# 2021 Regional Haze Four Factor Initial Control Determination

## Facility: Freeport-McMoRan, Sierrita Mine

*Air Quality Division*
*November 23, 2020*

# Table of Contents

Table of Contents ii
List of Figures ii
List of Tables ii
1 ADEQ Initial Regional Haze Four Factor Control Determination 1
1.1 ADEQ Initial Control Determination for Freeport-McMoRan Sierrita Mine 1
1.2 ADEQ Control Determination Finalization Timeline 1
2 ADEQ Four Factor Analysis 2
2.1 Summary 2
2.2 Facility Overview 2
2.2.1 Process Description 2
2.2.2 Emissions Inventory 3
2.3 ADEQ Screening Methodology 3
2.4 Existing Controls and Baseline Emissions Projections 4
2.4.1 Baseline Scenario (Projected 2028 Emissions Profile) 4
2.4.2 Existing Controls and Control Efficiencies 6
2.5 Four Factor Analysis Review 6
2.5.1 Technical Feasibility and Emission Reductions 6
2.5.2 Cost of Compliance 12
2.5.3 Time Necessary for Compliance 14
2.5.4 Energy and Non-Air Quality Impacts 14
2.5.5 Remaining Useful Life of Source 15
2.5.6 Visibility Impact 15

# List of Figures

Figure 1: Four Factor Control Determination Process Map 1

# List of Tables

Table 1: Emission Inventory for 2016-2018 .......... 3
Table 2  Processes Subject to Four Factor Analysis .......... 4
Table 3 Emissions for Baseline Control Scenario (2028 Projected Emissions) .......... 5
*Table 4 Technically Feasible Control Options for $PM_{10}$ Emissions from Haul Trucks Traveling on Mine Roads* .......... 9
Table 5 Technically Feasible Control Options for $PM_{10}$ Emissions from Loading Ores into Haul Trucks .......... 10
Table 6 Cost Effectiveness of Control Options for PM10 Emissions from Haul Trucks Traveling on Mine Roads .......... 14
Table 7 Cost Effectiveness of Control Options for $PM_{10}$ Emissions from Loading Ores into Haul Trucks .......... 14

# 1 ADEQ Initial Regional Haze Four Factor Control Determination

## 1.1 ADEQ Initial Control Determination for Freeport-McMoRan Sierrita Mine

ADEQ's initial determination is to find that it is reasonable not to require additional controls on Freeport-McMoRan Sierrita Mine during this planning period.

## 1.2 ADEQ Control Determination Finalization Timeline

In order to meet the State rulemaking process timeframe for proposed rule inclusion in the July 31st, 2021 Regional Haze state implementation plan (SIP) submittal, ADEQ must finalize all four factor analyses as expeditiously as possible. To provide an opportunity for interested stakeholders to review and comment on ADEQ's initial decision prior to finalization, the department intends to post initial decisions on the agency webpage along with the original source submitted four factor analyses. Once ADEQ has reviewed relevant stakeholder comments, the agency will revise its initial decisions if necessary and post final decisions (see Figure 1). ADEQ welcomes feedback on these initial decisions and invites any interested party to send their comments by **December 31st 2020** to:

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Please note that this review and feedback opportunity does not constitute an official state implementation plan or state rulemaking comment period. The agency intends to provide an official 30 day comment period on any proposed SIP or rulemaking action in accordance with Arizona Revised Statutes §§ 41-1023, 49-425, and 49-444.

**Figure 1: Four Factor Control Determination Process Map**

# 2 ADEQ Four Factor Analysis

## 2.1 Summary

ADEQ identified four processes that are subject to the four-factor analysis for the Freeport-McMoRan Sierrita complex: haul truck and vehicle travel on mine roads, the tailings, loading/unloading ore into haul trucks, and blasting operations. Freeport completed and submitted a four-factor analysis report for these processes in December 2019. As requested by ADEQ, Freeport further provided additional information in early and mid-2020. Following Guidance on Regional Haze State Implementation Plans for the Second Implementation Period[1], ADEQ reviewed these submittals and performed additional analyses. Upon review of the four-factor analysis, ADEQ's initial determination is that the emission controls Freeport is implementing reflect current best management practices for mining industry, and that it is reasonable not to require additional controls during this planning period.

## 2.2 Facility Overview

### 2.2.1 Process Description

Freeport-McMoRan Sierrita complex is located in southern Pima County, Arizona, southwest of Tucson and west of Green Valley-Sahuarita. The facility consists of three major operations: 1) mining operations, including the drilling and blasting of ore in open-pit copper mines, 2) the Sierrita concentrator operations for production of copper and molybdenum concentrates, and 3) the ROM oxide-leaching plant and the Twin Buttes Electrowinning facility (SX/EW) operations for production of high quality copper cathodes.

Emissions from the facility consist primarily of fugitive and non-fugitive particulate matter (PM) from mining and concentration operations, nitrogen oxide and carbon monoxide from portable and stationary combustion sources and volatile organic compounds from organic liquid storage activities. The facility controls particulate matter (PM) by wet scrubbers, fabric filter dust collectors (FFDC), baghouses, and water spray systems at various emission points. Fugitive dust emissions at the facility are controlled by wet suppression methods including water trucks, water sprays, surfactant use, dust suppression fans, water jets, foggers, and inherent moisture content.

The nearest Class I area is Saguaro National Park, located near Tucson in southeastern Pima County. This Class I area is located approximately 42 km from the facility.

[1] https://www.epa.gov/sites/production/files/2019-08/documents/8-20-2019_-_regional_haze_guidance_final_guidance.pdf

### 2.2.2 Emissions Inventory

Table 1 summarizes the facility-wide emissions during 2016-2018.

**Table 1: Emission Inventory for 2016-2018**

| Year | $PM_{10}$ (tpy) | $PM_{2.5}$ (tpy) | $NO_x$ (tpy) | $SO_2$ (tpy) | CO (tpy) | VOC (tpy) |
|---|---|---|---|---|---|---|
| 2016 | 817.65 | 161.64 | 86.65 | 9.99 | 315.70 | 38.05 |
| 2017 | 757.60 | 172.86 | 94.97 | 33.52 | 339.56 | 40.60 |
| 2018 | 658.18 | 156.09 | 139.26 | 42.08 | 511.40 | 39.09 |

## 2.3 ADEQ Screening Methodology

ADEQ applied a screening process to determine which emission units would undergo four-factor analysis[2]. Any processes that were identified as being effectively controlled were deferred from consideration for the current implementation period. Four-factor analysis would be conducted on the remaining processes that make up the top 80% of emissions at the source.

ADEQ determined the following processes and pollutants for which four-factor analysis must be performed:

- $PM_{10}$ emissions from unpaved mine roads
- $PM_{10}$ emissions from loading ore into haul trucks
- $PM_{10}$ emissions from the tailings
- $NO_x$ emissions from blasting operations

Freeport Sierrita determined that for the purposes of this analysis, unpaved road emissions would be divided into those that emanate from sources primarily in the pit (haul and water trucks) and those mainly utilized outside of the pit (light duty vehicles) due to the nature of the varying controls that can be used in either scenario. After the top 80% of emissions were recalculated, emissions from unpaved roads that are primarily travelled by light duty vehicles did not qualify to be analyzed in this analysis. From this point forward all controls discussed for unpaved roads will be exclusively for haul/water truck unpaved road emissions. Additionally, for truck loading and dumping emissions, dumping accounts for only 1% of the total, which is not considered significant. From this point forward all controls discussed for this process will be exclusively for truck loading.

[2] https://static.azdeq.gov/aqd/haze/4_factor_screening_approach.pdf

**Table 2 Processes Subject to Four Factor Analysis**

| Unit Process Description | Pollutant | 2018 Emissions Estimate (tpy) |
|---|---|---|
| Unpaved Roads – Haul/Water Trucks | PM10 | 307.31 |
| Unpaved Roads – Light Duty Vehicles | PM10 | 30.27 |
| Sierrita Tailings | PM10 | 165.4 |
| Blasting Operations | NOx | 127.5 |
| Truck Load/Dump | PM10 | 101.4 |

Freeport discusses in their report that pit retention, the effect of the pit wall reducing the dispersal of dust outside the pit, plays a factor to reduce emissions hitting the fenceline and travelling to nearby Class I Area. However, the degree to which this occurs at Sierrita is not well understood. Having said that, it is likely that the emissions estimates presented in this analysis for Sierrita sources within the pit are likely conservative due to pit retention.

## 2.4 Existing Controls and Baseline Emissions Projections

### 2.4.1 Baseline Scenario (Projected 2028 Emissions Profile)

Baseline emissions represent a realistic depiction of anticipated annual emissions for the source. Per the EPA's Guidance on Regional Haze Implementation Plans for the Second Implementation Period, the projected 2028 emissions can be a reasonable and convenient choice for use as the baseline emissions. ADEQ has developed a framework for projecting the 2028 emissions for permitted facilities in Arizona.[3]

To project the 2028 emissions for the Freeport Sierrita mine, ADEQ used the emissions data and throughput data from 2016-2018. A scaling factor was determined for each pollutant and emission unit by dividing the annual emissions by the annual throughput. Then the average scaling factor and average process throughput over the three-year period (2016-2018) was calculated. The projected annual emissions for each unit process was determined by multiplying the average scaling factor by the average process throughput.

Table 3 summarizes the 2028 projected emissions for the processes that are subject to four-factor analysis.

[3] https://static.azdeq.gov/aqd/haze/2028_emission_project_methodology.pdf

**Table 3 Emissions for Baseline Control Scenario (2028 Projected Emissions)**

| Emission source | Throughput | PM10 emissions (ton/yr) | 2016-2018 Ave. Throughput | 2016-2018 Ave. Scaling Factor | 2028 Projected PM10 Emissions (ton/yr) |
|---|---|---|---|---|---|
| **Unpaved Roads**[4] | | | | | |
| 2016 | 1,766,407 VMT | 538.60 | 1,749,351 VMT | 0.0002568 | 449.31 |
| 2017 | 1,577,120 VMT | 454.79 | | | |
| 2018 | 1,904,525 VMT | 337.58 | | | |
| **Loading Ores into Haul Trucks** | | | | | |
| 2016 | 50,068,364 tons | 49.39 | 57,882,719 tons | 9.85487E-07 | 81.72 |
| 2017 | 54,714,340 tons | 54.53 | | | |
| 2018 | 68,865,454 tons | 67.03 | | | |
| **Sierrita Tailings**[5] | | | | | |
| 2016 | 3,615 acres | 174.02 | 3615 acres | 0.0474081 | 171.38 |
| 2017 | 3,615 acres | 174.69 | | | |
| 2018 | 3,615 acres | 165.44 | | | |
| | | | | | |
| **Emission source** | **Throughput** | **NOx Emissions (ton/yr)** | **2016-2018 Ave. Throughput** | **2016-2018 Ave. Scaling Factor** | **2028 Projected NOx Emissions (ton/yr)** |
| **Blasting Operations**[6] | | | | | |
| 2016 | 9,241.64 tons | 78.55 | 11371.82 tons | .0085 | 96.66 |
| 2017 | 9,873 tons | 83.92 | | | |
| 2018 | 15,000.82 tons | 127.51 | | | |

[4] Based on all travel on unpaved roads, not just haul trucks
[5] Throughput is the area of the tailings impoundment
[6] Throughput is the tons of ammonium nitrate/fuel oil used (ANFO)

### 2.4.2 Existing Controls and Control Efficiencies

Freeport has identified a few control strategies already being implemented on some of these processes discussed above.

According to Freeport, the speed limit for haul trucks and other vehicles at the Sierrita mine is 34.5 miles per hour (mph). Although the vehicle speed restriction is one control options, the AP-42 Section 13.2.2 does not take the vehicle speed into account for estimating the $PM_{10}$ emissions for vehicles traveling on unpaved surfaces at industrial sites, and thus no control efficiency is calculated. Water is also currently applied to the haul roads at the Sierrita mine. A control efficiency of 90% has been used in Freeport's emissions inventories. Additionally, watering and the use of chemical dust suppressants are already in use for the Sierrita tailings.

There are no current emission control strategies being implemented for the loading of ores in haul trucks or for blasting operations at the Sierrita mine.

## 2.5 Four Factor Analysis Review

### 2.5.1 Technical Feasibility and Emission Reductions

#### 2.5.1.1 Control Options for PM10 Emissions from Haul Trucks Travelling on Mine Roads

Freeport has identified the following $PM_{10}$ control technologies for haul trucks traveling on mine roads based on a review of the RACT/BACT/LAER Clearinghouse ("RBLC") database, technical literature, practices and engineering experience at open-pit copper mines:

- Reduce the speed limit for haul trucks;
- Apply additional water to haul roads;
- Controlling freeboard in the haul trucks;
- Apply chemical dust suppressant to haul roads;
- Apply and maintain surface gravel on haul roads;
- Require haul trucks to be covered; and
- Paving the haul roads and maintain the pavement.

##### 2.5.1.1.1 Reduce the speed limit for haul trucks from 34.5 mph to 25 mph

Speed reduction for haul trucks will result in reduction of haul road emissions. However, reducing the speed limit for haul trucks would significantly impact overall operations, considering that haul truck travel is critical to the ore throughput. If a stricter speed limit were to be enforced, then Freeport would deploy additional haul trucks to maintain the same level of operations. This control option is technically feasible.

As previously discussed, the AP-42 Section 13.2.2 does not take the truck speed into account for estimating the $PM_{10}$ emissions for vehicles traveling on unpaved surfaces at industrial sites. ADEQ used a historical unpaved road emission factor equation in AP-42 to evaluate the control efficiency resulted from the truck speed reduction.[7] As indicated in this equation, emission is linearly proportional to truck speed. Currently, the speed limit for haul trucks and other vehicles at the Sierrita mine is 34.5 mph. If the speed for haul trucks reduces from 34.5 mph to 25 mph, the control efficiency would be 27.5%, resulting in an emission reduction of 124 tpy for $PM_{10}$.

Due to the complexity, ADEQ is unable to evaluate the changes in fuel consumption and tailpipe emissions associated with additional haul trucks. It is likely that adding more haul trucks would increase the fuel consumption and tailpipes emissions (such as $PM_{2.5}$ and NOx emissions), which could compromise the benefits from the truck speed restrictions.

#### 2.5.1.1.2 Apply additional water to haul roads

Additional water spray on the haul roads will result in emission reduction. Haul travel occurs inside the pit and outside the pit. However, too much watering could also lead to traction problems between the haul trucks and the roads. The facility will need to deploy additional water trucks. Additional watering for haul road travel is technically feasible.

The current control efficiency for watering at Sierrita mine is 90%. Additional watering can increase the control efficiency from 90% to 95%, resulting in a reduction of 224.7 tpy for $PM_{10}$.

AP-42 Figure 13.2.2-2 provides a relationship between the control efficiency and the moisture ratio for unpaved travel surfaces.[8] In order to increase the control efficiency from 90% to 95%, the moisture ratio should increase from 4 to 5 (25% increase in soil moisture). ADEQ assumed that the amount of additional water needed was proportional to the increase in moisture ratio.

#### 2.5.1.1.3 Increase freeboard in the haul trucks

Increasing freeboard could potentially reduce the amount of spillage onto haul roads, which can be a source of $PM_{10}$ emissions from vehicular traffic. This control option is technically feasible. However, increasing freeboard may reduce the capacity hauled per truck and would require purchasing additional haul trucks to make up for the production loss. Per email communications between ADEQ and the EPA Region 9, no data is available for the $PM_{10}$ control efficiency for this measure.[9] Since the emissions reductions could not be quantified, this control option is not considered further in the cost of compliance analysis.

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[7] https://www3.epa.gov/ttn/chief/ap42/ch13/bgdocs/b13s02-2.pdf Equation 2-1

[8] https://www3.epa.gov/ttn/chief/ap42/ch13/final/c13s0202.pdf Pg. 13.2.2-12

[9] Email communication between Ryan Templeton (ADEQ) and Panah Stauffer (EPA Region 9)

#### 2.5.1.1.4 Application of additional chemical dust suppressant to haul roads

Chemical dust suppressants are not currently used on unpaved haul roads at the Sierrita mine due to the extreme weight and crushing power of the haul trucks weighing about 860,000 pounds loaded. Per Freeport, chemical dust suppressants can also cause safety hazards by tire slippage during rainy days and when haul trucks make turns or travel on a slope. In addition, based on the several tests performed by Freeport, these chemicals can affect the recovery of copper in the floatation process. Due to safety and operation concerns, this control measure is considered technically infeasible.

#### 2.5.1.1.5 Application of surface gravel on haul roads

Although it is feasible to apply gravel to the haul roads, it is infeasible to maintain it. Gravel would immediately degrade when driven by 860,000 pounds loaded trucks. Constant application of new gravel would be needed to replace the gravel destroyed by the trucks. Large ruts would form and haul trucks would likely slip when traveling up or down a slope. Therefore, this control measure is considered technically infeasible.

#### 2.5.1.1.6 Covering of haul trucks

Haul truck covers are not commercially available to accommodate the size of the haul trucks. Covers would either have to be made in-house or a new type of cover would have to be prototyped and sourced. In addition, covering and uncovering loaded haul trucks could be accomplished only with manual labor and would pose unacceptable safety risks that could not be harmonized with applicable Mine Safety and Health Act ("MSHA") rules. For these reasons, covering haul trucks would be technically infeasible.

#### 2.5.1.1.7 Paving haul roads

Paving unpaved roads in an effort to reduce $PM_{10}$ emissions from haul truck traffic would require a substantial capital investment. Moreover, paving is not feasible for industrial roads subject to very heavy vehicles and/or spillage of material in transport. Due to the weight of the haul trucks at the Sierrita mine, which ranges up to 860,000 pounds, constant replacement of the pavement would be required, since the pavement would quickly be degraded by the weight and movement of the trucks. Therefore, paving the haul roads and maintaining the pavement would be technically infeasible.

Table 4 provides a summary of the technically feasible controls for $PM_{10}$ emissions from haul trucks traveling on mine roads.

| Control Options | $PM_{10}$ Emissions Reduction (tpy) | Note |
|---|---|---|
| Reduce the speed limit for haul trucks from 34.5 mph to 25 mph | 124 | Tailpipe emissions were not estimated |

| | | |
|---|---|---|
| Apply additional water to haul roads (increasing the control efficiency from 90% to 95%) | 224.7 | Apply additional water to haul roads both inside and outside the pit |
| Increase freeboard in the haul trucks | Emissions reductions could not be quantified | This control option is not considered further in the cost of compliance analysis |

*Table 4 Technically Feasible Control Options for $PM_{10}$ Emissions from Haul Trucks Traveling on Mine Roads*

#### 2.5.1.2 Control Options for PM10 Emissions from Loading Ores into Haul Trucks

Freeport has identified the following $PM_{10}$ control technologies based on a review of the RACT/BACT/LAER Clearinghouse ("RBLC") database, technical literature, practices and engineering experience at open-pit copper mines:

- Regular application of water to ores;
- Altering loading procedures; and
- Ceasing operations during high winds.

##### 2.5.1.2.1 Applying Water to Ores

According to Freeport, the Sierrita mine can operate up to 5 loading sites at a time. To apply the amount of water needed to increase the moisture content of ores to a level that would reduce emissions on a continuous basis, Sierrita would need to employ a water truck at each loading site to ensure that the moisture content in the ore during loading process is sufficient. This control option is technically feasible.

By using AP-42 section 13.2.4 and increasing the moisture content from 2% to 4.8%, a control efficiency of 71% is calculated[10]. This will result in 57.73 ton/yr $PM_{10}$ reduction.

An increase in moisture content of ores would not reduce the emissions from other downstream processes such as crushing. Per Freeport, all crushers are currently controlled with baghouses. Therefore, additional water would not provide any additional control but could actually cause reliability issues with the baghouse due to plugging with wet material. Most conveyor belt transfer points are also controlled by baghouses or water sprays. Additional water added at a truck loading point would only reduce the amount of water added at the spray bars. The PM control efficiency would be the same.

##### 2.5.1.2.2 Altering Loading Procedures

Altering loading procedures such as loading trucks on the downwind side of loading equipment can be a potential control option. This technique assumes that the loading equipment itself forms a windbreak. However, per Freeport, the massive electric shovels and haul trucks used in the copper mining industry cannot be moved whenever the wind shifts directions. Therefore, this control option would be technically infeasible.

[10] https://www3.epa.gov/ttn/chief/ap42/ch13/final/c13s0204.pdf

#### 2.5.1.2.3 Ceasing Operations during High Wind Hours

Ceasing operations during high winds (sustained wind speed over 25 mph) is a potential control method to reduce $PM_{10}$ emissions. This would reduce calculated emissions by assuming there are no emissions from loading during high winds. This control option is considered technically feasible.

A control efficiency of 1% was calculated for this control option based on proportion of hours that loading and dumping would not be in operation. High wind hours are those that average more than 25 mph per the onsite met station. This would reduce $PM_{10}$ emissions by 0.66 ton/yr.

Table 5 provides a summary of the technically feasible controls for $PM_{10}$ emissions from loading ores into haul trucks.

**Table 5 Technically Feasible Control Options for $PM_{10}$ Emissions from Loading Ores into Haul Trucks**

| Control Options | $PM_{10}$ Emissions Reduction (tpy) | Note |
|---|---|---|
| Apply water to ores to increase the moisture content from 2% to 4.8% | 57.73 | — |
| Ceasing loading operations during high wind hours | 0.66 | — |

### 2.5.1.3 Control Options for PM10 Emissions from the Tailings

Freeport has identified the following $PM_{10}$ control technologies for tailings emissions based on a review of the RACT/BACT/LAER Clearinghouse ("RBLC") database, technical literature, practices and engineering experience at open-pit copper mines:

- Apply additional water to the tailings;
- Apply chemical dust suppressant to the tailings;
- Apply and maintain crushed rock on the tailings;
- Cover the tailings with tarps;
- Revegetate the tailings;
- Erect an artificial windbreak on the tailings; and
- Plant trees or shrubs as a windbreak on the tailings.

#### 2.5.1.3.1 Applying Additional Water

Additional water application is not a feasible control option. The stability of the tailings impoundment is based on carefully controlling the water balance contained within the impoundment and applying additional water could affect that stability and reduce the safety of the tailings impoundment.

#### 2.5.1.3.2 Applying Chemical Dust Suppressant

Chemical dust suppressants are currently applied to the Sierrita tailings impoundment. FMSI typically applies 50,000 gallons of $MgCl_2$ per week depending on the weather. This control is already being used to the maximum extent possible, in accordance with PCC regulations and air quality permit conditions. Additional application of chemical dust suppressant is not technically feasible.

#### 2.5.1.3.3 Applying Crushed Rock

The application of crushed rock on an active tailings impoundment would be quickly covered by the deposition of fresh tailings material. Thus, this control measure is considered technically infeasible.

#### 2.5.1.3.4 Covering with Tarps

The covering of the tailings with tarps would require an immense quantity of tarps to cover the 3,600 acres of land, and continually would need to be moved as new material is added. For these reasons, covering the tailings with tarps would be technically infeasible.

#### 2.5.1.3.5 Revegetating

Revegetating would provide partial protection from the wind, potentially reducing PM10 emissions associated with windblown dust. The Sierrita tailings do not have enough topsoil to support plant growth and regular watering could create stability issues. Additionally, the tailings are still active, and vegetation would impede the addition of tailings material. For these reasons, revegetation would be technically infeasible.

#### 2.5.1.3.6 Erecting an Artificial Windbreak

Artificial windbreaks are used to prevent wind from reaching the disturbed surface and reducing PM10 emissions. The Sierrita tailings are over 3,600 acres of land and it would not be possible to erect a barrier tall enough to reduce wind speeds sufficiently. While artificial windbreaks are an available control, it is not technically feasible in this instance.

#### 2.5.1.3.7 Planting Trees or Shrubs as a Windbreak

Planting trees and shrubs would provide partial protection from the wind, potentially reducing PM10 emissions associated with windblown dust. The soil on the tailings is not conducive to plant growth, thus fresh soil would have to be brought in to allow for plant growth, in addition to the large quantity of water. Due to this, vegetation windbreaks are not technically feasible.

### 2.5.1.4 Control Options for NOx Emissions from Blasting Operations

Freeport was not able to identify any available or technically feasible NOx control technologies for blasting operations based on a review of the RACT/BACT/LAER Clearinghouse (“RBLC”) database, technical literature, practices and engineering experience at open-pit copper mines. Freeport does note that they will continue to perform blasting operations per best blasting practices.

## 2.5.2 Cost of Compliance

### 2.5.2.1 Cost Calculation Methodology

In general, the cost calculation methodologies ADEQ employed follow the recommendations in the EPA Air Pollution Control Cost Manual, specifically the concepts and methodology as discussed in chapter 2 of section 1.[11] ADEQ recognized that the generic cost estimate information for the processes in mining industry is very limited in the EPA documentation. Therefore, ADEQ mainly relied on the source-specific estimates Freeport provided. For example, the capital costs for new haul trucks and water trucks were directly from the vendor budgetary quotes, and the Operation and Maintenance (O&M) cost of trucks were estimated based on the actual costs in the Sierrita mine during the most recent years. Interest rates and the useful life for amortization purposes are discussed as follows.

As recommended in the EPA Control Cost Manual, the bank prime rate can be an appropriate estimate for interest rates if firm-specific nominal interest rates are not available. However, Freeport provided an interest rate of 9.25%, which was based on FMI Corporate Finance and estimated as the average of current weighted average cost of capital 11.5% and 2019 end of year weighted average cost of capital 7%.

A haul truck or water truck may last 10-12 years without a major refurbish. However, the rebuild process can significantly extend the useful life of trucks.[12] Freeport proposed a useful life of 20 years for both haul trucks and water trucks, which was determined appropriate by ADEQ as well.

### 2.5.2.2 Evaluation Criteria for Cost-Effectiveness

ADEQ performed an analysis to determine a reasonable cost-effectiveness ($/ton) threshold for Arizona emission sources that are subject to the four factor analysis in the regional haze second planning period. ADEQ gathered data on Round 1 Regional Haze Best Available Retrofit Technology (BART) and Reasonable Progress determinations through research of previous submittals and EPA determinations and through outreach to EPA, Federal Land Managers (FLMs), Western States, and WRAP. While EPA did not explicitly state whether they used cost and visibility thresholds or not for their determinations on Round 1, EPA generally rejected cases with a cost-effectiveness of greater than 5,000 $/ton regardless of whether a visibility benefit was significant or not. ADEQ found that none of the accepted cost-effectiveness values in Round 1 exceeded 5,300 $/ton. Adjusting the cost for inflation, ADEQ determined that any

[11] https://www.epa.gov/sites/production/files/2017-12/documents/epaccmcostestimationmethodchapter_7thedition_2017.pdf
[12] https://www.cat.com/en_US/campaigns/awareness/mining-truck-rebuilds.html

controls having an average cost-effectiveness of 6,500 $/ton or higher would be cost excessive and could be rejected without further justification.

#### 2.5.2.3 Results of Cost-Effectiveness Analysis

Table 5 provides a summary of cost effectiveness for control options for $PM_{10}$ emissions from haul trucks travelling on the Sierrita mine roads. Table 6 provides a summary of cost effectiveness for control options for $PM_{10}$ emissions from loading ores into haul trucks.

##### 2.5.2.3.1 Control Options for PM10 Emissions from Haul Trucks Travelling on Mine Roads

- As shown in Table 5, the speed reduction option for haul trucks has an average cost-effectiveness of $233,539/ton, which is significantly higher than the threshold of $6,500/ton. ADEQ has determined that this control option is cost prohibitive.
- The control option of additional water spray on haul roads has an average cost-effectiveness of $12,021/ton, significantly higher than the threshold of 6,500 $/ton as discussed above. As such, ADEQ has determined that this control option is cost prohibitive.

##### 2.5.2.3.2 Control Options for PM10 Emissions from Loading Ores into Haul Trucks

- As shown in Table 6, applying water to ores has an average cost-effectiveness of $179,501/ton, which is significantly higher than the threshold of $6,500/ton. ADEQ has determined that this control option is cost prohibitive.
- Ceasing operations during high wind hours has an average cost-effectiveness of $8,081,366/ton. ADEQ has determined that this control option is cost excessive.

**Table 6 Cost Effectiveness of Control Options for PM10 Emissions from Haul Trucks Traveling on Mine Roads**

| Control Option | Capital Cost ($) | Annualized Capital Cost ($/yr)[1] | Annual Operating & Maintenance Cost ($/yr) | Total Annual Cost ($/yr) | Emission Reduction (tpy) | Average Cost-Effectiveness ($/ton) |
|---|---|---|---|---|---|---|
| Reduce the speed limit for haul trucks to 25 mph | $40,500,000 | $4,515,947 | $24,377,580 | $28,893,527 | 124 | $233,539 |
| Apply additional water to haul roads | $3,100,000 | $345,665 | $2,354,779 | $2,700,444 | 224.7 | $12,021 |

*[1] Capital Recovery Factor = 11.15 based on an interest rate of 9.25% and a useful life of 20 years*

**Table 7 Cost Effectiveness of Control Options for $PM_{10}$ Emissions from Loading Ores into Haul Trucks**

| Control Option | Capital Cost ($) | Annualized Capital Cost ($/yr)[1] | Annual Operating & Maintenance Cost ($/yr) | Total Annual Cost ($/yr) | Emission Reduction (tpy) | Average Cost-Effectiveness ($/ton) |
|---|---|---|---|---|---|---|
| Apply additional water to ores | $13,100,000 | $1,460,714 | $8,901,846 | $10,362,560 | 57.73 | $179,501 |
| Ceasing operations during high wind hours | N/A | N/A | $5,349,315 | $5,349,315 | 0.66 | $8,081,366 |

*[1] Capital Recovery Factor = 11.15 based on an interest rate of 9.25% and a useful life of 20 years*

### 2.5.3 Time Necessary for Compliance

There is no requirement that controls determined to be necessary under 40 C.F.R. § 51.308 must be installed as expeditiously as practicable; rather, such controls should be in place by 2028, unless ADEQ concludes that the control cannot reasonably be installed and become operational until after 2028. Further evaluation of the time necessary for compliance was not evaluated given the controls identified were either currently implemented or cost prohibitive.

### 2.5.4 Energy and Non-Air Quality Impacts

Adding more haul trucks or water trucks will increase the consumption of fuel. Additional water spray on the haul roads/non-haul unpaved roads and ores will increase the water consumption. For other control options, the energy and non-air quality impacts are considered negligible.

### 2.5.5 Remaining Useful Life of Source

The concept of remaining useful life of source is typically used in the context of a discrete emission unit. Freeport proposed a useful life of 20 years for haul trucks and water trucks. ADEQ also determined that a useful life of 20 years for trucks would be appropriate, considering the useful life of trucks could be extended through the rebuilding process.

### 2.5.6 Visibility Impact

Freeport performed a Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) model to determine the probability that emissions from the Sierrita mine impact a Class I area when it experiences its 20% worst visibility days. The results of the HYSPLIT model indicate that the probability of emissions form the Sierrita mine impacting the Saguaro National Park is between 0.5% and 2%.