Peabody Western Coal Company

December 18, 2017

Gerardo Rios Air Permits Manager
Air Division (Attn: AIR-3)
USEPA Region 9
75 Hawthorne Street
San Francisco, CA 94105-3901
(FEDEX 2ND DAY)

RECEIVED
DEC 2 2 2017

Ms. Tennille Begay
Navajo Nation EPA
Air Quality Control Program
Operating Permit Program
P. O. Box 529
Fort Defiance, AZ 86504
(FEDEX 2ND DAY)

Re: PWCC / Kayenta Mine / Application for Synthetic Minor Source Permit

Dear Mr. Rios,

Peabody Western Coal Company (PWCC) hereby submits the attached application that has been prepared in accordance with applicable provisions of EPA's Tribal Minor Source Review Permit Program, 40 C.F.R. §49.151 *et seq.*, and relevant Agency guidance.
package.

PWCC owns and operates Kayenta Mine Complex ("Kayenta") - a surface coal mine on lands of the Navajo Nation and Hopi Tribe near Kayenta, Arizona. In addition to the Company's mining activities at that site, raw coal from that mining is subsequently crushed, screened, blended and stored at a collocated coal preparation plant prior to being loaded-out for rail shipment.

Kayenta Mine Complex is currently subject to a federal Title V operating permit issued by the Navajo Nation Environmental Protection Agency ("NNEPA") under a delegation of authority to administer that federal program (40 C.F.R. Part 71) from Region IX of the U.S. Environmental Protection Agency ("EPA" or "Agency").

The purpose of this permit submittal is to present PWCC's application to Region IX for a synthetic minor source permit for Kayenta. In keeping with terms and conditions of that permit, Kayenta would be classified as a minor source under both the federal Title V program and the federal prevention of significant deterioration ("PSD") program.

PWCC, USEPA and the NNEPA have been working closely on the air permit issues related to Kayenta the past two years. We appreciate the expertise and open discussions allowing us to get to this point. We also would like to thank the EPA and NNEPA staff, and in particular, Lisa Beckham, as she has provided open and transparent dialogue throughout this process. We look forward to working with her in the future on this application.

Please contact me at 928.913.9202, email at rlehn@peabodyenergy.com, or 928.913.9212 (fax) if you have any further questions.

Respectfully,

Randy S. Lehn
Director Environmental Services SW
Peabody Energy

Encl.

C: A. Rappleyea (PWCC-KC) w/o encl.
M. Shepherd (PWCC-KC)

Peabody Western Coal Company

PEABODY WESTERN COAL COMPANY
KAYENTA MINE COMPLEX

APPLICATION
for
SYNTHETIC MINOR SOURCE PERMIT

December 2017

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INTRODUCTION

Peabody Western Coal Company ("PWCC" or the "Company") owns and operates Kayenta Mine Complex ("Kayenta") - a surface coal mine on lands of the Navajo Nation and Hopi Tribe near Kayenta, Arizona. In addition to the Company's mining activities at that site, raw coal from that mining is subsequently crushed, screened, blended and stored at a collocated coal preparation plant prior to being loaded-out for rail shipment.

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The purpose of this document is to present PWCC's application to Region IX for a synthetic minor source permit for Kayenta. In keeping with terms and conditions of that permit, Kayenta would be classified as a minor source under both the federal Title V program and the federal prevention of significant deterioration ("PSD") program.

The Company's application has been prepared in accordance with applicable provisions of EPA's Tribal Minor New Source Review ("NSR") Permit Program, 40 C.F.R. §49.151 *et seq.*, and relevant Agency guidance. EPA Region IX's form for an "Application for Synthetic Minor Limit" has been completed and is included on the next page.

OMB Control No. 2060-0003
Approval expires 04/30/2017

United States Environmental Protection Agency
Pacific Southwest – Region 9
Federal Minor New Source Review Program in Indian Country

Application for Synthetic Minor Limit

Please submit information to:

U.S. EPA at:

Air Division, Permits Office (Air-3)
U.S. EPA, Region 9
75 Hawthorne Street
San Francisco, CA 94105

For more information:
http://www.epa.gov/caa-permitting/tribal-nsr-permits-region-9, call (415) 972-3974, or email R9AirPermits@epa.gov.

Tribe:

The Tribal Environmental Contact for the specific reservation.

Please contact EPA Region 9 if you need assistance in identifying the appropriate Tribal Environmental Contact and address.

A. General Source Information

Company Name	**Peabody Western Coal Company**
Source Name	**Kayenta Mine Complex**
Contact Information	**Randy Lehn** **Southwest Operations** **928-913-9202 (office)** **928-221-3574** **RLehn@PeabodyEnergy.com**
Mailing Address	**2836 West Shamrell Blvd.** **Flagstaff, AZ 86005**

B. Attachments

For each criteria air pollutant, hazardous air pollutant and for all emission units and air pollutant-generating activities to be covered by a limitation, include the following:

☐ **Item 1 -** The proposed limitation and a description of its effect on current actual, allowable and the potential to emit.
☐ **Item 2 -** The proposed testing, monitoring, recordkeeping, and reporting requirements to be used to demonstrate and assure compliance with the proposed limitation.
☐ **Item 3 -** A description of estimated efficiency of air pollution control equipment under present or anticipated operating conditions, including documentation of the manufacturer specifications and guarantees.
☐ **Item 4 -** Estimates of the Post-Change Allowable Emissions that would result from compliance with the proposed limitation, including all calculations for the estimates.
☐ **Item 5 –** Estimates of the potential emissions of Greenhouse Gas (GHG) pollutants.

BACKGROUND

Scope of Potential-to-Emit Calculation for Kayenta

The term "synthetic minor source" is defined at 40 C.F.R. §49.152 to mean

> a source that otherwise has the potential to emit regulated NSR pollutants in amounts that are at or above those for major sources in §49.167, §52.21 or §71.2 of this chapter, as applicable, but that has taken a restriction so that its potential to emit is less than such amounts for major sources. Such restrictions must be enforceable as a practical matter.

The major source threshold in §49.167 applies to a stationary source located in a nonattainment area. That threshold is not applicable to Kayenta because that source is not located in an area that has been designated by EPA as nonattainment for any air pollutant subject to a national ambient air quality standards ("NAAQS"). The major source threshold in §52.21 under the PSD program is 100 tpy for any source category specifically named in §52.21(b)(1)(i)(a). Neither surface coal mine nor coal preparation plant is one of those specifically named source categories.[1] Consequently, the applicable major source threshold under the PSD program for either of those two particular categories is 250 tpy.[2] Finally, the 100 tpy major source threshold in §71.2 (Title V) applies to a surface coal mine as well as to a coal preparation plant.

When determining whether a stationary source's potential-to-emit ("PTE" or "potential emissions") exceeds a major source threshold under §52.21 or §71.2, fugitive emissions from that source must be included in the threshold applicability determination if the source belongs to one of the source categories "listed" by EPA in keeping with §302(j) of the Clean Air Act ("CAA"). Coal preparation plant is one such "listed" source category,[3] but surface coal mine is not. Therefore, when determining whether Kayenta's surface coal mine with its collocated

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[1] "Coal cleaning plants (with thermal dryers) is one of the specifically named source categories. However, because Kayenta is a type of coal preparation plant that performs only crushing, screening and blending, Kayenta is not included within the source category named "coal cleaning plants (with thermal dryers)."

[2] 40 C.F.R. §52.21(b)(1)(i)(b).

[3] The relevant source category is "[a]ny other stationary source category which, as of August 7, 1980 is being regulated under section 111 or 112 of the Act." *See e.g.*, 40 C.F.R. §52.21(b)(1)(iii)(aa). Section 111 of the Act authorizes EPA to promulgate new source performance standards ("NSPS") for a variety of source categories. The source category of "coal preparation plant" is regulated by NSPS Subpart Y which was proposed on October 24, 1974 (39 Fed. Reg. 37922) and promulgated on January 15, 1976 (41 Fed. Reg. 2232).

preparation plant is "major," fugitive emissions from the coal preparation plant are included in that potential-to-emit calculation, but fugitive emissions from the surface coal mining are not.[4]

Particulate emissions from Kayenta's coal preparation plant as well as from its surface coal mining are entirely fugitive in nature.[5] As a result, Kayenta's potential-to-emit particulate matter is calculated as the sum of potential emissions from each stationary, particulate-emitting operation or activity at Kayenta's coal preparation plant. Aside from its individual coal preparation facilities, Kayenta's coal preparation plant does not include any other stationary, particulate-emitting activities which would otherwise contribute to Kayenta's potential-to-emit particulate matter. In other words, when determining whether Kayenta is classified as a minor source, its potential-to-emit is calculated as the sum of the potentials-to-emit from all of its coal preparation facilities.

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[4] *See, e.g.,* Letter from Cheryl L. Newton, EPA Region V, to Janet McCabe, Indiana Dep't of Environmental Management, of Mar. 6, 2003 (Attachment at 2) ("You include fugitive emissions only from the coal cleaning plant to determine if the source is a major stationary source.").

[5] Particulate matter, in the forms of PM, PM_{10} and $PM_{2.5}$, is the only regulated air pollutant whose potential emissions from Kayenta could possibly rise to the level of a major source. Therefore, the issue of potential to emit addressed in this document focuses solely on potential emissions of those forms of particulate matter (recognizing that PM is not a regulated air pollutant under the federal Title V program).

DESCRIPTION OF KAYENTA'S COAL PREPARATION PLANT

Process Flow – From Hopper Loading to Silo Storage Load-out

Kayenta's coal preparation plant consists of the following five separate, but interconnected, operating systems:

- Area J-28 where raw coal is crushed and screened;
- Area N-11 where raw coal is also crushed and screened;
- East Overland Conveyor which transports processed coal from Areas J-28 and N-11 to Area N-8;
- Area N-8 where originally processed coal is temporarily stored and then blended and screened; and
- West Overland Conveyor which transports product coal from Area N-8 to temporary silo storage prior to loading for shipment.

Kayenta's potential-to-emit particulate matter must be calculated by aggregating the potential-to-emit of each stationary, particulate-emitting activity at Kayenta's coal preparation plant. Aside from its coal preparation facilities, the preparation plant does not contain any other particulate-emitting activities.

The overall scope of Kayenta's coal preparation plant and the specific design configuration of its process flows are shown in Figure 1. EPA guidance prescribes that a coal preparation plant "begins at the first hopper (i.e., drop point) used to unload coal and ends at the load-out (i.e., distribution) of the coal either to a method of transportation (e.g., truck, train) or to the end-use piece of equipment."[6]

[6] 74 Fed. Reg. 51950, 51952 (Oct. 8, 2009).

In keeping with that guidance, the process flow of Kayenta's preparation plant begins with raw, wet coal from the Company's contiguous surface mining operations being loaded into hoppers at processing locations designated as Area J-28 and Area N-11. The raw coal arrives in a wet condition because water is sprayed onto that coal at the mine's pits before it is transported to Areas J-28 and N-11 by bottom-dump or end-dump haul trucks. Raw coal is unloaded into Hopper 5 at Area J-28 and into Hopper 4 at Area N-11. Hopper 6 at Area J-28 is a reclaim hopper that does not receive coal directly from the haul trucks.

In addition to hopper loading, particulate-emitting preparation activities at Area J-28 and at Area N-11 consist of coal crushing, screening and conveying facilities. Area J-28 also provides for interim storage of processed coal within a covered dome.

Importantly, the operation of Area J-28 is separate from and independent of the operation of Area N-11. That is, at any given time Area J-28 may be operating while Area N-11 is idle; or Area N-11 may be operating while Area J-28 is idle; or Area J-28 and Area N-11 may each be operating.

The East Overland Conveyor (EOC) consists of a series of covered belt conveyors which transport the combined productions of Areas J-28 and N-11 over several miles to a location designated as Area N-8. Processed coal from Area J-28 is discharged onto the tail (beginning) end of the EOC. Processed coal from Area N-11 is discharged onto the EOC at a location downstream from where the EOC receives processed coal from Area J-28.

Figure 1 shows that multiple, particulate-emitting coal preparation activities take place in Area N-8, where processed coal from Areas J-28 and N-11 may flow through one of four different parallel operations. Some of that previously processed coal that satisfies the quality specifications for Kayenta's final product goes through a final screening before being conveyed directly to Kayenta's coal storage silos. The remaining processed coal from Areas J-28 and N-11 is first loaded-in by belt conveyors to one of three separate interim storage piles and is then later loaded-out of each pile through a reclaim hopper and associated belt conveyors.

The particular pile selected for temporary storage at Area N-8 depends upon the ash and sulfur contents of the incoming coal from J-28 and N-11. The K-1 Pile is designated as the "Ready Pile," meaning that particular coal already meets product specifications but is being reserved for blending with other processed coal stored in Piles K-2 and K-3 that does not fully satisfy product specifications. In particular, the K-2 "High-Sulfur Pile" temporarily stores processed coal having a sulfur content above the limit established for final product. Similarly, the K-3 "High-Ash Pile" temporarily stores processed coal having an ash content above the limit established for final product.

Processed coal is reclaimed from N-8's three different storage piles and blended in proportionate amounts as needed to meet the quality specifications of Kayenta's final product. Blended coal then proceeds through final screening at Area N-8. After the process flow has gone through one of N-8's three parallel, interim-storage operations and then through final screening, product coal is conveyed to Kayenta's coal storage silos by the West Overland Conveyor (WOC).

The WOC consists of a series of covered belt conveyors which transport the final product from Area N-8 over several miles to storage silos. From there, product coal is loaded-out to a series of open rail cars for transportation from Kayenta.

The East Overland Conveyor with Area J-28 and/or Area N-11 typically operates two shifts per day during seven days per week. The West Overland Conveyor with Area N-8 typically operates three shifts per day during six days per week and two shifts per day for the remaining day of the week.

Operations of the coal preparation facilities and their wet suppression system (see below) remain essentially unchanged from one day to the next. Particulate emissions are generated by mechanical forces imparted by processing and conveying equipment; those mechanical forces from hoppers, crushers, screens and transfer points are applied to the coal from the same equipment each day. The physical properties of the coal that is impacted by those forces as it moves through the plant do not change significantly over time.

The following equipment, pictured in Figures 2 through 5, are representative of some of the different types of preparation facilities at Kayenta:

- Underground Hopper Transfer to Conveyor Belt;
- Parallel Primary Crushers (Enclosed)
- Belt-to-Belt Transfer through Chute
- Domed Stockpile (top)


Figure 2. Underground Hopper Transfer to Conveyor Belt


Figure 3. Parallel Primary Crushers

Figure 4. Belt-to-Belt Transfer Through Chute

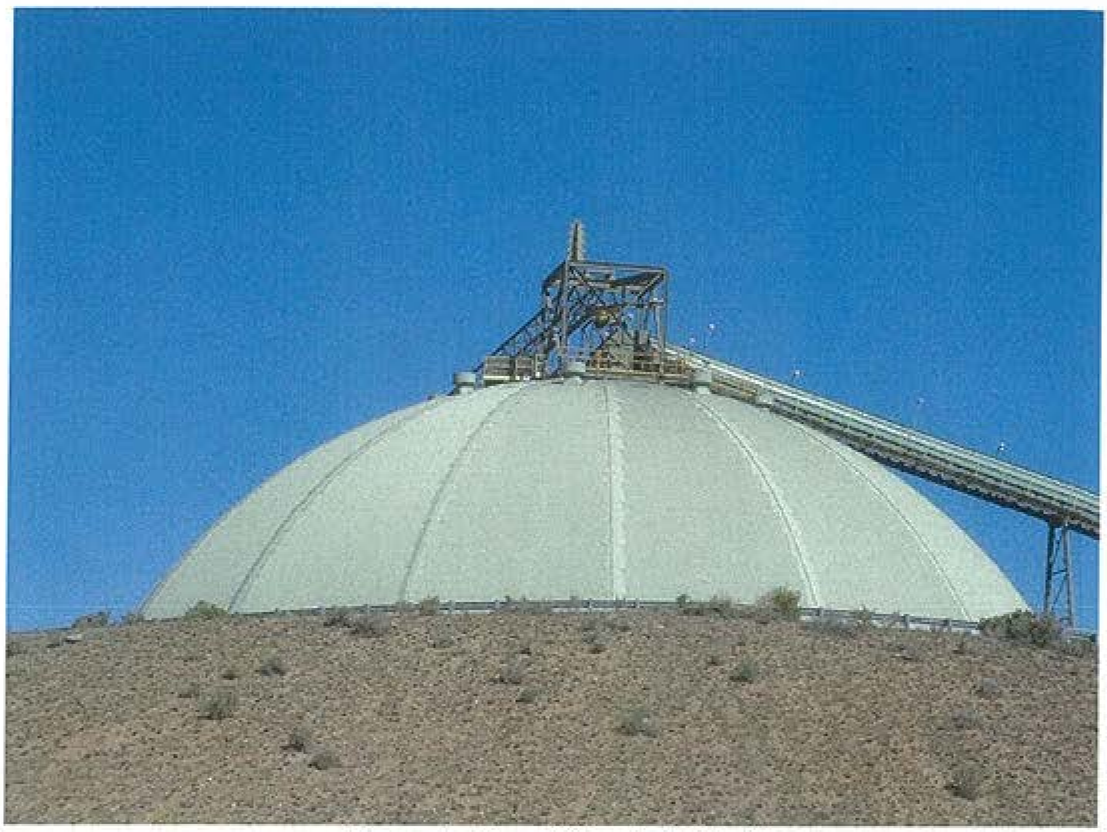

Figure 5. Domed Stockpile (top)

Control Technologies

With the application of wet suppression techniques in certain types of nonmetallic mineral processing plants, e.g., stone crushing, EPA has found that, "[d]ue to carryover of the small amount of moisture required, it has been shown that each source, with the exception of crushers, does not need to employ direct water sprays."[7] Nevertheless, Kayenta's process design includes a comprehensive system of water-with-surfactant sprays (and associated downstream residual water-with-surfactant) distributed strategically at multiple locations throughout the preparation plant. Rather than focus sprays solely on one or two preparation activities with the highest levels of uncontrolled emissions, Kayenta's wet suppression system is designed to raise and maintain an elevated level of moisture in coal as it flows throughout the preparation plant, i.e., from loading the hoppers at Areas J-28 and N-11 to loading the storage silos at the end of the West Overland Conveyor.

Moreover, consistent with typical process designs for preparation plants, enclosures cover Kayenta's processing and conveying equipment in order to minimize accumulations of coal dust which can threaten workers' health and safety. As a result of those inherent process design features, potential emissions of fugitive particulate matter from the preparation facilities are further reduced.

A subsequent section of this document provides details about the design and operation of each type of preparation facility at Kayenta and about the nature and quantity of particulate matter emitted from each such facility. That same section also addresses the type of wet suppression applied to each preparation facility and the range of control efficiencies generally considered to be characteristic of those different types of wet suppression.

Startup, Shutdown and Malfunction

Startup

A preparation Area at Kayenta cannot begin operation until its associated Overland Conveyor is up and running. Startup of those interconnected systems is done in reverse, i.e., going upstream in the process flow from the head end of the Overland Conveyor, through each of its belt

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[7] AP-42, Table 11.19.2-2, note b.

conveyors in series, to the last transfer point of the interconnected preparation Area. From there, startup continues to proceed backwards through the normal process flow of that Area until reaching the initial facility in that Area, i.e., either a truck hopper or a reclaim hopper.

Once all facilities in the interconnected systems have been ramped up to the predetermined operating rate, process flow (operation) begins with coal being introduced through the hopper(s) serving the interconnected systems. Coal is transferred by belt conveyor(s) from a hopper to the downstream crusher and from there by belt conveyors to the screen associated with that crusher. Thereafter, processed coal flows out of the preparation Area by belt conveyors and onto the connected Overland Conveyor for transport to the next destination (either Area N-8 or the storage silos).

If a particular preparation facility in the startup sequence is equipped with wet suppression sprays, those sprays are activated as coal first enters that preparation facility. Conversely, if a particular preparation facility in the startup sequence is not equipped with wet suppression sprays, the coal first entering that facility will nevertheless contain an elevated level of residual moisture due to previous application(s) of sprays upstream of that facility.

As coal flow is activated through one facility after another along the process flow during startup, coal flow rates do not depart significantly from the predetermined production rate. Consequently, the rate of spraying water-with-surfactant or water-only at a particular preparation facility typically varies little throughout each operating day. The rate of liquid application by a set of sprays, however, can be trimmed (slightly more or slightly less) to maintain the desired balance for sustained, steady-state operations.

Application of too much liquid spray with subsequent excessive carryover results in unacceptably high levels of coal-moisture that cause wet coal to stick to surfaces of conveyor belts, instead of smoothly sliding from the head of one belt to the tail of the next. If the extent of coal adhesion to belts is not quickly corrected, the affected conveyor belts (and any associated preparation and overland conveying facilities) must be shut down for the affected belts to be cleaned.

On the other hand, application of too little liquid spray with subsequent insufficient carryover results in unacceptably low levels of coal-moisture that do not fully suppress visible emissions of particulate matter from the affected facilities, as designed. Trained to determine the opacity of visible particulate emissions, plant personnel address the concern about any visible emissions by slightly increasing liquid flow to the affected spray(s) in a timely manner, thereby not compromising the presumptive control efficiencies[8] of the spray(s) and any related downstream carryover.

In sum, operation during startup of coal preparation facilities at Kayenta mimics normal operation of those facilities by using coal flow rates characteristic of those facilities' normal operations and by applying the designed means and levels of wet suppression when coal first begins flowing through those facilities. Importantly, periods of low visible emissions (<20% opacity) during startup are not indicative of excess emissions from the affected facilities because the presumptive efficiencies of the affected wet suppression remain applicable while corrective action is nevertheless taken to eliminate even those low levels of visible emissions.

Shutdown

When an operating system (at least one preparation Area and at least one Overland Conveyor) must be shutdown, the flow rate of coal is stopped at the beginning preparation facility in that system's process flow, i.e., at either a Truck Hopper or a Reclaim Hopper. Coal already within the process flow moves successively from one preparation facility to the next at the same flow rate that was being used for normal operation.

As coal flow through a particular facility is completed, any sprays associated with that facility are turned off. During a system shutdown, coal in any facility downstream of a spray-equipped facility will continue to realize wet suppression from residual moisture due to liquid having been earlier applied upstream.

During the sequencing of facility shutdowns, the flow rate of final coal through each facility is no different from that during its normal operation. The form of wet suppression designed for each preparation facility continues to be applied until coal no longer flows through that facility.

[8] A presumptive control efficiency is not actually quantified by measurements of inlet and outlet emissions from the control technology in question. Instead, if a qualitative correlation can be established between specific operating parameters and the relative levels of control efficiency, then a specific level of control efficiency is presumed to exist when the values of the correlated operating parameters for that efficiency level are satisfied. In Kayenta's case, as explained herein, maximum particulate-control efficiencies of different forms of wet suppression are presumed to be realized when visible emissions from the controlled facilities are less than 20% opacity.

In short, the rate of fugitive particulate emissions from each preparation facility during its shutdown is no different from that facility's emission rate during its normal operation.

Malfunction

Put simply, the malfunction of a coal preparation facility or of any related spray configuration does not result in any material increase in particulate emissions because, upon detection of the malfunction, the plant's process control system stops the operation of not only that facility but also all other facilities operating in conjunction with the malfunctioning unit. Upon correction, operation of the affected facilities is restarted from back to front in the process flow to avoid overcharging raw coal to the subject system.

Conclusion

As discussed in a subsequent section of this document, EPA emphasizes that emission limitations can effectively restrict a stationary source's PTE only when such limitations apply to all emissions at all times.[9] As demonstrated above, particulate emissions from Kayenta's coal preparation facilities during periods of their startup and shutdown are not expected to differ materially from those facilities' emissions during their normal operations.[10]

Applicability of NSPS Subpart Y

Subpart Y of the federal new source performance standards (NSPS) applies to coal preparation and processing plants.[11] Because construction of many of Kayenta's coal preparation facilities commenced after October 27, 1974 but before April 28, 2008, most of those facilities are subject to applicable provisions of the original Subpart Y promulgated in 1976.[12]

That NSPS applies only to the following types of preparation facilities at Kayenta: coal processing and conveying equipment (including breakers and crushers), coal storage systems

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[9] *In the Matter of Hu Honua Bioenergy Facility,* Order on Petition No. IX-2011-1 at 10-11 (Feb. 7, 2014) ("*Hu Honua Order*").

[10] The malfunction of a coal preparation facility at Kayenta does not result in any emissions.

[11] 40 C.F.R. Part 60, Subpart Y.

[12] 41 Fed. Reg. 2232, 2234 (Jan. 15, 1976).

(not including open storage piles) and coal transfer and loading systems.[13] Emissions of particulate matter from facilities subject to the original Subpart Y are regulated under NSPS only by a prohibition of visible emissions which exhibit 20% opacity or greater.[14]

Various arrays of spray nozzles at multiple locations were installed with those Subpart Y facilities to satisfy the 20% opacity standard applied by that rulemaking. The following Table 1 identifies those coal preparation facilities at Kayenta subject to Subpart Y and the particular method of wet suppression applied to each.

Table 1
Nature and Extent of Sprays at Subpart Y Facilities

Kayenta Facility	Nature/Extent of Wet Suppression
Hopper 5	84 Sprays[15]
Transfer Point 1 (TP1) (Hopper 5 to Belt 1-N Tail)	Total of 6 Sprays[16] 4 Sprays on Feeder Dust Cover 1 Free Fall Spray 1 Belt Spray
TP2 (Hopper 5 to Belt 1-S Tail)	Total of 6 Sprays 4 Sprays on Feeder Dust Cover 1 Free Fall Spray 1 Belt Spray
TP3 (Hopper 6 to Belt 8)	4 Sprays on top of Nico Feeder Deck 2 Belt Sprays
J28 North & South Primary Crushers	Total of 8 Sprays 1 Spray (each inlet) 3 Sprays (each outlet), as follows: - 2 Free Fall Sprays - 1 Belt Spray
TP4 (Belt 2 Head to J28 Screen)	1 Spray

[13] 40 C.F.R. § 60.254(a).

[14] *Id.*

[15] Each spray uses a water-with-surfactant mixture unless otherwise noted.

[16] Multiple groups of sprays at a single facility correspond to a different location for each group of sprays.

J28 Screen Cover	6 Sprays
TP5 (J28 Screen/Crusher to Belt 5 Tail)	Water-with-Surfactant Residual
TP6 (J28 Screen/Crusher to Belt 6 Tail)	2 Sprays
TP7 (Belt 6 Head to J-28 Dome Stockpile Feeder)	Water-with-Surfactant Residual
TP8 (Dome Stockpile Feeder to Dome Stockpile)	4 Sprays
Dome Stockpile	Water-with-Surfactant Residual
TP9 (Dome Stockpile Reclaim to Belt 5)	2 Sprays
TP10 (Belt 5 Head to EOC Belt 20 Tail)	Total of 6 Sprays 4 Free Fall Sprays 2 Chute Sprays
Hopper 4	49 Hopper Sprays
TP16 (Hopper 4 to Belt 34 Tail)	4 Sprays on Nico Feeder Deck
N11 Primary Crusher	3 Sprays (inlet)
TP17 (Belt 35 Head to N11 Screen)	2 Sprays
N11 Screen	4 Sprays
TP18 (N11 Screen to Belt 36 Tail)	1 Spray
TP19 (Belt 36 Head to EOC Belt 25 Tail)	3 Upper Sprays 3 Lower Sprays
TP20 (EOC Belt 25 Head to Belt 3 Tail)	2 Sprays
TP35 (Hopper 3 to Belt 18 Tail)	4 Sprays South Feeder (water only) 3 Sprays North Feeder (water only)
TP36 (Belt 18 Head to Belt 28 Tail)	Water-only Residual
TP37 (Belt 27 Head to Belt 31 Tail)	1 Spray 1 Free Fall Spray
TP38 (Belt 28 Head to Belt 31 Tail)	1 Spray 1 Free Fall Spray

TP39 (Belt 31 Head to N8 Screens)	Water-with-Surfactant Residual
N8 Screens	Water-with-Surfactant Residual
N8 Primary Crushers	Water-with-Surfactant Residual
TP40 (N8 Screens/Crushers to Belt 33 Tail)	Water-with-Surfactant Residual
TP41 (Belt 33 Head to Belt 30 Tail)	2 Sprays
TP42 (Belt 30 Head to WOC Belt 21A Tail)	2 Belt Sprays

Just because construction of a coal preparation facility at Kayenta commenced after October 27, 1974 does not necessarily mean the facility is subject to Subpart Y. Rather, that facility must also be one of the types of facilities designated in Subpart Y as "affected facilities," i.e., coal processing and conveying equipment (including breakers and crushers), coal storage systems, and coal transfer and loading systems.[17]

The term "coal processing equipment" is defined to mean "any machinery used to reduce the size of coal or to separate coal from refuse."[18] The Subpart Y definition of the term "conveying equipment" is particularly important. In particular, "coal conveying equipment" is defined to mean "the equipment used to convey to or remove coal and refuse from the [processing] machinery."[19]

By applying those Subpart Y definitions, EPA has concluded that "coal unloading that involves conveying coal to [preparation] plant machinery is regulated under Subpart Y."[20] Thus, for example, loading coal directly into a hopper at a preparation plant is subject to NSPS Subpart Y because that coal is being transferred to a crusher. On the other hand, "if the coal is unloaded for the purpose of storage, then that activity is not an affected facility under NSPS Subpart Y."[21] In

[17] 40 C.F.R. §60.250(b).

[18] 40 C.F.R. §60.251.

[19] *Id.*

[20] 63 Fed. Reg. 53,288 (Oct. 5, 1998).

[21] *Id.* PWCC is also mindful that EPA has defined the term "open storage pile" under Subpart Y to mean "any facility, including storage area that is not enclosed that is used to store coal, <u>including the equipment used in the loading, unloading, and conveying operations of the facility</u>." 40 C.F.R. §60.251 (emphasis added). EPA has a

short, "conveying equipment" that is subject to Subpart Y must be conveying coal to or from processing equipment such as crushers and screens.

Against that background, PWCC has determined that the following Kayenta conveyors with their transfer points are not affected facilities under NSPS Subpart Y:[22]

Table 2
Non-NSPS Conveyors with Transfer Points

Conveyor Number	Not Subject to Subpart Y Because
EOC20	Used to transport coal between areas of Mine
EOC21	Used to transport coal between areas of Mine
EOC22	Used to transport coal between areas of Mine
EOC23	Used to transport coal between areas of Mine
EOC24	Used to transport coal between areas of Mine
EOC25	Used to transport coal between areas of Mine
3	Construction commenced prior to Subpart Y applicability
3A	Construction commenced prior to Subpart Y applicability (also used for pile load-out)
4	Construction commenced prior to Subpart Y applicability (also used for pile load-in)
11	Used for pile load-in
12	Used for pile load-in
15	Used for pile load-in
16	Used for pile load-in
18	Used for pile load-out
27	Construction commenced prior to Subpart Y applicability (also used for pile load-out)
28	Construction commenced prior to Subpart Y applicability
30	Construction commenced prior to Subpart Y applicability
WOC21A	Construction commenced prior to Subpart Y applicability
WOC21	Construction commenced prior to Subpart Y applicability
WOC22	Construction commenced prior to Subpart Y applicability
WOC23	Construction commenced prior to Subpart Y applicability

Thus, a transfer point between two non-NSPS conveyors is not regulated by Subpart Y and its 20% opacity standard. Nevertheless, any emission reduction attributed to some form of wet

longstanding practice of defining the scope of an open storage pile to include equipment needed to support the pile's operation and maintenance.

[22] However, a transfer point consisting of the head of an NSPS conveyor and the tail of a non-NSPS conveyor, or vice versa, is deemed conveying equipment regulated by Subpart Y because that transfer point in question would not exist but for the presence of the conveyor subject to Subpart Y.

suppression at such a transfer point can be used in calculating that transfer point's potential emissions so long as that operational limitation (wet suppression) is legally enforceable and enforceable as a practical matter.

LIMITATIONS ON KAYENTA'S POTENTIAL-TO-EMIT

The concept of potential-to-emit refers to the maximum emissions a source can generate when being operated within the constraints of its design.[23] If PTE is restricted by enforceable limitations, then PTE may be calculated based on those limits, obviating concerns about the initial PTE calculation.[24]

The following types of limits may be utilized to restrict a source's PTE:[25]

- "Emission limits" are restrictions over a given period of time on the amount of a pollutant which may be emitted from a source.
- "Production limits" are restrictions on the amount of final product which can be manufactured or otherwise produced at a source.
- "Operational limits" are all other restrictions on the manner in which a source is run, including hours of operation, amount of raw material consumed, fuel combusted, or conditions which specify that the source must install and maintain add-on controls that operate at a specified emission rate or efficiency.

A permit which restricts PTE must contain, at a minimum, either a production or operational limitation in addition to the emission limitation in cases where the emission limitation does not reflect the maximum emissions of the source operating at full design capacity without pollution control equipment.[26]

To that end, this Section identifies and explains those specific limitations which PWCC proposes for Kayenta's coal preparation plant in order to restrict its PTE to minor source status under the federal programs for PSD and Title V. Those specific limitations will be applied by appropriate conditions within the PWCC-requested synthetic minor source permit. A subsequent section of this document explains how additional permit conditions are required to assure that those limitations restricting Kayenta's PTE are enforceable.

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[23] *U.S. v. Louisiana-Pacific Corp.*, 682 F. Supp. 1141, 1157 (D. Colo. 1988).

[24] *Hu Honua Order* at 13.

[25] EPA OAQPS, "Limiting Potential to Emit in New Source Permitting," 5 (June 13, 1989).

[26] *Id.* at 5-6.

Production Limitation

PWCC proposes that annual production of Kayenta's coal preparation plant be limited to a maximum not to exceed 8.9 million (MM) tons of coal per year.

Kayenta's PTE is calculated as the sum of the PTEs of all coal preparation facilities at that stationary source. Therefore, in order to compute each preparation facility's PTE, that facility's maximum operating capacity which corresponds to the plant's production limit must first be determined.

Maximum Design Capacities

Each stationary, particulate-emitting facility within Kayenta's coal preparation plant is identified in Table 3 along with the corresponding design capacity for that facility. When looking at the design configuration of the plant's process flow from beginning to end in conjunction with the individual design capacities of its different preparation facilities, the following explains how the design capacity of each of the major groupings of emission units listed in Table 3 must be 1,800 tph..[27]

(1) The maximum design capacities of Area N-11, of the East Overland Conveyor, of the West Overland Conveyor and of the Storage Silos must each be 1,800 tph because every preparation facility within each of their process flows has a maximum design capacity of 1,800 tph. However, identifying the maximum design capacities of Areas J-28 and N-8 is slightly more complicated due to the presence of key bottlenecks designed within those Areas.

(2) The last preparation facility in Area J-28's process flow is Transfer Point 10 (TP10), where prepared coal flows onto the East Overland Conveyor. The maximum design capacity of TP10 (and its associated belt conveyor) is 1,800 tph. Because all coal flowing through Area J-28 must pass through TP10, the maximum design capacity of TP10 fixes the maximum design capacity of Area J-28 at 1,800 tph.

[27] The group of coal sampling systems is not regarded as a major grouping of Kayenta's preparation facilities.

Table 3
Facilities' Design and Maximum Operating Capacities

Unit ID	Unit Description	Design Capacity, tons/hr*	Maximum Operating Capacity (C_i), tons/yr**
Area J-28 Emission Units			
J28H5	Hopper 5	2,600	5,582.215
TP1	TP from Hopper 5 to Belt 1-N	2,600	2,791,108
TP2	TP from Hopper 5 to Belt 1-S	2,600	2,791,108
TP3	TP from Hopper 6 to Belt 8	2,600	495,696
J28PC	Primary Crusher – Controlled (2 crushers)	2,600 each	6,077,911
TP4	TP from Belt 2 to Screen	2,600	6,077,911
J28S	Screen – Controlled	2,600	6,077,911
J28PC2	Primary Crusher – Controlled	500	303,896
TP5	TP from Screen/Crusher to Belt 5	2,600	1,047,722
TP6	TP from Screen/Crusher to Belt 6	2,600	5,030,190
TP7	TP from Belt 6 to Elevated Feeder	2,600	5,030,190
TP8	TP from Elevated Feeder to Dome Stockpile	2,600	5,030,190
J28DS	Dome Stockpile Wind Erosion	NA	NA
TP9	TP from Dome Stockpile Reclaim to Belt 5	2,600	5,030,190
TP10	TP from Belt 5 to EOC Belt 20	1,800	6,077,911
East Overland Conveyor (EOC) Emission Units			
TP11	TP from EOC Belt 20 to EOC Belt 21	1,800	6,077,911
TP12	TP from EOC Belt 21 to EOC Belt 22	1,800	6,077,911
TP13	TP from EOC Belt 22 to EOC Belt 23	1,800	6,077,911
TP14	TP from EOC Belt 23 to EOC Belt 24	1,800	6,077,911
TP15	TP from EOC Belt 24 to EOC Belt 25	1,800	6,077,911
Area N-11 Emission Units			
N11H4	Hopper 4	1,800	2,822,089
TP16	TP from Hopper 4 to Belt 34	1,800	2,822,089
N11PC	Primary Crusher – Controlled	1,800	2,822,089
TP17	TP from Belt 35 to Screen	1,800	2,822,089
N11S	Screen – Controlled	1,800	2,822,089
TP18	TP from Screen to Belt 36	1,800	2,822,089
TP19	TP from Belt 36 to EOC Belt 25	1,800	2,822,089
Area N-8 Emission Units			
TP20	TP from EOC Belt 25 to Belt 3	2,600	5,970,886
TP21	TP from Belt 3 to Belt 28	1,800	3,560,000
TP22	TP from Belt 3 to Belt 4	2,600	3,293,000
TP23	TP from Belt 4 to K1 Stockpile	2,600	3,293,000
K1D	Dozer on K1 Stockpile	NA	NA

K1WE	K1 Stockpile Wind Erosion	NA	NA
TP24	TP from Hopper 1 Slot Conveyor to Belt 27	1,800	3,293,000
TP25	TP from EOC Belt 25 to Belt 11	1,800	890,000
TP26	TP from Belt 11 to Belt 12	1,800	890,000
TP27	TP from Belt 12 to K2 Stockpile	1,800	890,000
K2D	Dozer on K2 Stockpile	NA	NA
K2WE	K2 Stockpile Wind Erosion	NA	NA
TP28	TP from Hopper 2 North to Belt 3A	2,600	445,000
TP29	TP from Hopper 2 South to Belt 3A	2,600	445,000
TP30	TP from Belt 3A to Belt 3	2,600	890,000
TP31	TP from EOC Belt 25 to Belt 14	2,600	2,047,000
TP32	TP from Belt 14 to Belt 15	2,600	2,047,000
TP33	TP from Belt 15 to Belt 16	2,600	2,047,000
TP34	TP from Belt 16 to K3 Stockpile	2,600	2,047,000
K3D	Dozer on K3 Stockpile	NA	NA
K3WE	K3 Stockpile Wind Erosion	NA	NA
TP35	TP from Hopper 3 to Belt 18	2,600	2,047,000
TP36	TP from Belt 18 to Belt 28	2,600	2,047,000
TP37	TP from Belt 27 to Belt 31	1,800	3,293,000
TP38	TP from Belt 28 to Belt 31	1,800	5,607,000
TP39	TP from Belt 31 to Screen	1,800	8,900,000
N8S	Screen – Controlled (2 screens)	1,800 each	8,900,000
N8PC	Primary Crusher – Controlled (2 crushers)	600 each	89,000
TP40	TP from Screen/Crusher to Belt 33	1,800	8,900,000
TP41	TP from Belt 33 to Belt 30	1,800	8,900.000
TP42	TP from Belt 30 to WOC Belt 21A	1,800	8,900,000
West Overland Conveyor (WOC) Emission Units			
TP43	TP from WOC Belt 21A to WOC Belt 21	1,800	8,900,000
TP44	TP from WOC Belt 21 to WOC Belt 22	1,800	8,900,000
TP45	TP from WOC Belt 22 to WOC Belt 23	1,800	8,900,000
Silo Emission Units			
TP46	TP from WOC Belt 23 to Silo Storage	1,800	8,900,000
TP47	Rail Loadout 1 from Silos	1,800	4,450,000
TP48	Rail Loadout 2 from Silos	1,800	4,450,000

* Transfer points at the feed and discharge ends of covered conveyor belts are the potentially significant sources of emissions from Kayenta's conveying equipment. Consequently, conveyors per se have not been identified as discrete emission units.

** When coal preparation plant is subject to production limit of 8,900,000 tpy

Importantly, that 1,800 tph maximum design capacity of TP10 restricts the maximum process flow of any upstream preparation facility having a design capacity greater than 1,800 tph. Thus, for example, Area J-28's primary crushing can never attain its maximum design capacity of 5,200 tph because the downstream TP10 cannot transfer more than 1,800 tph.

(3) A similar situation exists at Area N-8. The last preparation facility in Area N-8's process flow is TP42, where all of N-8's processed coal is transferred onto the West Overland Conveyor. Because all of Area N-8's process flow must pass through TP42, the maximum design capacity of Area N-8 can be no greater than the maximum design capacity of TP42, i.e., 1,800 tph.

Maximum Operating Capacities for PTE Calculations

Potential-to-emit does not refer to the maximum emissions that can be generated by a source hypothesizing the worst conceivable operation. Rather, the concept contemplates the maximum emissions that can be generated while operating the source as it is intended to be operated and as it is normally operated.[28]

(1) For three of the major groupings of coal preparation facilities. i.e., EOC, WOC and Silos, its maximum design capacity and its maximum operating capacity are one and the same. Furthermore, in light of the preparation plant's process design, the maximum operating capacity of each of those groupings must be the same as the plant's maximum production. Consequently, when production of Kayenta's preparation plant is limited to 8,900,000 tpy (as proposed), the maximum operating capacity of each of the above groupings must also be 8,900,000 tpy. Table 3 lists the maximum operating capacity for each preparation facility included within EOC, WOC and Silos.

(2) As noted above, all of Kayenta's process flow goes through transfer point TP42 at the end of Area N-8. Consequently, Kayenta's proposed production limit of 8,900,000 tpy constitutes the maximum operating capacity for TP42 and, thus, for Area N-8.

Upstream of transfer point TP42, four separate sets of preparation facilities operate in parallel paths in the process flow, i.e., three separate storage-and-conveying operations and one conveying operation with storage bypass. Transfer point TP42 restricts or "bottlenecks" the

[28] *U.S. v. Louisiana-Pacific* at 1158 (citing "broad holding" of *Alabama Power Co. v. Costle*, 636 F.2d 323 (D.C.Cir.1979)).

combined flow from those four parallel operations such that their maximum combined operating capacity must also be 8,900,000 tpy.

Process flows through three of the four parallel operations upstream of TP42 are measured. In particular, process flow through the Pile K-1 interim storage circuit is measured using the N-8 Ready Reclaim Scale (Scale 27) located on Conveyor Belt 27. Process flow through the Pile K-2 interim storage circuit is measured using the N-8 High-Sulfur Reclaim Scale (Scale 3A) located on Conveyor Belt 3A. Process flow through the Pile K-3 interim storage circuit is measured using the N-8 High-Ash Reclaim Scale (Scale 18) located on Conveyor Belt 18. The remaining process flow that bypasses any interim pile storage is calculated as the difference between the total process flow through Area N-8 and the sum of the individual process flows through the three interim storage circuits.

Relying on historical measurements of coal flows through those three interim storage circuits, plant personnel estimate that normal plant production may be represented by average annual coal flows through N-8's four parallel operations with the following distribution:[29]

- 37% of total N-8 flow is typically loaded in and out of Pile K-1;
- 10% of total N-8 flow is typically loaded in and out of Pile K-2;
- 23% of total N-8 flow is typically loaded in and out of Pile K-3; and
- 30% of total N-8 flow typically by-passes interim storage.

Accordingly, the maximum operating capacity of each of N-8's four parallel operations upstream of TP42 can be calculated as the product of Area N-8's maximum operating capacity (8,900,000 tpy) and the appropriate fraction listed above for the operation in question. For example, the maximum operating capacity of the parallel operation within Area N-8 that bypasses interim storage is 2,670,000 tpy [8,900,000 tpy x 0.30].[30]

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[29] As noted earlier, the concept of PTE "contemplates the maximum emissions that can be generated while operating the source as it is intended to be operated and as it is normally operated." *Louisiana-Pacific* at 1158.

[30] The Company emphasizes that the above-listed distribution of total process flow (8.9MM tpy) is intended to represent normal operations at Area N-8 on an annual basis. For any given year, however, flow distribution can vary considerably based on the qualities of processed coal being supplied by Areas J-28 and N-11 and on the availabilities of preparation facilities within each Area. Consequently, annual limits cannot be imposed on the maximum operating capacity of each of the four parallel operations in Area N-8 because Kayenta requires operational flexibility to adjust those process flow ratios as necessary to meet customer specifications. The fact remains that a combined maximum of 8,900,000 tons of coal will flow through those four parallel operations on an

(3) In keeping with Kayenta's process design, the maximum operating capacities of Areas J-28 and N-11 combined can be no greater than the plant's proposed production limit, i.e., 8,900,000 tpy. Historical measurements from scales located at the ends of the process flows of Areas J-28 and N-11 demonstrate that, on average, 68.3% of those two Areas' combined annual output is produced by Area J-28, while the remaining 31.7% is produced by Area N-11.[31]

Accordingly, the maximum operating capacity of each of those two Areas can be calculated as the product of their maximum combined operating capacity and the aforementioned production fraction for the Area in question. For example, the maximum operating capacity of Area J-28 is 6,077,911 tpy [8,900,000 tpy x 0.683][32].

In sum, when calculating the potential to emit for a particular coal preparation facility at Kayenta, that facility's maximum operating capacity is an essential input to that calculation. Table 3 lists the maximum operating capacity used in calculating the corresponding facility's PTE.

Operational Limitations

The Company proposes that the requested synthetic minor source permit also contain two types of operational limits as additional means for restricting Kayenta's PTE. In particular, the permit would require the specific form of wet suppression currently applied to each coal preparation facility to be operated and maintained whenever that facility is operating in order to assure continuous particulate emission reductions at the level of efficiency specified herein. In

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annual basis, and the above-listed distribution of those 8,900,000 tpy is a reasonable approach to calculating the PTE for each of those operations. It must also be recognized (as discussed later) that demonstrations of compliance with the source-wide PTE limits for PM, PM_{10} and $PM_{2.5}$ will be based on, among other parameters, periodic monitoring of actual flow rates through the parallel operations.

[31] *See*, n.28. Potential-to-emit does not refer to the maximum emissions that can be generated by a source hypothesizing the worst conceivable operation.

[32] Similar to the situation with the four parallel operations, the Company emphasizes that the quoted distribution of production rates between Area J-28 and Area N-11 is representative of their *average* annual operation. For any given year, however, actual flow distribution between Areas J-28 and N-11 can vary based not only on the qualities of coal being processed by each Area but also on the availability of the facilities within each Area. Consequently, annual limits cannot be imposed on the maximum operating capacity of either Area J-28 or Area N-11 because Kayenta requires operational flexibility to operate either of those Areas at rates up to 1,800 tph for an undefined period of time, *provided* that the plant production limit (or the maximum combined operating capacity of Areas J-28 and N-11) of 8,900,000 tpy is not exceeded. It must also be recognized (as discussed later) that demonstrations of compliance with the source-wide PTE limits for PM, PM_{10} and $PM_{2.5}$ will be based on, among other parameters, periodic monitoring of coal flow rates from both Area J-28 and Area N-11.

addition, the permit would acknowledge that a particular type of inherent process design feature, i.e., enclosure of certain particulate-emitting equipment, is installed as an integral component of several coal preparation facilities at Kayenta. Consequently, the collateral emission reductions achieved by such an enclosure are not only included in the calculation of potential-to-emit for such facilities but also when estimating those facilities' actual emissions in a demonstration of compliance with an applicable emission limitation.

Wet Suppression

Coal processing equipment fractures pieces of coal, thereby generating dust. That fracturing results in new dry surfaces on the coal which also create dust during processing. Conveying and handling equipment do not normally fracture the coal. Nevertheless, those types of equipment can also emit dust if surfaces of the coal are too dry.[33]

During development of the NSPS for coal preparation plants, EPA recognized that "water sprays have been demonstrated to be very effective for suppressing fugitive emissions and can be used to control even the most difficult fugitive emission problem."[34] A wet suppression system consists of a number of strategically placed liquid sprays designed to keep coal moist throughout the preparation process. The formation of dust is effectively suppressed by sprays designed to minimize the presence of dry surfaces in the coal being processed. Furthermore, moisture added to the coal causes smaller coal dust particles to adhere to larger pieces of coal to the point that agglomerated particles become too heavy to be airborne.[35]

Basic design principles for achieving effective "control" with wet suppression typically provide for one or more sprays to be installed at each point in the coal preparation process where coal particles might be (1) fractured, (2) allowed to free fall, or (3) subjected to strong air currents.[36]

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[33] EPA, *Nonmetallic Mineral Processing Plants – Background Information for Proposed Standards,* EPA-450/3-83-001a, 4-6 (Apr. 1983).

[34] 41 Fed. Reg. at 2233.

[35] *Id.* at 4-4.

[36] EPA, *Control Techniques for Particulate Emissions from Stationary Sources – Volume 1,* EPA-450/3-81-005a, 5-14 (Sept. 1982).

In order to allow sufficient time for the proper distribution of that added moisture, sprays normally begin as soon as possible after the raw coal is introduced into the processing plant.[37]

Because of its high surface tension, water alone is not a particularly effective wetting agent. Furthermore, coal wetted only with water may dry in a short period of time. In order to overcome inadequate, short-lived wetting typical of a water-only spray system, small amounts of a specially formulated surfactant are blended with water to reduce its surface tension before it is sprayed. Addition of that surfactant significantly improves the wetting efficiency of the water. Consequently, a minimum of added water is sufficient to suppress dust formation.[38]

Not only do such wetting agents provide better wetting of small particles, but they also often result in longer retention of the moisture film.[39] For that reason, material wetted directly by sprays of water-with-surfactant typically exhibits some carry-over dust control effect that will last through a number of downstream material handling stages.[40]

During EPA's original formulation of NSPS Subpart Y for coal preparation plants, the Agency identified water sprays as a "very effective" means of suppressing fugitive particulate emissions from coal preparation facilities.[41] Importantly, EPA also explained at that time that "the control of fugitive emissions at all [coal preparation] facilities <u>will be required</u> since there are several control techniques that can be applied[.]"[42] Region IX has previously acknowledged that wet suppression is used at Kayenta's preparation plant in order to comply with Subpart Y's opacity standard for particulate matter, now codified at 40 C.F.R. §60.254(a).[43]

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[37] EPA, *Air Pollution Control Techniques for Non-Metallic Minerals Industry*, EPA-450/3-82-014, 3-9 (Aug. 1982).

[38] *Id.* at 3-8 (Aug. 1982).

[39] EPA, *Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions*, EPA-450/3-77-010, 2-251 (Mar. 1977).

[40] EPA, *Control Techniques for Particulate Emissions from Stationary Sources – Volume 2*, EPA-450/3-81-005b, 9.7-10 (Sept. 1982); EPA, *Nonmetallic Mineral Processing Plants – Background Information for Proposed Standards*, EPA-450/3-83-001a, 4-6 (Apr. 1983).

[41] 41 Fed. Reg. 2232, 2233 (Jan. 15, 1976).

[42] *Id.* (emphasis added).

[43] EPA Region IX, "Title V Permit to Operate No. NN-OP 99-07: Response to Comments," 6 (Sept. 23, 2003) ("Since Peabody uses sprayers to comply with an opacity limit in an NSPS . . .").

The specific control strategy applied to fugitive particulate emissions from Kayenta's coal preparation facilities consists of a comprehensive system of wet suppression whose broad scope begins where wet raw coal is unloaded into hoppers at Areas J-28 and N-11 and ends where product coal is transferred from the West Overland Conveyor to the storage silos. That overall control system relies upon the following four different forms of wet suppression: (1) sprays of water-with-surfactant; (2) residual (carryover) water-with-surfactant; (3) sprays of water; and (4) residual water.

Kayenta's process flow diagram (Figure 1) shows that multiple spray nozzles applying water-with-surfactant are installed at numerous locations throughout the preparation plant. Those particular sprays are strategically placed at several points in and around preparation operations having the potential for generating high levels of fugitive particulate emissions, e.g., hoppers, crushers and screens.

Importantly, however, sprays of water-with-surfactant are also installed at other locations along the process flow. This element of Kayenta's control strategy ensures effective suppression of fugitive emissions from other "less-emitting' facilities by maintaining elevated coal moisture contents throughout the plant. In fact, the use of water <u>without</u> surfactant – either as a spray or as a residual - is not used with any processing equipment and is only utilized at 2 of the 48 transfer points within the plant.

Listed below in Table 4 is each of the four forms of wet suppression employed at Kayenta along with the specific preparation facilities at the plant that are equipped with that particular form of wet suppression. As documented fully within Appendix A, PWCC conducted an extensive review of EPA-published information regarding wet suppression technology and estimated control efficiencies achieved by different forms of wet suppression when applied to the types of facilities typically found at coal preparation plants and other nonmetallic mineral processing plants. Based on those findings from its technical literature review, Table 4 also identifies the Company's estimate of the "control efficiency" achieved by each form of wet suppression at Kayenta.

Table 4
Forms of Wet Suppression and Estimated Control Efficiencies

***(1)* Water-with-surfactant Sprays**

Estimated Control Efficiency	Facilities Applied To
91.5%[44]	Screens J28S, N11S
90%	Transfer Points TP1, TP2, TP3, TP4, TP6, TP8, TP9, TP10, TP16, TP17, TP18, TP19, TP20, TP37, TP38, TP41
77.5%[45]	Crushers J28PC, N11PC
70%	Hoppers J28H5, N11H4

***(2)* Water-with-surfactant Residual**

Estimated Control Efficiency	Facilities Applied To
91.5%[46]	Screens N8S
85%	Transfer Points TP5, TP7, TP39, TP40
77.5%[47]	Crushers J28PC2, N8PC

***(3)* Water-only Sprays**

Estimated Control Efficiency	Facilities Applied To
70%	Transfer Point TP35

***(4)* Water-only Residual**

Estimated Control Efficiency	Facilities Applied To
65%	Transfer Point TP36

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[44] Incorporated in the AP-42 "controlled" emission factor for this type of facility. Percentage reduction computed from AP-42 emission factors for "controlled" and "uncontrolled." The term "AP-42" is the abbreviated citation to EPA's longstanding document entitled *Compilation of Air Pollutant Emission Factors; Volume I – Stationary Point and Area Sources*. The current version of that document was published as the 5th edition in January 1995. Thereafter, individual subsections within the document have been periodically updated. Throughout PWCC's narrative herein, reference simply to "AP-42" is understood to mean the current 5th edition with its updates. Any reference to an earlier version of AP-42 includes its specific edition and the date published.

[45] *Id.*

[46] *Id.*

[47] *Id.*

In sum, when calculating the potential to emit for a particular coal preparation facility at Kayenta, an essential input to that calculation is the particulate control efficiency achieved by the particular form of wet suppression applied to that facility. Accordingly, the preceding Table 4 identifies the particular form of wet suppression applied to each such facility and the corresponding particulate control efficiency used in calculating that facility's PTE.

Inherent Process Design Features

When evaluating a source's maximum design capacity for determining its potential-to-emit, realistic assumptions which recognize inherent physical, operational and other restrictions need to be made.[48] "Such constraints should accurately reflect the true upper boundary of the source's ability to physically operate and the applicant should submit documentation to verify these constraints,"[49]

Over forty years ago EPA recognized that coal preparation facilities are typically enclosed by covering or sealing the process from the atmosphere so that any avenues for escaping emissions are small. As the Agency acknowledged, "[b]y minimizing the number and dimensions of the opening through which fugitive emissions can escape, the opacity and total mass rate of emissions can be reduced independently of the air pollution control devices."[50]

The designs of most preparation facilities at Kayenta include enclosures around individual facilities for the primary purpose of minimizing accumulations of coal dust in the workplace that would otherwise threaten workers' health and safety. In addition, the designs for several preparation facilities at Kayenta enclose those facilities underground in order for coal flows at those locations to utilize the force of gravity.

The following Table 5 identifies (1) the types of preparation facilities at Kayenta whose designs incorporate either an enclosure or a "chute"[51], (2) the estimated "control efficiency" realized by

[48] EPA, "Response to Issues Raised by Industry on Clean Air Act Implementation Reform," 46 (May 30, 1995).

[49] EPA, *New Source Review Workshop Manual (Draft)*, B-37 (Oct. 1990).

[50] 41 Fed. Reg. 2232, 2233 (Jan. 15, 1976) (emphasis added).

[51] A chute is typically employed with a belt-to-belt transfer where the head of the first belt is not at the same elevation as the lower tail of the second belt. The full enclosure (similar to ductwork) prevents fugitive particulate emissions that would otherwise occur with coal particles free-falling through ambient air and impacting a flat surface below. See, e.g., Figure 4.

covering each type of facility, and (3) specific, but not all, preparation facilities at Kayenta which are enclosed.[52]

Table 5
Inherent Process Design Features and Estimated Control Efficiencies

Type of Covered Facility	Estimated Control Efficiency	Facilities Affected[53]
Transfer Point: Hopper Bottom to Conveyor Belt	99% (underground enclosure)	TP1, TP2, TP3, TP9, TP16, TP24, TP28, TP29, TP35
Transfer Point: Elevated Feeder to Dome Stockpile	99% (full enclosure)	TP8
Wind Erosion: Dome Stockpile	100% (full enclosure)	J28DS

The Company has relied on its engineering judgment to estimate the above levels of control efficiency after reviewing how the subject enclosures surround or cover the associated facilities, effectively sealing them from the atmosphere. In the absence of both mechanical ventilation and ambient winds, process coal flowing through such enclosures does not typically encounter any disturbance sufficient to generate fugitive dust and then force it through any small opening on or around the enclosure. The high levels of control attributed to the above enclosures are supported by the fact that visible emissions from Kayenta's enclosed facilities are seldom, if ever, observed.

EPA has long held that emission reductions resulting from an inherent process design or operational feature of a pollutant-emitting facility are included in the calculation of that facility's potential-to-emit.[54] However, because an inherent process design feature is an integral,

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[52] Because enclosures of crushing and screening operations at coal preparation plants are standard design features for such facilities, the emission-reduction effects of those enclosures are incorporated within the respective emission factors selected to estimate particulate emission rates from those types of facilities at Kayenta. EPA's comment makes clear, however, that such enclosures are not regarded as air pollution control equipment but rather as inherent process design features that also happen to reduce particulate emissions.

[53] For the purpose of this document, additional emission reductions attributable to other enclosures or chutes surrounding numerous belt-to-belt transfers in the plant have not been quantified and included in the potential-to-emit calculations.

[54] *See, e.g.,* memorandum from John Seitz, EPA OAQPS, and Robert Van Heuvelen, EPA ORE, 8 (Jan. 25, 1995) ("Options for Limiting the Potential to Emit (PTE) of a Stationary Source Under Section 112 and Title V of the Clean Air Act (Act)") (hereinafter "Seitz/van Heuvelen Memo").

permanent component of that facility, EPA believes that an enforceable limitation requiring continuous use of that design feature is not essential. Or, as EPA has opined, "[a]lthough . . . source owners could in most cases readily accept enforceable limitations restricting the operation to its designed level, EPA believes this administrative requirement for such sources to be unnecessary and burdensome."[55]

Against that background, the Company proposes that the requested synthetic minor source permit include a condition which acknowledges that each enclosure listed above in Table 5 operates as an integral part of the designated preparation facility and realizes the stated level of continuous emission-reduction efficiency.

Emission Limitations

A synthetic minor source permit issued under the federal Minor NSR Program in Indian Country must include (1) limits on annual allowable emissions, in tpy, for those air pollutants that would otherwise exceed a major source threshold, and (2) emissions limitations for each emissions unit at the source that emits those pollutants.[56] The term "emissions limitation" is defined at 40 C.F.R. §49.152 to mean "a requirement established by the reviewing authority that limits the quantity, rate or concentration of emissions of air pollutants on a continuous basis, including any requirement relating to the operation or maintenance of a source to assure continuous emissions reduction and any design standard, equipment standard, work practice, operational standard or pollution prevention technique."

In Kayenta's case, PWCC seeks a synthetic minor source permit that restricts the coal preparation plant's potential-to-emit PM to less than 250 tpy. With that same permit, PWCC also seeks to restrict the coal preparation plant's potential-to-emit PM_{10} and its potential-to-emit $PM_{2.5}$ each to less than 100 tpy.

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[55] Memorandum from John Seitz, EPA OAQPS, to EPA Regional Air Directors of Sept. 6, 1995 ("Calculating Potential to Emit (PTE) for Emergency Generators") (*citing* Seitz/van Heuvelen Memo).

[56] 76 Fed. Reg. 38748, 38761 (July 1, 2011).

To restrict a stationary source's PTE effectively to less than the relevant major stationary source threshold, a permit's emission limitations must apply at all times to all actual emissions[.][57] The Company has explained that the scope of Kayenta's PTE determination only includes fugitive emissions from Kayenta's preparation plant. The Company has further explained that the scope of fugitive particulate emissions from Kayenta's coal preparation plant includes only such emissions from each of Kayenta's coal preparation facilities. Emission limitations set out below to restrict Kayenta's potential to emit particulate matter apply to fugitive particulate emissions from each of Kayenta's preparation facilities. Accordingly, those limitations identified below will apply to all actual particulate emissions which contribute to Kayenta's potential to emit particulate matter.

Kayenta's preparation facilities emit fugitive particulate matter during startups and shutdowns of those facilities as well as during their normal operations.[58] The Company has explained that the rates of fugitive particulate emissions from those facilities during startup and shutdown do not change materially from the rates of those emissions during normal operations of those facilities. Therefore, the emission limitations identified below to restrict Kayenta's potential to emit particulate matter apply at all times that those facilities emit particulate matter.

The federal Minor NSR Rule for Indian Country prescribes that "[t]he following procedures are generally acceptable for estimating emissions from air pollution sources:

(i) Source-specific emission tests;
(ii) Mass balance calculations;
(ii) Published, verifiable emission factors that are applicable to the source;
(iv) Other engineering calculations or
(v) Other procedures to estimate emissions specifically approved by the reviewing authority."[59]

[57] *Hu Honua Order* at 10-11; *In the Matter of Cash Creek Generation, LLC,* Order on Petition No. IV-2010-4 at 15 (June 22, 2012) ("*Cash Creek Order*"); *In the Matter of Kentucky Syngas,* Order on Petition No. IV-2010-9 at 29-30 (June 22, 2012) ("*Kentucky Syngas Order*").

[58] As previously explained, a malfunction in a preparation facility results in automatic shutdown of that facility and all others operating in conjunction with it.

[59] 49 C.F.R. §49.158(a).

As detailed in Appendix B, PWCC has provided an in-depth explanation for why the use of appropriate emission equations, or in some cases single-value emission factors, is the only technically feasible methodology that is available for quantifying Kayenta's fugitive particulate emissions. Since fugitive particulate emissions, by definition, do not emit through stacks, vents, or other functionally equivalent openings, as an engineering matter, no structure is available at any of Kayenta's preparation facilities to allow for a stack test or other direct measurement technique of those facilities' fugitive particulate emissions.[60] The need to estimate a mass emission rate of fugitive particulate matter is a primary reason why EPA has consistently stated that "[w]here data are lacking and other preferred approaches are not available, emissions factors may be used to estimate emissions in permitting and other applications."[61]

Because PSD threshold applicability determinations for coal mines require fugitive particulate emissions from collocated preparation plants to be quantified, EPA's well-settled guidance provides a list of references containing emission factors acceptable for use in those PTE calculations.[62] To that end, EPA Region IX has previously allowed the use of emission factors to calculate mass emission rates of fugitive particulate matter from coal preparation facilities when determining their respective PTEs.[63]

Nevertheless, the Company remains mindful of EPA's caution that "[b]efore using an emission factor compiled in AP-42, EPA advises users to exercise professional judgment to verify that a particular emission factor is sufficiently representative of emissions from the particular activity or source to which it is to be applied."[64] In that regard, the following discussion details the considerations and rationale which informed PWCC's engineering judgment during its selection

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[60] *In the Matter of Consolidated Environmental Management, Inc. – Nucor Steel Louisiana*, Order on Petition Nos. VI-2010-05, VI-2011-06 and VI-2012-07 at 54 (Jan. 30, 2014) ("*Nucor Steel Order*").

[61] *Cash Creek Order* at 25 (*citing* AP-42, Introduction at 1-2).

[62] EPA, *New Source Review Workshop Manual (Draft),* A.16-17 (Oct. 1990).

[63] *See, e.g.,* Navajo Nation EPA (NNEPA), "Part 71 Federal Operating Permit Draft Statement of Basis," Permit No. NN-OP-15-06 (Navajo Generating Station), Appendix A: Emission Calculations – PM, PM10 and PM2.5 from Coal Handling Operations (Sept. 4, 2015); NNEPA, "Part 71 Federal Operating Permit Revised Statement of Basis," Permit No. NN-OP-08-010-A (PWCC Black Mesa Complex), Appendix A (Nov. 4, 2009); EPA Region IX, "Part 71 Federal Operating Permit Statement of Basis," Permit No. NN-OP 99-07 (PWCC Black Mesa Complex), 5-7 (Sept. 23. 2003).

[64] *Cash Creek Order* at 5.

of the specific emission equation or factor to be applied to each preparation facility at Kayenta.[65] The resulting emission limitations on PM and PM_{10} from each preparation facility at Kayenta are shown in Table 6 at the end of this section.

Crushing

Preparation Areas J-28 and N-11 receive raw coal directly from Kayenta's mining operations. Area J-28 is equipped with two double-roll, primary crushers to process raw coal. Crushed coal at J-28 is then passed through one double-deck vibrating screen. Furthermore, Area N-11 is equipped with one double-roll, primary crusher to process raw coal. Crushed coal at N-11 is then passed through one single-deck vibrating screen.

In addition, single-roll crushers at Areas J-28 and N-8 receive rejects from the vibrating screens at those respective locations. In the past, PWCC had generally referred to those other crushers as "secondary crushers," i.e., ones that further reduce the size of coal originally processed by primary crushers. However, characterization of those particular crushers as "secondary crushers" misrepresents the true nature of their operation because they do not cause any further size reduction beyond that performed by the initial primary crushers.

Crushing is the process by which coarse material is reduced by mechanical energy and attrition to a desired size for mechanical separation (screening).[66] However, roll crushers, such as those used at Kayenta Mine Complex, produce no oversize.[67] Consequently, screens downstream of Kayenta's primary crushers are not needed to separate crushed coal into multiple sizes. Rather, because of the stringent size specification for Kayenta's product coal, screens are employed to minimize the risk of any oversized coal being shipped with that product.

"Rejects" from the vibrating screens at J-28 and N-8 consist mainly of crushed product coal that subsequently failed to pass through the screens within the time allotted by the process design of those screens.

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[65] The Company's substantive reasons for *rejecting* the use of other candidate emission equations/factors to quantify fugitive particulate emissions from Kayenta's preparation facilities are provided in Appendix C.

[66] EPA, *Nonmetallic Mineral Processing Plants – Background Information for Proposed Standards,* EPA-450/3-83-001a, 3-23 (Apr. 1983).

[67] *Id.* at 3-30.

> [T]he particles on the screening surface are crowded and continually interfering with each other at the [screen] openings; they are presented at high speed, nearly parallel to the screen surface with their most projected cross section in line with the center of the openings. As a direct result, many of the undersized particles are prevented for a considerable time from passing through the openings either due to their speed of travel or their angle of attack, and many, in fact, are rejected entirely as oversized.[68]

The amounts of those overflows of product coal from Kayenta's screens are small in comparison to the total coal throughput to the preparation facilities. For example, the amount of coal-product overflow from the N-11 screen is so very small as to be negligible. In addition, the Company estimates that no more than 5% of the total throughput to the J-28 screens and no more than 1% of the total throughput to the N-8 screens fail to pass through their respective screens.

Given the rather remote, but real, possibility that some coal could escape complete size-reduction during the initial crushing operation, the screen overflows of product coal at J-28 and N-8 (which would contain any such oversize) drop into single-roll crushers as a final means of insuring that any oversized pieces of coal do not find their way into Kayenta's product. Product coal in the screen overflow will simply pass through the crusher downstream of the screen with no further size reduction. Any small amount of oversize contained in the screen overflow will be crushed to the level intended to be realized by the initial crushing.[69]

With double-roll crushers, lumps of coal are caught between the rolls and crushed primarily by compression forces. Similarly, with single-roll crushers, coal particles are caught between the roll and a crushing plate and again crushed primarily by compression. Because crushing fractures the coal particles and creates new, dry surfaces, the generation of particulate emissions is inherent in the crushing process. Nevertheless, because roll crushers rely almost totally on compression forces, those types of crushers do not produce many small-sized particles, i.e., fines.

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[68] Nunenkamp, David C. (for EPA), *Coal Preparation Environmental Engineering Manual*, EPA-600/2-76-138, 99 (May 1976).

[69] For that reason, the single-roll crushers are no longer identified as secondary crushers. The single-roll crusher at Area J-28, formerly identified as J28SC, is now identified as Emission Unit J28PC2. Likewise, the single-roll crushers operating in parallel at Area N-8 are now collectively identified as Emission Unit N8PC.

Kayenta's crushers are equipped with an operational design feature that is commonplace throughout the industry. Enclosing the crushing apparatus effectively seals that process from the atmosphere except for openings where coal is fed to and discharged from that processing equipment.[70,71] Consequently, particulate emissions from an enclosed coal crusher typically consist only of fugitive emissions escaping from those few openings.[72] While those enclosures are designed primarily to provide worker protection from health and safety risks posed by accumulation of coal dust in the air and on all surfaces around the work areas, such enclosures also provide the collateral benefit of reducing the quantity of fugitive particulate matter that would otherwise be emitted from the crushing process into the atmosphere.

WebFIRE[73] and FIRE Version 5.0[74] are EPA's only primary sources of emission factors which expressly provide fugitive particulate emission factors for coal crushing. Moreover, because most of EPA's studies that characterize fugitive particulate emissions from processing of coal and other aggregate materials have their origins in the late-1970s and early-1980s, those emissions are often estimated only on the basis of PM or TSP, i.e., without corresponding estimates for PM_{10} or $PM_{2.5}$ emissions.

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[70] See, e.g., 41 Fed. Reg. 2232, 2233 (Jan. 15, 1976) ("By minimizing the number and dimensions of the openings through which fugitive emissions can escape, the opacity and total mass rate of emissions can be reduced independently of the air pollution control devices.").

[71] From a purely technical point of view, those activities "where coal is fed to and discharged from" a crusher consist of what are commonly referred to as "transfer points," where the material in question is typically transferred under the force of gravity from one surface to another surface. However, because those activities generally result in the only particulate emissions that can be attributed to the enclosed crusher, it has been a longstanding practice to regard emissions from those particular transfer points as crusher emissions. *See, e.g.*, EPA, *Engineering Reference Manual for Coding NEDS and EIS/P&R Forms, Vol. III: Compendia of Processes*, EPA-450/4-80-007B, 8.9-6 (Apr. 1980).

[72] EPA, *Engineering Reference Manual for Coding NEDS and EIS/P&R Forms, Vol. III – Compendia of Processes*, EPA-450/4-8-007b, 8.9-6 Apr. 1980 ("Emissions attributed to crushing do not occur from the crushing operation, but from the feed and discharge points.").

[73] "WebFIRE" is EPA's electronic database of emission factors for criteria and hazardous air pollutants from industrial and non-industrial processes. *See* http://cfpub.epa.gov/webfire/#compliance-functions.

[74] EPA, *FIRE Version 5.0; Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants*, EPA-454/R-95-012, Aug. 1995 (hereinafter "FIRE Version 5.0") (an earlier, hard-copy version of WebFIRE).

Given the limited availability of emission factors specifically for coal crushing, PWCC has selected the following particulate emission factors for that coal preparation activity based on EPA's relevant recommendations in AP-42, as explained below.

- *Selected Emission Factors*:

  PM = 0.0012 lb/ton (AP-42, Table 11.19.2-2)
  PM_{10} = 0.00054 lb/ton (AP-42, Table 11.19.2-2)

Published in AP-42, these emission factors were selected by PWCC based on EPA's application of technology transfer to particulate emissions from coal preparation. That is, given the unavailability of reliable emission factors for fugitive particulate emissions from the "initial coal preparation phase" (coal unloading, crushing screening, conveying, etc.), AP-42 indicates that fugitive emission information for sources in Section 13.2 of that document would be applicable to their coal-preparation counterparts.[75] In turn, for certain types of equipment addressed in Section 13.2, such as crushers and screens, AP-42 suggests that emissions from such equipment could be characterized by emissions information in Section 11.19.2 for similar operations in the crushed stone industry.[76] The fact that EPA has recommended the use of emission information from Section 11.19.2 is a strong indication of the Agency's belief that reliable factors specifically for crushing of coal are simply not available.

As Table 11.19.2-2 in AP-42 indicates, emission information for the crushed stone industry does not contain emission factors for particulate matter from primary crushers, i.e., the type of crusher used at Kayenta. However, a footnote of that Table states that "emission factors for PM-10 for tertiary crushers can be used <u>as an upper limit for primary . . . crushing</u>."[77] That statement flows from the general observation that size reduction of many materials is often accomplished in stages, with "emissions increas[ing] progressively from primary to secondary to tertiary crushing."[78]

[75] AP-42, p. 11.10-1.

[76] AP-42, Table 13.2.3-1.

[77] *Id.*, note o. (emphasis added).

[78] EPA, *Nonmetallic Mineral Processing Plants – Background Information for Proposed Standards*, EPA-450/3-83-001a, 3-34 (Apr. 1983).

Furthermore, for a particular stage of crushing, harder minerals (such as stone) often emit more particulate matter than softer minerals (such as coal).[79] Consequently, the use of emission factors for tertiary crushing of stone to estimate particulate emissions from primary crushing of coal is likely to be highly conservative.

Based on EPA's recommendation in Table 11.19.2-2, PWCC has selected the PM_{10} emission factor for tertiary crushing of stone, i.e., 0.00054 lb PM_{10}/ton, to be representative of PM_{10} emissions from the primary crushing of coal at Kayenta. PWCC also believes it is reasonable to regard the PM emission factors for tertiary crushing of stone as an estimate of the upper bounds for emissions of that particulate matter from primary crushing of coal.[80] Accordingly, PWCC has selected the PM emission factor for tertiary crushing of stone, i.e., 0.0012 lb PM/ton, to be representative of PM emissions from the primary crushing of coal at Kayenta.[81]

Particulate emission factors for operations in the crushed stone industry are actually presented in Table 11.19.2-2 on an "uncontrolled" and "controlled" basis. In particular, the factors for "controlled" emissions are based on stone processing facilities equipped with wet suppression.[82] As previously explained, NSPS Subpart Y established an emission standard for particulate matter based on each affected facility using some particulate control measure, such as wet suppression. Because each crusher at Kayenta is subject to NSPS Subpart Y and is equipped with wet suppression, that crusher's potential-to-emit particulate matter is estimated to be equal to the "controlled" emission factor for tertiary crushing in Table 11.19.2-2.

Acknowledging that Table 11.19.2-2 presents both uncontrolled and controlled particulate emission factors for various stone processing operations, EPA suggests that "[v]isual

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[79] EPA, *Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions*, EPA-450/3-77-010, 2-241 (Mar. 1977).

[80] PM is not a regulated pollutant under the Title V program. *See* memorandum from Lydia Wegman, EPA OAQPS, to EPA Regional Air Directors of Oct. 16, 1995 ("Definition of Regulated Pollutant for Particulate Matter for Purposes of Title V").

[81] As noted earlier, when NNEPA estimated Kayenta's potential to emit during the Title V permit renewal process for the Complex, NNEPA also quantified PM and PM_{10} emissions from Kayenta's primary and secondary crushers by relying on AP-42 emission factors for the tertiary crushing of stone. *See* NNEPA, "Federal Operating Permit Revised Statement of Basis," Permit No. NN-OP 08-010-A (PWCC Black Mesa Complex), Appendix A (Nov. 4, 2009).

[82] AP-42, Table 11.19.2-2, note b.

observations from each source under normal operating conditions are probably the best indicator of which emission factor is most appropriate."[83] When visually observing Kayenta's crushers in the past during their normal operations at various times of the year, emissions have rarely been visible, and when they were, they were barely perceptible to the human eye. In other words, the virtual absence of visible emissions from Kayenta's crushers during their normal operations strongly supports characterizing those facilities' particulate emissions with the "controlled" emission factor from Table 11.19.2-2.

When AP-42 publishes both an emission equation and a single-value emission factor to estimate emissions from a particular type of emissions unit, EPA generally recommends use of the emission equation because it typically is based on a greater number of emissions tests of the same type of emissions unit at various stationary sources.[84] Given the significant data base of emission test results for crushers in the crushed stone industry,[85] one would generally expect AP-42 to have characterized those emissions with an emission equation instead of the single-value emission factor that is published. Nevertheless, PWCC has decided to use that particular single-value emission factor in this instance due, in part, to that factor being supported by results from a significant number of emission tests.

Screening

At Preparation Area J-28 coal from its two primary crushers is screened by one (1) double-deck vibrating screen. At Preparation Area N-11 coal from its primary crusher is screened by one (1) single-deck vibrating screen. Thereafter, at Preparation Area N-8, prior to transfer of product coal to storage silos for subsequent shipment, all processed coal from Areas J-28 and N-11 is ultimately screened again by one of two (2) single-deck vibrating screens.

Each vibrating screen essentially consists of an inclined flat or slightly convex screening surface which is rapidly vibrated in a plane normal or nearly normal to the screen surface. The screening

[83] *Id.*

[84] AP-42, p. 11.9.4.

[85] AP-42, pp. 11.19.2 -16&17.

motion is of small amplitude but high frequency.[86] In the screening process, a mixture of coal particles with various sizes is dropped onto a vibrating mesh surface with openings of the desired size. Coal particles are separated into two fractions, i.e., the undersize which passes through the screen's openings and the oversize which is retained on the screen's surface.

However, as previously noted, roll crushers, such as those employed at Kayenta, typically produce no oversize. Consequently, while the screens at Areas J-28 and N-8 do produce relatively small amounts of rejects, those rejects primarily consist of product-size particles of coal that could not make their way through the screens' openings in the time allotted by the design for those screens.

Screens can emit significant amounts of particulate matter due to agitation of the material being screened, especially if the material is dry. Not only are dust particles formed when particles collide with each other while moving on the screen's surface, but dust is also formed by abrasion of those particles by the vibrating screen. However, like the typical design for coal crushers, vibrating screens for coal sizing are routinely equipped with an operational design feature that limits the amount of particulate matter released from the screen. Enclosing the screening surfaces, including non-porous curtains which hang above all sides of the screen and extend beyond the screen's vibrating surface, effectively seals that process from the atmosphere except for openings where coal is fed to and discharged from that processing equipment.[87]

While such enclosures are designed to provide worker protection from health and safety risks posed by accumulation of coal dust in the air and on all surfaces around the work area, that design feature provides the collateral benefit of also reducing the quantity of fugitive particulate matter that would otherwise be emitted from that preparation process into the atmosphere. During its original development of NSPS Subpart Y, EPA acknowledged that, with this

[86] EPA, *Nonmetallic Mineral Processing Plants – Background Information for Proposed Standards,* EPA-450/3-83-001a, 3-36 (Apr. 1983).

[87] See, e.g., 41 Fed. Reg. 2232, 2233 (Jan. 15, 1976) ("By minimizing the number and dimensions of the openings through which fugitive emissions can escape, the opacity and total mass rate of emissions can be reduced independently of the air pollution control devices.").

commonplace design feature for coal preparation facilities, "the opacity and the total mass rate of emissions can be reduced independently of the air pollution control devices."[88]

All of the screens at Kayenta are enclosed. Consequently, much like particulate emissions from coal crushing, particulate emissions from each screen consist of fugitive emissions escaping from those few openings in the enclosure where coal is fed to and discharged from the screen.[89]

- *Selected Emission Factors*:

PM	= 0.0022 lb/ton	(AP-42, Table 11.19.2-2)
PM_{10}	= 0.00074 lb/ton	(AP-42, Table 11.19.2-2)

Published in AP-42, these emission factors were selected by PWCC based on EPA's application of technology transfer to particulate emissions from coal preparation. That is, given the unavailability of reliable emission factors for fugitive particulate emissions from the "initial coal preparation phase" (coal unloading, crushing screening, conveying, etc.), AP-42 indicates that fugitive emission information for sources in Section 13.2 of that document would be applicable to their coal-preparation counterparts.[90]

In turn, for certain types of equipment addressed in Section 13.2, such as crushers and screens, AP-42 suggests that emissions from such equipment could be characterized by emissions information in Section 11.19.2 for similar operations in the crushed stone industry.[91] The fact that EPA has recommended the use of emission information from Section 11.19.2 is a strong indication of the Agency's belief that reliable factors specifically for estimating emissions from coal screening are simply not available.

The selected PM_{10} emission factor is published for "Screening (controlled)" in the current version (August 2004) of AP-42's Table 11.19.2-2. That current version of Table 11.19.2-2 was created by amending the former January 1995 version of those emission factors to incorporate

[88] 41 Fed. Reg. 2232, 2233 (Jan. 15, 1976).

[89] EPA, *Engineering Reference Manual for Coding NEDS and EIS/P&R Forms, Vol. III – Compendia of Processes*, EPA-450/4-8-007b, 8.9-6 Apr. 1980 ("Emissions attributed to crushing do not occur from the crushing operation, but from the feed and discharge points.").

[90] AP-42, p. 11.10-1.

[91] AP-42, Table 13.2.3-1.

additional results from a more recent program of emission testing of crushed stone processing operations.[92] That particular program included a series of particulate emission tests using EPA Method 201A in conjunction with a portable, track-mounted hood system that was designed and developed as part of that special test program to capture fugitive particulate emissions from vibrating screens at five different stone crushing plants. Those particular plants processed either granite or limestone.[93]

Prior to EPA's most recent update of AP-42 emission factors for the crushed stone industry, emission factors for PM from crushing, screening, etc. had been estimated by multiplying the PM_{10} emission factor (determined via field testing) by 2.1.[94] However, since 2003, AP-42's PM emission factors for those particular facilities, including the selected PM emission factor above, have been calculated based on an extrapolation method using PM_{10} and $PM_{2.5}$ test results.[95] EPA believes that its extrapolation method provides a more reasonable means to estimate TSP (or PM) and provides more flexibility to agencies which have different definitions of TSP (or PM).[96]

Application of the above factors for crushed stone screening to the screening of crushed coal is reasonable because those two materials are similar and because the operation in each instance involves screening. The type of ore or rock was originally believed to be one of primary factors influencing the amount of particulate emissions from most mineral processing operations.[97] However, more recent research on fugitive emissions from crushed stone operations has "consistently supported the conclusion that rock type is not a major variable."[98] In other words,

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[92] Memorandum from John Richards, Air Control Techniques, to William Kuykendal, EPA OAQPS, at 2-3, 6-7 and 10-11 (May 12, 2003) ("Background Information for Revised AP-42 Section 11.19.2, Crushed Stone Processing and Pulverized Mineral Processing") (hereinafter "Crushed Stone Background Information").

[93] *Id.*

[94] AP-42 (5th ed. 1995), p. 11.19.2-6, note c. "[R]elative ratios in AP-42 Sections 13.2.2 and 13.2.4 indicate that TSP emission factors may be estimated by multiplying PM-10 by 2.1."

[95] AP-42 (5th ed. 2003), p.11.19.2-10.

[96] Air Control Techniques on behalf of EPA, "Response to Comments" (to June 2003 draft updated version of AP-42, Section 11.19.2), 4-5 (Feb. 2004) (hereinafter "Response to Comments").

[97] EPA, *Nonmetallic Mineral Processing Plants – Background Information for Proposed Standards,* EPA-450/3-83-001a, 3-18 (Apr. 1983).

[98] Response to Comments at 17.

the fact that PWCC's selected emission factors were heavily influenced by emission tests of granite and limestone screening operations does not suggest that the magnitudes of particulate emissions from screening coal would be either higher or lower.

On the other hand, the nature of coal screening operations at Kayenta is fundamentally different from the kind of screening operation that served as the basis for the above emission factors. In particular, the emission factors which PWCC has selected to represent Kayenta's screening of coal were primarily developed from emission tests on screens that processed stone from tertiary crushers.[99] As such, the stone being screened had a relatively high proportion of small particles. Conversely, coal being screened at Kayenta has a relatively low proportion of fines because that coal is processed only by primary crushers.

When applying the selected emission factors from the crushed stone industry to Kayenta's coal screening, any potential effect of that fundamental difference between coal screens and stone screens should be considered. Particulate emissions from screening typically increase with an increase in the proportion of small particles in the screened material.[100] Consequently, because the proportion of fines in stone from tertiary crushers almost certainly is significantly higher than the typical proportion of small particles in coal from Kayenta's primary crushers, PWCC's selected emission factors in this instance (based on screening stone from tertiary crushers) should provide conservative estimates of the quantities of particulate matter emitted from Kayenta's coal screening operations.

Furthermore, the crushed stone screens which served as the basis for the above emission factors were most, if not all, triple-deck screens, i.e., three vertically stacked layers of screen.[101] By comparison, screening of crushed coal at Kayenta utilizes only one double-deck screen and three single-deck screens.

The type of screening equipment is a factor that affects the quantity of emissions from screening.[102] The cumulative agitation of material processed in a triple-deck screen is

[99] Crushed Stone Background Information at 2-3, 6-7 and 10-11.

[100] EPA-450/3-83-001a at 3-38.

[101] Crushed Stone Background Information at 2-3, 6-7 and 10-11.

[102] EPA-450/3-83-001a at 3-38.

undoubtedly greater than the material agitation caused by single- or double-deck screens. As a result, PWCC's selected emission factors in this instance (based on triple-deck screens) should provide conservative estimates of the quantities of particulate matter emitted from Kayenta's three single-deck and one double-deck screens.

The Company has selected emission factors for screening from AP-42, Table 11.19.2 where those factors for "controlled" emissions are based on stone processing facilities equipped with wet suppression.[103] Because each screen at Kayenta is subject to NSPS Subpart Y and is equipped with wet suppression, each screen's potential-to-emit particulate matter is estimated to be equal to the "controlled" emission factor for tertiary crushing in Table 11.19.2-2.

Acknowledging that Table 11.19.2-2 presents both uncontrolled and controlled particulate emission factors for various stone processing operations, EPA suggests that "[v]isual observations from each source under normal operating conditions are probably the best indicator of which emission factor is most appropriate."[104] When visually observing Kayenta's screens in the past during their normal operations at various times of the year, emissions have rarely been visible, and when they were, they were barely perceptible to the human eye. In other words, the virtual absence of visible emissions from Kayenta's screens during their normal operations strongly supports characterizing those facilities' particulate emissions with the "controlled" emission factor from Table 11.19.2-2.

When AP-42 publishes both an emission equation and a single-value emission factor to estimate emissions from a particular type of emissions unit, EPA generally recommends use of the emission equation because it typically is based on a greater number of emissions tests of the same type of emissions unit at various stationary sources.[105] Given the significant data base of emission test results for screens in the crushed stone industry,[106] one would generally expect AP-42 to have characterized those emissions with an emission equation instead of the published

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[103] AP-42, Table 11.19.2-2, note b.

[104] *Id.*

[105] AP-42, p. 11.9-4 (single-value, mine-specific emission factors compared to predictive equations allowing emission factor adjustments to specific source conditions).

[106] AP-42, pp. 11.19.2-16&17 ("References for Section 11.9.2").

single-value emission factor. Nevertheless, PWCC has decided to use that particular single-value emission factor in this instance due, in part, to that factor being supported by results from a significant number of emission tests.

Transfer Points on Belt Conveyors

When NSPS Subpart Y for coal preparation plants was proposed, the list of affected facilities that could be subject to Subpart Y included "coal transfer points" even though that particular type of facility was not defined in the proposal.[107] Nevertheless, when Subpart Y was later promulgated, the final list of affected facilities did not expressly include "coal transfer points." Instead, the promulgated list of "affected facilities" included "coal transfer and loading systems,"[108] suggesting that only those particular transfer points within a coal transfer and loading system could be subject to Subpart Y. Thus, on its face, the regulatory history of Subpart Y's development indicates that EPA may not have intended for all transfer points within a coal preparation plant to be affected facilities that could be subject to Subpart Y.

On the other hand, NSPS Subpart OOO, applicable to nonmetallic mineral processing plants, defines the term "transfer point" to mean "a point in a conveying operation where the nonmetallic mineral is transferred to or from a belt conveyor except where the nonmetallic mineral is being transferred to a stockpile."[109] Although Subpart OOO does not designate "transfer point" as one type of affected facility, that NSPS nevertheless lists "belt conveyor" as an affected facility.[110]

[107] 39 Fed. Reg. 37,922, 37,923 (Oct. 24, 1974) ("coal storage and coal transfer points").

[108] 41 Fed. Reg. 2232, 2234 (Jan. 15, 1976).

[109] 40 C.F.R. §60.671. A longstanding practice of EPA's regulation of open storage piles has been to regard those conveyors being used to load-in and load-out the pile as components of the storage pile. *See e.g.*, revised NSPS Subpart Y definition of "open storage pile" means "any facility, including storage area that is not enclosed that is used to store coal, including the equipment used in the loading, unloading, and conveying operations of the facility. 40 C.F.R. §60.251(m) (emphasis added); *see also* EPA, *Air Pollution Control Techniques for Non-Metallic Minerals Industry,* EPA-450/3-82-014, 3-6 (Aug. 1982); R. Bohn et al., *Fugitive Emissions from Integrated Iron and Steel Plants,* EPA-600/2-78-050, 2-15 (Mar. 1978); EPA, *Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions,* EPA-450/3-77-010, 2-32 (Mar. 1977) (Conveyors within the crushing or storage operations are considered to be integral to those operations.); PEDCo (for EPA), *Evaluation of Fugitive Dust Emissions from Mining, Task 1 Report: Identification of Fugitive Dust Sources Associated with Mining (Draft),* 57 (Apr. 1976); EPA, *Development of Emission Factors for Fugitive Dust Sources,* EPA-450/3-74-037, 102 (June 1974).

[110] 40 C.F.R. §60.670(a).

Notably, Subpart OOO prescribes a standard for particulate emissions "from any transfer point on belt conveyors."[111] Thus, in the context of the NSPS for nonmetallic mineral processing, it appears that EPA logically regards a transfer point on a belt conveyor to be part of that belt conveyor. That is, a transfer point under Subpart OOO is considered to be a part of one type of affected facility.

As a matter of practice over the years, permitting authorities appear to have generally regarded transfer points at coal preparation plants as affected facilities under NSPS Subpart Y. In particular, when EPA revised Subpart Y a few years ago, the Agency explicitly identified "transfer points" as having been designated as one type of affected facility in 1976, i.e., under the original Subpart Y.[112]

Both wind and mechanical forces can cause emissions of particulate matter from transfer points. Coal particles become briefly suspended in air as they pass from a conveyor belt to a receiving surface. Particulate emissions are created whenever ambient winds are sufficient to entrain some of the lighter coal particles falling through the air. In addition, coal free-falling for more than a few feet can generate dust as the fallen coal fractures into smaller pieces upon impacting the tail of a belt conveyor or some other receiving surface.[113]

Enclosure of transfer points at coal preparation plants is standard industry practice for minimizing the release of dangerous coal dust into surrounding work areas. Surrounding the head of a conveyor belt and its falling coal particles effectively shields those coal particles from ambient winds. Likewise, enclosure of the tail end of a belt conveyor or some other surface which receives those falling particles contains the release of any dust caused by the particles impacting that surface. Full enclosure is a standard design feature of belt-to-belt transfers of coal throughout Kayenta's preparation areas, including both Overland Conveyors.

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[111] 40 C.F.R. §60.672(a).

[112] Memorandum from C. Fellner, EPA, to Coal Preparation NSPS Docket (EPA-HQ-OAR-2008-0260), 1 (Apr. 2008). As noted earlier, "transfer point" was identified as an affected facility in the 1974 proposal of NSPS Subpart Y but was not included as such in the 1976 promulgation of that rule.

[113] EPA, *Air Pollution Control Techniques for Non-Metallic Minerals Industry*, EPA-450/3-82-014, 3-9 (Aug. 1982).

Particulate emissions from transferring raw coal from a hopper to its receiving belt conveyor(s) are prevented or contained by another type of enclosure. In particular, because Kayenta's preparation plant hoppers are designed for below-grade locations in order to allow the hoppers to be loaded by gravity, transfer of raw coal from the bottom of each hopper to its receiving belt is performed within an underground vault. As an integral feature of the hopper design, that underground vault acts much like an enclosure during the transfer of coal from the hopper to its receiving belt conveyor.

- *Selected Emission Equation for Transfer Points:*

$$E = [k(0.0032)]\frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \qquad \text{AP-42, Subsection 13.2.4}$$

where:
E = emission factor (lb/ton)
k = a dimensionless particle size multiplier (0.74 for TSP; 0.35 for PM_{10})
U = mean wind speed (mph)
M = coal moisture content (%)

The above equation, often referred to as the "standard drop equation", is applied to both continuous and batch drop operations.[114]

Based on technology-transfer considerations, EPA has recommended the use of emissions information in AP-42, Section 13.2 ("Fugitive Dust Sources") to estimate fugitive particulate emissions from different types of coal preparation facilities.[115] The standard drop equation in Subsection 13.2.4 was developed from the collective information obtained through evaluations of fugitive emissions from a variety of aggregate handling activities.[116] Application of this state-of-the-art methodology for estimating fugitive particulate emissions from the transfer of aggregate materials is appropriate for characterizing such emissions from the various transfer points within Kayenta's coal preparation process.

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114 *Id.* at p. 13.2.4-4. *See* EPA, *Control of Open Fugitive Dust Sources,* EPA-450/3-88-008, 4-3 (Sept. 1988).

115 AP-42, p. 11.10-1.

116 *See generally* Midwest Research Institute (for EPA), *Update of Fugitive Dust Emission Factors in AP-42 Section 11.2* (July 1987).

Belt Conveyors

In the early days of fugitive emissions studies, one of the "materials handling" activities noted as a potential source was frequently identified as "transfer and conveying."[117] Two types of affected facilities designated under NSPS Subpart Y in 1976 were "coal processing and conveying equipment."[118] However, it is generally accepted that the majority of emissions from an activity involving conveyor belts at coal preparation plants and at similar types of mineral processing plants occurs due to material transfer to or from a belt and not due to the material resting on the moving belt. Indeed, in NSPS Subpart OOO, applicable to processing and conveying of other nonmetallic minerals, a belt conveyor is designated as an affected facility, but the transfer point on that belt conveyor is the regulated source of particulate emissions.

EPA acknowledges that "[l]oss of material from the conveyors [in the coal preparation process] is primarily at the feeding, transfer and discharge points" rather than along the length of the conveyor itself.[119] "The majority of particulate emissions are generally from spillage and mechanical agitation of the material at transfer points."[120]

Excessive moisture in coal on conveyor belts can cause conveyor-discharge problems. If the coal gets too wet, it tends to cling to the belt. Some of the wet coal does not transfer to the next conveyor or other receiving facility, e.g., storage pile, but instead subsequently either falls from the belt's return strand or remains stuck to the belt during its return.

Most of Kayenta's belt conveyor belts are entirely outside. To prevent precipitation from causing excessive wetting of coal on those conveyor belts, the design of the conveying system provides for total covering on the windward side of each belt conveyor and for covering halfway down on the leeward side of each conveyor (in order to allow access for maintenance and repair).

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[117] See, e.g., *Evaluation of Fugitive Dust Emissions from Mining, Task 1 Report - Identification of Fugitive Dust Sources Associated with Mining (Draft)*, 48 (Apr. 1976); EPA, *Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions*, EPA-450/3-77-010, 2-5 (Mar. 1977).

[118] 40 C.F.R. § 60.250.

[119] PEDCo, *Evaluation of Fugitive Dust Emissions from Mining; Task 1 Report – Identification of Fugitive Dust Sources Associated with Mining (Draft)*, 49 (Apr. 1976); EPA, *Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions*, EPA-450/3-77-010, 2-6 (Mar. 1977);

[120] EPA-450/3-77-010 at 2-6.

Consequently, particulate emissions from the conveyors themselves are not an issue at Kayenta. Given the effective covering along the lengths of those conveyors, "emissions from conveying are minimal."[121] When coal conveyors are covered in that manner, "dusting does not occur to any great extent."[122]

Given the highly effective covers running the lengths of Kayenta's conveyor belts, and given the dust-suppression effect of residual moisture in the coal while being conveyed on those belts,[123] PWCC concludes that the quantity of potential fugitive particulate emissions from Kayenta's belt conveyors, excluding transfer points, is essentially zero. The characteristic absence of visible emissions along the lengths of those conveyors further supports the Company's conclusion.

Hopper Loading

A coal hopper is an underground, temporary storage container for coal. The hopper is designed with an open top located at ground level for loading coal by gravity into the hopper. Stored coal is then fed by gravity from the hopper's bottom onto a conveyor belt for subsequent transport to processing equipment.

Coal hoppers are used at Kayenta for two different purposes. Preparation Areas J-28 and N-11 each use a truck hopper to receive raw coal from the mining operations. Loading raw coal into truck hoppers is the beginning of Kayenta's coal preparation process. At those so-called "truck dumps," haul trucks with either bottom-dumps or end-dumps unload their raw coal into the open top of the hopper. Whenever raw coal is being loaded into a truck hopper, particulate matter becomes entrained in the displaced air and is emitted at ground level from the top of the hopper.

A reclaim hopper, on the other hand, does not receive coal from haul trucks. Instead, as the name implies, a reclaim hopper is used to "load-out" or to reclaim coal from a storage pile. Preparation Area J-28 utilizes a "high sulfur" reclaim hopper with a reserve stockpile of raw

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[121] EPA, *Engineering Reference Manual for Coding NEDS and EIS/P&R Forms,* "Volume III: Compendia of Processes," EPA-450/4-80-007B, 8.9-6 (Apr. 1980).

[122] PEDCo, *Evaluation of Fugitive Dust Emissions from Mining;* Task 1 Report – "Identification of Fugitive Dust Sources Associated with Mining," 51 (Apr. 1976) (quoting Hittman Associates, *Environmental Impacts, Efficiency, and Cost of Energy Supply and End Use: Vol. I Final Report,* (Nov. 1974)).

[123] As discussed in detail later in this document, residual moisture is one form of wet suppression – a control technique for emissions of particulate matter.

coal. A reclaim hopper is also used to load-out coal which has been processed at Area J-28 and then temporarily retained in J-28's domed storage facility. Finally, a reclaim hopper is used at Preparation Area N-8 to load-out each of the three open storage piles of processed coal.

A reclaim hopper serving a coal storage pile typically remains covered by that pile. As the pile covering the hopper is depleted by draw-down through that hopper, a dozer performing coal pile maintenance is used to replenish that pile. Because each reclaim hopper at Kayenta is consistently being loaded while covered by a pile of coal, that particular hopper-loading activity does not emit particulate matter. Particulate matter is, however, emitted whenever a dozer pushes coal in the pile to keep the top of its reclaim hopper covered by coal.

In sum, Kayenta's coal preparation operations rely on two truck hoppers and five reclaim hoppers. Particulate matter is emitted whenever a truck hopper is being loaded. Conversely, because a reclaim conveyor is typically covered by coal in its storage pile, loading of that particular type of hopper does not emit particulate matter.

- *Selected Emission Equation*:

$$E = A[k(0.0032)]\frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$ AP-42, Subsection 13.2.4

where:
E = emission factor (lb/ton)
k = a dimensionless particle size multiplier (0.74 for TSP; 0.35 for PM_{10})
U = mean wind speed (mph)
M = coal moisture content (%)
A = activity factor to account for "non-standard" drop operation = 3 (as explained below)

AP-42, Section 11.10 ("Coal Cleaning") recommends the use of emissions information in AP-42, Section 13.2 ("Fugitive Dust Sources") to characterize fugitive particulate emissions from facilities involved in the "initial phase" of coal preparation.[124] Hopper loading, of course, is the very first step in that "initial phase." Because hopper loading consists of dropping coal into a container, application of the aforementioned "standard drop equation" of Section 13.2.4 seems to be, on its face, the obvious approach to quantifying emissions from loading coal into hoppers.

[124] AP-42, p. 11.10-1.

Principles of technology transfer do suggest that emissions from dropping coal onto other coal in an open storage pile should be similar to emissions from dropping coal onto other coal contained within a hopper. However, one significant feature distinguishes drops addressed by the standard drop equation in Section 13.2.4 from batch drops of coal during hopper loading.

The standard drop equation was developed from results of EPA-sponsored studies which examined fugitive particulate emissions from activities such as front-end loaders dropping material into haul trucks, stacker conveyors dropping material onto storage piles, and conveyors' belt-to-belt material transfers.[125] Those investigations typically involved dropping materials onto unenclosed receiving surfaces. With that kind of material drop, fugitive particulate matter is emitted when the falling material impacts the receiving surface, thereby "exposing suspendable dust to ambient air currents."[126]

However, when coal is dropped into a hopper, particles cannot be entrained by ambient air currents because the four sides of the hopper prevent winds from entering that container. Instead, when coal is dropped into a hopper, air within the enclosed hopper flows upward and out of the hopper as that air is displaced by incoming coal. In certain circumstances that upward flow of air from the hopper can have a relatively high velocity which, in turn, can entrain a significant amount of particles in that upward flow.

Because the fundamental mechanism which generates fugitive particulates during hopper loading differs from the basic cause of particulate emissions when materials are dropped onto unenclosed surfaces, the "standard drop equation" is not appropriate "as-is" for estimating fugitive particulate emissions from loading coal into hoppers. However, as explained below, PWCC believes that a minor modification to the standard drop equation can make it applicable to hopper loading.

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[125] R. Bohn *et al.* (for EPA), *Fugitive Emissions from Integrated Iron and Steel Plants,* EPA-600/2-78-050, 4-2 (Mar. 1978).

[126] *Id.* at 2-17.

An early form of EPA's drop equation for material load-in to a storage pile was the following:[127]

$$E = \frac{(0.02)(K_1)\left(\frac{S}{1.5}\right)}{\left(\frac{PE}{100}\right)^2}$$

where:

$E =$ emission factor (lb/ton)
$K_1 =$ activity factor for the type of load-in relative to load-in with a front-end loader
$S =$ material silt content (%)
$PE =$ Thornthwaite's precipitation-evaporation index

The above predecessor to the standard drop equation currently in AP-42 was informed by a number of studies of fugitive particulate emissions, including studies where those emissions had been observed from different types of material load-in operations. Not surprisingly, those studies documented that different levels of fugitive particulate were emitted by different types of load-in operations. Consequently, EPA included the "activity factor," K_1, in the above drop equation as a way to quantify the mass emissions from one type of load-in operation relative to another.[128]

First, the Agency established both the baseline or reference quantity of fugitive particulates emitted during storage pile load-in with a front-end loader and the typical level of visible emissions associated with that particular operation. Activity factors (K_1) for use in the above equation were then developed for other types of load-in relative to the level of emissions from using the front-end loader. As EPA explained,

> if the device being used to load onto piles, such as a stacker loader, appears to generate less fugitive emissions, than would be generated by a front-end loader, an activity factor K_1 would be chosen. This ($K_1 = 0.75$) indicates that a stacker loader generates only 75 percent of the emissions that a front-end loader would if performing the same function.[129]

Early in its investigations of fugitive particulate emissions, EPA adopted this activity-factor approach as a means of quantifying relative amounts of emissions from different operations

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[127] EPA, *Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions,* EPA-450/3-77-010, 2-35 (Mar. 1977).

[128] *Id.* at 2-36.

[129] *Id.*

performing the same or similar function. PWCC believes that activity-factor approach provides a suitable method for estimating fugitive particulate emissions from Kayenta's hopper loading.

In particular, PWCC has quantified emissions from Kayenta's loading of coal into truck hoppers relative to the estimated emissions from load-in to Kayenta's storage piles with stacking conveyors. First, application of AP-42's standard drop equation is appropriate for estimating the rate of fugitive particulate matter emitted by a stacking conveyor at one of Kayenta's open storage piles.[130] Second, PWCC estimates that during normal operations, the average level of visible emissions from truck hopper loading at Kayenta is approximately three (3) times greater than the average level of visible emissions from the stacking conveyor.

Consequently, using EPA's activity-factor approach for estimating relative amounts of particulate emissions, PWCC estimates the average quantity of fugitive particulate emitted from truck hopper loading at Kayenta to be 3 times the average amount of fugitive particulate emitted by load-in to a storage pile at Kayenta with a stacking conveyor. In other words, PWCC has estimated truck hopper loading emissions with the standard drop equation and has then multiplied that result by an activity factor of 3.

Coal Pile Maintenance with Dozers

Kayenta's final product is a low-sulfur, low-ash coal. Because coal quality varies among the 35+ different coal seams mined at Kayenta, processed coal must often be blended to achieve the final product specifications. To that end, Preparation Area N-8 maintains three open storage piles of processed coal. Stockpile K-1, the "ready" pile, contains low-sulfur, low-ash coal which meets the quality specifications for Kayenta's product. Stockpile K-2, the "high-sulfur" pile contains coal with sulfur content in excess of the maximum allowed in the product. Stockpile K-3, the "high-ash" pile, contains coal with ash content in excess of the maximum allowed in the product.

Tracked bulldozers travel on each of the three open storage piles to perform what is commonly referred to as "pile maintenance." That activity includes dozers spreading coal recently added to each pile to maintain stability and configuration of the pile's slopes and its crown. Dozers are also used to level and compact the coal on the pile, thereby sealing the pile's interior from

[130] AP-42, p. 13.2.4-3.

moisture and oxygen. Finally, dozers are needed to push coal to open tops of hoppers to facilitate load-out of that coal via an underground reclaim conveyor.

For the reasons explained below, PWCC believes that the following AP-42 emission equations for bulldozing of *overburden* are appropriate for estimating fugitive emissions from dozers performing maintenance on coal piles in Kayenta's coal preparation plant. The Company clearly is aware that AP-42 also contains similar emission equations specifically designated for bulldozing coal. For that reason, the following discussion also provides a summary of PWCC's in-depth explanation in Appendix C for why those latter equations were not selected to estimate particulate emissions from Kayenta's use of dozers for coal pile maintenance.

- *Selected Emission Equations:*

$$E_{TSP} = \frac{5.7(s)^{1.2}}{(M)^{1.3}}$$ AP-42, Table 11.9-1

$$E_{PM10} = \frac{0.75(s)^{1.5}}{(M)^{1.4}}$$ AP-42, Table 11.9-1

where: E = emission rate (lb/hr)
s = silt content of the coal (wt. %)
M = moisture content of the coal (wt. %)

Overburden consists of that layer of earth between topsoil and the coal seam to be mined. At a typical western surface coal mine, overburden is first exposed by removal of topsoil. Overburden is then subsequently removed down to the coal seam, typically by a dragline. Excavated overburden is in turn placed in an adjacent, previously mined cut or pit, thereby forming an overburden spoils pile.

During the reclamation process after coal has been extracted from the earth, bulldozers are used to compact, shape and smooth the overburden piles into a surface configuration that mimics the original contour of the land prior to mining.[131] Spoils are sometimes stacked along the top edge of the pit, and dozers are later used during reclamation to push those spoils into the pit.

During an EPA-sponsored test program at three western surface coal mines in 1979-1980, fifteen (15) upwind-downwind TSP sampling tests were performed for dozers operating on overburden.

[131] AP-42, p.11.9-1.

As shown below, results of the dozer-on-overburden field test program have been summarized with a single-value TSP emission rate of 6.8 lb/hr along with the related distribution of results from the 15 individual test runs.[132]

No. Tests	Mean	Std Dev	Range
15	6.8	6.9	0.9-20.7

With the exception of a few unexplained outliers, the measured TSP emission rates for the 15 individual tests of dozer operation on overburden were more tightly grouped (less scattered) than their counterpart measured emission rates from dozer operation during the coal loading process in the pit area.[133] The limited variation in TSP emissions from dozer operation on overburden is most likely explained by the variation in soil characteristics of the different overburden being regraded.[134]

Importantly, dozer operation on overburden is very similar to dozer operation for coal pile maintenance. Both dozer operations generate fugitive particulate matter from dozer grading when the dozer's blade continuously disturbs the surface layer of the material being worked. Both dozer operations also emit fugitive particulate matter when the dozer pushes the material to spread it or to move it to another location. Both dozer operations must sometimes move the material by pushing it over the edge at one elevation where the material then free-falls to a lower level.

Finally, both operations also emit fugitive particulate when material falls off the dozer's tracks and when the dozer creates turbulent shear when passing over the surface of the coal or the overburden. In those latter instances, some particles become suspended in the air and are subsequently dispersed by ambient wind currents.

In sum, dozer operation for coal pile maintenance is very similar to dozer operation on overburden. Moreover, the causes of fugitive particulate emissions from both types of dozer operation are also very similar. Considerations of technology transfer therefore suggest that the

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[132] EPA, *Revision of Emission Factors for AP-42 Section 11.9 – Western Surface Coal Mining (Revised Final Report)*, Appendix F at F-37 (Sept. 1998).

[133] *Id.* at F-33.

[134] *Id.* at F-39.

AP-42 equations for estimating fugitive particulate emissions from dozer operation on overburden should be applicable for estimating fugitive particulate emissions from dozer operation for coal pile maintenance. Based on that rationale, PWCC has selected those particular AP-42 emission equations to estimate fugitive particulate emissions from dozers performing coal pile maintenance at Kayenta.

In light of the Company having selected AP-42 emission equations for the bulldozing of *overburden*, PWCC believes it is appropriate in this instance to summarize herein why the Company rejected other AP-42 emission equations which facially appear to be directly applicable to Kayenta's coal pile maintenance with dozers.

The same reference source relied on above, i.e., AP-42's Table 11.9-1 for western surface coal mining, contains emission equations designated specifically for the bulldozing of coal. However, as explained in considerable detail in Appendix C, the Company has found that the technical basis for those coal-dozing emission equations has little in common with the nature of dozer operation on Kayenta's coal piles.

First, the manner of dozer activity addressed by the AP-42 emission equations for bulldozing coal is simply not characteristic of dozer operation for coal pile maintenance at Kayenta. Those AP-42 emission equations were developed from a fugitive particulate sampling program at three surface coal mines. During field sampling, the dozer in question was being used to clean the floor of the pit where a shovel or front-end loader was also operating to load raw coal into haul trucks. For that particular dozer activity, the bulk of its particulate emissions are attributable not to surface grading by the dozer blade but rather to the tracks or tires of the dozer traffic moving about the truck-loading area in the pit.

On the other hand, a dozer performing coal pile maintenance typically operates at a lower speed than one that supports truck-loading on the floor of a mine's pit. Particulate emissions from pile maintenance are primarily due to (1) the dozer's blade slowly pushing coal from one pile location to another and (2) some of that relocated coal falling to a lower level of the pile. In other words, the predominant cause of particulate emissions related to the AP-42 emission equations for bulldozing coal is much different from the underlying cause of particulate emissions from coal pile maintenance with dozers.

Furthermore, background information about actual field conditions during the aforementioned sampling program for emissions from bulldozing coal reveals that sampling results almost certainly reflect substantial interference from plumes of particulate emitted by other adjacent operations, e.g., shovel scraping coal off the pit floor, shovel dumping coal onto beds of haul trucks, and truck traffic on the pit floor to and from the coal loading area. Consequently, the level of particulate actually emitted by dozer operations on the pit floor is almost certainly over-estimated by those AP-42 emission equations for bulldozing coal because sampling data supporting those equations were confounded by emissions from other nearby coal-loading activities.

As noted earlier, Appendix C provides a more in-depth explanation of the inappropriateness of using AP-42 emission equations for bulldozing coal in order to estimate particulate emissions from maintenance of Kayenta's coal piles using a dozer.

Coal Pile Wind Erosion[135]

An open storage pile of coal consists of non-homogeneous surfaces impregnated with non-erodible particles larger than approximately 1 centimeter. Dust can be generated at times when the wind velocity is sufficient to strip erodible material from the pile's surface. The term "friction velocity" is a measure of wind shear stress on the erodible surface. Erodible material is emitted from the pile surface when the surface's threshold friction velocity is exceeded.

A pile's surface has a finite availability of erodible material called the "erosion potential." Particulate emission rates tend to decay rapidly during an erosion event because wind gusts may substantially deplete a pile's erosion potential. In addition, any natural crusting of the pile's surface binds the erodible material, thereby reducing its erosion potential. On the other hand, each time the pile's surface is disturbed, e.g., when coal is added to or removed from the old surface, the erosion potential is restored.

As EPA explains,

> if typical values for threshold wind speed at 15 cm are corrected to typical wind sensor height (7-10 m), the resulting values

[135] The discussion which follows was synthesized mainly from materials contained in Section 13.2.5 of AP-42 and at EPA, *Control of Open Fugitive Dust Sources,* EPA-450/3-88-008, 4-4 to 4-17 (Sept. 1988).

> exceed the upper extremes of hourly wind speed observed in most areas of the country. In other words, mean atmospheric wind speeds are not sufficient to sustain wind erosion from flat surfaces of the type tested [including open piles of coal]. However, wind gusts may quickly deplete a substantial portion of the erosion potential. Because erosion potential has been found to increase rapidly with increasing wind speed, estimated emission should be related to the gusts of highest magnitude.[136]

Kayenta's Area N-8 includes three open storage piles of coal. Consequently, those piles are subject to wind erosion in keeping with the basic principles outlined above.

- *Selected Emission Equations*

$E = k\sum_{i=1}^{N} P_i$ — AP-42, Subsection 13.2.5 ("Industrial Wind Erosion Equations")

$P = 58(u^* - u_t)^2 + 25(u^* - u_t)$,

but $P = 0$ for $u^* \leq u_t$

where:

E = fugitive dust from pile erosion (g/m^2)
k = particle size multiplier (1.0 for PM; 0.5 for PM_{10})
N = number of disturbances per year
P_i = erosion potential corresponding to the observed (or probable) fastest mile of wind for the ith period between disturbances (g/m^2)
u^* = friction velocity (m/s)
u_t = threshold friction velocity (m/s)

Over several decades EPA has evaluated fugitive emissions due to wind erosion of open storage piles, including several such piles at western surface coal mines.[137] Initially, EPA developed various empirical equations based on field observations that correlated TSP emissions with (1) silt content of the aggregate, (2) number of "dry" days per year, and (3) percentage of time that wind speed exceeded 12 mph at the mean height of the pile.

Estimating fugitive dust emissions with EPA's industrial wind erosion equations was first added to AP-42 in 1988.[138] With those equations, EPA adopted a new approach to characterizing fugitive emissions generated by wind erosion of aggregate storage piles. Much of the data base

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[136] AP-42, p. 13.2.5-1.

[137] *See, e.g.*, PEDCo (for EPA), *Survey of Fugitive Dust from Coal Mines*, EPA-908/1-78-003 (Feb. 1978).

[138] AP-42, 4th ed., supp. B (Sept. 1988).

supporting the selected emission equations above consists of results from measuring emissions from wind erosion of coal piles.[139]

Those selected emission equations for estimating fugitive particulate emissions from wind erosion are provided in AP-42, Section 13.2. EPA's recommended reliance on emissions information from AP-42, Section 13.2 to estimate emissions from coal preparation facilities is particularly appropriate in light of the substantial role of coal storage piles in Agency wind erosion studies used to develop the selected emission equations.[140] Consequently, PWCC has selected AP-42's standard equations for estimating industrial wind erosion from coal storage piles because that approach represents state-of-the-art methodology for that type of emission estimates.

Summary

As a summary of the preceding discussion, footnotes in the following Table 6 provide thumbnail descriptions of the AP-42 emission equations and emission factors which PWCC selected for the purpose of quantifying particulate emissions from each preparation facility at Kayenta. In addition, the Table 6 columns labeled "Uncontrolled PM_{10} Emission Factor" and "Uncontrolled PM Emission Factor" identify the numerical values of facility-specific emission rates used to calculate the PTE of each preparation facility.[141]

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[139] EPA, *Revision of Emission Factors for AP-42, Section 11.9, Western Surface Coal Mining,* 7 (Sept. 1998).

[140] AP-42, p. 11.10-1.

[141] For the reasons previously explained, controlled emission factors were used to estimate particulate emissions from crushers and screens.

CALCULATION OF KAYENTA'S POTENTIAL-TO-EMIT

PWCC is requesting EPA Region IX's issuance of a synthetic minor source permit for the Company's Kayenta Mine Complex. That permit must contain enforceable limitations that will restrict Kayenta's potential-to-emit PM to less than 250 tpy and its potentials-to-emit PM_{10} and $PM_{2.5}$ each to less than 100 tpy.

To that end, the Company proposes a limit on Kayenta's allowable annual production as well as operational limits related to the plant's extensive wet suppression system for control of fugitive particulate matter emissions. In addition, restrictions on Kayenta's PTE caused by certain enclosures that are inherent process design features of specific preparation facilities are proposed for inclusion in the subject permit. Finally, the requested permit must contain limitations on PM and PM_{10} emission rates from each of Kayenta's preparation facilities.[142]

Kayenta's potential-to-emit particulate matter is determined as the sum of the potentials-to-emit particulate matter from all of Kayenta's coal preparation facilities. Accordingly, the following discussion demonstrates how the potentials to emit PM and PM_{10} have been estimated for each of those facilities.

Calculating PTE for Each Coal Preparation Facility

Hoppers, Crushers, Screens and Transfer Points

The general equation for calculating potential-to-emit PM or PM_{10} from these types of preparation facilities at Kayenta is the following:[143]

$$PTE_i = \{C_i \times ER_i \times [(1 - WS_i) \times (1 - IP_i)]\} \div 2000$$

where: PTE_i = potential to emit PM (or PM_{10}) from the ith preparation facility (truck hopper, crusher, screen or transfer point), tons PM (or PM_{10}) per year;

[142] For the purpose of restricting Kayenta's potential-to-emit $PM_{2.5}$, the Company has conservatively assumed that all PM_{10} emissions are composed of $PM_{2.5}$. Restriction of potential PM_{10} emissions to less than 100 tpy will therefore assure that potential $PM_{2.5}$ emissions are likewise restricted.

[143] This equation applies to most of Kayenta's facilities, i.e., emissions from hopper loading, crushing, screening and transfer points. Potential emissions from each of the three storage piles at Area N-8 are not calculated with the general equation above. Instead, emissions caused by coal pile maintenance with bulldozers are calculated with an AP-42 emissions equation discussed previously. Pile emissions caused by wind erosion are calculated with AP-42's industrial wind erosion equation.

C_i = maximum operating capacity of the ith preparation facility (truck hopper, crusher, screen or transfer point); tons coal per year;

ER_i = PM_{10} emission limitation for the ith preparation facility (truck hopper, crusher, screen or transfer point), lb PM (or PM_{10}) per ton coal;

WS_i = fractional control efficiency of form of wet suppression applied at ith preparation facility, % control efficiency ÷ 100; and

IPi = fractional control efficiency of type of enclosure around ith preparation facility only if specified by PWCC,[144] % control efficiency ÷ 100.

A brief description follows for each of the above parameters used in calculating PTEs for each of the truck hoppers, crushers, screens and transfer points.

- C_i: This throughput parameter corresponds to a facility's maximum annual operating capacity when coal production of the preparation plant is at its proposed limit, i.e., 8,900,000 tpy. The method for determining the maximum operating capacity of each preparation facility was addressed in the preceding section of this document. The value of C_i for each of the subject preparation facilities is shown in both Table 3 and Table 6.
- ER_i: This parameter is the particulate (PM or PM_{10}) mass emission limitation for each facility, determined on the basis of EPA-published emission factors/equations judged by the Company to be sufficiently representative of those emissions from the particular type of preparation facility used at Kayenta. The value of ER_i for each Kayenta preparation facility is shown in Table 6.
- WS_i: This parameter constitutes the presumptive control efficiency [90%, 85%, 70% or 65%][145] of the form of wet suppression applied to Kayenta's truck hopper, crusher, screen or transfer point in question. Expressed in terms of percentage, this parameter represents that portion of the total PM (or PM_{10}) emissions that would have been emitted from the subject facility but for the facility being equipped with the applicable form of wet suppression.

  The preceding section of this document summarizes PWCC's rationale for establishing the presumptive control efficiency achieved by each form of wet suppression at Kayenta.[146] For further details about that decision process, Appendix A describes not

[144] Applicable only to control efficiencies for enclosures recognized here for specific preparation facilities.

[145] As explained below, the Company has deliberately over-estimated the facilities' PTEs by actually using efficiency values significantly lower than the above control efficiencies demonstrated by PWCC to be representative of the performance of Kayenta's wet suppression system.

only the scope of the Company's research into published documents addressing control efficiencies for different wet suppression techniques but also the Company's engineering assessment of the most appropriate control efficiency applicable to each form of wet suppression applied at Kayenta.

- IP_i: This parameter reflects the collateral reduction of particulate emissions achieved by an inherent process design feature which encloses or surrounds a particular type of preparation facility. For a conservative approach to determining Kayenta's PTE, emission reductions realized by each facility enclosure at the preparation plant were not included in that determination. Instead, as shown in the preceding section of this document, only a few facilities (either underground or covered by a dome) were considered when accounting for an estimated percentage emission reduction achieved by a facility enclosure.

Finally, for estimating potential emissions from truck hoppers and transfer points, site-specific adjustment factors used in the Company's calculations consisted of a representative coal-moisture content of 13.3 wt.%[147] and a representative mean hourly wind speed of 7.6 mph.

For each hopper, crusher, screen and transfer point at Kayenta, PWCC applied the above generic equation using facility-specific values, as applicable, for maximum operating capacity, presumptive efficiency of wet suppression, reduction efficiency of inherent process design feature, and estimated PM_{10} and PM emission rates. The resulting estimated PTEs of PM and PM_{10} from each truck hopper, crusher, screen and transfer point at Kayenta's preparation plant are shown in Table 6.

Coal Pile Maintenance (CPM) by Bulldozers

Potential emissions from each of the three coal storage piles at Area N-8 during its maintenance by bulldozers were calculated with the following equations:

$$PTE_{CPM-PM} = \{\frac{5.7(s)^{1.2}}{(M)^{1.3}} \times H_{CPM}\} \div 2000\ \mathrm{lb/ton}$$

[147] As explained below, the Company has also deliberately over-estimated the facilities' PTEs by actually using a coal-moisture content of 6.9 wt%, significantly lower than the 13.3 wt% demonstrated by PWCC to be representative of the moisture content of coal being processed and handled in Kayenta's preparation plant.

$$PTE_{CPM-PM10} = \{\frac{0.75(s)^{1.5}}{(M)^{1.4}} \text{ x } H_{CPM}\} \div 2000 \text{ lb/ton}$$

where:

PTE_{CPM} = potential to emit PM (or PM_{10}) from coal pile maintenance of one of the three coal storage piles at Area N-8, tons PM (or PM_{10}) per year;

s = silt content of coal in the pile = 8.6 wt.%;

M = moisture content of coal in the pile = 13.3 wt%; and

H_{CPM} = total annual time spent by bulldozers performing coal pile maintenance on the pile, hours per year (5,900 on Pile K-1; 2,942 on Pile K-2; 2,948 on Pile K-3).

Previously measured site-specific adjustment factors for silt and moisture contents were considered to be representative of average annual values for those parameters.[148] Total annual hours of each dozer engine's operation were metered and then adjusted to reflect that dozer's actual time spent performing maintenance on each pile. Total annual hours of an individual pile's maintenance by dozers (H_{CPM}) were the following sums of annual hours of each dozer performing maintenance on that pile.

Pile	Annual Hours of Maintenance by Dozers
K-1	5,900
K-2	2,942
K-3	2,948

Table 6 shows the Company's estimated PTEs of PM and PM_{10} from each of Area N-8's three coal piles caused by bulldozers performing maintenance on that pile.

Coal Pile Wind Erosion

Potential emissions from wind erosion of each of the three coal storage piles at Area N-8 were calculated with the industrial wind erosion equations. In general, those equations produce estimates of the pile's so-called "erosion potential" (g/m^2), i.e., the mass of particulate emitted from an open pile per unit of pile surface area. That erosion potential is then multiplied by the relevant surface area of the pile to obtain the mass of particulate matter emitted due to wind erosion. EPA's industrial wind erosion equations were applied to Area N-8 coal piles under the

[148] Due to evaporation, the moisture content of some of the coal stored in open piles will be less than the normal moisture content of coal being processed and handled. PWCC has conservatively estimated that the moisture content of stored coal will be as low as 3.5%, i.e., about half of the moisture content of coal being processed and handled.

highly conservative assumption that each pile was completely disturbed on a daily basis, as follows:

$$E = k \sum_{i=1}^{N} P_i$$

$$P = 58(u^* - u_t)^2 + 25(u^* - u_t),$$

but $P = 0$ for $u^* \leq u_t$

where:

E = fugitive dust from pile erosion (g/m^2)
k = particle size multiplier (1.0 for PM; 0.5 for PM_{10})
N = number of disturbances per year = 365
P_i = erosion potential corresponding to the observed (or probable) fastest mile of wind for the ith period between disturbances (g/m^2)
u^* = friction velocity (m/s)
u_t = threshold friction velocity = 1.12 meters per second (m/s)[149]

The actual methodology for applying the predictive emission factor equations for wind erosion is explained in detail at pages 13.2.5-2 through 13.2.5-8 of AP-42. In addition, an example of the step-by-step application of the wind erosion equations to an open coal pile is provided at pages 13.2.5-9 through 13.2.5-13. As summarized below, PWCC applied the industrial wind erosion equations to site-specific data for the Area N-8 piles in accordance with that AP-42 guidance.

Erosion potential is a function of the number of pile disturbances per year. For the piles at Area N-8, PWCC estimates that, on average, about 25% of each pile is disturbed every day while the remaining 75% of the pile is disturbed every 12th day of the year.

However, in an effort to avoid under-estimating potential emissions from wind erosion at Kayenta's coal preparation plant, those potential emissions have been conservatively estimated based on an assumption that 100% of each N-8 pile is disturbed daily throughout the year. In other words, when determining PTE due to wind erosion of each of those coal piles, the use of a highly conservative value for the number of pile disturbances per year (N = 365) means that erosion potential (P_i) from that pile must be evaluated for each day of the year.

As part of a meteorological monitoring station (BM-MET9) at Kayenta, an anemometer mounted at 10 meters above ground-level is used to measure site-specific continuous wind speeds in units of knots. The AP-42 wind erosion emission calculations rely on the term "fastest mile of wind",

149 AP-42, Table 13,2.5-2. Default value for an uncrusted coal pile at a western surface coal mine.

which is not typically reported by present-day meteorological stations nor currently available "from the monthly LCD summaries for the nearest reporting weather station[.]"[150]

Instead, the hourly wind speeds at BM-MET9 are converted from knots to meters per second (m/s) and then the fastest mile of wind is calculated using the following equations:

- hourly wind speed x 1.52 = 3-second gust speed
- 3-second gust speed ÷ 1.2 = fastest mile of wind

The conversion factor from hourly wind speed to 3-second gust (x 1.52) is based on the Durst Curve, which is a graph defining the relation between maximum wind speed averaged over "t" seconds and wind speed averaged over one hour. The conversion from 3-second gust to fastest mile of wind (÷ 1.2) was determined from building code tables and wind load formulae. Thereafter, because wind erosion in this case is being evaluated on a daily basis, the fastest mile of wind (m/s) for each day (u^+) was determined from the day's list of hourly values for the fastest mile of wind.

After determining the fastest mile of wind for each day, the friction velocity for each day (u^*) for a conically shaped coal pile was calculated for normalized surface wind speeds (u_s/u_r) of 0.2, 0.6 and 0.9 (corresponding to the three subareas of the pile's surface area as illustrated by "Pile A" at Figure 13.2.5-2 of AP-42).

Appendix D displays those calculated values of daily friction velocity (u*) for the three different subareas of each pile. Using those daily friction velocities in concert with AP-42's default threshold friction velocity of 1.12 m/s, values of daily PM erosion potential (g/m^2) from each of the three subareas were calculated for the same day (whenever the friction velocity for that subarea exceeded the threshold friction velocity).

As another means for ensuring that Kayenta's potentials-to-emit PM and PM_{10} from wind erosion were not under-estimated, PWCC used five separate years of on-site wind speed data to assess the likely range of values for Kayenta's annual erosion potential. As shown in the summary table at the end of Appendix D, maximum annual erosion potentials for TSP (PM) and for PM_{10} from the Area N-8 piles occurred in calendar year 2011. Those 2011 values for

[150] AP-42, p. 13.2.5-5.

maximum annual erosion potential from each subarea of the pile were the basis for estimating the piles' potentials-to-emit.[151]

Potential-to-emit from wind erosion of a subarea of a pile is calculated as the product of that subarea's erosion potential and the actual area of the subarea. Table 13.2.5-3 of AP-42 shows the distribution of a pile's total surface area (in percent) for the three wind regimes with a pile configuration (Pile A) like those at N-8, i.e., 40% for $u_s/u_r = 0.2$; 48% for $u_s/u_r = 0.6$; 12% for $u_s/u_r = 0.9$. In order to ensure a conservative surface-area value for each subarea of a pile at N-8 (and therefore a conservative estimate of the subarea's potential to emit), PWCC identified the following maximum sizes that each N-8 pile had attained during the period from 2001 through 2013: $K1_{maxarea} = 43{,}708\ m^2$; $K2_{maxarea} = 36{,}828\ m^2$; $K3_{maxarea} = 36{,}423\ m^2$.

Therefore, potential-to-emit PM due to wind erosion ($PTE_{WE\text{-}PM}$) was calculated for each pile at Area N-8, as follows:

$$PTE_{WE\text{-}PM} = K \times [(2011\ \text{Annual PM Erosion Potential}_{us/ur = 0.6}) \times (\text{Pile Total Area})(0.48)] + [(2011\ \text{Annual PM Erosion Potential}_{us/ur = 0.9}) \times (\text{Pile Total Area})(0.12)]$$

where K = conversion factor = 1 lb/453.6 g x 1 ton/2000 lb

Potential-to-emit PM_{10} due to wind erosion ($PTE_{WE\text{-}PM10}$) was calculated for each pile at Area N-8 using that same equation with appropriate values for 2011 Annual PM_{10} Erosion $\text{Potential}_{us/ur = 0.6}$ and 2011 Annual PM_{10} Erosion $\text{Potential}_{us/ur = 0.9}$.[152]

Estimated potentials-to-emit PM and PM_{10} due to wind erosion of each of the three piles are shown in Table 6.

Adjustments to PTE Calculations to Offset Uncertainty from Emission Factors

It is axiomatic that source-specific emissions data are the preferred inputs to PTE calculations. But when source-specific emissions information is not available, and when actual measurements to obtain such source-specific information are not feasible, e.g., at coal preparation facilities

[151] Notably, as shown in Appendix D, there was no erosion potential from the subarea corresponding to $u_s/u_r = 0.2$.

[152] From AP-42, page 13.2.5-3, the value for the PM_{10} particle size multiplier (k) is 0.5. Thus, the calculated value for PM_{10} erosion potential will be half of the calculated value for PM erosion potential.

using wet suppression, the Company has explained why estimates of Kayenta's PTE must rely on emission factors.

Because an emission factor/equation represents an average of emissions from a variety of different sources throughout an industry (source category), and because an emission factor/equation is sometimes based on limited field tests, the application of an emission factor/equation to estimate emissions from a specific source often introduces a level of uncertainty in that estimate. Consequently, the possibility arises that one or more emission factors/equations used by PWCC may be biased low, thereby causing potential emissions of particulate matter from Kayenta's preparation facilities to be under-estimated.

In an effort to counter the possibility that Kayenta's PTE has been underestimated due to PWCC's need to rely on EPA-published emission factors/equations, the Company has adjusted other parameters within its PTE calculations in a deliberate attempt to over-estimate Kayenta's PTE by a significant amount. In particular, PWCC has altered its initial approach to calculating Kayenta's PTE, as follows:[153]

Control Efficiencies for Wet Suppression Have Been Under-estimated

After conducting a comprehensive review of EPA publications addressing the use of wet suppression and estimated efficiencies achieved by water sprays and residual moisture,[154] and after years of observing the near absence of visible emissions resulting from Kayenta's surfactant-enhanced wet suppression system, PWCC's reasoned judgment estimated the control efficiencies of that system's components, as follows:

- Sprays of water-with-surfactant 90%
- Residual water-with-surfactant 85%
- Sprays of water only 70%
- Residual water only 65%

[153] In addition to discussion of the following deliberate adjustments to calculation parameters in order to over-estimate Kayenta's PTE, recall the discussion in the previous subsection of this document wherein the Company estimated PTE due to wind erosion by using the maxima of values determined for both annual erosion potential and the surface area of each pile. Recall also that the 99% control efficiency attributed to enclosure of a transfer point was recognized in the calculation of PTE for only a small number of the total transfer points used at Kayenta.

[154] *See* Appendix A.

Now, however, in an effort to offset the possibility that PWCC's necessary reliance on EPA-published emission factors might result in under-estimating Kayenta's PTE, the Company has deliberately over-estimated Kayenta's PTE by discarding application of the above efficiency estimates and instead using the following control efficiencies to characterize the performance of Kayenta's surfactant-enhanced wet suppression system:[155]

• Sprays of water-with-surfactant	70%
• Residual water-with-surfactant	65%
• Sprays of water only	50%
• Residual water only	45%

Table 6 confirms that these latter, much lower, estimates of control efficiencies for wet suppression were actually used when calculating PTEs of the associated coal preparation facilities which in turn are determinative of Kayenta's PTE.

Moisture Correction Factors Are Lower than Expected Actual Values

The value for moisture in coal is used in the standard drop equation for estimating particulate emissions resulting from the transfer of coal using belt conveyors. The value of moisture in coal is also used in the emission equation for estimating particulate emissions from open storage piles being "worked" by one or more bulldozers. Those values for the "moisture correction factor" are in the denominator of each equation, meaning that estimated particulate emissions increase when coal-moisture values decrease.

For coal going through Kayenta's preparation plant, PWCC has historically used a moisture correction factor of 13.1% as representative of the typical coal-moisture content throughout the plant. In response to an earlier Region IX concern that PWCC's coal-moisture content for Kayenta was too high, the Company previously provided EPA with analytical results from 2+ years of coal samples from Area N-8 which demonstrated an average, site-specific moisture correction factor of 13.3%.

[155] Surfactant-enhanced sprays or surfactant-enhanced residual moisture are applied at all but two of Kayenta's preparation facilities equipped for wet suppression.

Moreover, Appendix E contains PWCC's analysis which explains the origin of AP-42's default moisture correction factor of 6.9% for coal at western surface coal mines[156] and why that value should not be construed as representative of a moisture correction factor for coal subject to the comprehensive wet suppression system at Kayenta's coal preparation plant.

Nevertheless, in an effort to offset the possibility that PWCC's necessary reliance on EPA-published emission factors might result in under-estimating Katenta's PTE, the Company has deliberately over-estimated Kayenta's PTE by using a very low value of 6.9% as the moisture correction factor to be applied in the standard drop equation used to predict PTEs from Kayenta's truck hoppers and transfer points.[157]

In addition, processed coal being directed to one of N-8's three piles for interim storage first passes through a transfer station where sprays of water-with-surfactant are applied to that coal. A key function of surfactant addition at that point is to retard evaporation of water during outside storage of the wetted coal.

For the purpose of conservatively estimating potential emissions of fugitive particulate matter from maintenance of coal piles with dozers at Area N-8, PWCC has estimated that coal on each of those piles, prior to being reclaimed, could lose as much as 50% of its original moisture after load-in to the pile (which already has been conservatively estimated to be only 6.9%). Thus, calculation of particulate emissions from Kayenta's coal pile maintenance has assumed a moisture content of no greater than 3.5% for coal being temporarily stored on one of N-8's open piles.

Kayenta's Restricted PTE

Kayenta Mine Complex's potential-to-emit particulate matter is calculated as the sum of the potential particulate emissions from each stationary, particulate-emitting activity at Kayenta's coal preparation plant. However, the coal preparation facilities identified herein are the only stationary, particulate-emitting activities at Kayenta's coal preparation plant. Emissions from those preparation facilities occur not only during normal, steady-state operation but also when

[156] AP-42, Table 13.2.4-1.

[157] PWCC has elected to implement this conservative approach for estimating Kayenta's PTE even though PWCC has demonstrated that the 6.9% moisture value in AP-42, Table 13.2.4-1 finds no support from the actual field test results alleged by AP-42 to be the basis for that value. *See* Appendix E.

facilities startup and shutdown. Given the respective characteristics of startup and shutdown for Kayenta's preparation facilities, particulate emission rates during those latter periods are not materially different from those facilities' particulate emission rates during normal, steady-state operation.

The Company has demonstrated herein that Kayenta's potential to emit particulate matter can be restricted by the following:

- A limitation on the coal preparation plant's allowable annual production;
- Operational limitations involving the use of certain forms of wet suppression that achieve presumptive levels of control efficiency;
- Inherent process design features (enclosures) which reduce particulate emissions from particular preparation facilities by specified levels; and
- Limitations on particulate mass emission rates from each preparation facility.

Table 6 indicates that Kayenta's estimated potential-to-emit PM is 171 tpy, considerably less than the PSD applicability threshold of 250 tpy. Table 6 also indicates that Kayenta's estimated potentials-to-emit PM_{10} and $PM_{2.5}$ are each 56.5 tpy, considerably less than the Title V applicability threshold of 100 tpy.[158]

In conclusion, Kayenta can qualify for a synthetic minor source permit, provided that conditions in that permit ensure that specific limitations which restrict Kayenta's PTE are both legally and practically enforceable.

[158] Because all PM_{10} is assumed to be $PM_{2.5}$ for the purpose of this document, Kayenta's PTE $PM_{2.5}$ is equal to the calculated PTE PM_{10} from that stationary source. Recall also that PM is not a regulated air pollutant under the Title V program.

ENFORCEABILITY OF LIMITS THAT RESTRICT KAYENTA'S POTENTIAL-TO-EMIT

Particulate matter, in its various regulated forms, is the only air pollutant whose source-wide potential emissions from Kayenta must be restricted in order to fall below the threshold levels which trigger applicability of the PSD program (250 tpy) and applicability of the Title V program (100 tpy). To that end, the Company has identified a limitation on annual production by Kayenta's coal preparation plant as well as operational[159] and emission limitations that collectively result in restricting Kayenta's estimated potential-to-emit to significantly less than those threshold applicability levels.

A limitation can be relied upon to restrict a source's PTE only if the limitation is both legally enforceable and enforceable as a practical matter.[160]

Legally Enforceable

In the above context, the term "legally enforceable" means that EPA and citizens must have a direct right to enforce restrictions and limitations imposed on a source to limit its exposure to Clean Air Act programs.[161] Consistent with the provisions of sections 301(a) and 301(d)(4) of the Clean Air Act, EPA has promulgated the Federal Minor New Source Review Program in Indian Country.[162] Consequently, any production, operational and emission limits that restrict Kayenta's PTE become legally enforceable at the time EPA exercises its statutory authority to issue the requested synthetic minor source permit containing those limits.

Enforceable as a Practical Matter

"Practical enforceability" for an emission limitation or for other standards (design standards, equipment standards, work practices, operational standards, pollution prevention techniques) in a permit for a source is achieved if the permit's provisions specify:

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[159] PWCC has also identified inherent process design features (enclosures) on several coal preparation facilities that act to restrict those facilities' PTEs.

[160] *Cash Creek Order* at 15.

[161] Seitz/van Heuvelen Memo at 2.

[162] 76 Fed. Reg. 38748, 38753 (Jul 1, 2011).

(i) A limitation or standard and the emissions units or activities at the source subject to the limitation or standard;

(ii) The time period for the limitation or standard (e.g., hourly daily, monthly and/or annual limits such as rolling annual limits)[163]; and

(iii) The method to determine compliance, including appropriate monitoring, recordkeeping, reporting and testing.[164]

The remainder of this section addresses how the above elements of practical enforceability can be implemented for each limitation specified herein that is needed to restrict Kayenta's potentials-to-emit PM, PM_{10} and $PM_{2.5}$ to less than the thresholds which trigger applicability of the federal PSD and Title V programs. As shown in this application, those elements must be applied to each stationary, particulate-emitting activity within Kayenta's coal preparation plant, i.e., each coal preparation facility.

The following discussions include suggested language for permit conditions related to the type and scope of specific limitations on (1) plant production, (2) control efficiencies of wet suppression techniques and inherent process design features, and (3) fugitive particulate emissions from each preparation facility. For each of those limitations, PWCC has included suggested language not only for comprehensive monitoring and recordkeeping requirements related to each facility but also for calculation of each facility's emissions.[165]

The Company, however, at this time has not suggested any specific reporting requirements associated with those numerous monitoring, recordkeeping and calculation requirements. PWCC believes it is unlikely that EPA desires either copies of the voluminous raw data and records collected under the requested permit or copies of all intermediate calculations in the determination of each facility's monthly emissions. Instead, the Company hopes the contents of

[163] PTE limitations should generally not exceed one month. *In the Matter of Yuhuang Chemical Inc. Methanol Plant*, Order on Petition No. VI-2015-03, at 15 (Aug. 31, 2016) ("*Yuhuang Order*").

[164] 40 C.F.R. § 49.152(d).

[165] For ease of identification, suggested language for permit conditions has been indented in the text of this document's narrative.

acceptable compliance reports will center on the results of monthly emission compliance calculations and the values of key parameters used in those calculations.

Practical Enforceability of Production Limitation

(1) Limitation: Production not to exceed 8,900,000 tons of blended, processed coal per year
Scope of Limitation: Coal preparation plant

(2) Time Period for Limitation: Annual, computed as 12-month rolling average

Explanation: The quantity of coal produced at Kayenta is determined by the amount of coal required by the ultimate consumer of that coal, i.e., Navajo Generating Station (NGS). Historically, NGS has operated as a base-load, summer-peaking electric generating plant where substantially more coal is burned during the summer than during the winter.

Compliance with a weekly or even a monthly production limit would be impracticable due to significant, variability in coal quantities used by NGS that must be produced/delivered by PWCC. The duration and frequency of those variations in weather and in the economics of competitive fuel supplies are unpredictable, and they typically change throughout the year.

(3) Compliance Monitoring: Preparation plant's monthly coal production

Explanation: In keeping with regulatory requirements of the Department of Interior's Bureau of Land Management (BLM), PWCC implements various measurements of coal quantities throughout the mining and processing activities of Kayenta Mine Complex. In particular, PWCC is required to measure and report to BLM the amount of coal produced by Kayenta's preparation plant on a monthly basis. Because procedures for processed coal measurement have been in place for decades to satisfy BLM's requirement, the Company proposes to utilize those same procedures to satisfy pending requirements of a synthetic minor source permit from EPA.

The preparation plant's monthly coal production is calculated as the sum of (1) the tons of processed coal sold for the month and (2) the change in tons in the stockpile inventory, i.e., the difference between tons in pile storage at the end of the month and tons in pile storage at the beginning of that month. If the tons in Kayenta's stockpiles increase during the month in question, then the change in stockpile inventory is positive, and that change is added to the tons sold during that month. Conversely, if the tons in Kayenta's stockpiles decrease during the month in question, then that change is subtracted from the tons sold.

The tons of processed coal sold during any month are based on scale readings of as-received coal that Navajo Generating Station provides to the Company. However, determination of monthly changes in stockpile inventory involves a more complex, multi-task process.

Stockpile Aerial Measurements

Kayenta's stockpile inventory of processed coal is maintained in three open storage piles at Area N-8 (Piles K-1, K-2 and K-3). The overall stockpile inventory for Kayenta Mine Complex also includes two open storage piles of raw coal located adjacent to the truck hopper at Area J-28 (Piles K-5 and K-6) and another open storage pile of raw coal located adjacent to the truck hopper at Area N-11 (Pile N-11)[166].

Rather than maintain all residual raw coal at stockpiles in the field to be delivered to the preparation areas on an as-needed basis, PWCC not only hauls raw coal directly from the pits to Kayenta's preparation plant for processing but also delivers some raw coal to three storage piles adjacent to the preparation facilities at Areas J-28 and N-11. This latter supply of raw coal can be loaded into prep plant hoppers on occasions when normal truck delivery directly to the hoppers encounters any operating problem.

The monthly change in overall stockpile inventory is based on the difference in measured coal pile inventories as of midnight on the first day of successive calendar months. For a given month, each pile's <u>size is measured</u> toward the end of that month, and then <u>size adjustments</u> are made for subsequent pile changes from the time of its measurement until midnight on the first day of the following month.

In particular, on or about the 25th of each month, each pile is surveyed using aerial photogrammetry. The survey data are run through a software program to create Digital Terrain Models which are used to calculate each pile's volume. An appropriate density corresponding to either processed coal or raw coal is then used to calculate the tons stored in each pile.

[166] PWCC's standard practice for designating coal piles at Kayenta uses the prefix letter "K". However, the raw coal pile at Area N-11 has had a longstanding designation as "N-11", with no prefix "K" associated with that particular pile.

Thereafter, adjustments to each pile's tonnage are made to account for any changes between the time of the aerial survey and midnight of the first day of the following month.

Stockpile Measured Adjustments

- Pile Decreases: A weigh scale is located on the conveyor belt which loads-out coal from each of the six piles. That scale is read on the day of a pile's aerial survey and at midnight on the first day of the following month. The difference in measured weights corresponds to any reduction in that pile's monthly tonnage from the time of the pile's aerial survey until midnight of the first day of the following month.

- Pile Increases – Processed Coal: A weigh scale is located on the conveyor belt which loads-in coal to each of the three piles at Area N-8. That scale is read on the day of a pile's aerial survey and at midnight on the first day of the following month. The difference in measured weights corresponds to any increase in that pile's monthly tonnage from the time of the pile's aerial survey until midnight of the first day of the following month.

- Pile Increases – Raw Coal: Load-in facilities for raw coal are not equipped with any scales. Consequently, between the day of the aerial survey of a raw coal pile and midnight of the first day of the following month, the numbers of bottom-dump and end-dump haul trucks delivering raw coal to Piles N-11, K-5 and K-6 must be counted. Assuming that, on average, each bottom-dump haul truck delivers 210 tons of coal and each end-dump haul truck delivers 80 tons of coal, any increase in one of those pile's monthly tonnage from the time of the pile's aerial survey until midnight of the first day of the following month is calculated as the sum of the tonnage delivered by each type of truck during that time period.[167]

> (a) Using its well-settled protocol for performing aerial photogrammetry, the permittee shall measure the surface area and volume of each of the following stockpiles on or about the 25th day of each calendar month: Piles K-1, K-2, K-3, N-11, K-5 and K-6;

[167] Monthly tonnage delivered = (210 tons/bottom-dump x number of bottom-dump deliveries per month) + (80 tons/end-dump x number of end-dump deliveries per month).

(b) From the day that aerial photogrammetry is performed for Piles K1, K-2 or K-3, the permittee shall observe the initial weight reading from the scale located on the load-in conveyor belt for that stockpile;

(c) On the day that aerial photogrammetry is performed for Piles N-11, K-5 or K-6, the permittee shall begin counting the number of haul trucks delivering raw coal to that stockpile;

(d) On the day that aerial photogrammetry is performed for a specific stockpile, the permittee shall observe the initial weight reading from the scale located on the load-out conveyor belt for that stockpile;

(e) At midnight of the first day following the latest calendar month when aerial photogrammetry was performed for Piles K1, K-2 or K-3, the permittee shall observe the final weight reading from the scale located on the load-in conveyor belt for that stockpile;

(f) At midnight of the first day following the latest calendar month when aerial photogrammetry was performed for Piles N-11, K-5 or K-6, the permittee shall cease counting the number of haul trucks delivering raw coal to that stockpile;

(g) At midnight of the first day of the month following the latest calendar month when aerial photogrammetry was performed for a specific stockpile, the permittee shall observe the final weight reading from the scale located on the load-out conveyor belt for that stockpile.

(4) Recordkeeping – Preparation plant's monthly coal production

Based on the measurements and readings made in (3) above during each calendar month, the permittee shall record each of the following for that month:

(a) Surface area, in m^2, of each of the following coal piles: K-1, K-2 and K-3;

(b) Volume, in ft^3, of each of the following coal piles: K-1, K-2, K-3, N-11, K-5 and K-6;

(c) The initial weight reading of the scale located on the conveyor belt which loads-out coal from each of the six coal storage piles, i.e., K-1, K-2, K-3, N-11, K-5 and K-6;

(d) The final weight reading of the scale located on the conveyor belt which loads-out coal from each of the six coal storage piles, i.e., K-1, K-2, K-3, N-11, K-5 and K-6;

(e) The initial weight reading of the scale located on the conveyor belt which loads-in coal to each of the following coal storage piles, i.e., K-1, K-2 and K-3;

(f) The final weight reading of the scale located on the conveyor belt which loads-in coal to each of the following coal storage piles, i.e., K-1, K-2 and K-3;

(g) The total number of bottom-dump haul trucks and the total number of end-dump haul trucks that delivered raw coal to each of the following coal storage piles – N-11, K-5 or K-6 -- from the date that the pile's monthly aerial survey was performed until midnight of the first day of the following month.

(5) Calculations: Preparation plant's monthly coal production

Based on the measurements and readings made in (3) above and recorded in (4) above during each calendar month, the permittee shall calculate each of the following for that month for each pile (K-1, K-2, K-3, N-11, K-5 and K-6):

(a) Intermediate Pile Size (tons) = volume determined for the pile from the Digital Terrain Model created from its monthly aerial survey multiplied by the applicable density of the type of coal stored, i.e., processed or raw;

(b) Pile Size Residual Increase (tons) = final weight from scale on load-in belt conveyor (first day of following month) minus initial weight from scale on load-in belt conveyor (day of aerial survey) [Piles K-1, K-2 and K-3];

(c) Pile Size Residual Increase (tons) = sum of (1) total number of bottom-dump haul truck deliveries to pile from day of aerial survey to first day of following month multiplied by 210 tons per truckload, and (2) total number of end-dump haul truck deliveries to pile from day of aerial survey to first day of following month multiplied by 80 tons per truckload, [Piles N-11, K-5 and K-6];

(d) Pile Size Residual Decrease (tons) = final weight from scale on load-out belt conveyor (first day of following month) minus initial weight from scale on load-out belt conveyor (day of aerial survey)

(e) Pile Size End-of-Month (tons) = Intermediate Pile Size + Pile Size Residual Increase – Pile Size Residual Decrease

(f) Monthly Stockpile Inventory (tons) = Sum of Pile Size End of Month for each of the six piles

(g) Change in Monthly Stockpile Inventory (tons) = Monthly Stockpile Inventory (tons) minus Previous Monthly Stockpile Inventory (tons)

(h) Monthly Production (tons) = Monthly Sales (tons, as received by NGS) + Change in Monthly Stockpile Inventory (tons)

(i) Annual Production = Monthly Production (tons) + Sum of Monthly Productions for Previous 11 Months

Practical Enforceability of Operational Limitations

A. *Application of Wet Suppression with Presumptive Control Efficiency*

(1.a) Limitation: The permittee shall operate and maintain the existing configuration of nozzles spraying a mixture of water with surfactant onto coal at each crusher, screen and transfer point designated below such that visible emissions from each designated facility are less than 20% opacity.

(i) The control efficiency of the wet suppression applied at such a transfer point (WS_{70}) shall be presumed to be 70% for the month in question if visible emissions from that transfer point comply with the 20% opacity standard in that month.

(ii) If visible emissions from a crusher comply with the 20% opacity standard in any calendar month, the controlled emission rates of PM and PM_{10} from that crusher for that month shall be:

$$ER_{C\text{-}PM} = 0.0012 \text{ lb/ton}$$

$$ER_{C\text{-}PM10} = 0.00054 \text{ lb/ton}$$

(iii) If visible emissions from a screen comply with the 20% opacity standard in any calendar month, the controlled emission rates of PM and PM_{10} from that screen for that month shall be:

$$ER_{S\text{-}PM} = 0.0022 \text{ lb/ton}$$

$$ER_{S\text{-}PM10} = 0.00074 \text{ lb/ton}$$

Scope of Limitation:

- Crushers J28PC, J28PC2, N11PC, N8PC;
- Screens J28S, N11S, N8S;
- NSPS Transfer Points TP1, TP2, TP3, TP4, TP6, TP8, TP9, TP10, TP16, TP17, TP18, TP19, TP20, TP37, TP38, TP41

(1.b) Limitation: The permittee shall operate and maintain the existing configuration of nozzles spraying a mixture of water with surfactant onto coal being loaded into each truck hopper designated below such that visible emissions from each hopper are less than 20% opacity.

(i) The control efficiency of the wet suppression applied at such a hopper (WS_{50}) shall be presumed to be 50% for the month in question if visible emissions from that hopper comply with the 20% opacity standard in that month.

Scope of Limitation: Hoppers J28H5, N11H4

(1.c) Limitation: The permittee shall maintain a residual (carryover) mixture of water with surfactant in coal at each transfer point designated below such that visible emissions from each transfer point are less than 20% opacity.

(i) The control efficiency of the wet suppression applied at such a transfer point (WS_{65}) shall be presumed to be 65% for the month in question if visible emissions from that transfer point comply with the 20% opacity standard in that month.

Scope of Limitation: NSPS Transfer Points TP5, TP7, TP39, TP40

(1.d) Limitation: The permittee shall operate and maintain the existing configuration of nozzles spraying water onto coal at the transfer point designated below such that visible emissions from that transfer point are less than 20% opacity.

(i) The control efficiency of the wet suppression applied at that transfer point (WS_{50}) shall be presumed to be 50% for the month in question if visible emissions from that transfer point comply with the 20% opacity standard in that month.

Scope of Limitation: NSPS Transfer Point TP35

(1.e) Limitation: The permittee shall maintain residual (carryover) water in coal at the transfer point designated below such that visible emissions from that transfer point are less than 20% opacity.

(i) The control efficiency of the wet suppression applied at that transfer point (WS_{45}) shall be presumed to be 45% for the month in question if visible emissions from that transfer point comply with the 20% opacity standard in that month.

Scope of Limitation: NSPS Transfer Point TP36

(1.f) Limitation: For each facility designated above in Conditions (1.a) through (1.e), compliance with the 20% opacity standard in those Conditions shall also constitute compliance with the applicable 20% opacity standard of NSPS Subpart Y.

Scope of Limitation:

- Hoppers J28H5, N11H4
- Crushers J28PC, J28PC2, N11PC, N8PC;
- Screens J28S, N11S, N8S;
- Transfer Points TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP16, TP17, TP18, TP19, TP20, TP37, TP38, TP39, TP40, TP41

(1.g) Limitation: The Permittee shall operate each of the transfer points designated below such that visible emissions from each are less than 20% opacity:

(i) If visible emissions from a transfer point listed below do not exceed that opacity standard during a calendar month, the uncontrolled emission rates of PM and PM_{10} from that transfer point for that month shall be:

$$ER_{TP\text{-}PM} = 0.000721 \text{ lb/ton}$$
$$ER_{TP\text{-}PM10} = 0.000341 \text{ lb/ton}$$

(ii) If visible emissions from a transfer point listed below exceed that opacity standard during a calendar month, the uncontrolled emission rates of PM and PM_{10} from that transfer point for that month shall be:

$$ER_{TP\text{-}PM} = 0.00144 \text{ lb/ton}$$
$$ER_{TP\text{-}PM10} = 0.000682 \text{ lb/ton}$$

(iii) For each transfer point herein, the presumptive control efficiency is 0%.

Scope of Limitation: Transfer Points TP11, TP12, TP13, TP14, TP15, TP21, TP22, TP23, TP25, TP26, TP27, TP30, TP31, TP32, TP33, TP34, TP42, TP43, TP 44, TP45, TP46, TP47, TP48

Explanation: NSPS Subpart Y for coal preparation plants imposes a 20% opacity standard to govern particulate emissions from designated types of coal preparation facilities.[168] The opacity

[168] 40 C.F.R. §60.254(a).

level of particulate matter emitted from a source equipped with add-on control equipment is an indicator of whether the subject control device is being operated and maintained properly.[169] In the case of coal preparation facilities subject to Subpart Y, such as those at Kayenta, EPA concluded that unquantifiable rates of fugitive particulate mass emissions from such facilities equipped with wet suppression techniques were nevertheless acceptable so long as the opacities of those particulate emissions remain below 20%.[170]

As a general rule, any presumption for control efficiency must be technically accurate, and the specific parameters upon which the presumptive efficiency is based must be enforceable limits to assure that the efficiency will be met.[171] However, in the case of a presumptive efficiency for a specific application of wet suppression to control fugitive particulate emissions, the technical accuracy of that presumptive efficiency cannot be verified because measurement of such emissions, with and without the wet suppression, is technically infeasible.

At best, presumptive efficiencies for the different forms of wet suppression applied at Kayenta can be estimated by using engineering judgment. Such an engineering analysis is typically informed by credible estimates of efficiencies for types of wet suppression applied to types of processing and handling facilities similar to those under consideration. In Appendix A, the Company describes the scope of and findings from its review of EPA-published information regarding estimated control efficiencies realized by wet suppression.

Notably, in discussing control efficiencies of wet suppression techniques employed in the crushed stone industry, EPA has found that, "[d]ue to carryover of the small amount of moisture

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[169] EPA OAQPS, "Public Comment Summary: Opacity Provisions under Standards of Performance for New Stationary Sources of Air Pollution," 20 (Aug. 1975) ("For a given category of well-controlled stationary sources, opacity can be established as an indicator of particulate matter emissions and proper operation and maintenance of the control system. Opacity standards established in this manner are a reasonable indicator of the emission reduction achievable by application of best control technology.")

[170] Unlike most NSPS regulation of particulate matter, the background information documents for development of Subpart Y do not contain any actual measurements of particulate mass emission rates from the types of facilities at Kayenta which are regulated by that NSPS. The omission of such emissions data from the early-1970s confirms what is still true today, i.e., that reliable, accurate measurements of fugitive particulate emissions from coal preparation facilities are infeasible.

[171] "Enforceability Requirements for Limiting Potential to Emit through SIP and § 112 Rules and General Permits," at 8 (attachment to memorandum from Kathie Stein, EPA Air Enforcement, to EPA Regional Air Directors, of Jan. 25, 1995).

required, it has been shown that each source, with the exception of crushers, does not need to employ direct water sprays."[172] In contrast, Kayenta's wet suppression system relies almost exclusively on either sprays of water-with-surfactant or carryover water-with-surfactant at multiple locations throughout the preparation plant's process flow.

Consequently, based on (1) the Company's literature review of estimated control efficiencies achieved by wet suppression applications to sources similar to Kayenta's preparation facilities, (2) EPA's preceding statement about overall control efficiencies realized by direct water sprays at a single location in stone crushing plants, and (3) many years of prior visible emissions surveys which document that visible emissions from Kayenta's preparation facilities are extremely infrequent, PWCC is confident that its estimated control efficiencies of 90% and 85% for the predominant forms of wet suppression at Kayenta are not unreasonable, i.e., there is some level of technical accuracy in the Company's estimated control efficiencies despite the lack of any feasible means for directly measuring that actual performance.[173]

Nevertheless, as previously explained, in an effort to counter any uncertainty arising from the Company's necessary reliance on emission factors in its PTE calculations for Kayenta, the Company's estimated presumptive control efficiencies of 90% and 85% from surfactant-enhanced wet suppression techniques have been adjusted downward to 70% and 65% for the affected PTE calculations.[174]

Finally, Kayenta's preparation plant includes some transfer points that are not subject to NSPS Subpart Y. Under the requested permit, those facilities, nevertheless, are each subject to a 20% opacity standard. Compliance with that limitation indicates operation of the facility in a manner that minimizes fugitive particulate emissions from the facility, consistent with the uncontrolled emission rates for PM and PM_{10} estimated by application of AP-42's standard drop equation.

(2) Time Period for Limitation: Monthly control efficiency, as confirmed by periodic monitoring

[172] AP-42, Table 11.19.2-2, note b.

[173] Other PWCC estimates of control efficiencies are 70% for one location with water-only sprays and 65% for one location with carryover (residual) water.

[174] In addition, the one estimated presumptive control efficiency of 70% (water spray) was adjusted downward to 50%, and the one estimated presumptive control efficiency of 65% (residual water) was adjusted downward to 45%.

Explanation: A previous section of this document entitled "Description of Kayenta's Coal Preparation Plant" details the basic operating parameters of facilities equipped with some form of wet suppression. Variations in operating parameters of those facilities that could affect the rates of their uncontrolled particulate emissions are not substantial.

If the rate of uncontrolled particulate emissions from a given coal preparation facility is not likely to vary substantially over time, the amount of liquid from sprays or from carryover required to achieve visible emissions of less than 20% opacity from that facility will also not deviate significantly. Therefore, a monthly limitation on each presumptive control efficiency listed above, as indicated by opacity or the specified alternative parameter, is not unreasonable and coincides with the time period for coal throughputs of individual facilities when demonstrating compliance with the limits on Kayenta's PTE.

(3.a) Compliance Monitoring - Opacity: Methods and Frequencies

Explanation: Most of the coal preparation facilities at Kayenta are subject to NSPS Subpart Y's 20% opacity standard promulgated in 1976. However, unlike most, in not all, other NSPS regulations, Subpart Y did not require any compliance monitoring. Consequently, when Kayenta Mine Complex (then known as "Black Mesa Complex") was issued its initial Title V permit in 2003, EPA Region IX had to impose periodic monitoring requirements sufficient to demonstrate compliance with the applicable 20% opacity standard.[175]

To that end, Kayenta's initial Title V permit required not only "a *daily* visual emission survey of each crusher, screen, or transfer point subject to NSPS Subpart Y" but also "a weekly observation of all water sprays associated with [those same] emission points[.]"[176] As Region IX commented at that time, "[w]e do not believe that . . . weekly visible emission surveys and annual method 9 testing are sufficient to assure compliance with a 20% opacity limit at coal handling equipment without baghouses."[177] The rationale for Region IX's comment at that time

[175] 40 C.F.R. § 71.6(a)(3)(i)(B).

[176] EPA Region IX, "Title V Permit to Operate; Permit Number NN-OP 99-07," Conditions II.C.1 and II.C.4, May 21, 2004. Weekly observation of a water meter associated with a water spray was required for those facilities where the sprays could not safely be accessed for observation.

[177] EPA Region IX, "Response to Comments," Title V Permit to Operate No. NN-OP 99-07, 5, Sept. 23, 2003.

is difficult to understand in light of EPA's explicit background information which accompanied development of Subpart Y.

The history of Subpart Y's development makes clear (1) that coal preparation facilities subject to Subpart Y would require some form of control technology to comply with the 20% opacity standard, and (2) that wet suppression was acknowledged by EPA as a "very effective," commonplace particulate control technology for coal preparation facilities.[178] Wet suppression's high level of effectiveness at Kayenta was demonstrated time after time during the source's initial permit term. Over that period, daily visual emission surveys rarely documented any visible emissions from the preparation plant's Subpart Y facilities, much less visible emissions in excess of 20% opacity.

As a result, when Kayenta's initial Title V permit was renewed, the monitoring frequency for visual emission surveys was revised from daily to weekly after "NNEPA and USEPA agree[d] that the frequency of VE surveys could be decreased based on an analysis of the source's compliance data during the initial permit term."[179]

Decisions by permitting authorities on matters such as frequency of compliance monitoring "are always case-specific, and vary depending on factors such as the size and potential to emit of the emission unit, emission limit, margin of compliance, variability of emissions, and whether a control device is necessary to comply with the emission limit."[180] Against that background, Kayenta's compliance data from another eight years, in addition to the initial permit term, continue to speak for themselves.

Visible emission surveys at Kayenta, now over a total of thirteen years, have consistently confirmed that the spray configurations on the affected preparation facilities are highly effective. The applicable 20% opacity limit is repeatedly satisfied by each Subpart Y facility – by a very wide margin. Appendix F to this document summarizes results of visible emission surveys over the past two and a half years. As shown therein, visible emissions were observed only during a

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[178] 41 Fed. Reg. at 2233.

[179] NNEPA, "Statement of Basis: Permit Number NN-OP 08-010," 4, Dec. 2009.

[180] *Id.* at 5.

few visible emission surveys over that entire period, and those emissions never exceeded an instantaneous value of 10% opacity.

In addition, Table 6 demonstrates that the potential to emit PM_{10} from an individual Subpart Y facility at Kayenta is typically less than 2.0 tpy – a level of emissions specifically designated as "insignificant" under the federal Title V program.[181] Furthermore, because operating characteristics of each of those facilities fluctuate little over time, and because the physical properties of coal being processed at Kayenta do not change appreciably, the levels of those facilities' emissions do not vary significantly.

In short, PWCC has estimated herein that Kayenta's potential emissions of PM_{10} and PM are only about 60 tpy and 170 tpy, respectively, i.e., no more than 60% of the minimum required for major source status under the Title V program and no more than 68% of the minimum required for major source status under the PSD program. The extensively documented, consistent level of very low visible particulate emissions from Kayenta's preparation facilities supports a reasonable conclusion that material fluctuations in potential emissions of particulate matter from the preparation plant are highly unlikely. Consequently, the Company requests EPA's concurrence that a monthly frequency for performing visible emission surveys of each hopper, crusher, screen and transfer point at Kayenta is sufficient to ensure that emissions of particulate matter from those facilities will not cause the plant's PTEs for PM, PM_{10} and $PM_{2.5}$ to exceed the levels required for a minor source under the federal PSD and Title V programs.

(3.a) Compliance Monitoring -- Opacity

> (i) For each preparation facility operating during daylight hours (other than those facilities listed below in Condition (3.b), the permittee shall conduct a visible emissions survey on a monthly frequency in accordance with Method 22 of 40 C.F.R. Part 60, Appendix A. Visible emissions from a facility for the calendar month comply with the 20% opacity standard if no instantaneous opacity reading from the Method 22 survey is 10% or greater.
>
> (ii) During a Method 22 survey, if an instantaneous opacity reading is 10% or greater, the permittee thereafter shall conduct a six-minute visible

[181] 40 C.F.R. §71.5(c)(11).

emissions observation in accordance with Method 9 of 40 C.F.R. Part 60, Appendix A. Visible emissions from a facility for the calendar month comply with the 20% opacity standard if that Method 9 six-minute observation is less than 20%.

(iii) For each preparation facility operating during daylight hours (other than those facilities listed below in Condition (3.b), the permittee shall conduct a six-minute visible emissions observation on a calendar quarter frequency in accordance with Method 9 of 40 C.F.R. Part 60, Appendix A.

(iv) If a preparation facility is not operating at the time the observer arrives for the scheduled visible emissions survey for that facility, a visible emissions survey for that facility is not required, unless the visible emissions survey for that facility from the previous month documented an instantaneous opacity of 10% or greater. In that latter case, the visible emissions survey for that facility must be performed later in that same month when the subject facility is operating.

(v) If one or more preparation facilities are housed within a single structure, the permittee shall conduct the Method 22 visible emissions survey or the Method 9 six-minute visible emissions observation at each opening in that structure where particulate matter vents to the atmosphere.

(3.b) Compliance Monitoring – Opacity: Exclusions

The permittee shall not be required to conduct either a monthly Method 22 visible emissions survey or a quarterly Method 9 six-minute visible emissions observation for each of the preparation facilities listed below because either the facility is underground or the coal throughput rate for any facility within a coal sampling system is *de minimis*

- TP1 (Transfer Point from Truck Hopper 5 to Belt 1-N);
- TP2 (Transfer Point from Truck Hopper 5 to Belt 1-S):
- TP3 (Transfer Point from Reclaim Hopper 6 to Belt 8);
- TP9 (Transfer Point from Dome Stockpile Reclaim Hopper to Belt 5);

- TP16 (Transfer Point from Truck Hopper 4 to Belt 34);
- TP24 (Transfer Point from Reclaim Hopper 1 to Belt 27);
- TP28 (Transfer Point from Reclaim Hopper 2-N to Belt 3A);
- TP29 (Transfer Point from Reclaim Hopper 2-S to Belt 3A);
- TP35 (Transfer Point from Reclaim Hopper 3 to Belt 18);
- J28SSC (J-28 Sample System Crusher);
- J28SSTP (J-28 Sample System Transfer Points (7));
- N11SSC (N-11 Sample System Crusher);
- N11SSTP (N-11 Sample System Transfer Points (6));
- N8SSC (N-8 Sample System Crusher); and
- N8SSTP (N-8 Sample System Transfer Points (5)).

(3.c) Compliance Monitoring – Spray Nozzles:

(a) For each preparation facility listed below that is equipped with either sprays of water-with-surfactant or sprays of water only, the permittee shall inspect all water sprays associated with the facility on a monthly frequency to verify that the spray heads are not clogged and that they are otherwise operating as designed.

- Transfer Points: TP3, TP4, TP6, TP8, TP9, TP10, TP17, TP18, TP19, TP20, TP35, TP37, TP38, TP41; and
- Hoppers: J28H5, N11H4

(b) If a liquid spray for any preparation facility is found to be clogged or otherwise not operating in keeping with the spray's design, then the permittee shall take corrective action to repair, replace or modify that spray within 24 hours of finding the spray's operating problem (or on the next weekday, if the spray's operating problem is found during a weekend or on a holiday).

(c) If a liquid spray for any preparation facility is found to be clogged or otherwise not operating in keeping with the spray's design, but the Method 22 results and six-minute Method 9 results (if required) for that facility for that month demonstrate compliance with the 20% opacity standard, then the control efficiency of that spray for that month shall only be 75% of the spray's presumptive control efficiency.

(d) During any calendar month, if a liquid spray for a preparation facility is found to be clogged or otherwise not operating in keeping with the spray's design, and if a six-minute Method 9 result (if any) for that facility for that month is 20% or greater, then the control efficiency of that spray for that month shall only be 25% of the spray's presumptive control efficiency.

(3.d) Compliance Monitoring – Water Meters:

The sprays serving the preparation facilities listed below cannot be accessed safely for direct inspection. Except for the crushers and screen, the other preparation facilities listed below are excluded from any requirement for Method 22 visible emissions surveys or Method 9 six-minute visible emissions observations. The permittee shall inspect the water meter associated with each facility listed below on a monthly frequency to determine whether the meter shows either a significant change in water pressure or a significant drop in water flow rate.

- TP1 (Transfer Point from Truck Hopper 5 to Belt 1-N);
- TP2 (Transfer Point from Truck Hopper 5 to Belt 1-S);
- TP3 (Transfer Point from Reclaim Hopper 6 to Belt 8);
- TP9 (Transfer Point from Dome Stockpile Reclaim Hopper to Belt 5);
- TP16 (Transfer Point from Truck Hopper 4 to Belt 34);
- TP35 (Transfer Point from Reclaim Hopper 3 to Belt 18):
- Screen J28S;
- North and south discharges from Crusher J28PC (not identified as individual transfer points because, by convention, such discharge locations are considered part of the crusher); and

- Feed and discharge points of Crusher N11PC (not identified as individual transfer points because, by convention, such feed and discharge locations are considered part of the crusher).

(i) If the meter for a listed facility, except the crushers and screen, shows either a significant change in water pressure or a significant drop in water flow rate, visible emissions from that facility shall not be deemed in compliance with the 20% opacity standard for the month in question, and the control efficiency of the spray on that facility for that month shall only be 50% of the spray's presumptive control efficiency.

(ii) If the meter for a listed crusher or screen shows either a significant change in water pressure or a significant drop in water flow rate, but the Method 22 results and six-minute Method 9 results (if required) for that facility for that month demonstrate compliance with the 20% opacity standard, then the control efficiency of the spray associated with that meter for that month shall only be 75% of the spray's presumptive control efficiency.

(iii) If the meter for a listed crusher or screen shows either a significant change in water pressure or a significant drop in water flow rate, and if the six-minute Method 9 results (if any) for that facility for that month are 20% or greater, then the control efficiency of the spray associated with that meter for that month shall only be 25% of the spray's presumptive control efficiency.

Explanation: Most of Kayenta's coal preparation facilities are regulated under the original version of NSPS Subpart Y that was promulgated in 1976.[182] Unlike other NSPS regulations, the original version of Subpart Y does not require any monitoring to demonstrate compliance with the 20% opacity standard, i.e., to demonstrate that the control technology installed on the subject affected facility is being operated and maintained properly. Consequently, during issuance of the

[182] 41 Fed. Reg. 2232 (Jan. 15, 1976) (codified at 40 C.F.R. §§60.250 *et seq.*)

initial Title V permit for Kayenta (then as part of the "Black Mesa Complex"), EPA Region IX imposed periodic monitoring requirements for Kayenta's Subpart Y affected facilities.

PWCC proposes to continue its ongoing application of Region IX's approach to demonstrating acceptable performance of wet suppression at Kayenta's Subpart Y preparation facilities by relying on that same periodic monitoring of those facilities. For the requested synthetic minor source permit, however, that periodic monitoring approach must be extended to each emissions unit which contributes to Kayenta's PTE, i.e., all coal preparation facilities at Kayenta.

Because control efficiencies of wet suppression applications at Kayenta cannot be directly measured, parametric monitoring of the performance of each wet suppression application is required. The opacity level of fugitive particulate emissions from a preparation facility equipped with wet suppression is the preferred indicator of the efficiency of that control technology. The operating status of liquid sprays at some preparation facilities is another parameter monitored to assess relative performance of that method of wet suppression.

For the most part, those compliance monitoring requirements developed originally by EPA Region IX have simply been re-stated and re-formatted herein to add further specificity, clarity and consistency. Tiered reductions in presumptive control efficiencies have been added as a consequence of deviations from the operational limitations used to restrict Kayenta's PTE.

(4.a) Recordkeeping -- Opacity:

The permittee shall record and maintain the following records for each Method 22 visible emissions survey and for each Method 9 six-minute visible emissions observation:

(a) Name of observer

(b) Affected preparation facility and confirmation that it was operating;

(c) Date and time of the Method 22 survey or the Method 9 observation;

(d) Statement of whether visible emissions were detected during Method 22 survey, and, if so, whether an instantaneous opacity of 10% or greater was observed;

(e) Result of follow-up Method 9 observation, if required.

(4.b) Recordkeeping – Sprays:

The permittee shall record and maintain the following records for each water spray and each water meter inspection:

(a) Name of inspector;

(b) Affected preparation facility;

(c) Date and time of the inspection;

(d) Whether the sprays (if inspected) were clogged or otherwise not operating as designed;

(e) Whether the water meters (if inspected) showed a significant change in water pressure or drop in water flow rate;

(g) A description of any corrective actions taken.

B. *Inherent Process Design Features*

A number of Kayenta's preparation facilities contain inherent process design features that provide a collateral benefit of also reducing fugitive particulate emissions from those facilities. As previously explained, EPA has long held that such emission reductions constitute restrictions on those facilities' potentials to emit.

The following list identifies (1) the types of preparation facilities at Kayenta whose designs incorporate an enclosure, (2) the estimated "control efficiency" realized by covering each type of facility, and (3) the specific preparation facilities at Kayenta whose calculated PTEs include the emission reductions achieved by their enclosures.[183]

[183] Because enclosures of crushing and screening operations at coal preparation plants are standard design features for such facilities, the emission-reduction effects of those enclosures are incorporated within the respective emission factors selected herein to estimate particulate emission rates from those types of facilities at Kayenta. EPA's preamble during its NSPS Subpart Y rulemaking makes clear, however, that such enclosures are not regarded as air pollution control equipment but rather as inherent process design features that also happen to reduce particulate emissions.

Type of Covered Facility	Estimated Control Efficiency	Kayenta Facilities Affected[184]
(1) Transfer Point: Hopper Bottom to Conveyor Belt	99% (underground enclosure)	TP1, TP2, TP3, TP9, TP16, TP24, TP28, TP29, TP35
(2) Area J-28 Storage Pile		Dome over Coal Pile
- covering transfer point from elevated feeder	99%	
- enclosing dome to prevent wind erosion	100%	

With respect to the need for permit conditions requiring the installation and use of inherent operational design features, EPA has opined that, "[a]lthough . . . source owners could in most cases readily accept enforceable limitations restricting the operation to its designed level, EPA believes this administrative requirement for such sources to be unnecessary and burdensome."[185] PWCC concurs with that Agency statement and asks that the requested permit contain a single condition, as follows:

> Limitation: Because the enclosure surrounding each preparation facility designated below constitutes an inherent process design feature of that facility, that enclosure is recognized as reducing any particulate matter emitted from that facility, after the effect of wet suppression applied to that facility (if any), by no less than 99%, as long as that enclosure remains a permanent part of that facility.

[184] The scope of those Kayenta preparation facilities that realize emission reductions due to inherent process design features has been limited herein only to those transfer points in underground locations along with a single transfer point and coal storage pile covered by a dome at Area J-28. Kayenta's PTE would be even lower than shown herein if the Company had also accounted for the emission reductions due to the covers and chutes surrounding many other transfer points at the preparation plant.

[185] Memorandum from John Seitz, EPA OAQPS, to EPA Regional Air Directors of Sept. 6, 1995 ("Calculating Potential to Emit (PTE) for Emergency Generators") (*citing* Seitz/van Heuvelen Memo of Jan.25, 1995 ("Options for Limiting the Potential to Emit (PTE) of a Stationary Source Under Section 112 and Title V of the Clean Air Act (Act)")).

Scope of Limitation:

- TP1 (Transfer Point from Truck Hopper 5 to Belt 1-N);
- TP2 (Transfer Point from Truck Hopper 5 to Belt 1-S):
- TP3 (Transfer Point from Reclaim Hopper 6 to Belt 8);
- TP8 (Transfer Point from Elevated Feeder to Dome Stockpile);
- J28DS (Dome Stockpile);
- TP9 (Transfer Point from Dome Stockpile Reclaim Hopper to Belt 5);
- TP16 (Transfer Point from Truck Hopper 4 to Belt 34);
- TP24 (Transfer Point from Reclaim Hopper 1 to Belt 27);
- TP28 (Transfer Point from Reclaim Hopper 2-N to Belt 3A);
- TP29 (Transfer Point from Reclaim Hopper 2-S to Belt 3A);
- TP35 (Transfer Point from Reclaim Hopper 3 to Belt 18);

Practical Enforceability of Emission Limitations

The requested synthetic minor source permit will require a periodic demonstration that Kayenta's actual annual particulate emissions are less that the applicable thresholds which define a major source for purposes of the federal Title V and PSD programs. If emission limitations are used to restrict a stationary source's PTE, then all actual emissions must be considered in determining compliance with the respective limitations.[186] The Company has previously demonstrated that "all actual emissions" in the context of Kayenta's potential to emit particulate matter consist of fugitive particulate emissions from all preparation facilities that comprise Kayenta's coal preparation plant.

In order for an emission limitation to be enforceable as a practical matter, the permit must clearly specify how emissions will be measured *or determined* for purposes of demonstrating compliance with the limitation.[187] The limitation must be supported by monitoring,

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[186] *Hu Honua Order* at 10-11; Cash Creek Order at 15; *Kentucky Syngas Order* at 29-30.

[187] *Hu Honua Order* at 10 (emphasis added).

recordkeeping and reporting requirements "sufficient to enable regulators and citizens to determine whether the limit has been exceeded."[188]

Identified below are (1) an emission limitation on fugitive particulate matter from each coal preparation facility at Kayenta, and (2) additional requirements for the time period, monitoring, recordkeeping, calculations and reporting that will be necessary for each limitation to be practically enforceable:

(1.a) Limitation – Crusher Emission Rate: Each crusher shall be operated only with concurrent operation of its existing configuration of nozzles which shall spray a mixture of water-with-surfactant. When demonstrating compliance with the permitted annual emission restrictions on PM and PM_{10} from Kayenta, the rate of controlled fugitive emissions of either PM or PM_{10} from each crusher shall be the following:

$$ER_{C\text{-}PM} = 0.0012 \text{ lb/ton}$$
$$ER_{C\text{-}PM10} = 0.00054 \text{ lb/ton}$$

(1.b) Limitation – Screen Emission Rate: Each screen shall be operated only with concurrent operation of its existing configuration of nozzles which shall spray a mixture of water-with-surfactant. When demonstrating compliance with the permitted annual emission restrictions on PM and PM_{10} from Kayenta, the rate of controlled fugitive emissions of either PM or PM_{10} from each screen shall be the following:

$$ER_{S\text{-}PM} = 0.0022 \text{ lb/ton}$$
$$ER_{S\text{-}PM10} = 0.00074 \text{ lb/ton}$$

(1.c) Limitation – NSPS Transfer Point Emission Rate: Each NSPS transfer point, except the two transfer points used for truck hopper loading, shall be operated only with concurrent application of its existing form of wet suppression. When demonstrating compliance with the permitted annual emission restrictions on PM and PM_{10} from Kayenta, the rate of uncontrolled fugitive emissions

[188] *Yuhuang Order* at 14 (*quoting In the Matter of Orange Recycling and Ethanol Production Facility, Pencor-Masada Oxynol, LLC,* Order on Petition No. II-2001-05, at 7 (Apr. 8, 2002) ("2002 *Pencor-Masada Order*"))

of either PM or PM_{10} from each transfer point shall be calculated using the following equation:

$$ER = [k(0.0032)]\frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

where:

ER_{TP-PM} or $E_{RP-PM10}$ = the monthly average emission rate of PM or PM_{10} (lb/ton)
k = a dimensionless particle size multiplier (0.74 for TSP; 0.35 for PM_{10})
U = monthly average mean wind speed (mph)
M = monthly moisture content of the process coal (wt.%)

(1.d) Limitation – Hopper Loading Emission Rate: Each of the two truck hoppers shall be operated only with concurrent operation of its existing configuration of nozzles which shall spray a mixture of water-with-surfactant. When demonstrating compliance with the permitted annual emission restrictions on PM and PM_{10} from Kayenta, the rate of uncontrolled fugitive emissions of either PM or PM_{10} from each hopper shall be calculated using the following equation:

$$ER = A[k(0.0032)]\frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

where:

ER_{HL-PM} or $ER_{HL-PM10}$ = the monthly emission rate of PM or PM_{10} (lb/ton)
k = a dimensionless particle size multiplier for coal (0.74 for TSP; 0.35 for PM_{10})
U = monthly average mean wind speed (mph)
M = monthly moisture content of the process coal (wt.%)
A = dimensionless activity factor to account for "non-standard" drop operation = 3 (As explained previously. This activity-factor approach has been used in the past by EPA when estimating emissions from a type of drop activity that are visually different from those of a front-end loader dropping aggregate material onto a flat, open-air surface – the reference

activity for development of the "standard drop equation" for transfer points.)

(1.e) Limitation – Coal Pile Maintenance Emission Rate:

$$ER_{TSP} = \frac{5.7(s)^{1.2}}{(M)^{1.3}}$$

$$ER_{PM10} = \frac{0.75(s)^{1.5}}{(M)^{1.4}}$$

where:

$ER_{CPM\text{-}PM}$ or $ER_{CPM\text{-}PM10}$ = the monthly emission rate of PM or PM_{10} (lb/hr);
s = monthly silt content of coal stored in pile (wt. %); and
M = monthly moisture content of coal stored in pile (wt.%).

(1.f) Limitation – Coal Pile Wind Erosion Emission Rate:

$$ER\text{we} = k\sum_{i=1}^{N} P_i$$

$$P = 58(u^* - u_t)^2 + 25(u^* - u_t),$$

$$\text{but} \quad P = 0 \text{ for } u^* \leq u_t$$

where:

$ER_{WE\text{-}PM}$ or $ER_{WE\text{-}PM10}$ = the monthly emission potential of PM or PM_{10} from pile erosion (g/m^2);
k = particle size multiplier (1.0 for PM; 0.5 for PM_{10});
N = number of disturbances per month (assumed daily disturbances);
P_i = erosion potential corresponding to the observed (or probable) fastest mile of wind for each day (g/m^2);
u^* = friction velocity (m/s); and
u_t = threshold friction velocity (m/s).

(1.g) Limitation – Non-NSPS Transfer Point Emission Rate:

(i) When demonstrating compliance with the permitted annual emission restrictions on PM and PM_{10} from Kayenta, the monthly rate of uncontrolled fugitive emissions of either PM or PM_{10} from each non-NSPS transfer point shall be the following, provided that visible emissions from the transfer point for the month in question comply with the applicable 20% opacity standard:

$$ER_{TP\text{-}PM} = 0.000721 \text{ lb/ton}$$
$$ER_{TP\text{-}PM10} = 0.000341 \text{ lb/ton}$$

(ii) When demonstrating compliance with the permitted annual emission restrictions on PM and PM_{10} from Kayenta, the monthly rate of uncontrolled fugitive emissions of either PM or PM_{10} from each non-NSPS transfer point shall be the following, provided that visible emissions from the transfer point do not comply with the 20% opacity standard:

$$ER_{TP\text{-}PM} = 0.00144 \text{ lb/ton}$$
$$ER_{TP\text{-}PM10} = 0.000682 \text{ lb/ton}$$

Explanation for Each Emission Limitation: The design/operating characteristics of each type of preparation facility at Kayenta and the nature of its particulate emissions have been provided in an earlier section of this document along with the particular emission factors/equations selected by the Company as most appropriate for representing the estimated rates of those emissions from Kayenta's facilities. In addition, a detailed discussion of other emission factors/equations that were considered for application to Kayenta's facilities, and the basis for the Company's rejection of same, is contained in Appendix C.

(2) Time Period for Each Emission Rate: Monthly

Explanation: Other than a start-up, a shutdown or a malfunction, Kayenta's preparation facilities operate in a continuous, steady-state manner. The characteristics of the coal being processed, handled and temporarily stored do not change materially. The intensity and frequency of the dust-generating mechanical forces on that coal from each piece of processing or handling equipment do not vary. Given the general absence of the kinds of transient operating conditions which could give rise to material variations in particulate emission rates from one or more preparation facilities, the rate or quantity of wet suppression applied to each facility does not require frequent monitoring and adjustment to ensure that the facility's visible emissions remain minimal, i.e., well below the applicable 20% standard.

In short, a time period for evaluating particulate mass emission rates from those facilities on a monthly basis provides sufficient assurance that the plant's actual annual particulate emissions, when rolled as a 12-month average, will be consistently lower than the relevant applicability thresholds for the federal PSD and Title V programs.

(3.a) Compliance Monitoring – Crusher Emission Rate: The emission rate from this type of preparation facility will not require monthly evaluation because it remains a constant value. Uncertainty associated with the use of this single-value emission factor will be reduced due to its application for estimates of long-term (annual) emissions on a rolling 12-month basis.

(3.b) Compliance Monitoring – Screen Emission Rate: The emission rate from this type of preparation facility will not require monthly evaluation because it remains a constant value. Uncertainty associated with the use of this single-value emission factor will be reduced due to its application for estimates of long-term (annual) emissions on a rolling 12-month basis.

(3.c&d) Compliance Monitoring – Transfer Point Emission Rate, including Hopper Loading:

(i) Process Coal Sampling: On a daily basis, the permittee shall collect a sample of processed coal using each of the coal sampling systems for Areas J-28, N-11 and N-8.

(ii) Process Coal Moisture Analysis: After a daily sample of coal has been collected from each of the three coal sampling systems, the actual daily moisture content of each sample (m_{J28}, m_{N11} and m_{N8}) shall be determined, in weight percent, with the following analytical methodologies:[189]

- ASTM Method 3302 – to measure the sample's loss of moisture during air-drying; and
- ASTM Method 3173 – to measure the sample's additional loss of moisture during oven-drying at 104 °C – 110 °C for one hour.

(iii) Wind Speed: The permittee shall use the existing anemometer and data logger for Kayenta's meteorological monitoring station, BM-MET9, to measure site-specific wind speed continuously and to convert those

[189] *See* EPA, *Coal Sampling and Analyses: Methods and Models*, EPA-600/7-85-024, 48 (June 1985)

measurements into values of hourly wind speed (U_h), in units of miles per hour.

Explanation: The emission rates from these types of facilities are each a function of coal moisture content and mean hourly wind speed. Wind speed and moisture content will be measured on an hourly and a daily basis, respectively. Monthly averages for each parameter will be calculated for subsequent use in calculating the monthly emissions of PM and PM_{10} from all transfer points at the preparation plant

Each of the preparation areas (J-28, N-11 and N-8) is equipped with an automated coal sampling system. At Area J-28 the coal sampling system is located downstream of the crushing and screening facilities, prior to the processed coal being transferred onto Belt 5 for subsequent transfer to the East Overland Conveyor. At Area N-11, processed coal is automatically sampled downstream of the crushing and screening facilities, prior to being transferred onto Belt 36 for subsequent transfer to the East Overland Conveyor. At Area N-8 the coal sampling system is located downstream of the screening facility, prior to the processed and blended (if necessary) coal being transferred onto Belt 30 for subsequent transfer to the West Overland Conveyor.

The analytical methodologies for determining coal moisture content are the same as those used by EPA for determining the moisture contents of coal at western surface coal mines which are reported in Table 13.2.4-1 of AP-42.[190]

PWCC operates, maintains and quality-assures an anemometer installed on a 10-meter meteorological tower as part of a multi-station ambient air monitoring network around the Kayenta Mine Complex.

(3.e) Compliance Monitoring – Coal Pile Maintenance Emission Rate:

(i) Stored Coal Sampling: On or about the 15th day of each calendar month, the permittee shall collect a sample of processed coal from one of the three interim storage piles (K-1, K-2 and K-3) at Area N-8. The specific pile sampled will rotate monthly as follows: K-1, then K-2, then K-3, then back to K-1 and repeat. Storage pile sampling shall be conducted in keeping with

[190] *See also* EPA, AP-42, Appendix C,2 ("Procedures for Laboratory Analysis of Surface/Bulk Dust Loading Samples"), C.2-2 ("Moisture Analysis") at C.2-5 (5th ed., July 1993).

those procedures contained in AP-42, Appendix C.1 ("Procedures for Sampling Surface/Bulk Dust Loading") at C.1-9 ("Samples from Coal Piles"), (5th ed., 1993).

(ii) Stored Coal Moisture Analysis: The permittee shall determine the actual monthly moisture content of each monthly coal sample from a coal storage pile (M_{K1}, M_{K2} or M_{K3}, as applicable), in weight percent, with the following analytical methodologies:[191]

- ASTM Method 3302 – to measure the sample's loss of moisture during air-drying; and
- ASTM Method 3173 – to measure the sample's additional loss of moisture during oven-drying at 104 °C – 110 °C for one hour.

(iii) Stored Coal Silt Analysis: The permittee shall determine the actual monthly silt content of each monthly coal sample from a coal storage pile (s_{K1}, s_{K2} or s_{K3}, as appropriate), in weight percent, with the following analytical methodology: AP-42, Appendix C.2 ("Procedures for Laboratory Analysis of Surface/Bulk Dust Loading Samples") at C.2-6 ("Silt Analysis"), (5th ed., July 1993).

(iv) Coal Pile Maintenance Hours: For each of the three coal storage piles at Area N-8, the permittee shall monitor the total number of hours in each calendar month that each bulldozer performed maintenance on that pile, $h_{iCPM-K1}$, $h_{iCPM-K2}$, $h_{iCPM-K3}$, where i represents the i^{th} bulldozer that performed h hours of pile maintenance on a specific pile. For each of those piles, monitoring of a bulldozer's operating time on a pile shall be conducted with an automatic timer on the bulldozer which aggregates its total monthly hours of maintenance on that pile.

Explanation: The rate of particulate emissions from a coal storage pile caused by bulldozers performing pile maintenance (lb/hr of dozer operation) is a function of coal moisture content (M) and coal silt content (s). Each of those parameters will be measured on a monthly basis for

[191] *See* EPA, *Coal Sampling and Analyses: Methods and Models*, EPA-600/7-85-024, 48 (June 1985)

subsequent use in calculating the monthly emissions of PM and PM_{10} from each interim storage pile at Area N-8.

The contents of each of those storage piles consist of processed coal from Areas J-28 and N-11 which is transported to each pile by the East Overland Conveyor. Given the relative uniformity of that incoming coal, physical properties of coal on each pile are not expected to be significantly different in any month. Therefore, monthly moisture and silt contents will be determined for coal sampled from one pile of coal, and those values of moisture content and silt content are assumed to be representative of those properties of coal within the other two piles. That is, for any given month: $M_{K1} = M_{K2} = M_{K3}$ and $s_{K1} = s_{K2} = s_{K3}$. Pile sampling will occur on a round-robin basis so that each pile is sampled at the same annual frequency.

The analytical methodologies for determining coal moisture content and coal silt content are the same as those used by EPA for determining those physical properties of coal at western surface coal mines, as reported in Table 13.2.4-1 of AP-42.[192]

(3.f) Compliance Monitoring – Coal Pile Wind Erosion Emission Rate

(i) Wind speed: The permittee shall use the existing anemometer and data logger for Kayenta's meteorological monitoring station, BM-MET9, to measure site-specific wind speed continuously, in knots, and to convert those measurements into values of hourly mean wind speed (u), in units of meters per second.

(ii) Pile surface area: During the last week of each calendar month, the permittee shall measure the total surface area (m^2) of each of the three coal storage piles (A_{K1}, A_{K2} and A_{K3}) in accordance with the methodology described in the discussion of "Stockpile Area Measurements" contained in this documents prior subsection entitled *Practical Enforceability of Production Limitation.*

[192] *See also* EPA, AP-42, Appendix C,2 ("Procedures for Laboratory Analysis of Surface/Bulk Dust Loading Samples") C.2-2 ("Moisture Analysis") at C.2-5 (5th ed., July 1993).

(4.a) Recordkeeping – Crusher Emission Rate: The rates of PM and PM_{10} controlled emissions from this type of preparation facility at Kayenta are recorded in this permit as constant values that require no periodic recordkeeping.

(4.b) Recordkeeping – Screen Emission Rate: The rates of PM and PM_{10} controlled emissions from this type of preparation facility at Kayenta are recorded in this permit as constant values that require no periodic recordkeeping.

(4.c&d) Recordkeeping – Transfer Point Emission Rate, including Truck Hopper Loading:

(i) Process Coal Moisture: The permittee shall record the daily measurement of actual coal moisture content (wt.%) from laboratory analysis of coal sampled daily from each processing area (m_{J28}, m_{N11} and m_{N8}). A record of each daily analytical result shall be maintained.

(ii) Wind Speed: The permittee shall maintain a record of actual mean hourly wind speeds (U_h, mph) measured each calendar month by the on-site anemometer.

(4.e) Recordkeeping – Coal Pile Maintenance Emission Rate:

(i) Storage Coal Moisture: The permittee shall record and maintain the monthly result for actual coal moisture content (wt.%) from laboratory analysis of coal sampled monthly from one of the interim coal storage piles (M_{K1} or M_{K2} or M_{K3}). A copy of each reported analytical result shall also be maintained.

Actual monthly moisture content M_{K1} or M_{K2} or M_{K3}, as applicable, shall apply to the following preparation facilities:

- K-1 Stockpile;
- TP24 from Reclaim Hopper 1 to Belt 27;
- K-2 Stockpile; and
- K-3 Stockpile.

(ii) Storage Silt Content: The permittee shall record and maintain the monthly result for actual silt content (wt.%) from laboratory analysis of coal sampled monthly from one of the interim coal storage piles (s_{K1} or s_{K2} or s_{K3}). A copy of each reported analytical result shall also be maintained.

Actual monthly silt content, s_{K1} or s_{K2} or s_{K3}, as applicable, shall apply to the following preparation facilities:

- K-1 Stockpile;
- K-2 Stockpile; and
- K-3 Stockpile;

(iii) Coal Pile Maintenance Hours: For each of the three coal storage piles at Area N-8, the permittee shall record and maintain the total number of hours in each calendar month that each bulldozer performed maintenance on that pile, $h_{iCPM-K1}$, $h_{iCPM-K2}$, $h_{iCPM-K3}$, where i represents the i^{th} bulldozer that performed h hours of pile maintenance on a specific pile.

(4.f) Recordkeeping -- Coal Pile Wind Erosion Emission Rate:

(i) The permittee shall record and maintain hourly mean wind speeds (u), m/sec, measured each calendar month by the on-site anemometer.

(ii) The permittee shall record and maintain the surface area of each coal storage pile at Area N-8 as measured during each calendar month.

(iii) The permittee shall record and maintain the following calculated values for each calendar month:

- Fastest mile of wind during each day;
- Friction velocities for each day for normalized wind speeds of 0.2, 0,6, and 0.9 (subareas of pile);
- PM and PM_{10} erosion potentials for each day for each subarea of pile;
- Surface areas of each subarea of pile.

(5.a) Calculation – Crusher Emission Rate: None (Fixed values of 0.0012 lb PM/ton of coal and 0.00054 lb PM_{10}/ton of coal)

(5.b) Calculation – Screen Emission Rate: None (Fixed values of 0.0022 lb PM/ton of coal and 0.00074 lb PM_{10}/ton of coal

(5.c) Calculation – Transfer Point Emission Rate:

(i) Process Coal Moisture:

Actual monthly moisture content of processed coal in each processing area (M_{J28}, M_{N11} and M_{N8}) shall be calculated as the sum of the daily measured moisture contents of coal from a specific area (m_{J28}, m_{N11} and m_{N8}) divided by the number of daily coal samples from that area during that month;

Actual monthly moisture content M_{J28} shall apply to coal at the following preparation facilities:

- J28H5 Truck Hopper 5 Loading;
- TP1 from Hopper 5 to Belt 1-N;
- TP2 from Hopper 5 to Belt 1-S;
- TP3 from Reclaim Hopper 6 to Belt 8;
- TP4 from Belt 2 to Screen;
- TP5 from Screen/Crusher to Belt 5;
- TP6 from Screen/Crusher to Belt 6;
- TP7 from Belt 6 to Elevated Feeder;
- TP8 from Elevated Feeder to Dome Stockpile;
- TP9 from Dome Stockpile Reclaim to Belt 5;
- TP10 from Belt 5 to EOC Belt 20
- TP11 from EOC Belt 20 to EOC Belt 21;
- TP12 from EOC Belt 21 to EOC Belt 22;
- TP13 from EOC Belt 22 to EOC Belt 23;
- TP14 from EOC Belt 23 to EOC Belt 24; and
- TP15 from EOC Belt 24 to EOC Belt 25.

Actual monthly moisture content M_{N11} shall apply to coal at the following preparation facilities:

- N11H4 Truck Hopper 4 Loading;
- TP16 from Hopper 4 to Belt 34;
- TP17 from Belt 35 to Screen;
- TP18 from Screen to Belt 36; and
- TP19 from Belt 36 to EOC Belt 25

Actual monthly moisture content M_{N8} shall apply to coal at the following preparation facilities:

- TP28 from Reclaim Hopper 2 North to Belt 3A;
- TP29 from Reclaim Hopper 2 South to Belt 3A;
- TP30 from Belt 3A to Belt 3;
- TP35 from Reclaim Hopper 3 to Belt 18;
- TP36 from Belt 18 to Belt 28;
- TP37 from Belt 27 to Belt 31;
- TP38 from Belt 28 to Belt 31;
- TP39 from Belt 31 to Screen;
- TP40 from Screen/Crusher to Belt 33;
- TP41 from Belt 33 to Belt 30;
- TP42 from Belt 30 to WOC Belt 21A;
- TP43 from WOC Belt 21A to45 WOC Belt 21;
- TP44 from WOC Belt 21 to WOC Belt 22;
- TP45 from WOC Belt 22 to WOC Belt 23;
- TP46 from WOC Belt 23 to Silo Storage;
- TP47 Rail Loadout 1 from Silos; and
- TP48 Rail Loadout 2 from Silos.

Monthly moisture content $M_{J28/N11}$ is the moisture content of mixed processed coal resulting from processed coal from Area N-11 being added to processed coal already on the East Overland Conveyor from Area J-28. $M_{J28/N11}$ shall be calculated according to the following:

- When $M_{J28} < M_{N11}$: $M_{J28/N11} = M_{J28}$

- When $M_{N11} < M_{J28}$: $M_{J28/N11} = M_{N11}$

Actual monthly moisture content $M_{J28/N11}$ shall apply to coal at the following transfer points:

- TP20 from EOC Belt 25 to Belt 3;
- TP21 from Belt 3 to Belt 28;
- TP22 from Belt 3 to Belt 4;
- TP23 from Belt 4 to K1 Stockpile;
- TP25 from EOC Belt 25 to Belt 11;
- TP26 from Belt 11 to Belt 12;
- TP27 from Belt 12 to K2 Stockpile;
- TP31 from Belt EOC Belt 25 to Belt 14;
- TP32 from Belt 14 to Belt 15;
- TP33 from Belt 15 to Belt 16; and
- TP34 from Belt 16 to K3 Stockpile.

(iv) Monthly mean wind speed, U, in mph, shall be determined by:

- Summing all hourly mean wind speeds (u) measured during the calendar month and dividing that sum by the number of hours of measured wind speed for that month; and

(v) For each calendar month the permittee shall calculate the actual monthly emission rates of PM and PM_{10} from each transfer point, excluding truck hoppers, with the following equation:

$$ER = [k(0.0032)]\frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

where:

$ER_{TP\text{-}PM}$ or $ER_{TP\text{-}PM10}$ = actual monthly emission rate of PM or PM_{10} from specific transfer point (lb/ton of coal)

k = a dimensionless particle size multiplier (0.74 for TSP; 0.35 for PM_{10})

U = site-specific actual monthly mean wind speed (mph)
M = actual monthly moisture content of the coal at that transfer point (wt.%)

Explanation: Once coal from Area N-11 is transferred onto the East Overland Conveyor containing coal from Area J-28, the moisture content of the mixed coal going to Area N-8 will be higher than the lower moisture content of the two separate coals but lower than the higher moisture content of the two separate coals. Emissions from the transfer points handling this mixed coal are inversely proportional to the coal's moisture content. Therefore, the moisture content of this mixed coal is conservatively estimated as the lower moisture content of the two separate coals.

(5.d) Calculation – Truck Hopper Loading Emission Rate: For each calendar month the permittee shall calculate the actual monthly emission rates of PM and PM_{10} from loading each truck hopper with the following equation:

$$ER = A[k(0.0032)]\frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

where:

$ER_{HL\text{-}PM}$ or $ER_{HL\text{-}PM10}$ = actual monthly emission rate of PM or PM_{10} from truck hopper (lb/ton of coal)
k = a dimensionless particle size multiplier for coal (0.74 for TSP; 0.35 for PM_{10})
u = site-specific actual monthly mean wind speed (mph)
M = actual monthly moisture content of the coal at that truck hopper (wt.%)
A = dimensionless activity factor to account for "non-standard" drop operation = 3

(5.e) Calculation -- Coal Pile Maintenance Emission Rate:

(i) For each calendar month the permittee shall calculate the actual hourly emission rates of PM and PM_{10} from maintenance of the three coal storage piles with bulldozers using the following equations:

$$ER_{CPM-PM} = \frac{5.7(s)^{1.2}}{(M)^{1.3}}$$

$$ER_{CPM-PM10} = \frac{0.75(s)^{1.5}}{(M)^{1.4}}$$

where:

ER_{CPM-PM} or $ER_{CPM-PM10}$ = actual hourly emission rate of PM or PM_{10} from maintenance of coal piles with dozers (lb/hr);

s = actual monthly silt content of the coal in pile (wt. %);

M = actual monthly moisture content of the coal in pile (wt.%).

(5.f) Calculation– Coal Pile Wind Erosion Emission Rate

(i) For each calendar month the permittee shall calculate the monthly erosion potentials for PM and PM_{10} from the coal storage piles at Area N-8 using the industrial wind erosion equations of AP-42, Section 13.2.5, as shown below.

$$ERwe = k\sum_{i=1}^{N} P_i$$

$$P_i = 58(u_i^* - u_t)^2 + 25(u_i^* - u_t),$$

but $P = 0$ for $u^* \leq u_t$

The methodology for performing those calculations for an individual pile shall be consistent with the following step-wise procedure at page 13.2.5-8 of AP-42:[193]

- Use a default value of 1.12 m/s for threshold friction velocity of an uncrusted coal pile at western surface coal mine;[194]
- N = number of days in the calendar month in question (meaning the entire surface area of the pile is disturbed each day of that calendar month);
- calculate u^+ = fastest mile of wind during each hour of a day, m/s, of the calendar month in question, by first converting hourly wind speeds at BM-MET9 from knots to meters per second (m/s) and then

[193] References to pages, tables or figures herein are to those in Section 13.2.5 of AP-42. For a conservative estimate of wind erosion from these piles, each pile is assumed to be completely disturbed every day of the month, meaning that erosion potential (P_i) must be evaluated on a daily basis.

[194] AP-42, Table 13.2.5-2.

calculating the fastest mile of wind during each hour using the following equations:

-- hourly wind speed x 1.52 = 3-second gust speed; and

-- 3-second gust speed ÷ 1.2 = fastest mile of wind.

- tabulate u^+ = fastest mile of wind during each day, m/s, of the calendar month in question (from the compiled list of fastest mile of wind during each hour of that day);
- Identify the values of 0.2, 0.6 and 0.9 as the applicable contours of normalized wind speeds, (u_s/u_r), for conically shaped piles at N-8 like "Pile A" in Figure 13.2.5-2;
- calculate u^* = friction velocity, m/s, for each day of the calendar month in question for each subarea of the pile corresponding to normalized surface wind speeds (u_s/u_r) of 0.2, 0.6 and 0.9;
- calculate daily erosion potential p_i for PM (or PM_{10}) in each subarea of the pile for the calendar month in question using the industrial wind erosion equation for each of the following: $u_s/u_r = 0.2$, $u_s/u_r = 0.6$ and $u_s/u_r = 0.9$, g/m^2/day;
- calculate monthly erosion potential of PM (or PM_{10}) in each subarea of the pile ($P_{us/ur\,=\,0.2}$, $P_{us/ur\,=\,0.6}$ and $P_{us/ur\,=\,0.9}$) by summing all daily erosion potentials for each subarea of the pile for the calendar month in question, g/m^2

DEMONSTRATING COMPLIANCE WITH MINOR SOURCE EMISSION LIMITS

Compliance with the requested permit's caps on actual annual emissions of PM and PM_{10} must each be demonstrated monthly by calculating actual annual emissions from the coal preparation plant as the sum of actual monthly emissions of PM and of PM_{10} from each preparation facility over a period of 12 consecutive months. Compliance with the requested permit's cap on actual annual emissions of $PM_{2.5}$ is satisfied by the conservative assumption that all emissions of PM_{10} consist of emissions of $PM_{2.5}$

(1) Limitations – Actual Annual Emissions from Kayenta's Coal Preparation Plant

> (a) Kayenta's coal preparation plant shall emit not emit 250 tons or more of PM per year, calculated monthly as the sum of each consecutive 12-month period.
>
> (b) Kayenta's coal preparation plant shall emit not emit 100 tons or more of PM_{10} per year, calculated monthly as the sum of each consecutive 12-month period.
>
> (c) Kayenta's coal preparation plant shall emit not emit 100 tons or more of $PM_{2.5}$ per year, calculated monthly as the sum of each consecutive 12-month period. For the purpose of determining compliance with this annual limit, all PM_{10} emitted from the preparation plant is assumed to be $PM_{2.5}$.

(2) Time Period for Limits: Each period of twelve (12) consecutive months.

<u>Calculating Actual Monthly Emissions</u>

Hoppers, Crushers, Screens and Transfer Points

(3.a-d) Compliance Monitoring – Hoppers, Crushers, Screens and Transfer Points;
Monthly Raw Coal Entering Plant

Explanation: In keeping with regulatory requirements of the Department of Interior's Bureau of Land Management (BLM), PWCC implements various measurements of coal quantities throughout the mining and processing activities of Kayenta Mine Complex. Because procedures for processed coal measurement have been in place for decades to satisfy BLM's requirement, the Company proposes to utilize those same procedures to satisfy pending requirements of a synthetic minor source permit from EPA.

The particulate emission rate for each of the subject preparation facilities (hoppers, crushers, screens and transfer points) is expressed in units of pounds of PM (or PM_{10}) per ton of coal throughput. Consequently, in order to determine the pounds of PM (or PM_{10}) emitted from one of those facilities in a given month, the coal throughput rate for that particular facility during that month must be known. To that end, PWCC utilizes the procedures outlined below for (1) quantifying the monthly amount of raw coal which enters the preparation plant and then (2) quantifying how that monthly amount of coal is distributed to individual processing, conveying and storage facilities in keeping with the design configuration of the plant's process flow.

Monthly Raw Coal Entering Preparation Plant

The monthly amount of raw coal entering Area J-28's preparation facilities is equal to the sum of (1) the amount of raw coal delivered from the mine pits of Areas J-19 and J-21 to the Area J-28 truck hopper, and (2) the change in the amount of raw coal stored in Piles K-5 and K-6 adjacent to the Area J-28 hoppers. Likewise, the monthly amount of raw coal entering Area N-11's preparation facilities is equal to the sum of (1) the amount of raw coal delivered from the mine pits of Area N-9 to the Area N-11 truck hopper, and (2) the change in the amount of raw coal stored in Pile N-11 adjacent to the N-11 hopper.[195]

Assuming no monthly accumulation of raw coal in a pit during mining operations, the monthly amount of raw coal delivered from a mine pit is equal to the amount of in-situ coal removed from coal seams associated with that pit. In keeping with its established procedures for BLM measuring and reporting of various coal quantities, each month PWCC uses a terrestrial global positioning system (GPS) to measure how much in-situ coal has been removed from coal seams associated with a specific pit.

Therefore, for any calendar month the total monthly amount of raw coal fed to the preparation facilities at Area J-28 is computed as the sum of (1) the monthly amount of raw coal removed

[195] As Kayenta's mine plan progresses over time, the mining locations for raw coal supplied to Area J-28 and/or to Area N-11 will likely change to some other Area(s) within the boundaries of the Complex. Notice of any such change in mining location will be provided to EPA in the Company's first semi-annual report which follows commencement of that change.

from mining at Area J-19, as determined by GPS, (2) the monthly amount of raw coal removed from mining at Area J-21, as determined by GPS, and (3) the overall change in inventories of raw coal stored in Piles K-5 and K-6, during the period between those monthly GPS field measurements and midnight of the first day of the following month.

Likewise, for any calendar month the total monthly amount of raw coal fed to the preparation facilities at Area N-11 is computed as the sum of (1) the monthly amount of raw coal removed from mining at Area N-9, as determined by GPS, and (2) the change in inventory of raw coal stored in Pile N-11, during the period between the monthly GPS field measurement and midnight of the first day of the following month.

(a) On or about the 25th day of each calendar month, the permittee shall use its well-settled protocol for performing terrain GPS measurements to measure the volume of in-situ coal removed from coal seams associated with the pits in Areas J-19 and J-21.

(b) On the day that terrain GPS measurements are made of coal removed from Areas J-19 and J-21 during each calendar month, the permittee shall begin counting the number of haul trucks delivering raw coal from those Areas to Piles K-5 and K-6 at Area J-28;

(c) On the day that terrain GPS measurements are made at Areas J-19 and J-21 during each calendar month, the permittee shall observe the initial weight readings from the scales located on the load-out conveyor belts for Piles K-5 and K-6;

(d) On or about the 25th day of each calendar month, the permittee shall use its well-settled protocol for performing terrain GPS measurements to measure the volume of in-situ coal removed from coal seams associated with the pit in Areas N-9.

(e) On the day that terrain GPS measurements are made of coal removed from Area N-9 during each calendar month, the permittee shall begin counting the number of haul trucks delivering raw coal from that Area to Pile N-11;

(f) On the day that terrain GPS measurements are made at Area N-9 during each calendar month, the permittee shall observe the initial weight reading from the scale located on the load-out conveyor belt for Pile N-11;

(g) At midnight of the first day following the latest calendar month when terrain GPS measurements were made at Areas J-19 and J-21, the permittee shall cease counting the number of haul trucks delivering raw coal from those Areas to Piles K-5 and K-6 at Area J-28;

(h) At midnight of the first day of the month following the latest calendar month when GPS measurements were made at Areas J-19 and J-21, the permittee shall observe the final weight readings from the scales located on the load-out conveyor belts for Piles K-5 and K-6;

(i) At midnight of the first day following the latest calendar month when terrain GPS measurements were made at Area N-9, the permittee shall cease counting the number of haul trucks delivering raw coal from those Areas to Pile N-11 at Area N-11;

(j) At midnight of the first day of the month following the latest calendar month when GPS measurements were made at Area N-9, the permittee shall observe the final weight reading from the scale located on the load-out conveyor belts for Piles N-11;

(4.a-d) Recordkeeping – Hoppers, Crushers, Screens and Transfer Points; Monthly Raw Coal Entering Plant

Based on the measurements and readings made in (3) above during each calendar month, the permittee shall record each of the following for that month:

(a) Volume, in ft^3, of coal removed from coal seams at pits in Areas J-19 and J-21, as determined from the monthly survey using terrain GPS;

(b) The total number of haul trucks that delivered raw coal to Piles K-5 and K-6 -- from the date that terrain GPS measurements were made at Areas J-19 and J-21 until midnight of the first day of the following month.

(c) The initial weight reading of the scales located on the conveyor belts which load-out coal from Piles K-5 and K-6;

(d) The final weight reading of the scales located on the conveyor belts which load-out coal from Piles K-5 and K-6;

(e) Volume, in ft^3, of coal removed from coal seams at pits in Area N-9, as determined from the monthly survey using terrain GPS;

(f) The total number of haul trucks that delivered raw coal to Pile N-11 -- from the date that terrain GPS measurements were made at Area N-9 until midnight of the first day of the following month.

(g) The initial weight reading of the scale located on the conveyor belt which loads-out coal from Pile N-11;

(h) The final weight reading of the scale located on the conveyor belt which loads-out coal from Pile N-11;

(5.a-d) Calculations – Hoppers, Crushers, Screens and Transfer Points; Monthly Raw Coal Entering Plant

Based on the measurements and readings made in (3) above and recorded in (4) above during each calendar month, the permittee shall calculate each of the following for that month to determine the quantities of raw coal entering the plant at Area J-28 and at Area N-11:

(a) J-19/J-21 Intermediate Coal Removed (tons) = sum of the volumes removed from coal seams at Areas J-19 and J-21, as determined from their monthly terrain GPS surveys, multiplied by the applicable density of raw coal;

(b) J-19/J-21 Coal Removed Residual Increase (tons) = sum of (1) total number of bottom-dump haul truck deliveries to Piles K-5 and K-6 from day of terrain GPS surveys of Areas J-19 and J-21 to first day of following month multiplied by 210 tons per truckload and (2) total number of end-dump haul truck deliveries to Piles K-5 and K-6 from day of terrain GPS surveys of Areas J-19 and J-21 to first day of following month multiplied by 80 tons per truckload;

(c) J-19/J-21 Coal Removed Residual Decrease (tons) = sum of (1) final weight from scale on Pile K-5 load-out belt conveyor (first day of following month) minus initial weight from scale on that load-out belt conveyor (day terrain GPS survey) and (2) final weight from scale on Pile K-6 load-out belt conveyor (first day of following month) minus initial weight from scale on that load-out belt conveyor (day terrain GPS survey)

(d) *Monthly Raw Coal Entering Plant at Area J-28* = (J-19/J-21 Intermediate Coal Removed) + (J-19/J-21 Coal Removed Residual Increase) - (J-19/J-21 Coal Removed Residual Decrease)

(e) N-9 Intermediate Coal Removed (tons) = volume removed from coal seams at Area N-9, as determined from its monthly terrain GPS survey, multiplied by the applicable density of raw coal;

(f) N-9 Coal Removed Residual Increase (tons) = sum of (1) total number of bottom-dump haul truck deliveries to Pile N-11 from day of terrain GPS survey of Area N-9 to first day of following month multiplied by 210 tons per truckload and (2) total number of end-dump haul truck deliveries to Pile N-11 from day of terrain GPS survey of Area N-9 to first day of following month multiplied by 80 tons per truckload;

(g) N-9 Coal Removed Residual Decrease (tons) = Final weight from scale on Pile N-11 load-out belt conveyor (first day of following month) minus initial weight from scale on that load-out belt conveyor (day terrain GPS survey);

(h) *Monthly Raw Coal Entering Plant at Area N-11* = (N-9 Intermediate Coal Removed) + (N-9 Coal Removed Residual Increase) - (N-9 Coal Removed Residual Decrease)

Calculations – Hoppers, Crushers, Screens and Transfer Points;
Monthly Coal Throughputs to Hoppers, Crushers, Screens and TPs

Explanation: Once the above monthly amounts of raw coal entering the preparation plant at Areas J-28 and N-11 have been calculated, the coal throughput rate for each of the plant's hoppers, crushers, screens and transfer points can be determined in keeping with the overall design of the process flow, beginning with loading raw coal into hoppers and ending with loading processed coal into railcars.

For each of the subject facilities, Table 7 indicates how the monthly coal flow rate through that facility is determined. In all but one instance, a facility's monthly throughput rate is calculated on the basis of other upstream facilities' flow rates that have been previously determined. In one case, a facility's monthly throughput rate is measured with a specific scale located on the affected conveyor belt. As shown in Table 7's column labeled "Determined As," a particular facility's monthly coal throughput rate (tons coal/month) is designated as that facility's "Emission Unit ID."

As an example of how the coal throughput rate, tons/month, for a particular facility is determined from Table 7, consider the following formula designation for determining that rate for J28H5, the throughput for raw coal being transferred into Hopper 5 in Area J-28:

$$T_{J28H5} = (\text{J-19} + \text{J-21 Produced}) - \text{TP3} + (\text{K-5 and K-6 Pile Changes})$$

where:

(J-19 + J-21 Produced) = Monthly Raw Coal Entering Plant at Area J-28, as calculated in accordance with the preceding equations (tons/month);

TP3 = Monthly Coal Throughput at Transfer Point 3, as measured by Belt Scale 8 (J-28 Raw Reclaim) (tons/month);

K-5 (or K-6) Pile Change = (Intermediate Pile Size) + (Pile Size Residual Increase) - (Pile Size Residual Decrease)[196] (tons/month).

[196] This equation for determining monthly change in pile size (tons) is presented in the previous section of this document which addresses the procedure for demonstrating compliance with the annual limit on plant production

In sum, the actual monthly coal throughput rate for each hopper, crusher, screen and transfer point (T_i) must each be calculated in a similar manner by applying the applicable formula for that facility as shown in the "Determined As" column of Table 7.

(a) For each calendar month the permittee shall calculate and then record actual monthly emissions of PM (or PM_{10}) from each truck hopper, crusher, screen and transfer point with the following generic equation:

$$E_i = \{T_i \times ER_i \times [1 - (WS_i/100)] \times [1 - (IP_i/100)]\} \div 2000 \text{ lb/ton}$$

where E_i = actual monthly emissions of PM (or PM_{10}) from the i^{th} facility of the type above, tons PM (or PM_{10}) per month;

T_i = actual monthly coal throughput rate of that i^{th} facility, tons coal per month, determined in accordance with the preceding discussion and the specific formula provided in Table 7;

ER_i = actual monthly emission rate of PM (or PM_{10}) from that facility, pounds of PM (or PM_{10}) per ton coal, determined in accordance with the discussion entitled "Practical Enforceability of Emission Limitations" in the previous section of this document.;

WS_i = actual monthly control efficiency of the specific form of wet suppression applied to that i^{th} facility, 70%, 65%, 50% or 45% presumptive, but can be lower due to monitoring results for that month;[197] determined in accordance with the discussion entitled "Practical Enforceability of Operational Limitations" in the previous section of this document; and

IP_i = actual monthly (fixed) control efficiency (99% or 100%) of a specific inherent process design feature (enclosure), if applicable to the i^{th} facility; specified in the discussion entitled "Practical Enforceability of Operational Limitations" in the previous section of this document.

("Calculations: Preparation plant's monthly coal production"). As shown therein, "Intermediate Pile Size" is the K-5 (or K-6) pile's size when measured by aerial photogrammetry in the latter part of each month; "Pile Size Residual Increase" is the increase in K-5 (or K-6) pile size due to haul trucks delivery of raw coal to that pile from the time of the aerial survey until the first day of the following month; "Pile Size Residual Decrease" is the decrease in K-5 (or K-6) pile size due to load-out from that pile from the time of the aerial survey until the first day of the following month.

[197] The value of this parameter for crushers and screens is zero because their respective emission factors are expressed on a controlled basis.

Coal Pile Maintenance

(5.e) Calculations -- Actual Monthly Emissions from Coal Pile Maintenance:

(i) For each calendar month the permittee shall calculate the actual monthly total hours of dozer maintenance on each coal storage pile at Area N-8 (H_{CPM-K1}, H_{CPM-K2}, H_{CPM-K3}) by summing the total number of hours of maintenance by each dozer on that pile during that month, as follows:

$$H_{CPM-K1} = \sum_{i=1}^{N} h_{iCPM-K1}$$

where:

$h_{iCPM-K1}$ = Actual monthly total hours of i^{th} dozer performing coal pile maintenance on Pile K-1;

H_{CPM-K1} = Actual monthly total hours of all dozers performing coal pile maintenance on Pile K-1;

Calculations of the actual monthly total hours of all dozers performing coal pile maintenance on either Pile K-2 or Pile K-3 are performed in the same manner as above for Pile K-1.

(ii) For each calendar month the permittee shall calculate actual monthly emissions of PM and PM_{10} from each of the three coal storage piles at Area N-8 due to coal pile maintenance with the following equations:

$$CPM_{PM-K1} = (ER_{CPM-PM} \times H_{CPM-K1}) \div 2000 \text{ lb/ton}$$

$$CPM_{PM10-K1} = (ER_{CPM-PM10} \times H_{CPM-K1}) \div 2000 \text{ lb/ton}$$

where:

CPM_{PM-K1} = actual monthly emissions of PM from coal pile maintenance of Pile K1, tons PM per month;

$CPM_{PM10-K1}$ = actual monthly emissions of PM_{10} from coal pile maintenance of Pile K1, tons PM_{10} per month;

$ER_{CPM\text{-}PM}$ or $ER_{CPM\text{-}PM10}$ = actual monthly emission rate of PM (or PM_{10}) from coal pile maintenance of Pile K1, tons PM (or PM_{10}) per hour, calculated in accordance with discussion entitled "Calculation -- Coal Pile Maintenance Emission Rate" in previous section of this document; and

$H_{CPM\text{-}K1}$ = Actual monthly total hours of all dozers performing coal pile maintenance on Pile K-1.

Actual monthly emissions of PM and PM_{10} from maintenance of Piles K-2 and K-3 with dozers are calculated in the same manner as that above for Pile K-1.

Coal Pile Wind Erosion

(5.f) Calculations – Actual Monthly Emissions from Coal Pile Wind Erosion:

(i) Identify the surface area of Pile K-1 (A_{K1}) for the calendar month in question, as measured during the conduct of aerial photogrammetry for each pile, m^2 (see "Compliance Monitoring – Preparation plant's monthly coal production");

(ii) From Table 13.2.5.3 in AP-42, identify each subarea's fraction of the total pile surface area, i.e., fractions of 0.40 for $u_s/u_r = 0.2$; 0.48 for $u_s/u_r = 0.6$; and 0.12 for $u_s/u_r = 0.9$;

(iii) Calculate the size of each subarea of Pile K-1 ($A_{K1us/ur = 0.2}$, $A_{K1us/ur = 0.6}$ and $A_{K1us/ur = 0.9}$) for the calendar month in question by multiplying the total surface area of the Pile K-1 times the fractional size for that subarea determined in the preceding step; m^2;

(iv) Calculate Pile K-1's monthly PM (or PM_{10}) emissions from each subarea by multiplying the subarea's monthly erosion potential times the subarea's surface area; and

(v) Calculate Pile K-1's monthly PM (or PM_{10}) emissions from wind erosion, $E_{K1WE\text{-}PM}$, (or $E_{K1WE\text{-}PM10}$), by adding the individual values of monthly PM (or PM_{10}) emissions from the three subareas of that pile.

Monthly emissions from wind erosion of Pile K-2 or Pile K-3 are each calculated with the identical steps above using applicable pile-specific information.

(5.g) Calculations -- Actual Monthly Emissions from Kayenta's Coal Preparation Plant

Explanation: The preceding parts of this section have explained in detail how actual monthly emissions of PM (or PM_{10}) shall be calculated for each truck hopper, each crusher, each screen and each transfer point at Kayenta's coal preparation plant. Other previous parts of this section have explained in detail how actual monthly emissions of PM (or PM_{10}) shall be calculated for dozer maintenance of three coal storage piles at the plant as well as for wind erosion of those piles.

For each calendar month, the permittee shall determine actual monthly emissions of PM (or PM_{10}) from Kayenta's coal preparation plant as the sum of the actual monthly emissions of PM (or PM_{10}) from each preparation facility at that plant, as calculated in accordance with the applicable equations and parameters detailed previously.

Monthly Compliance Demonstration

Explanation: The requested synthetic minor source permit is intended to restrict Kayenta's potential-to-emit PM to less than 250 tpy and to restrict Kayenta's potentials-to-emit PM_{10} and $PM_{2.5}$ each to less than 100 tpy. Compliance with those source-wide emission limitations is demonstrated when actual annual emissions of PM, PM_{10} and $PM_{2.5}$ from Kayenta's coal preparation plant are each below their applicable limit. Actual annual emissions from Kayenta's coal preparation are calculated on the basis of a rolling 12-month total.

(i) For each calendar month, the permittee shall calculate actual annual emissions of PM (or PM_{10}) from Kayenta's coal preparation plant as the sum of:

- actual monthly emissions of PM (or PM_{10}) from Kayenta's coal preparation plant during the current month; and
- the sum of actual monthly emissions of PM (or PM_{10}) from Kayenta's coal preparation plant during the previous eleven (11) months.

(ii) For the purpose of this compliance demonstration, actual annual emissions of $PM_{2.5}$ shall be equal to actual annual emissions of PM_{10}.

Peabody Western Coal Company

PEABODY WESTERN COAL COMPANY

KAYENTA MINE COMPLEX

APPLICATION

for

SYNTHETIC MINOR SOURCE PERMIT

APPENDICES

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APPENDIX A

APPENDIX A

FACILITY-SPECIFIC ASSESSMENT OF CONTROL EFFICIENCIES FROM WET SUPPRESSION

EPA acknowledged years ago that, "[d]ue to the unconfined nature of emissions from facilities controlled by the wet suppression technique, the quantitative measurement of mass particulate emissions is not possible."[1] If a facility's mass emissions cannot be quantitatively measured, both with and without the application of wet suppression, then clearly the emission-reduction efficiency of that particular wet suppression system cannot be reliably quantified by measurement. As a consequence, an estimate of the emission-reduction efficiency achieved by using wet suppression at a particular type of coal preparation facility must usually be based on prior estimates of such efficiencies provided in EPA-published documents for wet-suppression applications to the same or similar type of processing facility.

The technical basis for those EPA-published estimates of "control" efficiencies for applications of wet suppression to coal preparation facilities is usually little more than the reasoned engineering judgment of experienced air pollution control personnel. Sometimes, however, that engineering judgment has been informed by measured efficiencies for applications of wet suppression to similar types of emitting activities that were temporarily configured with special enclosures and stacks to accommodate conventional stack testing. In particular, the principle of technology transfer allows results from limited emission testing of types of facilities equipped with wet suppression in the crushed stone industry to inform estimates of emission-reduction efficiencies for applications of wet suppression to similar types of facilities at coal preparation plants.

Against that background, the Company has performed the following evaluation of the ranges of estimated control efficiencies achievable by the different forms of wet suppression applied to different types of coal preparation facilities at Kayenta.

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[1] EPA-450/3-81-005b at 9.7-10.

Crushing: ***Water-with-surfactant Sprays -- 77.5% "Control"; Incorporated in Emission Factor Selected for This Type of Facility***

Affected Facilities: J28PC (two identical crushers), N11PC

All of the raw coal from Kayenta's mining activities is initially crushed either by one of two identical double-roll crushers at Area J-28 or by a double-roll crusher at Area N-11. Each of those primary crushers is an "affected facility" under NSPS Subpart Y.[2] Each of those affected facilities has been equipped with a liquid spray system in order to comply with Subpart Y's standard for particulate matter.[3] Table 1 in the accompanying Application identifies the specific number and spatial configuration of spray nozzles located at each primary crusher.

PWCC has previously explained the very limited scope of available mass emission data obtained directly from coal preparation facilities (other than emissions from thermal dryers and air tables, which have no relevance here).[4] PWCC has also acknowledged EPA's recommendation that AP-42 information about fugitive emissions from aggregate processing, handling and storage is generally suitable for characterizing fugitive emissions from those same types of operations with coal. Not only are the types of equipment used by those industries (hoppers, crushers, screens, conveyors, etc.) very similar, but also some of the AP-42 emission equations for aggregate handling and storage were actually based in part on emission information from coal storage piles and their related load-in and load-out activities.

Therefore, PWCC has relied upon the AP-42 "controlled" emission factor for tertiary crushing of stone[5] to characterize particulate emissions from Kayenta's three primary crushers equipped with

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[2] 41 Fed. Reg. at 2234 (codified at 40 C.F.R. §60.250).

[3] 41 Fed. Reg. at 2233.

[4] During development of NSPS Subpart Y in the early-1970s, EPA did obtain data on visible emissions from certain types of coal preparation facilities. However, most of those visible emissions observations were performed on types of facilities that are not utilized at Kayenta. *See* EPA, *Background Information for Standards of Performance: Coal Preparation Plants; Volume 2: Test Data Summary*, EPA-450/2-74-021b (Oct. 1974); EPA, *Background Information for Standards of Performance: Coal Preparation Plants; Volume 3: Supplemental Information*, Appendix A, nEPA-450/2-74-021b (Oct. 1974);

[5] AP-42, Subsection 11.19.2.

sprays of water-with-surfactant. That emission factor for stone crushing with wet suppression[6] reflects a PM_{10} emission-reduction efficiency of 77.5%.

Relative to estimated "control" efficiencies for other applications of wet suppression at Kayenta, an emission-reduction efficiency of 77.5% for direct sprays of water-with-surfactant on Kayenta's primary crushers seems too low. First, when evaluating the extent of technology-transfer for this application of wet suppression, it is generally recognized that a tertiary crusher will normally create a larger proportion of fines in the processed material as compared to the distribution of fine particles in coal processed by a primary crusher.[7] Thus, for given configuration, sprays with a primary crusher are likely to be more efficient than sprays with a tertiary crusher given that the relatively smaller number of fine particles with primary crushing has a greater likelihood of being thoroughly wetted.

In addition, both the inlets and outlets of each primary crusher at Kayenta are configured with multiple spray nozzles to achieve complete particle wetting, thereby increasing the likelihood that a high level of control will be realized. Finally, the virtual absence of visible emissions from Kayenta's primary crushers bears witness to the highly efficient emission reduction actually achieved at those facilities by the multiple sprays of water-with-surfactant.

In sum, multiple sprays of water-with-surfactant are used to control particulate emissions from each primary crusher at Kayenta. PWCC has estimated the level of those emissions by using the AP-42 controlled emission factor for a tertiary crusher equipped with wet suppression. That emission factor corresponds to a 77.5% "control" efficiency, which the Company believes is a conservative (low) estimate of the actual efficiency achieved by the spray systems on Kayenta's primary crushers. PWCC has nevertheless chosen to apply that conservative emission factor when estimating those crushers' potentials to emit.

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[6] *See* AP-42, Table 11.19.2-2, note b ("Controlled sources (with wet suppression) are those that are part of the processing plant that employs current wet suppression technology similar to the study group.").

[7] EPA-450/3-83-001a at 3-38.

Crushing:		***Water-with-surfactant Residual -- 77.5% "Control"; Incorporated in Emission Factor Selected for This Type of Facility***
Affected Facilities:	J28PC2 (formerly J28SC), N8PC (two identical crushers, formerly N8SC)	

The above single-roll crusher at Area J-28 is estimated to process no more than 5% of the total coal throughput to its associated, upstream screen. Similarly, the above two single-roll crushers operating in parallel at Area N-8 are estimated to process collectively no more than 1% of the total coal throughput to their two associated, upstream screens. As PWCC has previously explained, most of the "rejects" from those screens that are fed to the subject three crushers are coal particles that already have been crushed to the desired product size but did not pass through the associated screens within the time allotted by their process design. Consequently, and contrary to PWCC's past description of those particular crushers, designation of the above three facilities as "secondary" crushers is inappropriate because they do not further reduce the size of any coal that was initially crushed.

The main purpose of those single-roll crushers downstream of the screens at J-28 and N-8 is to ensure that any oversize coal that may have somehow by-passed initial primary crushing is ultimately crushed to the desired size of Kayenta's product coal. Because those latter three crushing facilities actually crush much less coal than the initial primary crushers at J-28 and N-11 do, particulate emissions from the subject three facilities are significantly lower than their initial crushing counterparts. Consequently, particulate emissions from the subject crushers can be minimized by a wet-suppression approach that is less rigorous than the multiple water-with-surfactant sprays that are applied at each of the three initial primary crushers.

PWCC has previously explained its justification for relying on technology transfer to characterize particulate emissions from coal preparation facilities based on available emissions information for the same or similar types of facilities in the crushed stone industry. For example, PWCC has used the "controlled" emission factor for tertiary crushing in the crushed stone industry to estimate emissions from Kayenta's primary crushers at J-28 and N-11 that are equipped with water-with-surfactant sprays. Considerations of technology transfer likewise support using that same "controlled" emission factor for tertiary crushing in the crushed stone industry to estimate emissions from Kayenta's single-roll crushers at J-28 and N-8 that rely on water-with-surfactant residual instead of water-with-surfactant sprays. As explained below, supplemental emissions information for the crushed stone industry in AP-42 suggests that PWCC's decision is appropriate.

In a general discussion about the use of residual moisture to suppress formation of fugitive particulate emissions, EPA stated that "[i]f properly conditioned at the initial processing steps, continued application of the wetting agency can be minimized. The wetted material should exhibit some carry-over dust control effect that will last through a number of material handling stages."[8] With respect to widespread use of carry-over moisture in the stone crushing industry, EPA observed that "[d]ue to carry over or [sic] the small amount of moisture required, it has been shown that each source, with the exception of crushers, does not need to employ direct water sprays."[9]

More recently, in discussing reliance on residual moisture to suppress fugitive particulate emissions from coal preparation facilities, the Agency acknowledged that "[w]e agree that water carryover can be an adequate control measure for fugitive emissions for a number of affected facilities when sufficient moisture is delivered by upstream water sprays."[10] Thus, although the single-roll crushers at Kayenta are not equipped with direct sprays, the design of the process flow for that crushing operation provides for the incoming coal being thoroughly wetted by water-with-surfactant sprays immediately upstream of those crushers.

In particular, the J-28 screen immediately upstream of J28PC2 is equipped with no less than 6 direct sprays of water-with-surfactant. As a result, overflow coal dropping from that screen into the single-roll crusher below is assured of being thoroughly wetted by water-with-surfactant residual. Similarly, although the two screens at N-8 are not equipped with direct sprays, coal entering those screens has been thoroughly wetted by multiple water-with-surfactant sprays at Belt 31 which feeds those screens. Because the N-8 screens (N8S) and associated single-roll crushers (N8PC) are close-coupled, i.e., crusher installed directly below screen), coal entering

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[8] EPA, *Control Techniques for Particulate Emissions from Stationary Sources – Vol. 2,* EPA-450/3-81-005b, 9.7-10 (Sept. 1982) (emphasis added); EPA, *Nonmetallic Mineral Processing Plants – Background Information for Proposed Standards,* EPA-450/3-83-001a, 4-6 (Apr. 1983)

[9] AP-42, Table 11.19.2-2, note b.

[10] 74 Fed. Reg. 19,294, 19302 (Apr. 28, 2009).

each screen-crusher combination remains thoroughly wetted by water-with-surfactant residual carried-over from the sprays at Belt 31.

Indeed, AP-42's supplemental emission information for the crushed stone industry provides guidance for indirectly determining whether moisture in the process material is enough to achieve a high level of control of fugitive particulate emissions. Recall that Section 11.19.2 contains both uncontrolled and controlled particulate emission factors for various stone processing and handling activities. A controlled emission factors corresponds to a level of moisture added initially by sprays. Conversely, an uncontrolled emission factor corresponds to a lower moisture level that is below the range representative of control by wet suppression. In deciding which emission factor would be applicable for a given source, EPA explains that

> [v]isual observations of each source under normal operating conditions are probably the best indicator of which emission factor is most appropriate. Plants that employ sub-standard control measures as indicated by visual observations should use the uncontrolled emission factor with an appropriate control efficiency that best reflects the effectiveness of the controls employed.[11]

The unstated corollary to the above guidance is that a source which employs standard or effective control measures "as indicated by visual observations" should use the controlled emission factor.

The lack of visible emissions from the single-roll crushers at J-28 and N-8 during their normal operation indicates that each facility is employing standard or effective control measures. Therefore, in accordance with the above Agency guidance, PWCC has chosen to use the "controlled" emission factor for crushing in the crushed stone industry to estimate emissions from Kayenta's single-roll crushers processing coal containing water-with-surfactant residual. That specific emission factor is representative of control by wet suppression achieving an emission-reduction efficiency of 77.5%.

Although the Company believes that the 77.5% efficiency embedded within that "controlled" emission factor underestimates the level of actual control achieved by water-with-surfactant

[11] AP-42, Table 11.19.2-2, note b.

residual in coal processed by Kayenta's crushers, PWCC has nevertheless chosen to apply that conservative emission factor when estimating those crushers' potentials to emit.

Screening: ***Water-with-surfactant Sprays -- 91.5% "Control" Incorporated in Emission Factor Selected for This Type of Facility***

Affected Facilities: J28S, N11S

Kayenta's double-deck screen at Area J-28 and its single-deck screen at Area N-11 are each an "affected facility" under NSPS Subpart Y.[12] Each of those facilities has been equipped with a liquid spray system in order to comply with Subpart Y's standard for particulate matter.[13] The preceding table identifies the specific number and spatial configuration of spray nozzles located at each of the two screens.

The technical basis for estimating particulate emissions from these screens is the same as that for Kayenta's primary crushers. That is, given the lack of reliable emissions information for coal preparation facilities, PWCC has relied upon the AP-42 "controlled" emission factor for screening stone[14] to characterize particulate emissions from Kayenta's screens at J-28 and N-11. That emission factor for stone screening with wet suppression[15] reflects a PM_{10} emission-reduction efficiency of 91.5%.

In each of those Kayenta screening operations, the primary origin of fugitive particulate emissions, i.e., the screen's surface(s), is equipped with multiple sprays of water-with-surfactant to ensure thorough wetting not only of the incoming pieces of coal but also of the dry surfaces of any new particles created by the mechanical agitation of the screening process. In addition, the perimeters of the screens' are fitted with hanging curtains not only to contain any particulate matter that might be created on the screens therein but also to prevent the entry of local winds which might be strong enough to erode some particles from the screens' surfaces or to entrain some particles dropping onto the screens' surfaces.

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[12] 41 Fed. Reg. at 2234 (codified at 40 C.F.R. § 60.250).

[13] 41 Fed. Reg. at 2233.

[14] AP-42, Subsection 11.19.2.

[15] *See* AP-42, Table 11.19.2-2, note b ("Controlled sources (with wet suppression) are those that are part of the processing plant that employs current wet suppression technology similar to the study group.").

The overall levels of emission control at the subject screens are very high, as confirmed by the virtual absence of any visible emissions from those facilities. PWCC therefore concludes that the 91.5% level of control documented by EPA for wet suppression applied to screening stone is a reasonable approximation of the performance of the water-with-surfactant sprays on Kayenta's screens at J-28 and N-11.

Screening: ***Water-with-surfactant Residual -- 91.5% "Control" Incorporated in Emission Factor Selected for This Type of Facility***

Affected Facilities: N8S (two identical screens)

Raw coal at Kayenta is initially crushed and screened at either Area J-28 or Area N-11. Ultimately all of that coal is screened again by one of the two identical screens at Area N-8. Although water-with-surfactant is not sprayed directly onto the N-8 screens, water-with-surfactant residual, i.e., carry-over moisture, is effective in suppressing emissions of fugitive particulate matter from those latter screens.

PWCC has previously explained its justification for relying on technology transfer to characterize particulate emissions from coal preparation facilities based on available emissions information for the same or similar types of facilities in the crushed stone industry. For example, PWCC has used the "controlled" emission factor for screening in the crushed stone industry to estimate emissions from Kayenta's screens at J-28 and N-11 that are equipped with water-with-surfactant sprays. Considerations of technology transfer likewise support using that same "controlled" emission factor for screening in the crushed stone industry to estimate emissions from Kayenta's screens at N-8 that rely on water-with-surfactant residual instead of water-with-surfactant sprays. As explained below, supplemental emissions information for the crushed stone industry in AP-42 suggests that PWCC's decision is appropriate.

In a general discussion about the use of residual moisture to suppress formation of fugitive particulate emissions, EPA stated that "[i]f properly conditioned at the initial processing steps, continued application of the wetting agency can be minimized. The wetted material should exhibit some carry-over dust control effect that will last through a number of material handling stages."[16] With respect to widespread use of carry-over moisture in the stone crushing industry, EPA observed that "[d]ue to carry over or [sic] the small amount of moisture required, it has been shown that each source, with the exception of crushers, does not need to employ direct water sprays."[17]

More recently, in discussing reliance on residual moisture to suppress fugitive particulate emissions from coal preparation facilities, the Agency acknowledged that "[w]e agree that water carryover can be an adequate control measure for fugitive emissions for a number of affected facilities when sufficient moisture is delivered by upstream water sprays."[18] Thus, although Kayenta's screens at N-8 are not equipped with direct sprays, the design of the process flow for that operation provides for the incoming coal being thoroughly wetted by water-with-surfactant sprays immediately upstream of those crushers. In particular, coal entering those screens has been thoroughly wetted by multiple water-with-surfactant sprays at Belt 31 which feeds those screens.

Indeed, AP-42's supplemental emission information for the crushed stone industry provides guidance for indirectly determining whether moisture in the process material is enough to achieve a high level of control of fugitive particulate emissions. Recall that Section 11.19.2 contains both uncontrolled and controlled particulate emission factors for various stone processing and handling activities. A controlled emission factors corresponds to a level of moisture added initially by sprays. Conversely, an uncontrolled emission factor corresponds to a lower moisture level that is below the range representative of control by wet suppression. In deciding which emission factor would be applicable for a given source, EPA explains that

> [v]isual observations of each source under normal operating conditions are probably the best indicator of which emission factor is most appropriate. Plants that employ sub-standard control measures as indicated by visual observations should use the uncontrolled emission

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[16] EPA, *Control Techniques for Particulate Emissions from Stationary Sources – Vol. 2,* EPA-450/3-81-005b, 9.7-10 (Sept. 1982) (emphasis added); EPA, *Nonmetallic Mineral Processing Plants – Background Information for Proposed Standards,* EPA-450/3-83-001a, 4-6 (Apr. 1983)

[17] AP-42, Table 11.19.2-2, note b.

[18] 74 Fed. Reg. 19,294, 19302 (Apr. 28, 2009).

> factor with an appropriate control efficiency that best reflects the effectiveness of the controls employed.[19]

The unstated corollary to the above guidance is that a source which employs standard or effective control measures "as indicated by visual observations" should use the controlled emission factor.

The lack of visible emissions from the single-deck screens at N-8 during their normal operation indicates that each facility is employing standard or effective control measures. Therefore, in accordance with the above Agency guidance, PWCC has chosen to use the "controlled" emission factor for screening in the crushed stone industry to estimate emissions from Kayenta's screens which process coal containing water-with-surfactant residual. That specific emission factor is representative of control by wet suppression achieving an emission-reduction efficiency of 91.5%.

Transfer Points:	***Water-with-surfactant Sprays -- 90% "Control"***
Affected Facilities:	TP1, TP2, TP3, TP4, TP6, TP8, TP9, TP10, TP16, TP17, TP18, TP19, TP20, TP37, TP38 and TP41

Many of Kayenta's belt conveyors with their associated transfer points are "affected facilities" under NSPS Subpart Y.[20] Belt conveyors are generally regarded as de minimis sources of fugitive particulate matter except at their transfer points, i.e., the head of the belt from which material drops to the tail of the belt which receives that falling material.

Kayenta's Subpart Y transfer points are equipped with wet suppression in the form of either direct spray or residual moisture in order to ensure compliance with Subpart Y's standard for particulate matter.[21] The preceding table identifies those specific Subpart Y transfer points that are equipped with systems to spray a mixture of water-with-surfactant.

One approach to estimating the "control" efficiency of water-with-surfactant sprays applied to transfer points parallels the Company's approach used to estimate emissions from Kayenta's crushers and screens equipped with water-with-surfactant sprays. EPA has indicated that

[19] AP-42, Table 11.19.2-2, note b.

[20] 41 Fed. Reg. at 2234 (codified at 40 C.F.R. §60.250).

[21] 41 Fed. Reg. at 2233.

emission information about aggregate handling activities is transferable to similar handling activities at coal preparation plants.[22] Transporting aggregate materials via belt conveyors with their associated transfer points is one form of aggregate handling. Thus, in light of that technology-transfer consideration, a control efficiency representative of water-with-surfactant sprays applied to coal transfer points can be calculated using the uncontrolled and controlled emission factors for transfer points in the crushed stone industry.[23] Based on those emission factors, an emission-reduction efficiency of 96% has been calculated for the application of water-with-surfactant sprays to Kayenta's transfer points.

However, PWCC has used the "standard drop equation" in AP-42, Section 13.2.4 to estimate uncontrolled particulate emissions from Kayenta's transfer points. That particular equation has been gradually refined over time whenever EPA has gathered additional emissions data from various operations involved with the transfer of aggregate materials. Because of the reliability of that estimation method relative to other approaches, PWCC has used that emission equation in concert with an estimated "control" efficiency for water-with-surfactant sprays, as explained below, to estimate particulate emissions from Kayenta's transfer points equipped with such sprays.

For most sources of fugitive particulate emissions, including coal preparation facilities, "[d]ata on the control efficiency of wet suppression is minimal."[24] Because quantities of emissions controlled by wet suppression "are extremely hard to estimate,"[25] most emission-reduction efficiencies achieved by liquid sprays at transfer points historically have been based upon informed engineering judgment of personnel experienced in the field of air pollution control.

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[22] AP-42, p. 11.10-1.

[23] AP-42, Table 11.19.2-2 (In this context the terms "controlled" and "uncontrolled" refer to with and without wet suppression, respectively.)

[24] Weant, G. and Carpenter, B., "Fugitive Dust Emissions and Control," in EPA, *Symposium on the Transfer and Utilization of Particulate Control Technology, Vol. 4,* EPA-600/7-79-044d, 69 (Feb. 1979); EPA-450/3-77-010 at 1-4 ("measurement of process and non-process fugitive emissions have proven difficult").

[25] EPA-450/3-77-010 at 1-3.

EPA estimated years ago that a spray of water containing a chemical wetting agent, i.e., surfactant, was likely to realize a "control" efficiency as high as 90%.[26] Subsequent EPA studies of fugitive particulate emissions from the handling of aggregate, nonmetallic minerals (including coal), in general, and from conveying of those materials, in particular, have estimated control-efficiencies for sprays of water-with-surfactant that range mainly from 90% to 95%.[27]

As demonstrated by the control efficiencies quoted herein for wet suppression, PWCC has surveyed numerous EPA-published documents that contain reasoned estimates of those control efficiencies. In particular, because many of EPA's assessments of controls for fugitive particulate emissions occurred during the late-1970s and into the 1980s, the Company's control-efficiency survey focused heavily on estimates made during that era for control efficiencies of wet suppression applications.

After considering the results of its survey as well as the calculated 96% efficiency based on limited emission testing from the crushed stone industry, PWCC concludes that 90% is a reasonable, but yet conservative, estimate of the emission-reduction efficiency realized by water-with-surfactant sprays applied to Kayenta's transfer points. The virtual absence of visible emissions from those transfer points, once again, supports the Company's conclusion that water-with-surfactant sprays are highly effective at those facilities.

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[26] EPA, *Investigation of Fugitive Dust; Volume I – Sources, Emissions and Control,* EPA-450/3-74-036a, 4-27 (June 1974).

[27] EPA, *Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions,* EPA-450/3-77-010, 2-38 (Mar. 1977) (80-90% efficiency using water spray with chemical wetting agent on pile load-in); Bohn, R. *et al.* (for EPA), *Fugitive Emissions from Integrated Iron and Steel Plants,* EPA-600/2-78-050, 6-3 (Mar. 1978) (up to 95% control efficiency using water spray with chemical wetting agent on conveyor transfer station); EPA, *Control Techniques for Particulate Emissions from Stationary Sources – Volume 1,* EPA-450/3-81-005a, 5-14 (Sept. 1982) (up to 95% emission reduction using water spray with chemical wetting agent on material-handling operations) (citing Bohn, R. *et al.*, EPA-600/2-78-050); EPA, *Control Techniques for Particulate Emissions from Stationary Sources – Volume 2,* EPA-450/3-81-005b, 9.7-10 (Sept. 1982) (up to 90 percent efficiency using water spray with chemical wetting agent); Oleman *et al.* (Ohio EPA), *Fugitive Dust Control Technology,* Ch. 2.1.3.4 (1983) (water with chemical spray systems on transfer activity – 95%); EPA, *Nonmetallic Mineral Processing Plants – Background Information for Proposed Standards,* EPA-450/3-83-001a, 4-10 (Apr. 1983) (manufacturer claim of better than 90 percent control efficiency using water spray with chemical wetting agent on all process operations at rock crushing plant, from primary crushing to stockpile and reclaim); South Coast Air Quality Management District, "Particulate Matter (PM) Emission Factors for Processes/Equipment at Asphalt, Cement, Concrete and Aggregate Product Plants," (July 2010) (use of dust suppressant system to meet District's opacity standard is equivalent to 95% reduction in uncontrolled emissions from aggregate conveyor's transfer point).

Transfer Points: ***Water-with-surfactant Residual -- 85% "Control"***

Affected Facilities: TP5, TP7, TP39 and TP40

EPA has acknowledged that, "[i]f properly conditioned at the initial processing steps, continued application of the wetting agency can be minimized. The wetted material should exhibit some carry-over dust control effect that will last through a number of material handling stages."[28] Nevertheless, PWCC's control-efficiency survey for coal and other non-metallic mineral handling facilities did not identify multiple EPA estimates of control efficiencies expressly due to residual moisture in the aggregate material being handled.

However, during its relatively recent revision of NSPS Subpart Y, EPA acknowledged the "inherent dust control" due to residual moisture at transfer points in the coal preparation process after chemical application upstream. EPA estimated a control efficiency of 85% for that water-with-surfactant residual in coal at Subpart Y transfer points.[29]

PWCC has previously demonstrated how EPA relies upon visual observations of fugitive particulate emissions from individual facilities in the stone crushing industry as an indicator of whether wet suppression applied to a particular facility is achieving a high control efficiency or whether instead that facility is equipped with sub-standard controls.[30] Accordingly, based upon the typical absence of visible emissions from the normal conveyance of coal at Kayenta's Subpart Y transfer points downstream of a water-with-surfactant spray application, PWCC has adopted EPA's estimate of 85% efficiency as the level of control achieved by water-with-surfactant residual.

Transfer Point: ***Water-only Sprays -- 70% "Control"***

Affected Facility: TP35

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[28] EPA, *Control Techniques for Particulate Emissions from Stationary Sources – Vol. 2,* EPA-450/3-81-005b, 9.7-10 (Sept. 1982) (emphasis added); EPA, *Nonmetallic Mineral Processing Plants – Background Information for Proposed Standards,* EPA-450/3-83-001a, 4-6 (Apr. 1983)

[29] Memorandum from C. Fellner, EPA, to Coal Preparation NSPS Docket (EPA-HQ-OAR-2008-0260) of Apr. 2008 at 2 ("Model Plant Control Costing Estimates for Units Subject to the NSPS for Coal Preparation Plants (40 CFR Part 60, Subpart Y)).

[30] AP-42, Table 11.19.2-2, note b.

EPA estimated in a 1974 document that water sprays on aggregate handling operations could achieve an emission-reduction efficiency of at least 50%.[31] In that same time period, however, EPA also acknowledged during the original development of NSPS Subpart Y that "water sprays have been demonstrated to be very effective for suppressing fugitive emissions and can be used to control even the most difficult fugitive emission problem."[32]

That latter statement strongly suggests that EPA generally considered the control efficiencies of water sprays, at least when applied to fugitive particulate emissions from coal preparation facilities, to be significantly higher than 50%. Indeed, subsequent EPA studies of fugitive particulate emissions from the handling of aggregate, nonmetallic minerals (including coal), in general, and from conveying of those materials, in particular, have identified control-efficiency estimates for water sprays ranging from 50% to 80%.[33]

In this particular instance, visual observations cannot serve as an indicator of the relative efficiency of the subject water sprays because the transfer point in question (TP35) is located underground. Nevertheless, as a general proposition, PWCC believes that a reasonable estimate of the control efficiency of water-only sprays applied to transfer points at coal preparation plants is typically higher than 50% but not as high as the 90% efficiency which can be achieved by

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[31] EPA, *Investigation of Fugitive Dust; Volume I – Sources, Emissions and Control,* EPA-450/3-74-036a, 4-27 (June 1974).

[32] 41 Fed. Reg. at 2233 (emphasis added).

[33] Bohn, R. *et al.* (for EPA), *Fugitive Emissions from Integrated Iron and Steel Plants,* EPA-600/2-78-050, 6-3 (Mar. 1978) (70% control efficiency using water spray on conveyor transfer station); Weant, G. and Carpenter, B., "Fugitive Dust Emissions and Control," in EPA, *Symposium on the Transfer and Utilization of Particulate Control Technology, Vol. 4,* EPA-600/7-79-044d, 70 (Feb. 1979) (70% control for water spray on coal feeder-conveyor transfer point) (citing Seibel, R., "Dust Control at a Transfer Point Using Foam and Water Sprays," 12 (Table 9) (ca.1977)); EPA, *Energy from the West,* Energy Resource Development Systems Report, Vol. II – Coal, EPA-600/7-79-060b, 109 (Mar. 1979) (use of water sprays assumed to reduce emissions by 80%); EPA, *Development of Air Pollution Control Cost Functions for the Integrated Iron and Steel Industry,* EPA-450/1080-001, D-2 (July 1979) (58% to 75% for water spray on coal handling); EPA, *Control Techniques for Particulate Emissions from Stationary Sources – Volume 2,* EPA-450/3-81-005b, 9.7-10 (Sept. 1982) (50% efficiency with untreated water); Oleman *et al.* (Ohio EPA), *Fugitive Dust Control Technology,* Ch. 2.1.3.4 (1983) (water spray systems on transfer activity – 70%); Texas Natural Resource Conservation Commission, Report on the Coal Handling Emissions Evaluation Roundtable (hereinafter "CHEER Manual"), 29 (May 1996) (70% to 80% efficiencies for water sprays, as referenced in three unnamed permits); Countess Environmental, *WRAP Fugitive Dust Handbook,* 4-5 (Sept. 2006) (62% PM_{10} control efficiency for water spray on conveyor transfer point);

water-with-surfactant sprays. Accordingly, for the purpose of this analysis, the control efficiency of water-only sprays at Transfer Point 35 has been estimated to be 70%.[34]

Transfer Point: ***Water-only Residual -- 65% "Control"***

Affected Facility: TP36

Transfer Point 36, going from the head of Belt 18 to the tail of Belt 28, is Kayenta's only Subpart Y transfer point that relies solely on residual water (no surfactant) to suppress the formation of fugitive particulate emissions. During its recent revisions to Subpart Y, the Agency confirmed its belief "that water carryover can be an adequate control measure for fugitive emissions for a number of affected facilities when sufficient moisture is delivered by upstream water sprays."[35] In its studies of the effectiveness of wet suppression applied to different sources in the crushed stone industry similar to those at coal preparation plants, EPA has acknowledged that "[d]ue to carry over of the small amount of moisture required, it has been shown that each source, with the exception of crushers, does not need to employ direct water sprays."[36]

The Company has demonstrated that the representative level of control (85%) achieved by water-with-surfactant residual in coal at a transfer point downstream of water-with-surfactant sprays is generally not significantly lower than the typical level of control achieved by spraying water-with-surfactant directly onto the coal at that transfer point (90%). PWCC believes that the level of control achieved by water-only residual in coal at a transfer point downstream of water-only sprays should likewise not be significantly lower than the typical level of control achieved by spraying only water directly onto coal at that transfer point (70%). The Company therefore has selected an efficiency of 65% as a reasonable estimate of the level of control achieved by water-only residual in coal at Kayenta's Transfer Point 36.[37]

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[34] The Company is mindful of the fact that the estimated control efficiency of water-only sprays in this instance is substantially supplemented. Because Transfer Point 35 is located underground, the degree of emission reductions achieved at that transfer point is dominated by the 99% efficiency attributed to full enclosure of that facility.

[35] 74 Fed. Reg. 19,294, 19302 (Apr. 28, 2009).

[36] AP-42, Table 11.19.2-2, note b.

[37] Because only one of Kayenta's Subpart Y transfer points relies upon water-only residual as a means of control, the estimated control efficiency due to that residual moisture (65%) does not have a material impact on the overall estimate of Kayenta's potential to emit.

Truck Hopper Loading: ***Water-with-surfactant Sprays -- 70% Control***

Affected Facilities: N11H4 (Hopper 4), J28H5 (Hopper 5)

As noted earlier, the initial application of wet suppression at a coal preparation plant is normally where raw coal is loaded into a hopper. Fugitive particulate matter emitted during truck hopper loading results primarily from the combination of mechanical agitation of coal as it strikes the sides of the hopper and of the turbulence created by the air being displaced from the hopper by incoming coal.[38]

Although adhesion and agglomeration are usually a spray system's two principal mechanisms for suppressing dust formation, particle capture by water droplets contributes to the emission reduction achieved by a water spray at a prep plant's truck hopper. With particles entrained in air being discharged vertically from the top of that hopper, a mist of water droplets created by the hopper's sprays can directly impact some of those particles, causing the combined, heavier mass to settle-out within the hopper.[39]

One of EPA's earliest, published assessments of the use of water alone to control fugitive dust from aggregate handling operations estimated that control technique could achieve an emission-reduction efficiency of 50%.[40] That estimate of 50% emission-reduction efficiency when using water sprays on hoppers being loaded with coal was also quoted thereafter by other subsequent studies of fugitive dust emissions in the 1970s and early-1980s.[41]

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[38] EPA, *Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions,* EPA-450/3-77-010, 2-14 (Mar. 1977).

[39] Bohn, R. et al., *Fugitive Emissions from Integrated Iron and Steel Plants,* 6-4 (Mar. 1978).

[40] EPA, *Investigation of Fugitive Dust; Volume I – Sources, Emissions and Controls,* EPA-450/3-74-036a, 4-27 (June 1974).

[41] PEDCo (for EPA), *Evaluation of Fugitive Dust Emissions from Mining; Task 1 Report – Identification of Fugitive Dust Sources Associated with Mining (Draft),* 44 (Apr. 1976) (50% "estimated control efficiency of watering" for truck unloading coal into hopper); EPA, *Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions,* EPA-450/3-77-010, 2-245 (Mar. 1977) (50% estimated efficiency when using watering during truck dumping of coal; citing 1976 PEDCo report); Wyoming Division of Air Quality, "Guideline for Fugitive Dust Emission Factors for Mining Activities, " (Jan, 1979) (water sprays on coal truck dump – 50% control efficiency); Olemann *et al.* (Ohio EPA), *Fugitive Dust Control Technology,* Sec. 2.1.3.4 (1983) (50% control usually achieved with spray system on truck dumping of coal).

However, EPA has long-recognized the improvement in control efficiency when small quantities of an appropriate surfactant are blended with water to improve its wetting ability prior to spraying.[42] The Agency acknowledged years ago that manufacturers of continuous chemical spray systems for use in aggregate handling operations were claiming 90% dust removal efficiency. As EPA opined, 90% control efficiency from spraying water containing a surfactant "appears attainable when compared with a 50 percent control for watering alone."[43]

Moreover, one agency has more recently attributed a control efficiency of 95% to a dust suppressant system when used on aggregate loading and unloading operations to meet a 20% opacity limit.[44] In addition, two coal receiving operations using chemical wetting have each been permitted to meet a 10% opacity limit with an assumed 90% control efficiency.[45]

Given the numerous water-with-surfactant sprays located throughout the interiors of Kayenta's Hoppers 4 and 5, PWCC believes those specific spray systems achieve more emission control than the 50% efficiency that initially had been assumed many years ago for use of water-only sprays on hopper-loading operations. At the same time, however, PWCC does not believe that water-with-surfactant spray systems on Hoppers 4 and 5 at Kayenta are capable of consistently realizing a control efficiency of 90%, i.e., the estimated emission reduction when applying a spray of water with a wetting agent to other types of non-metallic mineral processing and handling facilities.

The batch loading of coal into a truck hopper is typically accompanied by a brief "puff" of visible emissions as coal particles entrained in the displaced air of the hopper are quickly exhausted from the top of the hopper. PWCC believes that those intermittent visible emissions from the hopper, although emitted only briefly during the loading process, precludes a conclusion that the hopper's water-with-surfactant spray system has reduced otherwise uncontrolled hopper emissions by as much as 90%.

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[42] EPA, *Air Pollution Control Techniques for Non-Metallic Minerals Industry*, EPA-450/3-82-014, 3-8 (Aug. 1982).

[43] EPA, *Investigation of Fugitive Dust; Volume I – Sources, Emissions and Controls,* EPA-450/3-74-036a, 4-27 (June 1974).

[44] South Coast Air Quality Management District, Rule 1157(d)(2).

[45] CHEER Manual at 24.

In light of the significant, overall range of control efficiencies that has been predicted for sprays applied to hopper loading operations, and given the Company's collective engineering judgment after visually comparing performances of different wet suppression systems on operations loading coal or other aggregate into hoppers, PWCC concludes that an emission-reduction efficiency of 70% is a reasonable estimate of the level of emission control achieved by the water-with-surfactant spray systems on Hoppers 4 and 5 at Kayenta.

APPENDIX B

APPENDIX B

ESTIMATES OF KAYENTA'S FUGITIVE PARTICULATE EMISSIONS MUST RELY ON EMISSION FACTORS

EPA has always identified a hierarchy of different methodologies for estimating emissions.[46] Procedures which EPA regards as generally acceptable for estimating emissions have been characterized as the following:

(i) Source-specific emission tests;
(ii) Mass balance calculations;
(iii) Published, verifiable emission factors that are applicable to the source;
(iv) Other engineering calculations; or
(v) Other procedures to estimate emissions specifically approved by the reviewing authority.[47]

Of those generally acceptable procedures for estimating emissions, facility-specific "stack testing" and continuous emission monitoring ("CEM") are the preferred methods for estimating emissions from a particular facility.[48] Such testing or monitoring consists of measuring the quantity of the pollutant contained in the facility's exhaust flow while it is confined within a stack, chimney, duct work or similar conveyance which discharges to the atmosphere. However, no coal preparation facility at Kayenta's discharges its particulate emissions to the atmosphere through a stack or other type of conveyance. Therefore, in the absence of any stacks or similar conveyances, the use of "stack testing" or CEM to estimate fugitive particulate emissions from Kayenta's coal preparation facilities is simply not possible.

Another generally acceptable method for estimating emissions is the material balance, where emissions are calculated as the difference between the measured amount of process material entering the facility and the measured amount of that material exiting the facility. However,

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[46] *See, e.g.,* AP-42, Introduction, Fig. 1 (1995). The term "AP-42" is the abbreviated citation to EPA's longstanding document entitled *Compilation of Air Pollutant Emission Factors; Volume I – Stationary Point and Area Sources.* The current version of that document was published as the 5th edition in January 1995. Thereafter, individual subsections within the document have been periodically updated. Throughout PWCC's narrative herein, reference simply to "AP-42" is understood to mean the current 5th edition with its updates. Any reference to an earlier version of AP-42 includes its specific edition and the date published.

[47] 40 C.F.R. §49.158(a)(2).

[48] AP-42, Introduction at 3 (1995).

material balances are not suitable for situations such as coal preparation facilities where a very small percentage of the material being processed is lost to the atmosphere.[49] In those circumstances where the amount of particulate emitted is so small relative to the process flows, the measurement technology is not capable of distinguishing any significant difference between the amount fed to the facility and the amount discharged. That is, within the range of accuracy of the instrument measuring coal flow rate, those two measured amounts at the facility's inlet and outlet would be the same.

When emissions from a facility cannot be reliably quantified by stack testing, CEM or material balance, those emissions may sometimes be estimated with appropriate engineering calculations. In this instance, "engineering calculations" would generally consist of computations that apply governing principles of physics to the type of unit operation in question and the particular material(s) that are processed by that operation. However, while various parameters which influence the nature and extent of particulate emissions from coal preparation have been identified, the inter-relationships between those parameters and the resultant emissions are still not understood to the extent that engineering calculations have been developed to estimate those emissions.

Thus, with the exception of emission factors, other generally acceptable procedures for estimating emissions cannot be used to quantify fugitive particulate emissions. Kayenta's potential-to-emit particulate matter is comprised entirely of fugitive particulate emissions from Kayenta's coal preparation facilities. Consequently, Kayenta's potential-to-emit particulate emissions must necessarily be determined by using emissions factors.

Determining Kayenta's PTE is one of those situations for which EPA has stated that "emission factors are frequently the best or only method available for estimating emissions, in spite of their limitations."[50] Or, as EPA advised one applicant during renewal of its federal Part 71 operating permit: "[I]f AP-42 are the only factors available and stack testing is not feasible at this time, we will work with the AP-42 factors in processing the permit."[51]

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[49] AP-42, Introduction at 3.

[50] *Id.* at 1.

[51] Electronic mail from Dierdre Rothery, EPA Region VIII, to Julie Best, BP America, of Jan. 4, 2006.

EPA's History of Accepting Emission Factors to Estimate Fugitive Emissions

EPA has always acknowledged that emission factor use may be appropriate in some permitting applications, such as in applicability determinations.[52] Threshold applicability determinations requiring calculations of stationary sources' potentials to emit first became a regulatory requirement with promulgation of the federal PSD program in 1980.[53]

However, after EPA had proposed its PSD rules but prior to finalizing that rulemaking, a number of commenters on that proposal asserted that threshold applicability determinations could not include fugitive emissions because the necessary data on fugitive emissions "were either unavailable or inadequate."[54] In response, EPA flatly disagreed with that assertion, explaining that the Agency

> has in the past published data and other information relating to the quantification of fugitive emissions for various categories of sources and, as some commenters noted, additional data and information are currently under development. EPA considers these publications concerning quantification of fugitive emissions as guidance to be used as the starting point for analysis, not a methodology or data which must be rigidly adhered to in all circumstances.[55]

Given its generally greater experience by 1980 in quantifying fugitive emissions from specific source categories which EPA traditionally had considered as "major polluters," EPA believed that its existing and soon-to-be-issued data and related information about fugitive emissions from those types of sources were generally sufficient to support quantification of such emissions for threshold applicability purposes.[56] To that end, in the preamble to its final PSD rulemaking, EPA included a list of technical references containing emission factors for quantifying fugitive emissions, primarily from those source categories for which the PSD regulations required inclusion of fugitive emissions in potential-to-emit calculations.

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[52] AP-42, Introduction at 2.

[53] 45 Fed. Reg. 52,676, 52,736 (Aug. 7, 1980) (definition of "potential to emit") (codified at 40 C.F.R. §52.21(b)(4)).

[54] 45 Fed. Reg. at 52,692.

[55] *Id.*

[56] *Id.* at 52,691-92.

Months after completing its 1980 PSD rulemaking, EPA published a "workshop manual" to describe the requirements of the federal PSD regulations and to provide suggested methods for meeting those requirements.[57] In that guidance the Agency acknowledged that a source-specific engineering analysis to quantify fugitive emissions would usually have to rely on published emission factors. As that Agency manual explained:

> Because fugitive emissions vary widely from source to source, they must be quantified through a source-specific engineering analysis. Common quantifiable fugitive emission sources include coal piles, road dust, and quarry emissions. . . . Suggested references for fugitive emissions data and associated analytic techniques are discussed in the preamble to the 1980 PSD regulations and are listed in Table A-1.[58]

Notably, several of EPA's "suggested references for fugitive emissions data" contained emission factors for fugitive particulate from various coal mining and coal preparation activities. In addition, EPA's 1980 PSD manual illustrated a PSD threshold applicability determination (PTE calculation) which included the use of fugitive particulate emission factors for storage and handling of coal.[59]

EPA subsequently revised its PSD workshop manual in 1990.[60] Agency policy regarding the use of emissions factors to quantify fugitive emissions for inclusion in applicability determinations remained unchanged. That is, EPA's manual continued to identify several technical references containing fugitive emission factors for use in quantifying fugitive emissions.[61]

Furthermore, a short time later in 1993, EPA stated that "[s]tatutory requirements for which AP-42 emission factors may be used include Prevention of Significant Deterioration (PSD) permit

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[57] EPA, *Prevention of Significant Deterioration Workshop Manual*, EPA-450/2-80-081 (Oct. 1980).

[58] *Id.* at I-A-5. Although EPA subsequently updated its PSD workshop manual in 1990, Agency guidance related to using emission factors in threshold applicability determinations did not change. Like its 1980 predecessor, several of the 1990 manual's "suggested references for fugitive emissions data" contained fugitive particulate emission factors for various coal mining and coal preparation activities. *See* EPA, *New Source Review Workshop Manual – Prevention of Significant Deterioration and Nonattainment Area Permitting (Draft)*, A-17 (Oct. 1990).

[59] *Id.* at I-A-29. *See also, e.g.*, EPA, *NSR and PSD Program Assistance and Development in EPA Region III -- Volume 1*, EPA-903/9-82-008a (June 1982) (including threshold applicability determinations using emission factors for coal preparation for the (1) proposed Vienna Generating Station – Unit 9, (2) proposed coal-fired boilers at Scott Paper Company facility; and (3) proposed coal mining complex with coal preparation for Big Mountain Coal).

[60] EPA, *New Source Review Workshop Manual (Draft)*, Oct. 1990.

[61] *Id.* at A-17.

applications[.]"[62] EPA's statement simply confirmed the Agency's basic policy that, in the absence of source-specific emissions information, emission factors could be used to quantify fugitive emissions for PSD purposes.

In the context of Title V permitting, EPA confirmed early in that permit program that using emission factors was an acceptable method for estimating emissions. As EPA's Title V guidance explained:

> Wherever emissions estimates are needed . . . , use of available information should suffice. Any information that is sufficient to support a reasonable belief as to compliance or the applicability or non-applicability of requirements will be acceptable for these purposes. That could include AP-42 emission factors, emissions factors in other EPA documents, or reasonable engineering projections, as well as test data.[63]

Although that Agency guidance for Title V permitting also recognized that other acceptable methodologies could be used to estimate emissions, EPA made clear that for purposes of Title V, "[g]enerally, the emissions factors contained in EPA's publication AP-42 and other EPA documents may be used to make any necessary calculation of emissions."[64]

In short, both EPA's PSD and Title V programs have long histories of allowing applicability determinations to use emission factors to estimate emissions, in general, and to estimate fugitive particulate emissions, in particular.

Need to Continue Accepting Emission Factors to Estimate Fugitive Particulate Emissions

EPA observed decades ago that

> agencies appear to be relying heavily upon AP-42 emission factors to estimate the emissions from most sources. The AP-42 document was not originally intended for use in estimating the emissions from specific single sources or processes. . . . States should be questioned concerning their ability to derive emission estimates from other

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[62] EPA, *Technical Procedures for Developing AP-42 Emission Factors and Preparing AP-42 Sections,* EPA-454/B-93-050, 4 (Oct. 1993). The Agency did qualify that statement by cautioning that "AP-42 factors should not be used when reliable and representative stack test data exist for a facility." *Id.* (emphasis in original).

[63] EPA, *White Paper for Streamlined Development of Part 70 Permit Applications ("White Paper #1"),* 7 (July 10, 1995).

[64] *Id.* at 18.

> available methods (e.g., stack test results, emission measurements from identical or similar sources, material balance equations, and emission factors developed from similar sources). Wherever possible, States should be encouraged to place a lesser degree of reliance on AP-42 emission factors and a greater reliance on more source-specific estimating methods.[65]

Thus, while EPA has a long history of accepting the use of emission factors for applicability determinations, at the same time EPA's well-established policy for estimating emissions has consistently stressed the use of more source-specific emissions information, wherever possible. In other words, as explained below, applicability of EPA's policy that prefers the use of source-specific emissions information instead of emission factors is inherently limited.

Beginning in 1971, EPA promulgated its first so-called "Reference Method" for measuring the amount of a pollutant emitted from "point sources," i.e., from stacks, vents and other conveyances.[66] Numerous "stack-testing" methods for various regulated pollutants from different source categories have since been developed over the years. Among other criteria of a standardized stack-test protocol, each Reference Method prescribes detailed equipment/instrumentation requirements, specific sampling and analytical procedures, and data-reduction techniques in order to quantify emissions of a specific pollutant within a stack or duct.[67]

Subsequently, in 1975 EPA began promulgating its so-called "Performance Specifications" for continuous emission monitoring systems ("CEMS"), also for the purpose of quantifying specific pollutants within stacks, ducts and similar conveyances.[68] CEMS for a variety of different pollutants have since been developed over the years. Among other criteria of a standardized continuous monitoring protocol, each Performance Specification prescribes requirements for specific monitoring instrumentation, for locations of the in-stack monitors or extractive sampling

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[65] EPA, *Guidelines for the Regional Evaluation of State and Local NSR Programs,* EPA-450/2-77—027, 23-24 (Nov. 1977) (emphasis added).

[66] 36 Fed. Reg. 24,876 (Dec. 23, 1971) (to be codified at 40 C.F.R. Part 60, Appendix A ("Test Methods")).

[67] 40 C.F.R. Part 60, Appendix A (Method 5 – particulate matter (PM); Method 6 – sulfur dioxide; Method 7 – nitrogen oxides (NO_x); . .) (There is even a Method 1 for establishing acceptable locations of sampling points inside the stack or duct, and a Method 2 for prescribing how velocity measurements must be made inside the stack or duct).

[68] 40 Fed. Reg. 64,250 (Oct. 6, 1975) (to be codified at 40 C.F.R. Part 60, Appendix B).

systems, and for detailed operation, maintenance and quality assurance of the monitoring system in order to quantify emissions of a specific pollutant within a stack or duct.[69]

Thus, over the past 40+ years, quantifying a pollutant's emissions by means of a "stack test" and/or CEMS has become a readily available, commonplace activity that is both technically and economically feasible for many categories of stationary sources. Consequently, for many facilities in those source categories, it is not unreasonable at this time for EPA to expect estimates of those facilities' emissions to be based on source-specific testing rather than on emission factors. An increasing number of threshold applicability determinations with their PTE calculations for both Title V and PSD purposes almost certainly are now being informed by source-specific testing or monitoring.

On the other hand, standardized, emission-measurement methodologies for quantifying fugitive particulate emissions have never been developed. During primarily the late-1970s and early-1980s, a few EPA contractors had developed quasi-experimental equipment and procedures for measuring ambient particulate concentrations downwind of the target source and then back-calculating the necessary source strength (fugitive particulate emission rate).[70] In addition, a sampling methodology using a portable, micro-scale wind tunnel was developed to capture fugitive particulate emissions from simulated wind erosion of different types of surfaces, e.g., open storage piles and exposed surfaces.[71]

However, unlike EPA's development of rigorous protocols for stack testing and continuous emission monitoring, a similar research and development program was never implemented for those "upwind-downwind," "exposure profiling" and "wind tunnel" methods for quantifying fugitive particulate emissions. Nor has some other methodology for measuring fugitive particulate emissions since been developed and standardized to the point of being technically and economically feasible for widespread use.

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[69] 40 C.F.R. Part 60, Appendix B (Performance Specification ("PS") 1 for opacity; PS 2 for sulfur dioxide and nitrogen oxides; PS 3 for oxygen and carbon dioxide; PS 4 for carbon monoxide . . .).

[70] *See, e.g.*, Cowherd *et al.* (for EPA), *Development of Emission Factors for Fugitive Dust Sources*, EPA-450/3-74-037 (1974) (upwind-downwind method; exposure profiling method).

[71] *See, e.g.*, Cowherd *et al.* (for EPA), *Iron and Steel Plant Open Source Fugitive Emission Evaluation*, EPA-600/2-79-103 (1979) (wind tunnel method).

In short, in 1980 when the regulatory term "potential to emit" was promulgated, the state of measurement technology for fugitive particulate matter was in its infancy, and it has not advanced significantly since then. Thus, it would be completely unreasonable for EPA to expect a threshold applicability determination with its PTE calculation to rely on source-specific testing instead of emission factors when the emissions in question are fugitive particulate matter.

Criteria for Selection of Emission Factors

When either a Title V or a PSD applicability determination relies on an emission factor, EPA guidance for selecting that emission factor states only that "[g]enerally, the emissions factors contained in EPA's publication AP-42 and other EPA documents may be used[.]"[72] EPA's earlier guidance for selection of an emission factor for a PSD applicability determination was essentially the same general directive, i.e., reference to EPA's "published data and other information relating to the quantification of fugitive emissions for various categories of sources and . . . additional data and information [that] are currently under development."[73] More recently, the federal minor NSR program for Indian country acknowledges that an emission factor is a generally acceptable method for estimating emissions, provided that the emission factor is published, verifiable and applicable to the source.

The Company has identified the emission factors which it has selected to quantify emissions from all of Kayenta's coal preparation facilities. In selecting each of those emission factors for this Title V proceeding, PWCC has nevertheless sought to satisfy the more rigorous criteria for selection of acceptable emission factors under the federal minor NSR program.

1. *Published*

Each of the emission factors selected to quantify fugitive particulate emissions from a particular type of coal preparation facility at Kayenta is contained in AP-42 and/or other EPA documents. Each such emission factor has therefore been "published."

[72] EPA, "White Paper #1" at 18.

[73] 45 Fed. Reg. 52,676, 52,692 (Aug. 7, 1980). As noted previously, with promulgation of its PSD rules, EPA specifically identified AP-42 and a number of other EPA documents as sources of emission factors and related information for many different source categories. *Id.* at 52,691.

2. *Applicable to the Source*

Section 11.10 of AP-42 applies to "Coal Cleaning." As such, that AP-42 subject matter focuses almost entirely upon emissions from wet and dry coal cleaning processes. Although it describes the "initial preparation phase of coal cleaning," i.e., raw coal unloading, crushing, screening, conveying and storage, Section 11.10 does not provide a specific emission factor for any of those latter operations.

AP-42, Section 11.9 ("Western Surface Coal Mining") contains a few emission factors that may also apply to certain coal preparation facilities.[74] However, as shown below, those few preparation-related factors have generally been superseded by newer, generic emission equations which EPA has developed for application to traditional aggregate processing facilities, including those for coal preparation.

EPA acknowledged years ago that,

> [i]n situations where there are no published emissions factors or other fugitive emissions data for a particular category of sources, EPA will consider quantification estimates developed by a source which have any reasonable or rational basis, including estimates based on the transfer of technology[.][75]

Technology transfer in the context of particulate emission factors is a process whereby a source of particulate emissions not yet characterized by an emission factor is related by engineering judgment to a similar source with an established particulate emission factor.[76] In particular, EPA has confirmed that the processes of (1) loading and unloading, (2) crushing, grinding and screening, and (3) transfer and conveying are commonly used in a variety of different industries.[77] Thus, for example, when estimating fugitive particulate emissions from unloading, crushing, screening, conveying and storage at coal preparation plants, Section 11.10 of AP-42 states that "[u]ncontrolled emission factors for various types of fugitive sources in coal cleaning

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[74] *E.g.*, AP-42, p. 11.9-10 (single-value emission factor for unloading raw coal from haul truck).

[75] 45 Fed. Reg. at 52,692.

[76] EPA, *PM10 Emission Factor Listing Developed by Technology Transfer*, EPA-450/4-89-023, 1 (Nov. 1989).

[77] EPA, *Assessment of Fugitive Particulate Emission Factors for Industrial Processes*, EPA-450/3-78-107, 1-4 (Sept. 1978).

facilities can be developed from the equations found in [AP-42,] Section 13.2, 'Fugitive Dust Sources.'"[78]

In other words, because Section 13.2 contains information about fugitive particulate emissions from various sources that are very similar to Kayenta's coal preparation facilities, EPA relies on the principle of technology transfer to authorize the use of fugitive particulate emission information about those sources in Section 13.2 to characterize fugitive particulate emissions from similar coal preparation facilities. Moreover, in Section 13.2 (and, by implication, Section 11.10), EPA further relies on the principle of technology transfer to characterize fugitive particulate emissions from facilities such as crushers and screens by recommending that such facilities' emissions can be estimated by applying "[f]actors for similar material/operations in Section 11.19.2" for the crushed stone industry.[79]

In sum, based on considerations of technology transfer, EPA authorizes the use of emission factors/equations found in AP-42, Sections 11.19 and 13.2 for certain processing, conveying, transfer and storage operations to estimate fugitive particulate emissions from their similar coal-preparation counterparts in Section 11.10. As demonstrated further herein, PWCC relies heavily on that technology transfer to ensure that fugitive particulate emissions from Kayenta's coal preparation facilities are quantified by using EPA-published emission factors which are applicable to those facilities.

3. *Verifiable*

Although EPA's minor NSR regulations prescribe that an acceptable emission factor must be "verifiable,"[80] neither those regulations nor the accompanying preamble[81] explain the meaning of that term in that particular context. Therefore, it is necessary to construe a reasonable meaning for that term when applied to emission factors.

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[78] *Id.*

[79] AP-42, p. 13.2.3-5.

[80] 40 C.F.R. § 49.158(a)(2).

[81] 76 Fed. Reg. 38,748-38,788 (July 1, 2011).

EPA guidance on "practical enforceability" explains that, when restricting potential to emit, general permits must provide "specific and technically accurate (verifiable) limits[.]"[82] As another example, in the preamble to its proposed carbon pollution emission guidelines for electric utility generating units, EPA states that "an emission standard is verifiable if adequate monitoring, recordkeeping and reporting requirements are in place to enable the state and the Administrator to independently evaluate, measure and verify compliance with it."[83]

Use of the term "verifiable" in the two examples above suggests that an emission factor would be "verifiable" if there were a means to independently measure the emission factor to demonstrate its accuracy. However, as previously explained, unlike the protocols for measuring emissions by stack testing and by CEMS, there is no technically and economically feasible method for measuring fugitive particulate emissions. In the absence of such a measurement method, the accuracy of an emission factor/equation for fugitive particulate emissions cannot be determined.

Accordingly, PWCC believes that, when the term "verifiable" is used to describe an emission factor/equation for fugitive particulate emissions, the most that term can reasonably mean is that the factor or equation has "the ability to be proven or substantiated."[84] In the absence of a standardized, technically feasible method for measuring fugitive particulate emissions, a permit applicant relying on an emission factor/equation to quantify those emissions cannot reasonably be expected to independently prove or substantiate the accuracy of that factor. However, the applicant should be able to identify the technical reference from which the emission factor/equation was obtained and to substantiate the underlying basis for the particular value of that factor.

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[82] Memorandum from Kathie Stein, EPA Air Enforcement Division, to EPA Regional Air Directors of Jan. 25, 1995 (Attachment entitled "Enforceability Requirements for Limiting Potential to Emit Through SIP and §112 Rules and General Permits" at 10).

[83] 79 Fed. Reg. 34,830, 34,913 (June 18, 2014).

[84] EPA, Office of Modeling, Monitoring Systems, and Quality Assurance, "Glossary of QA Terms of the Quality Assurance Management Staff," http://www.epa.gov/emap/html/pubs/docs/resdocs/qa_terms.html#vv, last visited Feb. 5, 2015.

Emission Factor Uncertainty

Emission factors have been used in the field of air pollution management and control for a long time. In fact, EPA's predecessor agency made the following comment regarding the broad utility of emission factors:

> Because an emission factor ideally represents the average measured emission rate from a number of similar installations (e.g., basic oxygen furnaces), the use of such factors is a logical and equitable substitute for determining potential emission rate for each individual source.[85]

Even today, EPA continues to acknowledge that, "[i]n most cases, [emission] factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages for all facilities in the source category (i.e., a population average)."[86] In more recent times, however, the fact that an emission factor represents an average emission rate has given rise to grave agency concerns about the level of uncertainty in any emission rate that has been calculated for an individual source by using such an emission factor.

Nevertheless, when the potential to emit must be determined for a facility's fugitive emissions of particulate matter, PWCC has previously explained how EPA has a well-established policy of allowing the use of applicable emission factors to make that determination. That is, even if such an emission factor for a particular source category is only representative of a population average of emissions from facilities within that category, EPA policy does not reject the application of that factor on the grounds that it "do[es] not necessarily reflect the level of emission appropriate for calculating PTE" for any specific facility belonging to that category.[87]

It is axiomatic that uncertainties are inherent within emission factors published in AP-42 and other EPA technical literature. Contrary to the understanding of some people, however, the emission factor rating scheme in AP-42 cannot provide an indication of the level of uncertainty with any emission factor.

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[85] Stumph, Terry *et al.*, U.S. Public Health Service, "Trends in Air Pollution Control Regulations," 21 (ca. 1969).

[86] AP-42, Introduction at 1.

[87] *In re Peabody Western Coal Company,* 12 E.A.D. 22, 37 (E.A.B. 2005) (internal citation omitted).

EPA uses a subjective rating system for AP-42 emission factors where a factor is assigned a quality rating of "A" through "E" based on the quality of the supporting emissions test data and on the amount and the representative characteristics of those data.[88] The utility of that rating system, however, is often misunderstood. In particular, the AP-42 rating for a given emission factor is useful only as a rough indicator of that factor's viability relative to other factors.[89] Although the accuracy for an "A"-rated emission factor is presumably greater than for a "B"-rated factor, the increase in accuracy (or the corresponding reduction in uncertainty) cannot be quantified based upon the relative ratings of those two emission factors.[90] In short, when comparing two different emission factors applicable to the same facility, the AP-42 ratings for those two factors do not indicate the level of uncertainty in either factor.

The AP-42 rating system for emission factors has very little relevance in this instant proceeding where PWCC has selected EPA emission factors and equations to quantify fugitive particulate emissions from Kayenta's coal preparation facilities. First, regardless of their relative ratings in AP-42, when both a predictive emission equation and a single-value emission factor are available to estimate emissions from a particular type of preparation facility, the emission equation is typically selected because it will "generally provide more accurate estimates of emissions."[91] Importantly, the AP-42 ratings for that emission factor and that emission equation do not indicate the accuracy of the equation relative to that of the factor.

Furthermore, even with considerations of technology transfer, AP-42 generally provides only one emission factor (or one emission equation) for estimating fugitive particulate emissions from most of the types of coal preparation facilities found at Kayenta. Consequently, if estimated emissions from such a type of facility were required for PWCC's determination of Kayenta's potential to emit, the Company had to use that only applicable emission factor or that single emission equation, regardless of its AP-42 rating.

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[88] AP-42, Introduction at 8; RTI International (for EPA), *Emissions Factor Uncertainty Assessment (Draft),"* 1-2 (Feb 2007).

[89] EPA, *"Improving Air Quality with Economic Incentive Programs,"* EPA-452/R-01-001, 69 (Jan. 2001).

[90] EPA, *Emissions Factor Program Improvement Program (Draft),* 17 (Sept. 2005).

[91] AP-42, Table 11.9-4, note c.

In other words, the rating system for AP-42 emission factors and equations had little to no bearing on the AP-42 factors and equations selected by PWCC to quantify fugitive particulate emissions from Kayenta's coal preparation facilities. Moreover, those AP-42 ratings provided no information about the level of uncertainty within any given emission factor or equation.

EPA has conducted a number of studies over the past ten years to identify possible means for systematically quantifying the uncertainties in emission factors. For example, in 2007 EPA issued a draft version of its *Emissions Factor Uncertainty Assessment* wherein the Agency evaluated the uncertainties of several high-rated AP-42 emission factors and then developed emission factor uncertainty ratios for a range of probability levels.[92] Importantly, however, EPA made clear at that time that its particular study was in no way intended to begin requiring future applications of emission factors to account for the uncertainties in those factors. As EPA stated:

> This study does not attempt to evaluate or provide guidance on the application of emissions factor uncertainty in making environmental decisions. How emissions factor uncertainty affects or can be incorporated into such decision making necessarily must reflect the needs of affected stakeholders consistent with various program objectives.[93]

Indeed, the website for the Agency's "Clearinghouse for Inventories and Emissions Factors" contains the following assurance that EPA's current policy for the use of emission factors does not provide for quantification of emission factor uncertainty and subsequent adjustment of the affected emission factor to account for that uncertainty:

> Since the posting of the Draft Emission Factor Uncertainty Assessment for comment on April 24, 2007, we have received numerous inquiries from interested stakeholders questioning whether the Agency intends to include the effect of uncertainty on a source's applicable emission-related requirements, or whether states or local authorities need to apply the effect of uncertainty to determine area compliance with NAAQS standards. As originally stated in the Draft Assessment, we do not attempt to evaluate or provide guidance on the application of emissions factor uncertainty in making environmental decisions. Moreover, any such decisions would be made only after a formal notice and comment rulemaking process. However, EPA did

[92] RTI International (for EPA), *Emissions Factor Uncertainty Assessment (Draft),"* 1-2 (Feb 2007).

[93] *Id.* at 1-1.

> not intend any change in current practices that would warrant rulemaking.[94]

In short, when using AP-42 emission factors and equations to estimate the potentials to emit fugitive particulate matter for Kayenta's coal preparation facilities, PWCC has no obligation to quantify the inherent levels of uncertainty in those factors and equations (if that were even possible) and then to adjust their values accordingly. Rather, PWCC must apply such emission factors and equation using the same approach that originated with the 1980 PSD regulations.

[94] EPA, OAQPS, http://www.epa.gov/ttn/chief/efpac/abefpac.html, last visited Feb. 4, 2015.

APPENDIX C

APPENDIX C

RATIONALE FOR REJECTION OF CERTAIN FACILITY-SPECIFIC EMISSION FACTORS

PWCC's application for a synthetic minor source permit for the Kayenta Mine Complex has provided an in-depth discussion of the Company's analyses which resulted in selection of specific emission factors or equations as the ones most appropriate for estimating fugitive particulate emissions from the different types of coal preparation facilities at Kayenta. The discussion herein, however, focuses on those alternative emission factors or equations that PWCC considered for application to Kayenta's preparation facilities and explains the Company's reasons for rejecting those alternatives for application to Kayenta' facilities.

Crushing

The following alternative particulate emission factors for coal crushing were identified but ultimately rejected for the reasons described below:

(1) PM = 0.02 lb/ton WebFIRE[95] and FIRE Version 5.0[96]

The above-cited value essentially serves as a default factor for PM emissions from coal crushing because it is contained in EPA's WebFIRE database[97] as well as in EPA's FIRE Version 5.0 database.[98] That 0.02 lb/ton value has been used in a variety of emission estimates for coal crushing.

For example, when EPA revised NSPS Subpart Y for coal preparation facilities in 2009, the Agency relied upon that emission factor to calculate baseline PM emissions from primary

[95] "WebFIRE" is EPA's electronic database of emission factors for criteria and hazardous air pollutants from industrial and non-industrial processes. *See* http://cfpub.epa.gov/webfire/#compliance-functions.

[96] EPA, *FIRE Version 5.0; Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants,* EPA-454/R-95-012, Aug. 1995 (hereinafter "FIRE Version 5.0").

[97] WebFIRE at http://cfpub.epa.gov/webfire/index.cfm?action=fire.simpleSearch, SCC 30501010 (last visited Oct. 7, 2014).

[98] FIRE Version 5.0 at EF-62 (SCC 30501010).

crushing prior to the application of any emission control technologies.[99] One technical report on emissions from coal handling characterizes 0.02 lb PM/ton as the "best estimate" for primary coal crushing because that factor was "based on coke, which we believe to have the most similar characteristics to coal as opposed to other materials, and therefore we assume th[is] factor to be the 'most' representative number[ ]."[100]

Closer scrutiny of the origin of that particular factor, however, raises significant concern about its credibility. First, WebFIRE notes that

> [t]his factor was present in AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants, March 1990, EPA 450/4-90-003. These factors may have been (and may still be) in an AP-42 section, or they may have been added to that March 1990 document from other sources.[101]

However, a check of the referenced Air Facility Subsystem document reveals only the 0.02 lb/ton factor with no citation for its basis or origin.[102]

Furthermore, EPA's FIRE Version 5.0 identifies the fourth edition of AP-42 (September 1985) as the reference for the PM emission factor of 0.02 lb/ton from coal crushing.[103] However, a search of AP-42's fourth edition found no emission information specific to coal crushing. Consequently, as EPA opines in WebFIRE, the PM emission factor of 0.02 lb/ton must have been obtained "from other sources."

PWCC's search of EPA's technical literature on emissions from coal preparation facilities has determined that the uncontrolled PM emission factor of 0.02 lb/ton from coal crushing likely first

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[99] Memorandum from Christian Fellner, EPA OAQPS, to Coal Preparation NSPS Docket #EPA-HQ-OAR-2008-0260, 3 (Apr. 2008) ("Model Plant Control Costing Estimates for Units Subject to the NSPS for Coal Preparation Plants (40 CFR Part 60, Subpart Y)").

[100] Texas Natural Resource Conservation Commission (TNRCC), *Coal Handling Emissions Evaluation Roundtable (CHEER) Workshop*, 16 (May 16, 1996) (hereinafter "CHEER Manual").

[101] http://cfpub.epa.gov/webfire/index.cfm?action=fire.showfactor&factorid=18948 (last visited Oct. 7, 2014).

[102] EPA, *Air Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants*, EPA 450/4-90-003, 120 (Mar. 1990).

[103] FIRE Version 5.0 at EF-62.

appeared in a 1976 EPA-contractor report on fugitive dust emissions from mining.[104] In particular, that report explained that the uncontrolled PM emission factor of 0.02 lb/ton from primary crushing was estimated "[b]ased on some data from coal processing for coke production."[105]

Aside from confirming that the 0.02 lb/ton emission factor for coal crushing was <u>not</u> "based on coke," as others have alleged, the 1976 reference source for that emission factor provides little information about its development. PWCC has been unable to document (1) the nature of the actual "coal processing" facilities from which "some data" were obtained, (2) the particular type of that "some data" or (3) the analytical methodology applied to "some data" to arrive at the "estimated" PM emission rate of 0.02 lb/ton.

In short, the reliability of the 0.02 lb PM/ton emission factor for primary coal crushing is highly suspect due to the absence of appropriate background technical details that are needed to support the use of that factor. Indeed, as EPA explained as early as 1978, that emission factor for primary coal crushing (0.02 lb/ton) "is not adequate for AP-42 inclusion because the type and extent of testing used to derive this factor are unknown."[106]

(2) PM_{10} = 0.006 lb/ton EPA's WebFIRE and EPA's FIRE Version 5.0

Just like the previously addressed rejected emission factor for PM, the above-cited value for PM_{10} essentially serves as a default factor for PM_{10} emissions from coal crushing because it is contained in both EPA's WebFIRE database and FIRE Version 5.0 database. However, an investigation of the technical grounds for that factor indicates that it also suffers from a lack of any reliable technical basis.

FIRE Version 5.0 and WebFIRE both cite Appendix C.1 ("Particle Size Distribution Data and Sized Emission Factors for Selected Sources") in the fourth edition of AP-42 as the reference

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[104] PEDCo, *Evaluation of Fugitive Dust Emissions from Mining; Task 1 Report – Identification of Fugitive Dust Sources Associated with Mining (Draft)*, (Apr. 1976); *see also* PEDCo, *Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions*, EPA-450/3-77-010, 2-241 (Mar. 1977).

[105] *Id.* at 46 (citing PEDCo, *North Dakota Air Quality Maintenance Area Analysis*, Appendix B ("Air Emission Sources from a Lurgi Dry-Ash Gasification Facility Using Lignite Coal"), Mar. 1976).

[106] EPA, *Assessment of Fugitive Particulate Emission Factors for Industrial Processes*, EPA-450/3-78-107, 2-91 (Sept. 1978).

source for the 0.006 lb PM_{10}/ton emission factor.[107] That reference contains results of particle-size testing of particulate emissions from a number of industrial processes.

However, the cited Appendix C.1 contains no particle-size information for particulate matter from coal crushers. Appendix C.1 does provide test results from ball mills for phosphate rock and feldspar which indicate PM_{10}/PM ratios of 0.308[108] and 0.323[109], respectively. Given those results, EPA apparently assumed that a PM_{10}/PM ratio of 0.30 is an appropriate representation of the particle-size distribution for particulate matter emitted from coal crushing. Thus, the PM_{10} emission factor for coal crushing (0.006 lb/ton) appears to have been derived simply by multiplying the above PM_{10}/PM ratio times the default PM emission factor for coal crushing (0.02 lb/ton).

In sum, apparently based directly on the 0.02 lb/ton emission factor for PM from coal crushing, the reliability of the 0.006 lb/ton emission factor for PM_{10} from coal crushing is likewise highly suspect due to the absence of appropriate background technical details that are needed to verify an acceptable underlying basis for that PM_{10} emission factor.

(3) PM = 0.06 lb/ton 1976 EPA-contractor report[110]

When EPA revised NSPS Subpart Y for coal preparation facilities in 2009, the Agency relied upon this emission factor to calculate baseline PM emissions from secondary crushing prior to the application of any emission control technologies.[111] Moreover, some regulators and industry representatives of the coal handling industry have alleged that this factor is the "best estimate" for secondary coal crushing because it was "based on coke, which we believe to have the most similar characteristics to coal as opposed to other materials, and therefore we assume th[is] factor

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[107] FIRE Version 5.0 at EF-62 (SCC 30501010); WebFIRE at http://cfpub.epa.gov/webfire/index.cfm?action=fire.simpleSearch, SCC 30501010 (last visited Oct. 7, 2014).

[108] AP-42 (4th ed.) at C.1-88.

[109] AP-42 (4th ed.) at C.1-92.

[110] PEDCo, *Evaluation of Fugitive Dust Emissions from Mining; Task 1 Report – Identification of Fugitive Dust Sources Associated with Mining (Draft)*, (Apr. 1976).

[111] Memorandum from Christian Fellner, EPA OAQPS, to Coal Preparation NSPS Docket #EPA-HQ-OAR-2008-0260, 3 (Apr. 2008) ("Model Plant Control Costing Estimates for Units Subject to the NSPS for Coal Preparation Plants (40 CFR Part 60, Subpart Y)").

to be the 'most' representative number[ ]."[112] However, research on the origin of this emission factor has found that reliance on that factor is not justified.

In particular, that research has found that the value of 0.06 lb PM/ton was estimated "[b]ased on some data from coal processing for coke production."[113] Furthermore, from all indications, this emission factor was apparently developed from some type of a material balance.[114] Given the high mass throughput rate fed to a coal crusher relative to the much smaller amount of any fugitive losses, the results of any material balance involving those two coal flows would be highly inexact. As EPA appropriately concluded about this emission factor, "[e]xtensive testing would be required before its incorporation into AP-42."[115]

Thus, given the lack of any background technical details to substantiate the basis for this emission factor, it cannot be considered as capable of providing a reliable estimate of PM emissions from coal crushing.

(4) PM = 0.16 lb/ton 1977 EPA-contractor report[116]

This uncontrolled PM emission factor is sometimes used to estimate emissions from secondary coal crushing,[117] but it was actually developed as an estimate of the combined PM emissions from the screening of coal with subsequent crushing of any oversize from the screening.[118] EPA

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[112] CHEER Manual at 16.

[113] PEDCo, *Evaluation of Fugitive Dust Emissions from Mining; Task 1 Report – Identification of Fugitive Dust Sources Associated with Mining (Draft)*, 46 (Apr. 1976) (citing PEDCo, *North Dakota Air Quality Maintenance Area Analysis*, Appendix B ("Air Emission Sources from a Lurgi Dry-Ash Gasification Facility Using Lignite Coal"), Mar. 1976).

[114] EPA, *Assessment of Fugitive Particulate Emission Factors for Industrial Processes*, EPA-450/3-78-107, 2-92 (Sept. 1978) (citing PEDCo, *North Dakota Air Quality Maintenance Area Analysis*, Appendix B ("Air Emission Sources from a Lurgi Dry-Ash Gasification Facility Using Lignite Coal"), Mar. 1976).

[115] *Id.* at 2-92.

[116] PEDCo, *Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions*, EPA-450/3-77-010, 2-241 (Mar. 1977).

[117] TNRCC, CHEER Manual at 16.

[118] PEDCo, *Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions*, EPA-450/3-77-010, 2-241 (Mar. 1977); EPA, *Assessment of Fugitive Particulate Emission Factors for Industrial Processes*, EPA-450/3-78-107, 2-89 (Sept. 1978). An earlier study examined the data referenced in a March 1976 report for EPA and "estimated" the distribution of emissions to be 0.10 lb/ton for "secondary screening" and 0.06 lb/ton for

has acknowledged that this factor was derived from a material balance and would not be incorporated into AP-42 without extensive testing.[119] Again, given the nature of the high mass throughput to the processing equipment and the small amounts of any fugitive losses, any material balance would necessarily be highly inexact. PWCC has rejected this emission factor for its lack of verification, i.e., the technical basis underlying its development is highly suspect and not fully known.

Screening

The following alternative particulate emission factors for coal screening were identified but ultimately rejected for the reasons described below:

(1) PM_{10} = 0.00084 AP-42, p. 11.19.2-6 (5th ed., Jan. 1995)

This controlled PM_{10} emission factor for screening was added to the AP-42 Subsection for crushed stone processing operations in January 1995. That particular factor was updated based primarily upon results of a PM_{10} emission test program conducted by EPA contractors at crushed stone plants in the early-1990s.[120] However, after also incorporating results from a further PM_{10} emission test program sponsored by the National, Stone, Sand and Gravel Association, EPA revised this emission factor to the value found in the current version (Aug. 2004) of the fifth edition of AP-42, i.e., the 0.00074 lb/ton value selected to estimate PM_{10} emissions from Kayenta's screening operations.

(2) PM = 0.10 lb/ton 1976 EPA-contractor report[121]

When EPA revised NSPS Subpart Y for coal preparation facilities in 2009, the Agency relied upon that emission factor to calculate baseline PM emissions from screening prior to the

"secondary crushing." PEDCo, *Evaluation of Fugitive Dust Emissions from Mining; Task 1 Report – Identification of Fugitive Dust Sources Associated with Mining (Draft)*, 46 (Apr. 1976).

119 EPA, *Assessment of Fugitive Particulate Emission Factors for Industrial Processes*, EPA-450/3-78-107, 2-92 (Sept. 1978).

120 AP-42, page 11.19.2-8, References 9-16 (5th ed. Jan.1995). Results included testing at one plant performed for the National Stone Association.

121 PEDCo, *Evaluation of Fugitive Dust Emissions from Mining; Task 1 Report – Identification of Fugitive Dust Sources Associated with Mining (Draft)*, (Apr. 1976).

application of any emission control technologies.[122] Moreover, some regulators and industry representatives of the coal handling industry have alleged that this factor is the "best estimate" for coal screening because it was "based on coke, which we believe to have the most similar characteristics to coal as opposed to other materials, and therefore we assume th[is] factor to be the 'most' representative number[ ]."[123]

However, research of the origin of this uncontrolled PM emission factor of 0.10 lb/ton for coal screening reveals only that the value was estimated "[b]ased on some data from coal processing for coke production."[124] From all indications, it appears that this emission factor was developed from a material balance.[125] Given the high mass throughput rate to a screen for crushed coal relative to the small amount of any fugitive losses, any material balance on that operation would be highly inexact. In EPA's words, "[e]xtensive testing would be required before its incorporation into AP-42."[126]

In sum, given the lack of any background technical details to substantiate the basis for this emission factor, it cannot be considered as capable of providing a reliable estimate of PM emissions from coal screening.

(3) PM = 0.16 lb/ton   1977 EPA-contractor report[127]

This particular uncontrolled PM emission factor was first published in the 1970s as an estimate of the combined PM emissions from secondary crushing and screening of coal.[128] EPA has

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[122] Memorandum from Christian Fellner, EPA OAQPS, to Coal Preparation NSPS Docket #EPA-HQ-OAR-2008-0260, 3 (Apr. 2008) ("Model Plant Control Costing Estimates for Units Subject to the NSPS for Coal Preparation Plants (40 CFR Part 60, Subpart Y)").

[123] CHEER Manual at 16.

[124] PEDCo, *Evaluation of Fugitive Dust Emissions from Mining; Task 1 Report – Identification of Fugitive Dust Sources Associated with Mining (Draft)*, 46 (Apr. 1976) (citing PEDCo, *North Dakota Air Quality Maintenance Area Analysis*, Appendix B ("Air Emission Sources from a Lurgi Dry-Ash Gasification Facility Using Lignite Coal"), Mar. 1976).

[125] EPA, *Assessment of Fugitive Particulate Emission Factors for Industrial Processes*, EPA-450/3-78-107, 2-92 (Sept. 1978) (citing PEDCo, *North Dakota Air Quality Maintenance Area Analysis*, Appendix B ("Air Emission Sources from a Lurgi Dry-Ash Gasification Facility Using Lignite Coal"), Mar. 1976).

[126] *Id.* at 2-92.

[127] PEDCo, *Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions*, EPA-450/3-77-010, 2-241 (Mar. 1977).

acknowledged that the factor was derived from a material balance and would not be incorporated into AP-42 without extensive testing.[129] Given the high mass throughput to the processing equipment and the small amounts of any fugitive losses, any material balance would necessarily be highly inexact. PWCC has rejected this emission factor for its lack of verification, i.e., the technical basis underlying its development is highly suspect and not fully known.

(4) PM_{10} = 0.12 lb/ton AP-42, 3rd ed., update package, p.8.19.2-4 and Table 8.19.1-1

Acknowledging that no emission factors were presented in the section for crushed stone processing, the 1985 update package for the third edition of AP-42 stated that screening emission factors in the section for sand and gravel processing "should be similar to those expected from screening crushed rock."[130] That latter reference contained uncontrolled emission factors for TSP and PM_{10} of 0.16 lb/ton and 0.12 lb/ton, respectively, from flat screens processing dry product.[131]

The fact that these particular emission factors for screening are listed under a category of operations entitled "Open Dust Sources" indicates that the screen associated with these factors bears no resemblance to the type of vibrating, fully enclosed screens used to screen crushed coal at Kayenta. In this instance, use of an emission factor applicable to flat, open screens in the crushed stone industry to estimate emissions from Kayenta's enclosed coal screening would be wholly inappropriate due to, among other factors, the vast difference in the basic designs of the two operations in question.

(5) No value WebFIRE and FIRE Version 5.0

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[128] PEDCo, *Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions,* EPA-450/3-77-010, 2-241 (Mar. 1977); EPA, *Assessment of Fugitive Particulate Emission Factors for Industrial Processes,* EPA-450/3-78-107, 2-89 (Sept. 1978). An earlier study examined the data referenced in a March 1976 report for EPA and "estimated" the distribution of emissions to be 0.06 lb/ton for secondary crushing and 0.10 lb/ton for "secondary screening." PEDCo, *Evaluation of Fugitive Dust Emissions from Mining; Task 1 Report – Identification of Fugitive Dust Sources Associated with Mining (Draft),* 46 (Apr. 1976).

[129] EPA, *Assessment of Fugitive Particulate Emission Factors for Industrial Processes,* EPA-450/3-78-107, 2-92 (Sept. 1978).

[130] AP-42, p. 8.19.2-4 (3rd ed., Sept. 1985).

[131] AP-42, p. 8.19.1-3. This reference source also presented an uncontrolled PM_{10} emission factor of 0.12 lb/ton for flat screens with dry product.

Neither of these two EPA primary reference sources for emission factors contains an entry for "screening" under SCC #3-05-010 ("Coal Mining, Cleaning, and Material Handling").

Transfer Points on Belt Conveyors

The following alternative particulate emission factors for transfer points on coal belt conveyors were identified but ultimately rejected for the reasons described below:

(1) Earlier Drop Equations

Development of the standard drop equation evolved over time as acquisitions of additional emissions information about transfers of aggregate materials led successively to new empirical expressions of the relationship between fugitive particulate emitted from the transfer and a host of different operating and physical parameters. The following shows two earlier drop equations that were developed by EPA but have since been replaced.

The following formula for emissions from a continuous drop operation (load-in to and load-out from a storage pile) was the first version of the standard drop equation to appear in AP-42.[132]

$$E = \frac{k(0.0018)\left(\frac{s}{5}\right)\left(\frac{U}{5}\right)\left(\frac{H}{10}\right)}{\left(\frac{M}{2}\right)^2}$$

where:

E = emission factor (lb/ton)
k = particle size multiplier (dimensionless)
s = material silt content (%)
U = mean wind speed
H = drop height (ft)
M = material moisture content (%)

Furthermore, prior to AP-42's first publication of a drop equation for material load-in to and load-out from an open storage pile, EPA relied on the following drop equation to characterize particulate matter emitted during load-in to a storage pile:[133]

132 AP-42 (3rd ed.), Supplement 14, p. 11.2.3-4 (May 1983); *see* EPA, *Iron & Steel Plant Open Source Fugitive Emission Evaluation,* EPA-600/2/79-103, 82 (May 1979).

133 EPA, *Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions,* EPA-450/3-77-010, 2-35 (Mar. 1977).

$$E = \frac{(0.02)(K_1)\left(\frac{S}{1.5}\right)}{\left(\frac{PE}{100}\right)^2}$$

where:

- E = emission factor (lb/ton)
- K_1 = activity factor for the type of load-in relative to load-in with a front-end loader
- S = material silt content (%)
- PE = Thornthwaite's precipitation-evaporation index

In sum, application of the current version of EPA's "standard drop equation" to estimate fugitive particulate emissions from transfers of aggregate materials such as coal is a well-established practice.[134] Former drop equations developed by EPA are deemed less applicable than the current version of the standard drop equation in AP-42, Section 13.2.4.

Hopper Loading

The following alternative particulate emission factors for loading coal into truck hoppers were identified but ultimately rejected for the reasons described below:

(1) Earlier Drop Equations

EPA's drop equations for estimating fugitive particulate matter first appeared in the 1970s. Each version of the drop equation was eventually updated with a different mathematical expression from time to time when EPA acquired additional, relevant information about fugitive particulate emissions. Given the standard drop equation currently contained in AP-42, all prior versions of the drop equation are considered to be inferior and obsolete.

(2) 0.066 lb TSP/ton AP-42, Table 11.9-4 and FIRE Version 5.0

Presented in AP-42, Section 11.9 ("Western Surface Coal Mining"), this generic TSP emission factor applies to the unloading of coal from trucks equipped with bottom dumps.[135] This emission factor is also presented in FIRE Version 5.0.[136] Notably, however, an AP-42 footnote

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[134] *See, e.g.*, memorandum from Christian Fellner, EPA OAQPS, to Coal Preparation NSPS Docket #EPA-HQ-OAR-2008-0260, 1 (Apr. 2008) ("Comparison of Emission Factors for Uncontrolled Emission Rates for Facilities Subject to the NSPS for Coal Preparation Plants (40 CFR Part 60, Subpart Y)"); *see also* CHEER Manual at 10-11.

[135] AP-42, Table 11.9-4.

[136] EPA, *FIRE Version 5.0, Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants*, EPA-454/R-95-012, page EF-63 (Aug. 1995) (citing 1985 fourth edition of AP-42 as the source of this factor).

to single-value emission factors for coal unloading and loading states that "[p]redictive emission factor equations, which generally provide more accurate estimates of emissions, are presented in Chapter [Section] 13."[137] That EPA guidance is consistent with the Agency recommendation in AP-42, Section 11.10 ("Coal Cleaning") which endorses the use of emissions information in Section 13.2 to estimate fugitive particulate matter emissions from coal preparation facilities.

(3) 0.01 lb PM_{10}/ton FIRE Version 5.0

FIRE Version 5.0 identifies the origin of this emission factor as a 1992 draft listing of PM_{10} emission factors developed by technology transfer.[138] PWCC was unable to locate that particular document. However, the note contained with the FIRE citation suggests that a PM emission factor for coal loading into a truck was used along with as assumed particle size distribution that had no more than 15% PM_{10}.

PWCC could not justify the selection of this emission factor to estimate fugitive particulate emissions from hopper loading at Kayenta due not only to the significant uncertainty in the technical background for this emission factor, but also in view of EPA's preference for the use of predictive emission equations instead of single-value emission factors.

(4) 0.0088 lb PM/ton AP-42, Section 12.5
0.0043 lb PM_{10}/ton AP-42, Section 12.5

Presented in AP-42, Section 12.5 ("Iron and Steel Production"), these emission factors apply to the batch drop of low-silt slag from a front-end loader to a truck.[139] In addition to the obvious differences in materials (low-silt slag and not coal) and in operations (front-end loader to truck and not truck bottom to hopper), EPA generally prefers reliance upon predictive emission equations, such as the standard drop equation, instead of single-value emission factors.[140]

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[137] *Id.*, footnote c.

[138] EPA, *PM_{10} Emission Factor Listing Developed by Technology Transfer and AIRS Source Classification Codes with Documentation*, Mar. 1992.

[139] AP-42, Table 12.5-4 (citing Bohn, EPA-600/2-78-050).

[140] AP-42, Table 11.9-4, footnote c.

(5) 0.02 lb TSP/ton 1978 EPA-contractor report

This emission factor for "coal unloading" was estimated by "reducing the EPA-published emission factor for unloading crushed rock to account for the larger size of coal and its higher moisture content."[141] In lieu of using single-value emission factors to estimate fugitive particulate emissions from coal handling operations, EPA generally recommends the use of predictive emission equations for similar materials/operations in AP-42, Section 13.2, .e.g., the standard drop equation.[142]

Coal Pile Maintenance with Dozers

The following alternative particulate emission factors for maintaining coal piles with bulldozers were identified but ultimately rejected for the reasons described below:

AP-42, Section 11.9 ("Western Surface Coal Mining") contains the following emission equations specifically designated for "Bulldozing" on coal. However, an investigation of the basis underlying those AP-42 emission equations reveals that they are not applicable to bulldozers performing coal pile maintenance. In light of that finding, PWCC believes it is appropriate first to explain why those particular emission equations in AP-42 for bulldozing coal were not selected to characterize fugitive particulate emissions from dozers performing coal pile maintenance at Kayenta.

- *Rejected Emission Equations*:

$$E_{TSP} = \frac{78.4(s)^{1.2}}{(M)^{1.3}}$$ AP-42, Table 11.9-1

$$E_{PM10} = \frac{14.0(s)^{1.5}}{(M)^{1.4}}$$ AP-42, Table 11.9-1

$$E_{PM2.5} = \frac{1.72(s)^{1.2}}{(M)^{1.3}}$$ AP-42, Table 11.9-1

where:

E = emission rate (lb/hr);
s = silt content of the coal (wt. %); and
M = moisture content of the coal (wt.%).

[141] PEDCo, *Assessment of Fugitive Particulate Emission Factors for Industrial Processes,* EPA-450/3-78-107, 2-89 (Sept. 1978).

[142] AP-42, Table 11.9-4, footnote c.

The above AP-42 emission equations for bulldozing coal are not applicable to bulldozers performing coal pile maintenance for the following reasons:

(1) Dozer Activity Addressed by AP-42 Is Not Like Dozer Activities for Coal Pile Maintenance.

The AP-42 emission equations for bulldozing coal were developed from upwind-downwind sampling results for dozer operation during the coal loading process in the pit area of the mine. With that operation, a loading shovel scoops up loose material from the blasted coal seam and dumps that coal from the shovel's bucket into the bed of a haul truck. Some coal is typically spilled during the coal loading. A dozer is usually assigned to the area being worked by the shovel to remove spilled coal that could damage the trucks' tires. In addition to cleanup of the loading area, the dozer is used to push chunks of coal along the pit floor to locations that are more easily reached by the less maneuverable shovel.[143]

Notably, a dozer supporting the coal-loading process in the pit does not emit particulate matter due to grading, i.e., lowering its blade while in motion to remove the upper layer of material comprising the ground surface. Instead, fugitive particulate emissions from a dozer during coal loading are due to the dozer's travel across the pit floor. More specifically, the force of the dozer's wheels or tracks pulverizes material on the pit floor around the shovel. Particles are lifted and dropped from the rolling wheels or tracks of the dozer while exposed to strong air currents due to turbulent shear with the surface caused by the moving dozer.[144] In addition, abrasion of chunks of coal being pushed across the pit floor generates fugitive particulate matter that becomes suspended in air by the passing dozer and subsequently dispersed by ambient wind currents.

On the other hand, the primary force that causes fugitive particulate emissions during coal pile maintenance is the dozer's blade continuously disturbing portions of the pile's surface while grading and pushing coal. In addition, a dozer performing coal pile maintenance causes

[143] *See, e.g.*, PEDCo (for EPA), *Evaluation of Fugitive Dust Emissions from Mining; Task 1 Report – Identification of Fugitive Dust Sources Associated with Mining (Draft)*, 31-32 (Apr. 1976).

[144] AP-42, p. 13.2.2-1.

emissions of fugitive particulate when it pushes coal over the side of one level of the pile and that coal free-falls to a lower level of the pile.

A dozer working a pile also results in wind-entrainment of particles that are emitted as the dozer's tracks move over the surface of the pile. However, those particular emissions are generally less than similar emissions from dozer activity during coal loading in the pit because a dozer's speed (and resultant turbulent shear) while performing coal pile maintenance is typically less than a dozer's speed on the floor of the pit.

In sum, the nature of the dozer activity and resultant emissions during development of the AP-42 emission equations for bulldozing coal are far different from the types of dozer activities and their emissions during coal pile maintenance. For that reason, application of technology transfer is not implicated in this instance. That is, there is little to suggest that the level of fugitive particulate emissions during coal pile maintenance by a dozer could reasonably be characterized by the level of emissions from dozer operation during the coal-loading process on the pit floor. The AP-42 emission equations for bulldozing coal are simply not applicable for quantifying fugitive particulate emissions from coal pile maintenance by a bulldozer.[145]

(2) AP-42 Equations Provide Substantial Over-prediction.

The AP-42 emission equations for bulldozing coal were based upon results from a single EPA-sponsored field test program in 1979-1980 at three different western surface coal mines.[146] A total of only twelve (12) tests were conducted using the upwind-downwind TSP sampling methodology while dozers operated in pit areas as part of the coal-loading operation. During the loading process, blasted raw coal was loaded into haul trucks by shovels and front-end loaders.[147]

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145 AP-42, Table 11.9-1 also contains a separate equation for estimating combined emissions from wind erosion and "maintenance" of an active coal storage pile, suggesting that emissions from coal pile maintenance would not also be estimated separately with a general equation for bulldozing coal.

146 EPA, *Improved Emission Factors for Fugitive Dust from Western Surface Coal Mining Sources,* EPA-600/7-84-048 (Mar. 1984).

147 EPA, *Revision of Emission Factors for AP-42 Section 11.9 - Western Surface Coal Mining (Rev. Final Report)* (hereinafter "Revised Section 11.9 Emission Factors") Appendix F at F-14, Sept. 1998.
Unlike tests for particulate matter emitted from stacks and similar conveyances, there are no standard or "reference" methods for measuring the rates of fugitive particulate emissions. As the name implies, the upwind-downwind methodology for sampling fugitive particulate emissions measures ambient levels of particulate matter both upwind and downwind of the emissions source. Once the impact of the source has been determined, its corresponding emission rate is then back-calculated with a dispersion model. Because this test method requires specialized

Consequently, EPA sought to measure a dozer's emissions downwind of the coal-loading area where significant fugitive particulate matter was also being emitted in that area by a shovel, a front-end loader and multiple haul trucks.

EPA's sampling results for dozer emissions almost certainly were confounded by interference from those other emissions, i.e., the unavoidable overlapping of emission plumes from each of the upwind sources.[148] EPA has acknowledged that the quality of the test data from the upwind-downwind testing for bulldozing coal was adversely affected due to the poorly defined characteristics of the plume from the bulldozing activity and the interference of the pit areas with plume dispersion.[149]

EPA addressed the unavoidable sampling interference by emissions from other sources with the following:

> Sampling of coal loading operations was complicated by the many related dust-producing activities that are associated with it. It is impossible to sample coal loading by the upwind-downwind method without also getting some contributions from the haul truck pulling into position, from a front-end loader [or dozer] cleaning spilled coal from the loading area, and from the shovel or front-end loader restacking the loose coal between trucks.[150]

Upwind-downwind sampling results for coal dozer emissions, in units of lb/hr, were reported as follows:[151]

Mine	Mean	Std Dev	Range
1	24.1	10.9	16.1-40.1
2	6.1	3.0	3.0-9.1
3	299	89.2	222-439
All	134.3	155.6	3.0-439

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sampling equipment as well as skilled test planners and operators, its routine use at individual sources is considered technically infeasible.

[148] *Id.*, Appendix C at C-4.

[149] *Id.*, Appendix E at E-15 and Appendix F at F-15.

[150] *Id.*, Appendix F at F-46.

[151] *Id.*, Appendix F at F-37 and F-39.

In evaluating those results, EPA commented that "[c]oal characteristics are also expected to explain part of this variation, but it is doubtful that the very high emission rates at the third mine can be explained with just those parameters."[152] It is difficult for PWCC to discern exactly what "parameters" EPA is referring to, but in any case it is unfortunate that EPA could not simply state what appears to be the obvious, i.e., that nearby concurrent emissions from a shovel, a loader and several trucks prevented collection of particulate matter emissions only from the dozer.

Sampling results for dozer emissions at Mine 3 almost certainly reflect significant interference by emissions from those other nearby sources. Similar, but less, interference could have occurred at Mines 1 and 2. Therefore, estimates from the AP-42 emission equations that were derived from those sampling results cannot reasonably be viewed as representative of emissions only from bulldozing coal (even if the dozers in that test program actually "bulldozed" or graded and pushed coal).

Another EPA statement also raises questions about the credibility of the Agency's sampling results and associated emission equations. In particular, EPA stated that "[d]ozers working coal had considerably higher emission rates that dozers working overburden."[153] However, as previously explained, during the sampling program for coal dozer emissions, the dozers were not grading coal at any of the three mines. Instead of "dozers working coal" during EPA's sampling program, dozers were used for cleaning the floor of the pit in the area of the coal-loading shovel. Thus, EPA's statement about the relative amounts of emissions from dozers working overburden compared with emissions from dozers working coal is fundamentally flawed because the test program did not obtain any sampling results of dozers actually working coal.

On the other hand, when EPA sampled emissions from "dozers working overburden," those dozers were actually grading and pushing that material. Visual observations alone can confirm that a "dozer[ ] working overburden" normally emits more fugitive particulate emissions than a dozer traveling (with no grading) on the pit floor during shovel loading. In light of the relatively minor dozer activity with coal during EPA's test program, the especially high levels of emissions

[152] *Id.* at F-39.

[153] *Id.*

measured from that activity at one mine relative to the measured results for dozers working overburden should have alerted EPA that the coal-related results were suspect.

Interference by emissions from a shovel, from a front-end loader and from multiple haul trucks almost certainly explains why EPA's sampling results for emissions from a dozer during the coal-loading process were inordinately higher than expected. Consequently, emission equations developed from those sampling results will typically over-predict actual emissions by a substantial margin.

In conclusion, the dozer activity whose emissions were sampled in order to develop the AP-42 emission equations for bulldozing coal bears little resemblance to the dozer activities which are performed at Kayenta during coal pile maintenance. Furthermore, those equations consistently over-predict because measured emissions to support development of those equations were substantially overstated due to interference by emissions from other, nearby non-dozer sources. Given those considerations, PWCC has rejected use of those AP-42 emission equations to estimate fugitive particulate emissions from coal pile maintenance at Kayenta.

- *Other Rejected Emission Factors/Equations*

(1) $E = k\left(\frac{s}{12}\right)^a \left(\frac{W}{3}\right)^b$ AP-42, Section 13.2.2

where k, a and b are empirical constants provided in Table 13.2.2-2 for $PM_{2.5}$, PM_{10} and PM_{30}, and

E = size-specific emission factor (lb/VMT)
s = surface material silt content (%)
W = mean vehicle weight (tons)

From its earliest days of studying fugitive particulate emissions from aggregate storage piles, EPA has consistently characterized those emissions as being primarily caused by four different dust-producing activities, i.e.,[154]

- Loading onto piles
- Wind erosion
- Load-out from piles
- Vehicular traffic

[154] EPA, *Development of Emission Factors for Fugitive Dust Sources,* EPA-450/3-74-037, 102 (June 1974).

The vague activity identified above only as "vehicular traffic" has been identified at other times as "equipment and vehicle movement in storage area"[155] and "storage pile maintenance and traffic."[156] The most recent version of AP-42 identifies that dust-producing activity at aggregate storage piles as "equipment traffic in storage area."[157]

EPA has explained that "the movement of trucks and loading equipment in the storage pile area is also a substantial source of dust."[158] Accordingly, EPA recommends using the AP-42 equations for vehicle traffic on unpaved surfaces to estimate emissions "from equipment traffic (trucks, front-end loaders, dozers, etc.) traveling between or on piles."[159] The equation in (1) above is the AP-42 equation for vehicles traveling on unpaved surfaces at industrial sites.[160] However, as explained below, the Company has rejected the use of that particular equation for estimating emissions from coal pile maintenance with bulldozers at Kayenta.

The AP-42 equation for estimating emissions from vehicles traveling on unpaved roads at industrial sites was developed from extensive testing with various types of motorized equipment at different kinds of industrial locations and publicly accessible unpaved roads.[161] EPA combined the emission testing results collected over that broad range of source conditions into a single large data set for emission factor development.[162] Some of those tests were conducted at surface coal mines.[163]

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[155] PEDCo (for EPA), *Evaluation of Fugitive Dust Emissions from* Mining; *Task 1 Report – Identification of Fugitive Dust Sources Associated with Mining (Draft)*, 57 (Apr. 1976); EPA, *Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions,* EPA-450/3-77-010, 2-32 (Mar. 1977).

[156] R. Bohn et al., *Fugitive Emissions from Integrated Iron and Steel Plants,* EPA-600/2-78-050, 4-2 (Mar. 1978).

[157] AP-42, p. 13.2.4-3.

[158] *Id.* at p. 13.2.4-1.

[159] *Id.* at p. 13.2.4-5 (emphasis added).

[160] *Id. at p. 13.2.2-4*

[161] Midwest Research Institute (for EPA), *Emission Factor Documentation for AP-42, Section 13.2.1 – Unpaved Roads,* 4-1 to 4-80 (Sept. 1998).

[162] *Id.* at 4-4.

[163] *See, e.g., id.* at 3-8

Testing of unpaved road emissions at surface coal mines included a substantial number of tests with very large off-road haul trucks as well as with light- and medium-duty trucks; a limited number of tests were also performed with scrapers and graders.[164] Tests of scrapers in the "travel mode" between cut and fill areas were included in the data base for AP-42's emission equation. On the other hand, tests of graders blading an unpaved road were not included in that data base because of their low speed and the additional road disturbance involved.[165] That is, the AP-42 emission equation for unpaved industrial roads is not appropriate for estimating fugitive particulate emissions from a grader blading an unpaved road.

A dozer blading during coal pile maintenance is similar to a grader blading an unpaved road. In each case, the operation is at low speed, and fugitive emissions are greater than when the equipment is only traveling over the unpaved road or surface of coal. The data base for AP-42's emission equation did not include tests of graders (dozers) blading during coal pile maintenance. Even if such tests had been performed, EPA almost certainly would not have included those results in its data base for the AP-42 emission equation because a dozer blading coal operates much like a grader blading an unpaved road. In other words, the AP-42 emission equation for unpaved industrial roads is not appropriate for estimating fugitive particulate emissions from a dozer blading during coal pile maintenance.

Table 13.2.2-3 in AP-42 summarizes the range of source conditions used in developing the emission equation for unpaved industrial roads. Notably, the mean number of wheels on the vehicles during the testing ranged from 4 to 17. Coal pile maintenance at Kayenta is performed by tracked (not wheeled) dozers. In other words, none of the testing to develop the AP-42 emission equation involved a tracked dozer traveling over an unpaved road, much less a tracked dozer working a coal pile.

Many of EPA's studies of emissions from aggregate storage piles have been with materials other than coal, where material load-in and load-out were typically performed by haul trucks, front-end loaders and similar forms of vehicular equipment. In light of those other, non-coal piles' reliance on haul trucks, front-end loaders and similar forms of vehicular traffic, use of the AP-42

[164] *Id.* at 4-3, Reference 4 (internal citation omitted); at 4-8, Reference 9 (internal citation omitted); at 4-11 (internal citation omitted).

[165] *Id.* at 4-15.

equation for unpaved industrial surfaces would therefore be appropriate for estimating emissions from that "equipment and vehicle movement in [the] storage area."

On the other hand, load-in and load-out for the three open storage piles of processed coal at Kayenta are performed with stacking and reclaiming conveyors. There is no need for the persistent movement of haul trucks, front-end loaders and other vehicular traffic around those particular piles. Instead, the only equipment traffic of any significance "between or on" those piles are dozers performing coal pile maintenance.

In conclusion, although EPA may recommend use of the AP-42 equation for unpaved industrial surfaces to estimate emissions from equipment traveling "on piles," the background information for that equation's development shows that it was not intended for estimating fugitive particulate emissions from coal pile maintenance.

(2) Other Generic Emission Equations for Vehicular Traffic "Between or on Piles"

As EPA's studies of fugitive particulate emissions from open storage piles during the 1970s and 1980s proceeded to obtain additional emissions data and related information, the Agency (or one of its contractors) from time to time would publish an updated version of an empirical equation for predicting emissions from equipment traffic around and on those piles.[166] However, the current AP-42 emission equation for vehicular traffic on unpaved surfaces has superseded each of those prior empirical equations.

(3) 0.13 lb PM_{30}/ton 1974 EPA-contractor report[167]

This could well be the first EPA-published emission factor for "vehicular traffic" in the area of an open storage pile. EPA had conducted some very rudimentary sampling of dust around aggregate storage piles. From those sampling results, EPA formulated an overall emission factor for a storage pile as well as emission factors for the other dust-producing activities at the storage piles (wind erosion, load-in, load-out). The above value for "vehicular traffic" around the piles

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[166] *See, e.g.*, EPA, *Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions*, EPA-450/3-77-010, 2-35 (Mar. 1977); R. Bohn et al., *Fugitive Emissions from Integrated Iron and Steel Plants*, EPA-600/2-78-050, 4-2 (Mar. 1978); EPA, *Control of Open Fugitive Dust Sources*, EPA-450/3-88-008, 3-2 (Sept. 1988).

[167] EPA, *Development of Emission Factors for Fugitive Dust Sources*, EPA-450/3-74-037, 102 (June 1974).

was determined as the difference between the total emission factor and the sum of the other three activities' factors.

The above single-value emission factor is not supported by reliable technical information and has been rejected for PWCC's use in estimating emissions from Kayenta's coal pile maintenance. EPA includes a caveat with many single-value emission factors, including those for coal mining, that reliance on predictive equations, when available, is preferred in lieu of single-value factors.

EPA has likely published other "updated" single-value emission factors for estimating "vehicular traffic" emissions around a storage pile, and they should all be considered inferior to applicable AP-42 emission equations.

Coal Pile Wind Erosion[168]

The following alternative particulate emission factors for maintaining coal piles with bulldozers were identified but ultimately rejected for the reasons described below:

- *Rejected Emission Factors/Equations*

(1) $E_{TSP} = 1.6u$ AP-42, 3rd ed., supp. 14 (1983)

where:

E_{TSP} = emissions of TSP from wind erosion (lb/(acre)(hr)); and
u = wind speed (mph).

This was the first emission factor to appear for an "active storage pile (wind erosion and maintenance)" in AP-42's Section for Western Surface Coal Mining.[169] This factor was based upon 16 field tests using the upwind-downwind method of TSP sampling at a surface coal mine in Northwest Colorado (6 tests), a surface coal mine in Southwest Wyoming (6 tests) and a surface coal mine in Central North Dakota (4 tests).[170]

[168] The discussion which follows was synthesized mainly from materials contained in Section 13.2.5 of AP-42 and at EPA, *Control of Open Fugitive Dust Sources*, EPA-450/3-88-008, 4-4 to 4-17 (Sept. 1988).

[169] AP-42, 3rd ed., supp. 14 (1983).

[170] EPA, *Review of Surface Coal Mining Emission Factors*, EPA-450/R-95-007, pp. H-10 & H-11 (July 1991) (citing K. Axetell, *Survey of Fugitive Dust from Coal Mines*, EPA-908/1-78-003 (Feb. 1978)).

The reliability of this equation is highly suspect because, among other reasons, the range of test conditions did not ensure that measured emissions were representative of those from wind erosion of an open coal storage pile. First, only "very light winds" were encountered during the test program.[171] In addition, the sizes of the coal storage piles were very large,[172] meaning the array of downwind samplers were unlikely to have captured the full plume of eroded coal particles. Moreover, because many of the tests were conducted while pile maintenance activities were also being performed, test results cannot be attributed solely to wind erosion.

(2) $E_{TSP} = 0.72u$ AP-42, Section 11.9, 5th ed., supp. E (1999)

This emission factor is a modification of the original 1983 emission factor above (1.6u). The original factor was revised by incorporating results from additional testing of storage piles at western surface mines. In particular, particulate emissions due to wind erosion of open coal storage piles were measured during 23 tests using the wind tunnel method of sampling at three separate mines.[173]

This revision of the original AP-42 emission factor is provided in the current version of AP-42, Section 11.9 ("Western Surface Coal Mining"). Because the data for the revised factor were again obtained while coal pile maintenance was ongoing at some piles, applicability of the emission factor is designated as "Active storage pile (wind erosion and maintenance)".[174] That is, the factor does not estimate particulate emissions only from wind erosion.

The amount of emission data informing this emissions factor for this particular dust-producing activity at coal storage piles is significant. However, as noted earlier, this same emission information for wind erosion of coal storage piles is a substantial portion of the larger data base supporting the PWCC-selected equations for industrial wind erosion. Consequently, this current emission factor from AP-42 for western surface coal mining has been rejected in favor of

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[171] EPA-450/R-95-007 at H-4.

[172] *Id.*

[173] EPA, *Improved Emission Factors for Fugitive Dust from Western Surface Coal Mining Sources,* EPA-600/7-84-048 (Mar. 1984).

[174] AP-42, Table 11.9-1.

applying the industrial wind erosion equations that are based not only on significant coal-related information but also on the underlying physics that govern wind erosion of surfaces.

(3) $$E = 1.7\left(\frac{s}{1.5}\right)\left[\frac{(365-p)}{235}\right]\left(\frac{f}{15}\right)$$ AP-42, 4th ed. (1985) ("Aggregate Handling and Storage Piles")

where

E = TSP emission factor (lb/day- acre);
s = silt content of aggregate (%);
p = number of days per year with precipitation ≥ 0.01 in.; and
f = percentage of time that unobstructed wind speed exceeds 12 mph at the mean pile height.

The above empirical equation was developed from field testing of fugitive particulate emissions from a variety of open storage piles of different types of aggregate over the course of several years.[175] As indicated above, EPA's approach to estimating such fugitive emissions in 1985 was based upon a correlation of TSP emissions rate with silt content, number of dry days per year, and percent of time that wind speed at the pile exceeded 12 mph.[176] Notably, inclusion of a threshold wind speed in the above equation indicates that EPA had begun to account for the important concept of erosion potential when characterizing fugitive emissions caused by wind erosion of piles.

This equation was recommended for use when estimating emissions from wind erosion of active storage piles.[177] In other words, emissions estimated with this approach would include emissions due to wind erosion of the pile, but could also include emissions due to pile load-in, pile load-out and equipment traffic around or on the pile.[178]

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[175] EPA, *Control of Open Fugitive Dust Sources,* EPA-450/3-88-008, 4-17 & 4-18 (Sept. 1988) (internal citations omitted). This document also presented the new concept of erosion potential as a means of estimating fugitive emissions due to wind erosion.

[176] The above AP-42 empirical equation for wind erosion in 1985 essentially replaced earlier empirical equations developed by EPA based on various field test results. *See, e.g.,* EPA, *Fugitive Emissions from Integrated Iron and Steel Plants,* EPA-600/2-78-050, 4-2 (Mar. 1978); EPA, *Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions,* EPA-450/3-77-010, 2-35 (Mar. 1977).

[177] AP-42, 4th ed., p. 11.2.3-5 (Sept. 1985).

[178] *Id.* at p. 11.2.3-1; *see also* EPA-450/3-88-008 at 4-17 ("wind emissions from continuously active piles").

This equation was deleted from AP-42 in September 1988 when AP-42 first adopted the now standard "industrial wind erosion equations," the methodology that applies concepts of threshold friction velocity and erosion potential that has been selected by PWCC to estimate fugitive emissions from wind erosion of open storage piles at N-8.

APPENDIX D

APPENDIX D
EROSION POTENTIAL CALCULATIONS FOR PILE AREAS DISTURBED DAILY

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2006	1	1	11.53	0.23	0.69	1.04	1.12	0.0	0.0	0.0
2006	1	2	12.69	0.25	0.76	1.14	1.12	0.0	0.0	0.6
2006	1	3	11.45	0.23	0.69	1.03	1.12	0.0	0.0	0.0
2006	1	4	7.36	0.15	0.44	0.66	1.12	0.0	0.0	0.0
2006	1	5	7.44	0.15	0.45	0.67	1.12	0.0	0.0	0.0
2006	1	6	4.26	0.09	0.26	0.38	1.12	0.0	0.0	0.0
2006	1	7	8.32	0.17	0.50	0.75	1.12	0.0	0.0	0.0
2006	1	8	10.16	0.20	0.61	0.91	1.12	0.0	0.0	0.0
2006	1	9	5.74	0.11	0.34	0.52	1.12	0.0	0.0	0.0
2006	1	10	4.59	0.09	0.28	0.41	1.12	0.0	0.0	0.0
2006	1	11	5.64	0.11	0.34	0.51	1.12	0.0	0.0	0.0
2006	1	12	5.71	0.11	0.34	0.51	1.12	0.0	0.0	0.0
2006	1	13	6.51	0.13	0.39	0.59	1.12	0.0	0.0	0.0
2006	1	14	8.28	0.17	0.50	0.75	1.12	0.0	0.0	0.0
2006	1	15	10.30	0.21	0.62	0.93	1.12	0.0	0.0	0.0
2006	1	16	11.05	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2006	1	17	3.80	0.08	0.23	0.34	1.12	0.0	0.0	0.0
2006	1	18	10.37	0.21	0.62	0.93	1.12	0.0	0.0	0.0
2006	1	19	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2006	1	20	4.70	0.09	0.28	0.42	1.12	0.0	0.0	0.0
2006	1	21	4.31	0.09	0.26	0.39	1.12	0.0	0.0	0.0
2006	1	22	6.43	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2006	1	23	6.59	0.13	0.40	0.59	1.12	0.0	0.0	0.0
2006	1	24	7.64	0.15	0.46	0.69	1.12	0.0	0.0	0.0
2006	1	25	9.72	0.19	0.58	0.87	1.12	0.0	0.0	0.0
2006	1	26	4.60	0.09	0.28	0.41	1.12	0.0	0.0	0.0
2006	1	27	6.18	0.12	0.37	0.56	1.12	0.0	0.0	0.0
2006	1	28	4.83	0.10	0.29	0.43	1.12	0.0	0.0	0.0
2006	1	29	8.36	0.17	0.50	0.75	1.12	0.0	0.0	0.0
2006	1	30	4.52	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2006	1	31	8.93	0.18	0.54	0.80	1.12	0.0	0.0	0.0
2006	2	1	9.61	0.19	0.58	0.86	1.12	0.0	0.0	0.0
2006	2	2	13.76	0.28	0.83	1.24	1.12	0.0	0.0	3.8
2006	2	3	5.88	0.12	0.35	0.53	1.12	0.0	0.0	0.0
2006	2	4	5.64	0.11	0.34	0.51	1.12	0.0	0.0	0.0
2006	2	5	10.17	0.20	0.61	0.92	1.12	0.0	0.0	0.0
2006	2	6	3.66	0.07	0.22	0.33	1.12	0.0	0.0	0.0
2006	2	7	5.71	0.11	0.34	0.51	1.12	0.0	0.0	0.0
2006	2	8	6.65	0.13	0.40	0.60	1.12	0.0	0.0	0.0
2006	2	9	6.35	0.13	0.38	0.57	1.12	0.0	0.0	0.0
2006	2	10	7.89	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2006	2	11	9.92	0.20	0.60	0.89	1.12	0.0	0.0	0.0
2006	2	12	4.84	0.10	0.29	0.44	1.12	0.0	0.0	0.0
2006	2	13	9.27	0.19	0.56	0.83	1.12	0.0	0.0	0.0
2006	2	14	7.88	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2006	2	15	19.54	0.39	1.17	1.76	1.12	0.0	1.5	39.6
2006	2	16	8.75	0.18	0.53	0.79	1.12	0.0	0.0	0.0
2006	2	17	12.87	0.26	0.77	1.16	1.12	0.0	0.0	1.0
2006	2	18	12.29	0.25	0.74	1.11	1.12	0.0	0.0	0.0
2006	2	19	7.71	0.15	0.46	0.69	1.12	0.0	0.0	0.0
2006	2	20	6.21	0.12	0.37	0.56	1.12	0.0	0.0	0.0
2006	2	21	3.89	0.08	0.23	0.35	1.12	0.0	0.0	0.0
2006	2	22	5.05	0.10	0.30	0.45	1.12	0.0	0.0	0.0
2006	2	23	7.74	0.15	0.46	0.70	1.12	0.0	0.0	0.0
2006	2	24	6.30	0.13	0.38	0.57	1.12	0.0	0.0	0.0
2006	2	25	5.80	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2006	2	26	7.74	0.15	0.46	0.70	1.12	0.0	0.0	0.0
2006	2	27	5.97	0.12	0.36	0.54	1.12	0.0	0.0	0.0
2006	2	28	11.54	0.23	0.69	1.04	1.12	0.0	0.0	0.0
2006	3	1	4.62	0.09	0.28	0.42	1.12	0.0	0.0	0.0
2006	3	2	6.38	0.13	0.38	0.57	1.12	0.0	0.0	0.0
2006	3	3	15.67	0.31	0.94	1.41	1.12	0.0	0.0	12.1
2006	3	4	7.98	0.16	0.48	0.72	1.12	0.0	0.0	0.0
2006	3	5	5.73	0.11	0.34	0.52	1.12	0.0	0.0	0.0
2006	3	6	9.16	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2006	3	7	9.96	0.20	0.60	0.90	1.12	0.0	0.0	0.0
2006	3	8	11.69	0.23	0.70	1.05	1.12	0.0	0.0	0.0
2006	3	9	9.63	0.19	0.58	0.87	1.12	0.0	0.0	0.0
2006	3	10	14.64	0.29	0.88	1.32	1.12	0.0	0.0	7.2
2006	3	11	10.01	0.20	0.60	0.90	1.12	0.0	0.0	0.0
2006	3	12	10.07	0.20	0.60	0.91	1.12	0.0	0.0	0.0
2006	3	13	6.18	0.12	0.37	0.56	1.12	0.0	0.0	0.0
2006	3	14	4.97	0.10	0.30	0.45	1.12	0.0	0.0	0.0

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2006	3	15	7.54	0.15	0.45	0.68	1.12	0.0	0.0	0.0
2006	3	16	6.03	0.12	0.36	0.54	1.12	0.0	0.0	0.0
2006	3	17	11.68	0.23	0.70	1.05	1.12	0.0	0.0	0.0
2006	3	18	15.09	0.30	0.91	1.36	1.12	0.0	0.0	9.2
2006	3	19	5.28	0.11	0.32	0.48	1.12	0.0	0.0	0.0
2006	3	20	7.65	0.15	0.46	0.69	1.12	0.0	0.0	0.0
2006	3	21	12.32	0.25	0.74	1.11	1.12	0.0	0.0	0.0
2006	3	22	5.28	0.11	0.32	0.48	1.12	0.0	0.0	0.0
2006	3	23	4.66	0.09	0.28	0.42	1.12	0.0	0.0	0.0
2006	3	24	4.40	0.09	0.26	0.40	1.12	0.0	0.0	0.0
2006	3	25	10.61	0.21	0.64	0.95	1.12	0.0	0.0	0.0
2006	3	26	9.74	0.19	0.58	0.88	1.12	0.0	0.0	0.0
2006	3	27	8.22	0.16	0.49	0.74	1.12	0.0	0.0	0.0
2006	3	28	10.40	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2006	3	29	13.08	0.26	0.78	1.18	1.12	0.0	0.0	1.6
2006	3	30	4.22	0.08	0.25	0.38	1.12	0.0	0.0	0.0
2006	3	31	10.59	0.21	0.64	0.95	1.12	0.0	0.0	0.0
2006	4	1	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2006	4	2	6.50	0.13	0.39	0.59	1.12	0.0	0.0	0.0
2006	4	3	8.83	0.18	0.53	0.79	1.12	0.0	0.0	0.0
2006	4	4	8.88	0.18	0.53	0.80	1.12	0.0	0.0	0.0
2006	4	5	19.82	0.40	1.19	1.78	1.12	0.0	2.0	42.2
2006	4	6	11.88	0.24	0.71	1.07	1.12	0.0	0.0	0.0
2006	4	7	3.91	0.08	0.23	0.35	1.12	0.0	0.0	0.0
2006	4	8	7.04	0.14	0.42	0.63	1.12	0.0	0.0	0.0
2006	4	9	9.98	0.20	0.60	0.90	1.12	0.0	0.0	0.0
2006	4	10	12.54	0.25	0.75	1.13	1.12	0.0	0.0	0.2
2006	4	11	7.38	0.15	0.44	0.66	1.12	0.0	0.0	0.0
2006	4	12	7.88	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2006	4	13	6.47	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2006	4	14	16.91	0.34	1.01	1.52	1.12	0.0	0.0	19.4
2006	4	15	10.15	0.20	0.61	0.91	1.12	0.0	0.0	0.0
2006	4	16	8.32	0.17	0.50	0.75	1.12	0.0	0.0	0.0
2006	4	17	16.86	0.34	1.01	1.52	1.12	0.0	0.0	19.1
2006	4	18	5.93	0.12	0.36	0.53	1.12	0.0	0.0	0.0
2006	4	19	6.32	0.13	0.38	0.57	1.12	0.0	0.0	0.0
2006	4	20	7.99	0.16	0.48	0.72	1.12	0.0	0.0	0.0
2006	4	21	7.79	0.16	0.47	0.70	1.12	0.0	0.0	0.0
2006	4	22	12.91	0.26	0.77	1.16	1.12	0.0	0.0	1.1
2006	4	23	15.36	0.31	0.92	1.38	1.12	0.0	0.0	10.6
2006	4	24	7.02	0.14	0.42	0.63	1.12	0.0	0.0	0.0
2006	4	25	4.69	0.09	0.28	0.42	1.12	0.0	0.0	0.0
2006	4	26	5.50	0.11	0.33	0.50	1.12	0.0	0.0	0.0
2006	4	27	9.06	0.18	0.54	0.82	1.12	0.0	0.0	0.0
2006	4	28	13.31	0.27	0.80	1.20	1.12	0.0	0.0	2.3
2006	4	29	7.69	0.15	0.46	0.69	1.12	0.0	0.0	0.0
2006	4	30	8.98	0.18	0.54	0.81	1.12	0.0	0.0	0.0
2006	5	1	7.78	0.16	0.47	0.70	1.12	0.0	0.0	0.0
2006	5	2	8.41	0.17	0.50	0.76	1.12	0.0	0.0	0.0
2006	5	3	9.16	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2006	5	4	10.35	0.21	0.62	0.93	1.12	0.0	0.0	0.0
2006	5	5	9.09	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2006	5	6	6.56	0.13	0.39	0.59	1.12	0.0	0.0	0.0
2006	5	7	8.64	0.17	0.52	0.78	1.12	0.0	0.0	0.0
2006	5	8	9.54	0.19	0.57	0.86	1.12	0.0	0.0	0.0
2006	5	9	11.87	0.24	0.71	1.07	1.12	0.0	0.0	0.0
2006	5	10	7.09	0.14	0.43	0.64	1.12	0.0	0.0	0.0
2006	5	11	5.71	0.11	0.34	0.51	1.12	0.0	0.0	0.0
2006	5	12	5.17	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2006	5	13	7.40	0.15	0.44	0.67	1.12	0.0	0.0	0.0
2006	5	14	9.69	0.19	0.58	0.87	1.12	0.0	0.0	0.0
2006	5	15	8.42	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2006	5	16	6.08	0.12	0.36	0.55	1.12	0.0	0.0	0.0
2006	5	17	6.32	0.13	0.38	0.57	1.12	0.0	0.0	0.0
2006	5	18	8.58	0.17	0.51	0.77	1.12	0.0	0.0	0.0
2006	5	19	7.02	0.14	0.42	0.63	1.12	0.0	0.0	0.0
2006	5	20	7.83	0.16	0.47	0.70	1.12	0.0	0.0	0.0
2006	5	21	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2006	5	22	16.50	0.33	0.99	1.49	1.12	0.0	0.0	16.9
2006	5	23	5.10	0.10	0.31	0.46	1.12	0.0	0.0	0.0
2006	5	24	5.52	0.11	0.33	0.50	1.12	0.0	0.0	0.0
2006	5	25	7.90	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2006	5	26	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2006	5	27	16.87	0.34	1.01	1.52	1.12	0.0	0.0	19.2
2006	5	28	11.74	0.23	0.70	1.06	1.12	0.0	0.0	0.0
2006	5	29	6.21	0.12	0.37	0.56	1.12	0.0	0.0	0.0
2006	5	30	5.69	0.11	0.34	0.51	1.12	0.0	0.0	0.0
2006	5	31	7.42	0.15	0.45	0.67	1.12	0.0	0.0	0.0
2006	6	1	6.93	0.14	0.42	0.62	1.12	0.0	0.0	0.0
2006	6	2	6.13	0.12	0.37	0.55	1.12	0.0	0.0	0.0
2006	6	3	6.90	0.14	0.41	0.62	1.12	0.0	0.0	0.0
2006	6	4	7.51	0.15	0.45	0.68	1.12	0.0	0.0	0.0
2006	6	5	7.13	0.14	0.43	0.64	1.12	0.0	0.0	0.0
2006	6	6	10.03	0.20	0.60	0.90	1.12	0.0	0.0	0.0
2006	6	7	10.44	0.21	0.63	0.94	1.12	0.0	0.0	0.0
2006	6	8	9.37	0.19	0.56	0.84	1.12	0.0	0.0	0.0
2006	6	9	9.39	0.19	0.56	0.85	1.12	0.0	0.0	0.0
2006	6	10	8.02	0.16	0.48	0.72	1.12	0.0	0.0	0.0
2006	6	11	6.33	0.13	0.38	0.57	1.12	0.0	0.0	0.0
2006	6	12	10.54	0.21	0.63	0.95	1.12	0.0	0.0	0.0
2006	6	13	11.37	0.23	0.68	1.02	1.12	0.0	0.0	0.0
2006	6	14	12.97	0.26	0.78	1.17	1.12	0.0	0.0	1.3
2006	6	15	11.03	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2006	6	16	8.14	0.16	0.49	0.73	1.12	0.0	0.0	0.0
2006	6	17	6.27	0.13	0.38	0.56	1.12	0.0	0.0	0.0
2006	6	18	6.76	0.14	0.41	0.61	1.12	0.0	0.0	0.0
2006	6	19	8.04	0.16	0.48	0.72	1.12	0.0	0.0	0.0
2006	6	20	7.06	0.14	0.42	0.64	1.12	0.0	0.0	0.0
2006	6	21	6.45	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2006	6	22	7.07	0.14	0.42	0.64	1.12	0.0	0.0	0.0
2006	6	23	6.51	0.13	0.39	0.59	1.12	0.0	0.0	0.0
2006	6	24	7.51	0.15	0.45	0.68	1.12	0.0	0.0	0.0
2006	6	25	10.72	0.21	0.64	0.96	1.12	0.0	0.0	0.0
2006	6	26	6.30	0.13	0.38	0.57	1.12	0.0	0.0	0.0
2006	6	27	6.28	0.13	0.38	0.57	1.12	0.0	0.0	0.0
2006	6	28	7.61	0.15	0.46	0.68	1.12	0.0	0.0	0.0
2006	6	29	9.85	0.20	0.59	0.89	1.12	0.0	0.0	0.0
2006	6	30	9.56	0.19	0.57	0.86	1.12	0.0	0.0	0.0
2006	7	1	9.74	0.19	0.58	0.88	1.12	0.0	0.0	0.0
2006	7	2	9.46	0.19	0.57	0.85	1.12	0.0	0.0	0.0
2006	7	3	8.47	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2006	7	4	8.17	0.16	0.49	0.74	1.12	0.0	0.0	0.0
2006	7	5	5.67	0.11	0.34	0.51	1.12	0.0	0.0	0.0
2006	7	6	7.90	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2006	7	7	8.27	0.17	0.50	0.74	1.12	0.0	0.0	0.0
2006	7	8	12.25	0.25	0.74	1.10	1.12	0.0	0.0	0.0
2006	7	9	9.27	0.19	0.56	0.83	1.12	0.0	0.0	0.0
2006	7	10	10.68	0.21	0.64	0.96	1.12	0.0	0.0	0.0
2006	7	11	5.60	0.11	0.34	0.50	1.12	0.0	0.0	0.0
2006	7	12	9.30	0.19	0.56	0.84	1.12	0.0	0.0	0.0
2006	7	13	7.40	0.15	0.44	0.67	1.12	0.0	0.0	0.0
2006	7	14	5.45	0.11	0.33	0.49	1.12	0.0	0.0	0.0
2006	7	15	12.40	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2006	7	16	6.55	0.13	0.39	0.59	1.12	0.0	0.0	0.0
2006	7	17	9.98	0.20	0.60	0.90	1.12	0.0	0.0	0.0
2006	7	18	7.50	0.15	0.45	0.68	1.12	0.0	0.0	0.0
2006	7	19	7.44	0.15	0.45	0.67	1.12	0.0	0.0	0.0
2006	7	20	6.88	0.14	0.41	0.62	1.12	0.0	0.0	0.0
2006	7	21	10.07	0.20	0.60	0.91	1.12	0.0	0.0	0.0
2006	7	22	5.98	0.12	0.36	0.54	1.12	0.0	0.0	0.0
2006	7	23	6.19	0.12	0.37	0.56	1.12	0.0	0.0	0.0
2006	7	24	7.56	0.15	0.45	0.68	1.12	0.0	0.0	0.0
2006	7	25	7.13	0.14	0.43	0.64	1.12	0.0	0.0	0.0
2006	7	26	7.74	0.15	0.46	0.70	1.12	0.0	0.0	0.0
2006	7	27	11.30	0.23	0.68	1.02	1.12	0.0	0.0	0.0
2006	7	28	8.90	0.18	0.53	0.80	1.12	0.0	0.0	0.0
2006	7	29	7.07	0.14	0.42	0.64	1.12	0.0	0.0	0.0
2006	7	30	6.38	0.13	0.38	0.57	1.12	0.0	0.0	0.0
2006	7	31	7.99	0.16	0.48	0.72	1.12	0.0	0.0	0.0
2006	8	1	7.65	0.15	0.46	0.69	1.12	0.0	0.0	0.0
2006	8	2	6.23	0.12	0.37	0.56	1.12	0.0	0.0	0.0
2006	8	3	8.16	0.16	0.49	0.73	1.12	0.0	0.0	0.0
2006	8	4	7.49	0.15	0.45	0.67	1.12	0.0	0.0	0.0
2006	8	5	4.45	0.09	0.27	0.40	1.12	0.0	0.0	0.0
2006	8	6	7.46	0.15	0.45	0.67	1.12	0.0	0.0	0.0
2006	8	7	8.04	0.16	0.48	0.72	1.12	0.0	0.0	0.0

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2006	8	8	7.47	0.15	0.45	0.67	1.12	0.0	0.0	0.0
2006	8	9	5.48	0.11	0.33	0.49	1.12	0.0	0.0	0.0
2006	8	10	4.05	0.08	0.24	0.36	1.12	0.0	0.0	0.0
2006	8	11	8.02	0.16	0.48	0.72	1.12	0.0	0.0	0.0
2006	8	12	7.51	0.15	0.45	0.68	1.12	0.0	0.0	0.0
2006	8	13	5.95	0.12	0.36	0.54	1.12	0.0	0.0	0.0
2006	8	14	5.97	0.12	0.36	0.54	1.12	0.0	0.0	0.0
2006	8	15	7.59	0.15	0.46	0.68	1.12	0.0	0.0	0.0
2006	8	16	7.78	0.16	0.47	0.70	1.12	0.0	0.0	0.0
2006	8	17	5.67	0.11	0.34	0.51	1.12	0.0	0.0	0.0
2006	8	18	5.40	0.11	0.32	0.49	1.12	0.0	0.0	0.0
2006	8	19	5.57	0.11	0.33	0.50	1.12	0.0	0.0	0.0
2006	8	20	9.04	0.18	0.54	0.81	1.12	0.0	0.0	0.0
2006	8	21	6.04	0.12	0.36	0.54	1.12	0.0	0.0	0.0
2006	8	22	5.76	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2006	8	23	5.61	0.11	0.34	0.50	1.12	0.0	0.0	0.0
2006	8	24	7.41	0.15	0.44	0.67	1.12	0.0	0.0	0.0
2006	8	25	7.49	0.15	0.45	0.67	1.12	0.0	0.0	0.0
2006	8	26	9.60	0.19	0.58	0.86	1.12	0.0	0.0	0.0
2006	8	27	6.84	0.14	0.41	0.62	1.12	0.0	0.0	0.0
2006	8	28	5.67	0.11	0.34	0.51	1.12	0.0	0.0	0.0
2006	8	29	5.76	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2006	8	30	7.26	0.15	0.44	0.65	1.12	0.0	0.0	0.0
2006	8	31	7.51	0.15	0.45	0.68	1.12	0.0	0.0	0.0
2006	9	1	7.78	0.16	0.47	0.70	1.12	0.0	0.0	0.0
2006	9	2	8.64	0.17	0.52	0.78	1.12	0.0	0.0	0.0
2006	9	3	6.36	0.13	0.38	0.57	1.12	0.0	0.0	0.0
2006	9	4	5.45	0.11	0.33	0.49	1.12	0.0	0.0	0.0
2006	9	5	7.49	0.15	0.45	0.67	1.12	0.0	0.0	0.0
2006	9	6	8.32	0.17	0.50	0.75	1.12	0.0	0.0	0.0
2006	9	7	6.61	0.13	0.40	0.59	1.12	0.0	0.0	0.0
2006	9	8	7.46	0.15	0.45	0.67	1.12	0.0	0.0	0.0
2006	9	9	6.47	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2006	9	10	6.27	0.13	0.38	0.56	1.12	0.0	0.0	0.0
2006	9	11	5.18	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2006	9	12	5.74	0.11	0.34	0.52	1.12	0.0	0.0	0.0
2006	9	13	5.40	0.11	0.32	0.49	1.12	0.0	0.0	0.0
2006	9	14	11.26	0.23	0.68	1.01	1.12	0.0	0.0	0.0
2006	9	15	16.30	0.33	0.98	1.47	1.12	0.0	0.0	15.7
2006	9	16	8.39	0.17	0.50	0.76	1.12	0.0	0.0	0.0
2006	9	17	7.45	0.15	0.45	0.67	1.12	0.0	0.0	0.0
2006	9	18	4.65	0.09	0.28	0.42	1.12	0.0	0.0	0.0
2006	9	19	7.13	0.14	0.43	0.64	1.12	0.0	0.0	0.0
2006	9	20	16.69	0.33	1.00	1.50	1.12	0.0	0.0	18.0
2006	9	21	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2006	9	22	9.32	0.19	0.56	0.84	1.12	0.0	0.0	0.0
2006	9	23	6.02	0.12	0.36	0.54	1.12	0.0	0.0	0.0
2006	9	24	5.64	0.11	0.34	0.51	1.12	0.0	0.0	0.0
2006	9	25	5.35	0.11	0.32	0.48	1.12	0.0	0.0	0.0
2006	9	26	6.16	0.12	0.37	0.55	1.12	0.0	0.0	0.0
2006	9	27	6.54	0.13	0.39	0.59	1.12	0.0	0.0	0.0
2006	9	28	6.09	0.12	0.37	0.55	1.12	0.0	0.0	0.0
2006	9	29	6.21	0.12	0.37	0.56	1.12	0.0	0.0	0.0
2006	9	30	6.27	0.13	0.38	0.56	1.12	0.0	0.0	0.0
2006	10	1	7.13	0.14	0.43	0.64	1.12	0.0	0.0	0.0
2006	10	2	10.65	0.21	0.64	0.96	1.12	0.0	0.0	0.0
2006	10	3	8.31	0.17	0.50	0.75	1.12	0.0	0.0	0.0
2006	10	4	9.98	0.20	0.60	0.90	1.12	0.0	0.0	0.0
2006	10	5	12.87	0.26	0.77	1.16	1.12	0.0	0.0	1.0
2006	10	6	14.09	0.28	0.85	1.27	1.12	0.0	0.0	5.0
2006	10	7	8.08	0.16	0.48	0.73	1.12	0.0	0.0	0.0
2006	10	8	6.66	0.13	0.40	0.60	1.12	0.0	0.0	0.0
2006	10	9	6.12	0.12	0.37	0.55	1.12	0.0	0.0	0.0
2006	10	10	5.43	0.11	0.33	0.49	1.12	0.0	0.0	0.0
2006	10	11	5.73	0.11	0.34	0.52	1.12	0.0	0.0	0.0
2006	10	12	4.90	0.10	0.29	0.44	1.12	0.0	0.0	0.0
2006	10	13	5.17	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2006	10	14	8.35	0.17	0.50	0.75	1.12	0.0	0.0	0.0
2006	10	15	4.94	0.10	0.30	0.44	1.12	0.0	0.0	0.0
2006	10	16	7.26	0.15	0.44	0.65	1.12	0.0	0.0	0.0
2006	10	17	10.73	0.21	0.64	0.97	1.12	0.0	0.0	0.0
2006	10	18	6.40	0.13	0.38	0.58	1.12	0.0	0.0	0.0
2006	10	19	4.32	0.09	0.26	0.39	1.12	0.0	0.0	0.0

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2006	10	20	7.11	0.14	0.43	0.64	1.12	0.0	0.0	0.0
2006	10	21	8.56	0.17	0.51	0.77	1.12	0.0	0.0	0.0
2006	10	22	7.08	0.14	0.42	0.64	1.12	0.0	0.0	0.0
2006	10	23	4.26	0.09	0.26	0.38	1.12	0.0	0.0	0.0
2006	10	24	6.56	0.13	0.39	0.59	1.12	0.0	0.0	0.0
2006	10	25	14.06	0.28	0.84	1.27	1.12	0.0	0.0	4.9
2006	10	26	9.65	0.19	0.58	0.87	1.12	0.0	0.0	0.0
2006	10	27	5.21	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2006	10	28	4.28	0.09	0.26	0.39	1.12	0.0	0.0	0.0
2006	10	29	6.26	0.13	0.38	0.56	1.12	0.0	0.0	0.0
2006	10	30	7.87	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2006	10	31	6.78	0.14	0.41	0.61	1.12	0.0	0.0	0.0
2006	11	1	4.69	0.09	0.28	0.42	1.12	0.0	0.0	0.0
2006	11	2	5.46	0.11	0.33	0.49	1.12	0.0	0.0	0.0
2006	11	3	5.09	0.10	0.31	0.46	1.12	0.0	0.0	0.0
2006	11	4	6.70	0.13	0.40	0.60	1.12	0.0	0.0	0.0
2006	11	5	4.86	0.10	0.29	0.44	1.12	0.0	0.0	0.0
2006	11	6	7.26	0.15	0.44	0.65	1.12	0.0	0.0	0.0
2006	11	7	4.90	0.10	0.29	0.44	1.12	0.0	0.0	0.0
2006	11	8	6.45	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2006	11	9	10.94	0.22	0.66	0.98	1.12	0.0	0.0	0.0
2006	11	10	7.11	0.14	0.43	0.64	1.12	0.0	0.0	0.0
2006	11	11	10.30	0.21	0.62	0.93	1.12	0.0	0.0	0.0
2006	11	12	6.95	0.14	0.42	0.63	1.12	0.0	0.0	0.0
2006	11	13	6.04	0.12	0.36	0.54	1.12	0.0	0.0	0.0
2006	11	14	15.20	0.30	0.91	1.37	1.12	0.0	0.0	9.8
2006	11	15	7.14	0.14	0.43	0.64	1.12	0.0	0.0	0.0
2006	11	16	4.27	0.09	0.26	0.38	1.12	0.0	0.0	0.0
2006	11	17	5.12	0.10	0.31	0.46	1.12	0.0	0.0	0.0
2006	11	18	6.65	0.13	0.40	0.60	1.12	0.0	0.0	0.0
2006	11	19	6.05	0.12	0.36	0.54	1.12	0.0	0.0	0.0
2006	11	20	6.11	0.12	0.37	0.55	1.12	0.0	0.0	0.0
2006	11	21	6.88	0.14	0.41	0.62	1.12	0.0	0.0	0.0
2006	11	22	6.37	0.13	0.38	0.57	1.12	0.0	0.0	0.0
2006	11	23	6.04	0.12	0.36	0.54	1.12	0.0	0.0	0.0
2006	11	24	6.31	0.13	0.38	0.57	1.12	0.0	0.0	0.0
2006	11	25	7.87	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2006	11	26	6.28	0.13	0.38	0.57	1.12	0.0	0.0	0.0
2006	11	27	10.73	0.21	0.64	0.97	1.12	0.0	0.0	0.0
2006	11	28	11.03	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2006	11	29	13.31	0.27	0.80	1.20	1.12	0.0	0.0	2.3
2006	11	30	8.47	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2006	12	1	5.55	0.11	0.33	0.50	1.12	0.0	0.0	0.0
2006	12	2	9.49	0.19	0.57	0.85	1.12	0.0	0.0	0.0
2006	12	3	6.27	0.13	0.38	0.56	1.12	0.0	0.0	0.0
2006	12	4	5.02	0.10	0.30	0.45	1.12	0.0	0.0	0.0
2006	12	5	5.00	0.10	0.30	0.45	1.12	0.0	0.0	0.0
2006	12	6	6.07	0.12	0.36	0.55	1.12	0.0	0.0	0.0
2006	12	7	5.61	0.11	0.34	0.50	1.12	0.0	0.0	0.0
2006	12	8	3.36	0.07	0.20	0.30	1.12	0.0	0.0	0.0
2006	12	9	6.17	0.12	0.37	0.56	1.12	0.0	0.0	0.0
2006	12	10	11.94	0.24	0.72	1.07	1.12	0.0	0.0	0.0
2006	12	11	7.13	0.14	0.43	0.64	1.12	0.0	0.0	0.0
2006	12	12	3.42	0.07	0.21	0.31	1.12	0.0	0.0	0.0
2006	12	13	4.05	0.08	0.24	0.36	1.12	0.0	0.0	0.0
2006	12	14	3.38	0.07	0.20	0.30	1.12	0.0	0.0	0.0
2006	12	15	7.23	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2006	12	16	11.15	0.22	0.67	1.00	1.12	0.0	0.0	0.0
2006	12	17	12.41	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2006	12	18	7.95	0.16	0.48	0.72	1.12	0.0	0.0	0.0
2006	12	19	4.66	0.09	0.28	0.42	1.12	0.0	0.0	0.0
2006	12	20	8.93	0.18	0.54	0.80	1.12	0.0	0.0	0.0
2006	12	21	7.02	0.14	0.42	0.63	1.12	0.0	0.0	0.0
2006	12	22	6.12	0.12	0.37	0.55	1.12	0.0	0.0	0.0
2006	12	23	9.18	0.18	0.55	0.83	1.12	0.0	0.0	0.0
2006	12	24	10.11	0.20	0.61	0.91	1.12	0.0	0.0	0.0
2006	12	25	3.39	0.07	0.20	0.31	1.12	0.0	0.0	0.0
2006	12	26	4.31	0.09	0.26	0.39	1.12	0.0	0.0	0.0
2006	12	27	9.45	0.19	0.57	0.85	1.12	0.0	0.0	0.0
2006	12	28	10.49	0.21	0.63	0.94	1.12	0.0	0.0	0.0
2006	12	29	10.56	0.21	0.63	0.95	1.12	0.0	0.0	0.0
2006	12	30	11.79	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2006	12	31	4.08	0.08	0.24	0.37	1.12	0.0	0.0	0.0

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2008	1	1	5.18	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2008	1	2	4.53	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2008	1	3	3.62	0.07	0.22	0.33	1.12	0.0	0.0	0.0
2008	1	4	7.75	0.16	0.47	0.70	1.12	0.0	0.0	0.0
2008	1	5	9.25	0.19	0.56	0.83	1.12	0.0	0.0	0.0
2008	1	6	10.32	0.21	0.62	0.93	1.12	0.0	0.0	0.0
2008	1	7	5.69	0.11	0.34	0.51	1.12	0.0	0.0	0.0
2008	1	8	4.19	0.08	0.25	0.38	1.12	0.0	0.0	0.0
2008	1	9	9.17	0.18	0.55	0.83	1.12	0.0	0.0	0.0
2008	1	10	4.03	0.08	0.24	0.36	1.12	0.0	0.0	0.0
2008	1	11	7.94	0.16	0.48	0.71	1.12	0.0	0.0	0.0
2008	1	12	4.05	0.08	0.24	0.36	1.12	0.0	0.0	0.0
2008	1	13	9.08	0.18	0.54	0.82	1.12	0.0	0.0	0.0
2008	1	14	8.54	0.17	0.51	0.77	1.12	0.0	0.0	0.0
2008	1	15	7.56	0.15	0.45	0.68	1.12	0.0	0.0	0.0
2008	1	16	11.41	0.23	0.68	1.03	1.12	0.0	0.0	0.0
2008	1	17	7.74	0.15	0.46	0.70	1.12	0.0	0.0	0.0
2008	1	18	6.33	0.13	0.38	0.57	1.12	0.0	0.0	0.0
2008	1	19	4.31	0.09	0.26	0.39	1.12	0.0	0.0	0.0
2008	1	20	5.55	0.11	0.33	0.50	1.12	0.0	0.0	0.0
2008	1	21	8.22	0.16	0.49	0.74	1.12	0.0	0.0	0.0
2008	1	22	5.08	0.10	0.30	0.46	1.12	0.0	0.0	0.0
2008	1	23	5.48	0.11	0.33	0.49	1.12	0.0	0.0	0.0
2008	1	24	10.68	0.21	0.64	0.96	1.12	0.0	0.0	0.0
2008	1	25	4.24	0.08	0.25	0.38	1.12	0.0	0.0	0.0
2008	1	26	4.53	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2008	1	27	9.54	0.19	0.57	0.86	1.12	0.0	0.0	0.0
2008	1	28	16.43	0.33	0.99	1.48	1.12	0.0	0.0	16.4
2008	1	29	6.78	0.14	0.41	0.61	1.12	0.0	0.0	0.0
2008	1	30	12.40	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2008	1	31	5.71	0.11	0.34	0.51	1.12	0.0	0.0	0.0
2008	2	1	6.97	0.14	0.42	0.63	1.12	0.0	0.0	0.0
2008	2	2	7.56	0.15	0.45	0.68	1.12	0.0	0.0	0.0
2008	2	3	11.40	0.23	0.68	1.03	1.12	0.0	0.0	0.0
2008	2	4	7.31	0.15	0.44	0.66	1.12	0.0	0.0	0.0
2008	2	5	7.74	0.15	0.46	0.70	1.12	0.0	0.0	0.0
2008	2	6	7.18	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2008	2	7	7.50	0.15	0.45	0.68	1.12	0.0	0.0	0.0
2008	2	8	6.71	0.13	0.40	0.60	1.12	0.0	0.0	0.0
2008	2	9	4.83	0.10	0.29	0.43	1.12	0.0	0.0	0.0
2008	2	10	4.55	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2008	2	11	6.02	0.12	0.36	0.54	1.12	0.0	0.0	0.0
2008	2	12	4.89	0.10	0.29	0.44	1.12	0.0	0.0	0.0
2008	2	13	10.98	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2008	2	14	10.46	0.21	0.63	0.94	1.12	0.0	0.0	0.0
2008	2	15	8.89	0.18	0.53	0.80	1.12	0.0	0.0	0.0
2008	2	16	8.06	0.16	0.48	0.73	1.12	0.0	0.0	0.0
2008	2	17	7.07	0.14	0.42	0.64	1.12	0.0	0.0	0.0
2008	2	18	3.61	0.07	0.22	0.32	1.12	0.0	0.0	0.0
2008	2	19	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2008	2	20	4.62	0.09	0.28	0.42	1.12	0.0	0.0	0.0
2008	2	21	5.07	0.10	0.30	0.46	1.12	0.0	0.0	0.0
2008	2	22	6.19	0.12	0.37	0.56	1.12	0.0	0.0	0.0
2008	2	23	5.98	0.12	0.36	0.54	1.12	0.0	0.0	0.0
2008	2	24	2.44	0.05	0.15	0.22	1.12	0.0	0.0	0.0
2008	2	25	4.74	0.09	0.28	0.43	1.12	0.0	0.0	0.0
2008	2	26	4.97	0.10	0.30	0.45	1.12	0.0	0.0	0.0
2008	2	27	4.33	0.09	0.26	0.39	1.12	0.0	0.0	0.0
2008	2	28	0.00	0.00	0.00	0.00	1.12	0.0	0.0	0.0
2008	2	29	0.00	0.00	0.00	0.00	1.12	0.0	0.0	0.0
2008	3	1	0.00	0.00	0.00	0.00	1.12	0.0	0.0	0.0
2008	3	2	17.19	0.34	1.03	1.55	1.12	0.0	0.0	21.3
2008	3	3	13.06	0.26	0.78	1.18	1.12	0.0	0.0	1.6
2008	3	4	11.29	0.23	0.68	1.02	1.12	0.0	0.0	0.0
2008	3	5	9.32	0.19	0.56	0.84	1.12	0.0	0.0	0.0
2008	3	6	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2008	3	7	5.47	0.11	0.33	0.49	1.12	0.0	0.0	0.0
2008	3	8	6.56	0.13	0.39	0.59	1.12	0.0	0.0	0.0
2008	3	9	11.01	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2008	3	10	7.14	0.14	0.43	0.64	1.12	0.0	0.0	0.0
2008	3	11	3.99	0.08	0.24	0.36	1.12	0.0	0.0	0.0
2008	3	12	8.13	0.16	0.49	0.73	1.12	0.0	0.0	0.0
2008	3	13	12.54	0.25	0.75	1.13	1.12	0.0	0.0	0.2

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2008	3	14	13.71	0.27	0.82	1.23	1.12	0.0	0.0	3.6
2008	3	15	13.68	0.27	0.82	1.23	1.12	0.0	0.0	3.5
2008	3	16	11.98	0.24	0.72	1.08	1.12	0.0	0.0	0.0
2008	3	17	7.99	0.16	0.48	0.72	1.12	0.0	0.0	0.0
2008	3	18	15.20	0.30	0.91	1.37	1.12	0.0	0.0	9.8
2008	3	19	5.46	0.11	0.33	0.49	1.12	0.0	0.0	0.0
2008	3	20	9.72	0.19	0.58	0.87	1.12	0.0	0.0	0.0
2008	3	21	6.97	0.14	0.42	0.63	1.12	0.0	0.0	0.0
2008	3	22	10.78	0.22	0.65	0.97	1.12	0.0	0.0	0.0
2008	3	23	5.32	0.11	0.32	0.48	1.12	0.0	0.0	0.0
2008	3	24	6.11	0.12	0.37	0.55	1.12	0.0	0.0	0.0
2008	3	25	6.70	0.13	0.40	0.60	1.12	0.0	0.0	0.0
2008	3	26	9.40	0.19	0.56	0.85	1.12	0.0	0.0	0.0
2008	3	27	10.94	0.22	0.66	0.98	1.12	0.0	0.0	0.0
2008	3	28	7.97	0.16	0.48	0.72	1.12	0.0	0.0	0.0
2008	3	29	9.73	0.19	0.58	0.88	1.12	0.0	0.0	0.0
2008	3	30	14.76	0.30	0.89	1.33	1.12	0.0	0.0	7.7
2008	3	31	9.07	0.18	0.54	0.82	1.12	0.0	0.0	0.0
2008	4	1	7.18	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2008	4	2	8.71	0.17	0.52	0.78	1.12	0.0	0.0	0.0
2008	4	3	9.79	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2008	4	4	6.02	0.12	0.36	0.54	1.12	0.0	0.0	0.0
2008	4	5	12.54	0.25	0.75	1.13	1.12	0.0	0.0	0.2
2008	4	6	8.40	0.17	0.50	0.76	1.12	0.0	0.0	0.0
2008	4	7	14.91	0.30	0.89	1.34	1.12	0.0	0.0	8.4
2008	4	8	8.75	0.18	0.53	0.79	1.12	0.0	0.0	0.0
2008	4	9	7.26	0.15	0.44	0.65	1.12	0.0	0.0	0.0
2008	4	10	12.34	0.25	0.74	1.11	1.12	0.0	0.0	0.0
2008	4	11	12.11	0.24	0.73	1.09	1.12	0.0	0.0	0.0
2008	4	12	5.32	0.11	0.32	0.48	1.12	0.0	0.0	0.0
2008	4	13	6.03	0.12	0.36	0.54	1.12	0.0	0.0	0.0
2008	4	14	7.12	0.14	0.43	0.64	1.12	0.0	0.0	0.0
2008	4	15	17.09	0.34	1.03	1.54	1.12	0.0	0.0	20.6
2008	4	16	12.57	0.25	0.75	1.13	1.12	0.0	0.0	0.3
2008	4	17	10.30	0.21	0.62	0.93	1.12	0.0	0.0	0.0
2008	4	18	5.70	0.11	0.34	0.51	1.12	0.0	0.0	0.0
2008	4	19	14.76	0.30	0.89	1.33	1.12	0.0	0.0	7.7
2008	4	20	12.16	0.24	0.73	1.09	1.12	0.0	0.0	0.0
2008	4	21	10.36	0.21	0.62	0.93	1.12	0.0	0.0	0.0
2008	4	22	5.79	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2008	4	23	12.31	0.25	0.74	1.11	1.12	0.0	0.0	0.0
2008	4	24	13.86	0.28	0.83	1.25	1.12	0.0	0.0	4.1
2008	4	25	8.18	0.16	0.49	0.74	1.12	0.0	0.0	0.0
2008	4	26	8.31	0.17	0.50	0.75	1.12	0.0	0.0	0.0
2008	4	27	7.17	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2008	4	28	6.99	0.14	0.42	0.63	1.12	0.0	0.0	0.0
2008	4	29	12.16	0.24	0.73	1.09	1.12	0.0	0.0	0.0
2008	4	30	15.59	0.31	0.94	1.40	1.12	0.0	0.0	11.7
2008	5	1	14.83	0.30	0.89	1.33	1.12	0.0	0.0	8.0
2008	5	2	7.30	0.15	0.44	0.66	1.12	0.0	0.0	0.0
2008	5	3	8.16	0.16	0.49	0.73	1.12	0.0	0.0	0.0
2008	5	4	6.94	0.14	0.42	0.62	1.12	0.0	0.0	0.0
2008	5	5	8.84	0.18	0.53	0.80	1.12	0.0	0.0	0.0
2008	5	6	8.54	0.17	0.51	0.77	1.12	0.0	0.0	0.0
2008	5	7	10.46	0.21	0.63	0.94	1.12	0.0	0.0	0.0
2008	5	8	7.68	0.15	0.46	0.69	1.12	0.0	0.0	0.0
2008	5	9	10.99	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2008	5	10	6.61	0.13	0.40	0.59	1.12	0.0	0.0	0.0
2008	5	11	8.61	0.17	0.52	0.77	1.12	0.0	0.0	0.0
2008	5	12	13.05	0.26	0.78	1.17	1.12	0.0	0.0	1.5
2008	5	13	9.63	0.19	0.58	0.87	1.12	0.0	0.0	0.0
2008	5	14	9.40	0.19	0.56	0.85	1.12	0.0	0.0	0.0
2008	5	15	14.55	0.29	0.87	1.31	1.12	0.0	0.0	6.8
2008	5	16	7.76	0.16	0.47	0.70	1.12	0.0	0.0	0.0
2008	5	17	8.54	0.17	0.51	0.77	1.12	0.0	0.0	0.0
2008	5	18	8.18	0.16	0.49	0.74	1.12	0.0	0.0	0.0
2008	5	19	9.92	0.20	0.60	0.89	1.12	0.0	0.0	0.0
2008	5	20	9.92	0.20	0.60	0.89	1.12	0.0	0.0	0.0
2008	5	21	14.11	0.28	0.85	1.27	1.12	0.0	0.0	5.1
2008	5	22	10.22	0.20	0.61	0.92	1.12	0.0	0.0	0.0
2008	5	23	8.63	0.17	0.52	0.78	1.12	0.0	0.0	0.0
2008	5	24	5.28	0.11	0.32	0.48	1.12	0.0	0.0	0.0
2008	5	25	11.49	0.23	0.69	1.03	1.12	0.0	0.0	0.0

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2008	5	26	7.64	0.15	0.46	0.69	1.12	0.0	0.0	0.0
2008	5	27	6.24	0.12	0.37	0.56	1.12	0.0	0.0	0.0
2008	5	28	12.96	0.26	0.78	1.17	1.12	0.0	0.0	1.3
2008	5	29	8.93	0.18	0.54	0.80	1.12	0.0	0.0	0.0
2008	5	30	6.35	0.13	0.38	0.57	1.12	0.0	0.0	0.0
2008	5	31	7.98	0.16	0.48	0.72	1.12	0.0	0.0	0.0
2008	6	1	8.30	0.17	0.50	0.75	1.12	0.0	0.0	0.0
2008	6	2	8.51	0.17	0.51	0.77	1.12	0.0	0.0	0.0
2008	6	3	9.17	0.18	0.55	0.83	1.12	0.0	0.0	0.0
2008	6	4	15.97	0.32	0.96	1.44	1.12	0.0	0.0	13.8
2008	6	5	7.09	0.14	0.43	0.64	1.12	0.0	0.0	0.0
2008	6	6	8.31	0.17	0.50	0.75	1.12	0.0	0.0	0.0
2008	6	7	12.08	0.24	0.72	1.09	1.12	0.0	0.0	0.0
2008	6	8	7.76	0.16	0.47	0.70	1.12	0.0	0.0	0.0
2008	6	9	6.08	0.12	0.36	0.55	1.12	0.0	0.0	0.0
2008	6	10	12.48	0.25	0.75	1.12	1.12	0.0	0.0	0.1
2008	6	11	9.54	0.19	0.57	0.86	1.12	0.0	0.0	0.0
2008	6	12	8.93	0.18	0.54	0.80	1.12	0.0	0.0	0.0
2008	6	13	5.84	0.12	0.35	0.53	1.12	0.0	0.0	0.0
2008	6	14	6.08	0.12	0.36	0.55	1.12	0.0	0.0	0.0
2008	6	15	7.64	0.15	0.46	0.69	1.12	0.0	0.0	0.0
2008	6	16	7.93	0.16	0.48	0.71	1.12	0.0	0.0	0.0
2008	6	17	7.59	0.15	0.46	0.68	1.12	0.0	0.0	0.0
2008	6	18	7.46	0.15	0.45	0.67	1.12	0.0	0.0	0.0
2008	6	19	8.35	0.17	0.50	0.75	1.12	0.0	0.0	0.0
2008	6	20	8.85	0.18	0.53	0.80	1.12	0.0	0.0	0.0
2008	6	21	6.74	0.13	0.40	0.61	1.12	0.0	0.0	0.0
2008	6	22	7.84	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2008	6	23	9.50	0.19	0.57	0.86	1.12	0.0	0.0	0.0
2008	6	24	7.35	0.15	0.44	0.66	1.12	0.0	0.0	0.0
2008	6	25	8.17	0.16	0.49	0.74	1.12	0.0	0.0	0.0
2008	6	26	6.88	0.14	0.41	0.62	1.12	0.0	0.0	0.0
2008	6	27	8.90	0.18	0.53	0.80	1.12	0.0	0.0	0.0
2008	6	28	6.68	0.13	0.40	0.60	1.12	0.0	0.0	0.0
2008	6	29	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2008	6	30	8.82	0.18	0.53	0.79	1.12	0.0	0.0	0.0
2008	7	1	6.07	0.12	0.36	0.55	1.12	0.0	0.0	0.0
2008	7	2	6.69	0.13	0.40	0.60	1.12	0.0	0.0	0.0
2008	7	3	7.94	0.16	0.48	0.71	1.12	0.0	0.0	0.0
2008	7	4	9.77	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2008	7	5	11.84	0.24	0.71	1.07	1.12	0.0	0.0	0.0
2008	7	6	8.98	0.18	0.54	0.81	1.12	0.0	0.0	0.0
2008	7	7	6.73	0.13	0.40	0.61	1.12	0.0	0.0	0.0
2008	7	8	6.83	0.14	0.41	0.61	1.12	0.0	0.0	0.0
2008	7	9	6.92	0.14	0.42	0.62	1.12	0.0	0.0	0.0
2008	7	10	4.91	0.10	0.29	0.44	1.12	0.0	0.0	0.0
2008	7	11	8.35	0.17	0.50	0.75	1.12	0.0	0.0	0.0
2008	7	12	7.57	0.15	0.45	0.68	1.12	0.0	0.0	0.0
2008	7	13	6.83	0.14	0.41	0.61	1.12	0.0	0.0	0.0
2008	7	14	6.55	0.13	0.39	0.59	1.12	0.0	0.0	0.0
2008	7	15	6.80	0.14	0.41	0.61	1.12	0.0	0.0	0.0
2008	7	16	6.79	0.14	0.41	0.61	1.12	0.0	0.0	0.0
2008	7	17	6.89	0.14	0.41	0.62	1.12	0.0	0.0	0.0
2008	7	18	6.92	0.14	0.42	0.62	1.12	0.0	0.0	0.0
2008	7	19	7.44	0.15	0.45	0.67	1.12	0.0	0.0	0.0
2008	7	20	8.75	0.18	0.53	0.79	1.12	0.0	0.0	0.0
2008	7	21	5.40	0.11	0.32	0.49	1.12	0.0	0.0	0.0
2008	7	22	5.81	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2008	7	23	10.21	0.20	0.61	0.92	1.12	0.0	0.0	0.0
2008	7	24	6.55	0.13	0.39	0.59	1.12	0.0	0.0	0.0
2008	7	25	9.39	0.19	0.56	0.85	1.12	0.0	0.0	0.0
2008	7	26	5.33	0.11	0.32	0.48	1.12	0.0	0.0	0.0
2008	7	27	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2008	7	28	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2008	7	29	5.65	0.11	0.34	0.51	1.12	0.0	0.0	0.0
2008	7	30	6.65	0.13	0.40	0.60	1.12	0.0	0.0	0.0
2008	7	31	6.21	0.12	0.37	0.56	1.12	0.0	0.0	0.0
2008	8	1	6.85	0.14	0.41	0.62	1.12	0.0	0.0	0.0
2008	8	2	7.80	0.16	0.47	0.70	1.12	0.0	0.0	0.0
2008	8	3	10.83	0.22	0.65	0.97	1.12	0.0	0.0	0.0
2008	8	4	7.18	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2008	8	5	4.72	0.09	0.28	0.42	1.12	0.0	0.0	0.0
2008	8	6	4.13	0.08	0.25	0.37	1.12	0.0	0.0	0.0

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2008	8	7	5.98	0.12	0.36	0.54	1.12	0.0	0.0	0.0
2008	8	8	8.89	0.18	0.53	0.80	1.12	0.0	0.0	0.0
2008	8	9	6.33	0.13	0.38	0.57	1.12	0.0	0.0	0.0
2008	8	10	7.23	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2008	8	11	7.94	0.16	0.48	0.71	1.12	0.0	0.0	0.0
2008	8	12	6.14	0.12	0.37	0.55	1.12	0.0	0.0	0.0
2008	8	13	6.28	0.13	0.38	0.57	1.12	0.0	0.0	0.0
2008	8	14	6.83	0.14	0.41	0.61	1.12	0.0	0.0	0.0
2008	8	15	9.35	0.19	0.56	0.84	1.12	0.0	0.0	0.0
2008	8	16	11.43	0.23	0.69	1.03	1.12	0.0	0.0	0.0
2008	8	17	10.73	0.21	0.64	0.97	1.12	0.0	0.0	0.0
2008	8	18	12.30	0.25	0.74	1.11	1.12	0.0	0.0	0.0
2008	8	19	6.68	0.13	0.40	0.60	1.12	0.0	0.0	0.0
2008	8	20	7.35	0.15	0.44	0.66	1.12	0.0	0.0	0.0
2008	8	21	8.13	0.16	0.49	0.73	1.12	0.0	0.0	0.0
2008	8	22	5.99	0.12	0.36	0.54	1.12	0.0	0.0	0.0
2008	8	23	7.40	0.15	0.44	0.67	1.12	0.0	0.0	0.0
2008	8	24	9.85	0.20	0.59	0.89	1.12	0.0	0.0	0.0
2008	8	25	4.99	0.10	0.30	0.45	1.12	0.0	0.0	0.0
2008	8	26	5.23	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2008	8	27	4.21	0.08	0.25	0.38	1.12	0.0	0.0	0.0
2008	8	28	9.47	0.19	0.57	0.85	1.12	0.0	0.0	0.0
2008	8	29	5.47	0.11	0.33	0.49	1.12	0.0	0.0	0.0
2008	8	30	6.79	0.14	0.41	0.61	1.12	0.0	0.0	0.0
2008	8	31	8.01	0.16	0.48	0.72	1.12	0.0	0.0	0.0
2008	9	1	9.56	0.19	0.57	0.86	1.12	0.0	0.0	0.0
2008	9	2	5.10	0.10	0.31	0.46	1.12	0.0	0.0	0.0
2008	9	3	6.80	0.14	0.41	0.61	1.12	0.0	0.0	0.0
2008	9	4	5.67	0.11	0.34	0.51	1.12	0.0	0.0	0.0
2008	9	5	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2008	9	6	5.93	0.12	0.36	0.53	1.12	0.0	0.0	0.0
2008	9	7	7.08	0.14	0.42	0.64	1.12	0.0	0.0	0.0
2008	9	8	10.35	0.21	0.62	0.93	1.12	0.0	0.0	0.0
2008	9	9	6.74	0.13	0.40	0.61	1.12	0.0	0.0	0.0
2008	9	10	7.89	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2008	9	11	5.73	0.11	0.34	0.52	1.12	0.0	0.0	0.0
2008	9	12	6.18	0.12	0.37	0.56	1.12	0.0	0.0	0.0
2008	9	13	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2008	9	14	5.27	0.11	0.32	0.47	1.12	0.0	0.0	0.0
2008	9	15	5.13	0.10	0.31	0.46	1.12	0.0	0.0	0.0
2008	9	16	6.19	0.12	0.37	0.56	1.12	0.0	0.0	0.0
2008	9	17	9.63	0.19	0.58	0.87	1.12	0.0	0.0	0.0
2008	9	18	6.11	0.12	0.37	0.55	1.12	0.0	0.0	0.0
2008	9	19	7.11	0.14	0.43	0.64	1.12	0.0	0.0	0.0
2008	9	20	8.01	0.16	0.48	0.72	1.12	0.0	0.0	0.0
2008	9	21	10.56	0.21	0.63	0.95	1.12	0.0	0.0	0.0
2008	9	22	9.60	0.19	0.58	0.86	1.12	0.0	0.0	0.0
2008	9	23	6.05	0.12	0.36	0.54	1.12	0.0	0.0	0.0
2008	9	24	5.84	0.12	0.35	0.53	1.12	0.0	0.0	0.0
2008	9	25	6.03	0.12	0.36	0.54	1.12	0.0	0.0	0.0
2008	9	26	6.87	0.14	0.41	0.62	1.12	0.0	0.0	0.0
2008	9	27	8.96	0.18	0.54	0.81	1.12	0.0	0.0	0.0
2008	9	28	8.40	0.17	0.50	0.76	1.12	0.0	0.0	0.0
2008	9	29	6.35	0.13	0.38	0.57	1.12	0.0	0.0	0.0
2008	9	30	7.09	0.14	0.43	0.64	1.12	0.0	0.0	0.0
2008	10	1	5.40	0.11	0.32	0.49	1.12	0.0	0.0	0.0
2008	10	2	5.41	0.11	0.32	0.49	1.12	0.0	0.0	0.0
2008	10	3	9.49	0.19	0.57	0.85	1.12	0.0	0.0	0.0
2008	10	4	13.44	0.27	0.81	1.21	1.12	0.0	0.0	2.7
2008	10	5	8.54	0.17	0.51	0.77	1.12	0.0	0.0	0.0
2008	10	6	10.35	0.21	0.62	0.93	1.12	0.0	0.0	0.0
2008	10	7	4.95	0.10	0.30	0.45	1.12	0.0	0.0	0.0
2008	10	8	3.56	0.07	0.21	0.32	1.12	0.0	0.0	0.0
2008	10	9	10.87	0.22	0.65	0.98	1.12	0.0	0.0	0.0
2008	10	10	14.26	0.29	0.86	1.28	1.12	0.0	0.0	5.6
2008	10	11	20.68	0.41	1.24	1.86	1.12	0.0	3.9	50.4
2008	10	12	5.31	0.11	0.32	0.48	1.12	0.0	0.0	0.0
2008	10	13	8.25	0.17	0.50	0.74	1.12	0.0	0.0	0.0
2008	10	14	7.28	0.15	0.44	0.66	1.12	0.0	0.0	0.0
2008	10	15	5.84	0.12	0.35	0.53	1.12	0.0	0.0	0.0
2008	10	16	4.94	0.10	0.30	0.44	1.12	0.0	0.0	0.0
2008	10	17	4.89	0.10	0.29	0.44	1.12	0.0	0.0	0.0
2008	10	18	6.71	0.13	0.40	0.60	1.12	0.0	0.0	0.0

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2008	10	19	6.04	0.12	0.36	0.54	1.12	0.0	0.0	0.0
2008	10	20	8.46	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2008	10	21	11.16	0.22	0.67	1.00	1.12	0.0	0.0	0.0
2008	10	22	14.31	0.29	0.86	1.29	1.12	0.0	0.0	5.8
2008	10	23	4.93	0.10	0.30	0.44	1.12	0.0	0.0	0.0
2008	10	24	5.76	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2008	10	25	4.91	0.10	0.29	0.44	1.12	0.0	0.0	0.0
2008	10	26	9.35	0.19	0.56	0.84	1.12	0.0	0.0	0.0
2008	10	27	4.67	0.09	0.28	0.42	1.12	0.0	0.0	0.0
2008	10	28	5.84	0.12	0.35	0.53	1.12	0.0	0.0	0.0
2008	10	29	5.51	0.11	0.33	0.50	1.12	0.0	0.0	0.0
2008	10	30	5.43	0.11	0.33	0.49	1.12	0.0	0.0	0.0
2008	10	31	4.84	0.10	0.29	0.44	1.12	0.0	0.0	0.0
2008	11	1	6.02	0.12	0.36	0.54	1.12	0.0	0.0	0.0
2008	11	2	10.98	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2008	11	3	8.59	0.17	0.52	0.77	1.12	0.0	0.0	0.0
2008	11	4	12.03	0.24	0.72	1.08	1.12	0.0	0.0	0.0
2008	11	5	11.03	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2008	11	6	8.64	0.17	0.52	0.78	1.12	0.0	0.0	0.0
2008	11	7	9.31	0.19	0.56	0.84	1.12	0.0	0.0	0.0
2008	11	8	3.90	0.08	0.23	0.35	1.12	0.0	0.0	0.0
2008	11	9	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2008	11	10	4.32	0.09	0.26	0.39	1.12	0.0	0.0	0.0
2008	11	11	2.94	0.06	0.18	0.26	1.12	0.0	0.0	0.0
2008	11	12	0.00	0.00	0.00	0.00	1.12	0.0	0.0	0.0
2008	11	13	4.78	0.10	0.29	0.43	1.12	0.0	0.0	0.0
2008	11	14	6.64	0.13	0.40	0.60	1.12	0.0	0.0	0.0
2008	11	15	4.29	0.09	0.26	0.39	1.12	0.0	0.0	0.0
2008	11	16	8.84	0.18	0.53	0.80	1.12	0.0	0.0	0.0
2008	11	17	6.99	0.14	0.42	0.63	1.12	0.0	0.0	0.0
2008	11	18	4.37	0.09	0.26	0.39	1.12	0.0	0.0	0.0
2008	11	19	4.85	0.10	0.29	0.44	1.12	0.0	0.0	0.0
2008	11	20	4.19	0.08	0.25	0.38	1.12	0.0	0.0	0.0
2008	11	21	5.70	0.11	0.34	0.51	1.12	0.0	0.0	0.0
2008	11	22	4.91	0.10	0.29	0.44	1.12	0.0	0.0	0.0
2008	11	23	6.14	0.12	0.37	0.55	1.12	0.0	0.0	0.0
2008	11	24	7.00	0.14	0.42	0.63	1.12	0.0	0.0	0.0
2008	11	25	4.50	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2008	11	26	7.94	0.16	0.48	0.71	1.12	0.0	0.0	0.0
2008	11	27	4.24	0.08	0.25	0.38	1.12	0.0	0.0	0.0
2008	11	28	8.84	0.18	0.53	0.80	1.12	0.0	0.0	0.0
2008	11	29	8.92	0.18	0.54	0.80	1.12	0.0	0.0	0.0
2008	11	30	9.22	0.18	0.55	0.83	1.12	0.0	0.0	0.0
2008	12	1	5.93	0.12	0.36	0.53	1.12	0.0	0.0	0.0
2008	12	2	9.77	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2008	12	3	7.80	0.16	0.47	0.70	1.12	0.0	0.0	0.0
2008	12	4	5.29	0.11	0.32	0.48	1.12	0.0	0.0	0.0
2008	12	5	5.23	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2008	12	6	5.16	0.10	0.31	0.46	1.12	0.0	0.0	0.0
2008	12	7	7.92	0.16	0.48	0.71	1.12	0.0	0.0	0.0
2008	12	8	8.88	0.18	0.53	0.80	1.12	0.0	0.0	0.0
2008	12	9	15.28	0.31	0.92	1.38	1.12	0.0	0.0	10.2
2008	12	10	4.76	0.10	0.29	0.43	1.12	0.0	0.0	0.0
2008	12	11	4.71	0.09	0.28	0.42	1.12	0.0	0.0	0.0
2008	12	12	3.96	0.08	0.24	0.36	1.12	0.0	0.0	0.0
2008	12	13	18.08	0.36	1.08	1.63	1.12	0.0	0.0	27.6
2008	12	14	9.68	0.19	0.58	0.87	1.12	0.0	0.0	0.0
2008	12	15	10.94	0.22	0.66	0.98	1.12	0.0	0.0	0.0
2008	12	16	7.14	0.14	0.43	0.64	1.12	0.0	0.0	0.0
2008	12	17	5.07	0.10	0.30	0.46	1.12	0.0	0.0	0.0
2008	12	18	11.65	0.23	0.70	1.05	1.12	0.0	0.0	0.0
2008	12	19	5.76	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2008	12	20	7.09	0.14	0.43	0.64	1.12	0.0	0.0	0.0
2008	12	21	3.72	0.07	0.22	0.33	1.12	0.0	0.0	0.0
2008	12	22	10.08	0.20	0.60	0.91	1.12	0.0	0.0	0.0
2008	12	23	6.56	0.13	0.39	0.59	1.12	0.0	0.0	0.0
2008	12	24	3.91	0.08	0.23	0.35	1.12	0.0	0.0	0.0
2008	12	25	18.18	0.36	1.09	1.64	1.12	0.0	0.0	28.4
2008	12	26	18.67	0.37	1.12	1.68	1.12	0.0	0.0	32.2
2008	12	27	5.66	0.11	0.34	0.51	1.12	0.0	0.0	0.0
2008	12	28	4.27	0.09	0.26	0.38	1.12	0.0	0.0	0.0
2008	12	29	3.99	0.08	0.24	0.36	1.12	0.0	0.0	0.0
2008	12	30	4.31	0.09	0.26	0.39	1.12	0.0	0.0	0.0

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2008	12	31	4.55	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2011	1	1	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2011	1	2	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2011	1	3	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2011	1	4	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2011	1	5	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2011	1	6	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2011	1	7	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2011	1	8	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2011	1	9	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2011	1	10	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	1	11	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2011	1	12	3.29	0.07	0.20	0.30	1.12	0.0	0.0	0.0
2011	1	13	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2011	1	14	13.05	0.26	0.78	1.17	1.12	0.0	0.0	1.5
2011	1	15	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2011	1	16	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2011	1	17	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2011	1	18	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	1	19	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2011	1	20	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2011	1	21	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2011	1	22	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2011	1	23	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2011	1	24	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2011	1	25	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2011	1	26	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2011	1	27	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2011	1	28	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2011	1	29	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2011	1	30	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2011	1	31	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2011	2	1	12.41	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2011	2	2	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2011	2	3	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2011	2	4	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2011	2	5	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2011	2	6	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2011	2	7	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2011	2	8	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2011	2	9	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2011	2	10	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2011	2	11	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2011	2	12	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2011	2	13	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2011	2	14	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2011	2	15	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	2	16	12.41	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2011	2	17	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2011	2	18	13.05	0.26	0.78	1.17	1.12	0.0	0.0	1.5
2011	2	19	18.24	0.36	1.09	1.64	1.12	0.0	0.0	28.8
2011	2	20	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2011	2	21	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2011	2	22	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2011	2	23	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	2	24	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2011	2	25	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2011	2	26	13.05	0.26	0.78	1.17	1.12	0.0	0.0	1.5
2011	2	27	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2011	2	28	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2011	3	1	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2011	3	2	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2011	3	3	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2011	3	4	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2011	3	5	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2011	3	6	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2011	3	7	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2011	3	8	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2011	3	9	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2011	3	10	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	3	11	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2011	3	12	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2011	3	13	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2011	3	14	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	3	15	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2011	3	16	12.41	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2011	3	17	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2011	3	18	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2011	3	19	14.31	0.29	0.86	1.29	1.12	0.0	0.0	5.8
2011	3	20	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2011	3	21	18.24	0.36	1.09	1.64	1.12	0.0	0.0	28.8
2011	3	22	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	3	23	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2011	3	24	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2011	3	25	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2011	3	26	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2011	3	27	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2011	3	28	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2011	3	29	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2011	3	30	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2011	3	31	12.41	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2011	4	1	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	4	2	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2011	4	3	17.61	0.35	1.06	1.58	1.12	0.0	0.0	24.2
2011	4	4	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2011	4	5	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2011	4	6	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2011	4	7	14.31	0.29	0.86	1.29	1.12	0.0	0.0	5.8
2011	4	8	18.87	0.38	1.13	1.70	1.12	0.0	0.3	33.9
2011	4	9	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2011	4	10	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2011	4	11	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2011	4	12	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2011	4	13	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2011	4	14	13.05	0.26	0.78	1.17	1.12	0.0	0.0	1.5
2011	4	15	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2011	4	16	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	4	17	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2011	4	18	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2011	4	19	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2011	4	20	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2011	4	21	13.68	0.27	0.82	1.23	1.12	0.0	0.0	3.5
2011	4	22	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2011	4	23	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2011	4	24	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2011	4	25	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2011	4	26	17.61	0.35	1.06	1.58	1.12	0.0	0.0	24.2
2011	4	27	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2011	4	28	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2011	4	29	16.34	0.33	0.98	1.47	1.12	0.0	0.0	15.9
2011	4	30	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2011	5	1	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2011	5	2	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2011	5	3	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	5	4	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2011	5	5	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	5	6	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2011	5	7	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2011	5	8	14.31	0.29	0.86	1.29	1.12	0.0	0.0	5.8
2011	5	9	14.31	0.29	0.86	1.29	1.12	0.0	0.0	5.8
2011	5	10	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2011	5	11	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2011	5	12	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2011	5	13	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2011	5	14	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2011	5	15	14.31	0.29	0.86	1.29	1.12	0.0	0.0	5.8
2011	5	16	13.05	0.26	0.78	1.17	1.12	0.0	0.0	1.5
2011	5	17	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2011	5	18	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2011	5	19	13.05	0.26	0.78	1.17	1.12	0.0	0.0	1.5
2011	5	20	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2011	5	21	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2011	5	22	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2011	5	23	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2011	5	24	13.68	0.27	0.82	1.23	1.12	0.0	0.0	3.5
2011	5	25	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2011	5	26	12.41	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2011	5	27	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2011	5	28	16.34	0.33	0.98	1.47	1.12	0.0	0.0	15.9
2011	5	29	22.17	0.44	1.33	2.00	1.12	0.0	7.8	66.3
2011	5	30	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2011	5	31	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2011	6	1	13.05	0.26	0.78	1.17	1.12	0.0	0.0	1.5
2011	6	2	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2011	6	3	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2011	6	4	12.41	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2011	6	5	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2011	6	6	18.87	0.38	1.13	1.70	1.12	0.0	0.3	33.9
2011	6	7	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2011	6	8	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2011	6	9	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2011	6	10	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2011	6	11	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2011	6	12	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2011	6	13	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2011	6	14	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	6	15	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	6	16	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2011	6	17	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2011	6	18	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2011	6	19	16.97	0.34	1.02	1.53	1.12	0.0	0.0	19.8
2011	6	20	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	6	21	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2011	6	22	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2011	6	23	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2011	6	24	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2011	6	25	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2011	6	26	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2011	6	27	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2011	6	28	12.41	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2011	6	29	13.68	0.27	0.82	1.23	1.12	0.0	0.0	3.5
2011	6	30	17.61	0.35	1.06	1.58	1.12	0.0	0.0	24.2
2011	7	1	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	7	2	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2011	7	3	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2011	7	4	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2011	7	5	13.05	0.26	0.78	1.17	1.12	0.0	0.0	1.5
2011	7	6	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2011	7	7	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2011	7	8	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2011	7	9	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2011	7	10	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2011	7	11	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2011	7	12	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2011	7	13	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2011	7	14	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2011	7	15	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2011	7	16	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2011	7	17	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2011	7	18	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	7	19	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	7	20	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2011	7	21	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2011	7	22	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2011	7	23	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	7	24	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2011	7	25	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2011	7	26	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	7	27	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2011	7	28	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
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2011	8	1	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2011	8	2	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2011	8	3	13.05	0.26	0.78	1.17	1.12	0.0	0.0	1.5
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Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2011	8	7	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2011	8	8	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	8	9	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2011	8	10	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	8	11	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2011	8	12	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
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2011	9	25	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2011	9	26	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
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2011	9	29	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2011	9	30	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2011	10	1	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2011	10	2	3.29	0.07	0.20	0.30	1.12	0.0	0.0	0.0
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2011	10	4	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2011	10	5	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
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2011	10	8	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
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2011	10	12	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2011	10	13	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2011	10	14	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2011	10	15	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
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2011	10	19	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2011	10	20	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2011	10	21	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	10	22	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2011	10	23	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2011	10	24	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2011	10	25	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2011	10	26	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2011	10	27	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2011	10	28	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2011	10	29	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2011	10	30	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2011	10	31	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2011	11	1	17.61	0.35	1.06	1.58	1.12	0.0	0.0	24.2
2011	11	2	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
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2011	11	12	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
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2011	12	29	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2011	12	30	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2011	12	31	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	1	1	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	1	2	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	1	3	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	1	4	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	1	5	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	1	6	3.29	0.07	0.20	0.30	1.12	0.0	0.0	0.0
2012	1	7	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2012	1	8	14.95	0.30	0.90	1.35	1.12	0.0	0.0	8.6
2012	1	9	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	1	10	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	1	11	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2012	1	12	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	1	13	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	1	14	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2012	1	15	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	1	16	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2012	1	17	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	1	18	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	1	19	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	1	20	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	1	21	14.95	0.30	0.90	1.35	1.12	0.0	0.0	8.6
2012	1	22	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	1	23	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	1	24	13.05	0.26	0.78	1.17	1.12	0.0	0.0	1.5
2012	1	25	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	1	26	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	1	27	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	1	28	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	1	29	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	1	30	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	1	31	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	2	1	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	2	2	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	2	3	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	2	4	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	2	5	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	2	6	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	2	7	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	2	8	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	2	9	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	2	10	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	2	11	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	2	12	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	2	13	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	2	14	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	2	15	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	2	16	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	2	17	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	2	18	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	2	19	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2012	2	20	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	2	21	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	2	22	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	2	23	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2012	2	24	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	2	25	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	2	26	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	2	27	16.97	0.34	1.02	1.53	1.12	0.0	0.0	19.8
2012	2	28	12.41	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2012	2	29	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	3	1	14.95	0.30	0.90	1.35	1.12	0.0	0.0	8.6
2012	3	2	14.31	0.29	0.86	1.29	1.12	0.0	0.0	5.8
2012	3	3	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	3	4	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	3	5	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	3	6	19.51	0.39	1.17	1.76	1.12	0.0	1.4	39.4
2012	3	7	14.95	0.30	0.90	1.35	1.12	0.0	0.0	8.6
2012	3	8	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2012	3	9	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	3	10	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	3	11	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	3	12	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2012	3	13	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	3	14	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	3	15	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	3	16	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	3	17	14.95	0.30	0.90	1.35	1.12	0.0	0.0	8.6
2012	3	18	16.97	0.34	1.02	1.53	1.12	0.0	0.0	19.8
2012	3	19	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	3	20	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	3	21	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2012	3	22	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	3	23	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	3	24	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	3	25	12.41	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2012	3	26	12.41	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2012	3	27	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	3	28	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	3	29	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	3	30	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	3	31	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2012	4	1	16.34	0.33	0.98	1.47	1.12	0.0	0.0	15.9
2012	4	2	13.68	0.27	0.82	1.23	1.12	0.0	0.0	3.5
2012	4	3	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	4	4	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	4	5	12.41	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2012	4	6	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2012	4	7	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	4	8	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	4	9	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	4	10	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	4	11	17.61	0.35	1.06	1.58	1.12	0.0	0.0	24.2
2012	4	12	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2012	4	13	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2012	4	14	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2012	4	15	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	4	16	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	4	17	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	4	18	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	4	19	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2012	4	20	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2012	4	21	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	4	22	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	4	23	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	4	24	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	4	25	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	4	26	13.05	0.26	0.78	1.17	1.12	0.0	0.0	1.5
2012	4	27	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	4	28	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	4	29	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	4	30	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	5	1	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	5	2	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	5	3	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	5	4	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	5	5	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	5	6	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	5	7	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	5	8	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	5	9	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	5	10	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	5	11	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	5	12	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	5	13	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2012	5	14	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	5	15	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2012	5	16	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2012	5	17	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2012	5	18	15.58	0.31	0.93	1.40	1.12	0.0	0.0	11.7
2012	5	19	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	5	20	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	5	21	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	5	22	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2012	5	23	13.68	0.27	0.82	1.23	1.12	0.0	0.0	3.5
2012	5	24	12.41	0.25	0.74	1.12	1.12	0.0	0.0	0.0

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2012	5	25	16.97	0.34	1.02	1.53	1.12	0.0	0.0	19.8
2012	5	26	20.90	0.42	1.25	1.88	1.12	0.0	4.4	52.6
2012	5	27	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	5	28	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	5	29	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	5	30	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	5	31	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	6	1	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	6	2	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	6	3	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	6	4	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	6	5	13.68	0.27	0.82	1.23	1.12	0.0	0.0	3.5
2012	6	6	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	6	7	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	6	8	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2012	6	9	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2012	6	10	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	6	11	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	6	12	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	6	13	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	6	14	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	6	15	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	6	16	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	6	17	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	6	18	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2012	6	19	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	6	20	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	6	21	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	6	22	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2012	6	23	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2012	6	24	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	6	25	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2012	6	26	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	6	27	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2012	6	28	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	6	29	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	6	30	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	7	1	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	7	2	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2012	7	3	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2012	7	4	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	7	5	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	7	6	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	7	7	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	7	8	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	7	9	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	7	10	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	7	11	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2012	7	12	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	7	13	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	7	14	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	7	15	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2012	7	16	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	7	17	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	7	18	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	7	19	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	7	20	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	7	21	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	7	22	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	7	23	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	7	24	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	7	25	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	7	26	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	7	27	12.41	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2012	7	28	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	7	29	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	7	30	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	7	31	13.68	0.27	0.82	1.23	1.12	0.0	0.0	3.5
2012	8	1	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	8	2	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	8	3	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2012	8	4	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	8	5	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2012	8	6	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	8	7	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	8	8	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	8	9	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2012	8	10	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	8	11	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2012	8	12	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	8	13	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2012	8	14	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	8	15	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	8	16	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	8	17	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2012	8	18	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	8	19	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	8	20	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	8	21	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	8	22	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	8	23	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	8	24	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	8	25	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	8	26	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	8	27	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	8	28	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	8	29	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	8	30	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2012	8	31	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	9	1	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	9	2	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	9	3	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	9	4	13.05	0.26	0.78	1.17	1.12	0.0	0.0	1.5
2012	9	5	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	9	6	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	9	7	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	9	8	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	9	9	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	9	10	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	9	11	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	9	12	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	9	13	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2012	9	14	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	9	15	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	9	16	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	9	17	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	9	18	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	9	19	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	9	20	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	9	21	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	9	22	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	9	23	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	9	24	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2012	9	25	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	9	26	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	9	27	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	9	28	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	9	29	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	9	30	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2012	10	1	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	10	2	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	10	3	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	10	4	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2012	10	5	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	10	6	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	10	7	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	10	8	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	10	9	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	10	10	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	10	11	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2012	10	12	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2012	10	13	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	10	14	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	10	15	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	10	16	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	10	17	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2012	10	18	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	10	19	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	10	20	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	10	21	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2012	10	22	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2012	10	23	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2012	10	24	13.05	0.26	0.78	1.17	1.12	0.0	0.0	1.5
2012	10	25	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2012	10	26	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	10	27	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	10	28	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	10	29	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	10	30	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	10	31	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	11	1	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	11	2	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	11	3	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	11	4	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	11	5	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	11	6	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	11	7	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	11	8	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2012	11	9	19.51	0.39	1.17	1.76	1.12	0.0	1.4	39.4
2012	11	10	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2012	11	11	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2012	11	12	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	11	13	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	11	14	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	11	15	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	11	16	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	11	17	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	11	18	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	11	19	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	11	20	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	11	21	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	11	22	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	11	23	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	11	24	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	11	25	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	11	26	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	11	27	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	11	28	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	11	29	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	11	30	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	12	1	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	12	2	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2012	12	3	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	12	4	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	12	5	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	12	6	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	12	7	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	12	8	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	12	9	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2012	12	10	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	12	11	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	12	12	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2012	12	13	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2012	12	14	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2012	12	15	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	12	16	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	12	17	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2012	12	18	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2012	12	19	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2012	12	20	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	12	21	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2012	12	22	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2012	12	23	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	12	24	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2012	12	25	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	12	26	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2012	12	27	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	12	28	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2012	12	29	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2012	12	30	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2012	12	31	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	1	1	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	1	2	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	1	3	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	1	4	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	1	5	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	1	6	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	1	7	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	1	8	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2013	1	9	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	1	10	15.58	0.31	0.93	1.40	1.12	0.0	0.0	11.7
2013	1	11	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	1	12	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2013	1	13	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	1	14	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	1	15	14.95	0.30	0.90	1.35	1.12	0.0	0.0	8.6
2013	1	16	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	1	17	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	1	18	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2013	1	19	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2013	1	20	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	1	21	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	1	22	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2013	1	23	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	1	24	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	1	25	2.66	0.05	0.16	0.24	1.12	0.0	0.0	0.0
2013	1	26	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	1	27	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	1	28	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2013	1	29	12.41	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2013	1	30	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	1	31	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	2	1	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2013	2	2	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	2	3	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2013	2	4	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2013	2	5	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2013	2	6	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	2	7	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	2	8	16.34	0.33	0.98	1.47	1.12	0.0	0.0	15.9
2013	2	9	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	2	10	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	2	11	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2013	2	12	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2013	2	13	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	2	14	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2013	2	15	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	2	16	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	2	17	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	2	18	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	2	19	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	2	20	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	2	21	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	2	22	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	2	23	14.31	0.29	0.86	1.29	1.12	0.0	0.0	5.8
2013	2	24	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2013	2	25	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	2	26	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2013	2	27	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	2	28	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	3	1	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2013	3	2	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2013	3	3	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	3	4	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	3	5	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	3	6	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2013	3	7	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2013	3	8	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2013	3	9	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	3	10	15.58	0.31	0.93	1.40	1.12	0.0	0.0	11.7
2013	3	11	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	3	12	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2013	3	13	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	3	14	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	3	15	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	3	16	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	3	17	12.41	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2013	3	18	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	3	19	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	3	20	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	3	21	14.31	0.29	0.86	1.29	1.12	0.0	0.0	5.8
2013	3	22	13.05	0.26	0.78	1.17	1.12	0.0	0.0	1.5
2013	3	23	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2013	3	24	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2013	3	25	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	3	26	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	3	27	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	3	28	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	3	29	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	3	30	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	3	31	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	4	1	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2013	4	2	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	4	3	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	4	4	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	4	5	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2013	4	6	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	4	7	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	4	8	18.24	0.36	1.09	1.64	1.12	0.0	0.0	28.8
2013	4	9	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2013	4	10	14.95	0.30	0.90	1.35	1.12	0.0	0.0	8.6
2013	4	11	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	4	12	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	4	13	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2013	4	14	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2013	4	15	13.68	0.27	0.82	1.23	1.12	0.0	0.0	3.5
2013	4	16	14.95	0.30	0.90	1.35	1.12	0.0	0.0	8.6
2013	4	17	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2013	4	18	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2013	4	19	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	4	20	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2013	4	21	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	4	22	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2013	4	23	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2013	4	24	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	4	25	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2013	4	26	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	4	27	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	4	28	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	4	29	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	4	30	13.05	0.26	0.78	1.17	1.12	0.0	0.0	1.5
2013	5	1	13.05	0.26	0.78	1.17	1.12	0.0	0.0	1.5
2013	5	2	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2013	5	3	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	5	4	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	5	5	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	5	6	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2013	5	7	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2013	5	8	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	5	9	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2013	5	10	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2013	5	11	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	5	12	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	5	13	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	5	14	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	5	15	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2013	5	16	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	5	17	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	5	18	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2013	5	19	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	5	20	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	5	21	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	5	22	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2013	5	23	14.95	0.30	0.90	1.35	1.12	0.0	0.0	8.6
2013	5	24	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2013	5	25	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	5	26	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	5	27	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	5	28	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2013	5	29	14.31	0.29	0.86	1.29	1.12	0.0	0.0	5.8
2013	5	30	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2013	5	31	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2013	6	1	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	6	2	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	6	3	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	6	4	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	6	5	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	6	6	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	6	7	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	6	8	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	6	9	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	6	10	12.41	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2013	6	11	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	6	12	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	6	13	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2013	6	14	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	6	15	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2013	6	16	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	6	17	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	6	18	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	6	19	12.41	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2013	6	20	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	6	21	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	6	22	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	6	23	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2013	6	24	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2013	6	25	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	6	26	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	6	27	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	6	28	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	6	29	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	6	30	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	7	1	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	7	2	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	7	3	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	7	4	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	7	5	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	7	6	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2013	7	7	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	7	8	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	7	9	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	7	10	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	7	11	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	7	12	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2013	7	13	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	7	14	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	7	15	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	7	16	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	7	17	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	7	18	12.41	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2013	7	19	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	7	20	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	7	21	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	7	22	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	7	23	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	7	24	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	7	25	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	7	26	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	7	27	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	7	28	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	7	29	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	7	30	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	7	31	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	8	1	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	8	2	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	8	3	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	8	4	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	8	5	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2013	8	6	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	8	7	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	8	8	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	8	9	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	8	10	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	8	11	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	8	12	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	8	13	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	8	14	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	8	15	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	8	16	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	8	17	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2013	8	18	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	8	19	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	8	20	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	8	21	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	8	22	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2013	8	23	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	8	24	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	8	25	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	8	26	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	8	27	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	8	28	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	8	29	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	8	30	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	8	31	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	9	1	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2013	9	2	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2013	9	3	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	9	4	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	9	5	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	9	6	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	9	7	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	9	8	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	9	9	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2013	9	10	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	9	11	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	9	12	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	9	13	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	9	14	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	9	15	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	9	16	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	9	17	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	9	18	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2013	9	19	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	9	20	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	9	21	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2013	9	22	16.97	0.34	1.02	1.53	1.12	0.0	0.0	19.8
2013	9	23	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	9	24	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	9	25	15.58	0.31	0.93	1.40	1.12	0.0	0.0	11.7
2013	9	26	19.51	0.39	1.17	1.76	1.12	0.0	1.4	39.4
2013	9	27	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	9	28	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2013	9	29	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	9	30	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	10	1	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	10	2	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	10	3	13.68	0.27	0.82	1.23	1.12	0.0	0.0	3.5
2013	10	4	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	10	5	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	10	6	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	10	7	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	10	8	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	10	9	15.58	0.31	0.93	1.40	1.12	0.0	0.0	11.7
2013	10	10	14.31	0.29	0.86	1.29	1.12	0.0	0.0	5.8
2013	10	11	3.29	0.07	0.20	0.30	1.12	0.0	0.0	0.0
2013	10	12	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	10	13	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2013	10	14	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	10	15	9.12	0.18	0.55	0.82	1.12	0.0	0.0	0.0
2013	10	16	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	10	17	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2013	10	18	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2013	10	19	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2013	10	20	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	10	21	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	10	22	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	10	23	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2013	10	24	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	10	25	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2013	10	26	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	10	27	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	10	28	15.58	0.31	0.93	1.40	1.12	0.0	0.0	11.7
2013	10	29	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2013	10	30	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	10	31	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	11	1	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	11	2	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	11	3	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	11	4	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	11	5	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	11	6	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2013	11	7	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2013	11	8	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	11	9	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	11	10	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	11	11	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	11	12	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	11	13	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2013	11	14	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	11	15	12.41	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2013	11	16	12.41	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2013	11	17	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	11	18	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2013	11	19	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	11	20	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	11	21	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	11	22	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0
2013	11	23	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	11	24	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2013	11	25	11.78	0.24	0.71	1.06	1.12	0.0	0.0	0.0
2013	11	26	6.46	0.13	0.39	0.58	1.12	0.0	0.0	0.0
2013	11	27	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	11	28	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2013	11	29	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2013	11	30	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2013	12	1	1.90	0.04	0.11	0.17	1.12	0.0	0.0	0.0
2013	12	2	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2013	12	3	12.41	0.25	0.74	1.12	1.12	0.0	0.0	0.0
2013	12	4	13.05	0.26	0.78	1.17	1.12	0.0	0.0	1.5
2013	12	5	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	12	6	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	12	7	13.05	0.26	0.78	1.17	1.12	0.0	0.0	1.5
2013	12	8	10.39	0.21	0.62	0.94	1.12	0.0	0.0	0.0
2013	12	9	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	12	10	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2013	12	11	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	12	12	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2013	12	13	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	12	14	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	12	15	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	12	16	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2013	12	17	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2013	12	18	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2013	12	19	9.75	0.20	0.59	0.88	1.12	0.0	0.0	0.0
2013	12	20	4.56	0.09	0.27	0.41	1.12	0.0	0.0	0.0
2013	12	21	8.49	0.17	0.51	0.76	1.12	0.0	0.0	0.0
2013	12	22	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	12	23	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2013	12	24	7.22	0.14	0.43	0.65	1.12	0.0	0.0	0.0
2013	12	25	13.68	0.27	0.82	1.23	1.12	0.0	0.0	3.5
2013	12	26	7.85	0.16	0.47	0.71	1.12	0.0	0.0	0.0
2013	12	27	5.83	0.12	0.35	0.52	1.12	0.0	0.0	0.0
2013	12	28	5.19	0.10	0.31	0.47	1.12	0.0	0.0	0.0
2013	12	29	11.02	0.22	0.66	0.99	1.12	0.0	0.0	0.0

Year	Month	Day	Fastest Mile of Wind During Disturbance Period U+ (m/s)	U* for u_s/u_r of 0.2 (m/s)	U* for u_s/u_r of 0.6 (m/s)	U* for u_s/u_r of 0.9 (m/s)	Ut* (m/s)	TSP erosion potential (g/m^2) for u_s/u_r of 0.2 (40% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.6 (48% of total pile area)	TSP erosion potential (g/m^2) for u_s/u_r of 0.9 (12% of total pile area)
2013	12	30	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0
2013	12	31	3.93	0.08	0.24	0.35	1.12	0.0	0.0	0.0

Total TSP for all disturbances (g/m^2)	0.0	24.4	1552.7
Total PM_{10} for all disturbances (g/m^2)	0.0	12.2	776.3

U+ = mean hourly wind speed x 1.52 (to approximate 3-second wind gust) / 1.2 (wind gust to fastest mile conversion)

To determine which year produces maximum erosion potential:

2006			
Total TSP for all disturbances (g/m^2)	0.0	3.5	264.1
Total PM_{10} for all disturbances (g/m^2)	0.0	1.7	132.0
2008			
Total TSP for all disturbances (g/m^2)	0.0	3.9	316.6
Total PM_{10} for all disturbances (g/m^2)	0.0	1.9	158.3
2011			
Total TSP for all disturbances (g/m^2)	0.0	8.4	422.6
Total PM_{10} for all disturbances (g/m^2)	0.0	4.2	211.3
2012			
Total TSP for all disturbances (g/m^2)	0.0	7.2	311.3
Total PM_{10} for all disturbances (g/m^2)	0.0	3.6	155.7
2012			
Total TSP for all disturbances (g/m^2)	0.0	1.4	238.1
Total PM_{10} for all disturbances (g/m^2)	0.0	0.7	119.0

APPENDIX E

APPENDIX E

APPROPRIATE COAL-MOISTURE CONTENT AT KAYENTA'S COAL PREPARATION PLANT

Leading up to this application for a synthetic minor source permit for Kayenta, the Company and EPA Region IX had several discussions about the scope of that application, certain approaches to estimating fugitive particulate emissions from preparation facilities and a preference for using site-specific information in such estimates, where practicable. One such matter for discussion was Region IX's concern that a site-specific coal-moisture content of 13.1 wt.%, used by PWCC in previous estimates of Kayenta's emissions, was significantly higher than a default value of 6.9 wt.% published in AP-42. Region IX suggested that the apparently elevated coal-moisture content of 13.1 wt.% may be attributable to the Company's reliance on an inappropriate analytical method.

The purposes of the following assessment are to demonstrate that:

(1) the AP-42 default coal-moisture content of 6.9 wt.% is not applicable when characterizing the moisture content of coal processed by Kayenta's coal preparation plant;

(2) the AP-42 default coal-moisture content of 6.9 wt.% contradicts coal-moisture contents reported in the specific section of AP-42 that addresses western surface coal mines; and

(3) the Company's analytical procedure for determining moisture content of coal from Kayenta's preparation plant is the same procedure employed by EPA for determining moisture in coal from western surface coal mines.

<u>AP-42's Default Moisture Content of 6.9 wt.% Is Not Applicable to Emission Estimates for Kayenta's Coal Preparation Plant</u>.

The AP-42 default moisture content for coal at western surface coal mines is provided within Table 13.2.4-1 of that document. AP-42 first published that table, entitled "Typical Silt and Moisture Content Values of Materials at Various Industries," in 1983.[179] Since that time, that

[179] AP-42, 3rd ed., supplement 14 (draft), subsection 11.2.3 (May 1983) (hereinafter "AP-42, 3rd ed.").

table's listing for western surface coal mining has always identified the moisture content of coal at western surface coal mines as ranging from 2.8% to 20%, with a mean value of 6.9%.[180]

Those particular coal-moisture values resulted from a 1979-1980 EPA field study of fugitive emissions from three western surface coal mines.[181] In particular, those values resulted from moisture analyses of seven different samples of blasted coal that had been loaded, by either a shovel or a front-end loader, from the floor of the mine's pit onto a haul truck. Importantly, the physical nature of those coal samples from which AP-42 coal-moisture values originate is very different from the physical nature of the coal sampled at Kayenta's preparation plant.

On the one hand, coal represented by the AP-42 mean moisture content of 6.9% is characterized by relatively large chunks with limited surface area per ton of coal. In the absence of any subsequent watering of that raw coal, the level of moisture adhering to that limited surface area can be no higher than that of the previously covered coal seam from which those chunks originated.

On the other hand, with the exception of the hoppers, Kayenta's preparation facilities operate with much smaller sizes of fractured coal that has significantly higher surface area per ton of coal. That difference in surface area means that Kayenta's smaller pieces of fractured, porous coal can retain larger amounts of moisture than can the same mass of raw coal on the pit floor.

Although coal at Kayenta's preparation plant originates as blasted raw coal on a pit floor, that particular raw coal is sprayed with water at the pit before being loaded onto haul trucks. Thereafter, as wet, raw coal is unloaded into a hopper at Kayenta's preparation plant, that coal is again thoroughly wetted -- this time by multiple nozzles within the hopper spraying a mixture of water and surfactant (wetting agent). Subsequently, wet raw coal is first crushed, and the crushed coal is then screened. In each of those process operations, the coal is sprayed with the water-surfactant mixture. Throughout the preparation plant's remaining handling and storage

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[180] *Id.; see also* AP-42, 5th ed., subsection 13.2.4, Table 13.2.4-1 (Nov. 2006).

[181] AP-42, 3rd ed., Table 11.2.3-1 (citing K. Axetell and C. Cowherd, Jr., *Improved Emission Factors for Fugitive Dust from Western Surface Coal Mining Sources,* 2 Volumes, EPA Contract No. 68-03-2924, PEDCo Environmental, Inc., Kansas City, MO, July 1981 (hereinafter "PEDCo/MRI Study")).

operations, crushed/screened coal is sprayed at multiple locations in the process flow to sustain a coal-moisture content sufficient to suppress the release of fugitive dust during those operations.

Therefore, an assumption that the moisture content of coal at any stage of Kayenta's *preparation* process should be similar to the default moisture content of 6.9% reported in A-42 for chunks of relatively dry, raw coal at western surface coal *mines* is inappropriate. In light of repeated additions of moisture to Kayenta's coal – from the pit floor to load-out on the West Overland Conveyor for subsequent shipment – a value of 13.1% as representative of the unbound moisture in processed coal at Kayenta's preparation plant is realistic and reasonable.

Other Coal-Moisture Contents Reported in AP-42 Are Much Higher.

According to Table 13.2.4-1, moisture content in coal at western surface coal mines ranges from 2.8% to 20% with a mean value of 6.9%. Moreover, the Table indicates that analyses of seven different coal samples taken at four different facilities were the basis for those reported moisture values.

Of the fourteen reference sources cited for Table 13.2.4-1, only one involved field testing at western surface coal mines which included coal analyses for moisture content. Thus, the Table's asserted basis for moisture values of coal at western surface coal mines must be the two-volume document entitled *Improved Emission Factors For Fugitive Dust From Western Coal Mining Sources* (July 1981). The field test program underlying that document's reported results is commonly referred to as the "PEDCo/MRI study" in recognition of the two EPA contractors that jointly conducted the field testing and associated laboratory analyses.

The PEDCo/MRI study forms the principal basis for EPA's recommended emission factors for western surface coal mining.[182] Contrary to the entry in Table 13.2.4-1, coal moisture contents were obtained during the PEDCo/MRI study at only three different mines instead of four. Perhaps, Table 13.2.4-1 identifies four mines because one of the three mines in the PEDCo/MRI study was visited during two different periods of time.[183]

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[182] EPA, *Revision of Emission Factors for AP-42 Section 11.9; Western Surface Coal Mining,* B-14 (Sept. 1998).

[183] *Id.* at C-36 (Sept. 1998).

The PEDCo/MRI study measured moisture contents in seven different samples of coal while it was being loaded into haul trucks. Those samples almost certainly are the same seven samples of coal identified in Table 13.2.4 from western surface coal mines. However, unlike coal moisture contents shown ranging from 2.8% to 20% in Table 13.2.4-1, the published moisture contents in coal loaded onto haul trucks during the PEDCo/MRI study varied from 6.6% to 38%.[184] Consequently, instead of the mean coal moisture content of 6.9% listed in Table 13.2.4-1, the mean moisture content of coal loaded onto haul trucks during the PEDCo/MRI study was 17.8%.[185]

The PEDCo/MRI study reported the moisture content of each of its seven different samples of coal being loaded into haul trucks as follows:[186]

- Mine 1 (one sample) 22%
- Mine 2 (one sample) 38%
- Mine 3 (five samples) 11.9%, 18.0%, 12.2%, 11.1% and 6.9%

Furthermore, prior to the PEDCo/MRI study, an early screening study was performed by PEDCo at five western surface coal mines in EPA Region VIII. Although no attempt was made to develop generally applicable emission factors from results of that early study,[187] the following coal moisture contents were measured for coal loading operations at the different mines:[188]

Mine Designation	Coal Moisture, %
A	10
B	18
C	24
D	38
E	30

In sum, AP-42, Section 13.2.4 lists a default value of 6.9% as the mean moisture content of coal at western surface coal mines, but the Section's cited references lack any basis for support of that

[184] EPA, *Revision of Emission Factors for AP-42 Section 11.9; Western Surface Coal Mining,* F-16 (Sept. 1998).

[185] *See* AP-42, 3rd ed., Supplement 14, Table 8.24-3 (May 1983).

[186] EPA, *Revision of Emission Factors for AP-42 Section 11.9; Western Surface Coal Mining,* F-127 (Sept. 1998).

[187] *Id.* at B-18 (Sept. 1998).

[188] *Id.* at F-9 to F-13.

default value. Instead, the reference which provides the vast majority of AP-42's emissions information for western surface coal mines, i.e., the PEDCo/MRI study report, provides individual moisture measurements for seven different samples of coal being loaded onto haul trucks that support a default value of 17.8% as the mean moisture content. An earlier PEDCo study at five different western surface coal mines has documented similar values for moisture contents of coal being loaded into haul trucks.[189]

PWCC's Analytical Method for Determining Moisture Content of Coal

The Company has estimated fugitive particulate emissions from Kayenta's numerous transfer points, including the loading of raw coal into hoppers, with EPA's "standard drop equation." The value for coal-moisture content, M (wt.%), appears in that emission equation as shown below:

$$E = [k(0.0032)]\frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

As previously discussed, that equation is provided in AP-42's Subsection 13.2.4 entitled "Aggregate Handling and Storage Piles." After discussing the types of emitting activities addressed by the standard drop equation, Subsection 13.2.4 acknowledges that "[t]he field and laboratory procedures for aggregate sampling are given in Reference 3."[190] "Reference 3" is entitled *Iron and Steel Plant Open Dust Source Fugitive Emission Evaluation.*[191]

Table B-1 within that "Reference 3" prescribes EPA's step-by-step laboratory procedures for determining moisture contents of various aggregate materials whose emissions were evaluated during the Agency's development of the standard drop equation. Notably, as the footnote in Table B-1 specifies: "*Dry materials* composed of hydrated minerals or organic materials *like*

[189] Again, those AP-42 coal-moisture values are from raw coal on pit floors at the mines and not from coal being processed and handled during multiple applications of wet suppression.

[190] AP-42, p. 13.2.4-4.

[191] C. Cowherd, Jr. *et al.*, *Iron and Steel Plant Open Dust Source Fugitive Emission Evaluation,* EPA-600/2-79-103, U.S. Environmental Protection Agency, Cincinnati, OH (May 1979). It should be noted that these "field and laboratory procedures for aggregate sampling" are now also described in Appendix C.2 of AP-42.

coal and certain soils *for only 1-1/2 hr.*"[192] EPA explains the need for limited drying time when determining coal-moisture content, as follows:

> Exceptions to this general procedure [contained in Table B-1] are made for any material composed of hydrated minerals or organic materials. Because of the danger of measuring chemically bound moisture for these materials if they are over-dried, the drying time should be lowered to only 1-1/2 hr. Coal and soil are examples of materials that should be analyzed by this latter procedure.[193]

PWCC follows that EPA guidance when determining the moisture content of coal samples. In particular, ASTM Method 3173 is employed to measure that sample's moisture loss from evaporation during oven-drying at 104°C - 110°C for one hour.[194]

Like EPA's approach, PWCC's procedure for analyzing coal-moisture content limits both the time and the temperature for drying coal in order to ensure the sample's weight loss may be attributed only to the evaporation of unbound water. At the same time that analytical procedure is designed to minimize any releases of chemically bound moisture, volatile materials and/or the decomposition of organic compounds, i.e., additional weight loss that would be incorrectly attributed to release of unbound moisture.

The Company's method for coal-moisture analysis is fully consistent with EPA's method for determining those moisture values for coal and other aggregate materials that were used to develop the Agency's standard drop equation. PWCC's analytical procedure does *not* measure elevated levels of sample weight loss that are due to oven-drying releases of bound moisture.

[192] *Id.* at B-13 (emphasis added).

[193] *Id.* at B-12.

[194] EPA, *Coal Sampling and Analyses: Methods and Models*, EPA-600/7-85-024, 48 (June 1985).

APPENDIX F

APPENDIX F
SUMMARIES OF WEEKLY VISIBLE EMISSION SURVEYS

Weekly Visible Emission Analysis for January 1 Through June 30, 2017.

Sequential Number	Emission Point/Unit[1]	Site Identification[1]	Monitoring Weeks Required [2]	Weeks Monitored	Weeks Visual Emissions Noted	Weeks Instantaneous Opacity >10%[1]	Method 9 Opacity Value [3] (%)[1]
1	J28TP	H/E Belt 8	26	26	0	0	N/A[1]
2	J28TP	H/E Belt 2	26	26	0	0	N/A
3	J28TP	T/E Belt 5	26	26	0	0	N/A
4	J28TP	T/E Belt 6	26	26	0	0	N/A
5	J28TP	H/E Belt 6 (Dome)	26	26	0	0	N/A
6	J28TP	K-5 Truck Hopper	26	26	3	0	N/A
7	J28TP	Reclaim Hopper	26	26	0	0	N/A
8	J28PC	H/E Belt 1-N	26	26	0	0	N/A
9	J28PC	H/E Belt 1-S	26	26	0	0	N/A
10	J28PC	T/E Belt 2-N	26	26	0	0	N/A
11	J28PC	T/E Belt 2-S	26	26	0	0	N/A
12	J28S	Screen Deck-Vibrex	26	26	0	0	N/A
13	J28SC	Secondary Crusher	26	26	0	0	N/A
14	N11TP	H/E Belt 35	26	26	0	0	N/A
15	N11TP	T/E Belt 36	26	26	0	0	N/A
16	N11TP	H/E Belt 36	26	26	0	0	N/A
17	N11TP	N-11 Truck Hopper	26	26	0	0	N/A
18	N11PC	H/E Belt 34 (Crusher)	26	26	0	0	N/A
19	N11PC	T/E Belt 35 (Crusher)	26	26	0	0	N/A
20	N11S	Screen Deck-Vibrex	26	26	0	0	N/A
21	N8TP	K-2 Low Sulfur Hopper	26	26	0	0	N/A
22	N8TP	K-3 High Sulfur Hopper	26	26	0	0	N/A
23	N8TP	H/E Belt 18	26	26	0	0	N/A
24	N8TP	T/E Belt 31	26	26	0	0	N/A
25	N8TP	H/E Belt 33	26	26	0	0	N/A
26	N8S	H/E Belt 31 (Screens 1/2)	26	26	0	0	N/A
27	N8SC	T/E Belt 33 (Crushers 1/2)	26	26	0	0	N/A
28	BMTP[4]	H/E Belt 3A	26	26	0	0	N/A
29	BMTP[4]	T/E Belt 3B	26	26	0	0	N/A
30	BMS[4]	Screen Deck-Vibrex	26	26	0	0	N/A
31	BMSC[4]	Secondary Crusher	26	26	0	0	N/A

[1] Abbreviations include TP - transfer point, PC - primary crusher, S - screen, SC - secondary crusher, H/E - head end, T/E - tail end, % - percent, and N/A - not applicable.
[2] Based upon semiannual period specified.
[3] Included for those days when instantaneous daily emission values equalled or exceeded 10%. Not applicable when instantaneous daily emission values were less than 10 percent.
[4] Black Mesa facilities idle from July 1 through December 31, 2016.

Weekly Visible Emission Analysis for July 1 Through December 31, 2016.

Sequential Number	Emission Point/Unit[1]	Site Identification[1]	Monitoring Weeks Required [2]	Weeks Monitored	Weeks Visual Emissions Noted	Weeks Instantaneous Opacity >10%[1]	Method 9 Opacity Value [3] (%)[1]
1	J28TP	H/E Belt 8	26	26	0	0	N/A[1]
2	J28TP	H/E Belt 2	26	26	0	0	N/A
3	J28TP	T/E Belt 5	26	26	0	0	N/A
4	J28TP	T/E Belt 6	26	26	0	0	N/A
5	J28TP	H/E Belt 6 (Dome)	26	26	0	0	N/A
6	J28TP	K-5 Truck Hopper	26	26	1	0	N/A
7	J28TP	Reclaim Hopper	26	26	0	0	N/A
8	J28PC	H/E Belt 1-N	26	26	0	0	N/A
9	J28PC	H/E Belt 1-S	26	26	0	0	N/A
10	J28PC	T/E Belt 2-N	26	26	0	0	N/A
11	J28PC	T/E Belt 2-S	26	26	0	0	N/A
12	J28S	Screen Deck-Vibrex	26	26	0	0	N/A
13	J28SC	Secondary Crusher	26	26	0	0	N/A
14	N11TP	H/E Belt 35	26	26	0	0	N/A
15	N11TP	T/E Belt 36	26	26	0	0	N/A
16	N11TP	H/E Belt 36	26	26	0	0	N/A
17	N11TP	N-11 Truck Hopper	26	26	0	0	N/A
18	N11PC	H/E Belt 34 (Crusher)	26	26	0	0	N/A
19	N11PC	T/E Belt 35 (Crusher)	26	26	0	0	N/A
20	N11S	Screen Deck-Vibrex	26	26	0	0	N/A
21	N8TP	K-2 Low Sulfur Hopper	26	26	0	0	N/A
22	N8TP	K-3 High Sulfur Hopper	26	26	0	0	N/A
23	N8TP	H/E Belt 18	26	26	0	0	N/A
24	N8TP	T/E Belt 31	26	26	0	0	N/A
25	N8TP	H/E Belt 33	26	26	0	0	N/A
26	N8S	H/E Belt 31 (Screens 1/2)	26	26	0	0	N/A
27	N8SC	T/E Belt 33 (Crushers 1/2)	26	26	0	0	N/A
28	BMTP[4]	H/E Belt 3A	26	26	0	0	N/A
29	BMTP[4]	T/E Belt 3B	26	26	0	0	N/A
30	BMS[4]	Screen Deck-Vibrex	26	26	0	0	N/A
31	BMSC[4]	Secondary Crusher	26	26	0	0	N/A

[1] Abbreviations include TP - transfer point, PC - primary crusher, S - screen, SC - secondary crusher, H/E - head end, T/E - tail end, % - percent, and N/A - not applicable.
[2] Based upon semiannual period specified.
[3] Included for those days when instantaneous daily emission values equalled or exceeded 10%. Not applicable when instantaneous daily emission values were less than 10 percent.
[4] Black Mesa facilities idle from July 1 through December 31, 2016.

Weekly Visible Emission Analysis for January 1 Through June 30, 2016.

Sequential Number	Emission Point/Unit[1]	Site Identification[1]	Monitoring Weeks Required[2]	Weeks Monitored	Weeks Visual Emissions Noted	Weeks Instantaneous Opacity >10%[1]	Method 9 Opacity Value[3] (%)[1]
1	J28TP	H/E Belt 8	26	26	0	0	N/A[1]
2	J28TP	H/E Belt 2	26	26	0	0	N/A
3	J28TP	T/E Belt 5	26	26	0	0	N/A
4	J28TP	T/E Belt 6	26	26	0	0	N/A
5	J28TP	H/E Belt 6 (Dome)	26	26	0	0	N/A
6	J28TP	K-5 Truck Hopper	26	26	1	0	N/A
7	J28TP	Reclaim Hopper	26	26	0	0	N/A
8	J28PC	H/E Belt 1-N	26	26	0	0	N/A
9	J28PC	H/E Belt 1-S	26	26	0	0	N/A
10	J28PC	T/E Belt 2-N	26	26	0	0	N/A
11	J28PC	T/E Belt 2-S	26	26	0	0	N/A
12	J28S	Screen Deck-Vibrex	26	26	0	0	N/A
13	J28SC	Secondary Crusher	26	26	0	0	N/A
14	N11TP	H/E Belt 35	26	26	0	0	N/A
15	N11TP	T/E Belt 36	26	26	0	0	N/A
16	N11TP	H/E Belt 36	26	26	0	0	N/A
17	N11TP	N-11 Truck Hopper	26	26	0	0	N/A
18	N11PC	H/E Belt 34 (Crusher)	26	26	0	0	N/A
19	N11PC	T/E Belt 35 (Crusher)	26	26	0	0	N/A
20	N11S	Screen Deck-Vibrex	26	26	0	0	N/A
21	N8TP	K-2 Low Sulfur Hopper	26	26	0	0	N/A
22	N8TP	K-3 High Sulfur Hopper	26	26	0	0	N/A
23	N8TP	H/E Belt 18	26	26	0	0	N/A
24	N8TP	T/E Belt 31	26	26	0	0	N/A
25	N8TP	H/E Belt 33	26	26	0	0	N/A
26	N8S	H/E Belt 31 (Screens 1/2)	26	26	0	0	N/A
27	N8SC	T/E Belt 33 (Crushers 1/2)	26	26	0	0	N/A
28	BMTP[4]	H/E Belt 3A	26	26	0	0	N/A
29	BMTP[4]	T/E Belt 3B	26	26	0	0	N/A
30	BMS[4]	Screen Deck-Vibrex	26	26	0	0	N/A
31	BMSC[4]	Secondary Crusher	26	26	0	0	N/A

[1] Abbreviations include TP - transfer point, PC - primary crusher, S - screen, SC - secondary crusher, H/E - head end, T/E - tail end, % - percent, and N/A - not applicable.
[2] Based upon semiannual period specified.
[3] Included for those days when instantaneous daily emission values equalled or exceeded 10%. Not applicable when instantaneous daily emission values were less than 10 percent.
[4] Black Mesa facilities idle from January 1 through June 30, 2016.

Weekly Visible Emission Analysis for July 1 Through December 31, 2015.

Sequential Number	Emission Point/Unit[1]	Site Identification[1]	Monitoring Weeks Required[2]	Weeks Monitored	Weeks Visual Emissions Noted	Weeks Instantaneous Opacity >10%[1]	Method 9 Opacity Value[3] (%)[1]
1	J28TP	H/E Belt 8	27	27	0	0	N/A[1]
2	J28TP	H/E Belt 2	27	27	0	0	N/A
3	J28TP	T/E Belt 5	27	27	0	0	N/A
4	J28TP	T/E Belt 6	27	27	0	0	N/A
5	J28TP	H/E Belt 6 (Dome)	27	27	0	0	N/A
6	J28TP	K-5 Truck Hopper	27	27	1	0	N/A
7	J28TP	Reclaim Hopper	27	27	0	0	N/A
8	J28PC	H/E Belt 1-N	27	27	0	0	N/A
9	J28PC	H/E Belt 1-S	27	27	0	0	N/A
10	J28PC	T/E Belt 2-N	27	27	0	0	N/A
11	J28PC	T/E Belt 2-S	27	27	0	0	N/A
12	J28S	Screen Deck-Vibrex	27	27	0	0	N/A
13	J28SC	Secondary Crusher	27	27	0	0	N/A
14	N11TP	H/E Belt 35	27	27	0	0	N/A
15	N11TP	T/E Belt 36	27	27	0	0	N/A
16	N11TP	H/E Belt 36	27	27	0	0	N/A
17	N11TP	N-11 Truck Hopper	27	27	0	0	N/A
18	N11PC	H/E Belt 34 (Crusher)	27	27	0	0	N/A
19	N11PC	T/E Belt 35 (Crusher)	27	27	0	0	N/A
20	N11S	Screen Deck-Vibrex	27	27	0	0	N/A
21	N8TP	K-2 Low Sulfur Hopper	27	27	0	0	N/A
22	N8TP	K-3 High Sulfur Hopper	27	27	0	0	N/A
23	N8TP	H/E Belt 18	27	27	0	0	N/A
24	N8TP	T/E Belt 31	27	27	0	0	N/A
25	N8TP	H/E Belt 33	27	27	0	0	N/A
26	N8S	H/E Belt 31 (Screens 1/2)	27	27	0	0	N/A
27	N8SC	T/E Belt 33 (Crushers 1/2)	27	27	0	0	N/A
28	BMTP[4]	H/E Belt 3A	27	27	0	0	N/A
29	BMTP[4]	T/E Belt 3B	27	27	0	0	N/A
30	BMS[4]	Screen Deck-Vibrex	27	27	0	0	N/A
31	BMSC[4]	Secondary Crusher	27	27	0	0	N/A

[1] Abbreviations include TP - transfer point, PC - primary crusher, S - screen, SC - secondary crusher, H/E - head end, T/E - tail end, % - percent, and N/A - not applicable.
[2] Based upon semiannual period specified.
[3] Included for those days when instantaneous daily emission values equalled or exceeded 10%. Not applicable when instantaneous daily emission values were less than 10 percent.
[4] Black Mesa facilities idle from July 1 through December 31, 2015.

Weekly Visible Emission Analysis for January 1 Through June 30, 2015.

Sequential Number	Emission Point/Unit[1]	Site Identification[1]	Monitoring Weeks Required [2]	Weeks Monitored	Weeks Visual Emissions Noted	Weeks Instantaneous Opacity >10%[1]	Method 9 Opacity Value [3] (%)[1]
1	J28TP	H/E Belt 8	25	25	0	0	N/A[1]
2	J28TP	H/E Belt 2	25	25	0	0	N/A
3	J28TP	T/E Belt 5	25	25	0	0	N/A
4	J28TP	T/E Belt 6	25	25	0	0	N/A
5	J28TP	H/E Belt 6 (Dome)	25	25	0	0	N/A
6	J28TP	K-5 Truck Hopper	25	25	1	0	N/A
7	J28TP	Reclaim Hopper	25	25	0	0	N/A
8	J28PC	H/E Belt 1-N	25	25	0	0	N/A
9	J28PC	H/E Belt 1-S	25	25	0	0	N/A
10	J28PC	T/E Belt 2-N	25	25	0	0	N/A
11	J28PC	T/E Belt 2-S	25	25	0	0	N/A
12	J28S	Screen Deck-Vibrex	25	25	0	0	N/A
13	J28SC	Secondary Crusher	25	25	0	0	N/A
14	N11TP	H/E Belt 35	25	25	0	0	N/A
15	N11TP	T/E Belt 36	25	25	0	0	N/A
16	N11TP	H/E Belt 36	25	25	0	0	N/A
17	N11TP	N-11 Truck Hopper	25	25	0	0	N/A
18	N11PC	H/E Belt 34 (Crusher)	25	25	0	0	N/A
19	N11PC	T/E Belt 35 (Crusher)	25	25	0	0	N/A
20	N11S	Screen Deck-Vibrex	25	25	0	0	N/A
21	N8TP	K-2 Low Sulfur Hopper	25	25	0	0	N/A
22	N8TP	K-3 High Sulfur Hopper	25	25	0	0	N/A
23	N8TP	H/E Belt 18	25	25	0	0	N/A
24	N8TP	T/E Belt 31	25	25	0	0	N/A
25	N8TP	H/E Belt 33	25	25	0	0	N/A
26	N8S	H/E Belt 31 (Screens 1/2)	25	25	0	0	N/A
27	N8SC	T/E Belt 33 (Crushers 1/2)	25	25	0	0	N/A
28	BMTP[4]	H/E Belt 3A	25	25	0	0	N/A
29	BMTP[4]	T/E Belt 3B	25	25	0	0	N/A
30	BMS[4]	Screen Deck-Vibrex	25	25	0	0	N/A
31	BMSC[4]	Secondary Crusher	25	25	0	0	N/A

[1] Abbreviations include TP - transfer point, PC - primary crusher, S - screen, SC - secondary crusher, H/E - head end, T/E - tail end, % - percent, and N/A - not applicable.
[2] Based upon semiannual period specified.
[3] Included for those days when instantaneous daily emission values equalled or exceeded 10%. Not applicable when instantaneous daily emission values were less than 10 percent.
[4] Black Mesa facilities idle from January 1 through June 30, 2015.