Arizona Department of Environmental Quality

2021 Regional Haze Four Factor Initial Control Determination

Facility: Phoenix Cement Company, Clarkdale Cement Plant

Air Quality Division
November 23, 2020

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1.1 ADEQ Initial Control Determination for PCC Clarkdale

ADEQ's initial determination is to find that it is reasonable not to require additional controls on Phoenix Cement Company (PCC) Clarkdale Cement Plant 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 evaluated six (6) emissions sources at Phoenix Cement. These sources included: Raw Storage Piles, Coal/Coke Storage Pile, Gypsum Storage Piles, Paved Plant Roads, Quarry Blasting, and material handling processes. The two largest emission sources from Phoenix Cement, the Raw Mill/Kiln and Coal Milling emission sources, were not evaluated as part of the second implementation period of the regional haze rule. These emission sources were not evaluated because they were required to install Selective Non-Catalytic Reduction (SNCR) as part of the first implementation period of the regional haze rule and were deemed effectively controlled. Upon review of all potential control options of emission sources included, ADEQ's initial determination is that no new controls are reasonable based on the review of the statutory four factors.

2.2 Facility Overview

2.2.1 Process Description

At the Phoenix Cement Company facility, cement is produced from various types of rock, including limestone, volcanic ash, and mill scale. First, limestone and other types of rock are blasted and transported by haul trucks from the quarry to the primary crusher or to stockpiles. Crushed rock is routed to surge piles for subsequent transfer to the secondary crusher. The secondary crusher is used in conjunction with feeders and screens to further reduce the size of the rock before it is sent to the raw mill storage bays.

The crushed rock is conveyed from the storage bays to the raw mill for grinding via the rock bin, elevator, and separator. Meal-size material from the raw mill is transported to the blending system which is composed of two blending silos and one homogenizing silo. The in-line raw mill applies residual heat from the pre-heater flue whereas the existing separator and raw mill each have a dryer that supplies heated air. From the blending system, the meal is pumped via the alleviator into a bin from which the meal is discharged into the kiln.

The portland cement manufacturing process consists of a state-of-the-art rotary kiln (Kiln 4) equipped with a five-stage, suspension pre-heater and in-line calciner. This system transforms the raw mix into clinker. The chemical reactions and physical processes that constitute the transformation are quite complex, but they can be conceptually divided into four stages, as a function of the location and temperature in the rotary kiln.

- Evaporation of uncombined water from raw materials as material temperature increases to 212°F;

- Dehydration, as the material temperature increases from 212°F to approximately 800°F to form oxides of silicon, aluminum, and iron;
- Calcination, during which carbon dioxide (CO2) is evolved, between 1,650°F and 1,800°F to form free lime (CaO); and
- Reaction of the oxides in the burning zone of the rotary kiln to form cement clinker at temperatures of approximately 2,750°F.

The indirect-fired modern kiln burns a blend of coal and pet-coke. Coal and pet-coke are stored in separate piles from which each is conveyed into a shared crusher for crushing. The crushed coal or coke is sent to either coal bin or pet-coke bin that feeds a coal roller mill in certain blend ratio. The milled fuel blend is then sent to one of the two pulverized fuel bins for storage before being air-conveyed into the burning zone of the kiln.

Clinker discharges from the kiln into a clinker cooler. Clinker is removed from the clinker cooler by drag chains and moveable grates onto a common conveyor belt that transports it to two clinker storage domes.

2.2.2 Baseline Emission Calculations

Table 1 Historical Emissions

Year	Clinker Production (Tons)	NO_x (tpy)	SO_2 (tpy)	PM(tpy)
2016	531,234	735	5	101
2017	662,171	954	1	114
2018	870,802	1,143	2	135

2.3 ADEQ Screening Methodology

The screening methodology used by the ADEQ relies on the emissions inventory data from ADEQ State and Local Emissions Inventory System (SLEIS). The method used for emissions data from 2015 – 2017 and throughput data from 2016 – 2018 for the 2028 emissions projections. The projected air pollutants include PM, SO_2, and NO_X. Quality assured 2018 emissions data were not available at the time of the analysis which is why 2015-2017 emissions datasets were utilized. Emission units, unit processes, process throughputs (inputs or outputs), and emissions for pollutants were reviewed for Phoenix Cement Company.

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 over the three-year period (2015-2017) was calculated. In addition, the average process throughput for the three-year period (2016-2018) was calculated. The projected annual emissions for each unit process was determined by multiplying the average scaling factor (2015-2017) by the average process throughput (2016-2018).

Then the ADEQ applied a screening process to determine which emission units would undergo four factor analysis. 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.

The projected 2028 emissions for PM, SO_2, and NO_X Phoenix Cement Company for top 80% sources are presented in Table 2 below.

Table 2: 2028 Emission Projections

EMISSION UNIT	PROCESS ID	Pollutant	Pollutant TPY	Status
RAW MILL/KILN	2	NO_X	729.4	Effectively Controlled
COAL MILLING	2	NO_X	83.4	Effectively Controlled
ROCK SAMPLING AND STORAGE	17	PM_{10}	31.4	Top 80%
COAL/COKE HANDLING 2	12	PM_{10}	12.1	Top 80%
GYPSUM HANDLING	4	PM_{10}	7.4	Top 80%
CEMENT STORAGE	1	PM_{10}	5.5	Top 80%
QUARRY RDS/BLAST/DRILL	2	NO_X	4.0	Top 80%
RAW STORAGE AND HOMOG2	1	PM_{10}	3.7	Top 80%
FINISH MILLING	9	PM_{10}	3.7	Top 80%
KILN FEED SYSTEM	1	PM_{10}	3.7	Top 80%
CLINKER HANDLING AND STR3	2	PM_{10}	3.2	Top 80%
RAW MILL	1	PM_{10}	2.7	Top 80%
CEMENT STORAGE 2	3	PM_{10}	2.6	Top 80%
CLINKER COOLING	1	PM_{10}	2.5	Top 80%

ROCK RECLAIMER AND TPS	9	PM_{10}	2.4	Top 80%
RAW STORAGE AND HOMOG1	1	PM_{10}	2.3	Top 80%
CLINKER HANDLING AND STR1	2	PM_{10}	2.3	Top 80%
CLINKER HANDLING AND STR3	3	PM_{10}	2.3	Top 80%
CEMENT STORAGE 2	1	PM_{10}	2.1	Top 80%

2.4 Proposed Control Methodology

2.4.1 Baseline Control Scenario (Projected 2028 Emissions Profile)

The ADEQ relied upon guidance from the Western Regional Air Partnership (WRAP) regarding the use of a "Q/d > 10" threshold to screen out sources from the four-factor analysis. To accomplish this, the ADEQ reviewed calendar year 2014 emission inventory data for sources of PM_{10}, NO_X, and SO_2.

To determine the "Q" value, the facility-wide PM_{10} primary, nitrogen oxide, and sulfur dioxide annual emissions were totaled. Since Phoenix Cement station had a "Q" value greater than 10, it was isolated by the ADEQ.

To determine the distance ("d") value, the ADEQ used GIS to plot the location of Phoenix Cement and the boundary of all Class I areas within Arizona and surrounding States. Then, the distance (the "d" value) from Phoenix Cement to the nearest Class I area boundary (in kilometers) was determined.

Once "Q" and "d" had been established, "Q/d" for Phoenix Cement was determined to be 14. These results are summarized in Table 3 below.

Table 3: Q/d inputs

Facility	Q (tpy)	d (km)	Q/D	Nearest CIA
Phoenix Cement - Clarkdale	140	10	14	Sycamore Canyon WA

2.4.2 Evaluated Controls and Emission Estimates

Phoenix Cement identified the following controls listed below.

2.4.2.1 Raw Storage Piles

2.4.2.1.1 Enclosure

Availability:

Other facilities have successfully implemented fully enclosing raw storage piles. Enclosing the raw storage piles is an available control measure.

Technical Feasibility:

Enclosing the raw storage piles would impact the facility processes and other environmental requirements. These impacts include:

- Preventing the raw material stackers and reclaimers from accessing the rails between the piles and performing their basic functions;
- Require a complete reconfiguration of the plant's sweetening system, which is integral to the quality of the raw feed;
- Encroach upon the only access road along that side of the plant to the point of eliminating the access
- Restrict Clinker Production during construction; and
- Disrupt the operation of the Spill Prevention, Control, and Countermeasure ("SPCC") plan and stormwater pollution prevention plan ("SWPPP").

Other facilities have successfully implanted enclosing raw storage piles, but due to these factors and the facility's immediately surrounding topography, the control option is not technically feasible.

Effectiveness:

The RBLC reports that a fully enclosed structure for the raw storage piles would have a 90% reduction in PM_{10} emissions.

2.4.2.1.2 Increase Moisture Content

Applying additional water to the stockpile would assist in the reduction of PM_{10} emissions associated with wind erosion. Applying water to the surface of the stockpile stabilizes the erodible surface by increasing the moisture content of the material being stored.

Availability:

Watering is a widely available resource for emission control.

Technical Feasibility:

Increasing the moisture content of the raw storage piles to a greater level, whether via the use of water sprays or otherwise, would adversely affect the raw feed chemistry and resulting kiln operation. Increasing the moisture content would also require the introduction of additional heat and air into the raw mill to drive off the additional moisture, which would increase energy consumption. This control method would also cause the raw material from the piles to stick to the conveyor belts and clog the transfer points before the material enters the raw mill system. For these reasons, increasing the moisture content of the raw storage piles would be technically infeasible.

Effectiveness:

Watering the pile can reduce the PM_{10} emissions by 90%.

2.4.2.1.3 Cover with Tarps

Covering the stockpile would assist in the reduction of PM_{10} emissions associated with windblown dust.

Availability:

Tarps are available as a control measure.

Technical Feasibility:

The use of tarp covers to control emissions from the storage piles would necessitate that the tarp covers be continually placed over, and then removed from, the piles as material is continually placed on and removed from the piles using the stackers and reclaimers. Automated or mechanical systems to place, remove, and then replace the tarps continuously are not commercially available. The tarp covers would need to be placed and removed by manual labor, each of the six piles occupies a surface area of roughly 10,000 square feet and averages 20 feet in height, and the sides of the piles are steep. For these reasons, covering the raw storage piles with tarps would be technically infeasible.

Effectiveness:

Utilizing tarps to cover piles provides shelter from the ambient wind and can provide a control efficiency of 90% for PM_{10} emissions.

2.4.2.2 Coal/Coke Storage Piles

2.4.2.2.1 Enclosure

Availability:

Other facilities have successfully implemented fully enclosing storage piles. Enclosing the storage piles is an available control measure.

Technical Feasibility:

Enclosing the raw coal/coke storage piles would impact the facility processes and other environmental requirements. These impacts include:

- Encroach upon the railroad tracks and prevent rail car access on that side of the pile;
- Prevent truck access to the ammonia storage building;
- Encroach upon the access road along that side of the plant, to the point of eliminating it;
- Halt clinker production for the duration of the construction; and
- Disrupt the operation of the Spill Prevention, Control, and Countermeasure (SPCC) plan and stormwater pollution prevention plan (SWPPP).

Due to these factors the control option is not technically feasible.

Effectiveness:

The RBLC reports that a fully enclosed structure for the raw storage piles would have a 90% reduction in PM_{10} emissions.

2.4.2.2.2 Increase Moisture Content

Availability:

Watering is a widely available resource for emission control.

Technical Feasibility:

Freshly mined coal has a heat of wetting which can cause temperature rise when water is added leading potentially to self-ignition if the coal is very dry. Additionally, feeding moist coal/coke into the in-line raw mill would require a reduction in kiln production or require the introduction of additional heat and air into the coal mill to drive off the additional moisture, which would increase energy consumption. For these reasons, increasing the moisture of the coal/coke storage pile would be technically infeasible.

Effectiveness:

This control method could result in an attributable PM_{10} control efficiency as high as 90%.

2.4.2.3 Gypsum Storage Pile

Phoenix Cement's gypsum storage pile is currently contained within a 3-sided and roofed enclosure with a control efficiency of 85%.

2.4.2.3.1 Enclosure

Availability:

Other facilities have successfully implemented fully enclosing storage piles. Also, Phoenix Cement already implements a 3-sided enclosure. Fully enclosing the storage piles is an available control measure.

Technical Feasibility:

The gypsum storage pile is currently controlled by a 3-sided and roofed enclosure. The current control has an efficiency of 85% reduction. A fully enclosed structure would have a control efficiency of 90%. The current location restricts retrofitting a fourth wall onto the existing structure and would restrict truck access to the piles. However, the gypsum storage pile can be moved and a new enclosed structure built elsewhere on the site. Therefore, this is a technically feasible option.

Effectiveness:

The gypsum storage pile is currently controlled by a 3-sided and roofed enclosure. The current control has an efficiency of 85% reduction. A fully enclosed structure would have a control efficiency of 90%.

2.4.2.3.2 Increase Moisture Content

Availability:

Watering is a widely available resource for emission control.

Technical Feasibility:

The gypsum procured by Phoenix Cement for use in the cement manufacturing process is naturally wet with a moisture of approximately 10%. The gypsum is necessarily dried in order to be introduced into the cement manufacturing process. Adding additional water the gypsum would interfere with the process. Thus, this control would be technically infeasible.

Effectiveness:

This control method could result in an attributable PM_{10} control efficiency as high as 90%.

2.4.2.3.3 Cover with Tarps

Availability:

Tarps are available as a control measure.

Technical Feasibility:

The need for the gypsum to be dried in order to be introduced into the cement manufacturing process. Covering the gypsum would inhibit the drying process and makes this control option technically infeasible.

Effectiveness:

Utilizing tarps to cover piles provides shelter from the ambient wind and can provide a control efficiency of 90% for PM_{10} emissions.

2.4.2.4 Paved Plant Roads

Phoenix Cement is currently required to remove earth or other material from paved streets onto which earth or other material has been transported by trucking or earth moving equipment, erosion by water or by other means per Condition B.IX.B.1.b(2) of Attachment "B" of Permit No. 69780.

2.4.2.4.1 Berm Installations

Availability:

This control method is available for Phoenix Cement.

Technical Feasibility:

This has already been implemented at Phoenix Cement and is a technically feasible.

Effectiveness:

These controls will limit visible dust emissions to 20% dust opacity and maintain stabilize surface.

2.4.2.4.2 Curbing/Paving or Shoulder Stabilization

Availability:

This control method is available for Phoenix Cement.

Technical Feasibility:

This has already been implemented at Phoenix Cement and is a technically feasible.

Effectiveness:

These controls will limit visible dust emissions to 20% dust opacity and maintain stabilize surface.

2.4.2.4.3 Curbing with Gutters

Availability:

This control method is available for Phoenix Cement.

Technical Feasibility:

This has already been implemented at Phoenix Cement and is a technically feasible.

Effectiveness:

These controls will limit visible dust emissions to 20% dust opacity and maintain stabilize surface.

2.4.2.4.4 Traffic Rerouting

Availability:

This control method is available for Phoenix Cement.

Technical Feasibility:

This has already been implemented at Phoenix Cement and is a technically feasible.

Effectiveness:

Traffic management plans are effective and not a costly way to reduce emissions from vehicular traffic on paved roads. However, Phoenix Cement already implements this emission control strategy and no additional changes can be made.

2.4.2.4.5 Storm Water Drainage

Availability:

This control method is available for Phoenix Cement.

Technical Feasibility:

This has already been implemented at Phoenix Cement and is a technically feasible.

Effectiveness:

These controls will limit visible dust emissions to 20% dust opacity and maintain stabilize surface.

2.4.2.4.6 Cover open-bodied vehicles

Covering open-bodied vehicles would assist in the reduction of PM_{10} emissions associated with haul truck travel. Haul truck coverage is a preventive control implemented to prevent material from being deposited onto surface.

Availability:

Covers are not available to accommodate the size of the haul trucks at Phoenix Cement.

Technical Feasibility:

Covers are not available to accommodate the size of the haul trucks at Phoenix Cement. In addition, requiring operators to cover haul trucks would pose a safety hazard as they would have to exit the vehicles in order to roll the cover down. There are not any known implementations of covering haul trucks.

Effectiveness:

Covering haul trucks would assist in the reduction of PM_{10} emissions associated with haul truck travel. Haul truck coverage is a control implemented to prevent material from being deposited onto the road surface.[1]

[1] WRAP Fugitive Dust Handbook Section 5, Table 5.5

2.4.2.4.7 Periodic Watering of Paved Roads

Availability:

Phoenix Cement currently applies water to unpaved roads at the Clarkdale facility in order to reduce track-out and associated PM_{10} emissions from vehicle traffic on unpaved roads. This is an available control method for Phoenix Cement.

Technical Feasibility:

Phoenix Cement currently applies water to unpaved roads at the Clarkdale facility in order to reduce track-out and associated PM_{10} emissions from vehicle traffic on unpaved roads. Therefore, applying water to the paved roads would be technically feasible.

Effectiveness:

This control method could result in an attributable PM_{10} control efficiency as high as 90%.

2.4.2.5 Quarry Blasting

No control measures are available to decrease NO_x emissions from quarry blasting at Phoenix Cement. This is based on a review of the RBLC database, other technical literature, practices at other cement manufacturing facilities, and engineering experience both generally and at the Phoenix Cement.

2.4.2.6 Material Handling Processes

Phoenix Cement already employs fabric filters/baghouses with enclosed transfer points for all of these emissions. There is no superior control technology that is commercially available for these emissions. This is based on a review of the RBLC database, other technical literature, practices at other cement manufacturing facilities, and engineering experience both generally and at the Clarkdale facility.

Table 4 Evaluated Controls

Source	Control Option	Technically Feasible (Y/N)	Pollutant Impacted	Control Effectiveness (%)
Raw Storage Piles	Enclosure	N	PM_{10}	N/A
Raw Storage Piles	Increase Moisture Content	N	PM_{10}	N/A
Raw Storage Piles	Cover with Tarps	N	PM_{10}	N/A
Coal/Coke Storage Pile	Increase Moisture Content	N	PM_{10}	N/A
Gypsum Storage Piles	Enclose	Y	PM_{10}	90%

Source	Control Option	Technically Feasible (Y/N)	Pollutant Impacted	Control Effectiveness (%)
Gypsum Storage Piles	Increase Moisture Content	N	PM_{10}	N/A
Gypsum Storage Piles	Cover with Tarps	N	PM_{10}	N/A
Paved Plant Roads	Berm Installation	N	PM_{10}	N/A
Paved Plant Roads	Curbing/Paving or Shoulder Stabilization	N	PM_{10}	N/A
Paved Plant Roads	Curbing with Gutters	N	PM_{10}	N/A
Paved Plant Roads	Traffic Rerouting	N	PM_{10}	N/A
Paved Plant Roads	Storm Water Drainage	N	PM_{10}	N/A
Paved Plant Roads	Cover open-bodied vehicles	N	PM_{10}	N/A
Paved Plant Roads	Watering	Y	PM_{10}	90%
Quarry Blasting	N/A	N	NO_X	N/A
Material Handling Processes	Fabric Filters	Y	PM_{10}	In-Use

2.5 Four Factor Analysis Review

2.5.1 Cost of Compliance

The cost of compliance for technically feasible options are evaluated below. The cost of compliance for these control technologies is summarize in Table 7. The interest assumed was 4.75% APR for all cost estimates in 2018 dollars.

2.5.1.1 Raw Storage Piles

There were no technically feasible control options for the emission source due to the site specifics. However, since a full enclosure has been shown as an effective control measure at other similar facilities, the cost of compliance was evaluated to further demonstrate that this is not a cost effective control if the site specific constraints were not present.

The capital cost associated with constructing the fully enclosed building is $42,350,000 based on Phoenix Cement's engineering estimates and vendor quotes for similar structures. This cost is annuitized over 30 years at 4.75% to yield an annual cost of $2,676,920 based on the capital recovery factor identified in the EPA Air Pollution Control Cost Manual. Additional operating costs include administration, taxes, and insurance. These costs contribute $1,694,000 based on 4% of the capital cost per EPA Air Pollution Control Cost Manual, Sixth Ed., 2002, Sect. 2.5.5.8, pg 2-34. Accounting for all these factors, the total annual cost for reconstructing the overhead crane building at Phoenix Cement is estimated to be $4,370,920.

The full enclosure estimated to have a 90% control efficiency resulting in a reduction of 28.31 tpy. The results in a cost effectiveness of $154,422 per ton of PM_{10} reduced.

2.5.1.2 Coal/Coke Storage Piles

There were no technically feasible control options for the emission source due to the site specifics. However, since a full enclosure has been shown as an effective control measure at other similar facilities, the cost of compliance was evaluated to further demonstrate that this is not a cost effective control if the site specific constraints were not present.

The capital cost associated with constructing the fully enclosed building is $24,200,000 based on Phoenix Cement's engineering estimates and vendor quotes for similar structures. This cost is annuitized over 30 years at 4.75% to yield an annual cost of $1,529,669 based on the capital recovery factor identified in the EPA Air Pollution Control Cost Manual. Additional operating costs include administration, taxes, and insurance. These costs contribute $968,000 based on 4% of the capital cost per EPA Air Pollution Control Cost Manual, Sixth Ed., 2002, Sect. 2.5.5.8, pg 2-34. Accounting for all these factors, the total annual cost for reconstructing the overhead crane building at Phoenix Cement is estimated to be $2,497,669.

The full enclosure estimated to have a 90% control efficiency resulting in a reduction of 10.94 tpy. The results in a cost effectiveness of $228,410 per ton of PM_{10} reduced.

2.5.1.3 Gypsum Storage Piles

The only technically feasible option to control emissions from this source is to fully enclose the gypsum storage piles. This source is currently controlled by a 3-sided enclosure that has a roof. The current control has an efficiency of 85% reduction. A fully enclosed structure would have a control efficiency of 90%.

The current structure cannot be retrofitted to add a fourth wall. However, if the pile was relocated, a larger enclosure can be constructed.

The capital cost associated with constructing the fully enclosed building is $2,860,000 based on Phoenix Cement's engineering estimates and vendor quotes for similar structures. This cost is annuitized over 30 years at 4.75% to yield an annual cost of $180,779 based on the capital recovery factor identified in the EPA Air Pollution Control Cost Manual. Additional operating costs include administration, taxes, and insurance. These costs contribute $114,400 based on 4% of the capital cost per EPA Air Pollution Control Cost Manual, Sixth Ed., 2002, Sect. 2.5.5.8, pg 2-34. Accounting for all these factors, the total annual cost for reconstructing the overhead crane building at Phoenix Cement is estimated to be $295,179.

The full enclosure estimated to have a 90% control efficiency resulting in a reduction of 0.37 tpy from the current baseline emissions from this source. The results in a cost effectiveness of $799,943 per ton of PM_{10} reduced.

2.5.1.4 Paved Plant Roads

Watering is the only technically feasible option to control emissions from paved plant roads.

The capital cost associated with purchasing an additional water truck for paved roads is $105,411 based on Phoenix Cement's previous water truck purchase adjusted to 2018 dollars. This cost is annuitized over 30 years at 4.75% to yield an annual cost of $11,729 based on the capital recovery factor identified in the EPA Air Pollution Control Cost Manual. Additional operating costs include administration, taxes, and insurance. These costs contribute $4,218 based on 4% of the capitol cost per EPA Air Pollution Control Cost Manual, Sixth Ed., 2002, Sect. 2.5.5.8, pg 2-34. The operating cost for the water truck is $69,080. Accounting for all these factors, the total annual cost for reconstructing the overhead crane building at Phoenix Cement is estimated to be $85,027.

The paved road watering is estimated to have a 90% control efficiency resulting in a reduction of 1.31 tpy. The results in a cost effectiveness of $64,709 per ton of PM_{10} reduced.

2.5.1.5 Quarry Blasting

There were no technically feasible control options for the emission source. Therefore, the cost of compliance was not evaluated for this source.

2.5.1.6 Material Handling Processes

There were no technically feasible control options that were improvements on the current controls for this emission source. Therefore, the cost of compliance was not evaluated for this source.

Table 5: Control Option Cost Effectiveness

Emission Source	Control option	Capital cost	Annualized capital cost	Annual operating & maintenance cost	Total annual cost ($/yr)	Emission reduction (tpy)	Cost-effectiveness ($/ton)
Paved Roads	Watering	$105,441	$11,729	$69,080	$85,027	1.31	$64,709
Gypsum Storage Piles	Full Enclosure	$2,860,000	$180,779	$114,00	$295,179	0.37	$799,943
Coal Storage Piles	Full Enclosure	$24,200,000	$1,529,669	$968,000	$2,497,669	10.94	$228,410

Emission Source	Control option	Capital cost	Annualized capital cost	Annual operating & maintenance cost	Total annual cost ($/yr)	Emission reduction (tpy)	Cost-effectiveness ($/ton)
Raw Storage Piles	Full Enclosure	$42,350,000	$2,676,920	$1,694,000	$4,370,920	28.31	$154,422

2.5.2 Time Necessary for Compliance

2.5.2.1 Raw Storage Piles

2.5.2.1.1 Enclosure

There were no technically feasible or cost effective control technologies for this source. Due to no cost effective controls, it was unnecessary for ADEQ to evaluate this component.

2.5.2.2 Coal/Coke Storage Piles

2.5.2.2.1 Enclosure

There were no technically feasible or cost effective control technologies for this source. Due to no cost effective controls, it was unnecessary for ADEQ to evaluate this component.

2.5.2.3 Gypsum Storage Piles

2.5.2.3.1 Enclosure

There were no cost effective control technologies for this source. Due to no cost effective controls, it was unnecessary for ADEQ to evaluate this component.

2.5.2.4 Paved Plant Roads

2.5.2.4.1 Watering

There were no cost effective control technologies for this source. Due to no cost effective controls, it was unnecessary for ADEQ to evaluate this component.

2.5.2.5 Quarry Blasting

There were no technically feasible control options for the emission source.

2.5.2.6 Material Handling Processes

There were no improved controls that were technically feasible available for the emission source.

2.5.3 Energy and Non-Air Quality Impacts

2.5.3.1 Raw Storage Piles

2.5.3.1.1 Enclosure

Constructing an enclosure on the raw storage piles would have several energy and non-air quality impacts. Constructing the enclosure would require clinker production to cease during the construction of the enclosure. Enclosing the raw storage piles would also disrupt the operation of the SPCC and SWPPP for the Phoenix Cement.

2.5.3.2 Coal/Coke Storage Piles

2.5.3.2.1 Enclosure

Enclosing the storage piles would disrupt the operation of the SPCC and SWPPP for the Phoenix Cement. This would require reconfiguration of certain SPCC- and SWPPP-regulated surface features, including the mill-scale pile, mill-scale pond, lined coal/coke/mill scale catchment, and lower pond for stormwater catchment and lead to difficulty managing stormwater and potential discharges to groundwater during the construction.

2.5.3.3 Gypsum Storage Piles

2.5.3.3.1 Enclosure

There would be no additional energy and non-air quality impact from implementing this control measure.

2.5.3.4 Paved Plant Roads

2.5.3.4.1 Watering

Additional water truck traffic, contact water management and associated energy consumption would be entailed. Also, if reclaimed water is used, then the water's quality would need to be assured and managed. Since the paved roads are adjacent to the equipment and building areas, the use of water would make it challenging to keep the paved roads clean, due to creation of mud that could stick to vehicles and increase track-out. Since there are many passenger vehicles that travel on the paved roads, watering them would pose a safety concern of tire slippage. Wet tires are more prone to puncture because water reduces the friction of cutting, shortening tire life.

2.5.3.5 Quarry Blasting

There were no technically feasible control options for the emission source.

2.5.3.6 Material Handling Processes

There were no improved controls that were technically feasible available for the emission source.

2.5.4 Remaining Useful Life of Source

2.5.4.1 Raw Storage Piles

There were no cost effective or technically feasible control options for the raw storage piles.

2.5.4.2 Coal/Coke Storage Piles

There were no cost effective or technically feasible control options for the coal/coke storage piles.

2.5.4.3 Gypsum Storage Piles

2.5.4.3.1 Enclosure

The useful life of the new building considered in this 4FA is estimated at 30 years. The remaining useful life of the Clarkdale facility is greater than 30 years.

2.5.4.4 Paved Plant Roads

2.5.4.4.1 Watering

The remaining useful life of the source and the useful life of the control measure do not play a role in this calculation.

2.5.4.5 Quarry Blasting

There were no technically feasible control options for the emission source.

2.5.4.6 Material Handling Processes

There were no improved controls that were technically feasible available for the emission source.