Air Pollution Model Glendale Springs, NC Appalachian Materials

Technical Report No. 15-274

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Blue Ridge Environmental Defense League

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Overview

On August 11, 2015, Appalachian Materials, LLC submitted an application to the North Carolina Division of Air Quality to build and operate a drum-mix asphalt plant on Glendale School Road in Glendale Springs, NC. The proposed asphalt plant site is also the site of a gravel quarry which has operated for several decades. The permit application submitted by Appalachian Materials and the draft permit now proposed by the Division of Air Quality would allow the construction of a 300 ton per hour drum mix plant producing 300 thousand tons of asphalt per year. The North Carolina Division of Air Quality has developed draft Permit No. 10445R00, which has not yet been approved by the Director of DAQ.

Findings

Our calculations indicate that the draft permit would not meet state standards for toxic air pollution (under 15A NCAC 2D .1104). This conclusion is not surprising if one considers that in addition to the smokestack emissions, a huge amount of fugitive volatile organic compounds could be emitted annually from the proposed Appalachian Materials asphalt plant. Fugitive emissions are pollutants which do not come from the smokestack. The results of our investigation are presented in Table 1, and in a map in Appendix B. The distances, in metric and English units, indicate how far from the proposed asphalt plant site on Glendale School Road excess pollution levels would contaminate the air with the compounds listed in column one. The spreadsheets for these data are included in Appendix C.

Table 1. Potential Pollution Levels Exceeding State Standards[1]

Pollutant	Distance (meters)	Distance (feet)
Benzene	10,000+	32,810+
Dioxin	3,000	9,843
Formaldehyde	700	2,297
Nickel	400	1,312
Mercury	200	656

Asphalt plants are regulated as point sources of air pollution. The principal source is the main smoke stack which carries emissions from the aggregate dryer and exits to the atmosphere after passing through the baghouse filter. But in addition to the main stack, asphalt plants have many sources of emissions including the asphalt cement heater and storage tank, fuel tanks, conveyor belts, hoppers and other equipment close to ground level. Because these emissions occur close to ground level and are not ejected upwards through the main stack, wind velocity is reduced and air pollution is not subject to the dispersion which occurs at higher levels. Stagnant air conditions and inversions increase the level of exposure to the local community. The photos in Figure 1 and Figure 2 were taken this year overlooking the South Fork of the New River in Glendale Springs in the vicinity of the proposed asphalt plant site. The air inversions are visible by the clouds in the valley.

[1] North Carolina Acceptable Ambient Levels, AALs, 15A NCAC 02D .1104, Toxic Air Pollutant Guidelines

Figure 1: Photographer: Pat Considine, Aug. 2015

Figure 2: Photographer: Pat Considine, Aug. 2015

The NC Division of Air Quality uses air dispersion computer modeling to derive the pollution limits for air quality permits. For our analysis, we employed an EPA spreadsheet based on the SCREEN3 air dispersion model which calculates all emission modeling modes: area source and volume source as well as point source. This model was dubbed ñworst caseò by its inventors at EPA. It provides reliable results because it takes into account the three ways sources may emit pollution: point, area and volume. For details see Appendix A.

The region of western North Carolina known as the High Country is subject to air inversions and other effects caused by the steep mountain terrain. The proposed site is located on a steep bank overlooking the New River. The photo of an operating asphalt plant illustrates the conditions which lead to excessive levels of particulate matter and high opacity which occur

in mountain regions. See Figure 3.[2] The plant in the photo was issued a permit to produce 100,000 tons of asphalt per year. If the draft permit is granted, the Appalachian Materials plant proposed for Glendale Springs would produce three times as much asphalt.

Figure 3. Operating Asphalt Plant

Fugitive Emissions Underestimated

Fugitive emissions are pollutants not emitted from the stack but released to the atmosphere. Based on the annual consumption of asphalt cement, one can calculate the asphalt vapor fugitive emissions from any plant. Asphalt cement typically comprises 5% (0.05) of the total hot mix plant production. Fugitive air emissions equal 1.07% (0.0107) of the consumed asphalt cement.[3]

So, for an asphalt plant producing 300,000 tons of hot mix asphalt per year:

300,000 tons hot mix x 0.05 = 15,000 tons/year of asphalt cement consumed.
Fugitive air emissions equal 1.07% (0.0107) of the consumed asphalt.
15,000 x 0.0107 = 161 tons per year of asphalt vapor fugitive emissions

The bulk of these fugitive emissions are condensed particulates. Volatile organic compounds (VOC) emissions are about 29% of the total. Therefore, about 47 tons of VOC and 114 tons of particulates may be emitted as fugitive emissions by a plant producing 300,000 tons of asphalt per year. To this must be added the total emitted from the smokestack itself.

The US EPA issued a report on asphalt plant fugitive emissions in 2001. The Blue Ridge Environmental Defense League participated in this review and co-authored a stakeholdersô dissenting opinion with a number of citizensôgroups and independent expertsð a Minority

[2] Rhodes Brothers Paving, NC Division of Air Quality Permit No. 08556R00, Site No. 1/57/00121

[3] Basis for this data is a mass balance analysis by Ravindra M. Nadkarni, Ph. D. in Metallurgy & Ceramic Engineering, University of Utah. Dr. Nadkarni authored or coauthored 70 professional papers or presentations on a variety of engineering subjects, including the economic impact of pollution control regulations, work which directly resulted in Section 119 of the Clean Air Act.

Reportò which was published with EPAôs study.[4] Examples of large fluctuations in emissions exist in the data gathered for this report by the EPA at a drum mix plant, where pollution increased by a factor of 2 to 3 over a 40 minute period. Episodes of high emissions caused by variations such as high temperatures were omitted by EPA because of a reliance on averages of data collected under ideal test conditions. Table 2 shows the effect of different volatile contents and operating temperatures on emissions from the asphalt storage silo and load-out alone in pounds per year.

Table 2. Changes in Emissions Caused by Asphalt Content and Temperature[5]

Load Out Emissions (a)	**EPA** (c)	**CITIZENS** (d)
Total Particulate Matter	**104**	**515**
Organic Particulate Matter	**68**	**478**
Total Organic Compounds (Method 25A)	**832**	**5,836**
Carbon Monoxide	**270**	**1,893**
Silo filling emissions (b)		
Total Particulate Matter	**117**	**423**
Organic Particulate Matter	**51**	**356**
Total Organic Compounds (Method 25A)	**2,437**	**17,100**
Carbon Monoxide	**236**	**1,656**

(a) Load-out emissions for both batch and drum plants - See AP-42, Table 11.1-14
(b) Load-out emissions for plants with silo storage- mainly, but not exclusively, drum plants. See AP-42, Table 11.1-14
(c) EPA estimates for drum plant in lb/200,000 tons of HMA. Volatility of 0.5%, 325 degrees-F
(d) Citizen estimates for drum plant in lb/200,000 tons of HMA. Volatility of 1.0%, 375 degrees-F

The Minority Report issued by citizens groups after the issuance of EPAôs fugitive emissions test results includes the following analysis:

> It can be seen that the emissions calculated by using EPA-derived equations, particularly emissions of noxious organic compounds, increase by over 600% under conditions of higher operating temperature and volatility contents. Both the EPA and the Citizen numbers would increased by another 20 to 30% to compensate for the low bias introduced by the ñbackground correctionò and ñMethod 204", discussed later in this report. Finally, it should be noted that although the numbers in Table 1 are shown on an annual basis to help compare them to Table 1 in the Executive Summary of the Emission Assessment Report, the citizens are aware that actual annual emissions will be lower since a plant will not always operate with an asphalt with a high volatiles content at high temperatures. On the other hand, the table

[4] ñMinority Report on Emissions from Asphalt Plants,ò *Hot Mix Asphalt Plants Stakeholders Opinions Report*, US Environmental Protection Agency Office of Air Quality Planning and Standards, Document #EPA-454/R-00-030, April 2001, page 49-67, Accessed 8/22/15 at http://www.epa.gov/ttnchie1/ap42/ch11/related/stkhld-opn.pdf

[5] *Id.*, page 49-67 (9)

clearly shows the type of variation in emissions that is likely to occur under such conditions with its acute effects on nearby residents.[6]

Based on reports from residents in communities with operating asphalt plants, we believe that periods of high emissions are frequent. Also, the computerized screening model used by the state for ground level fugitive emissions is inaccurate because such models do not apply within the atmospheric boundary layer, a distance of 30 feet from the ground where frictional effects predominate. This means that the stateôs use of such models for fugitive emissions will predict more dispersion and lower pollutant levels than will actually occur.

For example, Appalachian Materialsô permit application lists recycled asphalt pavement, or RAP, as an air pollution emission source. When a plant switches from one hot mix formula to another, emissions can increase. But a plant using RAP must use a higher operating temperature to provide extra heat to evaporate water associated with RAP, since RAP is stored in the open. Switching to a formula without RAP, the plant load-out will emit a higher level of organics because of overheating.

State Air Pollution Permit Fatally Flawed

The proposed asphalt plant site is also the site of a gravel quarry which has operated for several decades. The site has been significantly altered by the quarry operation. A review of topographic maps for the areað shown below in Figures C and Dð reveals that the site no longer conforms to the contour lines of maps updated as recently as 2013 by the US Geological Survey.[7] Figure 4, which includes an aerial view and is dated 2010, clearly shows the original contours of the slope without regard to the deep excavation caused by quarry operations. The same original and no longer correct contours may be seen in Figure 5, dated 2013. In order to accurately estimate ambient levels of pollution with a Gaussian dispersion computer model, accounting for downwind dispersion and cavitation effects resulting from the quarry walls, topographic maps used in the model must represent the actual contours of a given site. The site alterations require that a new, accurate map be generated before the stateôs modeling can be done.

Figure 4. US Geological Survey 2010 Map of Plant Site

USGS: NC_Glendale_Springs_20100825_TM_geo

[6] *Id.* page 49-67 (8)

[7] Map Locator, United States Geological Survey, accessed 25 August 2015 at http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&xcm=r3standardpitrex_prd&carea=%24ROOT&layout=6_1_61_48&uiarea=2)/.do

Figure 5. US Geological Survey 2013 Map of Plant Site

USGS: NC_Glendale_Springs_20130604_TM_geo

North Carolina regulations stipulate that ñgood engineering practice stack heightò is the greater of 65 meters measured from the ground-level elevation at the base of the stack or 2.5 times the height of nearby structures measured from the ground-level elevation at the base of the stack (NCAC 2D .0533). Contour intervals of 40 feet on the above maps reveal the steep drop along Glendale School Road down to the New River. However, according to the draft permit, the height of the stack for the proposed Appalachian Materials plant will be unknown. The draft permit states a height for a smokestack at a certain location, but it lacks a defined grade level; that is, there is no defined base elevation stipulated in the permit.

For example, the permit states that the height of the main stack, emission point CD-1, ñshall not be less than 25.49 feet and shall be located at UTM coordinates 17N 464365 4022333.ò Likewise, the height of the No. 2 fuel oil-fired asphalt cement heater, the second largest stack, ñshall not be less than 10.99 feet and shall be located at UTM coordinates 17N 464375 4022340.ò[8] Omitted here and elsewhere in the permit is the elevation of the base or the top of any air pollution emitting stacks, storage silos, or truck-loading areas. This type of information should be and typically is included relative to sea levelð amsl, above mean sea levelð in order to strictly define placement of the source and effectiveness of pollution control.

The DAQôs Air Permit Review, which forms the basis for the draft permit, indicates that the computer model used to predict pollution levels was compromised by the ñlack of representative surface and upper air meteorological data at this location.ò[9] The DAQ used AERSCREEN instead of AERMOD. Meteorological data is necessary for AERMOD. EPA guidance for the use of AERMOD states:

[8] North Carolina Division of Air Quality draft Permit No. 10445R00, Page 7
[9] NC Division of Air Quality Air Permit Review for Appalachian Materials, LLC, Glendale Asphalt Plant, App.# 0500074.15A, page 6.

> [T]o prepare the meteorological data for the AERMOD model (EPA, 2004b), the user must determine appropriate values for three surface characteristics: surface roughness length {zo}[10], albedo {r}, and Bowen ratio {Bo}.[11]
>
> Site specific meteorological data are assumed by definition to be representative of the application site; however, the determination of representativeness of site-specific data for AERMOD applications should also include an assessment of surface characteristics of the measurement and source locations and cannot be based solely on proximity. [12]

Emphases added. Surface characteristics include, for example, whether a plant site is surrounded by tall trees or flat pavement, whether there is a water body or dry land or both, the smokestack release height, plume buoyancy, downwash considerations, design of the plant and so forth. These surface factors affect pollution travel, direction and speed. Without thorough analysis, the predictions of whether a plant can operate within pollution limits is a guess. Lacking such data, one can fall back to the EPAôs Worst Case model, which we have done in this report.

Conclusion

The draft permit as written by the Division of Air Quality is fatally flawed. With this in mind, the Blue Ridge Environmental Defense League developed this report, employing tools which present a more accurate assessment of the pollution risks facing the residents of Glendale Springs. The results of our analysis indicate that the North Carolina Division of Air Qualityôs draft permit would not meet state standards for toxic air pollution and would present a severe risk to public health in at least a six-mile radius around the proposed asphalt plant site. Considering the large amount of toxic pollution in addition to that which comes from the smokestack, fugitive emissions, we recommend that Ashe County take steps to ensure that its Polluting Industries Ordinance be employed and strengthened in order to continue protecting the health and safety of the residents of Glendale Springs.

Louis A. Zeller
Executive Director
Blue Ridge Environmental Defense League

October 1, 2015

[10] Surface roughness length {zo}: The roughness length is used in numerical models to express the roughness of the surface. It affects the intensity of mechanical turbulence and the fluxes of various quantities above the surface. The 'roughness length' zo, depends on the frontal area of the average element (facing the wind) divided by the ground width it occupies. Vertical sub-gridscale heat exchange (by turbulent eddies) can be expressed as the vertical gradient of potential temperature times the roughness length. A lower roughness length implies less exchange between the surface and the atmosphere, but also stronger wind near the ground.

[11] In meteorology and hydrology, the Bowen ratio is used to describe the type of heat transfer in a water body.

[12] AERMOD Implementation Guide August 3, 2015, http://www3.epa.gov/ttn/scram/7thconf/aermod/aermod_implmtn_guide_3August2015.pdf

APPENDIX A: Modeling Information for Worst Case

Screen modeling tool to calculate worst case calculations

Air pollutant emission sources are commonly characterized as point, area or volume sources:

- Point source: A single, identifiable source of air pollutant emissions; for example, a combustion boiler flue gas stack. A point source has no geometric dimensions.
- Area source: A two-dimensional source of diffuse air pollutant emissions; for example, a landfill or vapors from a large spill of volatile liquid.
- Volume source: A three-dimensional source of diffuse air pollutant emissions. Essentially, it is an area source with height; for example, the fugitive gaseous emissions from piping flanges, valves and other equipment at various heights within industrial facilities such as petrochemical plants.

To calculate worst case calculations from point, area or volume source with spreadsheet:

If the emission rate is entered (where the big red value is) the spreadsheet will make the downwind calculations for each of the source types.

If the concern level is entered (at the smaller red value) the spreadsheet will make a comparison of the values.

Useful Conversion Factors

To convert concentrations in air (at 25°C) from ppm to mg/m^3:

$mg/m^3 = (ppm) \times (\text{molecular weight of the compound})/(24.45)$

e.g.: benzo(a)pyrene: 1 ppm = 10.3 mg/m^3.

To convert concentrations in air from $\mu g/m^3$ to mg/m^3:

$mg/m^3 = (\mu g/m^3) \times (1\ mg/1{,}000\ \mu g)$

To convert parts-per-million to milligrams/cubic meter and mg/m^3 to ppm:

$$mg/m^3 = (ppm) \times (\text{molecular weight of the compound})/(24.45)$$

$$ppm = \frac{24.45 \times mg/m^3}{\text{Mol. Wt.}}$$

Pounds per hour to grams per second conversion factor: Multiply pounds/hour by 0.126

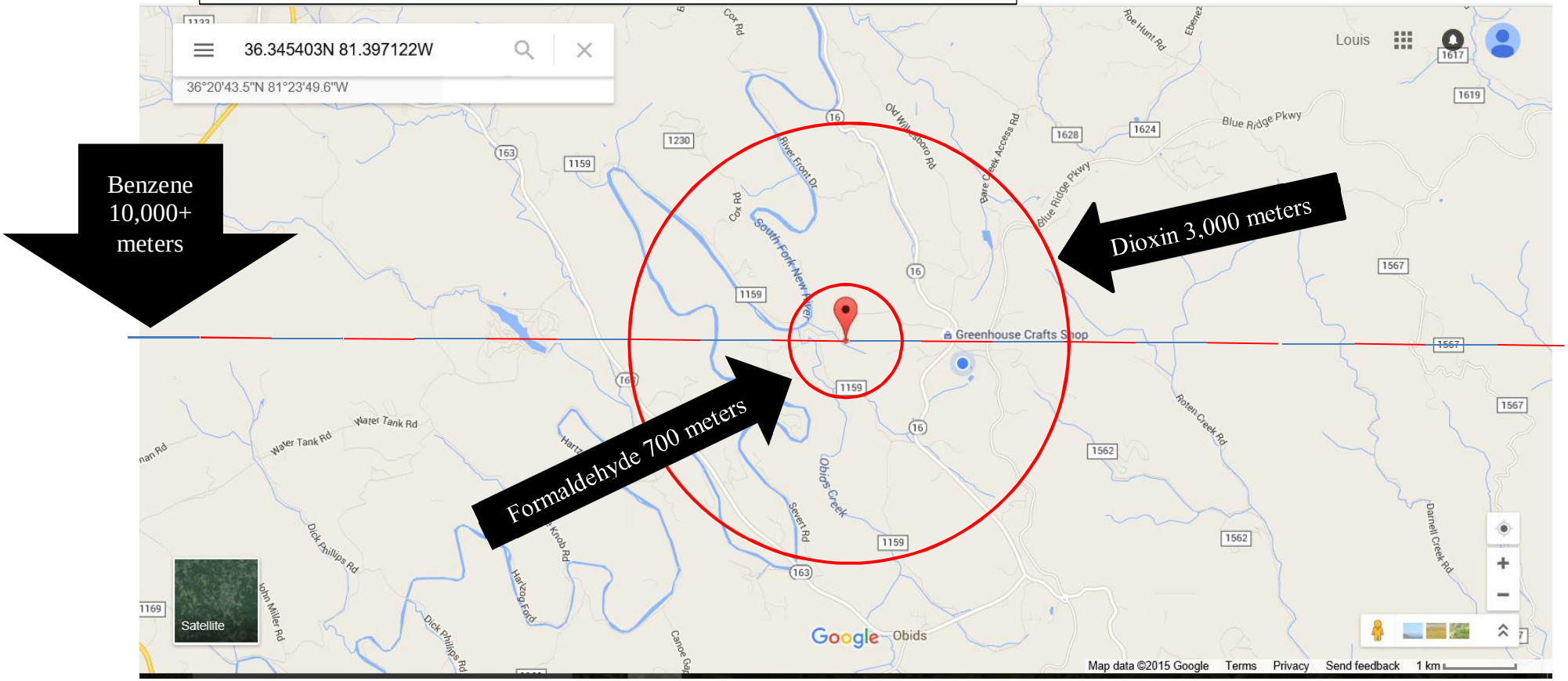
Because 0.126 grams/sec = 1 pound/hour

Pounds x 0.4536 = kilograms
Kg/1000 = grams

and

0.4536/3600 seconds per hour = 0.000126 kg/sec = 0.126 gm/sec

APPENDIX B: Extent of Pollution Estimated for Glendale Springs



The circles on this map of Glendale Springs illustrate the findings listed in Table 1 of this report. The distances show the extent of pollution above state of North Carolina Acceptable Ambient Levels, AALs, 15A NCAC 02D .1104, Toxic Air Pollutant Guidelines, based on maximum output of 300 tons per hour. Pollution emissions limits were taken from the NC Division of Air Quality draft permit for Appalachian Materials, LLC. The extent of the excess levels was generated by the data and listed in the spreadsheets, which are included in Appendix C. Table 1 includes distances in feet as well as meters.

Map Scale: 1000 meters
1 kilometer

APPENDIX C: Worst Case Spreadsheet Data

BENZENE

Enter the peak emission rate of the contaminant of concern:

Peak (30 min) Emission Rate =	**0.015**	**g/s**	**0.521**	**tons/yr**
MW=	**78**			
Concern level	**0.0000376**	**ppm**	**0.12**	**ug/m3**

Distance (M)	Point	Area	Volume	Worst	Recommendation
10	1.92E+02	2.58E+03	2.57E+02	**2.58E+03**	reduce emissions
100	1.11E+01	3.54E+02	1.15E+02	**3.54E+02**	reduce emissions
200	6.03E+00	1.40E+02	6.41E+01	**1.40E+02**	reduce emissions
300	4.15E+00	7.61E+01	4.13E+01	**7.61E+01**	reduce emissions
400	3.19E+00	4.82E+01	2.91E+01	**4.82E+01**	reduce emissions
500	2.59E+00	3.36E+01	2.17E+01	**3.36E+01**	reduce emissions
600	2.19E+00	2.49E+01	1.74E+01	**2.49E+01**	reduce emissions
700	1.86E+00	1.93E+01	1.41E+01	**1.93E+01**	reduce emissions
800	1.62E+00	1.56E+01	1.18E+01	**1.56E+01**	reduce emissions
900	1.62E+00	1.30E+01	1.01E+01	**1.30E+01**	reduce emissions
1000	1.63E+00	1.10E+01	8.70E+00	**1.10E+01**	reduce emissions
1100	1.60E+00	9.53E+00	7.61E+00	**9.53E+00**	reduce emissions
1200	1.61E+00	8.34E+00	6.73E+00	**8.34E+00**	reduce emissions
1300	1.60E+00	7.38E+00	6.00E+00	**7.38E+00**	reduce emissions
1400	1.59E+00	6.59E+00	5.40E+00	**6.59E+00**	reduce emissions
1500	1.57E+00	5.93E+00	4.89E+00	**5.93E+00**	reduce emissions
1600	1.54E+00	5.37E+00	4.46E+00	**5.37E+00**	reduce emissions
1700	1.51E+00	4.90E+00	4.08E+00	**4.90E+00**	reduce emissions
1800	1.47E+00	4.49E+00	3.75E+00	**4.49E+00**	reduce emissions
1900	1.44E+00	4.13E+00	3.47E+00	**4.13E+00**	reduce emissions
2000	1.40E+00	3.82E+00	3.26E+00	**3.82E+00**	reduce emissions
2100	1.36E+00	3.56E+00	3.05E+00	**3.56E+00**	reduce emissions
2200	1.32E+00	3.33E+00	2.85E+00	**3.33E+00**	reduce emissions
2300	1.28E+00	3.12E+00	2.68E+00	**3.12E+00**	reduce emissions
2400	1.25E+00	2.93E+00	2.53E+00	**2.93E+00**	reduce emissions
2500	1.21E+00	2.77E+00	2.39E+00	**2.77E+00**	reduce emissions
2600	1.18E+00	2.61E+00	2.26E+00	**2.61E+00**	reduce emissions
2700	1.14E+00	2.48E+00	2.14E+00	**2.48E+00**	reduce emissions
2800	1.11E+00	2.35E+00	2.04E+00	**2.35E+00**	reduce emissions
2900	1.08E+00	2.23E+00	1.94E+00	**2.23E+00**	reduce emissions
3000	1.05E+00	2.13E+00	1.86E+00	**2.13E+00**	reduce emissions
3500	9.16E-01	1.72E+00	1.51E+00	**1.72E+00**	reduce emissions
4000	8.09E-01	1.44E+00	1.26E+00	**1.44E+00**	reduce emissions
4500	7.22E-01	1.22E+00	1.08E+00	**1.22E+00**	reduce emissions
5000	6.49E-01	1.06E+00	9.38E-01	**1.06E+00**	reduce emissions
5500	5.88E-01	9.30E-01	8.25E-01	**9.30E-01**	reduce emissions
6000	5.37E-01	8.27E-01	7.34E-01	**8.27E-01**	reduce emissions
6500	4.92E-01	7.41E-01	6.59E-01	**7.41E-01**	reduce emissions

7000	4.54E-01	6.71E-01	5.97E-01	**6.71E-01**	reduce emissions
7500	4.21E-01	6.12E-01	5.46E-01	**6.12E-01**	reduce emissions
8000	3.93E-01	5.63E-01	5.02E-01	**5.63E-01**	reduce emissions
8500	3.67E-01	5.20E-01	4.64E-01	**5.20E-01**	reduce emissions
9000	3.44E-01	4.83E-01	4.31E-01	**4.83E-01**	reduce emissions
9500	3.24E-01	4.50E-01	4.02E-01	**4.50E-01**	reduce emissions
10000	3.06E-01	4.21E-01	3.76E-01	**4.21E-01**	reduce emissions

FORMALDEHYDE

Enter the peak emission rate of the contaminant of concern

Peak (30 min) Emission Rate =	**0.12**	**g/s**	**4.168**	**tons/yr**
MW=	**30**			
Concern level	**0.122**	**ppm**	**149.7**	**ug/m3**

Distance (M)	Point	Area	Volume	Worst	Recommendation
10	1.54E+03	2.06E+04	2.05E+03	**2.06E+04**	reduce emissions
100	8.84E+01	2.83E+03	9.24E+02	**2.83E+03**	reduce emissions
200	4.83E+01	1.12E+03	5.13E+02	**1.12E+03**	reduce emissions
300	3.32E+01	6.09E+02	3.30E+02	**6.09E+02**	reduce emissions
400	2.55E+01	3.86E+02	2.33E+02	**3.86E+02**	reduce emissions
500	2.07E+01	2.69E+02	1.74E+02	**2.69E+02**	reduce emissions
600	1.75E+01	1.99E+02	1.39E+02	**1.99E+02**	reduce emissions
700	1.48E+01	1.54E+02	1.13E+02	**1.54E+02**	reduce emissions
800	1.29E+01	1.25E+02	9.40E+01	**1.25E+02**	its OK
900	1.30E+01	1.04E+02	8.06E+01	**1.04E+02**	its OK
1000	1.30E+01	8.81E+01	6.96E+01	**8.81E+01**	its OK
1100	1.28E+01	7.62E+01	6.09E+01	**7.62E+01**	its OK
1200	1.28E+01	6.67E+01	5.38E+01	**6.67E+01**	its OK
1300	1.28E+01	5.90E+01	4.80E+01	**5.90E+01**	its OK
1400	1.27E+01	5.27E+01	4.32E+01	**5.27E+01**	its OK
1500	1.25E+01	4.74E+01	3.91E+01	**4.74E+01**	its OK
1600	1.23E+01	4.30E+01	3.56E+01	**4.30E+01**	its OK
1700	1.21E+01	3.92E+01	3.26E+01	**3.92E+01**	its OK
1800	1.18E+01	3.59E+01	3.00E+01	**3.59E+01**	its OK
1900	1.15E+01	3.30E+01	2.78E+01	**3.30E+01**	its OK
2000	1.12E+01	3.05E+01	2.61E+01	**3.05E+01**	its OK
2100	1.09E+01	2.85E+01	2.44E+01	**2.85E+01**	its OK
2200	1.06E+01	2.66E+01	2.28E+01	**2.66E+01**	its OK
2300	1.03E+01	2.50E+01	2.15E+01	**2.50E+01**	its OK
2400	9.97E+00	2.35E+01	2.02E+01	**2.35E+01**	its OK
2500	9.68E+00	2.21E+01	1.91E+01	**2.21E+01**	its OK
2600	9.40E+00	2.09E+01	1.81E+01	**2.09E+01**	its OK
2700	9.14E+00	1.98E+01	1.71E+01	**1.98E+01**	its OK
2800	8.88E+00	1.88E+01	1.63E+01	**1.88E+01**	its OK
2900	8.63E+00	1.79E+01	1.55E+01	**1.79E+01**	its OK
3000	8.39E+00	1.70E+01	1.49E+01	**1.70E+01**	its OK

3500	7.33E+00	1.38E+01	1.21E+01	**1.38E+01**	its OK
4000	6.47E+00	1.15E+01	1.01E+01	**1.15E+01**	its OK
4500	5.77E+00	9.78E+00	8.64E+00	**9.78E+00**	its OK
5000	5.19E+00	8.47E+00	7.50E+00	**8.47E+00**	its OK
5500	4.71E+00	7.44E+00	6.60E+00	**7.44E+00**	its OK
6000	4.29E+00	6.61E+00	5.87E+00	**6.61E+00**	its OK
6500	3.94E+00	5.93E+00	5.27E+00	**5.93E+00**	its OK
7000	3.63E+00	5.36E+00	4.78E+00	**5.36E+00**	its OK
7500	3.37E+00	4.90E+00	4.37E+00	**4.90E+00**	its OK
8000	3.14E+00	4.50E+00	4.02E+00	**4.50E+00**	its OK
8500	2.94E+00	4.16E+00	3.71E+00	**4.16E+00**	its OK
9000	2.76E+00	3.86E+00	3.45E+00	**3.86E+00**	its OK
9500	2.59E+00	3.60E+00	3.22E+00	**3.60E+00**	its OK
10000	2.45E+00	3.37E+00	3.01E+00	**3.37E+00**	its OK

MERCURY

Enter the peak emission rate of the contaminant of concern

Peak (30 min) Emission Rate =	**0.000098**	**g/s**	**0.003**	**tons/yr**
MW=	**200**			
Concern level	**0.0000734**	**ppm**	**0.6**	**ug/m3**

Distance (M)	**Point**	**Area**	**Volume**	**Worst**	**Recommendation**
10	1.26E+00	1.68E+01	1.68E+00	**1.68E+01**	reduce emissions
100	7.22E-02	2.31E+00	7.54E-01	**2.31E+00**	reduce emissions
200	3.94E-02	9.16E-01	4.19E-01	**9.16E-01**	reduce emissions
300	2.71E-02	4.97E-01	2.70E-01	**4.97E-01**	its OK
400	2.08E-02	3.15E-01	1.90E-01	**3.15E-01**	its OK
500	1.69E-02	2.19E-01	1.42E-01	**2.19E-01**	its OK
600	1.43E-02	1.63E-01	1.14E-01	**1.63E-01**	its OK
700	1.21E-02	1.26E-01	9.24E-02	**1.26E-01**	its OK
800	1.06E-02	1.02E-01	7.68E-02	**1.02E-01**	its OK
900	1.06E-02	8.50E-02	6.58E-02	**8.50E-02**	its OK
1000	1.06E-02	7.20E-02	5.68E-02	**7.20E-02**	its OK
1100	1.05E-02	6.22E-02	4.97E-02	**6.22E-02**	its OK
1200	1.05E-02	5.45E-02	4.40E-02	**5.45E-02**	its OK
1300	1.05E-02	4.82E-02	3.92E-02	**4.82E-02**	its OK
1400	1.04E-02	4.31E-02	3.53E-02	**4.31E-02**	its OK
1500	1.02E-02	3.87E-02	3.19E-02	**3.87E-02**	its OK
1600	1.01E-02	3.51E-02	2.91E-02	**3.51E-02**	its OK
1700	9.86E-03	3.20E-02	2.67E-02	**3.20E-02**	its OK
1800	9.64E-03	2.93E-02	2.45E-02	**2.93E-02**	its OK
1900	9.40E-03	2.70E-02	2.27E-02	**2.70E-02**	its OK
2000	9.16E-03	2.49E-02	2.13E-02	**2.49E-02**	its OK
2100	8.90E-03	2.32E-02	1.99E-02	**2.32E-02**	its OK
2200	8.64E-03	2.17E-02	1.86E-02	**2.17E-02**	its OK
2300	8.39E-03	2.04E-02	1.75E-02	**2.04E-02**	its OK

2400	8.14E-03	1.92E-02	1.65E-02	**1.92E-02**	its OK
2500	7.91E-03	1.81E-02	1.56E-02	**1.81E-02**	its OK
2600	7.68E-03	1.71E-02	1.48E-02	**1.71E-02**	its OK
2700	7.46E-03	1.62E-02	1.40E-02	**1.62E-02**	its OK
2800	7.25E-03	1.53E-02	1.33E-02	**1.53E-02**	its OK
2900	7.05E-03	1.46E-02	1.27E-02	**1.46E-02**	its OK
3000	6.85E-03	1.39E-02	1.21E-02	**1.39E-02**	its OK
3500	5.98E-03	1.13E-02	9.88E-03	**1.13E-02**	its OK
4000	5.29E-03	9.38E-03	8.26E-03	**9.38E-03**	its OK
4500	4.71E-03	7.99E-03	7.06E-03	**7.99E-03**	its OK
5000	4.24E-03	6.92E-03	6.13E-03	**6.92E-03**	its OK
5500	3.84E-03	6.08E-03	5.39E-03	**6.08E-03**	its OK
6000	3.51E-03	5.40E-03	4.80E-03	**5.40E-03**	its OK
6500	3.22E-03	4.84E-03	4.31E-03	**4.84E-03**	its OK
7000	2.97E-03	4.38E-03	3.90E-03	**4.38E-03**	its OK
7500	2.75E-03	4.00E-03	3.57E-03	**4.00E-03**	its OK
8000	2.56E-03	3.68E-03	3.28E-03	**3.68E-03**	its OK
8500	2.40E-03	3.40E-03	3.03E-03	**3.40E-03**	its OK
9000	2.25E-03	3.15E-03	2.82E-03	**3.15E-03**	its OK
9500	2.12E-03	2.94E-03	2.63E-03	**2.94E-03**	its OK
10000	2.00E-03	2.75E-03	2.46E-03	**2.75E-03**	its OK

NICKEL

Enter the peak emission rate of the contaminAnt of concern

Peak (30 min) Emission Rate =	**0.00238**	**g/s**	**0.083**	**tons/yr**
MW=	**58.69**			
Concern level	**0.0025**	**ppm**	**6.001**	**ug/m3**

Distance (M)	**Point**	**Area**	**Volume**	**Worst**	**Recommendation**
10	3.05E+01	4.09E+02	4.07E+01	**4.09E+02**	reduce emissions
100	1.75E+00	5.62E+01	1.83E+01	**5.62E+01**	reduce emissions
200	9.57E-01	2.22E+01	1.02E+01	**2.22E+01**	reduce emissions
300	6.59E-01	1.21E+01	6.55E+00	**1.21E+01**	reduce emissions
400	5.06E-01	7.65E+00	4.61E+00	**7.65E+00**	reduce emissions
500	4.11E-01	5.33E+00	3.44E+00	**5.33E+00**	its OK
600	3.48E-01	3.95E+00	2.76E+00	**3.95E+00**	its OK
700	2.94E-01	3.06E+00	2.24E+00	**3.06E+00**	its OK
800	2.57E-01	2.48E+00	1.86E+00	**2.48E+00**	its OK
900	2.58E-01	2.06E+00	1.60E+00	**2.06E+00**	its OK
1000	2.58E-01	1.75E+00	1.38E+00	**1.75E+00**	its OK
1100	2.54E-01	1.51E+00	1.21E+00	**1.51E+00**	its OK
1200	2.55E-01	1.32E+00	1.07E+00	**1.32E+00**	its OK
1300	2.54E-01	1.17E+00	9.53E-01	**1.17E+00**	its OK
1400	2.52E-01	1.05E+00	8.57E-01	**1.05E+00**	its OK
1500	2.49E-01	9.41E-01	7.76E-01	**9.41E-01**	its OK

1600	2.44E-01	8.52E-01	7.07E-01	**8.52E-01**	its OK
1700	2.39E-01	7.77E-01	6.47E-01	**7.77E-01**	its OK
1800	2.34E-01	7.12E-01	5.96E-01	**7.12E-01**	its OK
1900	2.28E-01	6.55E-01	5.50E-01	**6.55E-01**	its OK
2000	2.22E-01	6.06E-01	5.17E-01	**6.06E-01**	its OK
2100	2.16E-01	5.65E-01	4.83E-01	**5.65E-01**	its OK
2200	2.10E-01	5.28E-01	4.53E-01	**5.28E-01**	its OK
2300	2.04E-01	4.95E-01	4.26E-01	**4.95E-01**	its OK
2400	1.98E-01	4.66E-01	4.01E-01	**4.66E-01**	its OK
2500	1.92E-01	4.39E-01	3.79E-01	**4.39E-01**	its OK
2600	1.87E-01	4.15E-01	3.58E-01	**4.15E-01**	its OK
2700	1.81E-01	3.93E-01	3.40E-01	**3.93E-01**	its OK
2800	1.76E-01	3.72E-01	3.23E-01	**3.72E-01**	its OK
2900	1.71E-01	3.54E-01	3.07E-01	**3.54E-01**	its OK
3000	1.66E-01	3.37E-01	2.95E-01	**3.37E-01**	its OK
3500	1.45E-01	2.73E-01	2.40E-01	**2.73E-01**	its OK
4000	1.28E-01	2.28E-01	2.01E-01	**2.28E-01**	its OK
4500	1.15E-01	1.94E-01	1.71E-01	**1.94E-01**	its OK
5000	1.03E-01	1.68E-01	1.49E-01	**1.68E-01**	its OK
5500	9.33E-02	1.48E-01	1.31E-01	**1.48E-01**	its OK
6000	8.51E-02	1.31E-01	1.16E-01	**1.31E-01**	its OK
6500	7.81E-02	1.18E-01	1.05E-01	**1.18E-01**	its OK
7000	7.20E-02	1.06E-01	9.47E-02	**1.06E-01**	its OK
7500	6.68E-02	9.72E-02	8.67E-02	**9.72E-02**	its OK
8000	6.23E-02	8.93E-02	7.97E-02	**8.93E-02**	its OK
8500	5.82E-02	8.25E-02	7.37E-02	**8.25E-02**	its OK
9000	5.46E-02	7.66E-02	6.84E-02	**7.66E-02**	its OK
9500	5.14E-02	7.14E-02	6.38E-02	**7.14E-02**	its OK
10000	4.86E-02	6.68E-02	5.97E-02	**6.68E-02**	its OK

HEXACHLORO-P-DIBENZODIOXIN

Enter the peak emission rate of the contaminAnt of concern

Peak (30 min) Emission Rate =	**0.000000643**	**g/s**	**2E-05**	**tons/yr**
MW=	**390.86**			
Concern level	**4.75E-09**	**ppm**	**8E-05**	**ug/m3**

Distance (M)	Point	Area	Volume	Worst	Recommendation
10	8.25E-03	1.10E-01	1.10E-02	**1.10E-01**	reduce emissions
100	4.74E-04	1.52E-02	4.95E-03	**1.52E-02**	reduce emissions
200	2.59E-04	6.01E-03	2.75E-03	**6.01E-03**	reduce emissions
300	1.78E-04	3.26E-03	1.77E-03	**3.26E-03**	reduce emissions
400	1.37E-04	2.07E-03	1.25E-03	**2.07E-03**	reduce emissions
500	1.11E-04	1.44E-03	9.30E-04	**1.44E-03**	reduce emissions
600	9.40E-05	1.07E-03	7.47E-04	**1.07E-03**	reduce emissions
700	7.95E-05	8.27E-04	6.06E-04	**8.27E-04**	reduce emissions
800	6.93E-05	6.71E-04	5.04E-04	**6.71E-04**	reduce emissions
900	6.96E-05	5.57E-04	4.32E-04	**5.57E-04**	reduce emissions

1000	6.98E-05	4.72E-04	3.73E-04	**4.72E-04**	reduce emissions
1100	6.87E-05	4.08E-04	3.26E-04	**4.08E-04**	reduce emissions
1200	6.88E-05	3.58E-04	2.88E-04	**3.58E-04**	reduce emissions
1300	6.87E-05	3.16E-04	2.57E-04	**3.16E-04**	reduce emissions
1400	6.81E-05	2.82E-04	2.31E-04	**2.82E-04**	reduce emissions
1500	6.72E-05	2.54E-04	2.10E-04	**2.54E-04**	reduce emissions
1600	6.60E-05	2.30E-04	1.91E-04	**2.30E-04**	reduce emissions
1700	6.47E-05	2.10E-04	1.75E-04	**2.10E-04**	reduce emissions
1800	6.32E-05	1.92E-04	1.61E-04	**1.92E-04**	reduce emissions
1900	6.17E-05	1.77E-04	1.49E-04	**1.77E-04**	reduce emissions
2000	6.01E-05	1.64E-04	1.40E-04	**1.64E-04**	reduce emissions
2100	5.84E-05	1.53E-04	1.31E-04	**1.53E-04**	reduce emissions
2200	5.67E-05	1.43E-04	1.22E-04	**1.43E-04**	reduce emissions
2300	5.50E-05	1.34E-04	1.15E-04	**1.34E-04**	reduce emissions
2400	5.34E-05	1.26E-04	1.08E-04	**1.26E-04**	reduce emissions
2500	5.19E-05	1.19E-04	1.02E-04	**1.19E-04**	reduce emissions
2600	5.04E-05	1.12E-04	9.68E-05	**1.12E-04**	reduce emissions
2700	4.90E-05	1.06E-04	9.19E-05	**1.06E-04**	reduce emissions
2800	4.76E-05	1.01E-04	8.73E-05	**1.01E-04**	reduce emissions
2900	4.62E-05	9.57E-05	8.31E-05	**9.57E-05**	reduce emissions
3000	4.50E-05	9.11E-05	7.97E-05	**9.11E-05**	reduce emissions
3500	3.93E-05	7.38E-05	6.48E-05	**7.38E-05**	its OK
4000	3.47E-05	6.15E-05	5.42E-05	**6.15E-05**	its OK
4500	3.09E-05	5.24E-05	4.63E-05	**5.24E-05**	its OK
5000	2.78E-05	4.54E-05	4.02E-05	**4.54E-05**	its OK
5500	2.52E-05	3.99E-05	3.54E-05	**3.99E-05**	its OK
6000	2.30E-05	3.54E-05	3.15E-05	**3.54E-05**	its OK
6500	2.11E-05	3.18E-05	2.83E-05	**3.18E-05**	its OK
7000	1.95E-05	2.87E-05	2.56E-05	**2.87E-05**	its OK
7500	1.81E-05	2.63E-05	2.34E-05	**2.63E-05**	its OK
8000	1.68E-05	2.41E-05	2.15E-05	**2.41E-05**	its OK
8500	1.57E-05	2.23E-05	1.99E-05	**2.23E-05**	its OK
9000	1.48E-05	2.07E-05	1.85E-05	**2.07E-05**	its OK
9500	1.39E-05	1.93E-05	1.72E-05	**1.93E-05**	its OK
10000	1.31E-05	1.80E-05	1.61E-05	**1.80E-05**	its OK