The two primary areas that would experience elevation gain as a result of site development are the EMW Waste stockpile in the northeast corner of the proposed boundary and, to a lesser extent, the Soil Stockpile designed on the western edge of the proposed boundary (**Figure 3-1**).

This desktop viewshed analysis determined that portions of both SR 90 and the proposed re-alignment of the country road will have direct line-of-sight to newly constructed features within the proposed Emma permit boundary. In some cases the only visible features within the site are actually currently existing hills and ridges, so the viewshed from those points will not be significantly impacted by new mine activity. There are, however, many locations that the model indicates will have direct line-of-sight to newly constructed features, primarily the higher elevations of the proposed EMW Waste stockpile.

As for the residential structures to the south of the site, viewshed impacts vary widely based on each observer point's elevation and orientation on the hills and ridges that make up the local topography. **Figures 3-2 through 3-6** illustrate the viewshed from the observer point within each of the 3 categories that would experience the largest change in visibility, as measured by the area of proposed mine features in each modeled visibility grid. Category 3 (Residential Structures) has been broken into 3 subgroups here: houses in and around the Apache Mound subdivision, houses south of Apache Mound and west of SR 90, and houses south of Apache Mound and east of SR 90. The results shown on these 5 figures are the worst-case scenarios for each of the 5 groups. All other observer points have been modelled to experience lesser viewshed impacts, and in many cases no impact at all. See **Figure 2-1** for details for each observer point.

Overall, it is anticipated that the vast majority of visual impacts that result from the proposed project will be limited to a newly created line-of-sight with the top of the proposed EMW Waste stockpile, which sits on a ridge that is already visible from many of the observer points. Additionally, a closer look at **Figures 3-2 through 3-6** reveals that the observer locations that are expected to be able to see portions of the proposed mine features can actually already see large portions of the existing Tyrone Mine infrastructure. The yellow areas on these maps represent topography that the model has determined is already visible from each observer point prior to Emma construction, while the red areas represent features that will become visible due to construction based on the proposed EOY 2026 Emma design topography.

4.0 MITIGATION

The above analyses are associated with the operational layout of the Emma features at the EOY 2026. Reclamation activities will include the use of the entire Soil Stockpile for reclamation cover material, and portions of the EMW Waste stockpile for both backfill and reclamation cover within the Emma Pit. Thus, the Soil Stockpile will be entirely consumed during closure. The EMW stockpile configuration presented for EOY 2026 is designed to be larger than expected to allow for operational flexibility. It is not likely to be as large as shown. Tyrone has also proposed to backfill portions of the pit rather than haul it to the EMW stockpile. Therefore, it is even more likely that the EMW stockpile will not reach the elevation shown. The point of this is to express that the analysis described above is conservatively biased to present more visual impact than is likely to occur. The EMW Waste stockpile will be partially consumed during closure to facilitate closure of the Emma Pit. This will effectively reduce

the maximum elevation of the EMW Waste stockpile from 6,355 feet MSL during operations to approximately 6,300 feet MSL following reclamation. As such, there will be no Soil Stockpile present following closure, and the EMW Waste stockpile will be less visible due to the reduced surface elevation associated with reclamation of the Emma mine features. The EMW Waste stockpile will be graded, covered, and revegetated in accordance with applicable state regulations.

Please contact the undersigned with any questions or comments on the information contained in this report.

Respectfully submitted,

Golder Associates USA Inc.

Kevin Carpenter
Senior Project GIS Lead

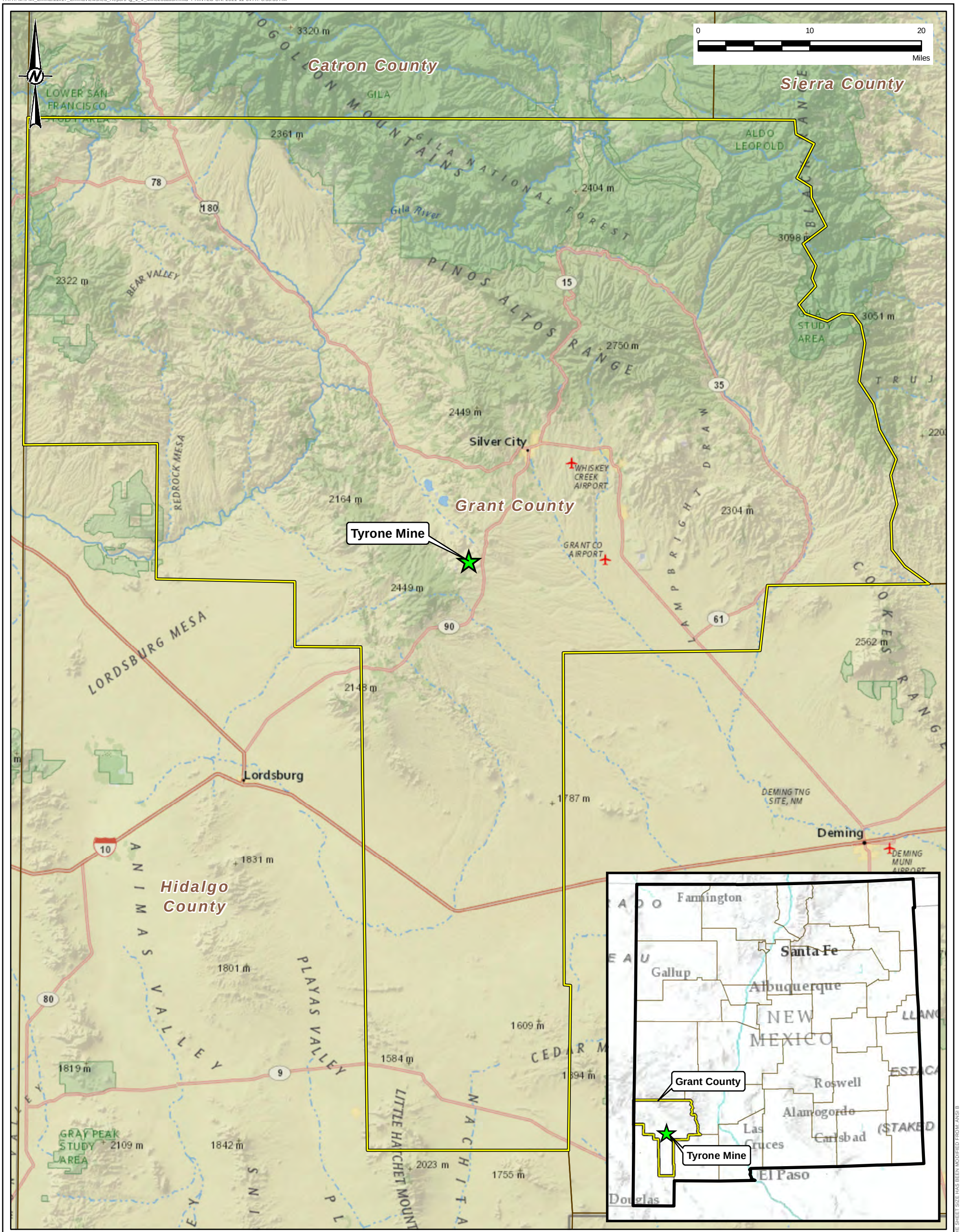
Todd Stein
Project Manager

5.0 REFERENCES

ESRI (2021). ArcMap Spatial Analyst Visibility Tool Documentation. Retrieved from https://desktop.arcgis.com/en/arcmap/10.3/tools/spatial-analyst-toolbox/visibility.htm.

USGS, 2019. New Mexico South Central 2018 D19 Airborne LiDAR Report, prepared by Woolpert. http://prd-tnm.s3.amazonaws.com/index.html?prefix=StagedProducts/Elevation/metadata/NM_SouthCentral_2018_D19/NM_SouthCentral_B2_2018/reports/

Figures



LEGEND

- TYRONE MINE
- GRANT COUNTY

REFERENCE

1. BASEMAPS: ESRI, NATIONAL GEOGRAPHIC.

CLIENT
FREEPORT-MACMORAN TYRONE, INC.

PROJECT
EMMA PERMIT SUPPORT
VIEWSHED, LIGHT AND NOISE IMPACT STUDY

TITLE
MINE LOCATION MAP

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-11-03
DESIGNED	KJC
PREPARED	KJC
REVIEWED	-
APPROVED	-

PROJECT NO.
21476949

FIGURE
1-1

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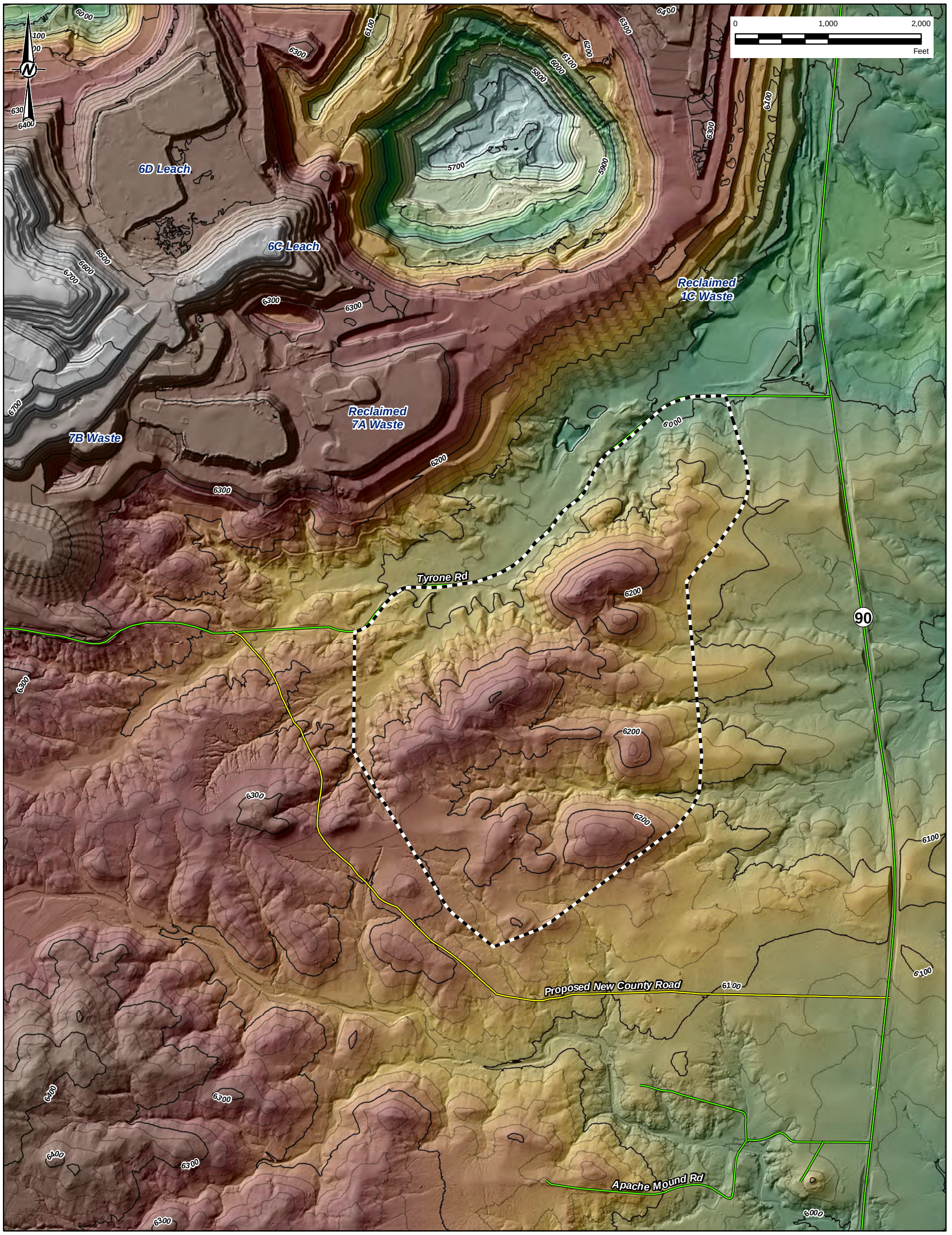

LEGEND

- EMMA PROPOSED PERMIT BOUNDARY
- EXISTING ROAD
- PROPOSED ROAD
- SURFACE ELEVATION CONTOURS (100 FOOT INTERVAL)
- SURFACE ELEVATION CONTOURS (25 FOOT INTERVAL)

EXISTING SURFACE ELEVATION (ft amsl)

HIGH : 6785.86

LOW : 5621.63

REFERENCE

1. SITE TOPOGRAPHY: TYRONE MINE AND IMMEDIATE VICINITY EXISTING GROUND CONTOURS PROVIDED BY FMI, 8/18/2021. SURROUNDING AREAS: USGS LIDAR SURVEY, 2019.

CLIENT
FREEPORT-MACMORAN TYRONE, INC.

PROJECT
EMMA PERMIT SUPPORT
VIEWSHED, LIGHT AND NOISE IMPACT STUDY

TITLE
EMMA EXPANSION PROJECT

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-11-03
DESIGNED	KJC
PREPARED	KJC
REVIEWED	-
APPROVED	-

PROJECT NO.
21476949

FIGURE
1-2

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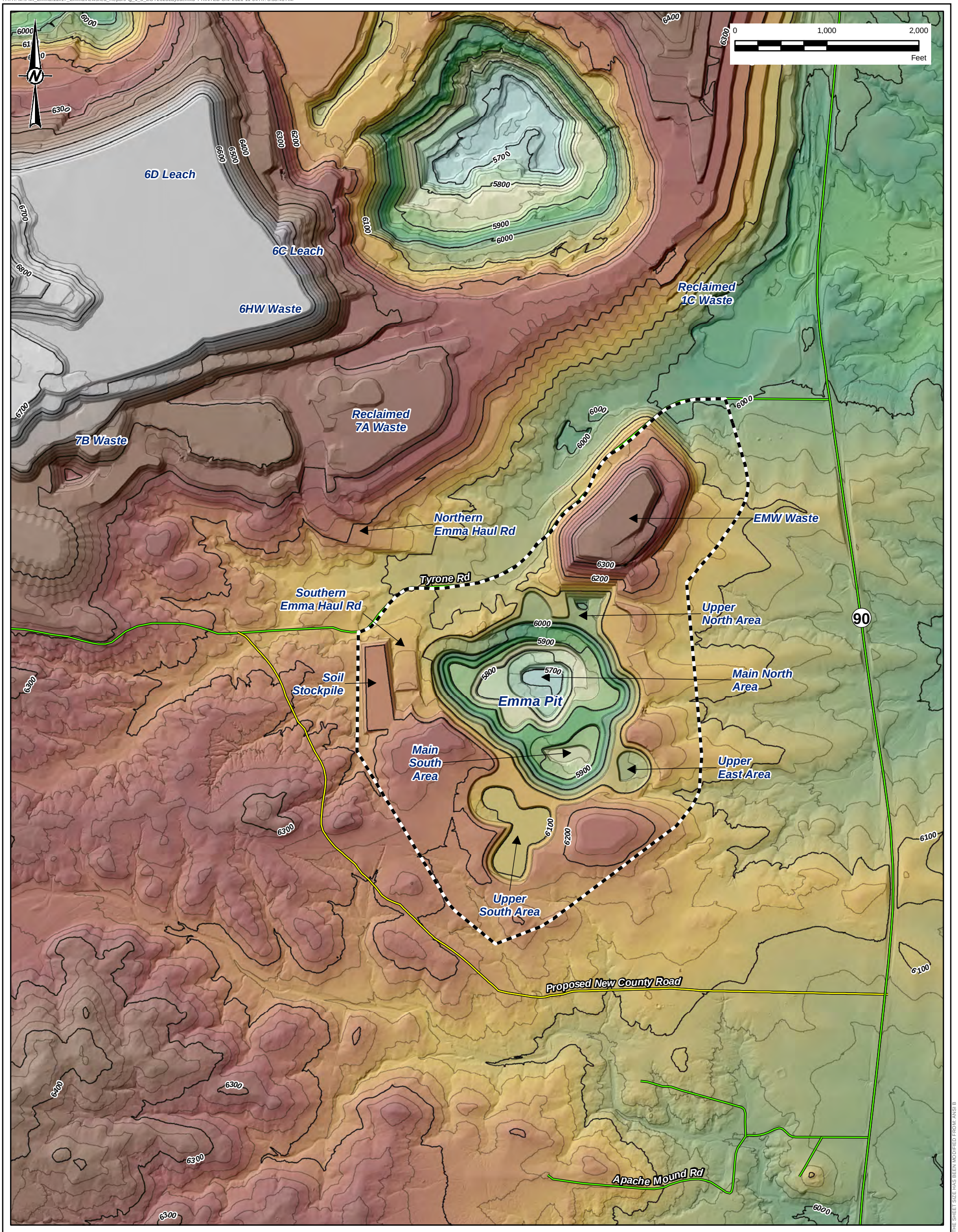

LEGEND

- EMMA PROPOSED PERMIT BOUNDARY
- EXISTING ROAD
- PROPOSED ROAD
- SURFACE ELEVATION CONTOURS (100 FOOT INTERVAL)
- SURFACE ELEVATION CONTOURS (25 FOOT INTERVAL)

PROPOSED SURFACE ELEVATION (ft amsl)

HIGH : 6910

LOW : 5630

REFERENCE

1. SITE TOPOGRAPHY: TYRONE MINE AND EMMA EXPANSION FINAL DESIGN CONTOURS PROVIDED BY FMI, 9/8/2021. SURROUNDING AREAS: USGS LIDAR SURVEY, 2019.

CLIENT
FREEPORT-MACMORAN TYRONE, INC.

PROJECT
EMMA PERMIT SUPPORT
VIEWSHED, LIGHT AND NOISE IMPACT STUDY

TITLE
LAYOUT OF EMMA FACILITIES AT THE END OF YEAR 2026

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-11-03
DESIGNED	KJC
PREPARED	KJC
REVIEWED	-
APPROVED	-

PROJECT NO.
21476949

FIGURE
1-3

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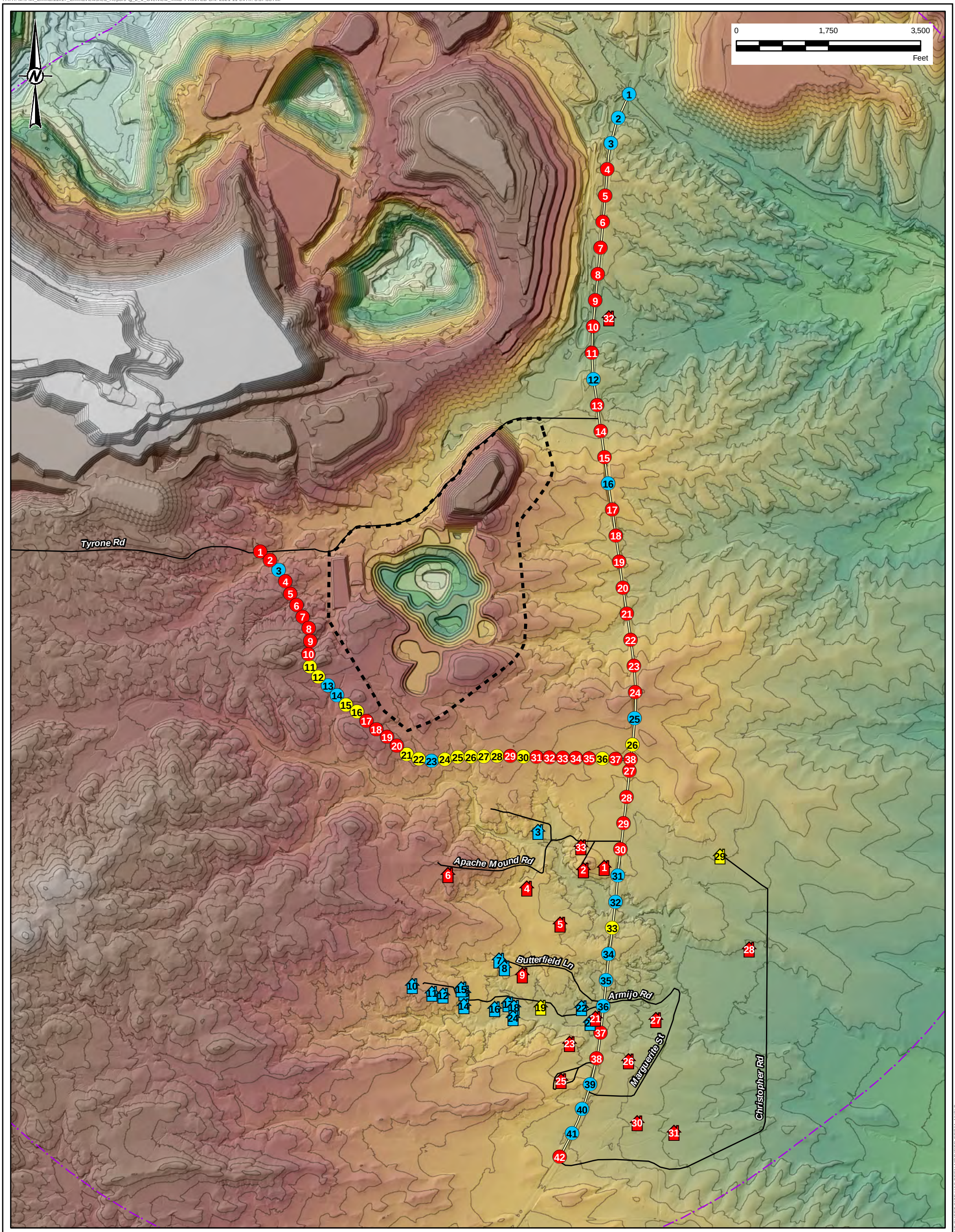

LEGEND

EMMA PROPOSED PERMIT BOUNDARY

2-MILE PERMIT BOUNDARY BUFFER

SIMULATED OBSERVER

CANNOT SEE ANY FEATURES WITHIN THE PROPOSED PERMIT BOUNDARY

CAN ONLY SEE FEATURES WITHIN THE PROPOSED PERMIT BOUNDARY THAT EXISTED PRIOR TO CONSTRUCTION

CAN SEE FEATURES WITHIN THE PROPOSED PERMIT BOUNDARY DUE TO PLANNED CONSTRUCTION

SURFACE ELEVATION (ft)

High : 6,910

Low : 5,322

DISCLAIMER

1. VIEWSHED ANALYSIES CONDUCTED USING ESRI ARCGIS 10.8 DESKTOP SOFTWARE. POTENTIAL OBSTRUCTIONS SUCH AS MAN-MADE FEATURES AND VEGETATION WERE DEEMED NEGLIGIBLE AT THIS SITE AND WERE NOT INCLUDED IN THE MODEL. MODEL INPUTS WERE LIMITED TO HIGH-RESOLUTION TOPOGRAPHY (SEE REFERENCE SECTION) AND OBSERVATION POINTS. A 6-FOOT VERTICAL OFFSET WAS APPLIED TO ALL OBSERVATION POINTS TO SIMULATE THE VIEWPOINT OF A PERSON ON FOOT OR IN A CAR. THE RESULTS OF THIS STUDY HAVE NOT BEEN FIELD-TRUTHED AND SHOULD BE CONSIDERED PRELIMINARY AND APPROXIMATE.

REFERENCE

1. SITE TOPOGRAPHY: TYRONE MINE AND EMMA EXPANSION FINAL DESIGN CONTOURS PROVIDED BY FMI, 9/8/2021. SURROUNDING AREAS: USGS LIDAR SURVEY, 2019.

CLIENT

FREEPORT-MACMORAN TYRONE, INC.

PROJECT

EMMA PERMIT SUPPORT
VIEWSHED, LIGHT AND NOISE IMPACT STUDY

TITLE

VIEWSHED ANALYSIS OVERVIEW - OBSERVER POINTS

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-11-03
DESIGNED	KJC
PREPARED	KJC
REVIEWED	-
APPROVED	-

PROJECT NO.

21476949

FIGURE

2-1

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1in

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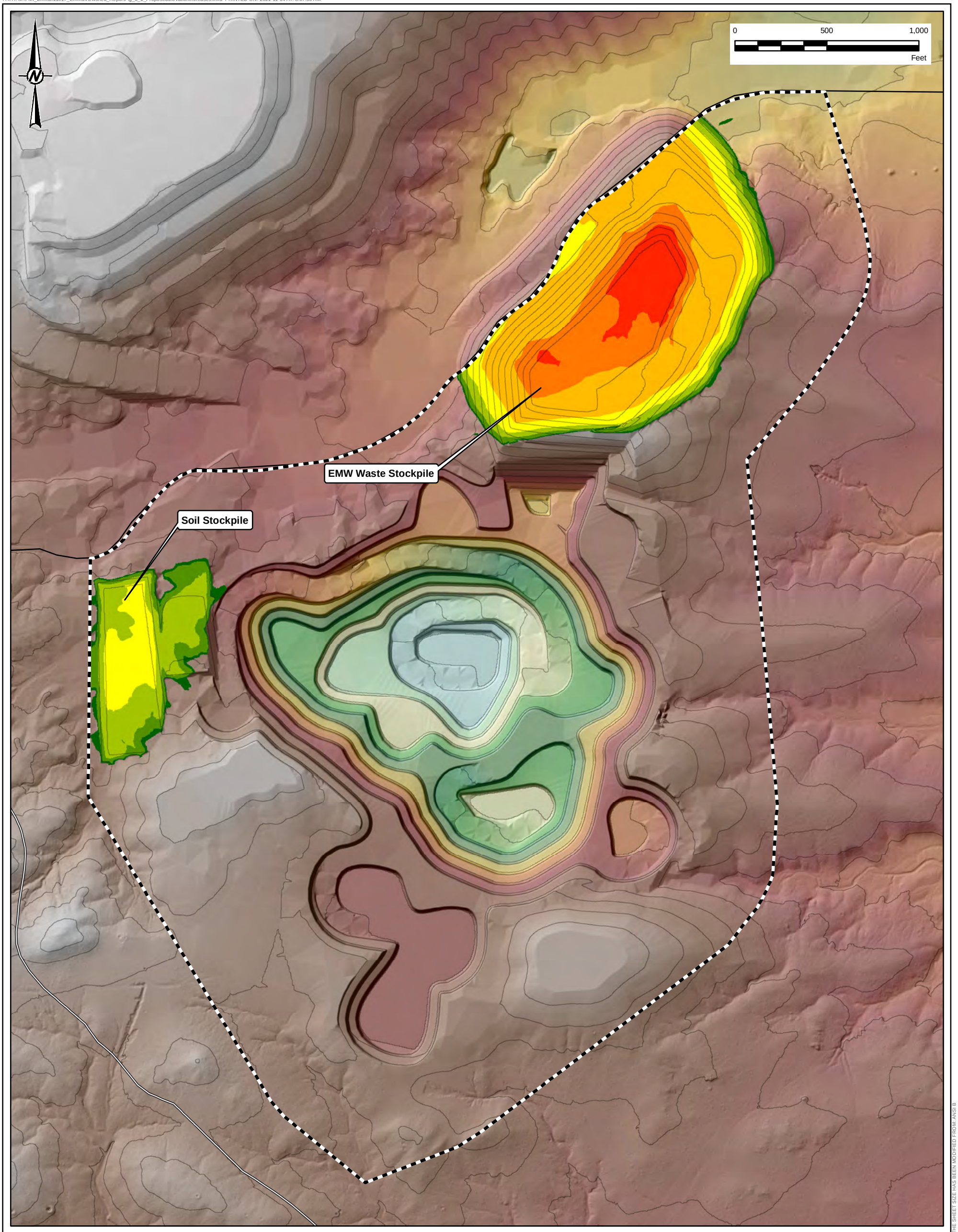

LEGEND

EMMA PROPOSED PERMIT BOUNDARY

AREAS PROJECTED TO SEE SIGNIFICANT ELEVATION GAINS IN FINAL DESIGN

FEET ABOVE EXISTING GRADE

- 0 - 10
- 11 - 25
- 26 - 50
- 51 - 100
- 101 - 200
- 201 - 250
- > 250

EOY 2026 SURFACE ELEVATION (ft)

High : 6,910

Low : 5,322

REFERENCE

1. SITE TOPOGRAPHY: TYRONE MINE AND EMMA EXPANSION FINAL DESIGN CONTOURS PROVIDED BY FMI, 9/8/2021. SURROUNDING AREAS: USGS LIDAR SURVEY, 2019.

CLIENT
FREEPORT-MACMORAN TYRONE, INC.

PROJECT
EMMA PERMIT SUPPORT
VIEWSHED, LIGHT AND NOISE IMPACT STUDY

TITLE
PROPOSED TOPOGRAPHY AT THE END OF YEAR 2026 - AREAS WITH SIGNIFICANT ELEVATION INCREASES

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-11-03
DESIGNED	KJC
PREPARED	KJC
REVIEWED	-
APPROVED	-

PROJECT NO.
21476949

FIGURE
3-1

golder.com