

**APPENDIX F**  
**AIR QUALITY CALCULATIONS**

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**TAB A. EMISSIONS SUMMARY**

**Table 1. Construction for Proposed Action: Institutional Support Projects**

YEAR	Area	VOC T/yr	CO T/yr	NOx T/yr	SO2 T/yr	PM10 T/yr	PM2.5 T/yr	CO2e MT/yr
TBD	Main Base Construction	1.01	4.85	14.62	0.20	14.54	2.14	1,291
	Mainland and Island	0.12	0.54	1.60	0.02	6.70	0.74	140
<b>TBD Construction Total</b>		<b>1.13</b>	<b>5.39</b>	<b>16.22</b>	<b>0.22</b>	<b>21.24</b>	<b>2.88</b>	<b>1,431</b>
TBD	Main Base Demo	0.11	0.73	1.28	0.03	13.34	1.43	157
	Mainland and Island	0.01	0.10	0.15	0.00	0.27	0.04	19
<b>TBD Demo Total</b>		<b>0.12</b>	<b>0.83</b>	<b>1.42</b>	<b>0.03</b>	<b>13.61</b>	<b>1.47</b>	<b>176</b>
2019	Main Base	0.02	0.13	0.21	0.00	0.12	0.03	25
	Mainland and Island	0.47	2.92	11.30	1.73	0.37	0.35	2,518
<b>2019 Total</b>		<b>0.49</b>	<b>3.05</b>	<b>11.50</b>	<b>1.73</b>	<b>0.49</b>	<b>0.38</b>	<b>2543</b>
2020	Main Base	0.07	0.37	1.05	0.02	0.11	0.06	94
	Mainland and Island	0.48	3.03	11.48	1.73	0.88	0.42	2,540
<b>2020 Total</b>		<b>0.56</b>	<b>3.39</b>	<b>12.53</b>	<b>1.75</b>	<b>0.99</b>	<b>0.48</b>	<b>2,634</b>
2021	Mainland and Island	0.47	2.91	11.28	1.73	0.36	0.35	2,515
2022	Main Base	0.01	0.09	0.13	0.00	0.98	0.11	17
	Mainland and Island	0.47	2.91	11.28	1.73	0.36	0.35	2,515
<b>2022 Total</b>		<b>0.48</b>	<b>2.99</b>	<b>11.41</b>	<b>1.73</b>	<b>1.34</b>	<b>0.46</b>	<b>2,532</b>
2023	Mainland and Island	<b>0.78</b>	<b>5.15</b>	<b>21.04</b>	<b>2.14</b>	<b>0.72</b>	<b>0.69</b>	<b>3,148</b>

**Table 2. Potential Annual Operations for Proposed Action**

Year	Activity	VOC T/yr	CO T/yr	NOx T/yr	SO <sub>2</sub> T/yr	PM <sub>10</sub> T/yr	PM <sub>2.5</sub> T/yr	CO2e MT/yr
2019-2025	3-MW Generators	1.43	12.50	2.39	ND	0.36	0.36	2,350
2019-2025	new launch envelope	0.00	68.13	7.20	ND	152.19	152.19	5,253
2019-2025	Annual UAS Operations	0.35	2.20	2.37	0.19	0.09	0.09	101.25
<b>2019 – 2025 Annual Total</b>		<b>1.78</b>	<b>82.83</b>	<b>11.96</b>	<b>0.19</b>	<b>152.64</b>	<b>152.64</b>	<b>7,704</b>

**Table 3. Comparison of Current Envelope Launch Vehicle (Antares + LMLV-3) Emissions to Proposed Envelope Launch Vehicle (LSLB + Falcon 9) Emissions**

Launch Vehicle	CO T/yr	NOx T/yr	(PM) T/yr	HCL T/yr	CO2 MT/yr
current envelope	184.1	0.0	153.6	125	646
new envelope	68.1	7.2	154.6	107.0	5,253
<b>Change:</b>	<b>-116.0</b>	<b>7.2</b>	<b>1.0</b>	<b>-18.1</b>	<b>4,607</b>

**Table 4. Comparison of Total Operational Emissions for UAS and Launch Vehicles**

UAV + Launch Operations	CO T/yr	NOx T/yr	CO2 MT/yr
current envelopes	184.3	0.4	655
new envelopes	70.3	9.6	5,354
<b>Change:</b>	<b>-114.0</b>	<b>9.2</b>	<b>4,699</b>

**TAB B. CONSTRUCTION EMISSIONS - PROPOSED ACTION INSTITUTIONAL SUPPORT PROJECTS**

- Basic Conversions**  
 453.59 grams per pound  
 43,560 Conversion from Acre to SF  
 0.03704 Cubic feet to Cubic Yards  
 0.1111 Square Feet to Square Yards  
 1.4 tons/CY for Gravel  
 80,000 lbs/Truck Load for Delivery  
 1.66 CY for each CY of asphalt/concrete demo  
 0.50 asphalt thickness for demolition  
 0.50 asphalt thickness for pavement  
 2000 pounds per ton  
 145 lb/ft<sup>3</sup> density of Hot Mix Asphalt  
 0.67 asphalt thickness for pavement on runways

TBD CONSTRUCTION  
 Table 1. Clearing - TBD

2.0 Acres Vehicle Trips = 11

Off-road Equipment	Cumulative Hours of Operation	Engine HP	Load Factor	Emission Factors						
				VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM <sub>10</sub> g/hp-hr	PM <sub>2.5</sub> g/hp-hr	CO <sub>2</sub> g/hp-hr
Dozer	24	145	0.58	0.38	1.41	4.17	0.12	0.30	0.29	535.69
Loader w/ integral Backhoe	24	87	0.21	1.43	7.35	6.35	0.15	1.06	1.03	691.66
Small backhoe	24	55	0.21	1.43	7.35	6.35	0.15	1.06	1.03	691.66
On-road Equipment	Cumulative Hours of Operation	Engine HP	Productivity based Speed (miles/hour)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO <sub>2</sub> lb/mile	PM <sub>10</sub> lb/mile	PM <sub>2.5</sub> lb/mile	CO <sub>2</sub> lb/mile
Dump Truck	11	230	16	0.00166	0.00858	0.03922	0.00002	0.00169	0.00164	3.38
				Annual Emissions						
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
				1.64	6.17	18.20	0.50	1.29	1.25	2,336
				1.36	6.96	6.01	0.14	1.01	0.98	655
				0.86	4.40	3.80	0.09	0.64	0.62	414
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
				0.30	1.54	7.02	0.00	0.30	0.29	605
<b>Subtotal (lbs):</b>				<b>4</b>	<b>19</b>	<b>35</b>	<b>1</b>	<b>3</b>	<b>3</b>	<b>4,011</b>
<b>Clearing Grand Total in Tons</b>				<b>0.00</b>	<b>0.01</b>	<b>0.02</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	
<b>Clearing Grand Total in Metric Tons</b>										<b>2</b>

Vehicle Trips = 11

**Table 2. Site Work - TBD**

Site Prep - Excavate/Fill (CY) 50,858 CY  
 Trenching (LF) 2,500 LF Assume 3' deep, 1' wide  
 Grading (SY) 26,944 SY Assume compact 0.5 feet (0.166 yards) 4,473 CY compacted

Off-road Equipment	Hours	Engine HP	Load Factor	VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM10 g/hp-hr	PM2.5 g/hp-hr	CO <sub>2</sub> g/hp-hr
Excavator	170	243	0.59	0.34	1.21	4.03	0.12	0.22	0.22	536
Skid Steer Loader	203	160	0.23	0.38	1.47	4.34	0.12	0.31	0.30	536
Dozer (Rubber Tired)	184	145	0.59	0.38	1.41	4.17	0.12	0.30	0.29	536
Compactor	21	103	0.58	0.40	1.57	4.57	0.12	0.32	0.31	536
Grader	10	285	0.58	0.34	1.21	4.07	0.12	0.23	0.22	536
Backhoe/Loader	4	87	0.59	0.35	1.25	4.23	0.12	0.24	0.23	536
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM lb	PM2.5 lb	CO <sub>2</sub> lb
Excavator				18.43	64.80	215.92	6.18	11.94	11.58	28,709.57
Skid Steer Loader				6.33	24.26	71.60	1.90	5.04	4.89	8,840.99
Dozer (Rubber Tired)				13.09	49.15	145.05	4.00	10.29	9.98	18,617.45
Compactor				1.08	4.28	12.45	0.31	0.87	0.84	1,460.81
Grader				1.20	4.21	14.19	0.40	0.79	0.76	1,868.27
Backhoe/loader				0.16	0.57	1.92	0.05	0.11	0.10	242.52

On-road Equipment	Hours	MPH	Engine HP	VOC lb/mile	CO lb/mile	NOx lb/mile	SO <sub>2</sub> lb/mile	PM10 lb/mile	PM2.5 lb/mile	CO <sub>2</sub> lb/mile
Dump Truck	170	5	230	0.0015	0.0080	0.0361	0.0000	0.0015	0.0015	3.4385
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM lb	PM2.5 lb	CO <sub>2</sub> lb
Dump Truck				1.29	6.82	30.57	0.02	1.28	1.24	2,915
<b>Subtotal in lb:</b>				<b>42</b>	<b>154</b>	<b>492</b>	<b>13</b>	<b>30</b>	<b>29</b>	<b>62,654</b>
<b>Site Prep Grand Total in Tons</b>				<b>0.02</b>	<b>0.08</b>	<b>0.25</b>	<b>0.01</b>	<b>0.02</b>	<b>0.01</b>	
<b>Site Prep Grand Total in Metric Tons</b>										<b>28</b>

Vehicle Trips = 92

**Table 3. RBR Demo - TBD**

71,040 SF 3,552 Estimated CY of debris based on 20 SF/CY

Off-road Equipment	Hours of Operation	Engine HP	Load Factor	Emission Factors						
				VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM <sub>10</sub> g/hp-hr	PM <sub>2.5</sub> g/hp-hr	CO <sub>2</sub> g/hp-hr
Hydraulic excavator	592	86	0.59	0.23	2.57	2.68	0.11	0.40	0.39	595.46
Wheel Loader w/ Integral Backhoe	592	87	0.23	1.07	6.13	5.02	0.14	0.95	0.92	692.77
Wheel mounted air compressor	592	49	0.59	0.26	1.41	3.51	0.11	0.23	0.22	536.20
				Annual Emissions						
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
Hydraulic excavator				15.16	170.21	177.51	7.53	26.69	25.88	39,433.37
Wheel Loader w/ integral Backhoe				27.86	160.03	131.14	3.69	24.78	24.04	18,092.25
Wheel mounted air compressor				9.90	53.16	132.37	4.07	8.75	8.49	20,231.58
<b>Subtotal (lbs):</b>				<b>52.93</b>	<b>383.40</b>	<b>441.02</b>	<b>15.29</b>	<b>60.21</b>	<b>58.41</b>	<b>77757.20</b>

On-road Equipment	Hours of Operation	Engine HP	Speed (mph)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO <sub>2</sub> lb/mile	PM <sub>10</sub> lb/mile	PM <sub>2.5</sub> lb/mile	CO <sub>2</sub> lb/mile
Dump Truck (12 CY Capacity)	326	230	27	0.001521	0.008042	0.036070	1.80E-05	0.001504	0.001458	3.438541
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
Dump Truck (12 CY Capacity)				13.39	70.79	317.49	0.16	13.24	12.83	30,266
<b>Subtotal (lbs):</b>				<b>66.32</b>	<b>454.19</b>	<b>758.51</b>	<b>15.45</b>	<b>73.46</b>	<b>71.24</b>	<b>108,023.23</b>
<b>Building Demo Grand Total in Tons</b>				<b>0.033</b>	<b>0.227</b>	<b>0.379</b>	<b>0.008</b>	<b>0.037</b>	<b>0.036</b>	
<b>Building Demo Grand Total in Metric Tons</b>										<b>49.00</b>

Vehicle Trips = 278

Table 4. Demo Asphalt Concrete RBR - TBD

72,604 SF 2,232 CY

Off-road Equipment	Hours of Operation	Engine HP	Load Factor	Emission Factors						
				VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM <sub>10</sub> g/hp-hr	PM <sub>2.5</sub> g/hp-hr	CO <sub>2</sub> g/hp-hr
Crawler Dozer w/attachments	263	125	0.58	0.34	1.21	4.08	0.12	0.23	0.22	535.79
Air Compressor	263	49	0.59	0.33	2.54	4.53	0.13	0.54	0.53	595.16
Excavator	61	380	0.59	0.31	2.50	4.51	0.13	0.55	0.54	595.21
				Annual Emissions						
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
Crawler Dozer w/attachments				14.48	50.84	171.82	4.85	9.52	9.23	22562.78
Wheel mounted air compressor				5.50	42.68	76.02	2.15	9.10	8.83	9994.14
Excavator				9.34	74.67	134.78	3.83	16.51	16.01	17800.11

On-road Equipment	Hours of Operation	Engine HP	Speed (mph)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO <sub>2</sub> lb/mile	PM <sub>10</sub> lb/mile	PM <sub>2.5</sub> lb/mile	CO <sub>2</sub> lb/mile
Dump Truck	205	230	27	0.0015	0.0080	0.0361	0.0000	0.0015	0.0015	3.4385
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
Dump Truck				8.42	44.51	199.65	0.10	8.33	8.07	19,032
<b>Subtotal (lbs):</b>				<b>38</b>	<b>213</b>	<b>582</b>	<b>11</b>	<b>43</b>	<b>42</b>	<b>69,389</b>
<b>Asphalt Demo Grand Total in Tons</b>				<b>0.02</b>	<b>0.11</b>	<b>0.29</b>	<b>0.01</b>	<b>0.02</b>	<b>0.02</b>	
<b>Asphalt Demo Grand Total in Metric Tons</b>										<b>31</b>

Vehicle Trips =

92

Table 5. Building Construction

120,000 SF Foundation  
120,000 SF Total

Off-road Equipment	Hours of Operation	Engine HP	Load Factor	Emission Factors						
				VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM10 g/hp-hr	PM2.5 g/hp-hr	CO <sub>2</sub> g/hp-hr
Crane	600	330	0.58	0.25	1.22	5.26	0.11	0.21	0.20	530
Concrete Truck	600	300	0.43	0.19	1.45	4.32	0.12	0.21	0.20	536
Diesel Generator	480	40	0.43	0.26	1.41	3.51	0.11	0.23	0.22	536
Telehandler	1,200	99	0.59	0.51	3.94	4.93	0.13	0.52	0.51	595
Scissors Lift	960	83	0.59	0.51	3.94	4.93	0.13	0.52	0.51	595
Skid Steer Loader	600	67	0.59	1.69	7.97	6.70	0.15	1.19	1.15	691
Pile Driver	6,188	260	0.43	0.46	1.55	5.90	0.11	0.31	0.30	530
All Terrain Forklift	24	84	0.59	0.51	3.94	4.93	0.13	0.52	0.51	595
				Annual Emissions						
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM lb	PM2.5 lb	CO <sub>2</sub> lb
Crane				62.21	308.75	1331.67	28.88	52.59	51.01	134,261
Concrete Truck				32.01	248.20	737.28	19.68	35.85	34.77	91,507
Diesel Generator				4.78	25.64	63.85	1.96	4.22	4.09	9,760
Telehandler				78.74	608.80	761.66	19.76	80.53	78.11	91,884
Scissors Lift				52.81	408.32	510.85	13.26	54.01	52.39	61,627
Skid Steer Loader				88.49	416.63	350.23	7.77	62.18	60.31	36,125
Pile Driver				707.73	2366.77	9001.43	173.76	478.69	464.33	807,780
All Terrain Forklift				1.34	10.33	12.93	0.34	1.37	1.33	1,559

On-road Equipment	Hours of Operation	Engine HP	Speed (mph)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO <sub>2</sub> lb/mile	PM lb/mile	PM2.5 lb/mile	CO <sub>2</sub> lb/mile
Delivery Truck	2,880	265	45	0.0015	0.0080	0.0361	0.0000	0.0015	0.0015	3.4385
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM lb	PM2.5 lb	CO <sub>2</sub> lb
Delivery Truck				197.16	1042.24	4674.68	2.34	194.98	188.93	445,635
<b>Subtotal (lbs):</b>				<b>1225</b>	<b>5436</b>	<b>17445</b>	<b>268</b>	<b>964</b>	<b>935</b>	<b>1680139</b>
<b>Building Construction Grand Total in Tons</b>				<b>0.61</b>	<b>2.72</b>	<b>8.72</b>	<b>0.13</b>	<b>0.48</b>	<b>0.47</b>	
<b>Building Construction Grand Total in Metric Tons</b>										<b>762</b>

Vehicle Trips =

1664



On-road Equipment	Hours of Operation	Engine HP	Productivity based Speed (miles/hour)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO2 lb/mile	PM lb/mile	PM2.5 lb/mile	CO <sub>2</sub> lb/mile
Dump Truck	44	230	17	0.001521	0.008042	0.036070	1.80E-05	0.001504	0.001458	3.438541
Water Truck	1	230	10	0.001521	0.008042	0.036070	1.80E-05	0.001504	0.001458	3.438541
				VOC lb	CO lb	NOx lb	SO2 lb	PM lb	PM2.5 lb	CO <sub>2</sub> lb
			Dump Truck	1.15	6.06	27.19	0.01	1.13	1.10	2,592
			Water Truck	0.02	0.09	0.42	0.00	0.02	0.02	40

Hot Mix Asphalt (HMA)	Volume of HMA (ft <sup>3</sup> )	Weight of HMA (tons)	VOC lb/ton of asphalt	VOC lb	CO lb	NOx lb	SO2 lb	PM10 lb	PM2.5 lb	CO <sub>2</sub> lb
Standard Hot Mix Asphalt	4,000	0	0.04	0.00	-	-	-	-	-	-
<b>Subtotal (lbs):</b>				<b>20</b>	<b>111</b>	<b>288</b>	<b>6</b>	<b>18</b>	<b>17</b>	<b>30,815</b>
<b>Paving Grand Total in Tons</b>				<b>0.01</b>	<b>0.06</b>	<b>0.14</b>	<b>0.00</b>	<b>0.01</b>	<b>0.01</b>	
<b>Paving Grand Total in Metric Tons</b>										<b>14</b>

Vehicle Trips =

7

Table 9. Runway Construction

Concrete Surface

187,500 SF  
20,831 SY

4.3 acres  
1.83 yards thick

<sup>1</sup> Off-road Equipment	<sup>2</sup> Cumulative Hours of Operation	<sup>3</sup> Engine HP	<sup>4</sup> Load Factor	<sup>6,7</sup> Emission Factors						
				VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM10 g/hp-hr	PM2.5 g/hp-hr	CO <sub>2</sub> g/hp-hr
Grader (CAT 120M2 or similar)	29	150	0.61	1.06	3.52	8.24	0.06	0.47	0.47	568
Steel drum roller/soil compactor	290	401	0.56	0.70	3.18	7.20	0.05	0.28	0.28	568
Paving/Concrete Machine	290	164	0.53	1.14	3.71	8.87	0.49	0.49	0.49	568
Curbing Machine	14	130	0.59	1.14	3.71	8.87	0.49	0.49	0.49	568
Cement and Motar Mixer 1	290	9	0.56	0.92	2.64	5.41	0.07	0.35	0.35	568
Cement and Motar Mixer 2	290	9	0.56	0.92	2.64	5.41	0.07	0.35	0.35	568
Cement and Motar Mixer 3	290	9	0.56	0.92	2.64	5.41	0.07	0.35	0.35	568
Tractor/Loader/Backhoe	290	75	0.55	1.50	4.22	8.33	0.06	0.80	0.80	568
<sup>1</sup> On-road Equipment	<sup>2</sup> Cumulative Hours of Operation	<sup>3</sup> Engine HP	<sup>5</sup> Speed (miles/hour)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO2 lb/mile	PM10 lb/mile	PM2.5 lb/mile	CO <sub>2</sub> lb/mile
Cement Truck	290	230	20	0.001521	0.008042	0.036070	1.80E-05	0.001504	0.001458	3.438541
Water Truck/Oil truck	29	230	10	0.001521	0.008042	0.036070	1.80E-05	0.001504	0.001458	3.438541

	Annual Emissions													
	VOC lb	CO lb	NOx lb	SO2 lb	PM lb	PM2.5 lb	CO <sub>2</sub> lb							
	6.21	20.58	48.15	0.33	2.74	2.74	3,321.35							
	99.97	456.55	1,032.14	7.17	40.45	40.45	81,512.80							
	63.01	205.70	492.61	27.43	27.43	27.43	31,551.00							
	2.78	9.08	21.73	1.21	1.21	1.21	1,392.06							
	2.96	8.51	17.42	0.21	1.12	1.12	1,829.46							
	2.96	8.51	17.42	0.21	1.12	1.12	1,829.46							
	2.96	8.51	17.42	0.21	1.12	1.12	1,829.46							
	39.50	111.19	219.34	1.58	21.13	21.13	14,973.30							
	VOC lb	CO lb	NOx lb	SO2 lb	PM lb	PM2.5 lb	CO <sub>2</sub> lb							
	8.82	46.60	209.01	0.10	8.72	8.45	19,924							
	0.44	2.33	10.45	0.01	0.44	0.42	996							
<b>Runway Construction Grand Total in Tons</b>								<b>0.11</b>	<b>0.44</b>	<b>1.04</b>	<b>0.02</b>	<b>0.05</b>	<b>0.05</b>	
<b>Runway Construction Grand Total in Metric Tons</b>														<b>72</b>

Vehicle Trips =

278



TBD - DEMO

Table 10. Demo Site Work - TBD

Site Prep - Excavate/Fill (CY) 33,692 CY  
 Trenching (LF) 0 LF  
 Grading (SY) 7,590 SY

Assume compact 0.5 feet (0.166 yards) 1,260 CY compacted

Off-road Equipment	Hours	Engine HP	Load Factor	VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM10 g/hp-hr	PM2.5 g/hp-hr	CO <sub>2</sub> g/hp-hr
Excavator	112	243	0.59	0.34	1.21	4.03	0.12	0.22	0.22	536
Skid Steer Loader	135	160	0.23	0.38	1.47	4.34	0.12	0.31	0.30	536
Dozer (Rubber Tired)	122	145	0.59	0.38	1.41	4.17	0.12	0.30	0.29	536
Compactor	6	103	0.58	0.40	1.57	4.57	0.12	0.32	0.31	536
Grader	3	285	0.58	0.34	1.21	4.07	0.12	0.23	0.22	536
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM lb	PM2.5 lb	CO <sub>2</sub> lb
			Excavator	12.21	42.92	143.04	4.09	7.91	7.67	19,019.29
			Skid Steer Loader	4.19	16.07	47.44	1.26	3.34	3.24	5,856.91
			Dozer (Rubber Tired)	8.67	32.56	96.09	2.65	6.81	6.61	12,333.54
			Compactor	0.30	1.21	3.51	0.09	0.25	0.24	411.50
			Grader	0.34	1.19	4.00	0.11	0.22	0.21	526.27

On-road Equipment	Hours	MPH	Engine HP	VOC lb/mile	CO lb/mile	NOx lb/mile	SO <sub>2</sub> lb/mile	PM10 lb/mile	PM2.5 lb/mile	CO <sub>2</sub> lb/mile
Dump Truck	112	5	230	0.0015	0.0080	0.0361	0.0000	0.0015	0.0015	3.4385
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM lb	PM2.5 lb	CO <sub>2</sub> lb
			Dump Truck	0.85	4.52	20.25	0.01	0.84	0.82	1,931
			<b>Subtotal in lb:</b>	<b>27</b>	<b>98</b>	<b>314</b>	<b>8</b>	<b>19</b>	<b>19</b>	<b>40,078</b>
			<b>Site Prep Grand Total in Tons</b>	<b>0.01</b>	<b>0.05</b>	<b>0.16</b>	<b>0.00</b>	<b>0.01</b>	<b>0.01</b>	<b>18</b>

Vehicle Trips =

59

Table 11. Demo Bldgs - TBD

153,102 SF

7,655 Estimated CY of debris based on 20 SF/CY

Off-road Equipment	Hours of Operation	Engine HP	Load Factor	Emission Factors						
				VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM <sub>10</sub> g/hp-hr	PM <sub>2.5</sub> g/hp-hr	CO <sub>2</sub> g/hp-hr
Hydraulic excavator	1,276	86	0.59	0.23	2.57	2.68	0.11	0.40	0.39	595.46
Wheel Loader w/ integral Backhoe	1,276	87	0.23	1.07	6.13	5.02	0.14	0.95	0.92	692.77
Wheel mounted air compressor	1,276	49	0.59	0.26	1.41	3.51	0.11	0.23	0.22	536.20
				Annual Emissions						
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
			Hydraulic excavator	32.68	366.84	382.56	16.22	57.51	55.79	84,984.91
			Wheel Loader w/ integral Backhoe	60.05	344.89	282.62	7.96	53.40	51.80	38,991.55
			Wheel mounted air compressor	21.35	114.56	285.28	8.78	18.86	18.29	43,602.12
			<b>Subtotal (lbs):</b>	<b>114.08</b>	<b>826.29</b>	<b>950.46</b>	<b>32.96</b>	<b>129.77</b>	<b>125.88</b>	<b>167578.58</b>

On-road Equipment	Hours of Operation	Engine HP	Speed (mph)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO <sub>2</sub> lb/mile	PM <sub>10</sub> lb/mile	PM <sub>2.5</sub> lb/mile	CO <sub>2</sub> lb/mile
Dump Truck (12 CY Capacity)	702	230	27	0.001521	0.008042	0.036070	1.80E-05	0.001504	0.001458	3.438541
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
			Dump Truck (12 CY Capacity)	28.84	152.43	683.67	0.34	28.52	27.63	65,174
			<b>Subtotal (lbs):</b>	<b>142.91</b>	<b>978.72</b>	<b>1,634.13</b>	<b>33.30</b>	<b>158.29</b>	<b>153.51</b>	<b>232,752.68</b>
			<b>Building Demo Grand Total in Tons</b>	<b>0.071</b>	<b>0.489</b>	<b>0.817</b>	<b>0.017</b>	<b>0.079</b>	<b>0.077</b>	
			<b>Building Demo Grand Total in Metric Tons</b>							<b>105.57</b>

Vehicle Trips =

598

Table 12. Demo Asphalt Concrete - TBD

15,358 SF 472 CY

Off-road Equipment	Hours of Operation	Engine HP	Load Factor	Emission Factors						
				VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM <sub>10</sub> g/hp-hr	PM <sub>2.5</sub> g/hp-hr	CO <sub>2</sub> g/hp-hr
Crawler Dozer w/attachments	263	125	0.58	0.34	1.21	4.08	0.12	0.23	0.22	535.79
Air Compressor	263	49	0.59	0.33	2.54	4.53	0.13	0.54	0.53	595.16
Excavator	61	380	0.59	0.31	2.50	4.51	0.13	0.55	0.54	595.21
				Annual Emissions						
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
Crawler Dozer w/attachments				14.48	50.84	171.82	4.85	9.52	9.23	22562.78
Wheel mounted air compressor				5.50	42.68	76.02	2.15	9.10	8.83	9994.14
Excavator				9.34	74.67	134.78	3.83	16.51	16.01	17800.11

On-road Equipment	Hours of Operation	Engine HP	Speed (mph)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO <sub>2</sub> lb/mile	PM <sub>10</sub> lb/mile	PM <sub>2.5</sub> lb/mile	CO <sub>2</sub> lb/mile
Dump Truck	205	230	27	0.0015	0.0080	0.0361	0.0000	0.0015	0.0015	3.4385
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
Dump Truck				8.42	44.51	199.65	0.10	8.33	8.07	19,032
<b>Subtotal (lbs):</b>				<b>38</b>	<b>213</b>	<b>582</b>	<b>11</b>	<b>43</b>	<b>42</b>	<b>69,389</b>
<b>Asphalt Demo Grand Total in Tons</b>				<b>0.02</b>	<b>0.11</b>	<b>0.29</b>	<b>0.01</b>	<b>0.02</b>	<b>0.02</b>	
<b>Asphalt Demo Grand Total in Metric Tons</b>										<b>31</b>

Vehicle Trips =

92

2019

Table 13. Building Demo - 2019

153,102 SF 7,655 Estimated CY of debris based on 20 SF/CY

Off-road Equipment	Cumulative Hours of Operation	Engine HP	Load Factor	Emission Factors						
				VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM <sub>10</sub> g/hp-hr	PM <sub>2.5</sub> g/hp-hr	CO <sub>2</sub> g/hp-hr
Hydraulic excavator with breakers and jackhammer bits	287	86	0.59	0.23	2.57	2.68	0.11	0.40	0.39	595.46
Wheel Loader w/ integral Backhoe	287	87	0.23	1.07	6.13	5.02	0.14	0.95	0.92	692.77
Wheel mounted air compressor	287	49	0.59	0.26	1.41	3.51	0.11	0.23	0.22	536.20
On-road Equipment	Cumulative Hours of Operation	Engine HP	Productivity based Speed (miles/hour)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO <sub>2</sub> lb/mile	PM <sub>10</sub> lb/mile	PM <sub>2.5</sub> lb/mile	CO <sub>2</sub> lb/mile
Dump Truck (12 CY Capacity)	158	230	27	0.00166	0.00858	0.03922	0.00002	0.00169	0.00164	3.38
				Annual Emissions						
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
				7.36	82.59	86.13	3.65	12.95	12.56	19,134
				13.52	77.65	63.63	1.79	12.02	11.66	8,779
				4.81	25.79	64.23	1.98	4.25	4.12	9,817
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
Subtotal (lbs):				7.15	36.97	169.00	0.08	7.29	7.08	14,575
<b>Building Demo Grand Total in Tons</b>				<b>0.016</b>	<b>0.112</b>	<b>0.192</b>	<b>0.004</b>	<b>0.018</b>	<b>0.018</b>	
<b>Building Demo Grand Total in Metric Tons</b>										<b>23.73</b>

Vehicle Trips =

135

Table 14. Demo Asphalt and Concrete- 2019

15,358 SF

94 CY

Off-road Equipment	Cumulative Hours of Operation	Engine HP	Load Factor	Emission Factors						
				VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM <sub>10</sub> g/hp-hr	PM <sub>2.5</sub> g/hp-hr	CO <sub>2</sub> g/hp-hr
Crawler Dozer w/attachments	11	125	0.58	0.34	1.21	4.08	0.12	0.23	0.22	535.79
Air Compressor	11	49	0.59	0.33	2.54	4.53	0.13	0.54	0.53	595.16
Excavator	3	380	0.59	0.31	2.50	4.51	0.13	0.55	0.54	595.21
On-road Equipment	Cumulative Hours of Operation	Engine HP	Productivity based Speed (miles/hour)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO <sub>2</sub> lb/mile	PM <sub>10</sub> lb/mile	PM <sub>2.5</sub> lb/mile	CO <sub>2</sub> lb/mile
Dump Truck	9	230	27	0.00166	0.00858	0.03922	0.00002	0.00169	0.00164	3.38
				Annual Emissions						
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
				0.60	2.12	7.17	0.20	0.40	0.39	942
				0.23	1.78	3.17	0.09	0.38	0.37	417
				0.39	3.14	5.67	0.16	0.69	0.67	748
Subtotal (lbs):				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
Subtotal (lbs):				0.41	2.11	9.63	0.00	0.42	0.40	830
Asphalt Demo Grand Total in Tons				2	9	26	0	2	2	2,938
Asphalt Demo Grand Total in Metric Tons				0.00	0.00	0.01	0.00	0.00	0.00	1

Vehicle Trips =

4

2020

Table 15. Building Demo - 2020

12,000 SF 600 Estimated CY of debris based on 20 SF/CY

Off-road Equipment	Cumulative Hours of Operation	Engine HP	Load Factor	Emission Factors						
				VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM <sub>10</sub> g/hp-hr	PM <sub>2.5</sub> g/hp-hr	CO <sub>2</sub> g/hp-hr
Hydraulic excavator with breakers and jackhammer bits	100	86	0.59	0.23	2.57	2.68	0.11	0.40	0.39	595.46
Wheel Loader w/ integral Backhoe	100	87	0.23	1.07	6.13	5.02	0.14	0.95	0.92	692.77
Wheel mounted air compressor	100	49	0.59	0.26	1.41	3.51	0.11	0.23	0.22	536.20
On-road Equipment	Cumulative Hours of Operation	Engine HP	Productivity based Speed (miles/hour)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO <sub>2</sub> lb/mile	PM <sub>10</sub> lb/mile	PM <sub>2.5</sub> lb/mile	CO <sub>2</sub> lb/mile
Dump Truck (12 CY Capacity)	55	230	27	0.00166	0.00858	0.03922	0.00002	0.00169	0.00164	3.38
				Annual Emissions						
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
				2.56	28.75	29.98	1.27	4.51	4.37	6,661
				4.71	27.03	22.15	0.62	4.19	4.06	3,056
				1.67	8.98	22.36	0.69	1.48	1.43	3,417
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
				2.49	12.87	58.83	0.03	2.54	2.46	5,074
<b>Subtotal (lbs):</b>				<b>11</b>	<b>78</b>	<b>133</b>	<b>3</b>	<b>13</b>	<b>12</b>	<b>18,208</b>
<b>Building Demo Grand Total in Tons</b>				<b>0.006</b>	<b>0.039</b>	<b>0.067</b>	<b>0.001</b>	<b>0.006</b>	<b>0.006</b>	
<b>Building Demo Grand Total in Metric Tons</b>										<b>8.26</b>
Vehicle Trips =				47						

Table 16. Building Construction-2020

12,000 SF Foundation  
12,000 SF Total

Off-road Equipment	Hours of Operation	Engine HP	Load Factor	Emission Factors						
				VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM <sub>10</sub> g/hp-hr	PM <sub>2.5</sub> g/hp-hr	CO <sub>2</sub> g/hp-hr
Crane	60	330	0.58	0.25	1.22	5.26	0.11	0.21	0.20	530
Concrete Truck	60	300	0.43	0.19	1.45	4.32	0.12	0.21	0.20	536
Diesel Generator	48	40	0.43	0.26	1.41	3.51	0.11	0.23	0.22	536
Telehandler	120	99	0.59	0.51	3.94	4.93	0.13	0.52	0.51	595
Scissors Lift	96	83	0.59	0.51	3.94	4.93	0.13	0.52	0.51	595
Skid Steer Loader	60	67	0.59	1.69	7.97	6.70	0.15	1.19	1.15	691
Pile Driver	619	260	0.43	0.46	1.55	5.90	0.11	0.31	0.30	530
All Terrain Forklift	2	84	0.59	0.51	3.94	4.93	0.13	0.52	0.51	595
				Annual Emissions						
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
Crane				6.22	30.88	133.17	2.89	5.26	5.10	13426.11
Concrete Truck				3.20	24.82	73.73	1.97	3.58	3.48	9150.71
Diesel Generator				0.48	2.56	6.39	0.20	0.42	0.41	975.95
Telehandler				7.87	60.88	76.17	1.98	8.05	7.81	9188.40
Scissors Lift				5.28	40.83	51.09	1.33	5.40	5.24	6162.72
Skid Steer Loader				8.85	41.66	35.02	0.78	6.22	6.03	3612.54
Pile Driver				70.77	236.68	900.14	17.38	47.87	46.43	80778.00
All Terrain Forklift				0.13	1.03	1.29	0.03	0.14	0.13	155.92



2022

Table 19. Building Demo - 2022

22,337 SF 1,117 Estimated CY of debris based on 20 SF/CY

Off-road Equipment	Cumulative Hours of Operation	Engine HP	Load Factor	Emission Factors						
				VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM <sub>10</sub> g/hp-hr	PM <sub>2.5</sub> g/hp-hr	CO <sub>2</sub> g/hp-hr
Hydraulic excavator with breakers and jackhammer bits	186	86	0.59	0.23	2.57	2.68	0.11	0.40	0.39	595.46
Wheel Loader w/ Integral Backhoe	186	87	0.23	1.07	6.13	5.02	0.14	0.95	0.92	692.77
Wheel mounted air compressor	186	49	0.59	0.26	1.41	3.51	0.11	0.23	0.22	536.20
On-road Equipment	Cumulative Hours of Operation	Engine HP	Productivity based Speed (miles/hour)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO <sub>2</sub> lb/mile	PM <sub>10</sub> lb/mile	PM <sub>2.5</sub> lb/mile	CO <sub>2</sub> lb/mile
Dump Truck (12 CY Capacity)	102	230	27	0.00166	0.00858	0.03922	0.00002	0.00169	0.00164	3.38
				Annual Emissions						
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
				4.76	53.48	55.77	2.37	8.38	8.13	12,390
				8.75	50.28	41.20	1.16	7.79	7.55	5,684
				3.11	16.70	41.59	1.28	2.75	2.67	6,357
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
				4.62	23.87	109.10	0.05	4.70	4.57	9,409
<b>Subtotal (lbs):</b>				<b>21</b>	<b>144</b>	<b>248</b>	<b>5</b>	<b>24</b>	<b>23</b>	<b>33,840</b>
<b>Building Demo Grand Total in Tons</b>				<b>0.011</b>	<b>0.072</b>	<b>0.124</b>	<b>0.002</b>	<b>0.012</b>	<b>0.011</b>	
<b>Building Demo Grand Total in Metric Tons</b>										<b>15.35</b>

Vehicle Trips = 87

Table 20. Demo Asphalt and Concrete- 2022

2,234 SF 69 CY

Off-road Equipment	Cumulative Hours of Operation	Engine HP	Load Factor	Emission Factors						
				VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM <sub>10</sub> g/hp-hr	PM <sub>2.5</sub> g/hp-hr	CO <sub>2</sub> g/hp-hr
D-6K Crawler Dozer with attachments	8	125	0.58	0.34	1.21	4.08	0.12	0.23	0.22	535.79
Wheel mounted air compressor	8	49	0.59	0.33	2.54	4.53	0.13	0.54	0.53	595.16
Pneumatic Paving Breaker and jackhammer on excavator (CAT 345D L or similar)	2	380	0.59	0.31	2.50	4.51	0.13	0.55	0.54	595.21
On-road Equipment	Cumulative Hours of Operation	Engine HP	Productivity based Speed (miles/hour)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO <sub>2</sub> lb/mile	PM <sub>10</sub> lb/mile	PM <sub>2.5</sub> lb/mile	CO <sub>2</sub> lb/mile
Dump Truck	6	230	27	0.00166	0.00858	0.03922	0.00002	0.00169	0.00164	3.38
				Annual Emissions						
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
				0.44	1.54	5.22	0.15	0.29	0.28	685
				0.17	1.30	2.31	0.07	0.28	0.27	303
				0.31	2.47	4.46	0.13	0.55	0.53	588
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
				0.27	1.40	6.42	0.00	0.28	0.27	553
<b>Subtotal (lbs):</b>				<b>1</b>	<b>7</b>	<b>18</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>2,130</b>
<b>Asphalt Demo Grand Total in Tons</b>				<b>0.00</b>	<b>0.00</b>	<b>0.01</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	
<b>Asphalt Demo Grand Total in Metric Tons</b>										<b>1</b>

Vehicle Trips = 3

Table 21. Fugitive Dust

Year	PM <sub>10</sub> tons/acre/mo	acres	days of disturbance	PM <sub>10</sub> Total (tons)	PM <sub>2.5</sub> /PM <sub>10</sub> Ratio	PM <sub>2.5</sub> Total (tons)
TBD - Construction	0.42	7.28	90	13.8	0.1	1.4
TBD - Demo	0.42	3.5	180	13.2	0.1	1.3
2019	0.42	0.2	30	0.1	0.1	0.0
2020	0.42	0.3	9	0.1	0.1	0.0
2022	0.42	0.5	90	1.0	0.1	0.1

Table 22. Annual Construction Worker POVs - 2019 - TBD

Year	Vehicle Trips	mile/trip	VOCs lb/mi	CO lb/mi	NOx lb/mi	SO <sub>2</sub> lb/mi	PM <sub>10</sub> lb/mi	PM <sub>2.5</sub> lb/mi	CO <sub>2</sub> g/mi	CH <sub>4</sub> g/mi	N <sub>2</sub> O g/mi
TBD - Construction	2,885	6	0.00129	0.03681	0.00510	0.00001	0.00021	0.00019	364.00	0.031	0.032
TBD - Demo	749	6	0.00129	0.03681	0.00510	0.00001	0.00021	0.00019	364.00	0.031	0.032
2019	138	6	0.00129	0.03681	0.00510	0.00001	0.00021	0.00019	364.00	0.031	0.032
2020	243	6	0.00129	0.03681	0.00510	0.00001	0.00021	0.00019	364.00	0.031	0.032
2022	90	6	0.00129	0.03681	0.00510	0.00001	0.00021	0.00019	364.00	0.031	0.032

  

VOCs ton/year	CO ton/year	NOx ton/year	SO <sub>2</sub> ton/year	PM <sub>10</sub> ton/year	PM <sub>2.5</sub> ton/year	CO <sub>2</sub> e metric ton/year
0.011	0.319	0.044	0.000	0.002	0.002	6.5
0.003	0.083	0.011	0.000	0.000	0.000	1.7
0.001	0.015	0.002	0.000	0.000	0.000	0.3
0.001	0.027	0.004	0.000	0.000	0.000	0.5
0.000	0.010	0.001	0.000	0.000	0.000	0.2

Table 23. Wallops Main Base Area Construction Summary

YEAR	VOC T/yr	CO T/yr	NOx T/yr	SO <sub>2</sub> T/yr	PM <sub>10</sub> T/yr	PM <sub>2.5</sub> T/yr	CO <sub>2</sub> MT/yr
TBD - Construction	1.01	4.85	14.62	0.20	14.54	2.14	1,291
TBD - Demo	0.11	0.73	1.28	0.03	13.34	1.43	157
2019	0.02	0.13	0.21	0.00	0.12	0.03	25
2020	0.07	0.37	1.05	0.02	0.11	0.06	94
2022	0.01	0.09	0.13	0.00	0.98	0.11	17

**TAB C. CONSTRUCTION EMISSIONS - CONTROL CENTER AREA**

**Basic Conversions**  
 453.59 grams per pound  
 43,560 Conversion from Acre to SF  
 0.03704 Cubic feet to Cubic Yards  
 0.1111 Square Feet to Square Yards  
 1.4 tons/CY for Gravel  
 80,000 lbs/Truck Load for Delivery  
 1.66 CY for each CY of asphalt/concrete demo  
 0.333333333 asphalt thickness for demolition  
 0.333333333 asphalt thickness for pavement  
 2000 pounds per ton  
 145 lb/ft<sup>3</sup> density of Hot Mix Asphalt  
 0.666666667 asphalt thickness for pavement on runways

**TBD Construction**

**Table 1. Clearing - TBD**

3.5 Acres				Vehicle Trips = 19							
Off-road Equipment	Cumulative Hours of Operation	Engine HP	Load Factor	Emission Factors							
				VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM <sub>10</sub> g/hp-hr	PM <sub>2.5</sub> g/hp-hr	CO <sub>2</sub> g/hp-hr	
Dozer	41	145	0.58	0.38	1.41	4.17	0.12	0.30	0.29	535.69	
Loader w/ integral Backhoe	41	87	0.21	1.43	7.35	6.35	0.15	1.06	1.03	691.66	
Small backhoe	41	55	0.21	1.43	7.35	6.35	0.15	1.06	1.03	691.66	
On-road Equipment	Cumulative Hours of Operation	Engine HP	Productivity based Speed (miles/hour)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO <sub>2</sub> lb/mile	PM <sub>10</sub> lb/mile	PM <sub>2.5</sub> lb/mile	CO <sub>2</sub> lb/mile	
Dump Truck	19	230	16	0.00166	0.00858	0.03922	0.00002	0.00169	0.00164	3.38	
				Annual Emissions							
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb	
				2.86	10.75	31.73	0.88	2.25	2.18	4,072.21	
				2.36	12.14	10.48	0.25	1.76	1.70	1,142.23	
				1.49	7.67	6.63	0.16	1.11	1.08	722.10	
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb	
				0.51	2.64	12.08	0.01	0.52	0.51	1,042	
<b>Subtotal (lbs):</b>				<b>7</b>	<b>33</b>	<b>61</b>	<b>1</b>	<b>6</b>	<b>5</b>	<b>6,979</b>	
<b>Clearing Grand Total in Tons</b>				<b>0.00</b>	<b>0.02</b>	<b>0.03</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>		
<b>Clearing Grand Total in Metric Tons</b>										<b>3</b>	

Vehicle Trips = 19

**Table 2. Site Prep**

Site Prep - Excavate/Fill (CY) 14,442 CY  
 Trenching (LF) 3,300 LF Assume 3' deep, 1' wide  
 Grading (SY) 32,263 SY Assume compact 0.5 feet (0.166 yards) 5,356 CY compacted

Off-road Equipment	Hours	Engine HP	Load Factor	VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM <sub>10</sub> g/hp-hr	PM <sub>2.5</sub> g/hp-hr	CO <sub>2</sub> g/hp-hr
Excavator	48	243	0.59	0.34	1.21	4.03	0.12	0.22	0.22	536
Skid Steer Loader	58	160	0.23	0.38	1.47	4.34	0.12	0.31	0.30	536
Dozer (Rubber Tired)	52	145	0.59	0.38	1.41	4.17	0.12	0.30	0.29	536
Compactor	25	103	0.58	0.40	1.57	4.57	0.12	0.32	0.31	536
Grader	11	285	0.58	0.34	1.21	4.07	0.12	0.23	0.22	536
Backhoe/Loader	5	87	0.59	0.35	1.25	4.23	0.12	0.24	0.23	536
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
Excavator				5.23	18.40	61.31	1.75	3.39	3.29	8,152.57
Skid Steer Loader				1.80	6.89	20.33	0.54	1.43	1.39	2,510.55
Dozer (Rubber Tired)				3.72	13.96	41.19	1.14	2.92	2.83	5,286.74
Compactor				1.29	5.13	14.91	0.38	1.04	1.01	1,749.16
Grader				1.44	5.04	16.99	0.48	0.94	0.91	2,237.05
Backhoe/loader				0.21	0.74	2.51	0.07	0.14	0.14	317.59



On-road Equipment	Hours	MPH	Engine HP	VOC lb/mile	CO lb/mile	NOx lb/mile	SO <sub>2</sub> lb/mile	PM10 lb/mile	PM2.5 lb/mile	CO <sub>2</sub> lb/mile
Dump Truck	48	5	230	0.0015	0.0080	0.0361	0.0000	0.0015	0.0015	3.4385
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM lb	PM2.5 lb	CO <sub>2</sub> lb
			Dump Truck	0.37	1.94	8.68	0.00	0.36	0.35	828
<b>Subtotal in lb:</b>				<b>14</b>	<b>52</b>	<b>166</b>	<b>4</b>	<b>10</b>	<b>10</b>	<b>21,081</b>
<b>Site Prep Grand Total in Tons</b>				<b>0.01</b>	<b>0.03</b>	<b>0.08</b>	<b>0.00</b>	<b>0.01</b>	<b>0.00</b>	
<b>Site Prep Grand Total in Metric Tons</b>										<b>10</b>

Vehicle Trips = 31

Table 3. Building Construction

12,000 SF Foundation  
12,000 SF Total

Off-road Equipment	Hours of Operation	Engine HP	Load Factor	Emission Factors						
				VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM10 g/hp-hr	PM2.5 g/hp-hr	CO <sub>2</sub> g/hp-hr
Crane	60	330	0.58	0.25	1.22	5.26	0.11	0.21	0.20	530
Concrete Truck	60	300	0.43	0.19	1.45	4.32	0.12	0.21	0.20	536
Diesel Generator	48	40	0.43	0.26	1.41	3.51	0.11	0.23	0.22	536
Telehandler	120	99	0.59	0.51	3.94	4.93	0.13	0.52	0.51	595
Scissors Lift	96	83	0.59	0.51	3.94	4.93	0.13	0.52	0.51	595
Skid Steer Loader	60	67	0.59	1.69	7.97	6.70	0.15	1.19	1.15	691
Pile Driver	619	260	0.43	0.46	1.55	5.90	0.11	0.31	0.30	530
All Terrain Forklift	2	84	0.59	0.51	3.94	4.93	0.13	0.52	0.51	595
				Annual Emissions						
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM lb	PM2.5 lb	CO <sub>2</sub> lb
			Crane	6.22	30.88	133.17	2.89	5.26	5.10	13426.11
			Concrete Truck	3.20	24.82	73.73	1.97	3.58	3.48	9150.71
			Diesel Generator	0.48	2.56	6.39	0.20	0.42	0.41	975.95
			Telehandler	7.87	60.88	76.17	1.98	8.05	7.81	9188.40
			Scissors Lift	5.28	40.83	51.09	1.33	5.40	5.24	6162.72
			Skid Steer Loader	8.85	41.66	35.02	0.78	6.22	6.03	3612.54
			Pile Driver	70.77	236.68	900.14	17.38	47.87	46.43	80778.00
			All Terrain Forklift	0.13	1.03	1.29	0.03	0.14	0.13	155.92

On-road Equipment	Hours of Operation	Engine HP	Speed (mph)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO <sub>2</sub> lb/mile	PM lb/mile	PM2.5 lb/mile	CO <sub>2</sub> lb/mile
Delivery Truck	288	265	45	0.0015	0.0080	0.0361	0.0000	0.0015	0.0015	3.4385
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM lb	PM2.5 lb	CO <sub>2</sub> lb
			Delivery Truck	19.72	104.22	467.47	0.23	19.50	18.89	44,563
<b>Subtotal (lbs):</b>				<b>123</b>	<b>544</b>	<b>1744</b>	<b>27</b>	<b>96</b>	<b>94</b>	<b>168014</b>
<b>Building Construction Grand Total in Tons</b>				<b>0.06</b>	<b>0.27</b>	<b>0.87</b>	<b>0.01</b>	<b>0.05</b>	<b>0.05</b>	
<b>Building Construction Grand Total in Metric Tons</b>										<b>76</b>

Vehicle Trips = 166

Table 4. Gravel Work

2,761 CY 197 trips 17,355 total miles

Off-road Equipment	Hours	Engine HP	Load Factor	VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM <sub>10</sub> g/hp-hr	PM <sub>2.5</sub> g/hp-hr	CO <sub>2</sub> g/hp-hr
Dozer	28	185	0.59	0.34	1.21	4.08	0.12	0.23	0.22	536
Wheel Loader for Spreading	35	87	0.59	0.35	1.25	4.23	0.12	0.24	0.23	536
Compactor	76	103	0.43	0.36	1.34	4.45	0.12	0.26	0.25	536
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM10 lb	PM2.5 lb	CO <sub>2</sub> lb
			Dozer	2.28	8.02	27.11	0.77	1.50	1.46	3559.76
			Wheel Loader for Spreading	1.36	4.88	16.53	0.45	0.93	0.90	2092.50
			Compactor	2.67	9.95	33.10	0.86	1.91	1.85	3983.35

On-road Equipment	Miles	Engine HP	VOC lb/mile	CO lb/mile	NOx lb/mile	SO <sub>2</sub> lb/mile	PM <sub>10</sub> lb/mile	PM <sub>2.5</sub> lb/mile	CO <sub>2</sub> lb/mile
Dump Truck	17,355	230	0.0015	0.0080	0.0361	0.0000	0.0015	0.0015	3.4385
			VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
Dump Truck			26.40	139.57	625.99	0.31	26.11	25.30	59,675
<b>Subtotal (lbs):</b>			<b>33</b>	<b>162</b>	<b>703</b>	<b>2</b>	<b>30</b>	<b>30</b>	<b>69,311</b>
<b>Gravel Work Grand Total in Tons</b>			<b>0.02</b>	<b>0.08</b>	<b>0.35</b>	<b>0.00</b>	<b>0.02</b>	<b>0.01</b>	
<b>Gravel Work Grand Total in Metric Tons</b>									<b>31</b>

Vehicle Trips = 22

Table 5. Concrete Work

Concrete Surface SF  
4,690 SY 1.83 yards thick

<sup>1</sup> Off-road Equipment	<sup>2</sup> Cumulative Hours of Operation	<sup>3</sup> Engine HP	<sup>4</sup> Load Factor	<sup>6,7</sup> Emission Factors						
				VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM <sub>10</sub> g/hp-hr	PM <sub>2.5</sub> g/hp-hr	CO <sub>2</sub> g/hp-hr
Grader (CAT 120M2 or similar)	7	150	0.61	1.06	3.52	8.24	0.06	0.47	0.47	568
Steel drum roller/soil compactor	65	401	0.56	0.70	3.18	7.20	0.05	0.28	0.28	568
Paving/Concrete Machine	65	164	0.53	1.14	3.71	8.87	0.49	0.49	0.49	568
Curbing Machine	3	130	0.59	1.14	3.71	8.87	0.49	0.49	0.49	568
Cement and Motar Mixer 1	65	9	0.56	0.92	2.64	5.41	0.07	0.35	0.35	568
Cement and Motar Mixer 2	65	9	0.56	0.92	2.64	5.41	0.07	0.35	0.35	568
Cement and Motar Mixer 3	65	9	0.56	0.92	2.64	5.41	0.07	0.35	0.35	568
Tractor/Loader/Backhoe	65	75	0.55	1.50	4.22	8.33	0.06	0.80	0.80	568
<sup>1</sup> On-road Equipment	<sup>2</sup> Cumulative Hours of Operation	<sup>3</sup> Engine HP	<sup>5</sup> Speed (miles/hour)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO <sub>2</sub> lb/mile	PM <sub>10</sub> lb/mile	PM <sub>2.5</sub> lb/mile	CO <sub>2</sub> lb/mile
Cement Truck	65	230	20	0.001521	0.008042	0.036070	1.80E-05	0.001504	0.001458	3.438541
Water Truck/Oil truck	7	230	10	0.001521	0.008042	0.036070	1.80E-05	0.001504	0.001458	3.438541

Annual Emissions										
VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb				
1.40	4.63	10.84	0.08	0.62	0.62	747.78				
22.51	102.79	232.38	1.61	9.11	9.11	18,352.00				
14.19	46.31	110.91	6.17	6.17	6.17	7,103.47				
0.63	2.04	4.89	0.27	0.27	0.27	313.41				
0.67	1.91	3.92	0.05	0.25	0.25	411.89				
0.67	1.91	3.92	0.05	0.25	0.25	411.89				
0.67	1.91	3.92	0.05	0.25	0.25	411.89				
8.89	25.03	49.38	0.36	4.76	4.76	3,371.13				
VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb				
1.98	10.49	47.06	0.02	1.96	1.90	4,486				
0.10	0.52	2.35	0.00	0.10	0.10	224				
<b>Runway Construction Grand Total in Tons</b>				<b>0.03</b>	<b>0.10</b>	<b>0.23</b>	<b>0.00</b>	<b>0.01</b>	<b>0.01</b>	
<b>Runway Construction Grand Total in Metric Tons</b>										<b>16</b>

Vehicle Trips = 63

Table 6. Paving

Pavement - Surface Area 2,400 SF  
Paving - HMA 800 CF 30 CY

Off-road Equipment	Hours of Operation	Engine HP	Load Factor	VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM g/hp-hr	PM <sub>2.5</sub> g/hp-hr	CO <sub>2</sub> g/hp-hr
Grader	7	145	0.59	0.38	1.41	4.16	0.12	0.30	0.29	536
Roller	11	401	0.59	0.34	2.46	5.53	0.12	0.34	0.33	536
Paving Machine	15	164	0.59	0.38	1.44	4.25	0.12	0.30	0.29	536
Asphalt Curbing Machine	1	130	0.59	0.40	1.57	4.57	0.12	0.32	0.31	536
				VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
Grader				0.50	1.86	5.49	0.15	0.39	0.38	707.24
Roller				1.96	14.13	31.76	0.66	1.94	1.88	3,074.15
Paving Machine				1.22	4.62	13.61	0.37	0.96	0.93	1,714.07
Asphalt Curbing Machine				0.07	0.27	0.77	0.02	0.05	0.05	90.57

On-road Equipment	Hours of Operation	Engine HP	Productivity based Speed (miles/hour)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO2 lb/mile	PM lb/mile	PM2.5 lb/mile	CO2 lb/mile
Dump Truck	6	230	17	0.001521	0.008042	0.036070	1.80E-05	0.001504	0.001458	3.438541
Water Truck	0	230	10	0.001521	0.008042	0.036070	1.80E-05	0.001504	0.001458	3.438541
				<b>VOC lb</b>	<b>CO lb</b>	<b>NOx lb</b>	<b>SO2 lb</b>	<b>PM lb</b>	<b>PM2.5 lb</b>	<b>CO2 lb</b>
			Dump Truck	0.16	0.82	3.68	0.00	0.15	0.15	351
			Water Truck	0.00	0.00	0.00	0.00	0.00	0.00	0

Hot Mix Asphalt (HMA)	Volume of HMA (ft³)	Weight of HMA (tons)	VOC lb/ton of asphalt	VOC lb	CO lb	NOx lb	SO2 lb	PM10 lb	PM2.5 lb	CO2 lb
Standard Hot Mix Asphalt	800	58	0.04	2.32	-	-	-	-	-	-
<b>Subtotal (lbs):</b>				<b>6</b>	<b>22</b>	<b>55</b>	<b>1</b>	<b>4</b>	<b>3</b>	<b>5,937</b>
<b>Paving Grand Total in Tons</b>				<b>0.00</b>	<b>0.01</b>	<b>0.03</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	
<b>Paving Grand Total in Metric Tons</b>										<b>3</b>

Vehicle Trips =

1

**TBD Demo**

Table 7. Building Demo - TBD

27,094 SF

1,355 Estimated CY of debris based on 20 SF/CY

Off-road Equipment	Hours of Operation	Engine HP	Load Factor	Emission Factors						
				VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO2 g/hp-hr	PM10 g/hp-hr	PM2.5 g/hp-hr	CO2 g/hp-hr
Hydraulic excavator	226	86	0.59	0.23	2.57	2.68	0.11	0.40	0.39	595.46
Wheel Loader w/ integral Backhoe	226	87	0.23	1.07	6.13	5.02	0.14	0.95	0.92	692.77
Wheel mounted air compressor	226	49	0.59	0.26	1.41	3.51	0.11	0.23	0.22	536.20
				Annual Emissions						
				VOC lb	CO lb	NOx lb	SO2 lb	PM10 lb	PM2.5 lb	CO2 lb
Hydraulic excavator				5.79	64.98	67.76	2.87	10.19	9.88	15,053.96
Wheel Loader w/ integral Backhoe				10.64	61.09	50.06	1.41	9.46	9.18	6,906.84
Wheel mounted air compressor				3.78	20.29	50.53	1.55	3.34	3.24	7,723.54
<b>Subtotal (lbs):</b>				<b>20.21</b>	<b>146.37</b>	<b>168.36</b>	<b>5.84</b>	<b>22.99</b>	<b>22.30</b>	<b>29684.33</b>

On-road Equipment	Hours of Operation	Engine HP	Speed (mph)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO2 lb/mile	PM10 lb/mile	PM2.5 lb/mile	CO2 lb/mile
Dump Truck	124	230	27	0.001521	0.008042	0.036070	1.80E-05	0.001504	0.001458	3.438541
				<b>VOC lb</b>	<b>CO lb</b>	<b>NOx lb</b>	<b>SO2 lb</b>	<b>PM10 lb</b>	<b>PM2.5 lb</b>	<b>CO2 lb</b>
			Dump Truck (12 CY Capacity)	5.09	26.92	120.76	0.06	5.04	4.88	11,512
<b>Subtotal (lbs):</b>				<b>25.30</b>	<b>173.29</b>	<b>289.12</b>	<b>5.90</b>	<b>28.02</b>	<b>27.18</b>	<b>41,196.57</b>
<b>Building Demo Grand Total in Tons</b>				<b>0.013</b>	<b>0.087</b>	<b>0.145</b>	<b>0.003</b>	<b>0.014</b>	<b>0.014</b>	
<b>Building Demo Grand Total in Metric Tons</b>										<b>18.69</b>

Vehicle Trips =

106

**2019**

Table 8. Building Demo - 2019

3,705 SF

185 Estimated CY of debris based on 20 SF/CY

Off-road Equipment	Cumulative Hours of Operation	Engine HP	Load Factor	Emission Factors						
				VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO2 g/hp-hr	PM10 g/hp-hr	PM2.5 g/hp-hr	CO2 g/hp-hr
Hydraulic excavator with breakers and jackhammer bits	31	86	0.59	0.23	2.57	2.68	0.11	0.40	0.39	595.46
Wheel Loader w/ integral Backhoe	31	87	0.23	1.07	6.13	5.02	0.14	0.95	0.92	692.77
Wheel mounted air compressor	31	49	0.59	0.26	1.41	3.51	0.11	0.23	0.22	536.20
On-road Equipment	Cumulative Hours of Operation	Engine HP	Productivity based Speed (miles/hour)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO2 lb/mile	PM10 lb/mile	PM2.5 lb/mile	CO2 lb/mile
Dump Truck	17	230	27	0.00166	0.00858	0.03922	0.00002	0.00169	0.00164	3.38

Annual Emissions						
VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
0.79	8.88	9.26	0.39	1.39	1.35	2,057
1.45	8.35	6.84	0.19	1.29	1.25	944
0.52	2.77	6.90	0.21	0.46	0.44	1,055
VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
0.77	3.98	18.18	0.01	0.78	0.76	1,568
<b>Subtotal (lbs):</b>	<b>4</b>	<b>24</b>	<b>41</b>	<b>1</b>	<b>4</b>	<b>5,624</b>
<b>Building Demo Grand Total in Tons</b>	<b>0.002</b>	<b>0.012</b>	<b>0.021</b>	<b>0.000</b>	<b>0.002</b>	<b>0.002</b>
<b>Building Demo Grand Total in Metric Tons</b>						<b>2.55</b>

Vehicle Trips =

10

**2020**

**Table 9. Building Demo - 2020**

36,106 SF

1,805 Estimated CY of debris based on 20 SF/CY

Off-road Equipment	Cumulative Hours of Operation	Engine HP	Load Factor	Emission Factors						
				VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM <sub>10</sub> g/hp-hr	PM <sub>2.5</sub> g/hp-hr	CO <sub>2</sub> g/hp-hr
Hydraulic excavator with breakers and jackhammer bits	301	86	0.59	0.23	2.57	2.68	0.11	0.40	0.39	595.46
Wheel Loader w/ integral Backhoe	301	87	0.23	1.07	6.13	5.02	0.14	0.95	0.92	692.77
Wheel mounted air compressor	301	49	0.59	0.26	1.41	3.51	0.11	0.23	0.22	536.20
On-road Equipment	Cumulative Hours of Operation	Engine HP	Productivity based Speed (miles/hour)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO <sub>2</sub> lb/mile	PM <sub>10</sub> lb/mile	PM <sub>2.5</sub> lb/mile	CO <sub>2</sub> lb/mile
Dump Truck	165	230	27	0.00166	0.00858	0.03922	0.00002	0.00169	0.00164	3.38

Annual Emissions						
VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
7.71	86.54	90.25	3.83	13.57	13.16	20,050
14.17	81.37	66.68	1.88	12.60	12.22	9,199
5.04	27.03	67.30	2.07	4.45	4.32	10,287
VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
7.47	38.61	176.49	0.08	7.61	7.39	15,221
<b>Subtotal (lbs):</b>	<b>34</b>	<b>234</b>	<b>401</b>	<b>8</b>	<b>37</b>	<b>54,756</b>
<b>Building Demo Grand Total in Tons</b>	<b>0.017</b>	<b>0.117</b>	<b>0.200</b>	<b>0.004</b>	<b>0.019</b>	<b>0.019</b>
<b>Building Demo Grand Total in Metric Tons</b>						<b>24.84</b>

Vehicle Trips =

94

**Table 10. Fugitive Dust**

Year	PM <sub>10</sub> tons/acre/mo	acres	days of disturbance	PM <sub>10</sub> Total (tons)	PM <sub>2.5</sub> /PM <sub>10</sub> Ratio	PM <sub>2.5</sub> Total (tons)
TBD - Construction	0.42	3.5	90	6.6	0.1	0.7
TBD - Demo	0.42	0.6	20	0.3	0.1	0.0
2019	0.42	0.1	5	0.0	0.1	0.0
2020	0.42	0.8	30	0.5	0.1	0.1

**Table 11. Annual Construction Worker POVs - 2019 - TBD**

Year	Vehicle Trips	mile/trip	VOCs lb/mi	CO lb/mi	NOx lb/mi	SO <sub>2</sub> lb/mi	PM <sub>10</sub> lb/mi	PM <sub>2.5</sub> lb/mi	CO <sub>2</sub> g/mi	CH <sub>4</sub> g/mi	N <sub>2</sub> O g/mi
TBD - Construction	302	6	0.00129	0.03681	0.00510	0.00001	0.00021	0.00019	364.00	0.031	0.032
TBD - Demo	106	6	0.00129	0.03681	0.00510	0.00001	0.00021	0.00019	364.00	0.031	0.032
2019	10	6	0.00129	0.03681	0.00510	0.00001	0.00021	0.00019	364.00	0.031	0.032
2020	94	6	0.00129	0.03681	0.00510	0.00001	0.00021	0.00019	364.00	0.031	0.032
VOCs	CO	NOx	SO <sub>2</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	CO <sub>2</sub> e metric ton/year					
ton/year	ton/year	ton/year	ton/year	ton/year	ton/year	ton/year					
0.001	0.033	0.005	0.000	0.000	0.000	0.7					
0.000	0.012	0.002	0.000	0.000	0.000	0.2					
0.000	0.001	0.000	0.000	0.000	0.000	0.0					
0.000	0.010	0.001	0.000	0.000	0.000	0.2					

Table 12. Wallops Mainland and Island Area Construction Summary

YEAR	VOC T/yr	CO T/yr	NOx T/yr	SO <sub>2</sub> T/yr	PM <sub>10</sub> T/yr	PM <sub>2.5</sub> T/yr	CO <sub>2</sub> MT/yr
TBD - Construction	0.12	0.54	1.60	0.02	6.70	0.74	140
TBD - Demo	0.01	0.10	0.15	0.00	0.27	0.04	19
2019	0.00	0.01	0.02	0.00	0.01	0.00	3
2020	0.02	0.12	0.20	0.00	0.52	0.07	25



Table 3. Annual Emissions from Dredging

YEAR	VOC T/yr	CO T/yr	NOx T/yr	SO <sub>2</sub> T/yr	PM <sub>10</sub> T/yr	PM <sub>2.5</sub> T/yr	CO <sub>2</sub> MT/yr
Annually	0.18	0.75	2.92	0.06	0.13	0.13	203

Bridge

Table 4. Site Prep - Excavate/Fill - Trenching - Grading - 2019-2022

Site Prep - Excavate/Fill (CY)	12,963 CY	Assume 100% hauled in or out	12,963 CY hauled
Trenching (LF)	0 LF	Assume 2 ft deep trench, 2 feet wide	0 CY
Grading (SY)	1,556 SF	Convert	173 SY
		Assume 100% hauled in or out	0 CY hauled
		Assume compact 0.5 feet (0.166 yards)	29 CY compacted

Off-road Equipment	Cumulative Hours of Operation	Engine HP	Load Factor	Emission Factors						
				VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM <sub>10</sub> g/hp-hr	PM <sub>2.5</sub> g/hp-hr	CO <sub>2</sub> g/hp-hr
Backhoe Excavator	43	243	0.59	0.34	1.21	4.03	0.12	0.22	0.22	535.79
Skid Steer Loader	52	160	0.23	0.38	1.47	4.34	0.12	0.31	0.30	535.67
Dozer	47	145	0.59	0.38	1.41	4.17	0.12	0.30	0.29	535.69
Scraper Hauler Excavator	47	365	0.58	0.38	1.42	4.19	0.12	0.30	0.29	535.69
Compactor	15	103	0.58	0.40	1.57	4.57	0.12	0.32	0.31	535.63
Grader	6	285	0.58	0.34	1.21	4.07	0.12	0.23	0.22	535.79
Trenching with backhoe loader	3	87	0.59	0.35	1.25	4.23	0.12	0.24	0.23	535.77
On-road Equipment	Cumulative Hours of Operation	Engine HP	Productivity based Speed (miles/hour)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO <sub>2</sub> lb/mile	PM <sub>10</sub> lb/mile	PM <sub>2.5</sub> lb/mile	CO <sub>2</sub> lb/mile
Dump Truck (12 CY capacity)	926	230	16	0.00166	0.00858	0.03922	0.00002	0.00169	0.00164	3.38
Delivery Truck	4	365	45	0.00166	0.00858	0.03922	0.00002	0.00169	0.00164	3.38

Annual Emissions							
VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb	
4.70	16.52	55.03	1.57	3.04	2.95	7,318	
1.61	6.18	18.25	0.48	1.28	1.25	2,253	
3.34	12.53	36.97	1.02	2.62	2.54	4,745	
8.27	31.11	91.78	2.53	6.50	6.30	11,742	
0.80	3.18	9.23	0.23	0.65	0.63	1,083	
0.76	2.67	8.99	0.25	0.50	0.48	1,183	
0.12	0.42	1.42	0.04	0.08	0.08	180	
VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb	
24.92	128.82	588.90	0.27	25.39	24.66	50,787	
0.26	1.35	6.18	0.00	0.27	0.26	533	
<b>Subtotal (lbs):</b>	<b>45</b>	<b>203</b>	<b>817</b>	<b>6</b>	<b>40</b>	<b>39</b>	<b>79,825</b>
<b>Site Prep Grand Total in Tons</b>				<b>0.02</b>	<b>0.10</b>	<b>0.41</b>	<b>0.00</b>
<b>Site Prep Grand Total in Metric Tons</b>							<b>36</b>

Vehicle Trips (per year)

6

Table 5. Construct bridge base (Cofferdams, Piers)

1400 Feet of Bridge 4466 CY Concrete

Off-road Equipment	Cumulative Hours of Operation	Engine HP	Engine KW	Load Factor	Emission Factors						
					VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM <sub>10</sub> g/hp-hr	PM <sub>2.5</sub> g/hp-hr	CO <sub>2</sub> g/hp-hr
Crane	2240	330	246	0.21	0.25	1.22	5.26	0.11	0.21	0.20	530.30
Backhoe/loader	622	98	73	0.21	0.35	1.25	4.23	0.12	0.24	0.23	535.77
Small generator	2489	10	7	0.43	0.26	1.41	3.51	0.11	0.23	0.22	536.20
Concrete Truck	213	300	224	0.43	0.19	1.45	4.32	0.12	0.21	0.20	536.26
Pile Driver	2,240	260	194	0.43	0.46	1.55	5.90	0.11	0.31	0.30	529.64
Marine Vessel Equipment	Cumulative Hours of Operation	Engine HP	Engine KW	Load Factor	VOC g/kw-hr	CO g/kw-hr	NOx g/kw-hr	SO <sub>2</sub> g/kw-hr	PM <sub>10</sub> g/kw-hr	PM <sub>2.5</sub> g/kw-hr	CO <sub>2</sub> g/kw-hr
Tugboat - main	2,240	2,000	1491	0.6	0.27	2.50	13.00	0.63	0.30	0.29	722.10
Tugboat - auxiliary	2,240	200	149	0.4	0.27	1.50	10.00	0.63	0.40	0.39	758.85
Work Boat	2,240	200	149	0.4	0.27	1.50	10.00	0.63	0.40	0.39	758.85
On-road Equipment	Cumulative Hours of Operation	Engine HP	Productivity based Speed (miles/hour)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO <sub>2</sub> lb/mile	PM <sub>10</sub> lb/mile	PM <sub>2.5</sub> lb/mile	CO <sub>2</sub> lb/mile	
Delivery truck	388	180	40	0.00166	0.00858	0.03922	0.00002	0.00169	0.00164	3.38	

  

Annual Emissions										
VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb				
84.09	417.35	1,800.06	39.04	71.09	68.96	181,484				
9.84	35.24	119.50	3.25	6.74	6.54	15,124				
6.19	33.24	82.77	2.55	5.47	5.31	12,651				
11.36	88.11	261.73	6.99	12.73	12.34	32,485				
256.20	856.78	3,258.54	62.90	173.29	168.09	292,419				
VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb				
1,193.15	11,047.65	57,447.79	2,784.01	1,325.72	1,286	3,191,004				
79.54	441.91	2,946.04	185.60	117.84	114	223,560				
79.54	441.91	2,946.04	185.60	117.84	114	223,560				
VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb				
25.78	133.26	609.18	0.28	26.27	25.51	52,537				
<b>1,746</b>	<b>13,495</b>	<b>69,472</b>	<b>3,270</b>	<b>1,857</b>	<b>1,801</b>	<b>4,224,824</b>				
<b>Bridge Construction Total in Tons</b>				<b>0.87</b>	<b>6.75</b>	<b>34.74</b>	<b>1.64</b>	<b>0.93</b>	<b>0.90</b>	
<b>Bridge Construction Total in Metric Tons</b>										<b>1916</b>

Vehicle Trips (per year)

378



Table 6. Construct superstructure, final roadway approaches (concrete)

26 Prestress Bridge Section      Approaches      40,000      SF  
 Pavement - Surface Area      40,000 SF      494 CY

Off-road Equipment	Cumulative Hours of Operation	Engine HP	Engine KW	Load Factor	Emission Factors						
					VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO <sub>2</sub> g/hp-hr	PM <sub>10</sub> g/hp-hr	PM <sub>2.5</sub> g/hp-hr	CO <sub>2</sub> g/hp-hr
Crane	416	170	127	0.21	0.25	1.22	5.26	0.11	0.21	0.20	530.30
Grader	184	150	112	0.59	1.06	3.52	8.24	0.06	0.47	0.47	568.30
Roller	184	30	22	0.59	0.70	3.18	7.20	0.05	0.28	0.28	568.30
Paving/Concrete Machine	245	164	122	0.53	1.14	3.71	8.87	0.49	0.49	0.49	568.30
Small diesel engines	245	25	19	0.43	0.26	1.41	3.51	0.11	0.23	0.22	536.20
Concrete Truck	155	300	224	0.43	0.19	1.45	4.32	0.12	0.21	0.20	536.26
Marine Vessel Equipment	Cumulative Hours of Operation	Engine HP	Engine KW	Load Factor	VOC g/kw-hr	CO g/kw-hr	NOx g/kw-hr	SO <sub>2</sub> g/kw-hr	PM <sub>10</sub> g/kw-hr	PM <sub>2.5</sub> g/kw-hr	CO <sub>2</sub> g/kw-hr
Tugboat - main	416	2,000	1491	0.6	0.27	2.5	13	0.63	0.3	0.29	722.10
Tugboat - auxiliary	416	200	149	0.4	0.27	1.5	10	0.63	0.4	0.39	758.85
Work Boat	416	200	149	0.4	0.27	1.5	10	0.63	0.4	0.39	758.85
On-road Equipment	Cumulative Hours of Operation	Engine HP	Productivity based Speed (miles/hour)	VOC lb/mile	CO lb/mile	NOx lb/mile	SO <sub>2</sub> lb/mile	PM <sub>10</sub> lb/mile	PM <sub>2.5</sub> lb/mile	CO <sub>2</sub> lb/mile	
Delivery truck	150	180	40	0.00166	0.00858	0.03922	0.00002	0.00169	0.00164	3.38	
					Annual Emissions						
					VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
					8.04	39.93	172.21	3.73	6.80	6.60	17,363
					38.07	126.27	295.34	2.04	16.81	16.81	20,374
					5.00	22.82	51.60	0.36	2.02	2.02	4,075
					53.29	173.94	416.57	23.19	23.19	23.19	26,681
					1.52	8.18	20.37	0.63	1.35	1.31	3,113
					8.28	64.21	190.73	5.09	9.27	8.99	23,672
					VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
					221.58	2,051.71	10,668.87	517.03	246.20	239	592,615
					14.77	82.07	547.12	34.47	21.88	21	41,518
					14.77	82.07	547.12	34.47	21.88	21	41,518
					VOC lb	CO lb	NOx lb	SO <sub>2</sub> lb	PM <sub>10</sub> lb	PM <sub>2.5</sub> lb	CO <sub>2</sub> lb
					9.97	51.52	235.52	0.11	10.15	9.86	20,312
<b>Subtotal (lbs):</b>					<b>375</b>	<b>2,703</b>	<b>13,145</b>	<b>621</b>	<b>360</b>	<b>350</b>	<b>791,242</b>
<b>Superstructure Construction Total in Tons</b>					<b>0.19</b>	<b>1.35</b>	<b>6.57</b>	<b>0.31</b>	<b>0.18</b>	<b>0.18</b>	
<b>Superstructure Construction Total in Metric Tons</b>											<b>359</b>

Vehicle Trips (per year)

70

Table 7. Demo Asphalt/Concrete- 2023

20,000 CY

Off-road Equipment	Cumulative Hours of Operation	Engine HP	Enging KW	Load Factor	Emission Factors						
					VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	SO2 g/hp-hr	PM10 g/hp-hr	PM2.5 g/hp-hr	CO2 g/hp-hr
D-6K Crawler Dozer with attachments	2,125	125	93	0.58	0.34	1.21	4.08	0.12	0.23	0.22	535.79
Wheel mounted air compressor	2,125	49	37	0.59	0.33	2.54	4.53	0.13	0.54	0.53	595.16
excavator (CAT 345D L or similar)	445	380	283	0.59	0.31	2.50	4.51	0.13	0.55	0.54	595.21
Marine Vessel Equipment	Cumulative Hours of Operation	Engine HP	Engine KW	Load Factor	VOC g/kw-hr	CO g/kw-hr	NOx g/kw-hr	SO2 g/kw-hr	PM10 g/kw-hr	PM2.5 g/kw-hr	CO2 g/kw-hr
Tugboat - main	523	2,000	1491	0.6	0.27	2.5	13	0.63	0.3	0.29	722.10
Tugboat - auxiliary	523	200	149	0.4	0.27	1.5	10	0.63	0.4	0.39	758.85
Work Boat	523	200	149	0.4	0.27	1.5	10	0.63	0.4	0.39	758.85
On-road Equipment	Cumulative Hours of Operation	Engine HP	Productivity based Speed (miles/hour)		VOC lb/mile	CO lb/mile	NOx lb/mile	SO2 lb/mile	PM10 lb/mile	PM2.5 lb/mile	CO2 lb/mile
Dump Truck	1,650	230	27		0.00166	0.00858	0.03922	0.00002	0.00169	0.00164	3.38
					Annual Emissions						
					VOC lb	CO lb	NOx lb	SO2 lb	PM10 lb	PM2.5 lb	CO2 lb
					116.73	410.00	1385.57	39.14	76.77	74.47	181,947
					44.38	344.13	613.06	17.34	73.39	71.19	80,593
					68.64	548.82	990.58	28.14	121.31	117.67	130,827
					VOC lb	CO lb	NOx lb	SO2 lb	PM10 lb	PM2.5 lb	CO2 lb
					278.31	2,576.98	13,400.29	649.40	309.24	300	744,335
					18.55	103.08	687.19	43.29	27.49	27	52,148
					18.55	103.08	687.19	43.29	27.49	27	52,148
					VOC lb	CO lb	NOx lb	SO2 lb	PM10 lb	PM2.5 lb	CO2 lb
					74.68	386.06	1,764.88	0.82	76.09	73.89	152,206
<b>Subtotal (lbs):</b>					<b>619.84</b>	<b>4472.15</b>	<b>19528.78</b>	<b>821.42</b>	<b>711.78</b>	<b>690.51</b>	<b>1,394,203</b>
Demo Asphalt/Concrete Total in Tons					<b>0.31</b>	<b>2.24</b>	<b>9.76</b>	<b>0.41</b>	<b>0.36</b>	<b>0.35</b>	
Demo Asphalt/Concrete Total in Metric Tons											<b>632</b>

Vehicle Trips (per year) 163

Table 9. Bridge POV 2019- 2023

Year	Vehicle Trips	mile/trip	VOCs lb/mi	CO lb/mi	NOx lb/mi	SO2 lb/mi	PM10 lb/mi	PM2.5 lb/mi	CO2 g/mi	CH4 g/mi	N2O g/mi
Any year 2019 - 2023	617	6	0.00128593	0.03681076	0.00509876	0.00001339	0.00020844	0.00019220	364.00	0.031	0.032
			VOCs ton/year	CO ton/year	NOx ton/year	SO2 ton/year	PM10 ton/year	PM2.5 ton/year	CO2e metric ton/year		
			2.38E-03	6.81E-02	9.43E-03	2.48E-05	3.86E-04	3.55E-04	1		

Table 10. Wallops Causeway Bridge Totals

YEAR	VOC T/yr	CO T/yr	NOx T/yr	SO2 T/yr	PM10 T/yr	PM2.5 T/yr	CO2 MT/yr
2019	0.28	2.16	8.35	1.67	0.23	0.22	2,313
2020	0.28	2.16	8.35	1.67	0.23	0.22	2,313
2021	0.28	2.16	8.35	1.67	0.23	0.22	2,313
2022	0.28	2.16	8.35	1.67	0.23	0.22	2,313
2023	0.59	4.39	18.12	2.08	0.58	0.56	2,945

Table 11. Causeway, Bridge and Dredging Totals

YEAR	VOC T/yr	CO T/yr	NOx T/yr	SO2 T/yr	PM10 T/yr	PM2.5 T/yr	CO2 MT/yr
2019	0.47	2.91	11.28	1.73	0.36	0.35	2,515
2020	0.47	2.91	11.28	1.73	0.36	0.35	2,515
2021	0.47	2.91	11.28	1.73	0.36	0.35	2,515
2022	0.47	2.91	11.28	1.73	0.36	0.35	2,515
2023	0.78	5.15	21.04	2.14	0.72	0.69	3,148

Project Name	Building Number	Type (Renov or Const)	Year	FootPrint (AC)	Clearing (AC)	Grading (sf)	Demo Bldgs (SF)	Demo asphalt/ concrete (SF)	Site Prep - Excavate/Fill (CY)	Trenching (LF)	Building Construction - Total Size (sf)	Building Construction foundation footprint (sf)	# Stories	Paving - Surface area (SF)	Pavement type, vehicle or aircraft	Paving - HMA (CY)	Sidewalks (sf)	Gravel Work (CY)	Concrete Work - sidewalks, etc (CY)	Concrete Work - foundation (CY)	Runway Construction (Concrete and Asphalt) (SF)	Concrete Fillings Required	Building Square Footage (original for Renovation)
<b>Main Base</b>																							
Commercial Space Terminal	N/A	New	TBD	0.80	-	35,000	-	-	1,296	-	35,000	35,000	1	3,500	Aircraft	1,167	1,750	745	22	5,185	-	-	
Runway 04/22 Extension	N/A	New	TBD	4.30	-	187,500	-	-	20,833	2,500	-	-	-	-	-	-	-	-	20,833	-	-	187,500	
Sounding Rocket Program Facility	E-107	New	TBD	0.46	0.25	20,000	6,040	604	1,329	-	20,000	20,000	-	2,000	Vehicle	667	1,000	426	12	2,963	-	-	
Range and Project Management Facility	N/A	RBR	TBD	1.72	1.72	-	65,000	72,000	27,400	-	65,000	65,000	1	6,500	Vehicle	2,167	3,250	1,384	40	9,630	-	-	
<b>Totals TBD</b>				<b>7.28</b>	<b>2.0</b>	<b>242,500</b>	<b>71,040</b>	<b>72,604</b>	<b>50,658</b>	<b>2,500</b>	<b>120,000</b>	<b>120,000</b>	<b>-</b>	<b>12,000</b>	<b>-</b>	<b>4,000</b>	<b>6,000</b>	<b>23,389</b>	<b>74</b>	<b>17,778</b>	<b>187,500</b>	<b>-</b>	<b>-</b>
Packing and Crating Facility	D-049	Demo	TBD	0.08	-	3,200	-	-	204	-	-	-	-	-	-	-	-	-	-	-	-	-	
ATC Tower	A-001	Demo	TBD	0.10	-	4,232	4,232	423	931	-	-	-	-	-	-	-	-	-	-	-	-	-	
Source Evaluation Board Building	A-131	Demo	TBD	0.02	-	882	882	88	194	-	-	-	-	-	-	-	-	-	-	-	-	-	
Air Support	C-015	Demo	TBD	0.12	-	5,097	5,097	510	1,121	-	-	-	-	-	-	-	-	-	-	-	-	-	
Groundwater Remediation Facility	E-010	Demo	TBD	0.08	-	3,809	3,809	393	860	-	-	-	-	-	-	-	-	-	-	-	-	-	
Management Education Center	E-104	Demo	TBD	0.80	-	35,000	35,000	3,500	7,700	-	-	-	-	-	-	-	-	-	-	-	-	-	
Reproduction Facility	F-001	Demo	TBD	0.14	-	5,940	5,940	594	1,307	-	-	-	-	-	-	-	-	-	-	-	-	-	
Telecommunications Facility	F-002	Demo	TBD	0.15	-	6,495	6,495	650	1,429	-	-	-	-	-	-	-	-	-	-	-	-	-	
Visitor Center	F-017	Demo	TBD	0.09	-	3,728	3,728	373	820	-	-	-	-	-	-	-	-	-	-	-	-	-	
Garage	H-030	Demo	TBD	0.05	-	2,068	2,068	207	455	-	-	-	-	-	-	-	-	-	-	-	-	-	
Empty Drum Storage	F-014	Demo	TBD	0.02	-	960	960	96	211	-	-	-	-	-	-	-	-	-	-	-	-	-	
WFF Administration	F-006	Demo	TBD	0.34	-	14,613	14,613	1,461	3,215	-	-	-	-	-	-	-	-	-	-	-	-	-	
Compressed Air Distribution Facility	F-021	Demo	TBD	-	-	110	110	11	24	-	-	-	-	-	-	-	-	-	-	-	-	-	
Rain Simulator Shelter	F-162	Demo	TBD	0.06	-	2,500	250	550	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Supply Warehouse	F-019	Demo	TBD	0.51	-	22,400	2,240	4,928	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Optical Lab	D-101	Demo	TBD	0.05	-	2,100	210	462	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Post Office	E-007	Demo	TBD	0.18	-	7,802	790	1,738	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Credit Union	N-533	Demo	TBD	0.03	-	1,446	192	328	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cafeteria/Photo Lab/Gift Shop	E-002	Demo	TBD	0.70	-	30,520	3,052	6,714	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<b>Totals TBD</b>				<b>3.52</b>	<b>-</b>	<b>68,311</b>	<b>153,102</b>	<b>15,358</b>	<b>33,692</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>-</b>	<b>0</b>	<b>-</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	
Central Heating Plant	D-008	Demo	2019	0.16	-	0	7,137	714	1,570	-	-	-	-	-	-	-	-	-	-	-	-	-	
<b>Totals 2019</b>				<b>0.16</b>	<b>-</b>	<b>0</b>	<b>7,137</b>	<b>714</b>	<b>1,570</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	
Consolidated Laboratories	N/A	RBR	2020	0.28	-	12,000	1,200	1,200	-	-	12,000	12,000	1	600	Vehicle	-	600	244	7	1,778	-	-	
<b>Totals 2020</b>				<b>0.28</b>	<b>-</b>	<b>12,000</b>	<b>1,200</b>	<b>1,200</b>	<b>-</b>	<b>-</b>	<b>12,000</b>	<b>12,000</b>	<b>1</b>	<b>600</b>	<b>Vehicle</b>	<b>-</b>	<b>600</b>	<b>244</b>	<b>7</b>	<b>1,778</b>	<b>-</b>	<b>-</b>	
Health/Quality Verification Lab	F-160	Demo	2022	0.51	-	22,337	2,234	4,914	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<b>Totals 2022</b>				<b>0.51</b>	<b>-</b>	<b>22,337</b>	<b>2,234</b>	<b>4,914</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	
<b>Mainland and Wallops Island</b>																							
ELV Launch Pad D-C		Infrastructure - New	TBD	3.18	3.18	15,389	-	-	6,840	500	-	-	1	-	-	-	-	0	-	-	0	10	
DoD SM-3 Vertical Launch System Pad		New	TBD	0.00	0.00	12	-	-	47	500	-	-	-	-	-	-	-	5	-	-	23	4	
ISSM Launch System Pad and Blockhouse		New	TBD	2,222	-	-	-	-	6,667	500	-	-	-	-	-	-	-	2,222	-	-	4,444	-	
Radar and Computer Facility (AEGIS)		New	TBD	0.34	0.34	14,640	-	-	889	1,800	12,000	12,000	1	2,400	Vehicle	800	240	535	3	222	-	-	
<b>Totals TBD</b>				<b>3.52</b>	<b>3.5</b>	<b>32,268</b>	<b>-</b>	<b>-</b>	<b>14,442</b>	<b>3,300</b>	<b>12,000</b>	<b>12,000</b>	<b>-</b>	<b>2,400</b>	<b>-</b>	<b>800</b>	<b>240</b>	<b>2,761</b>	<b>3</b>	<b>222</b>	<b>4,468</b>	<b>-</b>	
Block House 3		Demo	TBD	0.48	-	-	20872	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Terminal Cubicle		Demo	TBD	0.00	-	-	97	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cable Terminal		Demo	TBD	0.01	-	-	541	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Fuel Storage Magazine		Demo	TBD	0.04	-	-	3581	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Island Radar Control Building		Demo	TBD	0.08	-	-	3503	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Camera Stand		Demo	TBD	0.01	-	-	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<b>Totals TBD</b>				<b>0.6</b>	<b>-</b>	<b>-</b>	<b>27,094</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	
AN FSP Radar	Y-055	Demo	2019	0.08	-	-	3,550	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	
Sewer Ejector Station	Y-061	Demo	2019	0.00	-	-	195	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	
<b>Totals 2019</b>				<b>0.09</b>	<b>-</b>	<b>-</b>	<b>3,745</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	
Former Coast Guard Station		Demo	2020	0.10	-	-	4,140	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Bucket Motor Storage Facility		Demo	2020	0.19	-	-	8,200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Fire Department Support Building		Demo	2020	0.02	-	-	1,024	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Paint Shop		Demo	2020	0.06	-	-	2,410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Paint Shop Storage		Demo	2020	0.01	-	-	422	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Electrical Storage Building		Demo	2020	0.02	-	-	1,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
NSIC Performance Test Building		Demo	2020	0.27	-	-	11,617	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Block House 1		Demo	2020	0.08	-	-	3,300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Movable Launch Shelter Building		Demo	2020	0.04	-	-	1,890	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Launch Control Building		Demo	2020	0.01	-	-	340	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Rocket Flight Hardware Storage	Y-050	Demo	2020	0.02	-	-	555	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	
Fire Pump House	X-091	Demo	2020	0.01	-	-	235	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	
Relocation of Radar 3 (Relocated to Mainland)		Relocation	2020	0.01	-	-	625	-	-	-	625	625	1	-	-	-	-	12	-	93	-	-	
Storm Drainage Pump	Y-046	Demo	2020	0.00	-	-	48	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	
<b>Totals 2020</b>				<b>0.83</b>	<b>-</b>	<b>0</b>	<b>36,306</b>	<b>0</b>	<b>-</b>	<b>-</b>	<b>625</b>	<b>625</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>12</b>	<b>-</b>	<b>93</b>	<b>-</b>	<b>-</b>	
<b>Causeway</b>																							
Causeway Bridge			2019-2023	0.30	-	14,000	-	-	12,963	-	-	-	-	70,000	Vehicle - Concrete	-	-	-	-	-	-	Yes	
Causeway Bridge Demolition			2023	-	-	-	-	20,000	-	-	-	-	-	-	-	-	-	-	-	-	-	no	
Dredging			2019-2023	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	500,000	

20,000 tons construction debris  
20,000 CY  
based on 2000 lb/cy

**TAB F. OPERATIONAL EMISSIONS**

**Table 1. Antares Launch Exhaust Emissions**

Burn Rate: 2,414 lbm/sec Fuel (RP-1): 142,735 x 1 = 142,735 lbm  
 Time to 10,000 ft 45 sec Oxidizer (LOX): 390,779 x 1 = 390,779 lbm  
 Time to 3,000 feet 13.50 sec Sum: 533,514 lbm

Compound	Mole Fractions	Molecular Weight	Weight (g/gmole)	Weight Fraction	Total Mass (lbm)	Per-launch Mass (tons)	6 launches per year total (tons)	Below 3000 ft	
								AGL Mixing Height (tons)	Total in Metric Tons
CO	0.23932	28.01000	6.7033532	0.254385863	135,718	67.86	407.16	24.87	22.19
CO2	0.26632	44.01000	11.7207432	0.44479103	237,302	118.65	711.91		646
H	0.00144	1.00800	0.00145152	5.50838E-05	29	0.01	0.09		
H2	0.07231	0.32204	0.023286712	0.000883709	471	0.24	1.41		
H2O	0.01938	18.01500	7.5551307	0.280710007	152,964	76.48	458.89		
O	0.00002	15.99900	0.00031998	1.21429E-05	6	0.00	0.02		
OH	0.00118	17.00700	0.02006826	0.000761571	406	0.20	1.22		
O2	0.00004	31.9988	0.001279952	4.8573E-05	26	0.01	0.08		
SUM:	0.99999		26.35112	1.00000	533,514	266.76	1,600.54		

Source: Evaluation of Taurus II Static Test Firing and Normal Launch Rocket Plume Emissions, ACTA 2009

**Table 2. LMLV-3 Launch Exhaust Emissions<sup>1</sup>**

Burn Rate 1 for Castor IV: 4,436 lb/sec Fuel (NH4ClO4 in HTPB): 293,479 lb total  
 for 60 sec Total fuel burned in 60 sec: 88,720 lb  
 Burn Rate 2 for Castor IV: 1,367 lb/sec Burn duration: 80 sec  
 for 20 sec Total fuel burned in 20 sec: 27,340 lb  
 Time to 3,000 feet 20 sec Total fuel burned in 80 sec: 116,060 lb

Compound	Below 3000 ft	Below 3000 ft AGL	Total for 12 Launches	Total in Metric Tons
	AGL Mixing Height (lbs)	Mixing Height (tons)		
Al2O3	25,596	13	154	139
CO	26,544	13	159	144
HCl	20,856	10	125	114

Data from Environmental Assessment for Range Operations Expansion at the NASA Goddard Space Flight Center, 1997.

**Table 3. Total Existing Launch Envelope Emissions**

	Al2O3	HCl	CO	CO2
Total in Tons	154	125	184	712
Total in Metric Tons	139	114	167	646

note: CO2 is also emitted from solid rocket fuel combustion, but at much lower concentrations - around an order of magnitude lower compared to Al2O3 and HCl (ATK-EELV Program 1996). This would amount to less than 10 tons for the entire fuel-burning trajectory in 12 launches.

**Table 4. Large Space Launch Booster Emissions - with Castor 1200 solid rocket motors - 12 launches annually**

1,114,115 lb mass of the TP-1148 propellant per motor

Chemical	ACTA Weight Fraction <sup>1</sup>	Approx. lbs per launch	Approx. tons per launch (metric tons for CO2)	12 launches annually	
				T/yr except CO2 (MT/yr)	T/yr
Al2O3	0.16797	187,138	12.68	152.15	
CO	0.07510	83,770	5.68	68.13	
CO2	0.11299	125,884	7.74	92.87	
Cl	0.00052	579	0.04	0.47	
HCl	0.11813	131,610	8.92	107.03	
H	0.00001	11	0.00	0.01	
OH	0.00007	78	0.01	0.06	
H2	0.00333	3,710	0.25	3.02	
H2O	0.12725	141,771	9.61	115.30	
NO	0.00001	11	0.00	0.01	
N2	0.38621	430,282	29.16	349.93	
FeCl3	0.00261	2,908	0.20	2.38	

Castor 1200 burn time = 132.8 s  
 Time to reach 10,000 FT AGL = 20 s  
 Time to reach 3,000 FT AGL = 18 s  
 13.55% of total time

<sup>1</sup>ACTA 2012. Evaluation of Toxic Emissions for a Large Solid Propellant Launch Vehicle at Wallops Flight Facility. Table 5-1, page 27

**Table 5. Falcon 9 Launch Emissions - 6 Launches Annually Including RTLs**

Launch Vehicle	Max # launches/yr	RP-1 Use gal/launch	RP-1 MMBtu/gal	NOx Tons/launch	NOx Annual Tons	CO2 EF (kg/gal)	CO2 Metric Tons
Falcon 9	6	35,000	0.135	1.2	7.2	9.76	2,050

<sup>1</sup> From Table 4.5-1 of Environmental Assessment for the Operation and Launch of the Falcon 1 and Falcon 9 Space Vehicles at CCAFS, FL 2007

<sup>2</sup> From Environmental Assessment Falcon 9 and Falcon 9 Heavy Launch Vehicle Programs from SLC-4E, Vandenberg AFB 2011.

Vehicle	Max # RTLs/yr	Vertical Landing sec	CO2 Exhaust lb/sec	Total CO2 exhaust MT/yr
Falcon 9 - RTLs	6	17	1,121	3,111

<sup>1</sup> From Table 4.5-1 of Environmental Assessment for the Operation and Launch of the Falcon 1 and Falcon 9 Space Vehicles at CCAFS, FL 2007

**Table 6. Generator Operations**

Wallops Island

Two 3 -MW Caterpillar 175 emergency power generator

Meets EPA Interim Tier 4 emission requirements

Hours/yr	Fuel Flow Rate L/hr @ 100%	Emission Factors							Emissions					
		g/kW-hr VOCs	g/kW-hr CO	g/kW-hr NOx	g/kW-hr PM10	g/kW-hr CO2	kg/l	T/yr VOCs	T/yr CO	T/yr NOx	T/yr PM10	T/yr PM2.5	MT/yr CO2	
360	807	0.4	3.5	0.67	0.1	0.1	2.70	0.952	6.334	1.595	0.238	0.238	1,567	

<sup>1</sup>USEPA Interim Tier 4 emission standards

<sup>2</sup>Federal GHG Accounting and Reporting Guidance Technical Document, Appendix D, Table D-2. 2010.

Main Base

One 3 -MW Caterpillar 175 emergency power generator

Hours/yr	Fuel Flow Rate L/hr @ 60%	Emission Factors							Emissions					
		g/kW-hr VOCs	g/kW-hr CO	g/kW-hr NOx	g/kW-hr PM10	g/kW-hr CO2	kg/l	T/yr VOCs	T/yr CO	T/yr NOx	T/yr PM10	T/yr PM2.5	MT/yr CO2	
144	484	0.4	3.5	0.67	0.1	0.1	2.70	0.476	4.367	0.798	0.119	0.119	783	

<sup>1</sup>USEPA Interim Tier 4 emission standards

<sup>2</sup>Federal GHG Accounting and Reporting Guidance Technical Document, Appendix D, Table D-2. 2010.

Current Envelope	CO	CO2	NOx	PM	HCl
Antares	24.87	646			
LMLV-3	159			154	125
<b>Total</b>	<b>184</b>	<b>646</b>	<b>0</b>	<b>154</b>	<b>125</b>
New Envelope					
Castor 1200 Boost	68.13	92.87		154.56	107.03
Falcon 9		5,160	7.2		
<b>Total</b>	<b>68</b>	<b>5,253</b>	<b>7</b>	<b>155</b>	<b>107</b>
<b>Net change</b>	<b>-116.0</b>	<b>4,607.4</b>	<b>7.2</b>	<b>1.0</b>	<b>-18.1</b>

UAS

**Table 1. Operation of Viking UAS**

Model	HP	annual # flights	flight time (hr)	BSFC lb/hp-hr	VOC lb/hp-hr	CO lb/hp-hr	NOx lb/hp-hr	PM lb/hp-hr	CO2 g/hp-hr	VOC Tons	CO Tons	NOx Tons	PM Tons	CO2 Metric Tons
Viking 300	25	1,950	11	0.408	0.000966	0.004764	0.0097884	0.000588	188	0.11	0.52	1.07	0.06	101

**Table 2. Operation of MQ-4C**

Engine is Rolls-Royce/Allison AE3007H

Number Type of Operation	Number of Operations per Year	Power Setting	Fuel Flowrate (lb/hr)	Time in Mode	Total Fuel Used	Emission Factor (lb/1000 lb)						
						VOCs	CO	NOx	SO <sub>2</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	CO <sub>2</sub>
Taxi/Idle-out	1,950	Idle	427.65	0.1083	46.33	2.39	17.31	3.82	1.2	0.15	0.14	3.1
Takeoff	1,950	Military	3021.05	0.0067	20.14	0.26	0.83	20.5	1.2	0.27	0.24	3.1
Climbout	1,950	Intermediate	2531.72	0.0083	21.10	0.26	0.83	17.43	1.2	0.24	0.22	3.1
Approach	1,950	Approach	946.85	0.0267	25.25	0.61	3.27	7.77	1.2	0.22	0.2	3.1
Taxi/Idle-In	1,950	Idle	427.65	0.1083	46.33	2.39	17.31	3.82	1.2	0.15	0.14	3.1
						Total Emission in pounds						
						VOCs	CO	NOx	SO <sub>2</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	CO <sub>2</sub>
						215.9	1,563.8	345.1	108.4	13.6	12.6	280
						10.2	32.6	805.1	47.1	10.6	9.4	122
						10.7	34.1	717.1	49.4	9.9	9.1	128
						30.0	161.0	382.6	59.1	10.8	9.8	153
						215.9	1,563.8	345.1	108.4	13.6	12.6	280
<b>Annual emissions (tons/year)</b>						<b>0.24</b>	<b>1.68</b>	<b>1.30</b>	<b>0.19</b>	<b>0.03</b>	<b>0.03</b>	
<b>Annual Emission (metric ton/year)</b>												<b>0.44</b>

**Table 3. Net Change Based on Total Representative Annual UAS Operations**

Operations	VOCs	CO	NOx	SO <sub>2</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	CO <sub>2</sub>
Original Envelope	0.03	0.2	0.4	NA	0.05	0.05	9.6
New Envelope	0.35	2.20	2.37	0.19	0.09	0.09	101
<b>Net Change</b>	<b>0.32</b>	<b>2.00</b>	<b>1.97</b>	<b>NA</b>	<b>0.04</b>	<b>0.04</b>	<b>91.7</b>

