August 20, 2014
0111910030

Mr. Robert Hull
Senior AQ Engineer
Bay Area Air Quality Management District
939 Ellis Street
San Francisco, CA 94109

SUBJECT: RESPONSE TO QUESTIONS ABOUT LEHIGH CUPERTINO HRA

Dear Ted:

The purpose of this letter is to respond to the two comment letters from Mr. Frank R. Freedman, as requested by the Bay Area AQMD. These include the first letter ("Letter A") dated June 2, 2014 and the second letter ("Letter B") dated July 16, 2014. Each of the items will be discussed in turn.

In Letter B, there is a request to provide a protocol for HRA changes made as a function of the comments received. AQMD has also made this request. Thus, in this letter response, the protocol (explanation of methods used) is incorporated in each response item below.

Item #1—Wind gust speed for wind erosion calculations (Item #1 in Letter B, per Item A3 in Letter A, dated June 2, 2014—Note that the first two items in Letter A are being addressed by BAAQMD.)

It has been confirmed that the wind gust speed calculations used in wind erosion emission estimates incorporated in the December 2013 HRA used an adjustment factor corresponding to a wind monitor elevation that was not consistent with the measurement height for the dataset used. That dataset was obtained from an offsite monitoring network whose data was posted on a website. In order to correct this wind monitor elevation adjustment factor, the meteorological monitoring data is required, and, this original data is no longer available. However, onsite wind data, a preferred source, is available. The use of this onsite data was proposed to BAAQMD and, hence, per instructions received from BAAQMD, the on-site wind gust data for July 1, 2010 through June 30, 2011 has now been used for wind gust speed calculations.

Item #5—Operating hours for quarry roads and other roads (Item #5 in Letter B, dated July 16, 2014)

As of 2009, the quarry only operated five days per week, and this operating schedule was taken into account in wind erosion calculations. It is now assumed that all plant sections, including the quarry, operate 7 days/week, and thus the wind erosion calculations have been revised accordingly.

Both of these changes (wind gust correction and operating hours correction) have been incorporated in the wind erosion calculations, and the resulting change in emission factors is shown in the following table. These changes have been incorporated in the updated HRA emission rate calculations.

Parameter	Units	2013 HRA (Factor for Monitor Height Applied)	2010 On-Site Met Data Weekdays Only (No Factor)	2010 On-Site Met Data All Days (No Factor)
Wind erosion, unpaved roads	tons/acre*yr	0.73	0.73	1.2
Wind erosion, bauxite stockpile	tons/yr	0.074	0.078	0.14

Note,

1. Stockpile emissions a function of stockpile geometry. Example shown above is for the bauxite stockpile.

Item #2—Wind speed for material handling from stockpiles emission calculations (Item #2 in Letter B, dated July 16, 2014):

The same rationale for use of the onsite wind data set is applicable for this Item as for Item #1 above. This change has been incorporated in the updated HRA emission rate calculations.

Parameter	Units	2013 HRA (Factor for Monitor Height Applied)	2010 On-Site Met Data All Days (No Factor)
Material handling EF	lb/ton	1.88E-04	5.52E-03

Item #3—Benzene emission factor recalculation (Item #3 in Letter B):

The results from kiln benzene source tests in 2009, 2010, and 2012, which were used in the December 2013 HRA, were re-evaluated for use in developing a benzene emission factor with the units "pounds of benzene emitted per short ton of clinker produced". These source test results contained all of the data necessary to prepare such a factor. The results were checked for data abnormalities, and then used to calculate this factor. The results of this recalculation indicate a benzene emission rate which is higher than that used in the December 2013 HRA. The detailed results are contained in an attachment to this letter. This change has been incorporated in the updated HRA emission rate calculations.

Item #4—Hexavalent chromium emissions from feed materials and stockpiles (Item #4 in Letter B):

Under the AB2588 program, in cases where lab test results show non-detect values for a certain compound (in this case, hexavalent chromium) in a specified material, and engineering judgment and experience is that the compound will not be present in the material because of its production and handling, it is acceptable to use a zero value for the compound for that material. Because hexavalent chromium is generally only formed from trivalent chromium during combustion at high temperatures or under other severe oxidizing conditions, it is unlikely that hexavalent chromium will be present in the following raw materials because they have not previously been exposed to those conditions: Quarry overburden, limestone (all grades), iron ore, coal, coke, gypsum, and slag. Thus, no changes have been made to the updated HRA emission calculations for these materials.

Item #6—Diesel PM emission factor for emergency generator (Item #6 in Letter B):

It has been confirmed that the diesel emission factor used in the December 2013 HRA came from AP-42 Table 3.4-2 rather than 3.4-1. This is because the AP-42 section instructs the reader to use Table 3.4-2 for PM emission factor. Therefore, the emission factor selected was appropriate and acceptable to use. Thus, no changes have been made to the updated HRA emission calculations for these sources.

Item #7—Diesel emissions from mobile sources (Item #7 in Letter B)—To be addressed by BAAQMD

Item #8—Request for protocol (Item #8 in Letter B)— The above explanations have incorporated detailed descriptions of the methods used to evaluate topics of interest, and where required, any changes made to values used in the updated HRA emission calculations.

If you have questions regarding this matter, please call Anne McQueen with AMEC Environment & Infrastructure at (949) 574-7082.

Very truly yours,

Caryn A. Kelly
Senior Toxicologist

Anne McQueen, Ph.D., P.E.
Senior Associate Engineer

Enclosures:

1. 2010 Lehigh On-Site Met Data (July 1, 2010 through June 30, 2011)
2. Wind Erosion Emission Factor Calculation for Unpaved Road and Bauxite Stockpile Using 2010 Lehigh On-Site Met Data
3. Material Handling Emission Factor Calculations
4. Stationary Emergency Diesel Generator Emission Factor Support
5. Kiln Benzene emission factor calculation
6. Updated 2013 HRA emission rate tables for the kiln and fugitive sources

Met Data

8/15/2014

WIND DATA

COMPARISON OF WIND DATA USED IN 2008 CEIR AND LEHIGH ON-SITE DATA
SUNNYVALE, CA

	Per 2008 CEIR (note 1)		Lehigh Data 7/14 (note 2)		
Date	GustSpeedMaxMPH		Date	Gust MPH	Avg MPH
1/1/2008	17.8952		7/1/2010	15.18	4.77
1/2/2008	11.1845		7/2/2010	17.06	4.78
1/3/2008	51.4487		7/3/2010	18.05	4.60
1/4/2008	73.8177		7/4/2010	18.22	4.71
1/5/2008	38.0273		7/5/2010	15.99	4.29
1/6/2008	20.1321		7/6/2010	14.82	4.37
1/7/2008	24.6059		7/7/2010	18.05	5.04
1/8/2008	42.5011		7/8/2010	14.14	4.42
1/9/2008	11.1845		7/9/2010	14.79	4.49
1/10/2008	13.4214		7/10/2010	14.41	4.13
1/11/2008	15.6583		7/11/2010	14.97	4.59
1/12/2008	17.8952		7/12/2010	16.46	4.74
1/13/2008	17.8952		7/13/2010	17.15	4.76
1/14/2008	15.6583		7/14/2010	14.14	4.42
1/15/2008	24.6059		7/15/2010	18.05	4.20
1/16/2008	44.738		7/16/2010	12.68	3.89
1/17/2008	22.369		7/17/2010	11.93	3.76
1/18/2008	15.6583		7/18/2010	11.9	3.58
1/19/2008	13.4214		7/19/2010	13.39	3.83
1/20/2008	42.5011		7/20/2010	13.69	4.58
1/21/2008	29.0797		7/21/2010	13.9	4.57
1/22/2008	17.8952		7/22/2010	15.75	4.93
1/23/2008	8.9476		7/23/2010	15.48	4.79
1/24/2008	31.3166		7/24/2010	14.2	4.31
1/25/2008	42.5011		7/25/2010	15.93	4.43
1/26/2008	33.5535		7/26/2010	15.09	5.17
1/27/2008	42.5011		7/27/2010	16.97	5.02
1/28/2008	42.5011		7/28/2010	17.57	5.19
1/29/2008	26.8428		7/29/2010	14.68	4.62
1/30/2008	26.8428		7/30/2010	12.32	4.27
1/31/2008	29.0797		7/31/2010	15.48	4.39
2/1/2008	20.1321		8/1/2010	12.98	3.90
2/2/2008	53.6856		8/2/2010	13.01	3.92
2/3/2008	42.5011		8/3/2010	12.35	4.00
2/4/2008	40.2642		8/4/2010	14.97	4.58
2/5/2008	20.1321		8/5/2010	15.93	4.39
2/6/2008	26.8428		8/6/2010	15.12	4.58
2/7/2008	24.6059		8/7/2010	15.45	4.45
2/8/2008	20.1321		8/8/2010	22.55	4.71
2/9/2008	26.8428		8/9/2010	14.97	4.58
2/10/2008	17.8952		8/10/2010	13.36	4.51
2/11/2008	17.8952		8/11/2010	19.24	5.11
2/12/2008	24.6059		8/12/2010	15.18	4.46
2/13/2008	42.5011		8/13/2010	14.74	4.17
2/14/2008	40.2642		8/14/2010	14.59	4.36
2/15/2008	17.8952		8/15/2010	14.97	4.26
2/16/2008	15.6583		8/16/2010	13.75	4.35
2/17/2008	15.6583		8/17/2010	14.08	4.61
2/18/2008	20.1321		8/18/2010	16.32	4.40
2/19/2008	17.8952		8/19/2010	12.59	4.22
2/20/2008	17.8952		8/20/2010	13.75	4.42
2/21/2008	46.9749		8/21/2010	17.12	4.38
2/22/2008	29.0797		8/22/2010	20.4	4.85
2/23/2008	44.738		8/23/2010	16.38	4.76
2/24/2008	44.738		8/24/2010	15.78	6.60

WIND DATA

COMPARISON OF WIND DATA USED IN 2008 CEIR AND LEHIGH ON-SITE DATA
SUNNYVALE, CA

Date	Per 2008 CEIR (note 1) GustSpeedMaxMPH		Lehigh Data 7/14 (note 2) Date	Gust MPH	Avg MPH
2/25/2008	17.8952		8/25/2010	14.08	4.36
2/26/2008	17.8952		8/26/2010	15	3.95
2/27/2008	20.1321		8/27/2010	14.91	3.75
2/28/2008	20.1321		8/28/2010	22.31	5.23
2/29/2008	22.369		8/29/2010	19.18	4.76
3/1/2008	49.2118		8/30/2010	19.6	5.10
3/2/2008	33.5535		8/31/2010	19.21	4.70
3/3/2008	20.1321		9/1/2010	17.3	5.06
3/4/2008	31.3166		9/2/2010	17.6	6.39
3/5/2008	20.1321		9/3/2010	13.42	3.53
3/6/2008	20.1321		9/4/2010	10.8	3.22
3/7/2008	17.8952		9/5/2010	15.6	3.87
3/8/2008	26.8428		9/6/2010	16.55	5.35
3/9/2008	17.8952		9/7/2010	16.14	4.91
3/10/2008	24.6059		9/8/2010	23.41	5.71
3/11/2008	24.6059		9/9/2010	20.25	5.19
3/12/2008	29.0797		9/10/2010	16.67	4.51
3/13/2008	42.5011		9/11/2010	16.79	5.76
3/14/2008	38.0273		9/12/2010	14.29	3.79
3/15/2008	42.5011		9/13/2010	13.81	4.49
3/16/2008	46.9749		9/14/2010	13.6	4.46
3/17/2008	24.6059		9/15/2010	14.68	4.31
3/18/2008	24.6059		9/16/2010	15.96	4.25
3/19/2008	31.3166		9/17/2010	11.72	3.57
3/20/2008	31.3166		9/18/2010	15.93	4.63
3/21/2008	31.3166		9/19/2010	19.6	4.75
3/22/2008	22.369		9/20/2010	19.21	4.62
3/23/2008	22.369		9/21/2010	24.96	6.27
3/24/2008	26.8428		9/22/2010	22.07	5.96
3/25/2008	29.0797		9/23/2010	16.14	4.65
3/26/2008	42.5011		9/24/2010	14.29	5.40
3/27/2008	31.3166		9/25/2010	14.41	4.67
3/28/2008	22.369		9/26/2010	14.5	4.59
3/29/2008	33.5535		9/27/2010	15.12	5.85
3/30/2008	51.4487		9/28/2010	13.84	4.70
3/31/2008	20.1321		9/29/2010	13.33	4.43
4/1/2008	33.5535		9/30/2010	12.71	3.44
4/2/2008	22.369		10/1/2010	13.04	3.80
4/3/2008	29.0797		10/2/2010	11.63	3.61
4/4/2008	26.8428		10/3/2010	26.07	5.10
4/5/2008	40.2642		10/4/2010	28.15	6.89
4/6/2008	46.9749		10/5/2010	14.29	4.19
4/7/2008	29.0797		10/6/2010	20.19	4.50
4/8/2008	38.0273		10/7/2010	14.68	4.39
4/9/2008	29.0797		10/8/2010	15.33	4.61
4/10/2008	26.8428		10/9/2010	14.53	3.98
4/11/2008	20.1321		10/10/2010	12.95	3.25
4/12/2008	22.369		10/11/2010	14.65	5.20
4/13/2008	26.8428		10/12/2010	19.83	7.81
4/14/2008	40.2642		10/13/2010	13.51	5.40
4/15/2008	35.7904		10/14/2010	12.74	3.84
4/16/2008	24.6059		10/15/2010	12.77	3.56
4/17/2008	29.0797		10/16/2010	12.11	3.41
4/18/2008	24.6059		10/17/2010	17.15	3.27
4/19/2008	53.6856		10/18/2010	14.5	4.06

WIND DATA

COMPARISON OF WIND DATA USED IN 2008 CEIR AND LEHIGH ON-SITE DATA
SUNNYVALE, CA

Date	Per 2008 CEIR (note 1) GustSpeedMaxMPH		Lehigh Data 7/14 (note 2) Date	Gust MPH	Avg MPH
4/20/2008	40.2642		10/19/2010	12.47	3.51
4/21/2008	31.3166		10/20/2010	13.54	3.49
4/22/2008	35.7904		10/21/2010	19.89	5.39
4/23/2008	35.7904		10/22/2010	15.18	3.86
4/24/2008	26.8428		10/23/2010	27.65	8.23
4/25/2008	26.8428		10/24/2010	38.59	9.20
4/26/2008	29.0797		10/25/2010	23.11	5.72
4/27/2008	26.8428		10/26/2010	24.22	7.96
4/28/2008	26.8428		10/27/2010	15.15	5.56
4/29/2008	46.9749		10/28/2010	33.25	7.93
4/30/2008	35.7904		10/29/2010	34.68	5.28
5/1/2008	31.3166		10/30/2010	21.98	5.70
5/2/2008	24.6059		10/31/2010	14.2	5.87
5/3/2008	26.8428		11/1/2010	16.05	5.10
5/4/2008	35.7904		11/2/2010	17.06	5.39
5/5/2008	22.369		11/3/2010	12.2	4.19
5/6/2008	24.6059		11/4/2010	13.72	4.00
5/7/2008	29.0797		11/5/2010	20.76	3.64
5/8/2008	22.369		11/6/2010	22.37	4.94
5/9/2008	29.0797		11/7/2010	23.59	7.21
5/10/2008	24.6059		11/8/2010	24.31	7.61
5/11/2008	26.8428		11/9/2010	24.07	5.56
5/12/2008	35.7904		11/10/2010	25.41	6.86
5/13/2008	24.6059		11/11/2010	22.94	7.61
5/14/2008	24.6059		11/12/2010	15.57	5.68
5/15/2008	26.8428		11/13/2010	24.34	7.32
5/16/2008	26.8428		11/14/2010	24.16	7.03
5/17/2008	20.1321		11/15/2010	24.96	7.39
5/18/2008	24.6059		11/16/2010	15.27	7.01
5/19/2008	20.1321		11/17/2010	13.96	5.37
5/20/2008	46.9749		11/18/2010	11.9	3.64
5/21/2008	49.2118		11/19/2010	25.14	5.18
5/22/2008	55.9225		11/20/2010	31.17	7.09
5/23/2008	33.5535		11/21/2010	25.23	7.11

WIND DATA

COMPARISON OF WIND DATA USED IN 2008 CEIR AND LEHIGH ON-SITE DATA
SUNNYVALE, CA

Date	Per 2008 CEIR (note 1) GustSpeedMaxMPH		Lehigh Data 7/14 (note 2) Date	Gust MPH	Avg MPH
5/24/2008	20.1321		11/22/2010	24.55	5.73
5/25/2008	26.8428		11/23/2010	24.84	7.04
5/26/2008	35.7904		11/24/2010	22.1	7.84
5/27/2008	40.2642		11/25/2010	14.35	6.83
5/28/2008	42.5011		11/26/2010	12.08	4.04
5/29/2008	40.2642		11/27/2010	24.93	8.03
5/30/2008	26.8428		11/28/2010	28.99	8.71
5/31/2008	29.0797		11/29/2010	16.82	7.31
6/1/2008	40.2642		11/30/2010	11.19	3.65
6/2/2008	31.3166		12/1/2010	11.1	3.86
6/3/2008	33.5535		12/2/2010	9.81	2.86
6/4/2008	38.0273		12/3/2010	12.8	3.00
6/5/2008	29.0797		12/4/2010	31.11	9.32
6/6/2008	33.5535		12/5/2010	52.13	9.80
6/7/2008	26.8428		12/6/2010	36.41	7.51
6/8/2008	22.369		12/7/2010	12.23	4.18
6/9/2008	26.8428		12/8/2010	20.1	5.71
6/10/2008	29.0797		12/9/2010	13.15	3.14
6/11/2008	31.3166		12/10/2010	13.33	3.10
6/12/2008	29.0797		12/11/2010	7.668	2.29
6/13/2008	24.6059		12/12/2010	14.11	3.25
6/14/2008	22.369		12/13/2010	13.93	3.47
6/15/2008	24.6059		12/14/2010	19.03	3.90
6/16/2008	26.8428		12/15/2010	13.01	6.03
6/17/2008	22.369		12/16/2010	13.27	5.06
6/18/2008	22.369		12/17/2010	43.06	4.84
6/19/2008	24.6059		12/18/2010	37.49	7.55
6/20/2008	20.1321		12/19/2010	35.88	7.51
6/21/2008	44.738		12/20/2010	27.2	6.95
6/22/2008	22.369		12/21/2010	26.87	9.60
6/23/2008	22.369		12/22/2010	16.23	4.29
6/24/2008	29.0797		12/23/2010	15.24	4.66
6/25/2008	22.369		12/24/2010	20.31	7.63
6/26/2008	20.1321		12/25/2010	54.22	9.07
6/27/2008	20.1321		12/26/2010	15.96	4.77
6/28/2008	26.8428		12/27/2010	16.08	5.78
6/29/2008	26.8428		12/28/2010	41.16	6.68
6/30/2008	26.8428		12/29/2010	42.02	12.27
7/1/2008	29.0797		12/30/2010	22.07	6.16
7/2/2008	24.6059		12/31/2010	12.56	3.53
7/3/2008	29.0797		1/1/2011	33.58	7.78
7/4/2008	29.0797		1/2/2011	15.87	4.64
7/5/2008	29.0797		1/3/2011	10.65	3.90
7/6/2008	22.369		1/4/2011	10.68	4.57
7/7/2008	17.8952		1/5/2011	14.88	5.03
7/8/2008	20.1321		1/6/2011	15.6	3.57
7/9/2008	20.1321		1/7/2011	10.17	2.89
7/10/2008	22.369		1/8/2011	12.89	3.67
7/11/2008	26.8428		1/9/2011	15.84	5.74
7/12/2008	20.1321		1/10/2011	20.94	6.28
7/13/2008	26.8428		1/11/2011	16.11	2.86
7/14/2008	29.0797		1/12/2011	12.35	3.73
7/15/2008	26.8428		1/13/2011	15.48	3.03
7/16/2008	22.369		1/14/2011	16.7	5.58

COMPARISON OF WIND DATA USED IN 2008 CEIR AND LEHIGH ON-SITE DATA
SUNNYVALE, CA

	Per 2008 CEIR (note 1)		Lehigh Data 7/14 (note 2)		
Date	GustSpeedMaxMPH		Date	Gust MPH	Avg MPH
7/17/2008	24.6059		1/15/2011	17.96	5.47
7/18/2008	22.369		1/16/2011	11.13	3.01
7/19/2008	22.369		1/17/2011	14.08	3.88
7/20/2008	22.369		1/18/2011	19.42	6.03
7/21/2008	26.8428		1/19/2011	24.1	7.20
7/22/2008	22.369		1/20/2011	21.8	6.96
7/23/2008	22.369		1/21/2011	17.03	4.80
7/24/2008	26.8428		1/22/2011	20.28	5.13
7/25/2008	26.8428		1/23/2011	26.19	6.63
7/26/2008	33.5535		1/24/2011	14.56	4.29
7/27/2008	26.8428		1/25/2011	23.77	5.92
7/28/2008	22.369		1/26/2011	17.33	5.76
7/29/2008	29.0797		1/27/2011	12.26	4.08
7/30/2008	22.369		1/28/2011	12.59	3.61
7/31/2008	15.6583		1/29/2011	17.06	4.38
8/1/2008	22.369		1/30/2011	19.33	5.27
8/2/2008	22.369		1/31/2011	13.84	4.00
8/3/2008	24.6059		2/1/2011	24.07	6.96
8/4/2008	24.6059		2/2/2011	20.37	7.43
8/5/2008	22.369		2/3/2011	14.23	5.81
8/6/2008	26.8428		2/4/2011	14.47	4.64
8/7/2008	26.8428		2/5/2011	31.11	9.96
8/8/2008	26.8428		2/6/2011	32.84	9.33
8/9/2008	22.369		2/7/2011	23.03	6.76
8/10/2008	24.6059		2/8/2011	37.97	11.53
8/11/2008	20.1321		2/9/2011	22.1	8.52
8/12/2008	20.1321		2/10/2011	14.56	7.00
8/13/2008	20.1321		2/11/2011	13.07	5.18
8/14/2008	17.8952		2/12/2011	11.4	4.12
8/15/2008	17.8952		2/13/2011	10.5	3.34
8/16/2008	22.369		2/14/2011	36.59	10.15
8/17/2008	24.6059		2/15/2011	48.19	12.09
8/18/2008	29.0797		2/16/2011	37.82	9.35
8/19/2008	31.3166		2/17/2011	37.46	8.36
8/20/2008	35.7904		2/18/2011	25.68	7.18
8/21/2008	31.3166		2/19/2011	23.03	5.79
8/22/2008	24.6059		2/20/2011	16.49	4.82
8/23/2008	24.6059		2/21/2011	19.72	5.37
8/24/2008	20.1321		2/22/2011	15.81	6.30
8/25/2008	29.0797		2/23/2011	26.66	7.02
8/26/2008	20.1321		2/24/2011	23.83	6.05
8/27/2008	20.1321		2/25/2011	39.72	8.15
8/28/2008	20.1321		2/26/2011	18.07	6.25
8/29/2008	20.1321		2/27/2011	21.53	5.45
8/30/2008	20.1321		2/28/2011	22.34	6.68
8/31/2008	26.8428		3/1/2011	26.22	8.27
9/1/2008	26.8428		3/2/2011	42.71	11.68
9/2/2008	26.8428		3/3/2011	20.07	5.22

WIND DATA

COMPARISON OF WIND DATA USED IN 2008 CEIR AND LEHIGH ON-SITE DATA
SUNNYVALE, CA

	Per 2008 CEIR (note 1)		Lehigh Data 7/14 (note 2)		
Date	GustSpeedMaxMPH		Date	Gust MPH	Avg MPH
9/3/2008	20.1321		3/4/2011	15.54	5.71
9/4/2008	20.1321		3/5/2011	15.45	5.39
9/5/2008	20.1321		3/6/2011	30.84	6.29
9/6/2008	22.369		3/7/2011	47.45	8.82
9/7/2008	20.1321		3/8/2011	13.75	4.06
9/8/2008	20.1321		3/9/2011	14.17	4.01
9/9/2008	22.369		3/10/2011	26.48	5.56
9/10/2008	24.6059		3/11/2011	19.27	5.82
9/11/2008	20.1321		3/12/2011	13.12	4.88
9/12/2008	20.1321		3/13/2011	24.25	6.07
9/13/2008	20.1321		3/14/2011	15.27	4.37
9/14/2008	22.369		3/15/2011	30.03	5.69
9/15/2008	20.1321		3/16/2011	21.12	5.63
9/16/2008	24.6059		3/17/2011	25.2	7.48
9/17/2008	22.369		3/18/2011	49.74	9.47
9/18/2008	24.6059		3/19/2011	39.81	10.10
9/19/2008	31.3166		3/20/2011	47.09	7.61
9/20/2008	35.7904		3/21/2011	24.99	5.88
9/21/2008	24.6059		3/22/2011	28.01	9.10
9/22/2008	26.8428		3/23/2011	39.31	7.26
9/23/2008	20.1321		3/24/2011	50.76	10.36
9/24/2008	22.369		3/25/2011	19.8	5.56
9/25/2008	20.1321		3/26/2011	26.72	6.79
9/26/2008	20.1321		3/27/2011	22.85	6.66
9/27/2008	17.8952		3/28/2011	19.09	5.57
9/28/2008	22.369		3/29/2011	21.24	5.81
9/29/2008	22.369		3/30/2011	23.05	6.37
9/30/2008	17.8952		3/31/2011	20.4	7.36
10/1/2008	20.1321		4/1/2011	18.07	5.75
10/2/2008	26.8428		4/2/2011	14.14	4.32
10/3/2008	29.0797		4/3/2011	16.85	5.69
10/4/2008	38.0273		4/4/2011	14.5	5.45
10/5/2008	20.1321		4/5/2011	21.12	4.82
10/6/2008	17.8952		4/6/2011	26.69	5.73
10/7/2008	15.6583		4/7/2011	33.61	8.39
10/8/2008	26.8428		4/8/2011	20.19	6.09
10/9/2008	29.0797		4/9/2011	25.32	5.02
10/10/2008	51.4487		4/10/2011	20.79	5.46
10/11/2008	33.5535		4/11/2011	18.7	5.17
10/12/2008	31.3166		4/12/2011	24.04	5.96
10/13/2008	15.6583		4/13/2011	23.2	5.07

WIND DATA

COMPARISON OF WIND DATA USED IN 2008 CEIR AND LEHIGH ON-SITE DATA
SUNNYVALE, CA

Date	Per 2008 CEIR (note 1)		Lehigh Data 7/14 (note 2)		
	GustSpeedMaxMPH		Date	Gust MPH	Avg MPH
10/14/2008	20.1321		4/14/2011	17.93	5.46
10/15/2008	17.8952		4/15/2011	17.69	5.30
10/16/2008	17.8952		4/16/2011	23.08	5.13
10/17/2008	15.6583		4/17/2011	15.66	4.24
10/18/2008	22.369		4/18/2011	15.24	4.14
10/19/2008	20.1321		4/19/2011	15.81	3.93
10/20/2008	22.369		4/20/2011	27.86	6.51
10/21/2008	17.8952		4/21/2011	18.1	5.74
10/22/2008	20.1321		4/22/2011	21.98	4.63
10/23/2008	15.6583		4/23/2011	22.73	5.38
10/24/2008	15.6583		4/24/2011	18.28	5.40
10/25/2008	13.4214		4/25/2011	22.19	5.79
10/26/2008	15.6583		4/26/2011	21.3	6.03
10/27/2008	17.8952		4/27/2011	14.32	4.57
10/28/2008	15.6583		4/28/2011	23	6.75
10/29/2008	15.6583		4/29/2011	27.86	9.13
10/30/2008	33.5535		4/30/2011	33.97	10.22
10/31/2008	55.9225		5/1/2011	16.38	5.39
11/1/2008	44.738		5/2/2011	14.74	5.48
11/2/2008	24.6059		5/3/2011	19.33	5.34
11/3/2008	42.5011		5/4/2011	16.64	6.64
11/4/2008	38.0273		5/5/2011	16.17	5.92
11/5/2008	17.8952		5/6/2011	14.97	4.33
11/6/2008	24.6059		5/7/2011	24.4	6.04
11/7/2008	17.8952		5/8/2011	24.16	7.80
11/8/2008	33.5535		5/9/2011	20.01	5.03
11/9/2008	42.5011		5/10/2011	16.64	5.23
11/10/2008	20.1321		5/11/2011	16.38	4.89
11/11/2008	15.6583		5/12/2011	19.98	6.04
11/12/2008	22.369		5/13/2011	16.61	4.48
11/13/2008	31.3166		5/14/2011	24.7	6.03
11/14/2008	24.6059		5/15/2011	26.22	6.92
11/15/2008	20.1321		5/16/2011	35.85	9.49
11/16/2008	11.1845		5/17/2011	30.81	7.84
11/17/2008	15.6583		5/18/2011	29.88	7.62
11/18/2008	11.1845		5/19/2011	18.13	4.44

WIND DATA

COMPARISON OF WIND DATA USED IN 2008 CEIR AND LEHIGH ON-SITE DATA
SUNNYVALE, CA

Date	Per 2008 CEIR (note 1) GustSpeedMaxMPH		Lehigh Data 7/14 (note 2) Date	Gust MPH	Avg MPH
11/19/2008	20.1321		5/20/2011	15.48	4.68
11/20/2008	15.6583		5/21/2011	20.19	4.89
11/21/2008	26.8428		5/22/2011	24.87	6.56
11/22/2008	15.6583		5/23/2011	29.62	8.10
11/23/2008	17.8952		5/24/2011	17.42	5.58
11/24/2008	13.4214		5/25/2011	29.88	5.84
11/25/2008	13.4214		5/26/2011	22.16	6.08
11/26/2008	8.9476		5/27/2011	25.98	5.92
11/27/2008	17.8952		5/28/2011	33.79	8.04
11/28/2008	15.6583		5/29/2011	29.7	8.42
11/29/2008	24.6059		5/30/2011	30.6	7.03
11/30/2008	11.1845		5/31/2011	30.75	7.65
12/1/2008	13.4214		6/1/2011	24.99	6.32
12/2/2008	22.369		6/2/2011	20.61	5.45
12/3/2008	13.4214		6/3/2011	17.09	4.86
12/4/2008	15.6583		6/4/2011	43.66	10.17
12/5/2008	20.1321		6/5/2011	18.91	5.37
12/6/2008	17.8952		6/6/2011	24.84	5.65
12/7/2008	13.4214		6/7/2011	18.46	5.10
12/8/2008	20.1321		6/8/2011	14.94	4.70
12/9/2008	22.369		6/9/2011	14.02	4.70
12/10/2008	17.8952		6/10/2011	20.01	5.27
12/11/2008	13.4214		6/11/2011	21.33	5.07
12/12/2008	15.6583		6/12/2011	17.48	4.70
12/13/2008	42.5011		6/13/2011	17.9	4.60
12/14/2008	24.6059		6/14/2011	16.29	4.19
12/15/2008	42.5011		6/15/2011	15.39	3.74
12/16/2008	22.369		6/16/2011	14.59	4.13
12/17/2008	22.369		6/17/2011	15.54	3.96
12/18/2008	20.1321		6/18/2011	16.64	4.28
12/19/2008	20.1321		6/19/2011	20.52	4.69
12/20/2008	13.4214		6/20/2011	17.6	4.64
12/21/2008	29.0797		6/21/2011	15.45	5.01
12/22/2008	33.5535		6/22/2011	13.66	3.93
12/23/2008	22.369		6/23/2011	16.64	3.92
12/24/2008	40.2642		6/24/2011	16.46	4.22
12/25/2008	51.4487		6/25/2011	15.96	4.19
12/26/2008	29.0797		6/26/2011	16.91	4.02
12/27/2008	15.6583		6/27/2011	14.79	4.04
12/28/2008	20.1321		6/28/2011	18.13	3.91
12/29/2008	20.1321		6/29/2011	17.33	5.00
12/30/2008	17.8952		6/30/2011	17.15	4.35
12/31/2008	11.1845		-	-	-
Avg:	26.21		Avg:	20.02	5.51
Min:	8.95		Min:	7.67	2.29
Max:	73.82		Max:	54.22	12.27

Notes,
1. Wind data used in original CEIR downloaded from www.wunderground.com, but specific location not specified.
2. On-site data used. Per BAAQMD, use 7/1/2010 to 6/30/2011.

Wind Erosion 8/12/2014

TABLE C-1

WIND EROSION FROM UNPAVED ROADS

Lehigh Southwest Cement Company
Cupertino Facility

k (PM10) =	0.5		
threshold friction velocity (u^*_t) =	0.62		<=AP-42 [2]
Ef (PM10)=	0.73	ton/acre*yr	<=weekdays only
Ef (PM10)=	1.22	ton/acre*yr	<=365 days

Date	Day		N	u+ (m/s) [1,3]	u^*_{10} (m/s)	u* (m/s)	P_i (g/m^2)	Weekday Only:	Pi (g/m^2)
7/1/2010	Th		1	6.8	6.8	0.359667397	0		0
7/2/2010	Fr		2	7.6	7.6	0.404211185	0		0
7/3/2010		100	3	8.1	8.1	0.427667754	0		0
7/4/2010		100	4	8.1	8.1	0.43169565	0		0
7/5/2010	M		5	7.1	7.1	0.378859135	0		0
7/6/2010	T		6	6.6	6.6	0.351137735	0		0
7/7/2010	W		7	8.1	8.1	0.427667754	0		0
7/8/2010	Th		8	6.3	6.3	0.335026152	0		0
7/9/2010	Fr		9	6.6	6.6	0.35042693	0		0
7/10/2010		100	10	6.4	6.4	0.341423398	0		0
7/11/2010		100	11	6.7	6.7	0.354691761	0		0
7/12/2010	M		12	7.4	7.4	0.389995082	0		0
7/13/2010	T		13	7.7	7.7	0.406343601	0		0
7/14/2010	W		14	6.3	6.3	0.335026152	0		0
7/15/2010	Th		15	8.1	8.1	0.427667754	0		0
7/16/2010	Fr		16	5.7	5.7	0.300433636	0		0
7/17/2010		100	17	5.3	5.3	0.282663508	0		0
7/18/2010		100	18	5.3	5.3	0.281952702	0		0
7/19/2010	M		19	6.0	6.0	0.317256024	0		0
7/20/2010	T		20	6.1	6.1	0.324364075	0		0
7/21/2010	W		21	6.2	6.2	0.329339711	0		0
7/22/2010	Th		22	7.0	7.0	0.373172694	0		0
7/23/2010	Fr		23	6.9	6.9	0.366775448	0		0
7/24/2010		100	24	6.3	6.3	0.336447763	0		0
7/25/2010		100	25	7.1	7.1	0.377437525	0		0
7/26/2010	M		26	6.7	6.7	0.357534981	0		0
7/27/2010	T		27	7.6	7.6	0.40207877	0		0
7/28/2010	W		28	7.9	7.9	0.416294872	0		0
7/29/2010	Th		29	6.6	6.6	0.347820645	0		0
7/30/2010	Fr		30	5.5	5.5	0.291903974	0		0
7/31/2010		100	31	6.9	6.9	0.366775448	0		0
8/1/2010		100	32	5.8	5.8	0.307541687	0		0
8/2/2010	M		33	5.8	5.8	0.308252492	0		0
8/3/2010	T		34	5.5	5.5	0.292614779	0		0
8/4/2010	W		35	6.7	6.7	0.354691761	0		0

Onsite 2010 met data

TABLE C-1

WIND EROSION FROM UNPAVED ROADS
Lehigh Southwest Cement Company
Cupertino Facility

Date	Day		N	u+ (m/s) [1, 3]	u^{+}_{10} (m/s)	u* (m/s)	P_i (g/m^2)	Weekday Only:	Pi (g/m^2)
8/5/2010	Th		36	7.1	7.1	0.377437525	0		0
8/6/2010	Fr		37	6.8	6.8	0.358245787	0		0
8/7/2010		100	38	6.9	6.9	0.366064643	0		0
8/8/2010		100	39	10.1	10.1	0.534288524	0		0
8/9/2010	M		40	6.7	6.7	0.354691761	0		0
8/10/2010	T		41	6.0	6.0	0.316545219	0		0
8/11/2010	W		42	8.6	8.6	0.455863025	0		0
8/12/2010	Th		43	6.8	6.8	0.359667397	0		0
8/13/2010	Fr		44	6.6	6.6	0.349242255	0		0
8/14/2010		100	45	6.5	6.5	0.345688229	0		0
8/15/2010		100	46	6.7	6.7	0.354691761	0		0
8/16/2010	M		47	6.1	6.1	0.325785686	0		0
8/17/2010	T		48	6.3	6.3	0.333604542	0		0
8/18/2010	W		49	7.3	7.3	0.386677992	0		0
8/19/2010	Th		50	5.6	5.6	0.29830122	0		0
8/20/2010	Fr		51	6.1	6.1	0.325785686	0		0
8/21/2010		100	52	7.7	7.7	0.405632795	0		0
8/22/2010		100	53	9.1	9.1	0.48334749	0		0
8/23/2010	M		54	7.3	7.3	0.388099602	0		0
8/24/2010	T		55	7.1	7.1	0.373883499	0		0
8/25/2010	W		56	6.3	6.3	0.333604542	0		0
8/26/2010	Th		57	6.7	6.7	0.355402566	0		0
8/27/2010	Fr		58	6.7	6.7	0.353270151	0		0
8/28/2010		100	59	10.0	10.0	0.528602083	0		0
8/29/2010		100	60	8.6	8.6	0.454441414	0		0
8/30/2010	M		61	8.8	8.8	0.464392686	0		0
8/31/2010	T		62	8.6	8.6	0.45515222	0		0
9/1/2010	W		63	7.7	7.7	0.409897626	0		0
9/2/2010	Th		64	7.9	7.9	0.417005678	0		0
9/3/2010	Fr		65	6.0	6.0	0.317966829	0		0
9/4/2010		100	66	4.8	4.8	0.255889848	0		0
9/5/2010		100	67	7.0	7.0	0.369618669	0		0
9/6/2010	M		68	7.4	7.4	0.392127498	0		0
9/7/2010	T		69	7.2	7.2	0.382413161	0		0
9/8/2010	W		70	10.5	10.5	0.554664938	0		0
9/9/2010	Th		71	9.1	9.1	0.479793464	0		0
9/10/2010	Fr		72	7.5	7.5	0.394970718	0		0
9/11/2010		100	73	7.5	7.5	0.397813939	0		0

TABLE C-1

WIND EROSION FROM UNPAVED ROADS

Lehigh Southwest Cement Company
Cupertino Facility

Date	Day		N	u+ (m/s) [1, 3]	u^+_{10} (m/s)	u* (m/s)	P_i (g/m^2)	Weekday Only:	Pi (g/m^2)
9/12/2010		100	74	6.4	6.4	0.338580178	0		0
9/13/2010	M		75	6.2	6.2	0.327207296	0		0
9/14/2010	T		76	6.1	6.1	0.32223166	0		0
9/15/2010	W		77	6.6	6.6	0.347820645	0		0
9/16/2010	Th		78	7.1	7.1	0.37814833	0		0
9/17/2010	Fr		79	5.2	5.2	0.277687872	0		0
9/18/2010		100	80	7.1	7.1	0.377437525	0		0
9/19/2010		100	81	8.8	8.8	0.464392686	0		0
9/20/2010	M		82	8.6	8.6	0.45515222	0		0
9/21/2010	T		83	11.2	11.2	0.59138987	0		0
9/22/2010	W		84	9.9	9.9	0.522915642	0		0
9/23/2010	Th		85	7.2	7.2	0.382413161	0		0
9/24/2010	Fr		86	6.4	6.4	0.338580178	0		0
9/25/2010		100	87	6.4	6.4	0.341423398	0		0
9/26/2010		100	88	6.5	6.5	0.343555814	0		0
9/27/2010	M		89	6.8	6.8	0.358245787	0		0
9/28/2010	T		90	6.2	6.2	0.327918101	0		0
9/29/2010	W		91	6.0	6.0	0.315834414	0		0
9/30/2010	Th		92	5.7	5.7	0.301144441	0		0
10/1/2010	Fr		93	5.8	5.8	0.308963297	0		0
10/2/2010		100	94	5.2	5.2	0.275555456	0		0
10/3/2010		100	95	11.7	11.7	0.61768966	0		0
10/4/2010	M		96	12.6	12.6	0.666972149	1.302274		1.30227393
10/5/2010	T		97	6.4	6.4	0.338580178	0		0
10/6/2010	W		98	9.0	9.0	0.478371854	0		0
10/7/2010	Th		99	6.6	6.6	0.347820645	0		0
10/8/2010	Fr		100	6.9	6.9	0.363221423	0		0
10/9/2010		100	101	6.5	6.5	0.344266619	0		0
10/10/2010		100	102	5.8	5.8	0.306830882	0		0
10/11/2010	M		103	6.5	6.5	0.34710984	0		0
10/12/2010	T		104	8.9	8.9	0.469842192	0		0
10/13/2010	W		105	6.0	6.0	0.320099244	0		0
10/14/2010	Th		106	5.7	5.7	0.301855246	0		0
10/15/2010	Fr		107	5.7	5.7	0.302566051	0		0
10/16/2010		100	108	5.4	5.4	0.286928338	0		0
10/17/2010		100	109	7.7	7.7	0.406343601	0		0
10/18/2010	M		110	6.5	6.5	0.343555814	0		0
10/19/2010	T		111	5.6	5.6	0.295458	0		0
10/20/2010	W		112	6.1	6.1	0.32081005	0		0
10/21/2010	Th		113	8.9	8.9	0.471263803	0		0
10/22/2010	Fr		114	6.8	6.8	0.359667397	0		0

TABLE C-1

WIND EROSION FROM UNPAVED ROADS
Lehigh Southwest Cement Company
Cupertino Facility

Date	Day		N	u+ (m/s) [1,3]	u^{+}_{10} (m/s)	u* (m/s)	P_i (g/m^2)	Weekday Only:	Pi (g/m^2)
10/23/2010		100	115	12.4	12.4	0.655125397	0.949695		0
10/24/2010		100	116	17.3	17.3	0.914332335	12.38294		0
10/25/2010	M		117	10.3	10.3	0.547556887	0		0
10/26/2010	T		118	10.8	10.8	0.573856677	0		0
10/27/2010	W		119	6.8	6.8	0.358956592	0		0
10/28/2010	Th		120	14.9	14.9	0.787809021	5.828498		5.82849786
10/29/2010	Fr		121	15.5	15.5	0.821690733	7.401659		7.40165911
10/30/2010		100	122	9.8	9.8	0.520783227	0		0
10/31/2010		100	123	6.3	6.3	0.336447763	0		0
11/1/2010	M		124	7.2	7.2	0.380280746	0		0
11/2/2010	T		125	7.6	7.6	0.404211185	0		0
11/3/2010	W		126	5.5	5.5	0.289060754	0		0
11/4/2010	Th		127	6.1	6.1	0.32507488	0		0
11/5/2010	Fr		128	9.3	9.3	0.491877151	0		0
11/6/2010		100	129	10.0	10.0	0.530023694	0		0
11/7/2010		100	130	10.5	10.5	0.558929769	0		0
11/8/2010	M		131	10.9	10.9	0.575989092	0		0
11/9/2010	T		132	10.8	10.8	0.570302651	0		0
11/10/2010	W		133	11.4	11.4	0.602051947	0		0
11/11/2010	Th		134	10.3	10.3	0.543528991	0		0
11/12/2010	Fr		135	7.0	7.0	0.368907864	0		0
11/13/2010		100	136	10.9	10.9	0.576699897	0		0
11/14/2010		100	137	10.8	10.8	0.572435066	0		0
11/15/2010	M		138	11.2	11.2	0.59138987	0		0
11/16/2010	T		139	6.8	6.8	0.361799812	0		0
11/17/2010	W		140	6.2	6.2	0.330761321	0		0
11/18/2010	Th		141	5.3	5.3	0.281952702	0		0
11/19/2010	Fr		142	11.2	11.2	0.595654701	0		0
11/20/2010		100	143	13.9	13.9	0.738526532	3.777979		0
11/21/2010		100	144	11.3	11.3	0.597787116	0		0
11/22/2010	M		145	11.0	11.0	0.581675533	0		0
11/23/2010	T		146	11.1	11.1	0.588546649	0		0
11/24/2010	W		147	9.9	9.9	0.523626447	0		0
11/25/2010	Th		148	6.4	6.4	0.340001788	0		0
11/26/2010	Fr		149	5.4	5.4	0.286217533	0		0
11/27/2010		100	150	11.1	11.1	0.590679065	0		0
11/28/2010		100	151	13.0	13.0	0.686874693	1.931256		0
11/29/2010	M		152	7.5	7.5	0.398524744	0		0
11/30/2010	T		153	5.0	5.0	0.265130314	0		0
12/1/2010	W		154	5.0	5.0	0.262997899	0		0
12/2/2010	Th		155	4.4	4.4	0.232433278	0		0

TABLE C-1

WIND EROSION FROM UNPAVED ROADS
Lehigh Southwest Cement Company
Cupertino Facility

Date	Day		N	u+ (m/s) [1, 3]	u^+_{10} (m/s)	u* (m/s)	P_i (g/m²)	Weekday Only:	Pi (g/m²)
12/3/2010	Fr		156	5.7	5.7	0.303276856	0		0
12/4/2010		100	157	13.9	13.9	0.737104922	3.72301		0
12/5/2010		100	158	23.3	23.3	1.235142385	37.32577		0
12/6/2010	M		159	16.3	16.3	0.862680495	9.482854		9.48285411
12/7/2010	T		160	5.5	5.5	0.289771559	0		0
12/8/2010	W		161	9.0	9.0	0.476239439	0		0
12/9/2010	Th		162	5.9	5.9	0.311569583	0		0
12/10/2010	Fr		163	6.0	6.0	0.315834414	0		0
12/11/2010		100	164	3.4	3.4	0.181681792	0		0
12/12/2010		100	165	6.3	6.3	0.334315347	0		0
12/13/2010	M		166	6.2	6.2	0.330050516	0		0
12/14/2010	T		167	8.5	8.5	0.450887389	0		0
12/15/2010	W		168	5.8	5.8	0.308252492	0		0
12/16/2010	Th		169	5.9	5.9	0.314412803	0		0
12/17/2010	Fr		170	19.2	19.2	1.0202423	19.2973		19.2973036
12/18/2010		100	171	16.8	16.8	0.88826948	10.88091		0
12/19/2010		100	172	16.0	16.0	0.850122938	8.824554		0
12/20/2010	M		173	12.2	12.2	0.64446332	0.646293		0.64629333
12/21/2010	T		174	12.0	12.0	0.636644463	0.43218		0.4321798
12/22/2010	W		175	7.3	7.3	0.384545576	0		0
12/23/2010	Th		176	6.8	6.8	0.361089007	0		0
12/24/2010	Fr		177	9.1	9.1	0.481215074	0		0
12/25/2010		100	178	24.2	24.2	1.284661809	42.23951		0
12/26/2010		100	179	7.1	7.1	0.37814833	0		0
12/27/2010	M		180	7.2	7.2	0.380991551	0		0

TABLE C-1

WIND EROSION FROM UNPAVED ROADS

Lehigh Southwest Cement Company
Cupertino Facility

Date	Day	N	u+ (m/s) [1, 3]	u^+_{10} (m/s)	u* (m/s)	P_i (g/m^2)	Weekday Only:	Pi (g/m^2)
12/28/2010	T	181	18.4	18.4	0.975224641	16.19932		16.1993197
12/29/2010	W	182	18.8	18.8	0.995601055	17.57244		17.5724432
12/30/2010	Th	183	9.9	9.9	0.522915642	0		0
12/31/2010	Fr	184	5.6	5.6	0.297590415	0		0
1/1/2011	100	185	15.0	15.0	0.795627878	6.179716		0
1/2/2011	100	186	7.1	7.1	0.376015915	0		0
1/3/2011	M	187	4.8	4.8	0.252335822	0		0
1/4/2011	T	188	4.8	4.8	0.253046627	0		0
1/5/2011	W	189	6.7	6.7	0.352559346	0		0
1/6/2011	Th	190	7.0	7.0	0.369618669	0		0
1/7/2011	Fr	191	4.5	4.5	0.24096294	0		0
1/8/2011	100	192	5.8	5.8	0.305409272	0		0
1/9/2011	100	193	7.1	7.1	0.37530511	0		0
1/10/2011	M	194	9.4	9.4	0.496141982	0		0
1/11/2011	T	195	7.2	7.2	0.381702356	0		0
1/12/2011	W	196	5.5	5.5	0.292614779	0		0
1/13/2011	Th	197	6.9	6.9	0.366775448	0		0
1/14/2011	Fr	198	7.5	7.5	0.395681524	0		0
1/15/2011	100	199	8.0	8.0	0.425535339	0		0
1/16/2011	100	200	5.0	5.0	0.263708704	0		0
1/17/2011	M	201	6.3	6.3	0.333604542	0		0
1/18/2011	T	202	8.7	8.7	0.460127856	0		0
1/19/2011	W	203	10.8	10.8	0.571013456	0		0
1/20/2011	Th	204	9.7	9.7	0.516518396	0		0
1/21/2011	Fr	205	7.6	7.6	0.40350038	0		0
1/22/2011	100	206	9.1	9.1	0.480504269	0		0
1/23/2011	100	207	11.7	11.7	0.62053288	0.013338		0
1/24/2011	M	208	6.5	6.5	0.344977424	0		0
1/25/2011	T	209	10.6	10.6	0.5631946	0		0
1/26/2011	W	210	7.7	7.7	0.410608431	0		0
1/27/2011	Th	211	5.5	5.5	0.290482364	0		0
1/28/2011	Fr	212	5.6	5.6	0.29830122	0		0
1/29/2011	100	213	7.6	7.6	0.404211185	0		0
1/30/2011	100	214	8.6	8.6	0.45799544	0		0
1/31/2011	M	215	6.2	6.2	0.327918101	0		0
2/1/2011	T	216	10.8	10.8	0.570302651	0		0
2/2/2011	W	217	9.1	9.1	0.482636685	0		0
2/3/2011	Th	218	6.4	6.4	0.337158568	0		0
2/4/2011	Fr	219	6.5	6.5	0.342845009	0		0
2/5/2011	100	220	13.9	13.9	0.737104922	3.72301		0
2/6/2011	100	221	14.7	14.7	0.778094685	5.402015		0

TABLE C-1

WIND EROSION FROM UNPAVED ROADS

Lehigh Southwest Cement Company
Cupertino Facility

Date	Day	N	u+ (m/s) 1, 3	u^{+}_{10} (m/s)	u* (m/s)	P_i (g/m^2)	Weekday Only:	Pi (g/m^2)
2/7/2011	M	222	10.3	10.3	0.545661406	0		0
2/8/2011	T	223	17.0	17.0	0.899642362	11.52665		11.5266504
2/9/2011	W	224	9.9	9.9	0.523626447	0		0
2/10/2011	Th	225	6.5	6.5	0.344977424	0		0
2/11/2011	Fr	226	5.8	5.8	0.309674103	0		0
2/12/2011	100	227	5.1	5.1	0.27010595	0		0
2/13/2011	100	228	4.7	4.7	0.248781796	0		0
2/14/2011	M	229	16.4	16.4	0.866945326	9.710589		9.71058881
2/15/2011	T	230	21.5	21.5	1.141789977	28.83611		28.8361067
2/16/2011	W	231	16.9	16.9	0.896088337	11.32325		11.323245
2/17/2011	Th	232	16.7	16.7	0.887558675	10.84105		10.8410503
2/18/2011	Fr	233	11.5	11.5	0.608449193	0		0
2/19/2011	100	234	10.3	10.3	0.545661406	0		0
2/20/2011	100	235	7.4	7.4	0.390705888	0		0
2/21/2011	M	236	8.8	8.8	0.467235907	0		0
2/22/2011	T	237	7.1	7.1	0.374594305	0		0
2/23/2011	W	238	11.9	11.9	0.631668827	0.299618		0.29961805
2/24/2011	Th	239	10.7	10.7	0.56461621	0		0
2/25/2011	Fr	240	17.8	17.8	0.941105995	14.00798		14.0079754
2/26/2011	100	241	8.1	8.1	0.428141625	0		0
2/27/2011	100	242	9.6	9.6	0.51012115	0		0
2/28/2011	M	243	10.0	10.0	0.529312888	0		0
3/1/2011	T	244	11.7	11.7	0.621243685	0.031182		0.03118185
3/2/2011	W	245	19.1	19.1	1.011949573	18.70896		18.7089585
3/3/2011	Th	246	9.0	9.0	0.475528633	0		0
3/4/2011	Fr	247	6.9	6.9	0.368197058	0		0
3/5/2011	100	248	6.9	6.9	0.366064643	0		0
3/6/2011	100	249	13.8	13.8	0.730707676	3.478551		0
3/7/2011	M	250	21.2	21.2	1.124256784	27.35436		27.354364
3/8/2011	T	251	6.1	6.1	0.325785686	0		0
3/9/2011	W	252	6.3	6.3	0.335736957	0		0
3/10/2011	Th	253	11.8	11.8	0.627403997	0.188279		0.18827943
3/11/2011	Fr	254	8.6	8.6	0.45657383	0		0
3/12/2011	100	255	5.9	5.9	0.310858778	0		0
3/13/2011	100	256	10.8	10.8	0.574567482	0		0
3/14/2011	M	257	6.8	6.8	0.361799812	0		0
3/15/2011	T	258	13.4	13.4	0.711515937	2.773658		2.7736581
3/16/2011	W	259	9.4	9.4	0.500406813	0		0

TABLE C-1

WIND EROSION FROM UNPAVED ROADS
Lehigh Southwest Cement Company
Cupertino Facility

Date	Day	N	u+ (m/s) [1, 3]	u^+_{10} (m/s)	u* (m/s)	P_i (g/m^2)	Weekday Only:	Pi (g/m^2)
3/17/2011	Th	260	11.3	11.3	0.597076311	0		0
3/18/2011	Fr	261	22.2	22.2	1.178514909	32.05533		32.0553291
3/19/2011	100	262	17.8	17.8	0.94323841	14.14098		0
3/20/2011	100	263	21.1	21.1	1.115727122	26.64641		0
3/21/2011	M	264	11.2	11.2	0.592100675	0		0
3/22/2011	T	265	12.5	12.5	0.663655058	1.201911		1.20191078
3/23/2011	W	266	17.6	17.6	0.931391658	13.40875		13.4087478
3/24/2011	Th	267	22.7	22.7	1.202682284	34.25914		34.2591384
3/25/2011	Fr	268	8.9	8.9	0.469131387	0		0
3/26/2011	100	269	11.9	11.9	0.633090438	0.3372		0
3/27/2011	100	270	10.2	10.2	0.541396576	0		0
3/28/2011	M	271	8.5	8.5	0.452308999	0		0
3/29/2011	T	272	9.5	9.5	0.503250034	0		0
3/30/2011	W	273	10.3	10.3	0.546135276	0		0
3/31/2011	Th	274	9.1	9.1	0.48334749	0		0
4/1/2011	Fr	275	8.1	8.1	0.428141625	0		0
4/2/2011	100	276	6.3	6.3	0.335026152	0		0
4/3/2011	100	277	7.5	7.5	0.399235549	0		0
4/4/2011	M	278	6.5	6.5	0.343555814	0		0
4/5/2011	T	279	9.4	9.4	0.500406813	0		0
4/6/2011	W	280	11.9	11.9	0.632379633	0.31838		0.31837962
4/7/2011	Th	281	15.0	15.0	0.796338683	6.211996		6.21199628
4/8/2011	Fr	282	9.0	9.0	0.478371854	0		0
4/9/2011	100	283	11.3	11.3	0.599919531	0		0
4/10/2011	100	284	9.3	9.3	0.492587957	0		0
4/11/2011	M	285	8.4	8.4	0.443068532	0		0
4/12/2011	T	286	10.7	10.7	0.569591846	0		0
4/13/2011	W	287	10.4	10.4	0.549689302	0		0
4/14/2011	Th	288	8.0	8.0	0.424824534	0		0
4/15/2011	Fr	289	7.9	7.9	0.419138093	0		0
4/16/2011	100	290	10.3	10.3	0.546846082	0		0
4/17/2011	100	291	7.0	7.0	0.371040279	0		0
4/18/2011	M	292	6.8	6.8	0.361089007	0		0
4/19/2011	T	293	7.1	7.1	0.374594305	0		0
4/20/2011	W	294	12.5	12.5	0.660101033	1.095795		1.0957952
4/21/2011	Th	295	8.1	8.1	0.42885243	0		0
4/22/2011	Fr	296	9.8	9.8	0.520783227	0		0
4/23/2011	100	297	10.2	10.2	0.538553355	0		0
4/24/2011	100	298	8.2	8.2	0.43311726	0		0
4/25/2011	M	299	9.9	9.9	0.525758863	0		0
4/26/2011	T	300	9.5	9.5	0.504671644	0		0

TABLE C-1

WIND EROSION FROM UNPAVED ROADS

Lehigh Southwest Cement Company
Cupertino Facility

Date	Day	N	u+ (m/s) [1, 3]	u^+_{10} (m/s)	u* (m/s)	P_i (g/m^2)	Weekday Only:	Pi (g/m^2)
4/27/2011	W	301	6.4	6.4	0.339290983	0		0
4/28/2011	Th	302	10.3	10.3	0.544950601	0		0
4/29/2011	Fr	303	12.5	12.5	0.660101033	1.095795		1.0957952
4/30/2011	100	304	15.2	15.2	0.804868345	6.603934		0
5/1/2011	100	305	7.3	7.3	0.388099602	0		0
5/2/2011	M	306	6.6	6.6	0.349242255	0		0
5/3/2011	T	307	8.6	8.6	0.45799544	0		0
5/4/2011	W	308	7.4	7.4	0.394259913	0		0
5/5/2011	Th	309	7.2	7.2	0.383123966	0		0
5/6/2011	Fr	310	6.7	6.7	0.354691761	0		0
5/7/2011	100	311	10.9	10.9	0.578121507	0		0
5/8/2011	100	312	10.8	10.8	0.572435066	0		0
5/9/2011	M	313	8.9	8.9	0.474107023	0		0
5/10/2011	T	314	7.4	7.4	0.394259913	0		0
5/11/2011	W	315	7.3	7.3	0.388099602	0		0
5/12/2011	Th	316	8.9	8.9	0.473396218	0		0
5/13/2011	Fr	317	7.4	7.4	0.393549108	0		0
5/14/2011	100	318	11.0	11.0	0.585229559	0		0
5/15/2011	100	319	11.7	11.7	0.621243685	0.031182		0
5/16/2011	M	320	16.0	16.0	0.849412133	8.787839		8.78783907
5/17/2011	T	321	13.8	13.8	0.729996871	3.451682		3.45168184

TABLE C-1

WIND EROSION FROM UNPAVED ROADS
Lehigh Southwest Cement Company
Cupertino Facility

Date	Day		N	u+ (m/s) [1, 3]	u^{+}_{10} (m/s)	u* (m/s)	P_i (g/m^2)	Weekday Only:	Pi (g/m^2)
5/18/2011	W		322	13.4	13.4	0.707961912	2.647811		2.64781107
5/19/2011	Th		323	8.1	8.1	0.429563235	0		0
5/20/2011	Fr		324	6.9	6.9	0.366775448	0		0
5/21/2011		100	325	9.0	9.0	0.478371854	0		0
5/22/2011		100	326	11.1	11.1	0.589257455	0		0
5/23/2011	M		327	13.2	13.2	0.7018016	2.433147		2.43314712
5/24/2011	T		328	7.8	7.8	0.412740847	0		0
5/25/2011	W		329	13.4	13.4	0.707961912	2.647811		2.64781107
5/26/2011	Th		330	9.9	9.9	0.525048058	0		0
5/27/2011	Fr		331	11.6	11.6	0.615557244	0		0
5/28/2011		100	332	15.1	15.1	0.800603514	6.40691		0
5/29/2011		100	333	13.3	13.3	0.703697081	2.498729		0
5/30/2011	M		334	13.7	13.7	0.725021235	3.26524		3.26523953
5/31/2011	T		335	13.7	13.7	0.72857526	3.39812		3.39811957
6/1/2011	W		336	11.2	11.2	0.592100675	0		0
6/2/2011	Th		337	9.2	9.2	0.488323126	0		0
6/3/2011	Fr		338	7.6	7.6	0.40492199	0		0
6/4/2011		100	339	19.5	19.5	1.034458402	20.32445		0
6/5/2011		100	340	8.5	8.5	0.448044168	0		0
6/6/2011	M		341	11.1	11.1	0.588546649	0		0
6/7/2011	T		342	8.3	8.3	0.437382091	0		0
6/8/2011	W		343	6.7	6.7	0.353980956	0		0
6/9/2011	Th		344	6.3	6.3	0.332182932	0		0
6/10/2011	Fr		345	8.9	8.9	0.474107023	0		0
6/11/2011		100	346	9.5	9.5	0.505382449	0		0
6/12/2011		100	347	7.8	7.8	0.414162457	0		0
6/13/2011	M		348	8.0	8.0	0.424113729	0		0
6/14/2011	T		349	7.3	7.3	0.385967187	0		0
6/15/2011	W		350	6.9	6.9	0.364643033	0		0
6/16/2011	Th		351	6.5	6.5	0.345688229	0		0
6/17/2011	Fr		352	6.9	6.9	0.368197058	0		0
6/18/2011		100	353	7.4	7.4	0.394259913	0		0
6/19/2011		100	354	9.2	9.2	0.48619071	0		0
6/20/2011	M		355	7.9	7.9	0.417005678	0		0
6/21/2011	T		356	6.9	6.9	0.366064643	0		0
6/22/2011	W		357	6.1	6.1	0.32365327	0		0
6/23/2011	Th		358	7.4	7.4	0.394259913	0		0
6/24/2011	Fr		359	7.4	7.4	0.389995082	0		0
6/25/2011		100	360	7.1	7.1	0.37814833	0		0
6/26/2011		100	361	7.6	7.6	0.400657159	0		0
6/27/2011	M		362	6.6	6.6	0.35042693	0		0

TABLE C-1

WIND EROSION FROM UNPAVED ROADS
Lehigh Southwest Cement Company
Cupertino Facility

Date	Day	N	u+ (m/s) [1, 3]	u^{+}_{10} (m/s)	u* (m/s)	P_i (g/m^2)	Weekday Only:	Pi (g/m^2)
6/28/2011	T	363	8.1	8.1	0.429563235	0		0
6/29/2011	W	364	7.7	7.7	0.410608431	0		0
6/30/2011	Th	365	7.7	7.7	0.406343601	0		0
					Sum:	547.8653	g/m2*yr	330.043243
					Ef (TSP)=	2.44	ton/acre*yr	1.47
					Ef (PM10)=	1.22	ton/acre*yr	0.73

Notes:

1. For u^+ used gust speed. Data was taken at a height of 10 m with on-site meteorlogical data.
2. u^*_t obtained from Table 13.2.5-2 AP-42
3. Maximum wind gust speed was used in place of fastest mile.

← everyday

← weekdays only

WIND EROSION FROM BAUXITE STOCKPILE

Lehigh Southwest Cement Company
Cupertino Facility

Onsite 2010 Met data

k (PM10) = 0.5
threshold friction velocity (u^*_t) = 1.12 m/s

Date	N	u^+_z (m/s)	u_s/u_r: u^+_{10} (m/s)	Pile Subarea 0.2a u* (m/s)	0.2b u* (m/s)	0.6a u* (m/s)	0.9 u* (m/s)	Pile Subarea 0.2a P_i (g/m^2)	0.2b P_i (g/m^2)	0.6a P_i (g/m^2)	0.9 P_i (g/m^2)	Disregarding Weekends	0.2a P_i (g/m^2)	0.2b P_i (g/m^2)	0.6a P_i (g/m^2)	0.9 P_i (g/m^2)
7/1/2010	1	6.8	6.8	0.135724	0.135724	0.407171	0.610756	0	0	0	0	1	0	0	0	0
7/2/2010	2	7.6	7.6	0.152533	0.152533	0.457598	0.686396	0	0	0	0	1	0	0	0	0
7/3/2010	3	8.1	8.1	0.161384	0.161384	0.484152	0.726228	0	0	0	0	0	0	0	0	0
7/4/2010	4	8.1	8.1	0.162904	0.162904	0.488712	0.733068	0	0	0	0	0	0	0	0	0
7/5/2010	5	7.1	7.1	0.142966	0.142966	0.428897	0.643346	0	0	0	0	1	0	0	0	0
7/6/2010	6	6.6	6.6	0.132505	0.132505	0.397514	0.596272	0	0	0	0	1	0	0	0	0
7/7/2010	7	8.1	8.1	0.161384	0.161384	0.484152	0.726228	0	0	0	0	1	0	0	0	0
7/8/2010	8	6.3	6.3	0.126425	0.126425	0.379275	0.568912	0	0	0	0	1	0	0	0	0
7/9/2010	9	6.6	6.6	0.132237	0.132237	0.39671	0.595065	0	0	0	0	1	0	0	0	0
7/10/2010	10	6.4	6.4	0.128839	0.128839	0.386517	0.579776	0	0	0	0	0	0	0	0	0
7/11/2010	11	6.7	6.7	0.133846	0.133846	0.401538	0.602307	0	0	0	0	0	0	0	0	0
7/12/2010	12	7.4	7.4	0.147168	0.147168	0.441504	0.662256	0	0	0	0	1	0	0	0	0
7/13/2010	13	7.7	7.7	0.153337	0.153337	0.460012	0.690017	0	0	0	0	1	0	0	0	0
7/14/2010	14	6.3	6.3	0.126425	0.126425	0.379275	0.568912	0	0	0	0	1	0	0	0	0
7/15/2010	15	8.1	8.1	0.161384	0.161384	0.484152	0.726228	0	0	0	0	1	0	0	0	0
7/16/2010	16	5.7	5.7	0.113371	0.113371	0.340114	0.51017	0	0	0	0	1	0	0	0	0
7/17/2010	17	5.3	5.3	0.106665	0.106665	0.319996	0.479995	0	0	0	0	0	0	0	0	0
7/18/2010	18	5.3	5.3	0.106397	0.106397	0.319192	0.478788	0	0	0	0	0	0	0	0	0
7/19/2010	19	6.0	6.0	0.119719	0.119719	0.359158	0.538737	0	0	0	0	1	0	0	0	0
7/20/2010	20	6.1	6.1	0.122402	0.122402	0.367205	0.550807	0	0	0	0	1	0	0	0	0
7/21/2010	21	6.2	6.2	0.124279	0.124279	0.372837	0.559256	0	0	0	0	1	0	0	0	0
7/22/2010	22	7.0	7.0	0.14082	0.14082	0.42246	0.633689	0	0	0	0	1	0	0	0	0
7/23/2010	23	6.9	6.9	0.138406	0.138406	0.415217	0.622826	0	0	0	0	1	0	0	0	0
7/24/2010	24	6.3	6.3	0.126961	0.126961	0.380884	0.571326	0	0	0	0	0	0	0	0	0
7/25/2010	25	7.1	7.1	0.142429	0.142429	0.427288	0.640932	0	0	0	0	0	0	0	0	0
7/26/2010	26	6.7	6.7	0.134919	0.134919	0.404757	0.607135	0	0	0	0	1	0	0	0	0
7/27/2010	27	7.6	7.6	0.151728	0.151728	0.455184	0.682775	0	0	0	0	1	0	0	0	0
7/28/2010	28	7.9	7.9	0.157092	0.157092	0.471277	0.706916	0	0	0	0	1	0	0	0	0
7/29/2010	29	6.6	6.6	0.131253	0.131253	0.393759	0.590639	0	0	0	0	1	0	0	0	0
7/30/2010	30	5.5	5.5	0.110152	0.110152	0.330457	0.495686	0	0	0	0	1	0	0	0	0
7/31/2010	31	6.9	6.9	0.138406	0.138406	0.415217	0.622826	0	0	0	0	0	0	0	0	0
8/1/2010	32	5.8	5.8	0.116053	0.116053	0.34816	0.522241	0	0	0	0	0	0	0	0	0
8/2/2010	33	5.8	5.8	0.116322	0.116322	0.348965	0.523448	0	0	0	0	1	0	0	0	0
8/3/2010	34	5.5	5.5	0.110421	0.110421	0.331262	0.496893	0	0	0	0	1	0	0	0	0
8/4/2010	35	6.7	6.7	0.133846	0.133846	0.401538	0.602307	0	0	0	0	1	0	0	0	0
8/5/2010	36	7.1	7.1	0.142429	0.142429	0.427288	0.640932	0	0	0	0	1	0	0	0	0
8/6/2010	37	6.8	6.8	0.135187	0.135187	0.405561	0.608342	0	0	0	0	1	0	0	0	0
8/7/2010	38	6.9	6.9	0.138138	0.138138	0.414413	0.621619	0	0	0	0	0	0	0	0	0
8/8/2010	39	10.1	10.1	0.201618	0.201618	0.604855	0.907282	0	0	0	0	0	0	0	0	0
8/9/2010	40	6.7	6.7	0.133846	0.133846	0.401538	0.602307	0	0	0	0	1	0	0	0	0
8/10/2010	41	6.0	6.0	0.119451	0.119451	0.358353	0.53753	0	0	0	0	1	0	0	0	0
8/11/2010	42	8.6	8.6	0.172024	0.172024	0.516071	0.774107	0	0	0	0	1	0	0	0	0

WIND EROSION FROM BAUXITE STOCKPILE

Lehigh Southwest Cement Company
Cupertino Facility

k (PM10) = 0.5
threshold friction velocity (u^*_t) = 1.12 m/s

Date	N	u^+_z (m/s)	u_s/u_r: u^+_{10} (m/s)	Pile Subarea 0.2a u^* (m/s)	0.2b u^* (m/s)	0.6a u^* (m/s)	0.9 u^* (m/s)	Pile Subarea 0.2a P_i (g/m²)	0.2b P_i (g/m²)	0.6a P_i (g/m²)	0.9 P_i (g/m²)		Disregarding Weekends 0.2a P_i (g/m²)	0.2b P_i (g/m²)	0.6a P_i (g/m²)	0.9 P_i (g/m²)
8/12/2010	43	6.8	6.8	0.135724	0.135724	0.407171	0.610756	0	0	0	0	1	0	0	0	0
8/13/2010	44	6.6	6.6	0.13179	0.13179	0.395369	0.593053	0	0	0	0	1	0	0	0	0
8/14/2010	45	6.5	6.5	0.130448	0.130448	0.391345	0.587018	0	0	0	0	0	0	0	0	0
8/15/2010	46	6.7	6.7	0.133846	0.133846	0.401538	0.602307	0	0	0	0	0	0	0	0	0
8/16/2010	47	6.1	6.1	0.122938	0.122938	0.368814	0.553221	0	0	0	0	1	0	0	0	0
8/17/2010	48	6.3	6.3	0.125889	0.125889	0.377666	0.566498	0	0	0	0	1	0	0	0	0
8/18/2010	49	7.3	7.3	0.145916	0.145916	0.437749	0.656623	0	0	0	0	1	0	0	0	0
8/19/2010	50	5.6	5.6	0.112566	0.112566	0.337699	0.506549	0	0	0	0	1	0	0	0	0
8/20/2010	51	6.1	6.1	0.122938	0.122938	0.368814	0.553221	0	0	0	0	1	0	0	0	0
8/21/2010	52	7.7	7.7	0.153069	0.153069	0.459207	0.68881	0	0	0	0	0	0	0	0	0
8/22/2010	53	9.1	9.1	0.182395	0.182395	0.547186	0.820779	0	0	0	0	0	0	0	0	0
8/23/2010	54	7.3	7.3	0.146453	0.146453	0.439358	0.659037	0	0	0	0	1	0	0	0	0
8/24/2010	55	7.1	7.1	0.141088	0.141088	0.423264	0.634897	0	0	0	0	1	0	0	0	0
8/25/2010	56	6.3	6.3	0.125889	0.125889	0.377666	0.566498	0	0	0	0	1	0	0	0	0
8/26/2010	57	6.7	6.7	0.134114	0.134114	0.402343	0.603514	0	0	0	0	1	0	0	0	0
8/27/2010	58	6.7	6.7	0.133309	0.133309	0.399928	0.599893	0	0	0	0	1	0	0	0	0
8/28/2010	59	10.0	10.0	0.199472	0.199472	0.598417	0.897626	0	0	0	0	0	0	0	0	0
8/29/2010	60	8.6	8.6	0.171487	0.171487	0.514462	0.771693	0	0	0	0	0	0	0	0	0
8/30/2010	61	8.8	8.8	0.175243	0.175243	0.525728	0.788591	0	0	0	0	1	0	0	0	0
8/31/2010	62	8.6	8.6	0.171756	0.171756	0.515267	0.7729	0	0	0	0	1	0	0	0	0
9/1/2010	63	7.7	7.7	0.154678	0.154678	0.464035	0.696053	0	0	0	0	1	0	0	0	0
9/2/2010	64	7.9	7.9	0.157361	0.157361	0.472082	0.708123	0	0	0	0	1	0	0	0	0
9/3/2010	65	6.0	6.0	0.119987	0.119987	0.359962	0.539944	0	0	0	0	1	0	0	0	0
9/4/2010	66	4.8	4.8	0.096562	0.096562	0.289687	0.43453	0	0	0	0	0	0	0	0	0
9/5/2010	67	7.0	7.0	0.139479	0.139479	0.418436	0.627654	0	0	0	0	0	0	0	0	0
9/6/2010	68	7.4	7.4	0.147973	0.147973	0.443918	0.665877	0	0	0	0	1	0	0	0	0
9/7/2010	69	7.2	7.2	0.144307	0.144307	0.432921	0.649381	0	0	0	0	1	0	0	0	0
9/8/2010	70	10.5	10.5	0.209308	0.209308	0.627923	0.941884	0	0	0	0	1	0	0	0	0
9/9/2010	71	9.1	9.1	0.181054	0.181054	0.543162	0.814744	0	0	0	0	1	0	0	0	0
9/10/2010	72	7.5	7.5	0.149046	0.149046	0.447137	0.670705	0	0	0	0	1	0	0	0	0
9/11/2010	73	7.5	7.5	0.150118	0.150118	0.450355	0.675533	0	0	0	0	0	0	0	0	0
9/12/2010	74	6.4	6.4	0.127766	0.127766	0.383298	0.574947	0	0	0	0	0	0	0	0	0
9/13/2010	75	6.2	6.2	0.123474	0.123474	0.370423	0.555635	0	0	0	0	1	0	0	0	0
9/14/2010	76	6.1	6.1	0.121597	0.121597	0.364791	0.547186	0	0	0	0	1	0	0	0	0
9/15/2010	77	6.6	6.6	0.131253	0.131253	0.393759	0.590639	0	0	0	0	1	0	0	0	0
9/16/2010	78	7.1	7.1	0.142697	0.142697	0.428092	0.642139	0	0	0	0	1	0	0	0	0
9/17/2010	79	5.2	5.2	0.104788	0.104788	0.314364	0.471545	0	0	0	0	1	0	0	0	0
9/18/2010	80	7.1	7.1	0.142429	0.142429	0.427288	0.640932	0	0	0	0	0	0	0	0	0
9/19/2010	81	8.8	8.8	0.175243	0.175243	0.525728	0.788591	0	0	0	0	0	0	0	0	0
9/20/2010	82	8.6	8.6	0.171756	0.171756	0.515267	0.7729	0	0	0	0	1	0	0	0	0
9/21/2010	83	11.2	11.2	0.223166	0.223166	0.669498	1.004247	0	0	0	0	1	0	0	0	0
9/22/2010	84	9.9	9.9	0.197327	0.197327	0.59198	0.88797	0	0	0	0	1	0	0	0	0

WIND EROSION FROM BAUXITE STOCKPILE
Lehigh Southwest Cement Company
Cupertino Facility

k (PM10) = 0.5
threshold friction velocity (u^*_t) = 1.12 m/s

			u_s/u_r:	Pile Subarea				Pile Subarea					Disregarding Weekends			
				0.2a	0.2b	0.6a	0.9	0.2a	0.2b	0.6a	0.9		0.2a	0.2b	0.6a	0.9
		u^+_z	u^+_{10}	u^*	u^*	u^*	u^*	P_i	P_i	P_i	P_i		P_i	P_i	P_i	P_i
Date	N	(m/s)	(m/s)	(m/s)	(m/s)	(m/s)	(m/s)	(g/m^2)	(g/m^2)	(g/m^2)	(g/m^2)		(g/m^2)	(g/m^2)	(g/m^2)	(g/m^2)
9/23/2010	85	7.2	7.2	0.144307	0.144307	0.432921	0.649381	0	0	0	0	1	0	0	0	0
9/24/2010	86	6.4	6.4	0.127766	0.127766	0.383298	0.574947	0	0	0	0	1	0	0	0	0
9/25/2010	87	6.4	6.4	0.128839	0.128839	0.386517	0.579776	0	0	0	0	0	0	0	0	0
9/26/2010	88	6.5	6.5	0.129644	0.129644	0.388931	0.583397	0	0	0	0	0	0	0	0	0
9/27/2010	89	6.8	6.8	0.135187	0.135187	0.405561	0.608342	0	0	0	0	1	0	0	0	0
9/28/2010	90	6.2	6.2	0.123743	0.123743	0.371228	0.556842	0	0	0	0	1	0	0	0	0
9/29/2010	91	6.0	6.0	0.119183	0.119183	0.357548	0.536323	0	0	0	0	1	0	0	0	0
9/30/2010	92	5.7	5.7	0.113639	0.113639	0.340918	0.511377	0	0	0	0	1	0	0	0	0
10/1/2010	93	5.8	5.8	0.11659	0.11659	0.34977	0.524655	0	0	0	0	1	0	0	0	0
10/2/2010	94	5.2	5.2	0.103983	0.103983	0.31195	0.467924	0	0	0	0	0	0	0	0	0
10/3/2010	95	11.7	11.7	0.23309	0.23309	0.699271	1.048907	0	0	0	0	0	0	0	0	0
10/4/2010	96	12.6	12.6	0.251688	0.251688	0.755063	1.132594	0	0	0	0.324055	1	0	0	0	0.324055
10/5/2010	97	6.4	6.4	0.127766	0.127766	0.383298	0.574947	0	0	0	0	1	0	0	0	0
10/6/2010	98	9.0	9.0	0.180518	0.180518	0.541553	0.81233	0	0	0	0	1	0	0	0	0
10/7/2010	99	6.6	6.6	0.131253	0.131253	0.393759	0.590639	0	0	0	0	1	0	0	0	0
10/8/2010	100	6.9	6.9	0.137065	0.137065	0.411194	0.616791	0	0	0	0	1	0	0	0	0
10/9/2010	101	6.5	6.5	0.129912	0.129912	0.389736	0.584604	0	0	0	0	0	0	0	0	0
10/10/2010	102	5.8	5.8	0.115785	0.115785	0.347356	0.521034	0	0	0	0	0	0	0	0	0
10/11/2010	103	6.5	6.5	0.130985	0.130985	0.392955	0.589432	0	0	0	0	1	0	0	0	0
10/12/2010	104	8.9	8.9	0.177299	0.177299	0.531897	0.797845	0	0	0	0	1	0	0	0	0
10/13/2010	105	6.0	6.0	0.120792	0.120792	0.362377	0.543565	0	0	0	0	1	0	0	0	0
10/14/2010	106	5.7	5.7	0.113908	0.113908	0.341723	0.512584	0	0	0	0	1	0	0	0	0
10/15/2010	107	5.7	5.7	0.114176	0.114176	0.342528	0.513791	0	0	0	0	1	0	0	0	0
10/16/2010	108	5.4	5.4	0.108275	0.108275	0.324825	0.487237	0	0	0	0	0	0	0	0	0
10/17/2010	109	7.7	7.7	0.153337	0.153337	0.460012	0.690017	0	0	0	0	0	0	0	0	0
10/18/2010	110	6.5	6.5	0.129644	0.129644	0.388931	0.583397	0	0	0	0	1	0	0	0	0
10/19/2010	111	5.6	5.6	0.111494	0.111494	0.334481	0.501721	0	0	0	0	1	0	0	0	0
10/20/2010	112	6.1	6.1	0.12106	0.12106	0.363181	0.544772	0	0	0	0	1	0	0	0	0
10/21/2010	113	8.9	8.9	0.177835	0.177835	0.533506	0.800259	0	0	0	0	1	0	0	0	0
10/22/2010	114	6.8	6.8	0.135724	0.135724	0.407171	0.610756	0	0	0	0	1	0	0	0	0
10/23/2010	115	12.4	12.4	0.247217	0.247217	0.741651	1.112477	0	0	0	0	0	0	0	0	0
10/24/2010	116	17.3	17.3	0.345031	0.345031	1.035093	1.55264	0	0	0	21.672273	0	0	0	0	0
10/25/2010	117	10.3	10.3	0.206625	0.206625	0.619876	0.929814	0	0	0	0	1	0	0	0	0
10/26/2010	118	10.8	10.8	0.21655	0.21655	0.649649	0.974474	0	0	0	0	1	0	0	0	0
10/27/2010	119	6.8	6.8	0.135455	0.135455	0.406366	0.609549	0	0	0	0	1	0	0	0	0
10/28/2010	120	14.9	14.9	0.297286	0.297286	0.891859	1.337789	0	0	0	8.195779	1	0	0	0	8.195779
10/29/2010	121	15.5	15.5	0.310072	0.310072	0.930216	1.395324	0	0	0	11.279685	1	0	0	0	11.27969
10/30/2010	122	9.8	9.8	0.196522	0.196522	0.589566	0.884349	0	0	0	0	0	0	0	0	0
10/31/2010	123	6.3	6.3	0.126961	0.126961	0.380884	0.571326	0	0	0	0	0	0	0	0	0
11/1/2010	124	7.2	7.2	0.143502	0.143502	0.430507	0.64576	0	0	0	0	1	0	0	0	0
11/2/2010	125	7.6	7.6	0.152533	0.152533	0.457598	0.686396	0	0	0	0	1	0	0	0	0
11/3/2010	126	5.5	5.5	0.10908	0.10908	0.327239	0.490858	0	0	0	0	1	0	0	0	0

WIND EROSION FROM BAUXITE STOCKPILE
Lehigh Southwest Cement Company
Cupertino Facility

k (PM10) = 0.5
threshold friction velocity (u^*_t) = 1.12 m/s

Date	N	u^+_z (m/s)	u_s/u_r: u^+_{10} (m/s)	Pile Subarea 0.2a u^* (m/s)	0.2b u^* (m/s)	0.6a u^* (m/s)	0.9 u^* (m/s)	Pile Subarea 0.2a P_i (g/m^2)	0.2b P_i (g/m^2)	0.6a P_i (g/m^2)	0.9 P_i (g/m^2)	Disregarding Weekends	0.2a P_i (g/m^2)	0.2b P_i (g/m^2)	0.6a P_i (g/m^2)	0.9 P_i (g/m^2)
11/4/2010	127	6.1	6.1	0.12267	0.12267	0.368009	0.552014	0	0	0	0	1	0	0	0	0
11/5/2010	128	9.3	9.3	0.185614	0.185614	0.556842	0.835263	0	0	0	0	1	0	0	0	0
11/6/2010	129	10.0	10.0	0.200009	0.200009	0.600027	0.90004	0	0	0	0	0	0	0	0	0
11/7/2010	130	10.5	10.5	0.210917	0.210917	0.632751	0.949126	0	0	0	0	0	0	0	0	0
11/8/2010	131	10.9	10.9	0.217354	0.217354	0.652063	0.978095	0	0	0	0	1	0	0	0	0
11/9/2010	132	10.8	10.8	0.215209	0.215209	0.645626	0.968438	0	0	0	0	1	0	0	0	0
11/10/2010	133	11.4	11.4	0.227189	0.227189	0.681568	1.022352	0	0	0	0	1	0	0	0	0
11/11/2010	134	10.3	10.3	0.205105	0.205105	0.615316	0.922974	0	0	0	0	1	0	0	0	0
11/12/2010	135	7.0	7.0	0.139211	0.139211	0.417632	0.626447	0	0	0	0	1	0	0	0	0
11/13/2010	136	10.9	10.9	0.217623	0.217623	0.652868	0.979302	0	0	0	0	0	0	0	0	0
11/14/2010	137	10.8	10.8	0.216013	0.216013	0.64804	0.97206	0	0	0	0	0	0	0	0	0
11/15/2010	138	11.2	11.2	0.223166	0.223166	0.669498	1.004247	0	0	0	0	1	0	0	0	0
11/16/2010	139	6.8	6.8	0.136528	0.136528	0.409585	0.614377	0	0	0	0	1	0	0	0	0
11/17/2010	140	6.2	6.2	0.124816	0.124816	0.374447	0.56167	0	0	0	0	1	0	0	0	0
11/18/2010	141	5.3	5.3	0.106397	0.106397	0.319192	0.478788	0	0	0	0	1	0	0	0	0
11/19/2010	142	11.2	11.2	0.224775	0.224775	0.674326	1.011489	0	0	0	0	1	0	0	0	0
11/20/2010	143	13.9	13.9	0.278689	0.278689	0.836068	1.254102	0	0	0	4.3955702	0	0	0	0	0
11/21/2010	144	11.3	11.3	0.22558	0.22558	0.67674	1.01511	0	0	0	0	0	0	0	0	0
11/22/2010	145	11.0	11.0	0.2195	0.2195	0.658501	0.987751	0	0	0	0	1	0	0	0	0
11/23/2010	146	11.1	11.1	0.222093	0.222093	0.666279	0.999419	0	0	0	0	1	0	0	0	0
11/24/2010	147	9.9	9.9	0.197595	0.197595	0.592785	0.889177	0	0	0	0	1	0	0	0	0
11/25/2010	148	6.4	6.4	0.128303	0.128303	0.384908	0.577362	0	0	0	0	1	0	0	0	0
11/26/2010	149	5.4	5.4	0.108007	0.108007	0.32402	0.48603	0	0	0	0	1	0	0	0	0
11/27/2010	150	11.1	11.1	0.222898	0.222898	0.668693	1.00304	0	0	0	0	0	0	0	0	0
11/28/2010	151	13.0	13.0	0.259198	0.259198	0.777594	1.166391	0	0	0	1.2845979	0	0	0	0	0
11/29/2010	152	7.5	7.5	0.150387	0.150387	0.45116	0.67674	0	0	0	0	1	0	0	0	0
11/30/2010	153	5.0	5.0	0.100049	0.100049	0.300148	0.450221	0	0	0	0	1	0	0	0	0
12/1/2010	154	5.0	5.0	0.099244	0.099244	0.297733	0.4466	0	0	0	0	1	0	0	0	0
12/2/2010	155	4.4	4.4	0.087711	0.087711	0.263132	0.394698	0	0	0	0	1	0	0	0	0
12/3/2010	156	5.7	5.7	0.114444	0.114444	0.343332	0.514998	0	0	0	0	1	0	0	0	0
12/4/2010	157	13.9	13.9	0.278153	0.278153	0.834458	1.251688	0	0	0	4.2980043	0	0	0	0	0
12/5/2010	158	23.3	23.3	0.466091	0.466091	1.398274	2.097412	0	0	11.448185	79.844629	0	0	0	0	0
12/6/2010	159	16.3	16.3	0.32554	0.32554	0.976619	1.464929	0	0	0	15.523843	1	0	0	0	15.52384
12/7/2010	160	5.5	5.5	0.109348	0.109348	0.328043	0.492065	0	0	0	0	1	0	0	0	0
12/8/2010	161	9.0	9.0	0.179713	0.179713	0.539139	0.808708	0	0	0	0	1	0	0	0	0
12/9/2010	162	5.9	5.9	0.117573	0.117573	0.35272	0.52908	0	0	0	0	1	0	0	0	0
12/10/2010	163	6.0	6.0	0.119183	0.119183	0.357548	0.536323	0	0	0	0	1	0	0	0	0
12/11/2010	164	3.4	3.4	0.068559	0.068559	0.205678	0.308516	0	0	0	0	0	0	0	0	0
12/12/2010	165	6.3	6.3	0.126157	0.126157	0.37847	0.567705	0	0	0	0	0	0	0	0	0
12/13/2010	166	6.2	6.2	0.124547	0.124547	0.373642	0.560463	0	0	0	0	1	0	0	0	0
12/14/2010	167	8.5	8.5	0.170146	0.170146	0.510439	0.765658	0	0	0	0	1	0	0	0	0
12/15/2010	168	5.8	5.8	0.116322	0.116322	0.348965	0.523448	0	0	0	0	1	0	0	0	0

WIND EROSION FROM BAUXITE STOCKPILE
Lehigh Southwest Cement Company
Cupertino Facility

k (PM10) = 0.5
threshold friction velocity (u^*_t) = 1.12 m/s

Date	N	u^+_z (m/s)	u_s/u_r: u^+_{10} (m/s)	Pile Subarea 0.2a u^* (m/s)	0.2b u^* (m/s)	0.6a u^* (m/s)	0.9 u^* (m/s)	Pile Subarea 0.2a P_i (g/m^2)	0.2b P_i (g/m^2)	0.6a P_i (g/m^2)	0.9 P_i (g/m^2)		Disregarding Weekends 0.2a P_i (g/m^2)	0.2b P_i (g/m^2)	0.6a P_i (g/m^2)	0.9 P_i (g/m^2)
12/16/2010	169	5.9	5.9	0.118646	0.118646	0.355939	0.533909	0	0	0	0	1	0	0	0	0
12/17/2010	170	19.2	19.2	0.384997	0.384997	1.154991	1.732487	0	0	0.9457967	37.070307	1	0	0	0.9457967	37.07031
12/18/2010	171	16.8	16.8	0.335196	0.335196	1.005588	1.508382	0	0	0	18.458313	0	0	0	0	0
12/19/2010	172	16.0	16.0	0.320801	0.320801	0.962403	1.443605	0	0	0	14.163896	0	0	0	0	0
12/20/2010	173	12.2	12.2	0.243194	0.243194	0.729581	1.094372	0	0	0	0	1	0	0	0	0
12/21/2010	174	12.0	12.0	0.240243	0.240243	0.72073	1.081094	0	0	0	0	1	0	0	0	0
12/22/2010	175	7.3	7.3	0.145112	0.145112	0.435335	0.653002	0	0	0	0	1	0	0	0	0
12/23/2010	176	6.8	6.8	0.13626	0.13626	0.40878	0.61317	0	0	0	0	1	0	0	0	0
12/24/2010	177	9.1	9.1	0.181591	0.181591	0.544772	0.817158	0	0	0	0	1	0	0	0	0
12/25/2010	178	24.2	24.2	0.484778	0.484778	1.454334	2.181501	0	0	14.841553	91.891046	0	0	0	0	0
12/26/2010	179	7.1	7.1	0.142697	0.142697	0.428092	0.642139	0	0	0	0	0	0	0	0	0
12/27/2010	180	7.2	7.2	0.14377	0.14377	0.431311	0.646967	0	0	0	0	1	0	0	0	0
12/28/2010	181	18.4	18.4	0.368009	0.368009	1.104028	1.656042	0	0	0	30.066816	1	0	0	0	30.06682
12/29/2010	182	18.8	18.8	0.375699	0.375699	1.127096	1.690643	0	0	0.1803085	33.152842	1	0	0	0.1803085	33.15284
12/30/2010	183	9.9	9.9	0.197327	0.197327	0.59198	0.88797	0	0	0	0	1	0	0	0	0
12/31/2010	184	5.6	5.6	0.112298	0.112298	0.336895	0.505342	0	0	0	0	1	0	0	0	0
1/1/2011	185	15.0	15.0	0.300237	0.300237	0.900711	1.351066	0	0	0	8.8733675	0	0	0	0	0
1/2/2011	186	7.1	7.1	0.141893	0.141893	0.425678	0.638518	0	0	0	0	0	0	0	0	0
1/3/2011	187	4.8	4.8	0.095221	0.095221	0.285663	0.428495	0	0	0	0	1	0	0	0	0
1/4/2011	188	4.8	4.8	0.095489	0.095489	0.286468	0.429702	0	0	0	0	1	0	0	0	0
1/5/2011	189	6.7	6.7	0.133041	0.133041	0.399124	0.598686	0	0	0	0	1	0	0	0	0
1/6/2011	190	7.0	7.0	0.139479	0.139479	0.418436	0.627654	0	0	0	0	1	0	0	0	0
1/7/2011	191	4.5	4.5	0.090929	0.090929	0.272788	0.409182	0	0	0	0	1	0	0	0	0
1/8/2011	192	5.8	5.8	0.115249	0.115249	0.345746	0.51862	0	0	0	0	0	0	0	0	0
1/9/2011	193	7.1	7.1	0.141625	0.141625	0.424874	0.637311	0	0	0	0	0	0	0	0	0
1/10/2011	194	9.4	9.4	0.187223	0.187223	0.56167	0.842505	0	0	0	0	1	0	0	0	0
1/11/2011	195	7.2	7.2	0.144039	0.144039	0.432116	0.648174	0	0	0	0	1	0	0	0	0
1/12/2011	196	5.5	5.5	0.110421	0.110421	0.331262	0.496893	0	0	0	0	1	0	0	0	0
1/13/2011	197	6.9	6.9	0.138406	0.138406	0.415217	0.622826	0	0	0	0	1	0	0	0	0
1/14/2011	198	7.5	7.5	0.149314	0.149314	0.447941	0.671912	0	0	0	0	1	0	0	0	0
1/15/2011	199	8.0	8.0	0.160579	0.160579	0.481738	0.722607	0	0	0	0	0	0	0	0	0
1/16/2011	200	5.0	5.0	0.099513	0.099513	0.298538	0.447807	0	0	0	0	0	0	0	0	0
1/17/2011	201	6.3	6.3	0.125889	0.125889	0.377666	0.566498	0	0	0	0	1	0	0	0	0
1/18/2011	202	8.7	8.7	0.173633	0.173633	0.520899	0.781349	0	0	0	0	1	0	0	0	0
1/19/2011	203	10.8	10.8	0.215477	0.215477	0.64643	0.969645	0	0	0	0	1	0	0	0	0
1/20/2011	204	9.7	9.7	0.194913	0.194913	0.584738	0.877107	0	0	0	0	1	0	0	0	0
1/21/2011	205	7.6	7.6	0.152264	0.152264	0.456793	0.685189	0	0	0	0	1	0	0	0	0
1/22/2011	206	9.1	9.1	0.181322	0.181322	0.543967	0.815951	0	0	0	0	0	0	0	0	0
1/23/2011	207	11.7	11.7	0.234163	0.234163	0.70249	1.053735	0	0	0	0	0	0	0	0	0
1/24/2011	208	6.5	6.5	0.13018	0.13018	0.39054	0.585811	0	0	0	0	1	0	0	0	0
1/25/2011	209	10.6	10.6	0.212526	0.212526	0.637579	0.956368	0	0	0	0	1	0	0	0	0
1/26/2011	210	7.7	7.7	0.154947	0.154947	0.46484	0.69726	0	0	0	0	1	0	0	0	0

WIND EROSION FROM BAUXITE STOCKPILE

Lehigh Southwest Cement Company
Cupertino Facility

k (PM10) = 0.5
threshold friction velocity (u^*_t) = 1.12 m/s

Date	N	u^+_z (m/s)	u_s/u_r: u^+_{10} (m/s)	Pile Subarea 0.2a u^* (m/s)	Pile Subarea 0.2b u^* (m/s)	Pile Subarea 0.6a u^* (m/s)	Pile Subarea 0.9 u^* (m/s)	Pile Subarea 0.2a P_i (g/m^2)	Pile Subarea 0.2b P_i (g/m^2)	Pile Subarea 0.6a P_i (g/m^2)	Pile Subarea 0.9 P_i (g/m^2)	Disregarding Weekends	Disregarding Weekends 0.2a P_i (g/m^2)	Disregarding Weekends 0.2b P_i (g/m^2)	Disregarding Weekends 0.6a P_i (g/m^2)	Disregarding Weekends 0.9 P_i (g/m^2)
1/27/2011	211	5.5	5.5	0.109616	0.109616	0.328848	0.493272	0	0	0	0	1	0	0	0	0
1/28/2011	212	5.6	5.6	0.112566	0.112566	0.337699	0.506549	0	0	0	0	1	0	0	0	0
1/29/2011	213	7.6	7.6	0.152533	0.152533	0.457598	0.686396	0	0	0	0	0	0	0	0	0
1/30/2011	214	8.6	8.6	0.172828	0.172828	0.518485	0.777728	0	0	0	0	0	0	0	0	0
1/31/2011	215	6.2	6.2	0.123743	0.123743	0.371228	0.556842	0	0	0	0	1	0	0	0	0
2/1/2011	216	10.8	10.8	0.215209	0.215209	0.645626	0.968438	0	0	0	0	1	0	0	0	0
2/2/2011	217	9.1	9.1	0.182127	0.182127	0.546381	0.819572	0	0	0	0	1	0	0	0	0
2/3/2011	218	6.4	6.4	0.12723	0.12723	0.381689	0.572533	0	0	0	0	1	0	0	0	0
2/4/2011	219	6.5	6.5	0.129375	0.129375	0.388126	0.58219	0	0	0	0	1	0	0	0	0
2/5/2011	220	13.9	13.9	0.278153	0.278153	0.834458	1.251688	0	0	0	4.2980043	0	0	0	0	0
2/6/2011	221	14.7	14.7	0.293621	0.293621	0.880862	1.321293	0	0	0	7.3824128	0	0	0	0	0
2/7/2011	222	10.3	10.3	0.20591	0.20591	0.61773	0.926595	0	0	0	0	1	0	0	0	0
2/8/2011	223	17.0	17.0	0.339488	0.339488	1.018463	1.527695	0	0	0	19.832827	1	0	0	0	19.83283
2/9/2011	224	9.9	9.9	0.197595	0.197595	0.592785	0.889177	0	0	0	0	1	0	0	0	0
2/10/2011	225	6.5	6.5	0.13018	0.13018	0.39054	0.585811	0	0	0	0	1	0	0	0	0
2/11/2011	226	5.8	5.8	0.116858	0.116858	0.350574	0.525862	0	0	0	0	1	0	0	0	0
2/12/2011	227	5.1	5.1	0.101927	0.101927	0.30578	0.45867	0	0	0	0	0	0	0	0	0
2/13/2011	228	4.7	4.7	0.09388	0.09388	0.28164	0.42246	0	0	0	0	0	0	0	0	0
2/14/2011	229	16.4	16.4	0.327149	0.327149	0.981448	1.472171	0	0	0	15.997711	1	0	0	0	15.99771
2/15/2011	230	21.5	21.5	0.430864	0.430864	1.292592	1.938889	0	0	6.0425231	59.365775	1	0	0	6.0425231	59.36578
2/16/2011	231	16.9	16.9	0.338147	0.338147	1.01444	1.521659	0	0	0	19.398644	1	0	0	0	19.39864
2/17/2011	232	16.7	16.7	0.334928	0.334928	1.004783	1.507175	0	0	0	18.373842	1	0	0	0	18.37384
2/18/2011	233	11.5	11.5	0.229603	0.229603	0.68881	1.033216	0	0	0	0	1	0	0	0	0
2/19/2011	234	10.3	10.3	0.20591	0.20591	0.61773	0.926595	0	0	0	0	0	0	0	0	0
2/20/2011	235	7.4	7.4	0.147436	0.147436	0.442309	0.663463	0	0	0	0	0	0	0	0	0
2/21/2011	236	8.8	8.8	0.176315	0.176315	0.528946	0.793419	0	0	0	0	1	0	0	0	0
2/22/2011	237	7.1	7.1	0.141356	0.141356	0.424069	0.636104	0	0	0	0	1	0	0	0	0
2/23/2011	238	11.9	11.9	0.238366	0.238366	0.715097	1.072645	0	0	0	0	1	0	0	0	0
2/24/2011	239	10.7	10.7	0.213063	0.213063	0.639188	0.958782	0	0	0	0	1	0	0	0	0
2/25/2011	240	17.8	17.8	0.355134	0.355134	1.065403	1.598105	0	0	0	25.210481	1	0	0	0	25.21048
2/26/2011	241	8.1	8.1	0.161563	0.161563	0.484689	0.727033	0	0	0	0	0	0	0	0	0
2/27/2011	242	9.6	9.6	0.192499	0.192499	0.577496	0.866243	0	0	0	0	0	0	0	0	0
2/28/2011	243	10.0	10.0	0.199741	0.199741	0.599222	0.898833	0	0	0	0	1	0	0	0	0
3/1/2011	244	11.7	11.7	0.234432	0.234432	0.703295	1.054942	0	0	0	0	1	0	0	0	0
3/2/2011	245	19.1	19.1	0.381868	0.381868	1.145603	1.718405	0	0	0.6781029	35.729254	1	0	0	0.6781029	35.72925
3/3/2011	246	9.0	9.0	0.179445	0.179445	0.538334	0.807501	0	0	0	0	1	0	0	0	0
3/4/2011	247	6.9	6.9	0.138942	0.138942	0.416827	0.62524	0	0	0	0	1	0	0	0	0
3/5/2011	248	6.9	6.9	0.138138	0.138138	0.414413	0.621619	0	0	0	0	0	0	0	0	0
3/6/2011	249	13.8	13.8	0.275739	0.275739	0.827216	1.240824	0	0	0	3.8673233	0	0	0	0	0
3/7/2011	250	21.2	21.2	0.424248	0.424248	1.272744	1.909115	0	0	5.1717622	55.844653	1	0	0	5.1717622	55.84465
3/8/2011	251	6.1	6.1	0.122938	0.122938	0.368814	0.553221	0	0	0	0	1	0	0	0	0
3/9/2011	252	6.3	6.3	0.126693	0.126693	0.38008	0.570119	0	0	0	0	1	0	0	0	0

WIND EROSION FROM BAUXITE STOCKPILE

Lehigh Southwest Cement Company
Cupertino Facility

k (PM10) = 0.5
threshold friction velocity (u^*_t) = 1.12 m/s

			u_s/u_r:	Pile Subarea				Pile Subarea					Disregarding Weekends			
				0.2a	0.2b	0.6a	0.9	0.2a	0.2b	0.6a	0.9		0.2a	0.2b	0.6a	0.9
		u^+_z	u^+_{10}	u^*	u^*	u^*	u^*	P_i	P_i	P_i	P_i		P_i	P_i	P_i	P_i
Date	N	(m/s)	(m/s)	(m/s)	(m/s)	(m/s)	(m/s)	(g/m^2)	(g/m^2)	(g/m^2)	(g/m^2)		(g/m^2)	(g/m^2)	(g/m^2)	(g/m^2)
3/10/2011	253	11.8	11.8	0.236756	0.236756	0.710269	1.065403	0	0	0	0	1	0	0	0	0
3/11/2011	254	8.6	8.6	0.172292	0.172292	0.516876	0.775314	0	0	0	0	1	0	0	0	0
3/12/2011	255	5.9	5.9	0.117305	0.117305	0.351916	0.527873	0	0	0	0	0	0	0	0	0
3/13/2011	256	10.8	10.8	0.216818	0.216818	0.650454	0.975681	0	0	0	0	0	0	0	0	0
3/14/2011	257	6.8	6.8	0.136528	0.136528	0.409585	0.614377	0	0	0	0	1	0	0	0	0
3/15/2011	258	13.4	13.4	0.268497	0.268497	0.80549	1.208235	0	0	0	2.6574154	1	0	0	0	2.657415
3/16/2011	259	9.4	9.4	0.188833	0.188833	0.566498	0.849747	0	0	0	0	1	0	0	0	0
3/17/2011	260	11.3	11.3	0.225312	0.225312	0.675935	1.013903	0	0	0	0	1	0	0	0	0
3/18/2011	261	22.2	22.2	0.444723	0.444723	1.334168	2.001252	0	0	8.0145312	67.074361	1	0	0	8.0145312	67.07436
3/19/2011	262	17.8	17.8	0.355939	0.355939	1.067817	1.601726	0	0	0	25.502594	0	0	0	0	0
3/20/2011	263	21.1	21.1	0.421029	0.421029	1.263087	1.894631	0	0	4.7646734	54.168855	0	0	0	0	0
3/21/2011	264	11.2	11.2	0.223434	0.223434	0.670303	1.005454	0	0	0	0	1	0	0	0	0
3/22/2011	265	12.5	12.5	0.250436	0.250436	0.751308	1.126961	0	0	0	0.1768463	1	0	0	0	0.176846
3/23/2011	266	17.6	17.6	0.351469	0.351469	1.054406	1.581608	0	0	0	23.89899	1	0	0	0	23.89899
3/24/2011	267	22.7	22.7	0.453842	0.453842	1.361527	2.042291	0	0	9.4216279	72.393231	1	0	0	9.4216279	72.39323
3/25/2011	268	8.9	8.9	0.177031	0.177031	0.531092	0.796638	0	0	0	0	1	0	0	0	0
3/26/2011	269	11.9	11.9	0.238902	0.238902	0.716706	1.075059	0	0	0	0	0	0	0	0	0
3/27/2011	270	10.2	10.2	0.204301	0.204301	0.612902	0.919353	0	0	0	0	0	0	0	0	0
3/28/2011	271	8.5	8.5	0.170683	0.170683	0.512048	0.768072	0	0	0	0	1	0	0	0	0
3/29/2011	272	9.5	9.5	0.189906	0.189906	0.569717	0.854576	0	0	0	0	1	0	0	0	0
3/30/2011	273	10.3	10.3	0.206089	0.206089	0.618266	0.9274	0	0	0	0	1	0	0	0	0
3/31/2011	274	9.1	9.1	0.182395	0.182395	0.547186	0.820779	0	0	0	0	1	0	0	0	0
4/1/2011	275	8.1	8.1	0.161563	0.161563	0.484689	0.727033	0	0	0	0	1	0	0	0	0
4/2/2011	276	6.3	6.3	0.126425	0.126425	0.379275	0.568912	0	0	0	0	0	0	0	0	0
4/3/2011	277	7.5	7.5	0.150655	0.150655	0.451965	0.677947	0	0	0	0	0	0	0	0	0
4/4/2011	278	6.5	6.5	0.129644	0.129644	0.388931	0.583397	0	0	0	0	1	0	0	0	0
4/5/2011	279	9.4	9.4	0.188833	0.188833	0.566498	0.849747	0	0	0	0	1	0	0	0	0
4/6/2011	280	11.9	11.9	0.238634	0.238634	0.715901	1.073852	0	0	0	0	1	0	0	0	0
4/7/2011	281	15.0	15.0	0.300505	0.300505	0.901515	1.352273	0	0	0	8.9359805	1	0	0	0	8.935981
4/8/2011	282	9.0	9.0	0.180518	0.180518	0.541553	0.81233	0	0	0	0	1	0	0	0	0
4/9/2011	283	11.3	11.3	0.226385	0.226385	0.679154	1.018731	0	0	0	0	0	0	0	0	0
4/10/2011	284	9.3	9.3	0.185882	0.185882	0.557647	0.83647	0	0	0	0	0	0	0	0	0
4/11/2011	285	8.4	8.4	0.167196	0.167196	0.501587	0.752381	0	0	0	0	1	0	0	0	0
4/12/2011	286	10.7	10.7	0.21494	0.21494	0.644821	0.967231	0	0	0	0	1	0	0	0	0
4/13/2011	287	10.4	10.4	0.20743	0.20743	0.62229	0.933435	0	0	0	0	1	0	0	0	0
4/14/2011	288	8.0	8.0	0.160311	0.160311	0.480933	0.7214	0	0	0	0	1	0	0	0	0
4/15/2011	289	7.9	7.9	0.158165	0.158165	0.474496	0.711744	0	0	0	0	1	0	0	0	0
4/16/2011	290	10.3	10.3	0.206357	0.206357	0.619071	0.928607	0	0	0	0	0	0	0	0	0
4/17/2011	291	7.0	7.0	0.140015	0.140015	0.420046	0.630068	0	0	0	0	0	0	0	0	0
4/18/2011	292	6.8	6.8	0.13626	0.13626	0.40878	0.61317	0	0	0	0	1	0	0	0	0
4/19/2011	293	7.1	7.1	0.141356	0.141356	0.424069	0.636104	0	0	0	0	1	0	0	0	0
4/20/2011	294	12.5	12.5	0.249095	0.249095	0.747284	1.120926	0	0	0	0.0232068	1	0	0	0	0.023207

WIND EROSION FROM BAUXITE STOCKPILE
Lehigh Southwest Cement Company
Cupertino Facility

k (PM10) = 0.5
threshold friction velocity (u^*_t) = 1.12 m/s

Date	N	u^+_z	u_s/u_r: u^+_{10}	Pile Subarea 0.2a u^*	0.2b u^*	0.6a u^*	0.9 u^*	Pile Subarea 0.2a P_i	0.2b P_i	0.6a P_i	0.9 P_i		Disregarding Weekends 0.2a P_i	0.2b P_i	0.6a P_i	0.9 P_i
		(m/s)	(m/s)	(m/s)	(m/s)	(m/s)	(m/s)	(g/m^2)	(g/m^2)	(g/m^2)	(g/m^2)		(g/m^2)	(g/m^2)	(g/m^2)	(g/m^2)
4/21/2011	295	8.1	8.1	0.161831	0.161831	0.485493	0.72824	0	0	0	0	1	0	0	0	0
4/22/2011	296	9.8	9.8	0.196522	0.196522	0.589566	0.884349	0	0	0	0	1	0	0	0	0
4/23/2011	297	10.2	10.2	0.203228	0.203228	0.609683	0.914525	0	0	0	0	0	0	0	0	0
4/24/2011	298	8.2	8.2	0.16344	0.16344	0.490321	0.735482	0	0	0	0	0	0	0	0	0
4/25/2011	299	9.9	9.9	0.1984	0.1984	0.595199	0.892798	0	0	0	0	1	0	0	0	0
4/26/2011	300	9.5	9.5	0.190442	0.190442	0.571326	0.85699	0	0	0	0	1	0	0	0	0
4/27/2011	301	6.4	6.4	0.128034	0.128034	0.384103	0.576154	0	0	0	0	1	0	0	0	0
4/28/2011	302	10.3	10.3	0.205642	0.205642	0.616925	0.925388	0	0	0	0	1	0	0	0	0
4/29/2011	303	12.5	12.5	0.249095	0.249095	0.747284	1.120926	0	0	0	0.0232068	1	0	0	0	0.023207
4/30/2011	304	15.2	15.2	0.303724	0.303724	0.911172	1.366758	0	0	0	9.7005184	0	0	0	0	0
5/1/2011	305	7.3	7.3	0.146453	0.146453	0.439358	0.659037	0	0	0	0	0	0	0	0	0
5/2/2011	306	6.6	6.6	0.13179	0.13179	0.395369	0.593053	0	0	0	0	1	0	0	0	0
5/3/2011	307	8.6	8.6	0.172828	0.172828	0.518485	0.777728	0	0	0	0	1	0	0	0	0
5/4/2011	308	7.4	7.4	0.148777	0.148777	0.446332	0.669498	0	0	0	0	1	0	0	0	0
5/5/2011	309	7.2	7.2	0.144575	0.144575	0.433725	0.650588	0	0	0	0	1	0	0	0	0
5/6/2011	310	6.7	6.7	0.133846	0.133846	0.401538	0.602307	0	0	0	0	1	0	0	0	0

WIND EROSION FROM BAUXITE STOCKPILE
Lehigh Southwest Cement Company
Cupertino Facility

k (PM10) = 0.5
threshold friction velocity (u^*_t) = 1.12 m/s

			u_s/u_r:	Pile Subarea				Pile Subarea					Disregarding Weekends			
				0.2a	0.2b	0.6a	0.9	0.2a	0.2b	0.6a	0.9		0.2a	0.2b	0.6a	0.9
		u^+_z	u^+_{10}	u^*	u^*	u^*	u^*	P_i	P_i	P_i	P_i		P_i	P_i	P_i	P_i
Date	N	(m/s)	(m/s)	(m/s)	(m/s)	(m/s)	(m/s)	(g/m²)	(g/m²)	(g/m²)	(g/m²)		(g/m²)	(g/m²)	(g/m²)	(g/m²)
5/7/2011	311	10.9	10.9	0.218159	0.218159	0.654477	0.981716	0	0	0	0	0	0	0	0	0
5/8/2011	312	10.8	10.8	0.216013	0.216013	0.64804	0.97206	0	0	0	0	0	0	0	0	0
5/9/2011	313	8.9	8.9	0.178908	0.178908	0.536725	0.805087	0	0	0	0	1	0	0	0	0
5/10/2011	314	7.4	7.4	0.148777	0.148777	0.446332	0.669498	0	0	0	0	1	0	0	0	0
5/11/2011	315	7.3	7.3	0.146453	0.146453	0.439358	0.659037	0	0	0	0	1	0	0	0	0
5/12/2011	316	8.9	8.9	0.17864	0.17864	0.53592	0.80388	0	0	0	0	1	0	0	0	0
5/13/2011	317	7.4	7.4	0.148509	0.148509	0.445527	0.668291	0	0	0	0	1	0	0	0	0
5/14/2011	318	11.0	11.0	0.220841	0.220841	0.662524	0.993786	0	0	0	0	0	0	0	0	0
5/15/2011	319	11.7	11.7	0.234432	0.234432	0.703295	1.054942	0	0	0	0	0	0	0	0	0
5/16/2011	320	16.0	16.0	0.320533	0.320533	0.961599	1.442398	0	0	0	14.088495	1	0	0	0	14.08849
5/17/2011	321	13.8	13.8	0.275471	0.275471	0.826412	1.239617	0	0	0	3.8203149	1	0	0	0	3.820315
5/18/2011	322	13.4	13.4	0.267155	0.267155	0.801466	1.202199	0	0	0	2.4468785	1	0	0	0	2.446879
5/19/2011	323	8.1	8.1	0.162099	0.162099	0.486298	0.729447	0	0	0	0	1	0	0	0	0
5/20/2011	324	6.9	6.9	0.138406	0.138406	0.415217	0.622826	0	0	0	0	1	0	0	0	0
5/21/2011	325	9.0	9.0	0.180518	0.180518	0.541553	0.81233	0	0	0	0	0	0	0	0	0
5/22/2011	326	11.1	11.1	0.222361	0.222361	0.667084	1.000626	0	0	0	0	0	0	0	0	0
5/23/2011	327	13.2	13.2	0.264831	0.264831	0.794492	1.191739	0	0	0	2.0919566	1	0	0	0	2.091957
5/24/2011	328	7.8	7.8	0.155751	0.155751	0.467254	0.700881	0	0	0	0	1	0	0	0	0
5/25/2011	329	13.4	13.4	0.267155	0.267155	0.801466	1.202199	0	0	0	2.4468785	1	0	0	0	2.446879
5/26/2011	330	9.9	9.9	0.198131	0.198131	0.594394	0.891591	0	0	0	0	1	0	0	0	0
5/27/2011	331	11.6	11.6	0.232286	0.232286	0.696857	1.045286	0	0	0	0	1	0	0	0	0
5/28/2011	332	15.1	15.1	0.302115	0.302115	0.906344	1.359515	0	0	0	9.3152074	0	0	0	0	0
5/29/2011	333	13.3	13.3	0.265546	0.265546	0.796638	1.194957	0	0	0	2.1998114	0	0	0	0	0
5/30/2011	334	13.7	13.7	0.273593	0.273593	0.820779	1.231168	0	0	0	3.4959879	1	0	0	0	3.495988
5/31/2011	335	13.7	13.7	0.274934	0.274934	0.824802	1.237203	0	0	0	3.726805	1	0	0	0	3.726805
6/1/2011	336	11.2	11.2	0.223434	0.223434	0.670303	1.005454	0	0	0	0	1	0	0	0	0
6/2/2011	337	9.2	9.2	0.184273	0.184273	0.552819	0.829228	0	0	0	0	1	0	0	0	0
6/3/2011	338	7.6	7.6	0.152801	0.152801	0.458402	0.687603	0	0	0	0	1	0	0	0	0
6/4/2011	339	19.5	19.5	0.390362	0.390362	1.171085	1.756627	0	0	1.4284858	39.42277	0	0	0	0	0
6/5/2011	340	8.5	8.5	0.169073	0.169073	0.50722	0.76083	0	0	0	0	0	0	0	0	0
6/6/2011	341	11.1	11.1	0.222093	0.222093	0.666279	0.999419	0	0	0	0	1	0	0	0	0
6/7/2011	342	8.3	8.3	0.16505	0.16505	0.49515	0.742724	0	0	0	0	1	0	0	0	0
6/8/2011	343	6.7	6.7	0.133578	0.133578	0.400733	0.6011	0	0	0	0	1	0	0	0	0
6/9/2011	344	6.3	6.3	0.125352	0.125352	0.376056	0.564084	0	0	0	0	1	0	0	0	0
6/10/2011	345	8.9	8.9	0.178908	0.178908	0.536725	0.805087	0	0	0	0	1	0	0	0	0
6/11/2011	346	9.5	9.5	0.19071	0.19071	0.572131	0.858197	0	0	0	0	0	0	0	0	0
6/12/2011	347	7.8	7.8	0.156288	0.156288	0.468863	0.703295	0	0	0	0	0	0	0	0	0
6/13/2011	348	8.0	8.0	0.160043	0.160043	0.480129	0.720193	0	0	0	0	1	0	0	0	0
6/14/2011	349	7.3	7.3	0.145648	0.145648	0.436944	0.655416	0	0	0	0	1	0	0	0	0
6/15/2011	350	6.9	6.9	0.137601	0.137601	0.412803	0.619205	0	0	0	0	1	0	0	0	0
6/16/2011	351	6.5	6.5	0.130448	0.130448	0.391345	0.587018	0	0	0	0	1	0	0	0	0
6/17/2011	352	6.9	6.9	0.138942	0.138942	0.416827	0.62524	0	0	0	0	1	0	0	0	0

WIND EROSION FROM BAUXITE STOCKPILE

Lehigh Southwest Cement Company
Cupertino Facility

k (PM10) = 0.5
threshold friction velocity (u^*_t) = 1.12 m/s

			u_s/u_r:	Pile Subarea				Pile Subarea					Disregarding Weekends			
				0.2a	0.2b	0.6a	0.9	0.2a	0.2b	0.6a	0.9		0.2a	0.2b	0.6a	0.9
		u^+_z	u^+_{10}	u^*	u^*	u^*	u^*	P_i	P_i	P_i	P_i		P_i	P_i	P_i	P_i
Date	N	(m/s)	(m/s)	(m/s)	(m/s)	(m/s)	(m/s)	(g/m^2)	(g/m^2)	(g/m^2)	(g/m^2)		(g/m^2)	(g/m^2)	(g/m^2)	(g/m^2)
6/18/2011	353	7.4	7.4	0.148777	0.148777	0.446332	0.669498	0	0	0	0	0	0	0	0	0
6/19/2011	354	9.2	9.2	0.183468	0.183468	0.550405	0.825607	0	0	0	0	0	0	0	0	0
6/20/2011	355	7.9	7.9	0.157361	0.157361	0.472082	0.708123	0	0	0	0	1	0	0	0	0
6/21/2011	356	6.9	6.9	0.138138	0.138138	0.414413	0.621619	0	0	0	0	1	0	0	0	0
6/22/2011	357	6.1	6.1	0.122133	0.122133	0.3664	0.5496	0	0	0	0	1	0	0	0	0
6/23/2011	358	7.4	7.4	0.148777	0.148777	0.446332	0.669498	0	0	0	0	1	0	0	0	0
6/24/2011	359	7.4	7.4	0.147168	0.147168	0.441504	0.662256	0	0	0	0	1	0	0	0	0
6/25/2011	360	7.1	7.1	0.142697	0.142697	0.428092	0.642139	0	0	0	0	0	0	0	0	0
6/26/2011	361	7.6	7.6	0.151191	0.151191	0.453574	0.680361	0	0	0	0	0	0	0	0	0
6/27/2011	362	6.6	6.6	0.132237	0.132237	0.39671	0.595065	0	0	0	0	1	0	0	0	0
6/28/2011	363	8.1	8.1	0.162099	0.162099	0.486298	0.729447	0	0	0	0	1	0	0	0	0
6/29/2011	364	7.7	7.7	0.154947	0.154947	0.46484	0.69726	0	0	0	0	1	0	0	0	0
6/30/2011	365	7.7	7.7	0.153337	0.153337	0.460012	0.690017	0	0	0	0	1	0	0	0	0
							Sum:	0	0	62.93755	993.40626		0	0	30.454652	592.6671
							Pi x A	0	0	50,004	197,314		0	0	24,196	117,718
							Ef =	2.47E+05 g/yr				Ef =	1.42E+05 g/yr			
							PM10 Ef:	1.24E+05 g/yr				PM10 Ef=	7.10E+04 g/yr			
							E (ton/yr)	0.14 tons/yr		everyday disturbance		E (tons/yr)	7.81E-02 tons/yr for weekdays			

← every day

← weekdays only

Pile Area:

Area Section	u_s/u_r	% total A	A (m^2)
1	0.9	12	199
2	0.6	48	794
3	0.2	40	662
		Total Area:	1,655

Material Handling

COMPARISON OF MATERIAL HANDLING EMISSION FACTORS USING ON-SITE WIND DATA

Lehigh Southwest Cement Company
Cupertino Facility

Parameter	Units	EF (2013 CEIR Rev), Factor for Monitor Height Applied	EF (Lehigh 2010-2011 MET Data), No Factor Applied
Material Handling	lb/ton	1.88E-04	5.52E-03

TABLE B-5

MATERIAL HANDLING OF STOCKPILES
Lehigh Southwest Cement Company
Cupertino Facility

Equations for TSP Emission Factor as per EPA AP-42[1]
Example for Quarry Overburden

$$E_f = k \times 0.0032 \times \frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Equation element	Symbol	Value used	Notes
Particle size multiplier for PM10	k	0.35	pg. 13.2.4-4, AP-42 Aggregate Handling and Storage Piles
Mean wind speed (mph) @ 10 m	U	0.41	Average wind data from 2008 using NOAA monitoring station (see attached)
Moisture content (%) [2]	M	0.70	Assume no watering
PM10 emission factor (lb/ton)	E_f	1.88E-04	

Notes:
Wind speed data for 2008 assumed to be representative of typical year
1. Equation is from US EPA AP-42 discussion on aggregate handling and storage piles (13.2.4) equation 1
2. Values for moisture content taken from Table 13.2.4-1, AP-42. Assumed that all materials have moisture content of crushed limestone

TABLE B-5

MATERIAL HANDLING OF STOCKPILES
Lehigh Southwest Cement Company
Cupertino Facility

Equations for TSP Emission Factor as per EPA AP-42[1]
Example for Quarry Overburden

$$E_f = k \times 0.0032 \times \frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Equation element	Symbol	Value used	Notes
Particle size multiplier for PM10	k	0.35	pg. 13.2.4-4, AP-42 Aggregate Handling and Storage Piles
Mean wind speed (mph) @ 10 m	U	5.51	Average wind data from 2010 Lehigh Met Station
Moisture content (%) [2]	M	0.70	Assume no watering
PM10 emission factor (lb/ton)	E_f	5.52E-03	

Notes:
Wind speed data for 2008 assumed to be representative of typical year
1. Equation is from US EPA AP-42 discussion on aggregate handling and storage piles (13.2.4) equation 1
2. Values for moisture content taken from Table 13.2.4-1, AP-42. Assumed that all materials have moisture content of crushed limestone

Item 6 Diesel

EF

3.4 Large Stationary Diesel And All Stationary Dual-fuel Engines

3.4.1 General

The primary domestic use of large stationary diesel engines (greater than 600 horsepower [hp]) is in oil and gas exploration and production. These engines, in groups of 3 to 5, supply mechanical power to operate drilling (rotary table), mud pumping, and hoisting equipment, and may also operate pumps or auxiliary power generators. Another frequent application of large stationary diesels is electricity generation for both base and standby service. Smaller uses include irrigation, hoisting, and nuclear power plant emergency cooling water pump operation.

Dual-fuel engines were developed to obtain compression ignition performance and the economy of natural gas, using a minimum of 5 to 6 percent diesel fuel to ignite the natural gas. Large dual-fuel engines have been used almost exclusively for prime electric power generation. This section includes all dual-fuel engines.

3.4.2 Process Description

All reciprocating internal combustion (IC) engines operate by the same basic process. A combustible mixture is first compressed in a small volume between the head of a piston and its surrounding cylinder. The mixture is then ignited, and the resulting high-pressure products of combustion push the piston through the cylinder. This movement is converted from linear to rotary motion by a crankshaft. The piston returns, pushing out exhaust gases, and the cycle is repeated.

There are 2 ignition methods used in stationary reciprocating IC engines, compression ignition (CI) and spark ignition (SI). In CI engines, combustion air is first compression heated in the cylinder, and diesel fuel oil is then injected into the hot air. Ignition is spontaneous because the air temperature is above the autoignition temperature of the fuel. SI engines initiate combustion by the spark of an electrical discharge. Usually the fuel is mixed with the air in a carburetor (for gasoline) or at the intake valve (for natural gas), but occasionally the fuel is injected into the compressed air in the cylinder. Although all diesel- fueled engines are compression ignited and all gasoline- and gas-fueled engines are spark ignited, gas can be used in a CI engine if a small amount of diesel fuel is injected into the compressed gas/air mixture to burn any mixture ratio of gas and diesel oil (hence the name dual fuel), from 6 to 100 percent diesel oil.

CI engines usually operate at a higher compression ratio (ratio of cylinder volume when the piston is at the bottom of its stroke to the volume when it is at the top) than SI engines because fuel is not present during compression; hence there is no danger of premature autoignition. Since engine thermal efficiency rises with increasing pressure ratio (and pressure ratio varies directly with compression ratio), CI engines are more efficient than SI engines. This increased efficiency is gained at the expense of poorer response to load changes and a heavier structure to withstand the higher pressures.[1]

3.4.3 Emissions And Controls

Most of the pollutants from IC engines are emitted through the exhaust. However, some total organic compounds (TOC) escape from the crankcase as a result of blowby (gases that are vented from the oil pan after they have escaped from the cylinder past the piston rings) and from the fuel tank and carburetor because of evaporation. Nearly all of the TOCs from diesel CI engines enter the atmosphere from the exhaust. Crankcase blowby is minor because TOCs are not present during compression of the charge. Evaporative losses are insignificant in diesel engines due to the low volatility of diesel fuels. In general, evaporative losses are also negligible in engines using gaseous fuels because these engines receive their fuel continuously from a pipe rather than via a fuel storage tank and fuel pump.

The primary pollutants from internal combustion engines are oxides of nitrogen (NO_x), hydrocarbons and other organic compounds, carbon monoxide (CO), and particulates, which include both visible (smoke) and nonvisible emissions. Nitrogen oxide formation is directly related to high pressures and temperatures during the combustion process and to the nitrogen content, if any, of the fuel. The other pollutants, HC, CO, and smoke, are primarily the result of incomplete combustion. Ash and metallic additives in the fuel also contribute to the particulate content of the exhaust. Sulfur oxides also appear in the exhaust from IC engines. The sulfur compounds, mainly sulfur dioxide (SO_2), are directly related to the sulfur content of the fuel.[2]

3.4.3.1 Nitrogen Oxides -

Nitrogen oxide formation occurs by two fundamentally different mechanisms. The predominant mechanism with internal combustion engines is thermal NO_x which arises from the thermal dissociation and subsequent reaction of nitrogen (N_2) and oxygen (O_2) molecules in the combustion air. Most thermal NO_x is formed in the high-temperature region of the flame from dissociated molecular nitrogen in the combustion air. Some NO_x, called prompt NO_x, is formed in the early part of the flame from reaction of nitrogen intermediary species, and HC radicals in the flame. The second mechanism, fuel NO_x, stems from the evolution and reaction of fuel-bound nitrogen compounds with oxygen. Gasoline, and most distillate oils, have no chemically-bound fuel N_2 and essentially all NO_x formed is thermal NO_x.

3.4.3.2 Total Organic Compounds -

The pollutants commonly classified as hydrocarbons are composed of a wide variety of organic compounds and are discharged into the atmosphere when some of the fuel remains unburned or is only partially burned during the combustion process. Most unburned hydrocarbon emissions result from fuel droplets that were transported or injected into the quench layer during combustion. This is the region immediately adjacent to the combustion chamber surfaces, where heat transfer outward through the cylinder walls causes the mixture temperatures to be too low to support combustion.

Partially burned hydrocarbons can occur because of poor air and fuel homogeneity due to incomplete mixing, before or during combustion; incorrect air/fuel ratios in the cylinder during combustion due to maladjustment of the engine fuel system; excessively large fuel droplets (diesel engines); and low cylinder temperature due to excessive cooling (quenching) through the walls or early cooling of the gases by expansion of the combustion volume caused by piston motion before combustion is completed.[2]

3.4.3.3 Carbon Monoxide -

Carbon monoxide is a colorless, odorless, relatively inert gas formed as an intermediate combustion product that appears in the exhaust when the reaction of CO to CO_2 cannot proceed to completion. This situation occurs if there is a lack of available oxygen near the hydrocarbon (fuel) molecule during combustion, if the gas temperature is too low, or if the residence time in the cylinder is too short. The oxidation rate of CO is limited by reaction kinetics and, as a consequence, can be accelerated only to a certain extent by improvements in air and fuel mixing during the combustion process.[2-3]

3.4.3.4 Smoke, Particulate Matter, and PM-10 -

White, blue, and black smoke may be emitted from IC engines. Liquid particulates appear as white smoke in the exhaust during an engine cold start, idling, or low load operation. These are formed in the quench layer adjacent to the cylinder walls, where the temperature is not high enough to ignite the fuel. Blue smoke is emitted when lubricating oil leaks, often past worn piston rings, into the combustion chamber and is partially burned. Proper maintenance is the most effective method of preventing blue smoke emissions from all types of IC engines. The primary constituent of black smoke is agglomerated carbon particles (soot).[2]

3.4.3.5 Sulfur Oxides -

Sulfur oxide emissions are a function of only the sulfur content in the fuel rather than any combustion variables. In fact, during the combustion process, essentially all the sulfur in the fuel is oxidized to SO_2. The oxidation of SO_2 gives sulfur trioxide (SO_3), which reacts with water to give sulfuric acid (H_2SO_4), a contributor to acid precipitation. Sulfuric acid reacts with basic substances to give sulfates, which are fine particulates that contribute to PM-10 and visibility reduction. Sulfur oxide emissions also contribute to corrosion of the engine parts.[2,3]

Table 3.4-1 contains gaseous emission factors for the pollutants discussed above, expressed in units of pounds per horsepower-hour (lb/hp-hr), and pounds per million British thermal unit (lb/MMBtu). Table 3.4-2 shows the particulate and particle-sizing emission factors. Table 3.4-3 shows the speciated organic compound emission factors and Table 3.4-4 shows the emission factors for polycyclic aromatic hydrocarbons (PAH). These tables do not provide a complete speciated organic compound and PAH listing because they are based only on a single engine test; they are to be used only for rough order of magnitude comparisons.

Table 3.4-5 shows the NO_x reduction and fuel consumption penalties for diesel and dual-fueled engines based on some of the available control techniques. The emission reductions shown are those that have been demonstrated. The effectiveness of controls on a particular engine will depend on the specific design of each engine, and the effectiveness of each technique could vary considerably. Other NO_x control techniques exist but are not included in Table 3.4-5. These techniques include internal/external exhaust gas recirculation, combustion chamber modification, manifold air cooling, and turbocharging.

3.4.4 Control Technologies

Control measures to date are primarily directed at limiting NO_x and CO emissions since they are the primary pollutants from these engines. From a NO_x control viewpoint, the most important distinction between different engine models and types of reciprocating engines is whether they are rich-burn or lean-burn. Rich-burn engines have an air-to-fuel ratio operating range that is near stoichiometric or fuel-rich of stoichiometric and as a result the exhaust gas has little or no excess oxygen. A lean-burn engine has an air-to-fuel operating range that is fuel-lean of stoichiometric; therefore, the exhaust from these engines is characterized by medium to high levels of O_2. The most common NO_x control technique for diesel and dual fuel engines focuses on modifying the combustion process. However, selective catalytic reduction (SCR) and nonselective catalytic reduction (NSCR) which are post-combustion techniques are becoming available. Control for CO have been partly adapted from mobile sources.[5]

Combustion modifications include injection timing retard (ITR), preignition chamber combustion (PCC), air-to-fuel ratio, and derating. Injection of fuel into the cylinder of a CI engine initiates the combustion process. Retarding the timing of the diesel fuel injection causes the combustion process to occur later in the power stroke when the piston is in the downward motion and combustion chamber volume is increasing. By increasing the volume, the combustion temperature and pressure are lowered, thereby lowering NO_x formation. ITR reduces NO_x from all diesel engines; however, the effectiveness is specific to each engine model. The amount of NO_x reduction with ITR diminishes with increasing levels of retard.[5]

Improved swirl patterns promote thorough air and fuel mixing and may include a precombustion chamber (PCC). A PCC is an antechamber that ignites a fuel-rich mixture that propagates to the main combustion chamber. The high exit velocity from the PCC results in improved mixing and complete combustion of the lean air/fuel mixture which lowers combustion temperature, thereby reducing NO_x emissions.[5]

The air-to-fuel ratio for each cylinder can be adjusted by controlling the amount of fuel that enters each cylinder. At air-to-fuel ratios less than stoichiometric (fuel-rich), combustion occurs under conditions of insufficient oxygen which causes NO_x to decrease because of lower oxygen and lower temperatures. Derating involves restricting engine operation to lower than normal levels of power production for the given application. Derating reduces cylinder pressures and temperatures thereby lowering NO_x formation rates.[5]

SCR is an add-on NO_x control placed in the exhaust stream following the engine and involves injecting ammonia (NH_3) into the flue gas. The NH_3 reacts with the NO_x in the presence of a catalyst to form water and nitrogen. The effectiveness of SCR depends on fuel quality and engine duty cycle (load fluctuations). Contaminants in the fuel may poison or mask the catalyst surface causing a reduction or termination in catalyst activity. Load fluctuations can cause variations in exhaust temperature and NO_x concentration which can create problems with the effectiveness of the SCR system.[5]

NSCR is often referred to as a three-way conversion catalyst system because the catalyst reactor simultaneously reduces NO_x, CO, and HC and involves placing a catalyst in the exhaust stream of the engine. The reaction requires that the O_2 levels be kept low and that the engine be operated at fuel-rich air-to-fuel ratios.[5]

3.4.5 Updates Since the Fifth Edition

The Fifth Edition was released in January 1995. Revisions to this section since that date are summarized below. For further detail, consult the memoranda describing each supplement or the background report for this section.

Supplement A, February 1996

No changes.

Supplement B, October 1996

- The general text was updated.
- Controlled NO_x factors and PM factors were added for diesel units.
- Math errors were corrected in factors for CO from diesel units and for uncontrolled NO_x from dual fueled units.

Table 3.4-1. GASEOUS EMISSION FACTORS FOR LARGE STATIONARY DIESEL AND ALL STATIONARY DUAL-FUEL ENGINES[a]

Pollutant	Diesel Fuel (SCC 2-02-004-01)			Dual Fuel[b] (SCC 2-02-004-02)		
	Emission Factor (lb/hp-hr) (power output)	Emission Factor (lb/MMBtu) (fuel input)	EMISSION FACTOR RATING	Emission Factor (lb/hp-hr) (power output)	Emission Factor (lb/MMBtu) (fuel input)	EMISSION FACTOR RATING
NO_x						
Uncontrolled	0.024	3.2	B	0.018	2.7	D
Controlled	0.013[c]	1.9[c]	B	ND	ND	NA
CO	5.5 E-03	0.85	C	7.5 E-03	1.16	D
SO_x[d]	8.09 E-03S_1	1.01S_1	B	4.06 E-04S_1 + 9.57 E-03S_2	0.05S_1 + 0.895S_2	B
CO_2[e]	1.16	165	B	0.772	110	B
PM	0.0007[c]	0.1[c]	B	ND	ND	NA
TOC (as CH_4)	7.05 E-04	0.09	C	5.29 E-03	0.8	D
Methane	f	f	E	3.97 E-03	0.6	E
Nonmethane	f	f	E	1.32 E-03	0.2[g]	E

[a] Based on uncontrolled levels for each fuel, from References 2,6-7. When necessary, the average heating value of diesel was assumed to be 19,300 Btu/lb with a density of 7.1 lb/gallon. The power output and fuel input values were averaged independently from each other, because of the use of actual brake-specific fuel consumption (BSFC) values for each data point and of the use of data possibly sufficient to calculate only 1 of the 2 emission factors (e. g., enough information to calculate lb/MMBtu, but not lb/hp-hr). Factors are based on averages across all manufacturers and duty cycles. The actual emissions from a particular engine or manufacturer could vary considerably from these levels. To convert from lb/hp-hr to kg/kw-hr, multiply by 0.608. To convert from lb/MMBtu to ng/J, multiply by 430. SCC = Source Classification Code.

[b] Dual fuel assumes 95% natural gas and 5% diesel fuel.

[c] References 8-26. Controlled NO_x is by ignition timing retard.

[d] Assumes that all sulfur in the fuel is converted to SO_2. S_1 = % sulfur in fuel oil; S_2 = % sulfur in natural gas. For example, if sulfer content is 1.5%, then S = 1.5.

[e] Assumes 100% conversion of carbon in fuel to CO_2 with 87 weight % carbon in diesel, 70 weight % carbon in natural gas, dual-fuel mixture of 5% diesel with 95% natural gas, average BSFC of 7,000 Btu/hp-hr, diesel heating value of 19,300 Btu/lb, and natural gas heating value of 1050 Btu/scf.

[f] Based on data from 1 engine, TOC is by weight 9% methane and 91% nonmethane.

[g] Assumes that nonmethane organic compounds are 25% of TOC emissions from dual-fuel engines. Molecular weight of nonmethane gas stream is assumed to be that of methane.

Table 3.4-2. PARTICULATE AND PARTICLE-SIZING EMISSION FACTORS FOR LARGE UNCONTROLLED STATIONARY DIESEL ENGINES[a]

EMISSION FACTOR RATING: E

Pollutant	Emission Factor (lb/MMBtu) (fuel input)
Filterable particulate[b]	
< 1 μm	0.0478
< 3 μm	0.0479
< 10 μm	0.0496
Total filterable particulate	0.0620
Condensable particulate	0.0077
Total PM-10[c]	0.0573
Total particulate[d]	0.0697

[a] Based on 1 uncontrolled diesel engine from Reference 6. Source Classification Code 2-02-004-01. The data for the particulate emissions were collected using Method 5, and the particle size distributions were collected using a Source Assessment Sampling System. To convert from lb/MMBtu to ng/J, multiply by 430. PM-10 = particulate matter ≤ 10 micrometers (μm) aerometric diameter.
[b] Particle size is expressed as aerodynamic diameter.
[c] Total PM-10 is the sum of filterable particulate less than 10 μm aerodynamic diameter and condensable particulate.
[d] Total particulate is the sum of the total filterable particulate and condensable particulate.

Table 3.4-3. SPECIATED ORGANIC COMPOUND EMISSION FACTORS FOR LARGE UNCONTROLLED STATIONARY DIESEL ENGINES[a]

EMISSION FACTOR RATING: E

Pollutant	Emission Factor (lb/MMBtu) (fuel input)
Benzene[b]	7.76 E-04
Toluene[b]	2.81 E-04
Xylenes[b]	1.93 E-04
Propylene	2.79 E-03
Formaldehyde[b]	7.89 E-05
Acetaldehyde[b]	2.52 E-05
Acrolein[b]	7.88 E-06

[a]Based on 1 uncontrolled diesel engine from Reference 7. Source Classification Code 2-02-004-01. Not enough information to calculate the output-specific emission factors of lb/hp-hr. To convert from lb/MMBtu to ng/J, multiply by 430.
[b]Hazardous air pollutant listed in the *Clean Air Act*.

Table 3.4-4. PAH EMISSION FACTORS FOR LARGE UNCONTROLLED STATIONARY DIESEL ENGINES[a]

EMISSION FACTOR RATING: E

PAH	Emission Factor (lb/MMBtu) (fuel input)
Naphthalene[b]	1.30 E-04
Acenaphthylene	9.23 E-06
Acenaphthene	4.68 E-06
Fluorene	1.28 E-05
Phenanthrene	4.08 E-05
Anthracene	1.23 E-06
Fluoranthene	4.03 E-06
Pyrene	3.71 E-06
Benz(a)anthracene	6.22 E-07
Chrysene	1.53 E-06
Benzo(b)fluoranthene	1.11 E-06
Benzo(k)fluoranthene	<2.18 E-07
Benzo(a)pyrene	<2.57 E-07
Indeno(1,2,3-cd)pyrene	<4.14 E-07
Dibenz(a,h)anthracene	<3.46 E-07
Benzo(g,h,l)perylene	<5.56 E-07
TOTAL PAH	<2.12 E-04

[a] Based on 1 uncontrolled diesel engine from Reference 7. Source Classification Code 2-02-004-01. Not enough information to calculate the output-specific emission factors of lb/hp-hr. To convert from lb/MMBtu to ng/J, multiply by 430.

[b] Hazardous air pollutant listed in the *Clean Air Act*.

Table 3.4-5. NO_x REDUCTION AND FUEL CONSUMPTION PENALTIES FOR LARGE STATIONARY DIESEL AND DUAL-FUEL ENGINES[a]

Control Approach		Diesel (SCC 2-02-004-01) NO_x Reduction (%)	Diesel (SCC 2-02-004-01) ΔBSFC[b] (%)	Dual Fuel (SCC 2-02-004-02) NO_x Reduction (%)	Dual Fuel (SCC 2-02-004-02) ΔBSFC (%)
Derate	10%	ND	ND	<20	4
	20%	<20	4	ND	ND
	25%	5 - 23	1 - 5	1 - 33	1 - 7
Retard	2°	<20	4	<20	3
	4°	<40	4	<40	1
	8°	28 - 45	2 - 8	50 - 73	3 - 5
Air-to-fuel	3%	ND	ND	<20	0
	±10%	7 - 8	3	25 - 40	1 - 3
Water injection (H_2O/fuel ratio)	50%	25 - 35	2 - 4	ND	ND
SCR		80 - 95	0	80 - 95	0

[a] References 1,27-28. The reductions shown are typical and will vary depending on the engine and duty cycle. SCC = Source Classification Code. ΔBSFC = change in brake-specific fuel consumption. ND = no data.

References For Section 3.4

1. H. I. Lips, *et al.*, *Environmental Assessment Of Combustion Modification Controls For Stationary Internal Combustion Engines*, EPA-600/7-81-127, U. S. Environmental Protection Agency, Cincinnati, OH, July 1981.

2. *Standards Support And Environmental Impact Statement, Volume I: Stationary Internal Combustion Engines*, EPA-450/2-78-125a, U. S. Environmental Protection Agency, Research Triangle Park, NC, July 1979.

3. M. Hoggan, et. al., *Air Quality Trends in California's South Coast and Southeast Desert Air Basins, 1976-1990*, "Air Quality Management Plan, Appendix II-B", South Coast Air Quality Management District, July 1991.

4. *Limiting Net Greenhouse Gas Emissions In the United States, Volume II: Energy Responses*, report for the Office of Environmental Analysis, Office of Policy, Planning and Analysis, Department of Energy (DDE), DOE/PE-0101 Volume II, September 1991.

5. Snyder, R. B., *Alternative Control Techniques Document—NO_x Emissions from Stationary Reciprocating Internal Combustion Engines*, EPA-453/R-93-032, U. S. Environmental Protection Agency, Research Triangle Park, July 1993.

6. C. Castaldini, *Environmental Assessment Of NO_x Control On A Compression Ignition Large Bore Reciprocating Internal Combustion Engine, Volume I: Technical Results*, EPA-600/7-86/001a, U. S. Environmental Protection Agency, Cincinnati, OH, April 1984.

7. *Pooled Source Emission Test Report: Oil And Gas Production Combustion Sources, Fresno And Ventura Counties, California*, ENSR # 7230-007-700, Western States Petroleum Association, Bakersfield, CA, December 1990.

8. *Final Report For An Emission Compliance Test Program On Two Standby Generators Located At American Car Company*, Greenwich, CT, York Services Corp., 1987.

9. *Final Report For An Emission Compliance Test Program On A Standby Diesel Generator At South Central Connecticut Regional Water Authority*, West Haven, CT, York Services Corp., 1988.

10. *Air Emission From Stationary Diesel Engines For The Alaska Rural Electric Cooperative Association*, Environmetrics, 1992.

11. *Compliance Test Report For Particulate Emissions From A Caterpillar Diesel Generator*, St. Mary's Hospital, Waterburg, CT, TRC Environmental Consultants, 1987.

12. *Compliance Measured Particulate Emissions From An Emergency Diesel Generator, Silorsky Aircraft, United Technologies*, Stratford, CT, TRC Environmental Consultants, 1987.

13. *Compliance Test Report For Particulate Emissions From A Cummins Diesel Generator*, Colonial Gold Limited Partnership, Hartford, CT, TRC Environmental Consultants, 1988.

14. *Compliance Test Report For Particulate Emissions From A Cummins Diesel Generator*, CIGNA Insurance Company, Bloomfield, CT, TRC Environmental Consultants, 1988.

15. *Compliance Test Report For Particulate Emission From A Waukesha Diesel Generator*, Bristol Meyers, Wallinsford, CT, TRC Environmental Consultants, 1987.

16. *Compliance Test Report For Particulate Emissions From A Cummins Diesel Generator*, Connecticut General Life Insurance, Windsor, CT, TRC Environmental Consultants, 1987.

17. *Compliance Measured Particulate Emissions From An Emergency Diesel Generator*, Danbury Hospital, Danbury, CT, TRC Environmental Consultants, 1988.

18. *Compliance Test Report For Particulate Emissions From A Caterpillar Diesel Generator*, Colonial Metro Limited Partnership, Hartford, CT, TRC Environmental Consultants, 1988.

19. *Compliance Test Report For Particulate Emissions From A Caterpillar Diesel Generator*, Boehringer -Ingelheim Pharmaceuticals, Danbury, CT, TRC Environmental Consultants, 1988.

20. *Compliance Test Report For Emissions Of Particulate From An Emergency Diesel Generator*, Meriden - Wallingford Hospital, Meriden, CT, TRC Environmental Consultants, 1987.

21. *Compliance Test Report Johnson Memorial Hospital Emergency Generator Exhaust Stack*, Stafford Springs, CT, ROJAC Environmental Services, 1987.

22. *Compliance Test Report Union Carbide Corporation Generator Exhaust Stack*, Danbury, CT, ROJAC Environmental Services, 1988.

23. *Compliance Test Report Hartford Insurance Company Emergency Generator Exhaust Stack*, Bloomfield, CT, ROJAC Environmental Services, 1987.

24. *Compliance Test Report Hartford Insurance Group Emergency Generator Exhaust Stack*, Hartford, CT, ROJAC Environmental Services, 1987.

25. *Compliance Test Report Southern New England Telephone Company Emergency Generator Exhaust Stack*, North Haven, CT, ROJAC Environmental Services, 1988.

26. *Compliance Test Report Pfizer, Inc. Two Emergency Generator Exhaust Stacks*, Groton, CT, ROJAC Environmental Services, 1987.

27. L. M. Campbell, *et al.*, *Sourcebook: NO_x Control Technology Data, Control Technology Center*, EPA-600/2-91-029, U. S. Environmental Protection Agency, Cincinnati, OH, July 1991.

28. *Catalysts For Air Pollution Control*, Manufacturers Of Emission Controls Association (MECA), Washington, DC, March 1992.

Lehigh Cupertino kiln benzene data summary addendum to letter, August 20, 2014:

Below is a summary table showing recommended values for maximum hourly and annual average benzene emissions (lb/ton feed and lb/ton clinker), based on the 2009, 2011, and 2012 source test data summarized in Tables 1 and 2:

Kiln benzene emissions item	Recommended value based on Table 2 summary of 2009/2011/2012 data
Maximum hourly emissions, based on maximum of averages at either RM-on or RM-off, considering all three years	2.33
Average annual emissions, based on average of 70/30 ratio RM-on/RM-off for three years (lb/ton feed), using 1.55 ton feed per ton clinker	0.0065
Average annual emissions, based on average of 70/30 ratio RM-on/RM-off for three years, (lb/ton clinker)	0.0101

Note that the following changes were made to the 2012 data, based on observed outliers in data set:

1) 2012 RM-on high test—removed from 2012 RM-on average
2) 2012 RM-off high test—removed from 2012 RM-off average
3) 2012 RM-off production rate (feed and clinker rates)—values in average were replaced by using the same value as average for 2012 RM-on:

    The RM-off production rates in the original test report are low, and do not seem realistic, given that the flow rates (corrected to 7%O2) are not also lower than for other tests.

K:\11191.000.0\Stack Oct 12\Permit Apr 14\HRA comments\Benzene\Review\benzene data summary addendum Aug 20 14.docx

Lehigh Benzene Source Tests: Table 1

2009 Table 1: raw data from report, results calculated									
	RM On				RM Off				70% On/30% Off
	Run 1	Run 2	Run3	Average	Run 1	Run 2	Run3	Average	Weighted Average
Clinker Rate (tph)	199	199	199	**199**	199	199	199	**199**	**199**
Feed Rate (tph)	309	308	309	**309**	309	309	309	**309**	**309**
O2 (%)	12.56	10.81	10.86	**11.41**	10.96	12.82	11.11	**11.63**	**11.476**
Concentration (ug/m3)	1,200	1,200	990	**1,130**	1,300	1,400	980	**1,227**	**1,159**
Concentration (ug/m3 @ 7% O2)	2,000	1,653	1,371	**1,675**	1,818	2,408	1,391	**1,873**	**1,734**
Stack Flow (dscfm)	12,661	11,043	10,239	**11,314**	8,681	9,704	9,981	**9,455**	**10,757**
Total Flow (dscfm)	379,839	331,297	307,177	**339,438**	260,436	291,127	299,437	**283,666**	**322,706**
Stack Flow (dscfm @ 7% O2)	7,597	8,016	7,396	**7,669**	6,208	5,641	7,030	**6,293**	**7,256**
Total Flow (dscfm @ 7% O2)	227,903	240,489	221,875	**230,089**	186,240	169,230	210,898	**188,789**	**217,699**
Stack Emissions (lb/hr)	0.0569	0.0496	0.0380	**0.0482**	0.0423	0.0509	0.0366	**0.0433**	**0.0467**
Total Emissions (lb/hr)	1.707	1.489	1.139	**1.445**	1.268	1.527	1.099	**1.298**	**1.401**
Total Emissions (lb/ton feed)	0.0055	0.0048	0.0037	**0.0047**	0.0041	0.0049	0.0036	**0.0042**	**0.0045**
Total Emissions (lb/ton clinker)	0.0086	0.0075	0.0057	**0.0073**	0.0064	0.0077	0.0055	**0.0065**	**0.0070**

All calculated results within 10% of corresponding value in test report
Total flow is stack flow x 30.0, the flow factor derived from the 2012 source test.
Clinker rate is feed rate / 1.55, the feed/clinker factor derived from the 2012 source test.

Lehigh Benzene Source Tests: Table 1

2011 Table 1: raw data from report, results calculated									
	RM On				RM Off				70% On/30% Off
	Run 1	Run 2	Run3	Average	Run 1	Run 2	Run3	Average	Weighted Average
Clinker Rate (tph)	179	186	185	**183**	179	186	185	**183**	**183**
Feed Rate (tph)	278	289	287	**284**	278	289	287	**284**	**284**
O2 (%)	12.22	12.16	12.23	**12.20**	10.64	10.60	10.72	**10.65**	**11.74**
Concentration (ug/m3)	2,300	2,300	2,200	**2,267**	1,500	1,500	1,300	**1,433**	**2,017**
Concentration (ug/m3 @ 7% O2)	3,683	3,658	3,527	**3,623**	2,032	2,024	1,775	**1,944**	**3,119**
Stack Flow (dscfm)	8,563	9,066	9,167	**8,932**	8,563	9,066	9,167	**8,932**	**8,932**
Total Flow (dscfm)	256,893	272,000	275,017	**267,970**	256,893	272,000	275,017	**267,970**	**267,970**
Stack Flow (dscfm @ 7% O2)	5,347	5,701	5,718	**5,589**	6,321	6,718	6,714	**6,584**	**5,887**
Total Flow (dscfm @ 7% O2)	160,420	171,027	171,539	**167,662**	189,620	201,554	201,415	**197,530**	**176,622**
Stack Emissions (lb/hr)	0.0738	0.0781	0.0755	**0.0758**	0.0481	0.0509	0.0446	**0.0479**	**0.0674**
Total Emissions (lb/hr)	2.213	2.343	2.266	**2.274**	1.443	1.528	1.339	**1.437**	**2.023**
Total Emissions (lb/ton feed)	0.0080	0.0081	0.0079	**0.0080**	0.0052	0.0053	0.0047	**0.0051**	**0.0071**
Total Emissions (lb/ton clinker)	0.0124	0.0126	0.0123	**0.0124**	0.0081	0.0082	0.0072	**0.0078**	**0.0110**

RM On calculations are within 10% of corresponding value in test report. RM Off values more than 10% different from test report values due to report errors
Anomalies in 2011 report are in K:\11191.000.0\Stack Oct 12\Permit Apr 14\HRA comments\HRW to ATM deliv 8 4 14\Benzene\Anomalies in 2011 report.pdf
Due to errors in the report, concentrations from the 2011 report are from lab reports rather than summary tables.
Total flow is stack flow x 30.0, the flow factor derived from the 2012 source test.
Feed rate is clinker rate x 1.55, the feed/clinker factor derived from the 2012 source test.

Lehigh Benzene Source Tests: Table 1

2012 Table 1: raw data from report, results calculated									
	RM On				RM Off				70% On/30% Off
	Run 1	Run 2	Run3	Average	Run 1	Run 2	Run3	Average	Weighted Average
Clinker Rate (tph)	-	188	174	181	181	-	181	181	181
Feed Rate (tph)	-	292	270	281	281	-	281	281	281
O2 (%)	-	13.40	12.57	12.99	14.28	-	11.05	12.67	12.89
Concentration (ug/m3)	-	1,609	2,085	1,847	1,224	-	1,648	1,436	1,724
Concentration (ug/m3 @ 7% O2)	-	2,982	3,479	3,231	2,570	-	2,326	2,448	2,996
Stack Flow (dscfm)	-	13,409	9,546	11,478	14,310	-	10,019	12,165	11,684
Total Flow (dscfm)	-	402,272	286,381	344,327	429,314	-	300,585	364,950	350,513
Stack Flow (dscfm @ 7% O2)	-	7,235	5,721	6,478	6,815	-	7,100	6,958	6,622
Total Flow (dscfm @ 7% O2)	-	217,053	171,623	194,338	204,465	-	213,004	208,735	198,657
Stack Emissions (lb/hr)	-	0.0808	0.0746	0.0777	0.0656	-	0.0618	0.0637	0.0735
Total Emissions (lb/hr)	-	2.424	2.237	2.330	1.968	-	1.855	1.912	2.205
Total Emissions (lb/ton feed)	-	0.0083	0.0083	0.0083	0.0070	-	0.0066	0.0068	0.0078
Total Emissions (lb/ton clinker)	-	0.0129	0.0128	0.0129	0.0109	-	0.0102	0.0105	0.0122

All calculated results within 10% of corresponding value in test report

Clinker chosen to correspond from summary in appendix (PDF page 236) with feed rate listed on summary table.

RM On Run 1 and RM Off Run 2 are excluded because of anomalous benzene emissions (4 lb/hr)

RM Off feed and clinker rate are the average of RM On rates because measured rates are abnormally low for the flow rate (150 tph clinker)

Lehigh Benzene Source Tests: Table 1

Table 1 Calculation Parameters

	RM On				RM Off			
	Run 1	**Run 2**	**Run3**	**Average**	**Run 1**	**Run 2**	**Run3**	**Average**
Flow Ratio from 2012 Test	-	30.00	30.00	30.00	30.00	-	30.00	30.00
Average Flow Ratio:	**30.00**							

	RM On				RM Off			
	Run 1	**Run 2**	**Run3**	**Average**	**Run 1**	**Run 2**	**Run3**	**Average**
Feed/Clinker Ratio from 2012 Test	-	1.55	1.55	1.55	1.55	-	1.55	1.55
Average Feed/Clinker Ratio:	**1.55**							

1 m3 = 35.315 ft3
1 lb = 453,592,370 ug
1 hr = 60 mins

Lehigh Benzene Source Tests: Table 2

	RM On				RM Off				70% On/30% Off
	2009	2011	2012	Average	2009	2011	2012	Average	Weighted Average
Clinker Rate (tph)	199	183	181	**188**	199	183	181	**188**	**188**
Feed Rate (tph)	309	284	281	**291**	309	284	281	**291**	**291**
O2 (%)	11.41	12.20	12.99	**12.20**	11.63	10.65	12.67	**11.65**	**12.03**
Concentration (ug/m3)	1,130	2,267	1,847	**1,748**	1,227	1,433	1,436	**1,365**	**1,633**
Concentration (ug/m3 @ 7% O2)	1,675	3,623	3,231	**2,843**	1,873	1,944	2,448	**2,088**	**2,616**
Stack Flow (dscfm)	11,314	8,932	11,478	**10,575**	9,455	8,932	12,165	**10,184**	**10,457**
Total Flow (dscfm)	339,438	267,970	344,327	**317,245**	283,666	267,970	364,950	**305,529**	**313,730**
Stack Flow (dscfm @ 7% O2)	7,669	5,589	6,478	**6,579**	6,293	6,584	6,958	**6,612**	**6,589**
Total Flow (dscfm @ 7% O2)	230,089	167,662	194,338	**197,363**	188,789	197,530	208,735	**198,351**	**197,659**
Stack Emissions (lb/hr)	0.0482	0.0758	0.0777	**0.0672**	0.0433	0.0479	0.0637	**0.0516**	**0.0625**
Total Emissions (lb/hr)	1.445	2.274	2.330	**2.017**	1.298	1.437	1.912	**1.549**	**1.876**
Total Emissions (lb/ton feed)	0.0047	0.0080	0.0083	**0.0070**	0.0042	0.0051	0.0068	**0.0054**	**0.0065**
Total Emissions (lb/ton clinker)	0.0073	0.0124	0.0129	**0.0108**	0.0065	0.0078	0.0105	**0.0083**	**0.0101**

2012 RM On Run 1 and 2012 RM Off Run 2 are excluded because of anomalous benzene emissions (4 lb/hr)

2012 RM Off feed and clinker rate are the average of RM On rates because measured rates are abnormally low for the flow rate (150 tph clinker)