**APPENDIX A: Emissions Calculations**

**Greenhouse Gas Calculations**

**Scope I Emissions**

<table>
<thead>
<tr>
<th>Methane Emissions from the Mine</th>
<th>methane liberation</th>
<th>undetectable on the rock face</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAM monitoring by MSHA</td>
<td>1st qtr calendar yr 2012</td>
<td>84,545 (ft³/day)</td>
</tr>
<tr>
<td></td>
<td>2nd qtr calendar yr 2012</td>
<td>41,898 (ft³/day)</td>
</tr>
<tr>
<td></td>
<td>3rd qtr calendar yr 2012</td>
<td>175,851 (ft³/day)</td>
</tr>
<tr>
<td></td>
<td>4th qtr calendar yr 2012</td>
<td>120,325 (ft³/day)</td>
</tr>
<tr>
<td><strong>Average value:</strong></td>
<td></td>
<td><strong>105,654 (ft³/day)</strong></td>
</tr>
</tbody>
</table>

extrapolating estimated annual methane emissions from average daily emissions:

\[
105,654 \text{ ft}^3/\text{day CH}_4 = 4.486 \text{ lb/day CH}_4^a \\
4.486 \text{ lb/day CH}_4 \times 365 \text{ day/yr} = 1637 \text{ lb/yr CH}_4 \\
1637 \text{ lb/yr CH}_4 / 2204.6 \text{ lb/metric ton} = 0.7425 \text{ metric ton/yr CH}_4 \\
0.7425 \text{ metric ton/yr CH}_4 \times 21^b = 15.59 \text{ metric tons CO}_2/\text{yr} \\
\]

^a conversion done on US EPA Coalbed Methane outreach Program’s Interactive Units Converter at: [http://www.epa.gov/cmop/resources/converter.html](http://www.epa.gov/cmop/resources/converter.html)

^b 21 is the GHG equivalent emissions per 1 unit of CH₄
Emission Calculations for Combustion Sources

Equations\(^b\):

\[
\begin{align*}
\text{CO}_2 &= 1 \times 10^{-3} \times \text{Fuel} \times \text{HHV} \times \text{EF} \\
\text{CH}_4 &= 1 \times 10^{-3} \times \text{Fuel} \times \text{HHV} \times \text{EF} \\
\text{N}_2\text{O} &= 1 \times 10^{-3} \times \text{Fuel} \times \text{HHV} \times \text{EF}
\end{align*}
\]

where HHV = high heating value = 0.138 MMBtu/gal

and EF = emission factors =

\[
\begin{align*}
\text{CO}_2 &= 73.96 \text{ kg/MBBu} \\
\text{CH}_4 &= 3.00 \times 10^{-3} \text{ kg/MBBu} \\
\text{N}_2\text{O} &= 6.00 \times 10^{-4} \text{ kg/MBBu}
\end{align*}
\]

\(^b\)Equations and emission factors based on Tier 1 calculation methodology from 40 CFR 98 Subpart C, Table C-1 and Table C-2

<table>
<thead>
<tr>
<th>diesel fired equipment</th>
<th>Horsepower</th>
<th>Heat Input Rate(^c)</th>
<th>Fuel Consumption</th>
<th>(metric tons/year)</th>
<th>(\text{CO}_2)</th>
<th>(\text{CH}_4)(^c)</th>
<th>(\text{N}_2\text{O})(^c)</th>
<th>(\text{CO}_{2\text{e}})</th>
</tr>
</thead>
<tbody>
<tr>
<td>front end loader</td>
<td>200 hp</td>
<td>0.51 MMBtu/hr</td>
<td>9,116 gal/yr</td>
<td>93.0</td>
<td>0.0038</td>
<td>0.00075</td>
<td>93</td>
<td></td>
</tr>
</tbody>
</table>

\(^c\)converted to \(\text{CO}_{2\text{e}}\) based on 40 CFR 98 Subpart A, \(\text{CH}_4 \times 21 = \text{CO}_{2\text{e}}\) and \(\text{N}_2\text{O} \times 310 = \text{CO}_{2\text{e}}\)

Total Scope I Emissions: 93 metric tons \(\text{CO}_{2\text{e}}/\text{yr}\) + 15.59 metric tons \(\text{CO}_{2\text{e}}\) = \textbf{109 metric tons \(\text{CO}_{2\text{e}}/\text{yr}\)}

Emissions Calculations for
BLM Coal Lease OHES 57390 EA
### Greenhouse Gas Calculations

#### Scope II Emissions

**2012 Electricity Usage Emissions**

<table>
<thead>
<tr>
<th>Equation(^d):</th>
<th>metric ton CO(<em>{2e}) = Electricity used (kWh) x state value of the eGRID non-baseload output emissions rate (MTCO(</em>{2e})/kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012 Electricity Usage in #6 &amp; #7 mines</td>
<td>Ohio Emissions Rate</td>
</tr>
<tr>
<td>38.6 million Kwh/yr</td>
<td>0.000891 metric ton CO2e/kWh</td>
</tr>
</tbody>
</table>

Because the #6 mine produced the approximate value of coal that would be recovered from the proposed lease parcels and because it represents 70% of the total production between mine #6 and #7, the total CO2e value was multiplied by 70% to get a rough estimate of the electricity emissions that would occur if the proposed lease parcels were mined.

**Total Scope II Emissions:** 34,393.660 metric ton CO\(_{2e}\) x 0.7 = **24,100 metric tons CO\(_{2e}\)**

\(^d\) Equation is from the EPA Pollution Prevention Program's Greenhouse Gas Calculator at: [http://www.epa.gov/p2/pubs/resources/measurement.html](http://www.epa.gov/p2/pubs/resources/measurement.html)
# Greenhouse Gas Calculations

## Scope III Emissions

<table>
<thead>
<tr>
<th>Parcel</th>
<th>Acres</th>
<th>$1,800 \times #ac \times \text{coal seam thickness (4.5ft)} = \text{total short tons coal}$</th>
<th>Recoverable Coal in short tons (using 45% recovery rate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>x41</td>
<td>80</td>
<td>648,000</td>
<td>291,600</td>
</tr>
<tr>
<td>x37</td>
<td>109.35</td>
<td>885,736</td>
<td>398,581.20</td>
</tr>
<tr>
<td>x76</td>
<td>10</td>
<td>81,000</td>
<td>36,450</td>
</tr>
<tr>
<td>x38 &amp; x53 (Perry County)</td>
<td>80</td>
<td>648,000</td>
<td>291,600</td>
</tr>
<tr>
<td>x35 &amp; x38 (Morgan County)</td>
<td>60.94</td>
<td>493,614</td>
<td>222,126.30</td>
</tr>
<tr>
<td>x81</td>
<td>86.25</td>
<td>698,625</td>
<td>314,381.25</td>
</tr>
<tr>
<td>x32</td>
<td>6</td>
<td>48,600</td>
<td>21,870</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td>432.54</td>
<td><strong>3,503,575</strong></td>
<td><strong>1,576,609</strong></td>
</tr>
</tbody>
</table>

### Coal Combustion

Converting short tons of recoverable coal to metric tons:

$1,576,609 \text{ short tons} \times 0.907185 \text{ metric tons/short ton} = 1,403,276.04 \text{ metric tons of coal}$

Converting metric tons of coal to metric tons of CO2e (represents emissions from combusting the coal at a power plant):

$\frac{1,403,276.04 \text{ metric tons of coal} \times 2,128.82 \text{ kg CO2e/metric ton coal}}{1 \text{ metric ton CO2e}/1,000 \text{ kg CO2e}} = 2,987,322 \text{ metric ton CO2e}$

---

*Equation is from the EPA Pollution Prevention Program’s Greenhouse Gas Calculator at: [http://www.epa.gov/p2/pubs/resources/measurement.html](http://www.epa.gov/p2/pubs/resources/measurement.html)*

---

Emissions Calculations for  
BLM Coal Lease OHES 57390 EA
Air Emissions of Criteria Pollutants

- 1,576,609 tons of coal from seven non-contiguous parcels (432.54 total acres) over life of project
- No surface mining activities (using existing mine entrances)
- Assuming no control technologies, no need for large equipment purchases
- Emission factors below are in lb/ton of material processed

1. Fugitive Dust:
   - Fugitive dust results in PM (generally from haul roads, blasting, drilling, screening, conveying, storage piles, loaders, and also any preprocessing that may occur)

Mining activities (blasting/drilling) and Crushing and Conveying

AP-42 section 11.24 Metallic Minerals Processing

- Since the mine will not be vented, PM emissions “inside” are not assumed to become ambient; therefore there are no emissions associated with underground mining (blasting/drilling) using existing entrances.
- Crushing will occur in an enclosed structure – I was not informed whether this structure is vented. If the structure is not vented there will be no associated emissions. Since I was not informed, I am assuming the structure is vented and am including the emissions in the calculations. The moisture content is 7% +/- or slightly higher (considered high moisture – refer to High Moisture Ore – Primary Crushing).
  - $E_{PM} = 0.02 \times 1,576,609 \text{ tons coal} = 31,532.18 \text{ lbs PM} ÷ 2,000\text{lbs/ton} = \textbf{15.77 tons PM}$
  - $E_{PM10} = 0.009 \times 1,576,609 \text{ tons coal} = 14,189.48 \text{ lbs PM10} ÷ 2,000\text{lbs/ton} = \textbf{7.09 tons PM10}$
- Conveying (Electric motors driven): #6 Mine Conveyor – 2,500’ covered and #7 Mine Conveyor – 2,500’ covered {Adding material to the pile by a conveyor stacker is a continuous drop operation}
  - No emissions associated with time on covered 2,500’ conveyor
  - Conveyor emissions apply to loading/unloading operation (conveyor belt transfer points)
    - $E_{PM} = 0.01 \times 1,576,609 \text{ tons coal} = 15,766.09 \text{ lbs PM at each transfer point} × 2 \text{ transfer points} = 31,532.18 \text{ lbs PM} ÷ 2,000\text{lbs/ton} = \textbf{15.77 tons PM over life of project}$
    - $E_{PM10} = 0.004 \times 1,576,609 \text{ tons coal} = 6,306.44 \text{ lbs PM10 at each transfer point} × 2 \text{ transfer points} = 12,612.87 \text{ lbs PM10} ÷ 2,000\text{lbs/ton} = \textbf{6.31 tons PM over life of project}$

Emissions Calculations for
BLM Coal Lease OHES 57390 EA
Emissions Calculations for BLM Coal Lease OHES 57390 EA

Washing

AP-42 section 11.10 Coal Cleaning

- Washing performed on-site in an enclosed plant
- Drying is associated with a multilouvered dryer in an enclosed structure. I was not informed whether this structure is vented. If the structure is not vented there will be no associated emissions. Since I was not informed, I am assuming the structure is vented and am including the emissions in the calculations.

\[ E_{PM} = 3.7 \times 1,576,609 \text{ tons coal} = 5,833,453.3 \text{ lbs} \div 2,000 \text{ lbs/ton} = 2,916.73 \text{ tons PM over life of project} \]

Emissions Calculations for BLM Coal Lease OHES 57390 EA
- $E_{PM2.5} = \text{No Data}$
- $E_{PM10} = \text{No Data}$
- $E_{PM(\text{inorganic condensable})} = 0.057 \times 1,576,609 \text{ tons coal} = 89,866.71 \text{ lbs} \div 2,000 \text{ lbs/ton} = \text{44.93 tons inorganic condensable PM over life of project}$
- $E_{PM(\text{organic condensable})} = 0.018 \times 1,576,609 \text{ tons coal} = 228,378.96 \text{ lbs} \div 2,000 \text{ lbs/ton} = \text{14.19 tons organic condensable PM over life of project}$
- $E_{VOC} = \text{No Data}$
- $E_{SO2} = \text{No Data}$
- $E_{NOx} = \text{No Data}$
- $E_{CO2} \text{ calculations performed separately}$
Table 11.10-1. PM EMISSION FACTORS FOR COAL CLEANING\textsuperscript{a}

EMISSION FACTOR RATING: D (except as noted)

<table>
<thead>
<tr>
<th>Process</th>
<th>Filterable PM\textsuperscript{b}</th>
<th>Condensable PM\textsuperscript{c}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PM</td>
<td>PM-2.5</td>
</tr>
<tr>
<td>Multilayered dryer\textsuperscript{d} (SCC 3-05-010-03)</td>
<td>3.7</td>
<td>ND</td>
</tr>
<tr>
<td>Fluidized bed dryer\textsuperscript{e} (SCC 3-05-010-01)</td>
<td>26\textsuperscript{f}</td>
<td>3.8\textsuperscript{g}</td>
</tr>
<tr>
<td>Fluidized bed dryer with venturi scrubber\textsuperscript{l} (SCC 3-05-010-01)</td>
<td>0.17</td>
<td>ND</td>
</tr>
<tr>
<td>Fluidized bed dryer with venturi scrubber and tray scrubber\textsuperscript{m} (SCC 3-05-010-01)</td>
<td>0.025</td>
<td>ND</td>
</tr>
<tr>
<td>Air tables with fabric filter\textsuperscript{n} (SCC 3-05-010-13)</td>
<td>0.032\textsuperscript{q}</td>
<td>ND</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Emission factor units are lb/ton of coal feed, unless noted. 1 lb/ton = 2 kg/Mg. SCC = Source Classification Code. ND = no data.

\textsuperscript{b} Filterable PM is that PM collected on or prior to the filter of an EPA Method 5 (or equivalent) sampling train.

\textsuperscript{c} Condensable PM is that PM collected in the impinger portion of a PM sampling train.

\textsuperscript{d} Reference 11. Alternate SCC is 3-05-310-03, which corresponds to units of lb/thousand tons of coal feed. To determine the emission factor for this alternate SCC, multiply the factor in this table by 1,000.

\textsuperscript{e} Alternate SCC is 3-05-310-01, which corresponds to units of lb/thousand tons of coal feed. To determine the emission factor for this alternate SCC, multiply the factor in this table by 1,000.

\textsuperscript{f} References 12,15.

\textsuperscript{g} References 12,15. EMISSION FACTOR RATING: E. Particle size data from Reference 15 used in conjunction with filterable PM data from References 12 and 15. Actual cut size of PM-2.5 data was 2.7 microns.

\textsuperscript{h} Reference 12.

\textsuperscript{i} References 12,13,15-16,20. See footnote "c" above for alternate SCC.

\textsuperscript{j} Reference 21. Tray scrubber using NaOH as the scrubbing liquid. See footnote "c" above for alternate SCC.

\textsuperscript{k} Alternate SCC is 3-05-310-13, which corresponds to units of lb/thousand tons of coal feed. To determine the emission factor for this alternate SCC, multiply the factor in this table by 1,000.

BLM Coal Lease OHES 57390 EA
Emissions from Storage Piles

AP-42 section 13.2.4 Aggregate Handling and Storage Piles

- 2 stockpiles of coal in open area before and after crushing – Raw Coal and Washed Coal approximately 20-30,000 tons per pile
- Coal moisture content, particle size, and mean wind speed = Coal Moisture content is 7% +/-, max size is 4” – average is usually less than 4”. There is some clay associated with the coal, when washed out it is removed to the collection ponds as slurry – 8% +/- clay removed from the coal.
- Average/minimum particle size not provided, therefore selected conservative estimate < 30µm
Mean wind speed not provided so average Ohio value of 15.4mph selected

\[
\text{EF} = 0.74(0.0032)x((15.4/5)^{1.3} \div (7\% / 2)^{1.4}) = 0.001769
\]

\[E_{PM} = 0.001769 \times 1,576,609 \text{ tons coal} = 2,789 \text{ lbs} \div 2,000 \text{ lbs/ton} = 1.39 \text{ tons PM over life of project}
\]

2. Fuel combustion:

- From onsite motorized equipment, including mobile sources (e.g., haul trucks), heavy equipment, and generators
- Combustion results in PM, NOx and SO2 (along with GHGs, CO, VOCs and trace HAPs)
- The removal of coal from the mine is done by a conveyor system that is covered – There are diesel trucks that move coal from the piles or the conveyors, that also transport coal off site (all covered/tarped). There are 2 -200Hp Diesel Dump Trucks used around the piles, all less than 10 years old, for hauling around the impoundments, hauling coarse refuse and waste to impoundment. One 300 HP diesel water tank truck is used for dust control within site on unpaved roads, approximately 4 miles/day when weather conditions require.
- Based on EPA Standards (http://www.epa.gov/otaq/cert/hd-cert/stds-eng.pdf) and 2003 truck date, EFs = 1.3 g HC/hp-hr; 15.5 g CO/hp-hr; 5 g NOx/hp-hr; and 0.25 g PM/hp-hr

Emissions Calculations for BLM Coal Lease OHES 57390 EA
Annual days of operation and hours/day for each dump truck – 250 days per year est. 16hr days.

Calculate diesel dump trucks emissions:
- 16 hrs/day × 250 days/year = 4,000 hrs/yr × 2 dump trucks = 8,000 hrs/yr of diesel dump truck use
- Estimated 1 year of mining.
- \( E_{HC} = 1.3 \times 200\text{HP} \times 8,000\text{hr} \times 0.002205 \text{ lb/g} \div 2000 \text{ lb/ton} = 2.29 \text{ tons HC} \)
- \( E_{CO} = 15.5 \times 200\text{HP} \times 8,000\text{hr} \times 0.002205 \text{ lb/g} \div 2000 \text{ lb/ton} = 27.34 \text{ tons CO} \)
- \( E_{NOx} = 5 \times 200\text{HP} \times 8,000\text{hr} \times 0.002205 \text{ lb/g} \div 2000 \text{ lb/ton} = 8.82 \text{ tons NOx} \)
- \( E_{PM} = 0.25 \times 200\text{HP} \times 8,000\text{hr} \times 0.002205 \text{ lb/g} \div 2000 \text{ lb/ton} = 0.44 \text{ tons PM} \)

Calculate diesel water tank emissions:
- For hrs/day assume ratio to dump trucks based on miles/day: 25 miles/day by dump truck ÷ 16 hours/day = 1.56 ratio = 4 miles/day by water tank ÷ X hrs/day. X = 2.56 hours/day.
- Assuming same days/year as dump trucks to be conservative = 250 days/year.
- 2.56 hrs/day × 250 days/year = 640 hrs/yr of diesel water tank use
- \( E_{HC} = 1.3 \times 300\text{HP} \times 640\text{hr} \times 0.002205 \text{ lb/g} \div 2000 \text{ lb/ton} = 0.28 \text{ tons HC} \)
- \( E_{CO} = 15.5 \times 300\text{HP} \times 640\text{hr} \times 0.002205 \text{ lb/g} \div 2000 \text{ lb/ton} = 3.28 \text{ tons CO} \)
- \( E_{NOx} = 5 \times 300\text{HP} \times 640\text{hr} \times 0.002205 \text{ lb/g} \div 2000 \text{ lb/ton} \times = 1.06 \text{ tons NOx} \)
- \( E_{PM} = 0.25 \times 300\text{HP} \times 640\text{hr} \times 0.002205 \text{ lb/g} \div 2000 \text{ lb/ton} \times = 0.05 \text{ tons PM} \)

25 vehicle miles traveled per day per vehicle (ave 250 days per year) on unpaved roads:
- From the WRAP Fugitive Dust Handbook, EF of 2.27 lbs PM10/VMT for unpaved roads (PM2.5/PM10 ratio for unpaved roads is 0.1)
- For water tank, assume same days/year as dump trucks to be conservative.
- Vehicle miles traveled = (2 dump trucks × 25 miles/day × 250 days/yr) + (1 water tank × 4 miles/day × 250 days/year) = 12500 + 1000 = 13,500 vehicle miles traveled
- \( E_{PM10} = 2.27 \text{ lbs} \times 13,500 \text{ VMT} \div 2,000 \text{ lb/ton} = 15.32 \text{ tons PM10} \)
- \( E_{PM2.5} = 0.1 \times 15.32 \text{ tons} = 1.53 \text{ tons PM2.5} \)
# Emissions Calculations for BLM Coal Lease OHES 57390 EA

## Total Air Emissions of Criteria Pollutants

<table>
<thead>
<tr>
<th>Activity</th>
<th>PM (tons)</th>
<th>PM10 (tons)</th>
<th>PM2.5 (tons)</th>
<th>PM_{inorganic condensable} (tons)</th>
<th>PM_{organic condensable} (tons)</th>
<th>SO2 (tons)</th>
<th>NOx (tons)</th>
<th>CO (tons)</th>
<th>HC (ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Venting from underground mine</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Conveyor transfer</td>
<td>15.77</td>
<td>6.31</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Crushing</td>
<td>15.77</td>
<td>7.09</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Washing</td>
<td>2,916.73</td>
<td>---</td>
<td>44.93</td>
<td>14.19</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Storage piles</td>
<td>1.39</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Vehicle use</td>
<td>0.49</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>9.88</td>
<td>30.62</td>
<td>2.57</td>
<td>---</td>
</tr>
<tr>
<td>Roads traveled</td>
<td>---</td>
<td>15.32</td>
<td>1.53</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Totals</td>
<td>2,934.38</td>
<td>28.72</td>
<td>1.53</td>
<td>44.93</td>
<td>14.19</td>
<td>9.88</td>
<td>30.62</td>
<td>2.57</td>
<td>---</td>
</tr>
</tbody>
</table>