Appendix Q

General Conformity Determination

Prepared for:
TransCanada Keystone XL Pipeline, LP
Houston

Keystone XL Pipeline
General Conformity Determination

TransCanada
December 2010
Document No.: 10623-006-120A

AECOM

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1.0 Introduction

TransCanada Keystone Pipeline, LP (Keystone) is proposing to construct and operate a crude oil pipeline and related facilities from Hardisty, Alberta, Canada, to the Port Arthur and east Houston areas of Texas in the United States (US). The project, known as the Keystone XL Project (Project), will have a nominal capacity to deliver up to 900,000 barrels per day (bpd) of crude oil from an oil supply hub near Hardisty to existing terminals in Nederland near Port Arthur and Moore Junction in Harris County, Texas. The project will consist of three new pipeline segments plus additional pumping capacity on the Cushing Extension Segment of the Keystone Pipeline Project (Keystone Cushing Extension). The Steele City Segment of the Project extends from Hardisty, Alberta southeast to Steele City, Nebraska. The Gulf Coast Segment extends from Cushing, Oklahoma south to Nederland, Texas. The Houston Lateral extends from the Gulf Coast Segment, in Liberty County, Texas southwest to Moore Junction, Harris County, near the Houston Ship Channel (please refer to **Figure 1.1-1**). A surge relief tank is proposed to be constructed at the end of the Gulf Coast segment in Nederland, TX. In total, the Project will consist of approximately 1,707 miles of new, 36-inch-diameter pipeline, consisting of approximately 327 miles in Canada and 1,380 miles within the US. It will interconnect with the northern and southern termini of the previously approved 298-mile-long, 36-inch-diameter Keystone Cushing Extension. The Project is planned to be placed into service in phases. The Gulf Coast Segment is planned to be in-service in 2011. The Steele City Segment and the Houston Lateral are planned to be in-service in 2012.

The Department of State (DOS) has determined that actions by TransCanada Keystone Pipeline, LP (Keystone) regarding the proposed Keystone XL Project (Project) would be subject to the requirements of the Federal Clean Air Act General Conformity Rule for the Houston-Galveston-Brazoria (HGB) severe ozone nonattainment area and the Beaumont-Port Arthur (BPA) moderate ozone nonattainment area. The DOS requested documentation pertaining to estimated Project emissions of ozone precursors i.e., oxides of nitrogen (NO_x) and volatile organic compounds (VOC) in the HGB and BPA ozone nonattainment areas to determine if emissions of these pollutants are above the de minimis thresholds or would be “regionally significant” and thus subject to the General Conformity Rule. Annual emissions from both construction and operational activities were estimated for comparison with the de minimis thresholds and regional significance levels. A project’s emissions are considered to be regionally significant if the emissions exceed 10 percent of a nonattainment area’s emissions inventory for that area.

2.0 Regulatory Background – General Conformity

Section 176(c) of the Federal Clean Air Act states that Federal agencies cannot engage, support, or provide financial assistance for licensing, permitting, or approving any project that could cause or contribute to the severity and/or number of violations of National Ambient Air Quality Standards (NAAQS) or could inhibit the expeditious attainment of these standards. Pursuant to statutory requirements of section 176(c), the USEPA promulgated implementing regulations in Parts 51 (Subpart W) and 93 (Subpart B - "Determining Conformity of General Federal Actions to State or Federal Implementation Plans.") of Title 40 of the Code of Federal Regulations. These regulations, commonly referred to as the General Conformity Rule, apply to all Federal actions except for those related to transportation plans, programs, and projects under Title 23 U.S. Code or the Federal Transit Act, which are subject to Transportation Conformity.

The General Conformity Rule defines a Federal action as any activity engaged in by a department, agency, or instrumentality of the Federal government or any activity that a department, agency, or instrumentality of the Federal government supports in any way, provides financial assistance for, licenses, permits, or approves. The General Conformity Rule applies only to Federal actions in locations designated as maintenance or nonattainment areas for any criteria air pollutant under 40 CFR § 81, "Designation of Areas for Air Quality Planning Purposes."

A Federal action is subject to the General Conformity Rule if it is not classified as an exempt activity, as listed in 40 CFR § 93 Subpart B, and if the total direct and indirect emissions of a pollutant (or its precursors), for which the area is classified as a nonattainment or a maintenance area, equal or exceed either:

1. the emission thresholds established in the General Conformity regulations, or

2. 10 percent of the total emissions budget for the entire nonattainment area.

De minimis thresholds for each ozone nonattainment precursor are based on the severity of the non-attainment classification. For the HGB severe ozone nonattainment areas, the de minimis thresholds for the ozone precursor, i.e., volatile organic compounds (VOC) and oxides of nitrogen (NO_X), is 25 tons per year (tpy) for each pollutant. For the BPA moderate ozone nonattainment area, the de minimis thresholds for emission of the ozone precursors VOC and NO_X is 25 tpy each.

If the projected construction and operational emissions are less than both these thresholds, then the Federal action is presumed to conform to the State Implementation Plan (SIP) or Nonattainment Plan. In the state of Texas, Rule 30 TAC 101.30, "Conformity of General Federal Actions to State Implementation Plans" incorporates Federal General Conformity regulations by reference.

3.0 General Conformity Applicability

3.1 Houston-Galveston-Brazoria Severe Ozone Nonattainment Area

3.1.1 Construction Activities

Project-related construction activities, such as the installation of intermediate pumping stations and pipelines, would require Federal actions (e.g., licenses, permits, and/or approvals from Federal agencies) that could be applicable to the General Conformity Rule. The Gulf Coast Segment (GCS) Project will enter Liberty County (and the HGB severe ozone nonattainment area) at Mile Post (MP) 413.4. The Houston Lateral (a lateral segment branching off the Gulf Coast Segment) extends from the GCS at Pump Station 41 to Moore Junction in Harris County, TX. Construction of the GCS Segment (part of Spread 5 and 6 that is located in the HGB nonattainment area) as well as pump station PS-41 is scheduled to occur from May 1, 2011 through August 30, 2011. Construction of the Houston Lateral is scheduled to begin on May 1, 2012 and continue through September 30, 2012. Since Liberty, Chambers, and Harris Counties are part of the HGB severe ozone nonattainment area, direct and indirect emissions associated with federal actions taken for Project construction and operation activities in Liberty, Chambers, and Harris Counties were analyzed to determine applicability of the General Conformity Rule. Emissions of ozone precursor compounds, oxides of nitrogen (NO_X) and volatile organic compounds (VOC) were analyzed in this conformity determination.

Project-related construction that would occur in Liberty, Chambers, and Harris Counties includes pipeline installation and pumping station (PS-41) construction. The activities associated with construction are further separated by equipment types (on-road and non-road), open burning emissions, fugitive dust and personnel commute. **Table 3-1** compares Project-related construction emissions in Liberty, Chambers, and Harris Counties, with General Conformity Rule de minimis thresholds and 10 percent regional emission levels. The detailed Project construction emission calculations are provided in **Appendix A** of this attachment. The emissions calculations reflect the latest project schedule information.

Table 3-1 Estimated Project-related Construction Emissions in Liberty, Chambers, and Harris Counties (HGB Nonattainment Area) Compared to General Conformity Thresholds

Pollutant	Year	Estimated Project Construction Emissions (tons/year)	General Conformity Threshold (tons/year)[1]	10% of Regional Emissions Budget (tons/year)[2]
NO_X	2011[3]	40.0	25	40,848
VOC	2011[3]	10.8	25	39,013
NO_X	2012	65.4	25	40,848
VOC	2012	30.1	25	39,013

[1] 40 CFR 93.153 (amended July 17, 2006)

[2] Year 2002 tons per year emissions (Houston-Galveston-Brazoria Eight-Hour Ozone Non-Attainment Area Revisions to the State Implementation Plan for the Control of Ozone Air Pollution, Appendix F).

[3] NO_X and VOC emissions for the year 2011 include emissions from construction of the main Gulf Coast segment and PS-41.

As shown in **Table 3-1**, construction-related emissions represent less than 10 percent of the regional emissions budget. Therefore, the second criterion of comparing the projected emissions of NO_x and VOC to the significance thresholds (25 tons per year for a severe ozone nonattainment area) given in the General Conformity regulations was evaluated.

Based on an evaluation of the direct and indirect emissions associated with construction of the project, the estimated emissions of NO_X and VOC are projected to exceed the general conformity threshold of 25 tons per year by 15 tons per year for NO_x for the year 2011.

The estimated emissions of NO_X are projected to exceed the general conformity threshold of 25 tons per year by 40.4 tons per year for NO_x and 5.1 tons per year for VOC for the year 2012. Therefore, a General Conformity Determination is required.

3.1.2 Operational Activities

Pipelines themselves have no operational emissions. The only facility that is a part of this project, has operational emissions and is located in the HGB nonattainment area is an intermediate pumping station, Pumping Station No. 41 (PS-41) which will begin operation in the year 2012. Emission sources at PS-41 include a crude sump and fugitive sources such as valves, pumps, flanges and compressors. **Table 3-2** shows the estimated NO_x and VOC operational emissions for the PS-41 pumping station.

Table 3-2 Estimated Project-related Operational Emissions in Liberty, Chambers, and Harris Counties (HGB ozone nonattainment area) Compared to General Conformity Thresholds

Project	Pollutant	Estimated Project Operational Emissions (tons/year)	General Conformity Threshold (tons/year)[1]	10% of Regional Emissions Budget (tons/year)[2]
PS-41	NO_X	-	25	40,848
	VOC	0.1	25	39,013

1 40 CFR 93.153 (amended July 17, 2006)

2 Year 2002 tons per year emissions (Houston-Galveston-Brazoria Eight-Hour Ozone Non- Attainment Area Revisions to the State Implementation Plan for the Control of Ozone Air Pollution, Appendix F).

Since the operational emissions of NO_X and VOC are well below the 25 tpy threshold, the General Conformity Rule does not apply to operational activities.

3.2 Beaumont-Port Arthur Moderate Ozone Nonattainment Area

3.2.1 Construction Activities

Project-related construction activities, such as the installation of intermediate pumping stations, surge tanks and pipelines, would require Federal actions (e.g., licenses, permits, and/or approvals from Federal agencies) that could be applicable to the General Conformity Rule. The pipeline will enter Liberty County (in the HGB severe ozone nonattainment area) MP 413.4 before entering Hardin County at MP 437.3 and Jefferson County at MP 449.6. Additionally, a surge tank will be constructed in Nederland, TX (Jefferson County). Since both Hardin and Jefferson Counties are located in the Beaumont-Port Arthur (BPA) moderate ozone nonattainment area, direct and indirect emissions associated with Federal actions taken for Project construction in the

counties were analyzed to determine applicability to the General Conformity Rule. As such, construction related emissions of ozone precursor compounds, oxides of nitrogen (NO_X) and volatile organic compounds (VOC) were analyzed in this conformity determination.

Project-related construction that would occur in Jefferson and Hardin Counties includes pipeline installation and surge tank construction. The activities associated with construction are further separated by equipment types (on-road and non-road), open burning emissions, fugitive dust and personnel commute. **Table 3-3** compares Project-related construction emissions in Jefferson and Hardin Counties, with General Conformity Rule de minimis thresholds and 10 percent regional emission levels. The detailed Project construction emission calculations are provided in **Appendix A** of this attachment. The emissions calculations reflect current project schedule information.

Table 3-3 Estimated Project-related Construction Emissions in Jefferson and Hardin Counties (BPA ozone nonattainment area) Compared to General Conformity Thresholds

Pollutant	Year	Estimated Project Construction Emissions (tons/year)	General Conformity Threshold (tons/year)[1]	10% of Regional Emissions Budget (tons/year)[2]
NO_X	2011	74.78	100	70,544
VOC	2011	35.89	100	117,818

1 40 CFR 93.153 (amended July 17, 2006)

2 Year 2002 tons per year emissions (Beaumont-Port Arthur Eight-Hour Ozone Redesignation and Maintenance Plan SIP Revision, Appendix B: Texas 2002 Periodic Emissions Inventory Area, Nonroad Mobile, and Biogenic Sources).

As shown in **Table 3-3**, construction-related emissions represent less than 10 percent of the regional emissions budget. Therefore, the second criterion of comparing the projected emissions of NO_x and VOC to the significance thresholds (100 tons per year for a moderate ozone nonattainment area) given in the General Conformity regulations was evaluated.

Based on an evaluation of the direct and indirect emissions associated with construction of the project, the estimated emissions of NO_X and VOC are below the General Conformity significance threshold of 100 tons per year for a moderate ozone nonattainment area for 2011. Hence, the conformity determination is complete for the portion of the pipeline and surge tank that would be located in the BPA nonattainment area and the proposed construction activity is presumed to conform to the SIP.

3.2.2 Operational Activities

Pipelines themselves have no operational emissions. The only facility that is a part of this project, has operational emissions and is located in the BPA nonattainment area is a surge tank which will begin operation in the year 2012. **Table 3-4** shows the estimated NO_x and VOC operational emissions for the surge tank and associated component fugitives.

Table 3-4 Estimated Project-related Operational Emissions in Jefferson and Hardin Counties (BPA ozone nonattainment area) Compared to General Conformity Thresholds

Project	Pollutant	Estimated Project Operational Emissions (tons/year)	General Conformity Threshold (tons/year)[1]	10% of Regional Emissions Budget (tons/year)[2]
Surge Tank	NO_X	-		
	VOC	0.11 (tons/event)		
Fugitive Components	NO_X	-		
	VOC	14.80		
Total Emissions	**NO_X**	**-**	**100**	**70,544**
	VOC	**16.02**	**100**	**117,818**

1 40 CFR 93.153 (amended July 17, 2006)

2 Year 2002 tons per year emissions (Houston-Galveston-Brazoria Eight-Hour Ozone Non- Attainment Area Revisions to the State Implementation Plan for the Control of Ozone Air Pollution, Appendix F).

Since the operational emissions of NO_X and VOC are well below the 100 tpy threshold for the BPA moderate ozone nonattainment area, the General Conformity Rule does not apply to operational activities.

4.0 General Conformity Determination

4.1 Houston-Galveston-Brazoria Severe Ozone Nonattainment Area

The Houston-Galveston-Brazoria eight county area was re-classified as a severe non-attainment for the 8-hour ozone standard in 2008. The TCEQ developed an air quality nonattainment plan as required by USEPA to ensure that these counties would reduce emissions and work towards achieving future attainment. The most recent revision of the nonattainment plan was adopted as part of the Texas SIP on May 23, 2007. The Project can demonstrate conformity with the nonattainment plan by meeting one or more of the following requirements:

- Demonstrate that the total direct and indirect emissions are specifically identified and accounted for in the applicable SIP;
- Document that the total direct and indirect emissions from the action along with all other emissions in the area will not exceed the SIP emissions budget;
- Obtain a written statement from the State to revise the SIP to include the emissions from the action;
- Document that any on-road motor vehicle emissions are included in the current regional emission analysis for the area's transportation plan or transportation improvement program;
- Fully offset the total direct and indirect emissions by reducing emissions of the same pollutant or precursor in the same nonattainment or nonattainment area; or
- Where appropriate, in accordance with 40 CFR 51.858(4), conduct air quality modeling that can demonstrate that the emissions will not cause or contribute to new violations of the standards, or increase the frequency or severity of any existing violations of the standards.

For the construction of the main pipeline and PS-41 within the HGB severe nonattainment area, NO_X emissions are projected to exceed the 25 tpy threshold by 15 tpy in 2011. For the construction of the Houston lateral NO_X emissions are projected to exceed the 25 tpy threshold by 36.5 tpy in 2012.

The emissions calculations for non-road mobile sources are conservatively based on Tier 2 engine standards as adopted by EPA. In addition to this engine standard, several actions as part of the Texas SIP could be used to mitigate emissions during the construction phase of the Project:

- Utilize construction contractors that participate in the Texas Emission Reduction Plan (TERP) grant program or require contractors to apply for TERP grant funds,
- Give preference through the bidding process to "Green/Clean" Contractors:,
- Require construction contracts to use diesel fuels that meet the Texas Low Emission Diesel (TxLED) standards,
- Require construction contractors to use Best Management Practices in relation to air quality.

In determining whether a Project is in conformity with the state implementation plan (SIP), the emissions from the project are compared to the allowable emissions inventory to determine if the expected emissions increase

can be accommodated in the SIP emissions budget. According to the email communication between Ms. Seemantini Deshpande of AECOM and Mr. Koy Howard of TCEQ **(Appendix A-6)**, TCEQ has reviewed the May 23, 2007 revision of the Houston/Galveston Area SIP for Eight-Hour Ozone (entitled "HGB 1997 Eight-Hour Ozone Nonattainment Area RFP SIP Revision") and determined the 2011 and 2012 compliance year emission inventories for Construction Emissions category. Estimated Project construction emissions were compared to the SIP emissions budget for 2011 and 2012 for NO_X and VOC by TCEQ and were determined to be well under the emissions budget allotted for this category. Therefore, the expected increase in emissions due to construction activities is accounted for in the SIP emissions budget and the proposed activity within the HGB nonattainment area is presumed to conform to the SIP.

5.0 Finding of Conformity

As discussed in Section 4, the two phases of the Project will meet the requirements of the General Conformity Rule through a combination of the proposed mitigation measures and accommodation of the construction related emissions in the SIP budget. The Project will not exceed the total budgeted emissions in the applicable SIP.

Appendix A

Emission Calculations

CONSTRUCTION EMISSIONS

Keystone XL Pipeline

HGB Severe Ozone Nonattainment Area

Main Pipeline

	2011 Construction Emissions: Main Pipeline in the HGB Nonattainment Area (tons)																
	HC	CO	NOx	SO2	TSP	PM10	PM2.5	CO2e	Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs	1,3-Butadiene	Formaldehyde	Acetaldehyde
CONSTRUCTION NONROAD	2.55	23.02	34.76	1.45	1.45	1.45	1.45	4863.969715	4.58E-02	2.01E-02	1.40E-02	1.27E-01	4.54E-03	8.24E-03	1.92E-03	5.79E-02	3.76E-02
CONSTRUCTION ONROAD	0.75	13.51	2.20	0.01	0.08	0.08	0.08	941.68	2.24E-02				4.55E-04		2.69E-03	8.70E-03	6.56E-03
OPEN BURNING	6.69	78.66	1.43	-	11.83	8.66	7.52	1,618.24									
FUGITIVE DUST					86.76	43.38	6.51										
PAVED ROAD DUST					6.87	1.08	0.11										
TOTAL	**9.99**	**115.20**	**38.39**	**1.46**	**106.99**	**54.65**	**15.67**	**7,423.90**	**6.81E-02**	**2.01E-02**	**1.40E-02**	**1.27E-01**	**4.99E-03**	**8.24E-03**	**4.61E-03**	**6.66E-02**	**4.42E-02**
Since the project is proposed to be located in an ozone nonattainment area, the pollutants of interest are HC (VOC) and NOx.																	

Main Pipeline Line Construction: Criteria Emissions from Non-Road Engines

Equipment	Daily Hours operated	Number of equpt Per Station	Units	Days of Operation Per Unit	Units	Days of Operation Per Unit	Units	Days of Operation Per Unit	2011 TOTAL Hours	Equpt Horsepwr	Fuel Type	BSFC [1,a]	Criteria Pollutants EFss (g/hp-hr) [1,a]				TAF Assignment [2,b]	Load Factor [3]
	hrs/eqpt/day		Pre-welding days (18 days)		Welding days (72 days)		Clean-up days (18 days)		hrs	hp		lb/hp-hr	HC	CO	NOx	PM		
D-7 Dozer	8	2	12	12	12	31	7	42	6,470	240	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
D-8 Dozer	8	0	13	12	22	31	18	42	12,762	310	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59
D-8 Ripper	0	0	0	0	0	26	0	30	0	310	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59
D-5 Tow	8	0	0	12	2	31	2	42	1,172	120	Diesel	0.367	0.3384	0.8667	4.1	0.18	None	0.43
D-7 Tow	8	0	0	12	1	31	1	42	586	240	Diesel	0.367	0.3085	0.7475	4	0.13	None	0.43
D-6 Tack	8	0	3	12	3	31	3	42	2,040	200	Diesel	0.367	0.3085	0.7475	4	0.13	None	0.43
CAT 225	8	2	0	12	7	31	4	42	3,088	150	Diesel	0.367	0.3384	0.8667	4.1	0.18	Hi	0.59
CAT 235	8	0	0	12	26	31	15	42	11,518	250	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
CAT 235 w/ Hammer	0	0	0	0	0	26	0	30	0	260	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Bending Machine 22-36	8	0	0	12	1	31	0	42	248	159	Diesel	0.367	0.3384	0.8667	4.1	0.18	None	0.43
Crane LS-98A (35 ton)	0	2	0	0	0	26	0	30	0	230	Diesel	0.367	0.3085	0.7475	4	0.13	None	0.43
Farm Tractor	8	1	2	12	2	31	2	42	1,360	60	Diesel	0.408	0.3672	2.3655	4.7	0.24	Hi	0.59
Frontend Loader 977	8	1	2	12	2	31	2	42	1,360	190	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Motor Grader 14G	8	1	2	12	2	31	2	42	1,360	200	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Sideboom 571	8	0	0	12	1	31	0	42	248	200	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Sideboom 572	8	0	0	12	1	31	1	42	586	230	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Sideboom 583	8	0	0	12	22	31	4	42	6,808	310	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59
Sideboom 594	8	0	0	12	4	31	4	42	2,344	410	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59
Air Compressor 1750 cfm	8	1	0	12	3	31	1	42	1,082	50	Gasoline	0.484	0.27	11.94	0.69	0.06	None	0.56
Pump - 3"	8	1	0	12	1	31	1	42	586	20	Gasoline	0.868	5.5	387.02	4.5	0.06	None	0.69
Pump - 6"	8	1	0	12	9	31	9	42	5,274	40	Gasoline	0.484	0.27	11.94	0.69	0.06	None	0.69
Emergency Engines	8	4	0	12	9	31	2	42	2,908	10	Gasoline	0.868	5.5	387.02	4.5	0.06	None	0.68
TOTAL (Tons)																		

NOTES:

Notes 1 through 9 apply to diesel engines.

Note 1: Brake-specific fuel consumption and Zero hour steady state EF (EFss; g/hp-hr) assumed to be Tier 2 engines, from Table A2 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling-Compression-Ignition", April 2004, EPA-420-P-04-009.

Engine Size (HP)		HC	CO	NOx	PM	BSFC	M. Life
1	11	0.5508	4.1127	4.3	0.5	0.408	2500
12	16	0.438	2.161	4.4399	0.2665	0.408	2500
17	25	0.438	2.161	4.4399	0.2665	0.408	2500
26	50	0.2789	1.5323	4.7279	0.3389	0.408	4667
51	100	0.3672	2.3655	4.7	0.24	0.408	4667
101	175	0.3384	0.8667	4.1	0.18	0.367	4667
176	300	0.3085	0.7475	4	0.1316	0.367	7000
301	600	0.1669	0.8425	4.3551	0.1316	0.367	7000
601	750	0.1669	1.3272	4.1	0.1316	0.367	7000
751	2500	0.1669	0.7642	4.1	0.1316	0.367	7000

Note 2: Transient Adjustment Factors and TAF assignment and TAF from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Note 3: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.

Note 4: Median life is taken from Table 1 of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.

Note 5: Age factor and Deterioration factors calculated using Equation 4 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Age Factor = LF * cumulative hours / median life {Age factor is assumed to be greater than one, i.e. the equipment is approximately at the end of its useful life.

Deterioration Factor = 1 + (A * Age Factor^b), where b = 1 for desel engines and A is taken from Table A4 from source

Note 6: Adjusted Emission Factors for HC, NOx, and CO are calculated using Equation 1 (Table A4) from, "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009. Relative Deterioration factors for Tier II engines was used.

Adjusted EF = Efss * TAF * DF

Note 7: SO2 calculated from Equation 7 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

SO2=BSFC*453.6*(1-soxcnv)-HC)*0.01*soxdsl*2

where: soxcnv = 0.02247 and soxdsl = 0.05

Note 8: Adjusted Emission Factor for particulate matter is calculated using Equations 2 and 5 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Adjusted EF = Efss * TAF * DF - Spm adj

Spm adj = BSFC*453.6*7.0*soxcnv*0.01*(soxbas-soxdsl)

where: soxbas = 0.33

Note 9: Construction is proposed to occur between March 2012 and December 2012 approximately. Annual Emissions are calculated using the following calculation

(Emission factor (g/hp-hr) * horsepower * hours operated * load factor) / (2000 lb/ton * 453.6 g/lb)

Notes a through d apply to gasoline engines.

Note a: Fuel Type Gasoline only: Brake specific fuel consumption and emission factors (EFss; g/hp-hr) asssumed to be Phase 2 side-valved for < 25hp from Table 5 and Table 6 for > 25hp of "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019

Note b: Fuel Type Galosine only: Transient Adjsutment Factors assumed to be Phase 2 for >25 Hp (for <25Hp TAFs emission factors are based on unadjusted steady-state test results) from Table 20 of "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019.

Note c: Fuel Type Gasoline only: Deterioration Factors from Table 2 (Phase 2-Side valved) for <25 Hp of "Nonroad Spark-Ignition Engine Emission Deterioration Factors", December 2005, EPA420-R-05-023.

Fuel Type Gasoline only: Deterioration Factors from Table 7 for >25 Hp of "Nonroad Spark-Ignition Engine Emission Deterioration Factors", December 2005, EPA420-R-05-023.

Note d: Fuel Type Gasoline only: SO2 calculated from Sulfur Dioxide Emission Factor calculations from "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019.

SO2=BSFC*453.6*(1-soxcnv)-HC)*0.01*soxdsl*2

where: soxcnv = 0.03 and soxdsl = 0.0339

Main Pipeline Line Construction: Criteria Emissions from Non-Road Engines

Equipment	TAF [2,b]					$BSFC_{adj}$	Median Life [4]	Age Factor [5]	"A" [5]				Deterioration factor [5,c]				Adjusted EF (g/hp-hr) [6]					2011 Emissions (tons) [9]				
	BSFC	HC	CO	NOx	PM		Hours		HC	CO	NOx	PM	HC	CO	NOx	PM	HC	CO	NOx	SO2 [7,d]	PM [8]	HC	CO	NOx	SO2	PM
D-7 Dozer	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.34	1.27	3.87	0.17	0.17
D-8 Dozer	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.181	1.419	4.175	0.164	0.164	0.47	3.65	10.74	0.42	0.42
D-8 Ripper	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.181	1.419	4.175	0.164	0.164	0.00	0.00	0.00	0.00	0.00
D-5 Tow	1.00	1.00	1.00	1.00	1.00	0.3670	4667	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.350	0.954	4.137	0.162	0.192	0.02	0.06	0.28	0.01	0.01
D-7 Tow	1.00	1.00	1.00	1.00	1.00	0.3670	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.319	0.823	4.036	0.162	0.121	0.02	0.05	0.27	0.01	0.01
D-6 Tack	1.00	1.00	1.00	1.00	1.00	0.3670	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.319	0.823	4.036	0.162	0.121	0.06	0.16	0.78	0.03	0.02
CAT 225	1.01	1.05	1.53	0.95	1.23	0.3707	4667	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.367	1.460	3.930	0.164	0.252	0.11	0.44	1.18	0.05	0.08
CAT 235	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.63	2.36	7.18	0.31	0.31
CAT 235 w/ Hammer	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.00	0.00	0.00	0.00	0.00
Bending Machine 22-36	1.00	1.00	1.00	1.00	1.00	0.3670	4667	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.350	0.954	4.137	0.162	0.192	0.01	0.02	0.08	0.00	0.00
Crane LS-98A (35 ton)	1.00	1.00	1.00	1.00	1.00	0.3670	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.319	0.823	4.036	0.162	0.121	0.00	0.00	0.00	0.00	0.00
Farm Tractor	1.01	1.05	1.53	0.95	1.23	0.4121	4667	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.399	3.985	4.505	0.182	0.353	0.02	0.21	0.24	0.01	0.02
Frontend Loader 977	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.06	0.21	0.64	0.03	0.03
Motor Grader 14G	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.06	0.22	0.68	0.03	0.03
Sideboom 571	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.01	0.04	0.12	0.01	0.01
Sideboom 572	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.03	0.11	0.34	0.01	0.01
Sideboom 583	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.181	1.419	4.175	0.164	0.164	0.25	1.95	5.73	0.23	0.23
Sideboom 594	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.181	1.419	4.175	0.164	0.164	0.11	0.89	2.61	0.10	0.10
Air Compressor 1750 cfm	1.00	1.00	1.00	1.00	1.00	0.4840	4667	> 1	-	-	-	-	0.640	0.360	0.150	0.260	0.173	4.298	0.104	0.144	0.016	0.01	0.14	0.00	0.00	0.00
Pump - 3"	1.00	1.00	1.00	1.00	1.00	0.8680	2500	> 1	-	-	-	-	1.935	0.887	0.000	1.935	10.643	343.29	0.000	0.252	0.116	0.09	3.06	0.00	0.00	0.00
Pump - 6"	1.00	1.00	1.00	1.00	1.00	0.4840	4667	> 1	-	-	-	-	0.640	0.360	0.150	0.260	0.173	4.298	0.104	0.144	0.016	0.03	0.69	0.02	0.02	0.00
Emergency Engines	1.00	1.00	1.00	1.00	1.00	0.8680	2500	> 1	-	-	-	-	1.935	0.887	0.000	1.935	10.643	343.287	0.000	0.252	0.116	0.23	7.48	0.00	0.01	0.00
TOTAL (Tons)																						**2.55**	**23.02**	**34.76**	**1.45**	**1.45**

Main Pipeline Construction: GHG Emissions from Non-Road Engines

Equipment	Daily Hours operated	2011 TOTAL Hours	Equipment HP	Fuel Type	BSFC	TAF Assignment	Load Factor [2]	TAF [1] BSFC	$BSFC_{adj}$	Greenhouse Gases					2011 Emissions (Tons)			
										CO_2	CH_4		N2O					
	hrs/eqpt/day	hrs	hp		lb/hp-hr					g/hp-hr [3]	[4]	lb/hp-hr	Ef (g/gal) [4]	lb/hp-hr	CO_2	CH_4	N_2O	CO_2e [5]
D-7 Dozer	8	6,470	240	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	540.57	0.05	0.02	548.92
D-8 Dozer	8	12,762	310	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	1,378.52	0.13	0.06	1,399.79
D-8 Ripper	0	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00
D-5 Tow	8	1,172	120	Diesel	0.367	None	0.43	1	0.3670	529.92	0.58	6.66E-05	0.26	2.98E-05	35.33	0.00	0.00	36.07
D-7 Tow	8	586	240	Diesel	0.367	None	0.43	1	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	35.33	0.00	0.00	36.08
D-6 Tack	8	2,040	200	Diesel	0.367	None	0.43	1	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	102.50	0.01	0.01	104.67
CAT 225	8	3,088	150	Diesel	0.367	Hi	0.59	1.01	0.3707	535.17	0.58	6.72E-05	0.26	3.01E-05	161.22	0.02	0.01	163.71
CAT 235	8	11,518	250	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	1,002.42	0.10	0.04	1,017.91
CAT 235 w/ Hammer	0	0	260	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00
Bending Machine 22-36	8	248	159	Diesel	0.367	None	0.43	1	0.3670	529.92	0.58	6.66E-05	0.26	2.98E-05	9.90	0.00	0.00	10.11
Crane LS-98A (35 ton)	0	0	230	Diesel	0.367	None	0.43	1	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	0.00	0.00	0.00	0.00
Farm Tractor	8	1,360	60	Diesel	0.408	Hi	0.59	1.01	0.4121	594.99	0.58	7.47E-05	0.26	3.35E-05	31.58	0.00	0.00	32.06
Frontend Loader 977	8	1,360	190	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	89.96	0.01	0.00	91.34
Motor Grader 14G	8	1,360	200	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	94.69	0.01	0.00	96.15
Sideboom 571	8	248	200	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	17.27	0.00	0.00	17.53
Sideboom 572	8	586	230	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	46.92	0.00	0.00	47.64
Sideboom 583	8	6,808	310	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	735.38	0.07	0.03	746.73
Sideboom 594	8	2,344	410	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	334.87	0.03	0.01	340.04
Air Compressor 1750 cfm	8	1,082	50	Gasoline	0.484	None	0.56	1	0.4840	699.77	0.50	7.57E-05	0.22	3.33E-05	23.37	0.00	0.00	23.69
Pump - 3"	8	586	20	Gasoline	0.868	None	0.69	1	0.8680	1222.00	0.50	1.36E-04	0.22	5.97E-05	10.89	0.00	0.00	11.02
Pump - 6"	8	5,274	40	Gasoline	0.484	None	0.69	1	0.4840	699.77	0.50	7.57E-05	0.22	3.33E-05	112.28	0.01	0.00	113.54
Emergency Engines	8	2,908	10	Gasoline	0.868	None	0.68	1	0.8680	1222.00	0.50	1.36E-04	0.22	5.97E-05	26.64	0.00	0.00	26.95
TOTAL (Tons)															**4,789.63**	**0.46**	**0.21**	**4,863.97**

NOTES:

Note 1: Transient Adjustment Factors and TAF assignment and from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Note 2: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.

Note 3: Carbon dioxide is calculated using Equation 6 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

CO2= ((BSFC*453.6) - HC) * 0.87 * (44/12)

HC is the hydrocarbon emission factor from criteria pollutant calculation,

0.87 is the mass fraction of carbon mass in diesel and

44/12 is the molecular weight ratio of CO2 to carbon

Note 4: Emission Factors from Table 13.6 of The Climate Registry General Reporting Protocol Version 1.0, tons calculated using 7.05 lb/gal from AP-42 Appendix A and adjusted BSFC

Note 5: Carbon dioxide equivalents calculated using IPCC Second Assessment Report (SAR) Global Warming Potentials CO2 = 1, CH4 = 21, N2O = 310.

CO2e= CO2 + (CH4 * 21) + (N2O * 310)

Main Pipeline Construction: HAP Emissions from Non-Road Engines

Equipment	Daily Hours operated	Number of eqpt.	2011 TOTAL Hours	Equipment Horsepower	Fuel Type	BSFC	TAF Assignment [1]	Load Factor [2]	BSFC TAF [1]	$BSFC_{adj}$	HAP Emission Factors (lb/MMBtu)[3]					
	hrs/eqpt/day		hrs	hp		lb/hp-hr					Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs
D-7 Dozer	8	2	6,470	240	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-8 Dozer	8	0	12,762	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-8 Ripper	0	0	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-5 Tow	8	0	1,172	120	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-7 Tow	8	0	586	240	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-6 Tack	8	0	2,040	200	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 225	8	2	3,088	150	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 235	8	0	11,518	250	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 235 w/ Hammer	0	0	0	260	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Bending Machine 22-36	8	0	248	159	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Crane LS-98A (35 ton)	0	2	0	230	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Farm Tractor	8	1	1,360	60	Diesel	0.408	Hi	0.59	1.01	0.4121	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Frontend Loader 977	8	1	1,360	190	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Motor Grader 14G	8	1	1,360	200	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 571	8	0	248	200	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 572	8	0	586	230	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 583	8	0	6,808	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 594	8	0	2,344	410	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Air Compressor 1750 cfm	8	1	1,082	50	Gasoline	0.484	None	0.56	1	0.4840	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 3"	8	1	586	20	Gasoline	0.868	None	0.69	1	0.8680	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 6"	8	1	5,274	40	Gasoline	0.484	None	0.69	1	0.4840	N/A	N/A	N/A	N/A	N/A	N/A
Emergency Engines	8	4	2,908	10	Gasoline	0.868	None	0.68	1	0.8680	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL (Tons)																

NOTES:

Note 1: Transient Adjustment Factors and TAF assignment and from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Note 2: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005. TAF Assignment of Hi/Lo is based on the Load Factor.

Note 3: Emission factors (lb/MMBtu) from AP-42 Section 3.3, Table 3.3-2. Note that HAP emission factors for gasoline fired engines are not available.

Note 4: Tons are calculated using 7.05 lb/gal from AP-42 Appendix A and 5.825 MMBtu/barrel from Table 13.1 of The Climate Registry Genral Reporting Protocol version 1.0

Main Pipeline Construction: HAP Emissions from Non-Road Engines

Equipment	HAP Emission Factors (lb/MMBtu)[3]			2011 HAP Emissions (Tons)[4]								
	1,3-Butadiene	Formaldehyde	Acetaldehyde	Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs	1,3-Butadiene	Formaldehyde	Acetaldehyde
D-7 Dozer	3.91E-05	1.18E-03	7.67E-04	5.28E-03	2.32E-03	1.61E-03	1.46E-02	5.24E-04	9.51E-04	2.21E-04	6.68E-03	4.34E-03
D-8 Dozer	3.91E-05	1.18E-03	7.67E-04	1.35E-02	5.90E-03	4.11E-03	3.72E-02	1.33E-03	2.42E-03	5.64E-04	1.70E-02	1.11E-02
D-8 Ripper	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D-5 Tow	3.91E-05	1.18E-03	7.67E-04	4.74E-04	2.08E-04	1.45E-04	1.31E-03	4.70E-05	8.53E-05	1.99E-05	5.99E-04	3.89E-04
D-7 Tow	3.91E-05	1.18E-03	7.67E-04	4.74E-04	2.08E-04	1.45E-04	1.31E-03	4.70E-05	8.53E-05	1.99E-05	5.99E-04	3.89E-04
D-6 Tack	3.91E-05	1.18E-03	7.67E-04	1.37E-03	6.02E-04	4.20E-04	3.80E-03	1.36E-04	2.47E-04	5.76E-05	1.74E-03	1.13E-03
CAT 225	3.91E-05	1.18E-03	7.67E-04	1.58E-03	6.91E-04	4.81E-04	4.36E-03	1.56E-04	2.84E-04	6.60E-05	1.99E-03	1.30E-03
CAT 235	3.91E-05	1.18E-03	7.67E-04	9.80E-03	4.29E-03	2.99E-03	2.71E-02	9.71E-04	1.76E-03	4.10E-04	1.24E-02	8.05E-03
CAT 235 w/ Hammer	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bending Machine 22-36	3.91E-05	1.18E-03	7.67E-04	1.33E-04	5.82E-05	4.06E-05	3.67E-04	1.32E-05	2.39E-05	5.57E-06	1.68E-04	1.09E-04
Crane LS-98A (35 ton)	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Farm Tractor	3.91E-05	1.18E-03	7.67E-04	3.09E-04	1.35E-04	9.43E-05	8.53E-04	3.06E-05	5.56E-05	1.29E-05	3.90E-04	2.54E-04
Frontend Loader 977	3.91E-05	1.18E-03	7.67E-04	8.79E-04	3.85E-04	2.69E-04	2.43E-03	8.71E-05	1.58E-04	3.68E-05	1.11E-03	7.23E-04
Motor Grader 14G	3.91E-05	1.18E-03	7.67E-04	9.25E-04	4.06E-04	2.83E-04	2.56E-03	9.17E-05	1.67E-04	3.88E-05	1.17E-03	7.61E-04
Sideboom 571	3.91E-05	1.18E-03	7.67E-04	1.69E-04	7.40E-05	5.15E-05	4.67E-04	1.67E-05	3.04E-05	7.07E-06	2.13E-04	1.39E-04
Sideboom 572	3.91E-05	1.18E-03	7.67E-04	4.58E-04	2.01E-04	1.40E-04	1.27E-03	4.55E-05	8.26E-05	1.92E-05	5.80E-04	3.77E-04
Sideboom 583	3.91E-05	1.18E-03	7.67E-04	7.18E-03	3.15E-03	2.19E-03	1.99E-02	7.12E-04	1.29E-03	3.01E-04	9.08E-03	5.90E-03
Sideboom 594	3.91E-05	1.18E-03	7.67E-04	3.27E-03	1.43E-03	9.99E-04	9.04E-03	3.24E-04	5.89E-04	1.37E-04	4.13E-03	2.69E-03
Air Compressor 1750 cfm	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 3"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 6"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Emergency Engines	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL (Tons)				**4.58E-02**	**2.01E-02**	**1.40E-02**	**1.27E-01**	**4.54E-03**	**8.24E-03**	**1.92E-03**	**5.79E-02**	**3.76E-02**

Main Pipeline Construction: Criteria and GHG Emissions from On-Road Vehicles

Equipment	Daily Hours operated	Number	Units per station	Days of Operation	Units per station	Days of Operation	Units per station	Days of Operation	Vehicle Class [1]	2011 Miles traveled [2]	Fuel Type	Criteria Pollutants Emission Factor (g/VMT) [3]				
		eqpt	Pre-welding days (18 days)		Welding days (49 days)		Clean-up days (39 days)									
	hr/eqpt/day	#										VOC	CO	NOx	SO_2	PM
Automobile	2	50	20	12	50	31	20	42	LDGV	131,500	Diesel	0.627	12.7	0.588	0.0068	0.0249
Bus	3	7	2	12	7	31	1	42	URBANBUS	21,206	Diesel	0.257	2.121	10.677	0.0218	0.226
Pickup 4x4	5	100	20	12	100	31	20	42	LDGV	522,500	Diesel	0.627	12.7	0.588	0.0068	0.0249
Welding Rig	10	30	0	12	30	31	5	42	LDGV	285,313	Diesel	0.627	12.7	0.588	0.0068	0.0249
Winch Truck	8	3	3	12	3	31	0	42	HDDV3	25,650	Diesel	0.16	0.541	2.319	0.0082	0.0848
Dump Truck	8	1	1	12	1	31	1	42	HDDV3	17,000	Diesel	0.16	0.541	2.319	0.0082	0.0848
Flatbed Truck	9	8	1	12	8	31	2	42	HDDV3	77,456	Diesel	0.16	0.541	2.319	0.0082	0.0848
Fuel Truck	10	2	1	12	2	31	2	42	HDDV3	39,563	Diesel	0.16	0.541	2.319	0.0082	0.0848
Grease Truck	10	1	1	12	1	31	1	42	HDDV3	21,250	Diesel	0.16	0.541	2.319	0.0082	0.0848
Mechanic Rig	10	1	1	12	1	31	1	42	HDDV2B	21,250	Diesel	0.149	0.508	2.182	0.0074	0.0966
Skid Truck	10	1	1	12	1	31	0	42	HDDV3	10,688	Diesel	0.16	0.541	2.319	0.0082	0.0848
Stringing Tr.& Tr.	10	15	0	12	15	31	0	42	HDDV3	116,250	Diesel	0.16	0.541	2.319	0.0082	0.0848
Truck & Float	10	9	0	12	9	31	5	42	HDDV3	122,563	Diesel	0.16	0.541	2.319	0.0082	0.0848
Truck & Lowboy	10	5	5	12	5	31	2	42	HDDV3	74,563	Diesel	0.16	0.541	2.319	0.0082	0.0848
TOTAL (Tons)																

NOTES:

Note 1: Vehicle Classes were taken from Mobile6.2 based on estimated gross weight of the vehicle.

Note 2: Vehicle miles traveled are based on an assumed 25 mi/hr on average/ vehicle based on arterial roads.

Note 3: Emission factors from Mobile6.2.

Note 4: Emission Factors from Table 13.4 of The Climate Registry General Reporting Protocol Version 1.1 applicable to "Diesel Heavy Duty Vehicles" all model year vehicles.
Note that Efs applicable to light duty gasoline vehicles was used for the vehicle category "automobiles" (MY 2000).

Note 5: Carbon dioxide equivalents calculated using IPCC Second Assessment Report (SAR) Global Warming Potentials CO2 = 1, CH4 = 21, N2O = 310.
CO2e= CO2 + (CH4 * 21) + (N2O * 310)

Main Pipeline Construction: Criteria and GHG Emissions from On-Road Vehicles

Equipment	Greenhouse Gasses Ef (g/mile)			2011 Emissions (Tons)								
				Criteria Pollutants					Greenhouse Gases			
	CO_2 [3]	CH_4 [4]	N_2O [4]	VOC	CO	NOx	SO_2	PM	CO_2	CH_4	N_2O	CO_2e [5]
Automobile	368.1	0.0273	0.0178	0.0909	1.8409	0.0852	0.0010	0.00	53.36	3.96E-03	2.58E-03	54.24
Bus	2342.9	0.0051	0.0048	0.0060	0.0496	0.2496	0.0005	0.01	54.77	1.19E-04	1.12E-04	54.80
Pickup 4x4	368.1	0.0273	0.0178	0.3611	7.3147	0.3387	0.0039	0.01	212.01	1.57E-02	1.03E-02	215.52
Welding Rig	368.1	0.0273	0.0178	0.1972	3.9942	0.1849	0.0021	0.01	115.77	8.59E-03	5.60E-03	117.68
Winch Truck	875.4	0.0051	0.0048	0.0045	0.0153	0.0656	0.0002	0.00	24.75	1.44E-04	1.36E-04	24.80
Dump Truck	875.4	0.0051	0.0048	0.0030	0.0101	0.0435	0.0002	0.00	16.40	9.56E-05	8.99E-05	16.43
Flatbed Truck	875.4	0.0051	0.0048	0.0137	0.0462	0.1980	0.0007	0.01	74.74	4.35E-04	4.10E-04	74.88
Fuel Truck	875.4	0.0051	0.0048	0.0070	0.0236	0.1011	0.0004	0.00	38.18	2.22E-04	2.09E-04	38.25
Grease Truck	875.4	0.0051	0.0048	0.0037	0.0127	0.0543	0.0002	0.00	20.51	1.19E-04	1.12E-04	20.54
Mechanic Rig	789.4	0.0051	0.0048	0.0035	0.0119	0.0511	0.0002	0.00	18.49	1.19E-04	1.12E-04	18.53
Skid Truck	875.4	0.0051	0.0048	0.0019	0.0064	0.0273	0.0001	0.00	10.31	6.01E-05	5.65E-05	10.33
Stringing Tr.& Tr.	875.4	0.0051	0.0048	0.0205	0.0693	0.2972	0.0011	0.01	112.18	6.54E-04	6.15E-04	112.38
Truck & Float	875.4	0.0051	0.0048	0.0216	0.0731	0.3133	0.0011	0.01	118.27	6.89E-04	6.48E-04	118.48
Truck & Lowboy	875.4	0.0051	0.0048	0.0132	0.0445	0.1906	0.0007	0.01	71.95	4.19E-04	3.95E-04	72.08
TOTAL (Tons)				**0.748**	**13.512**	**2.200**	**0.012**	**0.081**	**941.68**	**3.13E-02**	**2.13E-02**	**948.95**

Main Pipeline Construction: HAP Emissions from On-Road Vehicles

Equipment	Daily Hours operated	Vehicle Class [1]	2011 Miles traveled/year [2]	Fuel Type	Hazardous Air Pollutants Emission Factor (mg/VMT) [3]				
	hr/eqpt/day		miles/yr		Acetaldehyde	Acrolein	Benzene	1,3-butadiene	Formaldehyde
Automobile	2	LDGV	131,500	Diesel	4.04	0.24	16.45	2.04	4.51
Bus	3	URBANBUS	21,206	Diesel	7.75	0.94	2.83	1.64	21.05
Pickup 4x4	5	LDGV	522,500	Diesel	4.04	0.24	16.45	2.04	4.51
Welding Rig	10	LDGV	285,313	Diesel	4.04	0.24	16.45	2.04	4.51
Winch Truck	8	HDDV3	25,650	Diesel	3.78	0.32	9.09	0.94	6.11
Dump Truck	8	HDDV3	17,000	Diesel	3.78	0.32	9.09	0.94	6.11
Flatbed Truck	9	HDDV3	77,456	Diesel	3.78	0.32	9.09	0.94	6.11
Fuel Truck	10	HDDV3	39,563	Diesel	3.78	0.32	9.09	0.94	6.11
Grease Truck	10	HDDV3	21,250	Diesel	3.78	0.32	9.09	0.94	6.11
Mechanic Rig	10	HDDV2B	21,250	Diesel	3.74	0.29	9.34	0.89	5.92
Skid Truck	10	HDDV3	10,688	Diesel	3.78	0.32	9.09	0.94	6.11
Stringing Tr.& Tr.	10	HDDV3	116,250	Diesel	3.78	0.32	9.09	0.94	6.11
Truck & Float	10	HDDV3	122,563	Diesel	3.78	0.32	9.09	0.94	6.11
Truck & Lowboy	10	HDDV3	74,563	Diesel	3.78	0.32	9.09	0.94	6.11
TOTAL (Tons)									

NOTES:

Note 1: Vehicle Classes were taken from Mobile6.2 based on estimated gross weight of the vehicle.

Note 2: Vehicle miles traveled are based on an assumed 25 mi/hr on average/ vehicle based on arterial roads.

Note 3: HAP Emission factors taken from Mobile6.2

Main Pipeline Construction: HAP Emissions from On-Road Vehicles

Equipment	Hazardous Air Pollutants 2010 Emissions (Tons)				
	Acetaldehyde	**Acrolein**	**Benzene**	**1,3-butadiene**	**Formaldehyde**
Automobile	5.86E-04	3.48E-05	2.38E-03	2.96E-04	6.54E-04
Bus	1.81E-04	2.20E-05	6.62E-05	3.83E-05	4.92E-04
Pickup 4x4	2.33E-03	1.38E-04	9.47E-03	1.17E-03	2.60E-03
Welding Rig	1.27E-03	7.55E-05	5.17E-03	6.42E-04	1.42E-03
Winch Truck	1.07E-04	9.05E-06	2.57E-04	2.66E-05	1.73E-04
Dump Truck	7.08E-05	6.00E-06	1.70E-04	1.76E-05	1.14E-04
Flatbed Truck	3.23E-04	2.73E-05	7.76E-04	8.03E-05	5.22E-04
Fuel Truck	1.65E-04	1.40E-05	3.96E-04	4.10E-05	2.66E-04
Grease Truck	8.85E-05	7.50E-06	2.13E-04	2.20E-05	1.43E-04
Mechanic Rig	8.76E-05	6.79E-06	2.19E-04	2.08E-05	1.39E-04
Skid Truck	4.45E-05	3.77E-06	1.07E-04	1.11E-05	7.20E-05
Stringing Tr.& Tr.	4.84E-04	4.10E-05	1.16E-03	1.20E-04	7.83E-04
Truck & Float	5.11E-04	4.32E-05	1.23E-03	1.27E-04	8.25E-04
Truck & Lowboy	3.11E-04	2.63E-05	7.47E-04	7.73E-05	5.02E-04
TOTAL (Tons)	**0.0066**	**0.0005**	**0.0224**	**0.0027**	**0.0087**

Main Pipeline Construction: Emissions from Slash/Brush Burning

Volume and Area of Prescribed Burning			
1 cu. Yd.	=	0.00062	acre-foot
333251 cu. yd.	=	206.62	acre-foot
Area disturbed/ burned	=	207	acre

Vegetation Type Distribution		
Tree Tops/Stumps	=	50% [a]
Hay/Gass	=	50% [a]

Fuel Load Emission Factor			
Hay/grass	=	1.0	ton/acre [b]
Tree Tops and Stumps	=	9.0	ton/acre [c]

Weight of Wood/Hay Burned			
Hay/grass	=	103.31	tons
Tree Tops and Stumps	=	929.77	tons

Emission factors for wildfire, prescribed burning and slash burns calculated under dry conditions for each fuel component [d]										
Fuel Component	Emission factor (lb/ton)									
	% of total Vegetation	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2	NO_x	NH_3
Litter, Wood 0-1"	25%	52	3	6	15	8	9	3483	2.5	0.5
Wood 1-3"	25%	111	6	9	20	12	14	3373	2.5	1.1
Wood 3+"	25%	174	9	12	26	16	19	3263	2.5	1.7
Herb, Shrub	25%	249	12	16	33	21	25	3116	2.5	2.6

Emission from prescribed wood burning									
Fuel Component	Emissions (tons)								
	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2	NO_x	NH_3
Litter, Wood 0-1"	6.04	0.35	0.70	1.74	0.93	1.05	404.80	0.29	0.06
Wood 1-3"	12.90	0.70	1.05	2.32	1.39	1.63	392.01	0.29	0.13
Wood 3+"	20.22	1.05	1.39	3.02	1.86	2.21	379.23	0.29	0.20
Herb, Shrub	28.94	1.39	1.86	3.84	2.44	2.91	362.15	0.29	0.30
TOTAL	**68.11**	**3.49**	**5.00**	**10.92**	**6.62**	**7.79**	**1538.19**	**1.16**	**0.69**

Emission factors for crop residue burning [e]									
Crop Residue	Emission factor (lb/ton)								
	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2 [f]	NO_x	NH_3
Hay/Grasses	204.3	6.3	32.7	17.6	17.4	16.9	-	5.1	6.7

Emissions from crop residue burning									
Crop Residue	Emissions (tons)								
	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2	NO_x	NH_3
Hay/Grasses	10.55	0.33	1.69	0.91	0.90	0.87	-	0.26	0.35

Emissions from prescribed burning and crop residue burning									
	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2	NO_x	NH_3
TOTAL	**78.66**	**3.81**	**6.69**	**11.83**	**7.52**	**8.66**	**1,538.19**	**1.43**	**1.03**

NOTES:

(a) Taken from http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_mp_e0100_1070n_08.pdf.

(b)Taken from Table 5 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(c) Fuel loading value of tree tops and stumps taken from AP-42 Table 13.1-1. Value applicable to southern region (Region 8) were used.

(d) Taken from Table 2 and 3 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(e)Taken from Table 6 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(f) Emission factor of CO_2 for hay/grass burning was not available.

PM EMISSIONS FROM LAND DISTURBED: Pipeline Construction in HGB Nonattainment Area

2011 Activities		
Area Name:	Pipeline	
Area of Land Disturbance over the total months of construction (acres):	72.3	
Months of Construction Activity (May-August 2011)[(1)]:	4	
	total tons[(2)]	tons/month
PM2.5	6.5	1.6
PM10	43.4	10.8
PM30	86.8	21.7

	Heavy Construction Operations			Notes
Factor	**PM2.5**	**PM10**	**PM30**	
tons/acre/month	0.09	0.60	1.20	(3)
From AP-42, Section 13.2.3 Heavy Construction Operations: For construction activity operations: **E = 1.2 tons/acre/month of activity**				

NOTES:

(1) Construction is projected to occur over 4 months.

(2) Total tons is for entire construction duration, which is expected to be over an 4 month period. PM2.5 is particulate matter less than 2.5 microns. PM10 is particulate matter less than 10 microns. PM30 is particulate matter less than 30 microns.

(3) From AP-42 Section 13.2.3.3. Note that a factor of 1.2 ton/acre/month is conservatively high for TSP since it assumes that construction occurs over 30 days of the month which is not true in this case. Particle size multiplier (k) of 0.5 and 0.075 were used to determine the fraction of PM10 and PM2.5, respectively (taken from AP-42 Section 13.2.5.3).

PERSONNEL COMMUTE-PM EMISSIONS FROM PAVED ROADS: Main Pipeline Construction

Total Number of miles for 2011	1,486,750	miles for 2011	(1)

Emissions = VMT roundtrip/trip * 'X' trips for the construction period / 2000

All Paved Roads			
Emissions (ton/year)	**PM2.5**	**PM10**	**PM30 (TSP)**
2011	0.11	1.08	6.87

All Paved Roads				Notes
Emission Factor	**PM2.5**	**PM10**	**PM30**	
lb/VMT	0.0001	0.0015	0.0092	(2)

From AP-42, Section 13.2.1 Paved Roads:

For all paved roads:

E={[k*((sL/2)^0.65)*((W/3)^1.5)] -C}*(1-P/4N)

where

E = size specific emission factor (lb/VMT)
k = particulate size multiplier
sL = road surface silt loading (g/m2)
W = mean vehicle weight (tons)
C = emission factor for 1980's vehicle fleet exhaust, brake wear, and tire wear.
P = number of wet days with at least 0.254 mm (0.01 in) of precipitation during the averaging period, and
N = number of days in the averaging period

Parameter	All Paved Roads 2010			Notes
	PM2.5	**PM10**	**PM30**	
k	0.004	0.016	0.082	(3)
sL	0.2	0.2	0.2	(4)
W	2.1	2.1	2.1	(5)
C	0.00036	0.00047	0.00047	(6)

NOTES:

(1) Number of personnel is assumed to be a constant during the entire construction schedule.
(2) Derived from equation, based on lb/VMT, P=120 from Figure 13.2.1-2, N=365
(3) From AP-42 Table 13.2-1.1 in lb/VMT.
(4) Silt content taken from AP-42 Table 13.2.1-3 for 500-5,000 ADT ubiquitous baseline.
(5) Average worker vehicle weight based on average car or light duty truck sold in the US last year 4,144 pounds from EPA. 4,144 pounds = 2.07 tons
(6) From AP-42 Table 13.2-1.2 in lb/VMT.

CONSTRUCTION EMISSIONS

Keystone XL Pipeline

HGB Severe Ozone Nonattainment Area

Pumping Station No. 41

	2011 Construction Emissions: PS-41 in the HGB Nonattainment Area (tons)																
	HC	CO	NOx	SO2	TSP	PM10	PM2.5	CO2e	Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs	1,3-Butadiene	Formaldehyde	Acetaldehyde
CONSTRUCTION NONROAD	0.29	6.52	1.19	0.06	0.06	0.06	0.06	204.9289247	1.74E-03	7.62E-04	5.31E-04	4.80E-03	1.72E-04	3.13E-04	7.28E-05	2.20E-03	1.43E-03
CONSTRUCTION ONROAD	0.19	3.59	0.31	0.00	0.01	0.01	0.01	156.94	5.17E-03				8.69E-05		6.29E-04	1.64E-03	1.36E-03
OPEN BURNING	0.32	3.81	0.07	-	0.57	0.42	0.36	78.32									
FUGITIVE DUST					12.00	6.00	0.90										
PAVED ROAD DUST					1.43	0.23	0.02										
TOTAL	**0.80**	**13.92**	**1.57**	**0.06**	**14.08**	**6.72**	**1.36**	**440.19**	**6.91E-03**	**7.62E-04**	**5.31E-04**	**4.80E-03**	**2.59E-04**	**3.13E-04**	**7.02E-04**	**3.84E-03**	**2.79E-03**
Since the project is proposed to be located in an ozone nonattainment area, the pollutants of interest are HC (VOC) and NOx.																	

PS-41 Construction: Criteria Emissions from Non-Road Engines

Equipment	Daily Hours operated	Number of equpt Per Station	Units per Station: Pre-welding days (18 days)	Days of Operation Per Unit	Units per Station: Welding days (72 days)	Days of Operation Per Unit	Units per Station: Clean-up days (18 days)	Days of Operation Per Unit	2011 TOTAL Hours	Equpt Horsepwr	Fuel Type	BSFC [1,a]	Criteria Pollutants EFss (g/hp-hr) [1,a]				TAF Assignment [2,b]	Load Factor [3]
	hrs/eqpt/day								hrs	hp		lb/hp-hr	HC	CO	NOx	PM		
D-7 Dozer	8	2	2	9	0		1	9	216	240	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
D-8 Dozer	0	0	0		0		0		0	310	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59
D-8 Ripper	0	0	0		0		0		0	310	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59
D-5 Tow	0	0	0		0		0		0	120	Diesel	0.367	0.3384	0.8667	4.1	0.18	None	0.43
D-7 Tow	0	0	0		0		0		0	240	Diesel	0.367	0.3085	0.7475	4	0.13	None	0.43
D-6 Tack	0	0	0		0		0		0	200	Diesel	0.367	0.3085	0.7475	4	0.13	None	0.43
CAT 225	8	2	0		2	72	2	18	1,440	150	Diesel	0.367	0.3384	0.8667	4.1	0.18	Hi	0.59
CAT 235	0	0	0		0		0		0	250	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
CAT 235 w/ Hammer	0	0	0		0		0		0	260	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Bending Machine 22-36	0	0	0		0		0		0	159	Diesel	0.367	0.3384	0.8667	4.1	0.18	None	0.43
Crane LS-98A (35 ton)	10	2	0		2	36	1	9	810	230	Diesel	0.367	0.3085	0.7475	4	0.13	None	0.43
Farm Tractor	8	1	1	18	1	36	1	18	576	60	Diesel	0.408	0.3672	2.3655	4.7	0.24	Hi	0.59
Frontend Loader 977	8	1	1	2	1	5	1	2	72	190	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Motor Grader 14G	8	1	1	2	0	5	1	2	32	200	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Sideboom 571	0	0	0		0		0		0	200	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Sideboom 572	0	0	0		0		0		0	230	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Sideboom 583	0	0	0		0		0		0	310	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59
Sideboom 594	0	0	0		0		0		0	410	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59
Air Compressor 1750 cfm	8	1	0		1	36	1	9	360	50	Gasoline	0.484	0.27	11.94	0.69	0.06	None	0.56
Pump - 3"	8	1	0		1	36	1	36	576	20	Gasoline	0.868	5.5	387.02	4.5	0.06	None	0.69
Pump - 6"	8	1	0		1	36	1	36	576	40	Gasoline	0.484	0.27	11.94	0.69	0.06	None	0.69
Emergency Engines	8	4	0		2	36	2	36	1,152	10	Gasoline	0.868	5.5	387.02	4.5	0.06	None	0.68
TOTAL (Tons)																		

NOTES:

Notes 1 through 9 apply to diesel engines.

Note 1: Brake-specific fuel consumption and Zero hour steady state EF (EFss; g/hp-hr) assumed to be Tier 2 engines, from Table A2 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling-Compression-Ignition", April 2004, EPA-420-P-04-009.

Engine Size (HP)		HC	CO	NOx	PM	BSFC	M. Life
1	**11**	0.5508	4.1127	4.3	0.5	0.408	2500
12	**16**	0.438	2.161	4.4399	0.2665	0.408	2500
17	**25**	0.438	2.161	4.4399	0.2665	0.408	2500
26	**50**	0.2789	1.5323	4.7279	0.3389	0.408	4667
51	**100**	0.3672	2.3655	4.7	0.24	0.408	4667
101	**175**	0.3384	0.8667	4.1	0.18	0.367	4667
176	**300**	0.3085	0.7475	4	0.1316	0.367	7000
301	**600**	0.1669	0.8425	4.3551	0.1316	0.367	7000
601	**750**	0.1669	1.3272	4.1	0.1316	0.367	7000
751	**2500**	0.1669	0.7642	4.1	0.1316	0.367	7000

Note 2: Transient Adjustment Factors and TAF assignment and TAF from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Note 3: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.

Note 4: Median life is taken from Table 1 of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.

Note 5: Age factor and Deterioration factors calculated using Equation 4 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Age Factor = LF * cumulative hours / median life {Age factor is assumed to be greater than one, i.e. the equipment is approximately at the end of its useful life.

Deterioration Factor = 1 + (A * Age Factor^b), where b = 1 for desel engines and A is taken from Table A4 from source

Note 6: Adjusted Emission Factors for HC, NOx, and CO are calculated using Equation 1 (Table A4) from, "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009. Relative Deterioration factors for Tier II engines was used.

Adjusted EF = Efss * TAF * DF

Note 7: SO2 calculated from Equation 7 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

SO2=BSFC*453.6*(1-soxcnv)-HC)*0.01*soxdsl*2

where: soxcnv = 0.02247 and soxdsl = 0.05

Note 8: Adjusted Emission Factor for particulate matter is calculated using Equations 2 and 5 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Adjusted EF = Efss * TAF * DF - Spm adj

Spm adj = BSFC*453.6*7.0*soxcnv*0.01*(soxbas-soxdsl)

where: soxbas = 0.33

Note 9: Construction is proposed to occur between March 2012 and December 2012 approximately. Annual Emissions are calculated using the following calculation

(Emission factor (g/hp-hr) * horsepower * hours operated * load factor) / (2000 lb/ton * 453.6 g/lb)

Notes a through d apply to gasoline engines.

Note a: Fuel Type Gasoline only: Brake specific fuel consumption and emission factors (EFss; g/hp-hr) asssumed to be Phase 2 side-valved for < 25hp from Table 5 and Table 6 for > 25hp of "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019

Note b: Fuel Type Galosine only: Transient Adjsutment Factors assumed to be Phase 2 for >25 Hp (for <25Hp TAFs emission factors are based on unadjusted steady-state test results) from Table 20 of "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019.

Note c: Fuel Type Gasoline only: Deterioration Factors from Table 2 (Phase 2-Side valved) for <25 Hp of "Nonroad Spark-Ignition Engine Emission Deterioration Factors", December 2005, EPA420-R-05-023.

Fuel Type Gasoline only: Deterioration Factors from Table 7 for >25 Hp of "Nonroad Spark-Ignition Engine Emission Deterioration Factors", December 2005, EPA420-R-05-023.

Note d: Fuel Type Gasoline only: SO2 calculated from Sulfur Dioxide Emission Factor calculations from "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019.

SO2=BSFC*453.6*(1-soxcnv)-HC)*0.01*soxdsl*2

where: soxcnv = 0.03 and soxdsl = 0.0339

PS-41 Construction: Criteria Emissions from Non-Road Engines

Equipment	TAF [2,b]					$BSFC_{adj}$	Median Life [4]	Age Factor [5]	"A" [5]				Deterioration factor [5,c]				Adjusted EF (g/hp-hr) [6]					2011 Emissions (tons) [9]				
	BSFC	HC	CO	NOx	PM		Hours		HC	CO	NOx	PM	HC	CO	NOx	PM	HC	CO	NOx	SO2 [7,d]	PM [8]	HC	CO	NOx	SO2	PM
D-7 Dozer	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.01	0.04	0.13	0.01	0.01
D-8 Dozer	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.181	1.419	4.175	0.164	0.164	0.00	0.00	0.00	0.00	0.00
D-8 Ripper	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.181	1.419	4.175	0.164	0.164	0.00	0.00	0.00	0.00	0.00
D-5 Tow	1.00	1.00	1.00	1.00	1.00	0.3670	4667	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.350	0.954	4.137	0.162	0.192	0.00	0.00	0.00	0.00	0.00
D-7 Tow	1.00	1.00	1.00	1.00	1.00	0.3670	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.319	0.823	4.036	0.162	0.121	0.00	0.00	0.00	0.00	0.00
D-6 Tack	1.00	1.00	1.00	1.00	1.00	0.3670	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.319	0.823	4.036	0.162	0.121	0.00	0.00	0.00	0.00	0.00
CAT 225	1.01	1.05	1.53	0.95	1.23	0.3707	4667	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.367	1.460	3.930	0.164	0.252	0.05	0.21	0.55	0.02	0.04
CAT 235	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.00	0.00	0.00	0.00	0.00
CAT 235 w/ Hammer	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.00	0.00	0.00	0.00	0.00
Bending Machine 22-36	1.00	1.00	1.00	1.00	1.00	0.3670	4667	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.350	0.954	4.137	0.162	0.192	0.00	0.00	0.00	0.00	0.00
Crane LS-98A (35 ton)	1.00	1.00	1.00	1.00	1.00	0.3670	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.319	0.823	4.036	0.162	0.121	0.03	0.07	0.36	0.01	0.01
Farm Tractor	1.01	1.05	1.53	0.95	1.23	0.4121	4667	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.399	3.985	4.505	0.182	0.353	0.01	0.09	0.10	0.00	0.01
Frontend Loader 977	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.00	0.01	0.03	0.00	0.00
Motor Grader 14G	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.00	0.01	0.02	0.00	0.00
Sideboom 571	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.00	0.00	0.00	0.00	0.00
Sideboom 572	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.00	0.00	0.00	0.00	0.00
Sideboom 583	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.181	1.419	4.175	0.164	0.164	0.00	0.00	0.00	0.00	0.00
Sideboom 594	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.181	1.419	4.175	0.164	0.164	0.00	0.00	0.00	0.00	0.00
Air Compressor 1750 cfm	1.00	1.00	1.00	1.00	1.00	0.4840	4667	> 1	-	-	-	-	0.640	0.360	0.150	0.260	0.173	4.298	0.104	0.144	0.016	0.00	0.05	0.00	0.00	0.00
Pump - 3"	1.00	1.00	1.00	1.00	1.00	0.8680	2500	> 1	-	-	-	-	1.935	0.887	0.000	1.935	10.643	343.29	0.000	0.252	0.116	0.09	3.01	0.00	0.00	0.00
Pump - 6"	1.00	1.00	1.00	1.00	1.00	0.4840	4667	> 1	-	-	-	-	0.640	0.360	0.150	0.260	0.173	4.298	0.104	0.144	0.016	0.00	0.08	0.00	0.00	0.00
Emergency Engines	1.00	1.00	1.00	1.00	1.00	0.8680	2500	> 1	-	-	-	-	1.935	0.887	0.000	1.935	10.64	343.29	0.000	0.252	0.116	0.09	2.96	0.00	0.00	0.00
TOTAL (Tons)																						**0.29**	**6.52**	**1.19**	**0.06**	**0.06**

PS-41 Construction: GHG Emissions from Non-Road Engines

Equipment	Daily Hours operated	2011 TOTAL Hours	Equipment HP	Fuel Type	BSFC	TAF Assignment	Load Factor [2]	TAF [1] BSFC	$BSFC_{adj}$	Greenhouse Gases					2011 Emissions (Tons)			
										CO_2	CH_4		N2O					
	hrs/eqpt/day	hrs	hp		lb/hp-hr					g/hp-hr [3]	[4]	lb/hp-hr	Ef (g/gal) [4]	lb/hp-hr	CO_2	CH_4	N_2O	CO_2e [5]
D-7 Dozer	8	216	240	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	18.05	0.00	0.00	18.33
D-8 Dozer	0	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00
D-8 Ripper	0	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00
D-5 Tow	0	0	120	Diesel	0.367	None	0.43	1	0.3670	529.92	0.58	6.66E-05	0.26	2.98E-05	0.00	0.00	0.00	0.00
D-7 Tow	0	0	240	Diesel	0.367	None	0.43	1	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	0.00	0.00	0.00	0.00
D-6 Tack	0	0	200	Diesel	0.367	None	0.43	1	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	0.00	0.00	0.00	0.00
CAT 225	8	1,440	150	Diesel	0.367	Hi	0.59	1.01	0.3707	535.17	0.58	6.72E-05	0.26	3.01E-05	75.18	0.01	0.00	76.34
CAT 235	0	0	250	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00
CAT 235 w/ Hammer	0	0	260	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00
Bending Machine 22-36	0	0	159	Diesel	0.367	None	0.43	1	0.3670	529.92	0.58	6.66E-05	0.26	2.98E-05	0.00	0.00	0.00	0.00
Crane LS-98A (35 ton)	10	810	230	Diesel	0.367	None	0.43	1	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	46.80	0.01	0.00	47.80
Farm Tractor	8	576	60	Diesel	0.408	Hi	0.59	1.01	0.4121	594.99	0.58	7.47E-05	0.26	3.35E-05	13.37	0.00	0.00	13.58
Frontend Loader 977	8	72	190	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	4.76	0.00	0.00	4.84
Motor Grader 14G	8	32	200	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	2.23	0.00	0.00	2.26
Sideboom 571	0	0	200	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00
Sideboom 572	0	0	230	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00
Sideboom 583	0	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00
Sideboom 594	0	0	410	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00
Air Compressor 1750 cfm	8	360	50	Gasoline	0.484	None	0.56	1	0.4840	699.77	0.50	7.57E-05	0.22	3.33E-05	7.78	0.00	0.00	7.88
Pump - 3"	8	576	20	Gasoline	0.868	None	0.69	1	0.8680	1222.00	0.50	1.36E-04	0.22	5.97E-05	10.71	0.00	0.00	10.83
Pump - 6"	8	576	40	Gasoline	0.484	None	0.69	1	0.4840	699.77	0.50	7.57E-05	0.22	3.33E-05	12.26	0.00	0.00	12.40
Emergency Engines	8	1,152	10	Gasoline	0.868	None	0.68	1	0.8680	1222.00	0.50	1.36E-04	0.22	5.97E-05	10.55	0.00	0.00	10.68
TOTAL (Tons)															**201.69**	**0.02**	**0.01**	**204.93**

NOTES:

Note 1: Transient Adjustment Factors and TAF assignment and from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Note 2: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.

Note 3: Carbon dioxide is calculated using Equation 6 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

CO2= ((BSFC*453.6) - HC) * 0.87 * (44/12)

HC is the hydrocarbon emission factor from criteria pollutant calculation,

0.87 is the mass fraction of carbon mass in diesel and

44/12 is the molecular weight ratio of CO2 to carbon

Note 4: Emission Factors from Table 13.6 of The Climate Registry General Reporting Protocol Version 1.0, tons calculated using 7.05 lb/gal from AP-42 Appendix A and adjusted BSFC

Note 5: Carbon dioxide equivalents calculated using IPCC Second Assessment Report (SAR) Global Warming Potentials CO2 = 1, CH4 = 21, N2O = 310.

CO2e= CO2 + (CH4 * 21) + (N2O * 310)

PS-41 Construction: HAP Emissions from Non-Road Engines

Equipment	Daily Hours operated	Number of eqpt.	2011 TOTAL Hours	Equipment Horsepower	Fuel Type	BSFC	TAF Assignment [1]	Load Factor [2]	BSFC TAF [1]	$BSFC_{adj}$	HAP Emission Factors (lb/MMBtu)[3]					
	hrs/eqpt/day		hrs	hp		lb/hp-hr					Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs
D-7 Dozer	8	2	216	240	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-8 Dozer	0	0	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-8 Ripper	0	0	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-5 Tow	0	0	0	120	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-7 Tow	0	0	0	240	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-6 Tack	0	0	0	200	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 225	8	2	1,440	150	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 235	0	0	0	250	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 235 w/ Hammer	0	0	0	260	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Bending Machine 22-36	0	0	0	159	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Crane LS-98A (35 ton)	10	2	810	230	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Farm Tractor	8	1	576	60	Diesel	0.408	Hi	0.59	1.01	0.4121	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Frontend Loader 977	8	1	72	190	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Motor Grader 14G	8	1	32	200	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 571	0	0	0	200	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 572	0	0	0	230	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 583	0	0	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 594	0	0	0	410	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Air Compressor 1750 cfm	8	1	360	50	Gasoline	0.484	None	0.56	1	0.4840	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 3"	8	1	576	20	Gasoline	0.868	None	0.69	1	0.8680	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 6"	8	1	576	40	Gasoline	0.484	None	0.69	1	0.4840	N/A	N/A	N/A	N/A	N/A	N/A
Emergency Engines	8	4	1,152	10	Gasoline	0.868	None	0.68	1	0.8680	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL (Tons)																

NOTES:

Note 1: Transient Adjustment Factors and TAF assignment and from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Note 2: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005. TAF Assignment of Hi/Lo is based on the Load Factor.

Note 3: Emission factors (lb/MMBtu) from AP-42 Section 3.3, Table 3.3-2. Note that HAP emission factors for gasoline fired engines are not available.

Note 4: Tons are calculated using 7.05 lb/gal from AP-42 Appendix A and 5.825 MMBtu/barrel from Table 13.1 of The Climate Registry Genral Reporting Protocol version 1.0

PS-41 Construction: HAP Emissions from Non-Road Engines

Equipment	HAP Emission Factors (lb/MMBtu)[3]			2011 HAP Emissions (Tons)[4]								
	1,3-Butadiene	Formaldehyde	Acetaldehyde	Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs	1,3-Butadiene	Formaldehyde	Acetaldehyde
D-7 Dozer	3.91E-05	1.18E-03	7.67E-04	1.76E-04	7.73E-05	5.39E-05	4.88E-04	1.75E-05	3.18E-05	7.39E-06	2.23E-04	1.45E-04
D-8 Dozer	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D-8 Ripper	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D-5 Tow	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D-7 Tow	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D-6 Tack	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CAT 225	3.91E-05	1.18E-03	7.67E-04	7.35E-04	3.22E-04	2.24E-04	2.03E-03	7.28E-05	1.32E-04	3.08E-05	9.29E-04	6.04E-04
CAT 235	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CAT 235 w/ Hammer	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bending Machine 22-36	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane LS-98A (35 ton)	3.91E-05	1.18E-03	7.67E-04	6.27E-04	2.75E-04	1.92E-04	1.74E-03	6.22E-05	1.13E-04	2.63E-05	7.94E-04	5.16E-04
Farm Tractor	3.91E-05	1.18E-03	7.67E-04	1.31E-04	5.73E-05	3.99E-05	3.61E-04	1.30E-05	2.35E-05	5.48E-06	1.65E-04	1.07E-04
Frontend Loader 977	3.91E-05	1.18E-03	7.67E-04	4.65E-05	2.04E-05	1.42E-05	1.29E-04	4.61E-06	8.38E-06	1.95E-06	5.89E-05	3.83E-05
Motor Grader 14G	3.91E-05	1.18E-03	7.67E-04	2.18E-05	9.54E-06	6.65E-06	6.02E-05	2.16E-06	3.92E-06	9.12E-07	2.75E-05	1.79E-05
Sideboom 571	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sideboom 572	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sideboom 583	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sideboom 594	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Air Compressor 1750 cfm	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 3"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 6"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Emergency Engines	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL (Tons)				**1.74E-03**	**7.62E-04**	**5.31E-04**	**4.80E-03**	**1.72E-04**	**3.13E-04**	**7.28E-05**	**2.20E-03**	**1.43E-03**

PS-41 Construction: Criteria and GHG Emissions from On-Road Vehicles

Equipment	Daily Hours operated	Number	Units per station	Days of Operation	Units per station	Days of Operation	Units per station	Days of Operation	Vehicle Class [1]	2011 Miles traveled [2]	Fuel Type	Criteria Pollutants Emission Factor (g/VMT) [3]				
		eqpt	Pre-welding days (18 days)		Welding days (49 days)		Clean-up days (39 days)									
	hr/eqpt/day	#										VOC	CO	NOx	SO_2	PM
Automobile	2	10	10	18	10	72	5	18	LDGV	49,500	Diesel	0.627	12.7	0.588	0.0068	0.0249
Bus	0	0	0		0		0		URBANBUS	0	Diesel	0.257	2.121	10.677	0.0218	0.226
Pickup 4x4	5	10	10	18	10	72	5	18	LDGV	123,750	Diesel	0.627	12.7	0.588	0.0068	0.0249
Welding Rig	10	4	0		4	72	4	9	LDGV	81,000	Diesel	0.627	12.7	0.588	0.0068	0.0249
Winch Truck	0	0	0		0		0		HDDV3	0	Diesel	0.16	0.541	2.319	0.0082	0.0848
Dump Truck	8	2	2	10	1	20	2	18	HDDV3	15,200	Diesel	0.16	0.541	2.319	0.0082	0.0848
Flatbed Truck	9	1	1	9	1	72	1	18	HDDV3	22,275	Diesel	0.16	0.541	2.319	0.0082	0.0848
Fuel Truck	0	0	0		0		0		HDDV3	0	Diesel	0.16	0.541	2.319	0.0082	0.0848
Grease Truck	0	0	0		0		0		HDDV3	0	Diesel	0.16	0.541	2.319	0.0082	0.0848
Mechanic Rig	0	0	0		0		0		HDDV2B	0	Diesel	0.149	0.508	2.182	0.0074	0.0966
Skid Truck	0	0	0		0		0		HDDV3	0	Diesel	0.16	0.541	2.319	0.0082	0.0848
Stringing Tr.& Tr.	0	0	0		0		0		HDDV3	0	Diesel	0.16	0.541	2.319	0.0082	0.0848
Truck & Float	10	1	1	9	1	36	1	9	HDDV3	13,500	Diesel	0.16	0.541	2.319	0.0082	0.0848
Truck & Lowboy	10	1	1	9	1	5	1	5	HDDV3	4,750	Diesel	0.16	0.541	2.319	0.0082	0.0848
TOTAL (Tons)																

NOTES:

Note 1: Vehicle Classes were taken from Mobile6.2 based on estimated gross weight of the vehicle.

Note 2: Vehicle miles traveled are based on an assumed 25 mi/hr on average/ vehicle based on arterial roads.

Note 3: Emission factors from Mobile6.2.

Note 4: Emission Factors from Table 13.4 of The Climate Registry General Reporting Protocol Version 1.1 applicable to "Diesel Heavy Duty Vehicles" all model year vehicles.
Note that Efs applicable to light duty gasoline vehicles was used for the vehicle category "automobiles" (MY 2000).

Note 5: Carbon dioxide equivalents calculated using IPCC Second Assessment Report (SAR) Global Warming Potentials CO2 = 1, CH4 = 21, N2O = 310.
CO2e= CO2 + (CH4 * 21) + (N2O * 310)

PS-41 Construction: Criteria and GHG Emissions from On-Road Vehicles

Equipment	Greenhouse Gasses Ef (g/mile)			2011 Emissions (Tons)								
				Criteria Pollutants					Greenhouse Gases			
	CO_2 [3]	CH_4 [4]	N_2O [4]	VOC	CO	NOx	SO_2	PM	CO_2	CH_4	N_2O	CO_2e [5]
Automobile	368.1	0.0273	0.0178	0.0342	0.6930	0.0321	0.0004	0.00	20.09	1.49E-03	9.71E-04	20.42
Bus	2342.9	0.0051	0.0048	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00E+00	0.00E+00	0.00
Pickup 4x4	368.1	0.0273	0.0178	0.0855	1.7324	0.0802	0.0009	0.00	50.21	3.72E-03	2.43E-03	51.04
Welding Rig	368.1	0.0273	0.0178	0.0560	1.1339	0.0525	0.0006	0.00	32.87	2.44E-03	1.59E-03	33.41
Winch Truck	875.4	0.0051	0.0048	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00E+00	0.00E+00	0.00
Dump Truck	875.4	0.0051	0.0048	0.0027	0.0091	0.0389	0.0001	0.00	14.67	8.55E-05	8.04E-05	14.69
Flatbed Truck	875.4	0.0051	0.0048	0.0039	0.0133	0.0569	0.0002	0.00	21.49	1.25E-04	1.18E-04	21.53
Fuel Truck	875.4	0.0051	0.0048	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00E+00	0.00E+00	0.00
Grease Truck	875.4	0.0051	0.0048	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00E+00	0.00E+00	0.00
Mechanic Rig	789.4	0.0051	0.0048	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00E+00	0.00E+00	0.00
Skid Truck	875.4	0.0051	0.0048	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00E+00	0.00E+00	0.00
Stringing Tr.& Tr.	875.4	0.0051	0.0048	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00E+00	0.00E+00	0.00
Truck & Float	875.4	0.0051	0.0048	0.0024	0.0081	0.0345	0.0001	0.00	13.03	7.59E-05	7.14E-05	13.05
Truck & Lowboy	875.4	0.0051	0.0048	0.0008	0.0028	0.0121	0.0000	0.00	4.58	2.67E-05	2.51E-05	4.59
TOTAL (Tons)				**0.186**	**3.593**	**0.307**	**0.002**	**0.012**	**156.94**	**7.96E-03**	**5.28E-03**	**158.74**

PS-41 Construction: HAP Emissions from On-Road Vehicles

Equipment	Daily Hours operated	Vehicle Class [1]	2011 Miles traveled/year [2]	Fuel Type	Hazardous Air Pollutants Emission Factor (mg/VMT) [3]				
	hr/eqpt/day		miles/yr		Acetaldehyde	Acrolein	Benzene	1,3-butadiene	Formaldehyde
Automobile	2	LDGV	49,500	Diesel	4.04	0.24	16.45	2.04	4.51
Bus	0	URBANBUS	0	Diesel	7.75	0.94	2.83	1.64	21.05
Pickup 4x4	5	LDGV	123,750	Diesel	4.04	0.24	16.45	2.04	4.51
Welding Rig	10	LDGV	81,000	Diesel	4.04	0.24	16.45	2.04	4.51
Winch Truck	0	HDDV3	0	Diesel	3.78	0.32	9.09	0.94	6.11
Dump Truck	8	HDDV3	15,200	Diesel	3.78	0.32	9.09	0.94	6.11
Flatbed Truck	9	HDDV3	22,275	Diesel	3.78	0.32	9.09	0.94	6.11
Fuel Truck	0	HDDV3	0	Diesel	3.78	0.32	9.09	0.94	6.11
Grease Truck	0	HDDV3	0	Diesel	3.78	0.32	9.09	0.94	6.11
Mechanic Rig	0	HDDV2B	0	Diesel	3.74	0.29	9.34	0.89	5.92
Skid Truck	0	HDDV3	0	Diesel	3.78	0.32	9.09	0.94	6.11
Stringing Tr.& Tr.	0	HDDV3	0	Diesel	3.78	0.32	9.09	0.94	6.11
Truck & Float	10	HDDV3	13,500	Diesel	3.78	0.32	9.09	0.94	6.11
Truck & Lowboy	10	HDDV3	4,750	Diesel	3.78	0.32	9.09	0.94	6.11
TOTAL (Tons)									

NOTES:

Note 1: Vehicle Classes were taken from Mobile6.2 based on estimated gross weight of the vehicle.

Note 2: Vehicle miles traveled are based on an assumed 25 mi/hr on average/ vehicle based on arterial roads.

Note 3: HAP Emission factors taken from Mobile6.2

PS-41 Construction: HAP Emissions from On-Road Vehicles

Equipment	Hazardous Air Pollutants 2010 Emissions (Tons)				
	Acetaldehyde	**Acrolein**	**Benzene**	**1,3-butadiene**	**Formaldehyde**
Automobile	2.20E-04	1.31E-05	8.98E-04	1.11E-04	2.46E-04
Bus	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pickup 4x4	5.51E-04	3.27E-05	2.24E-03	2.78E-04	6.15E-04
Welding Rig	3.61E-04	2.14E-05	1.47E-03	1.82E-04	4.03E-04
Winch Truck	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	6.33E-05	5.36E-06	1.52E-04	1.57E-05	1.02E-04
Flatbed Truck	9.28E-05	7.86E-06	2.23E-04	2.31E-05	1.50E-04
Fuel Truck	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Grease Truck	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mechanic Rig	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Skid Truck	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stringing Tr.& Tr.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Truck & Float	5.63E-05	4.76E-06	1.35E-04	1.40E-05	9.09E-05
Truck & Lowboy	1.98E-05	1.68E-06	4.76E-05	4.92E-06	3.20E-05
TOTAL (Tons)	**0.0014**	**0.0001**	**0.0052**	**0.0006**	**0.0016**

PS-41 Construction: Emissions from Slash/Brush Burning

Volume and Area of Prescribed Burning			
Area disturbed/ burned	=	10	acre

Vegetation Type Distribution		
Tree Tops/Stumps	=	50% [(a)]
Hay/Gass	=	50% [(a)]

Fuel Load Emission Factor			
Hay/grass	=	1.0	ton/acre [(b)]
Tree Tops and Stumps	=	9.0	ton/acre [(c)]

Weight of Wood/Hay Burned			
Hay/grass	=	5.00	tons
Tree Tops and Stumps	=	45.00	tons

Emission factors for wildfire, prescribed burning and slash burns calculated under dry conditions for each fuel component [(d)]										
Fuel Component	**Emission factor (lb/ton)**									
	% of total Vegetation	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2	NO_x	NH_3
Litter, Wood 0-1"	25%	52	3	6	15	8	9	3483	2.5	0.5
Wood 1-3"	25%	111	6	9	20	12	14	3373	2.5	1.1
Wood 3+"	25%	174	9	12	26	16	19	3263	2.5	1.7
Herb, Shrub	25%	249	12	16	33	21	25	3116	2.5	2.6

Emission from prescribed wood burning									
Fuel Component	**Emissions (tons)**								
	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2	NO_x	NH_3
Litter, Wood 0-1"	0.29	0.02	0.03	0.08	0.05	0.05	19.59	0.01	0.00
Wood 1-3"	0.62	0.03	0.05	0.11	0.07	0.08	18.97	0.01	0.01
Wood 3+"	0.98	0.05	0.07	0.15	0.09	0.11	18.35	0.01	0.01
Herb, Shrub	1.40	0.07	0.09	0.19	0.12	0.14	17.53	0.01	0.01
TOTAL	**3.30**	**0.17**	**0.24**	**0.53**	**0.32**	**0.38**	**74.45**	**0.06**	**0.03**

Emission factors for crop residue burning [e]									
Crop Residue	**Emission factor (lb/ton)**								
	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2 [f]	NO_x	NH_3
Hay/Grasses	204.3	6.3	32.7	17.6	17.4	16.9	-	5.1	6.7

Emissions from crop residue burning									
Crop Residue	**Emissions (tons)**								
	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2	NO_x	NH_3
Hay/Grasses	0.51	0.02	0.08	0.04	0.04	0.04	-	0.01	0.02

Emissions from prescribed burning and crop residue burning									
	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2	NO_x	NH_3
TOTAL	**3.81**	**0.18**	**0.32**	**0.57**	**0.36**	**0.42**	**74.45**	**0.07**	**0.05**

NOTES:

(a) Taken from http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_mp_e0100_1070n_08.pdf.

(b)Taken from Table 5 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(c) Fuel loading value of tree tops and stumps taken from AP-42 Table 13.1-1. Value applicable to southern region (Region 8) were used.

(d) Taken from Table 2 and 3 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(e)Taken from Table 6 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(f) Emission factor of CO_2 for hay/grass burning was not available.

PM EMISSIONS FROM LAND DISTURBED: Pipeline and PS-41 Construction

2011 Activities		
Area Name:	Pipeline	
Area of Land Disturbance over the total months of construction (acres):	10	
Months of Construction Activity (May-August 2011)[(1)]:	4	
	total tons[(2)]	tons/month
PM2.5	0.9	0.2
PM10	6.0	1.5
PM30	12.0	3.0

	Heavy Construction Operations			Notes
Factor	**PM2.5**	**PM10**	**PM30**	
tons/acre/month	0.09	0.60	1.20	(3)
From AP-42, Section 13.2.3 Heavy Construction Operations:				
For construction activity operations: **E = 1.2 tons/acre/month of activity**				

NOTES:

(1) Construction is projected to occur over 4 months.

(2) Total tons is for entire construction duration, which is expected to be over an 4 month period. PM2.5 is particulate matter less than 2.5 microns. PM10 is particulate matter less than 10 microns. PM30 is particulate matter less than 30 microns.

(3) From AP-42 Section 13.2.3.3. Note that a factor of 1.2 ton/acre/month is conservatively high for TSP since it assumes that construction occurs over 30 days of the month which is not true in this case. Particle size multiplier (k) of 0.5 and 0.075 were used to determine the fraction of PM10 and PM2.5, respectively (taken from AP-42 Section 13.2.5.3).

PERSONNEL COMMUTE-PM EMISSIONS FROM PAVED ROADS:PS-41
Construction

Total Number of miles for 2011	309,975	miles for 2011	(1)

Emissions = VMT roundtrip/trip * 'X' trips for the construction period / 2000

All Paved Roads			
Emissions (ton/year)	**PM2.5**	**PM10**	**PM30 (TSP)**
2011	0.02	0.23	1.43

All Paved Roads				Notes
Emission Factor	**PM2.5**	**PM10**	**PM30**	
lb/VMT	0.0001	0.0015	0.0092	(2)

From AP-42, Section 13.2.1 Paved Roads:

For all paved roads:

E={[k*((sL/2)^0.65)*((W/3)^1.5)] -C}*(1-P/4N)

where

E = size specific emission factor (lb/VMT)
k = particulate size multiplier
sL = road surface silt loading (g/m2)
W = mean vehicle weight (tons)
C = emission factor for 1980's vehicle fleet exhaust, brake wear, and tire wear.
P = number of wet days with at least 0.254 mm (0.01 in) of precipitation during the averaging period, and
N = number of days in the averaging period

Parameter	All Paved Roads 2010			Notes
	PM2.5	**PM10**	**PM30**	
k	0.004	0.016	0.082	(3)
sL	0.2	0.2	0.2	(4)
W	2.1	2.1	2.1	(5)
C	0.00036	0.00047	0.00047	(6)

NOTES:

(1) Number of personnel is assumed to be a constant during the entire construction schedule.
(2) Derived from equation, based on lb/VMT, P=120 from Figure 13.2.1-2, N=365
(3) From AP-42 Table 13.2-1.1 in lb/VMT.
(4) Silt content taken from AP-42 Table 13.2.1-3 for 500-5,000 ADT ubiquitous baseline.
(5) Average worker vehicle weight based on average car or light duty truck sold in the US last year 4,144 pounds from EPA. 4,144 pounds = 2.07 tons
(6) From AP-42 Table 13.2-1.2 in lb/VMT.

OPERATIONAL EMISSIONS

Keystone XL Pipeline

HGB Severe Ozone Nonattainment Area

Pumping Station No. 41

	Annual Operational Emissions: Pumping Station - 41 (tons per year)										
	HC	CO	NOx	SO2	TSP	PM10	PM2.5	CO2e	Benzene	Toluene	Xylenes
TOTAL	9.81E-02	-	-	-	-	-	-	0.55	1.57E-02	2.62E-02	3.67E-02
Since the project is proposed to be located in an ozone nonattainment area, the pollutants of interest are HC (VOC) and NOx.											

PUMPING STATION No. 41: CRITERIA POLLUTANT EMISSIONS

Pumping Station 41: Annual VOC Emissions from Crude Sump

Tank No.	Working Capacity		Height	Diameter	Product	Annual Turnovers	Throughput [(a)]	Working Losses	Breathing Losses	Total Losses	
	bbl	gal	ft	ft			gal/yr	lb/year	lb/year	lb/year	ton/yr
Sump 1	60	2,500	14	6	Crude Oil	12	30,000	143.82	0.00	143.82	7.19E-02
TOTAL										**143.82**	**0.072**

Pumping Station - 41: Fugitive Emissions

Service	Components	Emission Factor [(a), (b)]	VOC Emissions	
	#	(lb/hr) / component	lb/hr	ton/year
Valves	13	1.85E-05	0.00024	0.001
Pumps	5	1.13E-03	0.006	0.025
Flanges and Connectors	109	8.60E-07	0.000	0.000
Total			**0.006**	**0.03**

Notes:

(a) Emission factors taken from TCEQ's "Equipment Leak Fugitives" document, May 2000. Emission factors pertaining to Oil and Gas Production Operations for Heavy Oil <20° API were used.

(b) Factors give the total organic compound emission rate. Assume that all TOCs are VOCs to be conservative.

PUMPING STATION 41: GHG EMISSIONS

GHG (CH4) Emissions from Fugitive Emissions at Pumping Station- 41

Freeport Pumping Station: Fugitive Emissions

Service	Components	Emission Factor [a], [b]	TOC Emissions		CH4 Emissions	CO2e Emissions
	#	(lb/hr) / component	lb/hr	ton/year	ton/year	ton/year
Valves	13	2.E-05	0.00024	0.001	0.001	0.022
Pumps	5	1.E-03	0.006	0.025	0.025	0.520
Flanges and Connectors	109	9.E-07	0.0001	0.00041	0.00041	0.009
Total			0.006	0.03	**0.03**	**0.55**

Notes:

(a) Operators of crude oil pipeline facilities which handle weathered or dead crude may use the Oil and Gas Heavy Oil (< 20° API gravity) factors to estimate fugitive emissions.

(b) Factors give the total organic compound emission rate. It is conservatively assumed that all of the TOC is CH4 to estimate the GHG emissions. CH4 emissions are represented as CO2e emissions by mutiplying them with a GWP of 21.

CONSTRUCTION EMISSIONS

Keystone XL Pipeline

HGB Severe Ozone Nonattainment Area

Houston Lateral Segment

	2012 Construction Emissions: Houston Lateral Segment in the HGB Nonattainment Area (tons)																
	HC	CO	NOx	SO2	TSP	PM10	PM2.5	CO2e	Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs	1,3-Butadiene	Formaldehyde	Acetaldehyde
CONSTRUCTION NONROAD	4.15	38.06	56.29	2.35	2.35	2.35	2.35	7866.749597	7.40E-02	3.25E-02	2.26E-02	2.05E-01	7.34E-03	1.33E-02	3.10E-03	9.36E-02	6.09E-02
CONSTRUCTION ONROAD	1.33	24.14	3.87	0.02	0.14	0.14	0.14	1671.85	3.97E-02				8.05E-04		4.79E-03	1.54E-02	1.16E-02
OPEN BURNING	24.64	289.85	5.25	-	43.61	31.91	27.72	5,963.00									
FUGITIVE DUST					774.00	387.00	58.05										
PAVED ROAD DUST					12.15	1.91	0.19										
TOTAL	**30.12**	**352.04**	**65.41**	**2.37**	**832.25**	**423.31**	**88.45**	**15,501.60**	**1.14E-01**	**3.25E-02**	**2.26E-02**	**2.05E-01**	**8.14E-03**	**1.33E-02**	**7.89E-03**	**1.09E-01**	**7.25E-02**
Since the project is proposed to be located in an ozone nonattainment area, the pollutants of interest are HC (VOC) and NOx.																	

Houston Lateral Pipeline Construction: Criteria Emissions from Non-Road Engines

Equipment	Daily Hours operated	Units per spread Pre-welding days (21 days)	Units per spread Welding days (61 days)	Units per spread Clean-up days (49 days)	2012 TOTAL Hours	Equpt Horsepwr	Fuel Type	BSFC [1,a]	Criteria Pollutants EFss (g/hp-hr) [1,a]				TAF Assignment [2,b]	Load Factor [3]	TAF [2,b]				
	hrs/eqpt/day				hrs	hp		lb/hp-hr	HC	CO	NOx	PM			BSFC	HC	CO	NOx	PM
D-7 Dozer	8	12	12	7	10,616	240	Diesel	0.367	0.3085	0.7475	4	0.1316	Hi	0.59	1.01	1.05	1.53	0.95	1.23
D-8 Dozer	8	13	22	18	19,976	310	Diesel	0.367	0.1669	0.8425	4.3551	0.1316	Hi	0.59	1.01	1.05	1.53	0.95	1.23
D-8 Ripper	0	0	0	0	0	310	Diesel	0.367	0.1669	0.8425	4.3551	0.1316	Hi	0.59	1.01	1.05	1.53	0.95	1.23
D-5 Tow	8	0	2	2	1,760	120	Diesel	0.367	0.3384	0.8667	4.1	0.18	None	0.43	1.00	1.00	1.00	1.00	1.00
D-7 Tow	8	0	1	1	880	240	Diesel	0.367	0.3085	0.7475	4	0.1316	None	0.43	1.00	1.00	1.00	1.00	1.00
D-6 Tack	8	3	3	3	3,144	200	Diesel	0.367	0.3085	0.7475	4	0.1316	None	0.43	1.00	1.00	1.00	1.00	1.00
CAT 225	8	0	7	4	4,984	150	Diesel	0.367	0.3384	0.8667	4.1	0.18	Hi	0.59	1.01	1.05	1.53	0.95	1.23
CAT 235	8	0	26	15	18,568	250	Diesel	0.367	0.3085	0.7475	4	0.1316	Hi	0.59	1.01	1.05	1.53	0.95	1.23
CAT 235 w/ Hammer	0	0	0	0	0	260	Diesel	0.367	0.3085	0.7475	4	0.1316	Hi	0.59	1.01	1.05	1.53	0.95	1.23
Bending Machine 22-36	8	0	1	0	488	159	Diesel	0.367	0.3384	0.8667	4.1	0.18	None	0.43	1.00	1.00	1.00	1.00	1.00
Crane LS-98A (35 ton)	0	0	0	0	0	230	Diesel	0.367	0.3085	0.7475	4	0.1316	None	0.43	1.00	1.00	1.00	1.00	1.00
Farm Tractor	8	2	2	2	2,096	60	Diesel	0.408	0.3672	2.3655	4.7	0.24	Hi	0.59	1.01	1.05	1.53	0.95	1.23
Frontend Loader 977	8	2	2	2	2,096	190	Diesel	0.367	0.3085	0.7475	4	0.1316	Hi	0.59	1.01	1.05	1.53	0.95	1.23
Motor Grader 14G	8	2	2	2	2,096	200	Diesel	0.367	0.3085	0.7475	4	0.1316	Hi	0.59	1.01	1.05	1.53	0.95	1.23
Sideboom 571	8	0	1	0	488	200	Diesel	0.367	0.3085	0.7475	4	0.1316	Hi	0.59	1.01	1.05	1.53	0.95	1.23
Sideboom 572	8	0	1	1	880	230	Diesel	0.367	0.3085	0.7475	4	0.1316	Hi	0.59	1.01	1.05	1.53	0.95	1.23
Sideboom 583	8	0	22	4	12,304	310	Diesel	0.367	0.1669	0.8425	4.3551	0.1316	Hi	0.59	1.01	1.05	1.53	0.95	1.23
Sideboom 594	8	0	4	4	3,520	410	Diesel	0.367	0.1669	0.8425	4.3551	0.1316	Hi	0.59	1.01	1.05	1.53	0.95	1.23
Air Compressor 1750 cfm	8	0	3	1	1,856	50	Gasoline	0.484	0.27	11.94	0.69	0.06	None	0.56	1.00	1.00	1.00	1.00	1.00
Pump - 3"	8	0	1	1	880	20	Gasoline	0.868	5.5	387.02	4.5	0.06	None	0.69	1.00	1.00	1.00	1.00	1.00
Pump - 6"	8	0	9	9	7,920	40	Gasoline	0.484	0.27	11.94	0.69	0.06	None	0.69	1.00	1.00	1.00	1.00	1.00
Emergency Engines	8	0	9	2	5,176	10	Gasoline	0.868	5.5	387.02	4.5	0.06	None	0.68	1.00	1.00	1.00	1.00	1.00
TOTAL (Tons)																			

NOTES:

Notes 1 through 9 apply to diesel engines.

Note 1: Brake-specific fuel consumption and Zero hour steady state EF (EFss; g/hp-hr) assumed to be Tier 2 engines, from Table A2 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling-Compression-Ignition", April 2004, EPA-420-P-04-009.

Engine Size (HP	HC	CO	NOx	PM	BSFC	M. Life
11	0.5508	4.1127	4.3	0.5	0.408	2500
16	0.438	2.161	4.4399	0.2665	0.408	2500
25	0.438	2.161	4.4399	0.2665	0.408	2500
50	0.2789	1.5323	4.7279	0.3389	0.408	4667
100	0.3672	2.3655	4.7	0.24	0.408	4667
175	0.3384	0.8667	4.1	0.18	0.367	4667
300	0.3085	0.7475	4	0.1316	0.367	7000
600	0.1669	0.8425	4.3551	0.1316	0.367	7000
750	0.1669	1.3272	4.1	0.1316	0.367	7000
2500	0.1669	0.7642	4.1	0.1316	0.367	7000

Note 2: Transient Adjustment Factors and TAF assignment and TAF from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Note 3: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.

Note 4: Median life is taken from Table 1 of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.

Note 5: Age factor and Deterioration factors calculated using Equation 4 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Age Factor = LF * cumulative hours / median life {Age factor is assumed to be greater than one, i.e. the equipment is approximately at the end of its useful life.

Deterioration Factor = 1 + (A * Age Factor^b), where b = 1 for desel engines and A is taken from Table A4 from source

Note 6: Adjusted Emission Factors for HC, NOx, and CO are calculated using Equation 1 (Table A4) from, "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009. Relative Deterioration factors for Tier II engines was used.

Adjusted EF = Efss * TAF * DF

Note 7: SO2 calculated from Equation 7 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

SO2=BSFC*453.6*(1-soxcnv)-HC)*0.01*soxdsl*2

where: soxcnv = 0.02247 and soxdsl = 0.05

Note 8: Adjusted Emission Factor for particulate matter is calculated using Equations 2 and 5 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Adjusted EF = Efss * TAF * DF - Spm adj

Spm adj = BSFC*453.6*7.0*soxcnv*0.01*(soxbas-soxdsl)

where: soxbas = 0.33

Note 9: Construction is proposed to occur between March 2012 and December 2012 approximately. Annual Emissions are calculated using the following calculation

(Emission factor (g/hp-hr) * horsepower * hours operated * load factor) / (2000 lb/ton * 453.6 g/lb)

Notes a through d apply to gasoline engines.

Note a: Fuel Type Gasoline only: Brake specific fuel consumption and emission factors (EFss; g/hp-hr) asssumed to be Phase 2 side-valved for < 25hp from Table 5 and Table 6 for > 25hp of "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019

Note b: Fuel Type Galosine only: Transient Adjsutment Factors assumed to be Phase 2 for >25 Hp (for <25Hp TAFs emission factors are based on unadjusted steady-state test results) from Table 20 of "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019.

Note c: Fuel Type Gasoline only: Deterioration Factors from Table 2 class 2 for <25 Hp of "Nonroad Spark-Ignition Engine Emission Deterioration Factors", December 2005, EPA420-R-05-023.

Fuel Type Gasoline only: Deterioration Factors from Table 7 for >25 Hp of "Nonroad Spark-Ignition Engine Emission Deterioration Factors", December 2005, EPA420-R-05-023.

Note d: Fuel Type Gasoline only: SO2 calculated from Sulfur Dioxide Emission Factor calculations from "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019.

SO2=BSFC*453.6*(1-soxcnv)-HC)*0.01*soxdsl*2

where: soxcnv = 0.03 and soxdsl = 0.0339

Houston Lateral Pipeline Construction: Criteria Emissions from Non-Road Engines

Equipment	$BSFC_{adj}$	Median Life [4]	Age	"A" [5]				Deterioration factor [5,c]				Adjusted EF (g/hp-hr) [6]					2012 Emissions (tons) [9]				
		Hours	Factor	HC	CO	NOx	PM	HC	CO	NOx	PM	HC	CO	NOx	SO2 [7,d]	PM [8]	HC	CO	NOx	SO2	PM
D-7 Dozer	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.56	2.09	6.35	0.27	0.27
D-8 Dozer	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.181	1.419	4.175	0.164	0.164	0.73	5.72	16.81	0.66	0.66
D-8 Ripper	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.181	1.419	4.175	0.164	0.164	0.00	0.00	0.00	0.00	0.00
D-5 Tow	0.3670	4667	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.350	0.954	4.137	0.162	0.192	0.04	0.10	0.41	0.02	0.02
D-7 Tow	0.3670	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.319	0.823	4.036	0.162	0.121	0.03	0.08	0.40	0.02	0.01
D-6 Tack	0.3670	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.319	0.823	4.036	0.162	0.121	0.10	0.25	1.20	0.05	0.04
CAT 225	0.3707	4667	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.367	1.460	3.930	0.164	0.252	0.18	0.71	1.91	0.08	0.12
CAT 235	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	1.01	3.80	11.58	0.50	0.50
CAT 235 w/ Hammer	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.00	0.00	0.00	0.00	0.00
Bending Machine 22-36	0.3670	4667	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.350	0.954	4.137	0.162	0.192	0.01	0.04	0.15	0.01	0.01
Crane LS-98A (35 ton)	0.3670	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.319	0.823	4.036	0.162	0.121	0.00	0.00	0.00	0.00	0.00
Farm Tractor	0.4121	4667	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.399	3.985	4.505	0.182	0.353	0.03	0.33	0.37	0.01	0.03
Frontend Loader 977	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.09	0.33	0.99	0.04	0.04
Motor Grader 14G	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.09	0.34	1.05	0.04	0.04
Sideboom 571	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.02	0.08	0.24	0.01	0.01
Sideboom 572	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.04	0.17	0.50	0.02	0.02
Sideboom 583	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.181	1.419	4.175	0.164	0.164	0.45	3.52	10.36	0.41	0.41
Sideboom 594	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.181	1.419	4.175	0.164	0.164	0.17	1.33	3.92	0.15	0.15
Air Compressor 1750 cfm	0.4840	4667	> 1	-	-	-	-	0.640	0.360	0.150	0.260	0.173	4.298	0.104	0.144	0.016	0.01	0.25	0.01	0.01	0.00
Pump - 3"	0.8680	2500	> 1	-	-	-	-	1.935	0.887	0.000	1.935	10.643	343.29	0.000	0.252	0.116	0.14	4.60	0.00	0.00	0.00
Pump - 6"	0.4840	4667	> 1	-	-	-	-	0.640	0.360	0.150	0.260	0.173	4.298	0.104	0.144	0.016	0.04	1.04	0.02	0.03	0.00
Emergency Engines	0.8680	2500	> 1	-	-	-	-	1.935	0.887	0.000	1.935	10.643	343.29	0.000	0.252	0.116	0.41	13.32	0.00	0.01	0.00
TOTAL (Tons)																	**4.15**	**38.06**	**56.29**	**2.35**	**2.35**

Houston Lateral Pipeline Construction: GHG Emissions from Non-Road Engines

Equipment	Daily Hours operated	2012 TOTAL Hours	Equipment HP	Fuel Type	BSFC	TAF Assignment	Load Factor [2]	TAF [1]	$BSFC_{adj}$	Greenhouse Gases					2012 Emissions (Tons)			
										CO_2	CH_4		N2O					
	hrs/eqpt/day	hrs	hp		lb/hp-hr			BSFC		g/hp-hr [3]	[4]	lb/hp-hr	Ef (g/gal) [4]	lb/hp-hr	CO_2	CH_4	N_2O	CO_2e [5]
D-7 Dozer	8	10,616	240	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	886.96	0.09	0.04	900.66
D-8 Dozer	8	19,976	310	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	2,157.75	0.21	0.09	2,191.05
D-8 Ripper	0	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00
D-5 Tow	8	1,760	120	Diesel	0.367	None	0.43	1	0.3670	529.92	0.58	6.66E-05	0.26	2.98E-05	53.05	0.01	0.00	54.17
D-7 Tow	8	880	240	Diesel	0.367	None	0.43	1	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	53.06	0.01	0.00	54.18
D-6 Tack	8	3,144	200	Diesel	0.367	None	0.43	1	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	157.97	0.02	0.01	161.32
CAT 225	8	4,984	150	Diesel	0.367	Hi	0.59	1.01	0.3707	535.17	0.58	6.72E-05	0.26	3.01E-05	260.21	0.03	0.01	264.23
CAT 235	8	18,568	250	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	1,615.99	0.16	0.07	1,640.95
CAT 235 w/ Hammer	0	0	260	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00
Bending Machine 22-36	8	488	159	Diesel	0.367	None	0.43	1	0.3670	529.92	0.58	6.66E-05	0.26	2.98E-05	19.49	0.00	0.00	19.90
Crane LS-98A (35 ton)	0	0	230	Diesel	0.367	None	0.43	1	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	0.00	0.00	0.00	0.00
Farm Tractor	8	2,096	60	Diesel	0.408	Hi	0.59	1.01	0.4121	594.99	0.58	7.47E-05	0.26	3.35E-05	48.66	0.00	0.00	49.42
Frontend Loader 977	8	2,096	190	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	138.64	0.01	0.01	140.78
Motor Grader 14G	8	2,096	200	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	145.93	0.01	0.01	148.19
Sideboom 571	8	488	200	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	33.98	0.00	0.00	34.50
Sideboom 572	8	880	230	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	70.46	0.01	0.00	71.55
Sideboom 583	8	12,304	310	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	1,329.05	0.13	0.06	1,349.56
Sideboom 594	8	3,520	410	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	502.87	0.05	0.02	510.63
Air Compressor 1750 cfm	8	1,856	50	Gasoline	0.484	None	0.56	1	0.4840	699.77	0.50	7.57E-05	0.22	3.33E-05	40.09	0.00	0.00	40.64
Pump - 3"	8	880	20	Gasoline	0.868	None	0.69	1	0.8680	1222.00	0.50	1.36E-04	0.22	5.97E-05	16.36	0.00	0.00	16.55
Pump - 6"	8	7,920	40	Gasoline	0.484	None	0.69	1	0.4840	699.77	0.50	7.57E-05	0.22	3.33E-05	168.62	0.01	0.01	170.50
Emergency Engines	8	5,176	10	Gasoline	0.868	None	0.68	1	0.8680	1222.00	0.50	1.36E-04	0.22	5.97E-05	47.41	0.00	0.00	47.96
TOTAL (Tons)															**7,746.55**	**0.75**	**0.34**	**7,866.75**

NOTES:

Note 1: Transient Adjustment Factors and TAF assignment and from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Note 2: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.

Note 3: Carbon dioxide is calculated using Equation 6 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

CO2= ((BSFC*453.6) - HC) * 0.87 * (44/12)
HC is the hydrocarbon emission factor from criteria pollutant calculation,
0.87 is the mass fraction of carbon mass in diesel and
44/12 is the molecular weight ratio of CO2 to carbon

Note 4: Emission Factors from Table 13.6 of The Climate Registry General Reporting Protocol Version 1.0, tons calculated using 7.05 lb/gal from AP-42 Appendix A and adjusted BSFC

Note 5: Carbon dioxide equivalents calculated using IPCC Second Assessment Report (SAR) Global Warming Potentials CO2 = 1, CH4 = 21, N2O = 310.

CO2e= CO2 + (CH4 * 21) + (N2O * 310)

Houston Lateral Pipeline Construction: HAP Emissions from Non-Road Engines

Equipment	Daily Hours operated	2012 TOTAL Hours	Equipment Horsepower	Fuel Type	BSFC	TAF Assignment [1]	Load Factor [2]	BSFC TAF [1]	$BSFC_{adj}$	HAP Emission Factors (lb/MMBtu) [3]					
	hrs/eqpt/day	hrs	hp		lb/hp-hr					Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs
D-7 Dozer	8	10,616	240	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-8 Dozer	8	19,976	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-8 Ripper	0	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-5 Tow	8	1,760	120	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-7 Tow	8	880	240	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-6 Tack	8	3,144	200	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 225	8	4,984	150	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 235	8	18,568	250	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 235 w/ Hammer	0	0	260	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Bending Machine 22-36	8	488	159	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Crane LS-98A (35 ton)	0	0	230	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Farm Tractor	8	2,096	60	Diesel	0.408	Hi	0.59	1.01	0.4121	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Frontend Loader 977	8	2,096	190	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Motor Grader 14G	8	2,096	200	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 571	8	488	200	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 572	8	880	230	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 583	8	12,304	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 594	8	3,520	410	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Air Compressor 1750 cfm	8	1,856	50	Gasoline	0.484	None	0.56	1	0.4840	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 3"	8	880	20	Gasoline	0.868	None	0.69	1	0.8680	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 6"	8	7,920	40	Gasoline	0.484	None	0.69	1	0.4840	N/A	N/A	N/A	N/A	N/A	N/A
Emergency Engines	8	5,176	10	Gasoline	0.868	None	0.68	1	0.8680	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL (Tons)															

NOTES:

Note 1: Transient Adjustment Factors and TAF assignment and from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Note 2: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005. TAF Assignment of Hi/Lo is based on the Load Factor.

Note 3: Emission factors (lb/MMBtu) from AP-42 Section 3.3, Table 3.3-2. Note that HAP emission factors for gasoline fired engines are not available.

Note 4: Tons are calculated using 7.05 lb/gal from AP-42 Appendix A and 5.825 MMBtu/barrel from Table 13.1 of The Climate Registry Genral Reporting Protocol version 1.0

Houston Lateral Pipeline Construction: HAP Emissions from Non-Road Engines

Equipment	HAP Emission Factors (lb/MMBtu)[3]			2012 HAP Emissions (Tons)[4]								
	1,3-Butadiene	Formaldehyde	Acetaldehyde	Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs	1,3-Butadiene	Formaldehyde	Acetaldehyde
D-7 Dozer	3.91E-05	1.18E-03	7.67E-04	8.67E-03	3.80E-03	2.65E-03	2.40E-02	8.59E-04	1.56E-03	3.63E-04	1.10E-02	7.12E-03
D-8 Dozer	3.91E-05	1.18E-03	7.67E-04	2.11E-02	9.23E-03	6.43E-03	5.83E-02	2.09E-03	3.79E-03	8.83E-04	2.66E-02	1.73E-02
D-8 Ripper	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D-5 Tow	3.91E-05	1.18E-03	7.67E-04	7.11E-04	3.12E-04	2.17E-04	1.97E-03	7.05E-05	1.28E-04	2.98E-05	9.00E-04	5.85E-04
D-7 Tow	3.91E-05	1.18E-03	7.67E-04	7.11E-04	3.12E-04	2.17E-04	1.97E-03	7.05E-05	1.28E-04	2.98E-05	9.00E-04	5.85E-04
D-6 Tack	3.91E-05	1.18E-03	7.67E-04	2.12E-03	9.28E-04	6.47E-04	5.86E-03	2.10E-04	3.81E-04	8.88E-05	2.68E-03	1.74E-03
CAT 225	3.91E-05	1.18E-03	7.67E-04	2.54E-03	1.11E-03	7.77E-04	7.03E-03	2.52E-04	4.58E-04	1.07E-04	3.22E-03	2.09E-03
CAT 235	3.91E-05	1.18E-03	7.67E-04	1.58E-02	6.92E-03	4.82E-03	4.37E-02	1.57E-03	2.84E-03	6.62E-04	2.00E-02	1.30E-02
CAT 235 w/ Hammer	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bending Machine 22-36	3.91E-05	1.18E-03	7.67E-04	2.61E-04	1.15E-04	7.98E-05	7.23E-04	2.59E-05	4.71E-05	1.10E-05	3.31E-04	2.15E-04
Crane LS-98A (35 ton)	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Farm Tractor	3.91E-05	1.18E-03	7.67E-04	4.76E-04	2.08E-04	1.45E-04	1.32E-03	4.72E-05	8.56E-05	1.99E-05	6.01E-04	3.91E-04
Frontend Loader 977	3.91E-05	1.18E-03	7.67E-04	1.35E-03	5.94E-04	4.14E-04	3.75E-03	1.34E-04	2.44E-04	5.68E-05	1.71E-03	1.11E-03
Motor Grader 14G	3.91E-05	1.18E-03	7.67E-04	1.43E-03	6.25E-04	4.36E-04	3.94E-03	1.41E-04	2.57E-04	5.98E-05	1.80E-03	1.17E-03
Sideboom 571	3.91E-05	1.18E-03	7.67E-04	3.32E-04	1.46E-04	1.01E-04	9.18E-04	3.29E-05	5.98E-05	1.39E-05	4.20E-04	2.73E-04
Sideboom 572	3.91E-05	1.18E-03	7.67E-04	6.89E-04	3.02E-04	2.10E-04	1.90E-03	6.83E-05	1.24E-04	2.89E-05	8.71E-04	5.66E-04
Sideboom 583	3.91E-05	1.18E-03	7.67E-04	1.30E-02	5.69E-03	3.96E-03	3.59E-02	1.29E-03	2.34E-03	5.44E-04	1.64E-02	1.07E-02
Sideboom 594	3.91E-05	1.18E-03	7.67E-04	4.91E-03	2.15E-03	1.50E-03	1.36E-02	4.87E-04	8.84E-04	2.06E-04	6.21E-03	4.04E-03
Air Compressor 1750 cfm	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 3"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 6"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Emergency Engines	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL (Tons)				**7.40E-02**	**3.25E-02**	**2.26E-02**	**2.05E-01**	**7.34E-03**	**1.33E-02**	**3.10E-03**	**9.36E-02**	**6.09E-02**

Houston Lateral Pipeline Construction: Criteria and GHG Emissions from On-Road Vehicles

Equipment	Daily Hours operated	Number	Units per spread	Units per spread	Units per spread	Vehicle Class [1]	2012 Miles traveled [2]	Fuel Type	Criteria Pollutants Emission Factor (g/VMT) [3]				
	hrs/eqpt/day	eqpt #	Pre-welding days (21 days)	Welding days (61 days)	Clean-up days (49 days)				VOC	CO	NOx	SO_2	PM
Automobile	2	50	20	50	20	LDGV	222,500	Diesel	0.627	12.7	0.588	0.0068	0.0249
Bus	3	7	2	7	1	URBANBUS	38,850	Diesel	0.257	2.121	10.677	0.0218	0.226
Pickup 4x4	5	100	20	100	20	LDGV	937,500	Diesel	0.627	12.7	0.588	0.0068	0.0249
Welding Rig	10	30	0	30	5	LDGV	518,750	Diesel	0.627	12.7	0.588	0.0068	0.0249
Winch Truck	8	3	3	3		HDDV3	49,200	Diesel	0.16	0.541	2.319	0.0082	0.0848
Dump Truck	8	1	1	1	1	HDDV3	26,200	Diesel	0.16	0.541	2.319	0.0082	0.0848
Flatbed Truck	9	8	1	8	2	HDDV3	136,575	Diesel	0.16	0.541	2.319	0.0082	0.0848
Fuel Truck	10	2	1	2	2	HDDV3	60,250	Diesel	0.16	0.541	2.319	0.0082	0.0848
Grease Truck	10	1	1	1	1	HDDV3	32,750	Diesel	0.16	0.541	2.319	0.0082	0.0848
Mechanic Rig	10	1	1	1	1	HDDV2B	32,750	Diesel	0.149	0.508	2.182	0.0074	0.0966
Skid Truck	10	1	1	1	0	HDDV3	20,500	Diesel	0.16	0.541	2.319	0.0082	0.0848
Stringing Tr.& Tr.	10	15	0	15	0	HDDV3	228,750	Diesel	0.16	0.541	2.319	0.0082	0.0848
Tuck.& Float	10	9	0	9	5	HDDV3	198,500	Diesel	0.16	0.541	2.319	0.0082	0.0848
Truck & Lowboy	10	5	5	5	2	HDDV3	127,000	Diesel	0.16	0.541	2.319	0.0082	0.0848
TOTAL (Tons)													

NOTES:

Note 1: Vehicle Classes were taken from Mobile6.2 based on estimated gross weight of the vehicle.

Note 2: Vehicle miles traveled are based on an assumed 25 mi/hr on average/ vehicle based on arterial roads.

Note 3: Emission factors from Mobile6.2.

Note 4: Emission Factors from Table 13.4 of The Climate Registry General Reporting Protocol Version 1.1 applicable to "Diesel Heavy Duty Vehicles" all model year vehicles.
Note that Efs applicable to light duty gasoline vehicles was used for the vehicle category "automobiles" (MY 2000).

Note 5: Carbon dioxide equivalents calculated using IPCC Second Assessment Report (SAR) Global Warming Potentials CO2 = 1, CH4 = 21, N2O = 310.
CO2e= CO2 + (CH4 * 21) + (N2O * 310)

Houston Lateral Pipeline Construction: Criteria and GHG Emissions from On-Road Vehicles

Equipment	Greenhouse Gasses Ef (g/mile)			2012 Emissions (Tons)								
				Criteria Pollutants					Greenhouse Gases			
	CO_2 [3]	CH_4 [4]	N_2O [4]	VOC	CO	NOx	SO_2	PM	CO_2	CH_4	N_2O	CO_2e [5]
Automobile	368.1	0.0273	0.0178	0.1538	3.1149	0.1442	0.0017	0.01	90.28	6.70E-03	4.37E-03	91.78
Bus	2342.9	0.0051	0.0048	0.0110	0.0908	0.4572	0.0009	0.01	100.33	2.18E-04	2.06E-04	100.40
Pickup 4x4	368.1	0.0273	0.0178	0.6480	13.1244	0.6076	0.0070	0.03	380.40	2.82E-02	1.84E-02	386.70
Welding Rig	368.1	0.0273	0.0178	0.3585	7.2622	0.3362	0.0039	0.01	210.49	1.56E-02	1.02E-02	213.97
Winch Truck	875.4	0.0051	0.0048	0.0087	0.0293	0.1258	0.0004	0.00	47.48	2.77E-04	2.60E-04	47.56
Dump Truck	875.4	0.0051	0.0048	0.0046	0.0156	0.0670	0.0002	0.00	25.28	1.47E-04	1.39E-04	25.33
Flatbed Truck	875.4	0.0051	0.0048	0.0241	0.0814	0.3491	0.0012	0.01	131.79	7.68E-04	7.23E-04	132.03
Fuel Truck	875.4	0.0051	0.0048	0.0106	0.0359	0.1540	0.0005	0.01	58.14	3.39E-04	3.19E-04	58.25
Grease Truck	875.4	0.0051	0.0048	0.0058	0.0195	0.0837	0.0003	0.00	31.60	1.84E-04	1.73E-04	31.66
Mechanic Rig	789.4	0.0051	0.0048	0.0054	0.0183	0.0788	0.0003	0.00	28.50	1.84E-04	1.73E-04	28.56
Skid Truck	875.4	0.0051	0.0048	0.0036	0.0122	0.0524	0.0002	0.00	19.78	1.15E-04	1.08E-04	19.82
Stringing Tr.& Tr.	875.4	0.0051	0.0048	0.0403	0.1364	0.5847	0.0021	0.02	220.74	1.29E-03	1.21E-03	221.14
Tuck.& Float	875.4	0.0051	0.0048	0.0350	0.1184	0.5074	0.0018	0.02	191.55	1.12E-03	1.05E-03	191.89
Truck & Lowboy	875.4	0.0051	0.0048	0.0224	0.0757	0.3246	0.0011	0.01	122.55	7.14E-04	6.72E-04	122.77
TOTAL (Tons)				**1.332**	**24.135**	**3.873**	**0.022**	**0.141**	**1658.91**	**5.59E-02**	**3.80E-02**	**1671.85**

Houston Lateral Pipeline Construction: HAP Emissions from On-Road Vehicles

Equipment	Daily Hours operated	Number eqpt	Vehicle Class [1]	2012 Miles traveled [2]	Fuel Type	Hazardous Air Pollutants Emission Factor (mg/VMT) [3]				
	hrs/eqpt/day	#		miles/yr		Acetaldehyde	Acrolein	Benzene	1,3-butadiene	Formaldehyde
Automobile	2	50	LDGV	222,500	Diesel	4.04	0.24	16.45	2.04	4.51
Bus	3	7	URBANBUS	38,850	Diesel	7.75	0.94	2.83	1.64	21.05
Pickup 4x4	5	100	LDGV	937,500	Diesel	4.04	0.24	16.45	2.04	4.51
Welding Rig	10	30	LDGV	518,750	Diesel	4.04	0.24	16.45	2.04	4.51
Winch Truck	8	3	HDDV3	49,200	Diesel	3.78	0.32	9.09	0.94	6.11
Dump Truck	8	1	HDDV3	26,200	Diesel	3.78	0.32	9.09	0.94	6.11
Flatbed Truck	9	8	HDDV3	136,575	Diesel	3.78	0.32	9.09	0.94	6.11
Fuel Truck	10	2	HDDV3	60,250	Diesel	3.78	0.32	9.09	0.94	6.11
Grease Truck	10	1	HDDV3	32,750	Diesel	3.78	0.32	9.09	0.94	6.11
Mechanic Rig	10	1	HDDV2B	32,750	Diesel	3.74	0.29	9.34	0.89	5.92
Skid Truck	10	1	HDDV3	20,500	Diesel	3.78	0.32	9.09	0.94	6.11
Stringing Tr.& Tr.	10	15	HDDV3	228,750	Diesel	3.78	0.32	9.09	0.94	6.11
Tuck.& Float	10	9	HDDV3	198,500	Diesel	3.78	0.32	9.09	0.94	6.11
Truck & Lowboy	10	5	HDDV3	127,000	Diesel	3.78	0.32	9.09	0.94	6.11
TOTAL (Tons)										

NOTES:

Note 1: Vehicle Classes were taken from Mobile6.2 based on estimated gross weight of the vehicle.

Note 2: Vehicle miles traveled are based on an assumed 25 mi/hr on average/ vehicle based on arterial roads.

Note 3: HAP Emission factors taken from Mobile6.2

Houston Lateral Pipeline Construction: HAP Emissions from On-Road Vehicles

Equipment	Hazardous Air Pollutants 2012 Emissions (Tons)				
	Acetaldehyde	**Acrolein**	**Benzene**	**1,3-butadiene**	**Formaldehyde**
Automobile	9.91E-04	5.89E-05	4.03E-03	5.00E-04	1.11E-03
Bus	3.32E-04	4.03E-05	1.21E-04	7.02E-05	9.01E-04
Pickup 4x4	4.17E-03	2.48E-04	1.70E-02	2.11E-03	4.66E-03
Welding Rig	2.31E-03	1.37E-04	9.41E-03	1.17E-03	2.58E-03
Winch Truck	2.05E-04	1.74E-05	4.93E-04	5.10E-05	3.31E-04
Dump Truck	1.09E-04	9.24E-06	2.63E-04	2.71E-05	1.76E-04
Flatbed Truck	5.69E-04	4.82E-05	1.37E-03	1.42E-04	9.20E-04
Fuel Truck	2.51E-04	2.13E-05	6.04E-04	6.24E-05	4.06E-04
Grease Truck	1.36E-04	1.16E-05	3.28E-04	3.39E-05	2.21E-04
Mechanic Rig	1.35E-04	1.05E-05	3.37E-04	3.21E-05	2.14E-04
Skid Truck	8.54E-05	7.23E-06	2.05E-04	2.12E-05	1.38E-04
Stringing Tr.& Tr.	9.53E-04	8.07E-05	2.29E-03	2.37E-04	1.54E-03
Tuck.& Float	8.27E-04	7.00E-05	1.99E-03	2.06E-04	1.34E-03
Truck & Lowboy	5.29E-04	4.48E-05	1.27E-03	1.32E-04	8.55E-04
TOTAL (Tons)	**0.0116**	**0.0008**	**0.0397**	**0.0048**	**0.0154**

Houston Lateral Pipeline Construction: Emissions from Slash/Brush Burning

Volume and Area of Prescribed Burning			
1 cu. Yd.	=	0.00062	acre-foot
1227985 cu. yd.	=	761.35	acre-foot
Area disturbed/ burned	=	761.35	acre

Vegetation Type Distribution			
Tree Tops/Stumps	=	50%	(a)
Hay/Gass	=	50%	(a)

Fuel Load Emission Factor			
Hay/grass	=	1.0	ton/acre (b)
Tree Tops and Stumps	=	9.0	ton/acre (c)

Weight of Wood/Hay Burned			
Hay/grass	=	380.68	tons
Tree Tops and Stumps	=	3,426.08	tons

Emission factors for wildfire, prescribed burning and slash burns calculated under dry conditions for each fuel component (d)										
Fuel Component	Emission factor (lb/ton)									
	% of total Vegetation	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2	NO_x	NH_3
Litter, Wood 0-1"	25%	52	3	6	15	8	9	3483	2.5	0.5
Wood 1-3"	25%	111	6	9	20	12	14	3373	2.5	1.1
Wood 3+"	25%	174	9	12	26	16	19	3263	2.5	1.7
Herb, Shrub	25%	249	12	16	33	21	25	3116	2.5	2.6

Emission from prescribed wood burning									
Fuel Component	Emissions (tons)								
	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2	NO_x	NH_3
Litter, Wood 0-1"	22.27	1.28	2.57	6.42	3.43	3.85	1491.63	1.07	0.21
Wood 1-3"	47.54	2.57	3.85	8.57	5.14	6.00	1444.52	1.07	0.47
Wood 3+"	74.52	3.85	5.14	11.13	6.85	8.14	1397.41	1.07	0.73
Herb, Shrub	106.64	5.14	6.85	14.13	8.99	10.71	1334.46	1.07	1.11
TOTAL	**250.96**	**12.85**	**18.42**	**40.26**	**24.41**	**28.69**	**5668.02**	**4.28**	**2.53**

Emission factors for crop residue burning [e]									
Crop Residue	Emission factor (lb/ton)								
	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2 [f]	NO_x	NH_3
Hay/Grasses	204.3	6.3	32.7	17.6	17.4	16.9	-	5.1	6.7

Emissions from crop residue burning									
Crop Residue	Emissions (tons)								
	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2	NO_x	NH_3
Hay/Grasses	38.89	1.20	6.22	3.35	3.31	3.22	-	0.97	1.28

Emissions from prescribed burning and crop residue burning									
	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2	NO_x	NH_3
TOTAL	**289.85**	**14.05**	**24.64**	**43.61**	**27.72**	**31.91**	**5,668.02**	**5.25**	**3.80**

NOTES:

(a) Taken from http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_mp_e0100_1070n_08.pdf.

(b)Taken from Table 5 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(c) Fuel loading value of tree tops and stumps taken from AP-42 Table 13.1-1. Value applicable to southern region (Region 8) were used.

(d) Taken from Table 2 and 3 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(e)Taken from Table 6 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(f) Emission factor of CO_2 for hay/grass burning was not available.

PM EMISSIONS FROM LAND DISTURBED: Houston Lateral Pipeline Construction

2012 Activities		
Area Name:	**Pipeline**	
Area of Land Disturbance over the total months of construction (acres):	645	
Months of Construction Activity (May-September 2012) (1):	5	
	total tons (2)	tons/month
PM2.5	58.1	11.6
PM10	387.0	77.4
PM30	774.0	154.8

	Heavy Construction Operations			Notes
Factor	**PM2.5**	**PM10**	**PM30**	
tons/acre/month	0.09	0.60	1.20	(3)
From AP-42, Section 13.2.3 Heavy Construction Operations: For construction activity operations: **E = 1.2 tons/acre/month of activity**				

NOTES:

(1) Construction is projected to occur over 5 months.

(2) Total tons is for entire construction duration, which is expected to be over an 5 month period. PM2.5 is particulate matter less than 2.5 microns. PM10 is particulate matter less than 10 microns. PM30 is particulate matter less than 30 microns.

(3) From AP-42 Section 13.2.3.3. Note that a factor of 1.2 ton/acre/month is conservatively high for TSP since it assumes that construction occurs over 30 days of the month which is not true in this case. Particle size multiplier (k) of 0.5 and 0.075 were used to determine the fraction of PM10 and PM2.5, respectively (taken from AP-42 Section 13.2.5.3).

PERSONNEL COMMUTE-PM EMISSIONS FROM PAVED ROADS: Houston Lateral Pipeline Construction

Number of Roundtrips for 2012	2,630,075	Miles for 2012	(1)

Emissions = VMT roundtrip/trip * 'X' miles for the construction period / 2000

All Paved Roads			
Emissions (ton/year)	**PM2.5**	**PM10**	**PM30 (TSP)**
2012	0.19	1.91	12.15

All Paved Roads				Notes
Emission Factor	**PM2.5**	**PM10**	**PM30**	
lb/VMT	0.0001	0.0015	0.0092	(2)

From AP-42, Section 13.2.1 Paved Roads:

For all paved roads:

E={[k*((sL/2)^0.65)*((W/3)^1.5)] -C}*(1-P/4N)

where

E = size specific emission factor (lb/VMT)
k = particulate size multiplier
sL = road surface silt loading (g/m2)
W = mean vehicle weight (tons)
C = emission factor for 1980's vehicle fleet exhaust, brake wear, and tire wear.
P = number of wet days with at least 0.254 mm (0.01 in) of precipitation during the averaging period, and
N = number of days in the averaging period

Parameter	All Paved Roads 2010			Notes
	PM2.5	**PM10**	**PM30**	
k	0.004	0.016	0.082	(3)
sL	0.2	0.2	0.2	(4)
W	2.1	2.1	2.1	(5)
C	0.00036	0.00047	0.00047	(6)

NOTES:

(1) Number of personnel is assumed to be a constant during the entire construction schedule.
(2) Derived from equation, based on lb/VMT, P=120 from Figure 13.2.1-2, N=365
(3) From AP-42 Table 13.2-1.1 in lb/VMT.
(4) Silt content taken from AP-42 Table 13.2.1-3 for 500-5,000 ADT ubiquitous baseline.
(5) Average worker vehicle weight based on average car or light duty truck sold in the US last year 4,144 pounds from EPA. 4,144 pounds = 2.07 tons
(6) From AP-42 Table 13.2-1.2 in lb/VMT.

CONSTRUCTION EMISSIONS

Keystone XL Pipeline

BPA Marginal Ozone Nonattainment Area

Gulf Coast Main Segment

	2011 Construction Emissions: Pipeline Construction in BPA Nonattainment Area (tons)																
	HC	CO	NOx	SO2	TSP	PM10	PM2.5	CO2e	Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs	1,3-Butadiene	Formaldehyde	Acetaldehyde
CONSTRUCTION NONROAD	4.47	40.73	60.57	2.54	2.53	2.53	2.53	8,532.45	7.97E-02	3.49E-02	2.43E-02	2.20E-01	7.90E-03	1.44E-02	3.34E-03	1.01E-01	6.55E-02
CONSTRUCTION ONROAD	1.30	23.53	3.80	0.02	0.14	0.14	0.14	1,627.23	3.88E-02				7.88E-04		4.68E-03	1.51E-02	1.14E-02
OPEN BURNING	22.13	260.33	4.72	-	39.17	28.66	24.90	5,355.71									
FUGITIVE DUST					679.32	339.66	50.95										
PAVED ROAD DUST					11.90	1.87	0.18										
TOTAL	**27.90**	**324.58**	**69.09**	**2.56**	**733.05**	**372.86**	**78.70**	**15,515.39**	**1.19E-01**	**3.49E-02**	**2.43E-02**	**2.20E-01**	**8.69E-03**	**1.44E-02**	**8.02E-03**	**1.16E-01**	**7.69E-02**
Since the project is proposed to be located in an ozone nonattainment area, the pollutants of interest are HC (VOC) and NOx.																	

Pipeline Construction: Criteria Emissions from Non-Road Engines

Equipment	Daily Hours operated	Units per spread	Days for 2 BPA Counties (Jefferson + Hardin)	Units per spread	Days for 2 BPA Counties (Jefferson + Hardin)	Units per spread	Days for 2 BPA Counties (Jefferson + Hardin)	2011 TOTAL Hours	Equpt Horsepwr	Fuel Type	BSFC [1,a]	Criteria Pollutants EFss (g/hp-hr) [1,a]				TAF Assignment [2,b]	Load Factor [3]
		Pre-welding days (21 days)		Welding days (61 days)		Clean-up days (49 days)											
	hrs/eqpt/day							hrs	hp		lb/hp-hr	HC	CO	NOx	PM		
D-7 Dozer	8	12	20	12	57	7	69	11,262	240	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
D-8 Dozer	8	13	20	22	57	18	69	22,022	310	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59
D-8 Ripper	8	0	0	0	0	0	0	0	310	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59
D-5 Tow	8	0	20	2	57	2	69	2,010	120	Diesel	0.367	0.3384	0.8667	4.1	0.18	None	0.43
D-7 Tow	8	0	20	1	57	1	69	1,005	240	Diesel	0.367	0.3085	0.7475	4	0.13	None	0.43
D-6 Tack	8	3	20	3	57	3	69	3,502	200	Diesel	0.367	0.3085	0.7475	4	0.13	None	0.43
CAT 225	8	0	20	7	57	4	69	5,387	150	Diesel	0.367	0.3384	0.8667	4.1	0.18	Hi	0.59
CAT 235	8	0	20	26	57	15	69	20,088	250	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
CAT 235 w/ Hammer	8	0	0	1	0	0	0	0	260	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Bending Machine 22-36	8	0	20	1	57	0	69	456	159	Diesel	0.367	0.3384	0.8667	4.1	0.18	None	0.43
Crane LS-98A (35 ton)	8	0	0	2	0	0	0	0	230	Diesel	0.367	0.3085	0.7475	4	0.13	None	0.43
Farm Tractor	8	2	20	2	57	2	69	2,334	60	Diesel	0.408	0.3672	2.3655	4.7	0.24	Hi	0.59
Frontend Loader 977	8	2	20	2	57	2	69	2,334	190	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Motor Grader 14G	8	2	20	2	57	2	69	2,334	200	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Sideboom 571	8	0	20	1	57	0	69	456	200	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Sideboom 572	8	0	20	1	57	1	69	1,005	230	Diesel	0.367	0.3085	0.7475	4	0.13	Hi	0.59
Sideboom 583	8	0	20	22	57	4	69	12,227	310	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59
Sideboom 594	8	0	20	4	57	4	69	4,019	410	Diesel	0.367	0.1669	0.8425	4.355	0.13	Hi	0.59
Air Compressor 1750 cfm	8	0	20	9	57	1	69	4,653	50	Gasoline	0.484	0.27	11.94	0.69	0.06	None	0.56
Pump - 3"	8	0	20	1	57	1	69	1,005	20	Gasoline	0.868	5.5	387.02	4.5	0.06	None	0.69
Pump - 6"	8	0	20	9	57	9	69	9,043	40	Gasoline	0.484	0.27	11.94	0.69	0.06	None	0.69
Emergency Engines	8	0	20	9	57	2	69	5,202	10	Gasoline	0.868	5.5	387.02	4.5	0.06	None	0.68
TOTAL (Tons)																	

NOTES:

Notes 1 through 9 apply to diesel engines.

Note 1: Brake-specific fuel consumption and Zero hour steady state EF (EFss; g/hp-hr) assumed to be Tier 2 engines, from Table A2 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling-Compression-Ignition", April 2004, EPA-420-P-04-009.

Engine Size (HP)	HC	CO	NOx	PM	BSFC	M. Life
11	0.5508	4.1127	4.3	0.5	0.408	2500
16	0.438	2.161	4.4399	0.2665	0.408	2500
25	0.438	2.161	4.4399	0.2665	0.408	2500
50	0.2789	1.5323	4.7279	0.3389	0.408	4667
100	0.3672	2.3655	4.7	0.24	0.408	4667
175	0.3384	0.8667	4.1	0.18	0.367	4667
300	0.3085	0.7475	4	0.1316	0.367	7000
600	0.1669	0.8425	4.3551	0.1316	0.367	7000
750	0.1669	1.3272	4.1	0.1316	0.367	7000
2500	0.1669	0.7642	4.1	0.1316	0.367	7000

Note 2: Transient Adjustment Factors and TAF assignment and TAF from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.
Note 3: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.
Note 4: Median life is taken from Table 1 of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.
Note 5: Age factor and Deterioration factors calculated using Equation 4 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Age Factor = LF * cumulative hours / median life {Age factor is assumed to be greater than one, i.e. the equipment is approximately at the end of its useful life.

Deterioration Factor = 1 + (A * Age Factor^b), where b = 1 for desel engines and A is taken from Table A4 from source
Note 6: Adjusted Emission Factors for HC, NOx, and CO are calculated using Equation 1 (Table A4) from, "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009. Relative Deterioration factors for Tier II engines was used.

Adjusted EF = Efss * TAF * DF
Note 7: SO2 calculated from Equation 7 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

SO2=BSFC*453.6*(1-soxcnv)-HC)*0.01*soxdsl*2
where: soxcnv = 0.02247 and soxdsl = 0.05

Note 8: Adjusted Emission Factor for particulate matter is calculated using Equations 2 and 5 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Adjusted EF = Efss * TAF * DF - Spm adj
Spm adj = BSFC*453.6*7.0*soxcnv*0.01*(soxbas-soxdsl)
where: soxbas = 0.33

Note 9: Construction is proposed to occur between March 2012 and December 2012 approximately. Annual Emissions are calculated using the following calculation
(Emission factor (g/hp-hr) * horsepower * hours operated * load factor) / (2000 lb/ton * 453.6 g/lb)

Notes a through d apply to gasoline engines.

Note a: Fuel Type Gasoline only: Brake specific fuel consumption and emission factors (EFss; g/hp-hr) asssumed to be Phase 2 side-valved for < 25hp from Table 5 and Table 6 for > 25hp of "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019

Note b: Fuel Type Galosine only: Transient Adjsutment Factors assumed to be Phase 2 for >25 Hp (for <25Hp TAFs emission factors are based on unadjusted steady-state test results) from Table 20 of "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019.

Note c: Fuel Type Gasoline only: Deterioration Factors from Table 2 class 2 for <25 Hp of "Nonroad Spark-Ignition Engine Emission Deterioration Factors", December 2005, EPA420-R-05-023.

Fuel Type Gasoline only: Deterioration Factors from Table 7 for >25 Hp of "Nonroad Spark-Ignition Engine Emission Deterioration Factors", December 2005, EPA420-R-05-023.

Note d: Fuel Type Gasoline only: SO2 calculated from Sulfur Dioxide Emission Factor calculations from "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019.

SO2=BSFC*453.6*(1-soxcnv)-HC)*0.01*soxdsl*2
where: soxcnv = 0.03 and soxdsl = 0.0339

Pipeline Construction: Criteria Emissions from Non-Road Engines

Equipment	TAF [2,b]					$BSFC_{adj}$	Median Life [4]	Age Factor	"A" [5]				Deterioration factor [5,c]				Adjusted EF (g/hp-hr) [6]					2011 Emissions (tons) [9]				
	BSFC	HC	CO	NOx	PM		Hours		HC	CO	NOx	PM	HC	CO	NOx	PM	HC	CO	NOx	SO2 [7,d]	PM [8]	HC	CO	NOx	SO2	PM
D-7 Dozer	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.59	2.21	6.74	0.29	0.29
D-8 Dozer	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.181	1.419	4.175	0.164	0.164	0.80	6.30	18.53	0.73	0.73
D-8 Ripper	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.181	1.419	4.175	0.164	0.164	0.00	0.00	0.00	0.00	0.00
D-5 Tow	1.00	1.00	1.00	1.00	1.00	0.3670	4667	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.350	0.954	4.137	0.162	0.192	0.04	0.11	0.47	0.02	0.02
D-7 Tow	1.00	1.00	1.00	1.00	1.00	0.3670	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.319	0.823	4.036	0.162	0.121	0.04	0.09	0.46	0.02	0.01
D-6 Tack	1.00	1.00	1.00	1.00	1.00	0.3670	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.319	0.823	4.036	0.162	0.121	0.11	0.27	1.34	0.05	0.04
CAT 225	1.01	1.05	1.53	0.95	1.23	0.3707	4667	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.367	1.460	3.930	0.164	0.252	0.19	0.77	2.07	0.09	0.13
CAT 235	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	1.09	4.11	12.52	0.54	0.54
CAT 235 w/ Hammer	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.00	0.00	0.00	0.00	0.00
Bending Machine 22-36	1.00	1.00	1.00	1.00	1.00	0.3670	4667	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.350	0.954	4.137	0.162	0.192	0.01	0.03	0.14	0.01	0.01
Crane LS-98A (35 ton)	1.00	1.00	1.00	1.00	1.00	0.3670	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.319	0.823	4.036	0.162	0.121	0.00	0.00	0.00	0.00	0.00
Farm Tractor	1.01	1.05	1.53	0.95	1.23	0.4121	4667	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.399	3.985	4.505	0.182	0.353	0.04	0.36	0.41	0.02	0.03
Frontend Loader 977	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.10	0.36	1.11	0.05	0.05
Motor Grader 14G	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.10	0.38	1.16	0.05	0.05
Sideboom 571	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.02	0.07	0.23	0.01	0.01
Sideboom 572	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.05	0.19	0.58	0.02	0.02
Sideboom 583	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.181	1.419	4.175	0.164	0.164	0.45	3.50	10.29	0.40	0.41
Sideboom 594	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.181	1.419	4.175	0.164	0.164	0.19	1.52	4.47	0.18	0.18
Air Compressor 1750 cfm	1.00	1.00	1.00	1.00	1.00	0.4840	4667	> 1	-	-	-	-	0.640	0.360	0.150	0.260	0.173	4.298	0.104	0.144	0.016	0.02	0.62	0.01	0.02	0.00
Pump - 3"	1.00	1.00	1.00	1.00	1.00	0.8680	2500	> 1	-	-	-	-	1.935	0.887	0.000	1.935	#####	343.29	0.000	0.252	0.116	0.16	5.25	0.00	0.00	0.00
Pump - 6"	1.00	1.00	1.00	1.00	1.00	0.4840	4667	> 1	-	-	-	-	0.640	0.360	0.150	0.260	0.173	4.298	0.104	0.144	0.016	0.05	1.18	0.03	0.04	0.00
Emergency Engines	1.00	1.00	1.00	1.00	1.00	0.8680	2500	> 1	-	-	-	-	1.935	0.887	0.000	1.935	#####	343.29	0.000	0.252	0.116	0.41	13.38	0.00	0.01	0.00
TOTAL (Tons)																						**4.47**	**40.73**	**60.57**	**2.54**	**2.53**

Pipeline Construction: GHG Emissions from Non-Road Engines

Equipment	Daily Hours operated	2011 TOTAL Hours	Equipment HP	Fuel Type	BSFC	TAF Assign ment	Load Factor [2]	TAF [1] BSFC	$BSFC_{adj}$	Greenhouse Gases					2011 Emissions (Tons)			
										CO_2	CH_4		N2O					
	hrs/eqpt/day	hrs	hp		lb/hp-hr					g/hp-hr [3]	[4]	lb/hp-hr	Ef (g/gal) [4]	lb/hp-hr	CO_2	CH_4	N_2O	CO_2e [5]
D-7 Dozer	8	11,262	240	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	940.97	0.09	0.04	955.51
D-8 Dozer	8	22,022	310	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	2,378.71	0.23	0.10	2,415.42
D-8 Ripper	8	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00
D-5 Tow	8	2,010	120	Diesel	0.367	None	0.43	1	0.3670	529.92	0.58	6.66E-05	0.26	2.98E-05	60.57	0.01	0.00	61.86
D-7 Tow	8	1,005	240	Diesel	0.367	None	0.43	1	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	60.58	0.01	0.00	61.87
D-6 Tack	8	3,502	200	Diesel	0.367	None	0.43	1	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	175.94	0.02	0.01	179.67
CAT 225	8	5,387	150	Diesel	0.367	Hi	0.59	1.01	0.3707	535.17	0.58	6.72E-05	0.26	3.01E-05	281.26	0.03	0.01	285.60
CAT 235	8	20,088	250	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	1,748.28	0.17	0.08	1,775.28
CAT 235 w/ Hammer	8	0	260	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	0.00	0.00	0.00	0.00
Bending Machine 22-36	8	456	159	Diesel	0.367	None	0.43	1	0.3670	529.92	0.58	6.66E-05	0.26	2.98E-05	18.21	0.00	0.00	18.60
Crane LS-98A (35 ton)	8	0	230	Diesel	0.367	None	0.43	1	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	0.00	0.00	0.00	0.00
Farm Tractor	8	2,334	60	Diesel	0.408	Hi	0.59	1.01	0.4121	594.99	0.58	7.47E-05	0.26	3.35E-05	54.20	0.01	0.00	55.04
Frontend Loader 977	8	2,334	190	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	154.41	0.01	0.01	156.79
Motor Grader 14G	8	2,334	200	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	162.53	0.02	0.01	165.04
Sideboom 571	8	456	200	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	31.75	0.00	0.00	32.24
Sideboom 572	8	1,005	230	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	80.45	0.01	0.00	81.70
Sideboom 583	8	12,227	310	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	1,320.75	0.13	0.06	1,341.13
Sideboom 594	8	4,019	410	Diesel	0.367	Hi	0.59	1.01	0.3707	535.76	0.58	6.72E-05	0.26	3.01E-05	574.19	0.06	0.02	583.05
Air Compressor 1750 cfm	8	4,653	50	Gasoline	0.484	None	0.56	1	0.4840	699.77	0.50	7.57E-05	0.22	3.33E-05	100.49	0.01	0.00	101.88
Pump - 3"	8	1,005	20	Gasoline	0.868	None	0.69	1	0.8680	1222.00	0.50	1.36E-04	0.22	5.97E-05	18.68	0.00	0.00	18.89
Pump - 6"	8	9,043	40	Gasoline	0.484	None	0.69	1	0.4840	699.77	0.50	7.57E-05	0.22	3.33E-05	192.53	0.01	0.01	194.68
Emergency Engines	8	5,202	10	Gasoline	0.868	None	0.68	1	0.8680	1222.00	0.50	1.36E-04	0.22	5.97E-05	47.65	0.00	0.00	48.20
TOTAL (Tons)															**8,402.15**	**0.81**	**0.37**	**8,532.45**

NOTES:

Note 1: Transient Adjustment Factors and TAF assignment and from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Note 2: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.

Note 3: Carbon dioxide is calculated using Equation 6 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

CO2= ((BSFC*453.6) - HC) * 0.87 * (44/12)
HC is the hydrocarbon emission factor from criteria pollutant calculation,
0.87 is the mass fraction of carbon mass in diesel and
44/12 is the molecular weight ratio of CO2 to carbon

Note 4: Emission Factors from Table 13.6 of The Climate Registry General Reporting Protocol Version 1.0, tons calculated using 7.05 lb/gal from AP-42 Appendix A and adjusted BSFC

Note 5: Carbon dioxide equivalents calculated using IPCC Second Assessment Report (SAR) Global Warming Potentials CO2 = 1, CH4 = 21, N2O = 310.

CO2e= CO2 + (CH4 * 21) + (N2O * 310)

Pipeline Construction: HAP Emissions from Non-Road Engines

Equipment	Daily Hours operated hrs/eqpt/day	TOTAL HOURS hrs	Equipment Horsepower hp	Fuel Type	BSFC lb/hp-hr	TAF Assignment [1]	Load Factor [2]	BSFC TAF [1]	$BSFC_{adj}$	HAP Emission Factors (lb/MMBtu) [3]					
										Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs
D-7 Dozer	8	11,262	240	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-8 Dozer	8	22,022	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-8 Ripper	8	0	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-5 Tow	8	2,010	120	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-7 Tow	8	1,005	240	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
D-6 Tack	8	3,502	200	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 225	8	5,387	150	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 235	8	20,088	250	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
CAT 235 w/ Hammer	8	0	260	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Bending Machine 22-36	8	456	159	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Crane LS-98A (35 ton)	8	0	230	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Farm Tractor	8	2,334	60	Diesel	0.408	Hi	0.59	1.01	0.4121	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Frontend Loader 977	8	2,334	190	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Motor Grader 14G	8	2,334	200	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 571	8	456	200	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 572	8	1,005	230	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 583	8	12,227	310	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sideboom 594	8	4,019	410	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Air Compressor 1750 cfm	8	4,653	50	Gasoline	0.484	None	0.56	1	0.4840	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 3"	8	1,005	20	Gasoline	0.868	None	0.69	1	0.8680	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 6"	8	9,043	40	Gasoline	0.484	None	0.69	1	0.4840	N/A	N/A	N/A	N/A	N/A	N/A
Emergency Engines	8	5,202	10	Gasoline	0.868	None	0.68	1	0.8680	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL (Tons)															

NOTES:

Note 1: Transient Adjustment Factors and TAF assignment and from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Note 2: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005. TAF Assignment of Hi/Lo is based on the Load Factor.

Note 3: Emission factors (lb/MMBtu) from AP-42 Section 3.3, Table 3.3-2. Note that HAP emission factors for gasoline fired engines are not available.

Note 4: Tons are calculated using 7.05 lb/gal from AP-42 Appendix A and 5.825 MMBtu/barrel from Table 13.1 of The Climate Registry Genral Reporting Protocol version 1.0

Pipeline Construction: HAP Emissions from Non-Road Engines

Equipment	HAP Emission Factors (lb/MMBtu)[3]			2011 HAP Emissions (Tons)[4]								
	1,3-Butadiene	Formaldehyde	Acetaldehyde	Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs	1,3-Butadiene	Formaldehyde	Acetaldehyde
D-7 Dozer	3.91E-05	1.18E-03	7.67E-04	9.19E-03	4.03E-03	2.81E-03	2.54E-02	9.12E-04	1.66E-03	3.85E-04	1.16E-02	7.56E-03
D-8 Dozer	3.91E-05	1.18E-03	7.67E-04	2.32E-02	1.02E-02	7.09E-03	6.42E-02	2.30E-03	4.18E-03	9.73E-04	2.94E-02	1.91E-02
D-8 Ripper	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D-5 Tow	3.91E-05	1.18E-03	7.67E-04	8.12E-04	3.56E-04	2.48E-04	2.25E-03	8.05E-05	1.46E-04	3.40E-05	1.03E-03	6.68E-04
D-7 Tow	3.91E-05	1.18E-03	7.67E-04	8.12E-04	3.56E-04	2.48E-04	2.25E-03	8.05E-05	1.46E-04	3.40E-05	1.03E-03	6.68E-04
D-6 Tack	3.91E-05	1.18E-03	7.67E-04	2.36E-03	1.03E-03	7.21E-04	6.52E-03	2.34E-04	4.25E-04	9.88E-05	2.98E-03	1.94E-03
CAT 225	3.91E-05	1.18E-03	7.67E-04	2.75E-03	1.21E-03	8.40E-04	7.60E-03	2.73E-04	4.95E-04	1.15E-04	3.48E-03	2.26E-03
CAT 235	3.91E-05	1.18E-03	7.67E-04	1.71E-02	7.49E-03	5.22E-03	4.72E-02	1.69E-03	3.08E-03	7.16E-04	2.16E-02	1.40E-02
CAT 235 w/ Hammer	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bending Machine 22-36	3.91E-05	1.18E-03	7.67E-04	2.44E-04	1.07E-04	7.46E-05	6.75E-04	2.42E-05	4.40E-05	1.02E-05	3.09E-04	2.01E-04
Crane LS-98A (35 ton)	3.91E-05	1.18E-03	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Farm Tractor	3.91E-05	1.18E-03	7.67E-04	5.30E-04	2.32E-04	1.62E-04	1.46E-03	5.25E-05	9.54E-05	2.22E-05	6.70E-04	4.35E-04
Frontend Loader 977	3.91E-05	1.18E-03	7.67E-04	1.51E-03	6.61E-04	4.61E-04	4.17E-03	1.50E-04	2.72E-04	6.32E-05	1.91E-03	1.24E-03
Motor Grader 14G	3.91E-05	1.18E-03	7.67E-04	1.59E-03	6.96E-04	4.85E-04	4.39E-03	1.57E-04	2.86E-04	6.66E-05	2.01E-03	1.31E-03
Sideboom 571	3.91E-05	1.18E-03	7.67E-04	3.10E-04	1.36E-04	9.48E-05	8.58E-04	3.08E-05	5.59E-05	1.30E-05	3.92E-04	2.55E-04
Sideboom 572	3.91E-05	1.18E-03	7.67E-04	7.86E-04	3.45E-04	2.40E-04	2.17E-03	7.79E-05	1.42E-04	3.29E-05	9.94E-04	6.46E-04
Sideboom 583	3.91E-05	1.18E-03	7.67E-04	1.29E-02	5.65E-03	3.94E-03	3.57E-02	1.28E-03	2.32E-03	5.40E-04	1.63E-02	1.06E-02
Sideboom 594	3.91E-05	1.18E-03	7.67E-04	5.61E-03	2.46E-03	1.71E-03	1.55E-02	5.56E-04	1.01E-03	2.35E-04	7.09E-03	4.61E-03
Air Compressor 1750 cfm	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 3"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pump - 6"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Emergency Engines	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL (Tons)				**7.97E-02**	**3.49E-02**	**2.43E-02**	**2.20E-01**	**7.90E-03**	**1.44E-02**	**3.34E-03**	**1.01E-01**	**6.55E-02**

Pipeline Construction: Criteria and GHG Emissions from On-Road Vehicles

Equipment	Daily Hours operated hr/eqpt/day	Units per spread Pre-welding days (21 days)	Days for 2 BPA Counties (Jefferson + Hardin)	Units per spread Welding days (61 days)	Days for 2 BPA Counties (Jefferson + Hardin)	Units per spread Clean-up days (49 days)	Days for 2 BPA Counties (Jefferson + Hardin)	Vehicle Class [1]	2011 Miles traveled [2]	Fuel Type	Criteria Pollutants Emission Factor (g/VMT) [3] VOC	CO	NOx	SO_2	PM
Automobile	2	20	20	50	57	20	60	LDGV	222,300	Diesel	0.627	12.7	0.588	0.0068	0.0249
Bus	3	2	20	7	57	1	60	URBANBUS	37,433	Diesel	0.257	2.121	10.677	0.0218	0.226
Pickup 4x4	5	20	20	100	57	20	60	LDGV	912,000	Diesel	0.627	12.7	0.588	0.0068	0.0249
Welding Rig	10	0	20	30	57	5	60	LDGV	501,875	Diesel	0.627	12.7	0.588	0.0068	0.0249
Winch Truck	8	3	20	3	57		60	HDDV3	46,380	Diesel	0.16	0.541	2.319	0.0082	0.0848
Dump Truck	8	1	20	1	57	1	60	HDDV3	27,360	Diesel	0.16	0.541	2.319	0.0082	0.0848
Flatbed Truck	9	1	20	8	57	2	60	HDDV3	133,943	Diesel	0.16	0.541	2.319	0.0082	0.0848
Fuel Truck	10	1	20	2	57	2	60	HDDV3	63,325	Diesel	0.16	0.541	2.319	0.0082	0.0848
Grease Truck	10	1	20	1	57	1	60	HDDV3	34,200	Diesel	0.16	0.541	2.319	0.0082	0.0848
Mechanic Rig	10	1	20	1	57	1	60	HDDV2B	34,200	Diesel	0.149	0.508	2.182	0.0074	0.0966
Skid Truck	10	1	20	1	57	0	60	HDDV3	19,325	Diesel	0.16	0.541	2.319	0.0082	0.0848
Stringing Tr.& Tr.	10	0	20	15	57	0	60	HDDV3	213,750	Diesel	0.16	0.541	2.319	0.0082	0.0848
Tuck.& Float	10	0	20	9	57	5	60	HDDV3	202,625	Diesel	0.16	0.541	2.319	0.0082	0.0848
Truck & Lowboy	10	5	20	5	57	2	60	HDDV3	126,375	Diesel	0.16	0.541	2.319	0.0082	0.0848
TOTAL (Tons)															

NOTES:

Note 1: Vehicle Classes were taken from Mobile6.2 based on estimated gross weight of the vehicle.

Note 2: Vehicle miles traveled are based on an assumed 25 mi/hr on average/ vehicle based on arterial roads.

Note 3: Emission factors from Mobile6.2.

Note 4: Emission Factors from Table 13.4 of The Climate Registry General Reporting Protocol Version 1.1 applicable to "Diesel Heavy Duty Vehicles" all model year vehicles.
Note that Efs applicable to light duty gasoline vehicles was used for the vehicle category "automobiles" (MY 2000).

Note 5: Carbon dioxide equivalents calculated using IPCC Second Assessment Report (SAR) Global Warming Potentials CO2 = 1, CH4 = 21, N2O = 310.
CO2e= CO2 + (CH4 * 21) + (N2O * 310)

Pipeline Construction: Criteria and GHG Emissions from On-Road Vehicles

Equipment	Greenhouse Gasses Ef (g/mile)			2011 Emissions (Tons)								
				Criteria Pollutants					Greenhouse Gases			
	CO_2 [3]	CH_4 [4]	N_2O [4]	VOC	CO	NOx	SO_2	PM	CO_2	CH_4	N_2O	CO_2e [5]
Automobile	368.1	0.0273	0.0178	0.1536	3.1121	0.1441	0.0017	0.01	90.20	6.69E-03	4.36E-03	91.69
Bus	2342.9	0.0051	0.0048	0.0106	0.0875	0.4406	0.0009	0.01	96.67	2.10E-04	1.98E-04	96.74
Pickup 4x4	368.1	0.0273	0.0178	0.6303	12.7674	0.5911	0.0068	0.03	370.05	2.74E-02	1.79E-02	376.18
Welding Rig	368.1	0.0273	0.0178	0.3469	7.0259	0.3253	0.0038	0.01	203.64	1.51E-02	9.85E-03	207.01
Winch Truck	875.4	0.0051	0.0048	0.0082	0.0277	0.1186	0.0004	0.00	44.76	2.61E-04	2.45E-04	44.84
Dump Truck	875.4	0.0051	0.0048	0.0048	0.0163	0.0699	0.0002	0.00	26.40	1.54E-04	1.45E-04	26.45
Flatbed Truck	875.4	0.0051	0.0048	0.0236	0.0799	0.3424	0.0012	0.01	129.25	7.53E-04	7.09E-04	129.49
Fuel Truck	875.4	0.0051	0.0048	0.0112	0.0378	0.1619	0.0006	0.01	61.11	3.56E-04	3.35E-04	61.22
Grease Truck	875.4	0.0051	0.0048	0.0060	0.0204	0.0874	0.0003	0.00	33.00	1.92E-04	1.81E-04	33.06
Mechanic Rig	789.4	0.0051	0.0048	0.0056	0.0192	0.0823	0.0003	0.00	29.76	1.92E-04	1.81E-04	29.82
Skid Truck	875.4	0.0051	0.0048	0.0034	0.0115	0.0494	0.0002	0.00	18.65	1.09E-04	1.02E-04	18.68
Stringing Tr.& Tr.	875.4	0.0051	0.0048	0.0377	0.1275	0.5464	0.0019	0.02	206.26	1.20E-03	1.13E-03	206.64
Tuck.& Float	875.4	0.0051	0.0048	0.0357	0.1208	0.5180	0.0018	0.02	195.53	1.14E-03	1.07E-03	195.88
Truck & Lowboy	875.4	0.0051	0.0048	0.0223	0.0754	0.3230	0.0011	0.01	121.95	7.10E-04	6.69E-04	122.17
TOTAL (Tons)				**1.300**	**23.529**	**3.800**	**0.021**	**0.139**	**1627.23**	**5.45E-02**	**3.71E-02**	**1639.86**

Pipeline Construction: HAP Emissions from On-Road Vehicles

Equipment	Daily Hours operated	Vehicle Class [1]	2011 Miles traveled/year [2]	Fuel Type	Hazardous Air Pollutants Emission Factor (mg/VMT) [3]				
	hr/eqpt/day		miles/yr		Acetaldehyde	Acrolein	Benzene	1,3-butadiene	Formaldehyde
Automobile	2	LDGV	222,300	Diesel	4.04	0.24	16.45	2.04	4.51
Bus	3	URBANBUS	37,433	Diesel	7.75	0.94	2.83	1.64	21.05
Pickup 4x4	5	LDGV	912,000	Diesel	4.04	0.24	16.45	2.04	4.51
Welding Rig	10	LDGV	501,875	Diesel	4.04	0.24	16.45	2.04	4.51
Winch Truck	8	HDDV3	46,380	Diesel	3.78	0.32	9.09	0.94	6.11
Dump Truck	8	HDDV3	27,360	Diesel	3.78	0.32	9.09	0.94	6.11
Flatbed Truck	9	HDDV3	133,943	Diesel	3.78	0.32	9.09	0.94	6.11
Fuel Truck	10	HDDV3	63,325	Diesel	3.78	0.32	9.09	0.94	6.11
Grease Truck	10	HDDV3	34,200	Diesel	3.78	0.32	9.09	0.94	6.11
Mechanic Rig	10	HDDV2B	34,200	Diesel	3.74	0.29	9.34	0.89	5.92
Skid Truck	10	HDDV3	19,325	Diesel	3.78	0.32	9.09	0.94	6.11
Stringing Tr.& Tr.	10	HDDV3	213,750	Diesel	3.78	0.32	9.09	0.94	6.11
Tuck.& Float	10	HDDV3	202,625	Diesel	3.78	0.32	9.09	0.94	6.11
Truck & Lowboy	10	HDDV3	126,375	Diesel	3.78	0.32	9.09	0.94	6.11
TOTAL (Tons)									

NOTES:

Note 1: Vehicle Classes were taken from Mobile6.2 based on estimated gross weight of the vehicle.

Note 2: Vehicle miles traveled are based on an assumed 25 mi/hr on average/ vehicle based on arterial roads.

Note 3: HAP Emission factors taken from Mobile6.2

Pipeline Construction: HAP Emissions from On-Road Vehicles

Equipment	Hazardous Air Pollutants 2011 Emissions (Tons)				
	Acetaldehyde	**Acrolein**	**Benzene**	**1,3-butadiene**	**Formaldehyde**
Automobile	9.90E-04	5.88E-05	4.03E-03	5.00E-04	1.11E-03
Bus	3.20E-04	3.88E-05	1.17E-04	6.77E-05	8.69E-04
Pickup 4x4	4.06E-03	2.41E-04	1.65E-02	2.05E-03	4.53E-03
Welding Rig	2.23E-03	1.33E-04	9.10E-03	1.13E-03	2.49E-03
Winch Truck	1.93E-04	1.64E-05	4.65E-04	4.81E-05	3.12E-04
Dump Truck	1.14E-04	9.65E-06	2.74E-04	2.83E-05	1.84E-04
Flatbed Truck	5.58E-04	4.72E-05	1.34E-03	1.39E-04	9.02E-04
Fuel Truck	2.64E-04	2.23E-05	6.35E-04	6.56E-05	4.26E-04
Grease Truck	1.43E-04	1.21E-05	3.43E-04	3.54E-05	2.30E-04
Mechanic Rig	1.41E-04	1.09E-05	3.52E-04	3.36E-05	2.23E-04
Skid Truck	8.05E-05	6.82E-06	1.94E-04	2.00E-05	1.30E-04
Stringing Tr.& Tr.	8.91E-04	7.54E-05	2.14E-03	2.21E-04	1.44E-03
Tuck.& Float	8.44E-04	7.15E-05	2.03E-03	2.10E-04	1.36E-03
Truck & Lowboy	5.27E-04	4.46E-05	1.27E-03	1.31E-04	8.51E-04
TOTAL (Tons)	**0.0114**	**0.0008**	**0.0388**	**0.0047**	**0.0151**

Pipeline Construction: Emissions from Slash/Brush Burning

Volume and Area of Prescribed Burning			
1 cu. Yd.	=	0.00062	acre-foot
1654385 cu. yd.	=	1025.72	acre-foot
Area disturbed/ burned	=	683.81	acre

Vegetation Type Distribution			
Tree Tops/Stumps	=	50%	(a)
Hay/Gass	=	50%	(a)

Fuel Load Emission Factor			
Hay/grass	=	1.0	ton/acre (b)
Tree Tops and Stumps	=	9.0	ton/acre (c)

Weight of Wood/Hay Burned			
Hay/grass	=	341.91	tons
Tree Tops and Stumps	=	3,077.16	tons

Emission factors for wildfire, prescribed burning and slash burns calculated under dry conditions for each fuel component (d)										
Fuel Component	Emission factor (lb/ton)									
	% of total Vegetation	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2	NO_x	NH_3
Litter, Wood 0-1"	25%	52	3	6	15	8	9	3483	2.5	0.5
Wood 1-3"	25%	111	6	9	20	12	14	3373	2.5	1.1
Wood 3+"	25%	174	9	12	26	16	19	3263	2.5	1.7
Herb, Shrub	25%	249	12	16	33	21	25	3116	2.5	2.6

Emission from prescribed wood burning									
Fuel Component	Emissions (tons)								
	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2	NO_x	NH_3
Litter, Wood 0-1"	20.00	1.15	2.31	5.77	3.08	3.46	1339.72	0.96	0.19
Wood 1-3"	42.70	2.31	3.46	7.69	4.62	5.39	1297.41	0.96	0.42
Wood 3+"	66.93	3.46	4.62	10.00	6.15	7.31	1255.10	0.96	0.65
Herb, Shrub	95.78	4.62	6.15	12.69	8.08	9.62	1198.55	0.96	1.00
TOTAL	**225.40**	**11.54**	**16.54**	**36.16**	**21.92**	**25.77**	**5090.77**	**3.85**	**2.27**

Emission factors for crop residue burning [e]									
Crop Residue	Emission factor (lb/ton)								
	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2 [f]	NO_x	NH_3
Hay/Grasses	204.3	6.3	32.7	17.6	17.4	16.9	-	5.1	6.7

Emissions from crop residue burning									
Crop Residue	Emissions (tons)								
	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2	NO_x	NH_3
Hay/Grasses	34.93	1.08	5.59	3.01	2.97	2.89	-	0.87	1.15

Emissions from prescribed burning and crop residue burning									
	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2	NO_x	NH_3
TOTAL	**260.33**	**12.62**	**22.13**	**39.17**	**24.90**	**28.66**	**5,090.77**	**4.72**	**3.41**

NOTES:

(a) Taken from http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_mp_e0100_1070n_08.pdf.

(b)Taken from Table 5 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(c) Fuel loading value of tree tops and stumps taken from AP-42 Table 13.1-1. Value applicable to southern region (Region 8) were used.

(d) Taken from Table 2 and 3 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(e)Taken from Table 6 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(f) Emission factor of CO_2 for hay/grass burning was not available.

PM EMISSIONS FROM LAND DISTURBED: Pipeline

2011 Activities		
Area Name:	**Pipeline**	
Area of Land Disturbance over the total months of construction (acres):	566.1	
Months of Construction Activity (May-September 2011) [(1)]:	5	
	total tons [(2)]	tons/month
PM2.5	50.9	10.2
PM10	339.7	67.9
PM30	679.3	135.9

	Heavy Construction Operations			Notes
Factor	**PM2.5**	**PM10**	**PM30**	
tons/acre/month	0.09	0.60	1.20	(3)
From AP-42, Section 13.2.3 Heavy Construction Operations: For construction activity operations: **E = 1.2 tons/acre/month of activity**				

NOTES:

(1) Construction is projected to occur over 5 months.

(2) Total tons is for entire construction duration, which is expected to be over an 5 month period. PM2.5 is particulate matter less than 2.5 microns. PM10 is particulate matter less than 10 microns. PM30 is particulate matter less than 30 microns.

(3) From AP-42 Section 13.2.3.3. Note that a factor of 1.2 ton/acre/month is conservatively high for TSP since it assumes that construction occurs over 30 days of the month which is not true in this case. Particle size multiplier (k) of 0.5 and 0.075 were used to determine the fraction of PM10 and PM2.5, respectively (taken from AP-42 Section 13.2.5.3).

PERSONNEL COMMUTE-PM EMISSIONS FROM PAVED ROADS: Pipeline

Worker Vehicle Emissions

Number of Roundtrips for 2011	2,575,090	miles for 2011	(1)

Emissions = VMT roundtrip/trip * 'X' trips for the construction period / 2000

All Paved Roads			
Emissions (ton/year)	**PM2.5**	**PM10**	**PM30 (TSP)**
2011	0.18	1.87	11.90

All Paved Roads				Notes
Emission Factor	**PM2.5**	**PM10**	**PM30**	
lb/VMT	0.0001	0.0015	0.0092	(2)

From AP-42, Section 13.2.1 Paved Roads:

For all paved roads:

E={[k*((sL/2)^0.65)*((W/3)^1.5)] -C}*(1-P/4N)

where

E = size specific emission factor (lb/VMT)
k = particulate size multiplier
sL = road surface silt loading (g/m2)
W = mean vehicle weight (tons)
C = emission factor for 1980's vehicle fleet exhaust, brake wear, and tire wear.
P = number of wet days with at least 0.254 mm (0.01 in) of precipitation during the averaging period, and
N = number of days in the averaging period

Parameter	All Paved Roads 2011			Notes
	PM2.5	**PM10**	**PM30**	
k	0.004	0.016	0.082	(3)
sL	0.2	0.2	0.2	(4)
W	2.1	2.1	2.1	(5)
C	0.00036	0.00047	0.00047	(6)

NOTES:

(1) Number of personnel is assumed to be a constant during the entire construction schedule.
(2) Derived from equation, based on lb/VMT, P=120 from Figure 13.2.1-2, N=365
(3) From AP-42 Table 13.2-1.1 in lb/VMT.
(4) Silt content taken from AP-42 Table 13.2.1-3 for 500-5,000 ADT ubiquitous baseline.
(5) Average worker vehicle weight based on average car or light duty truck sold in the US last year 4,144 pounds from EPA. 4,144 pounds = 2.07 tons
(6) From AP-42 Table 13.2-1.2 in lb/VMT.

CONSTRUCTION EMISSIONS

Surge Tank

BPA Moderate Ozone Nonattainment Area

	2011 Construction Emissions: Surge Tank in the BPA Nonattainment Area (tons)																
	HC	CO	NOx	SO2	TSP	PM10	PM2.5	CO2e	Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs	1,3-Butadiene	Formaldehyde	Acetaldehyde
CONSTRUCTION NONROAD	7.68	306.05	5.51	0.54	0.30	0.30	0.30	2474.914729	2.94E-02	1.29E-02	8.97E-03	8.12E-02	2.91E-03	5.29E-03	1.23E-03	3.71E-02	2.41E-02
CONSTRUCTION ONROAD	0.15	2.96	0.14	0.00	0.01	0.01	0.01	85.72	3.83E-03				5.59E-05		4.75E-04	1.05E-03	9.41E-04
OPEN BURNING	0.16	1.90	0.03	-	0.29	0.21	0.18	39.16									
FUGITIVE DUST					6.00	3.00	0.45										
PAVED ROAD DUST					0.98	0.15	0.01										
TOTAL	**7.98**	**310.91**	**5.69**	**0.54**	**7.57**	**3.67**	**0.96**	**2,599.79**	**3.32E-02**	**1.29E-02**	**8.97E-03**	**8.12E-02**	**2.97E-03**	**5.29E-03**	**1.71E-03**	**3.82E-02**	**2.51E-02**
Since the project is proposed to be located in an ozone nonattainment area, the pollutants of interest are HC (VOC) and NOx.																	

Surge Tanks Construction: Criteria Emissions from Non-Road Engines

Equipment	Daily Hours operated	2011 TOTAL Hours	Equpt Horsepwr	Fuel Type	BSFC [1,a]	Criteria Pollutants EFss (g/hp-hr) [1,a]				TAF Assignment [2,b]	Load Factor [3]	TAF [2,b]					$BSFC_{adj}$	Median Life [4]	Age Factor [5]
	hrs/eqpt/day	hrs	hp		lb/hp-hr	HC	CO	NOx	PM			BSFC	HC	CO	NOx	PM		Hours	
Generator	10	1,200	500	Gasoline	0.367	5.5	387.02	4.5	0.06		0.68	0.87	1.00	1.00	1.00	1.00	0.3186	7000	
Pump	10	1,100	700	Gasoline	0.367	5.5	387.02	4.5	0.06		0.69	0.87	1.00	1.00	1.00	1.00	0.3186	7000	
Gas Cut Off Saw	10	1,100	310	Gasoline	0.367	5.5	387.02	4.5	0.06		0.78	0.87	1.00	1.00	1.00	1.00	0.3186	7000	
Tractor Trailers	10	550	200	Diesel	0.367	0.3085	0.7475	4	0.1316	Hi	0.59	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1
Bulldozer	10	900	100	Diesel	0.367	0.3672	2.3655	4.7	0.24	Hi	0.59	1.01	1.05	1.53	0.95	1.23	0.3707	4667	> 1
Backhoe	10	1,100	200	Diesel	0.367	0.3085	0.7475	4	0.1316	Lo	0.21	1.18	2.29	2.57	1.10	1.97	0.4331	7000	> 1
Sheeps Foot Roller	10	700	200	Diesel	0.367	0.3085	0.7475	4	0.1316	Hi	0.59	1.01	1.05	1.53	0.95	1.23	0.3707	7000	> 1
Scraper	10	700	100	Diesel	0.367	0.3672	2.3655	4.7	0.24	Hi	0.59	1.01	1.05	1.53	0.95	1.23	0.3707	4667	> 1
Track Hoe	10	400	300	Diesel	0.367	0.3085	0.7475	4	0.1316	Lo	0.21	1.18	2.29	2.57	1.10	1.97	0.4331	7000	> 1
Tamper/compactor	10	1,100	400	Diesel	0.367	0.1669	0.8425	4.3551	0.1316	None	0.43	1.00	1.00	1.00	1.00	1.00	0.3670	7000	> 1
Drilling Rig	10	150	100	Diesel	0.367	0.3672	2.3655	4.7	0.24	None	0.43	1.00	1.00	1.00	1.00	1.00	0.3670	4667	> 1
Welding machine	10	400	40	Diesel	0.408	0.2789	1.5323	4.7279	0.3389	Lo	0.21	1.18	2.29	2.57	1.10	1.97	0.4814	4667	> 1
Forklift	10	600	9	Diesel	0.408	0.5508	4.1127	4.3	0.5	Hi	0.59	1.01	1.05	1.53	0.95	1.23	0.4121	2500	> 1
Plate Compactor	10	1,100	5	Diesel	0.408	0.5508	4.1127	4.3	0.5	None	0.49	1.00	1.00	1.00	1.00	1.00	0.4080	2500	> 1
Mixers	10	200	300	Diesel	0.367	0.3085	0.7475	4	0.1316	None	0.43	1.00	1.00	1.00	1.00	1.00	0.3670	7000	> 1
Pressure Washer	10	200	24	Diesel	0.408	0.438	2.161	4.4399	0.2665	None	0.43	1.00	1.00	1.00	1.00	1.00	0.4080	2500	> 1
RT Crane 35 tn	10	1,100	250	Diesel	0.367	0.3085	0.7475	4	0.1316	None	0.43	1.00	1.00	1.00	1.00	1.00	0.3670	7000	> 1
RT Crane 50 tn	10	300	300	Diesel	0.367	0.3085	0.7475	4	0.1316	None	0.43	1.00	1.00	1.00	1.00	1.00	0.3670	7000	> 1
Welding Rig	10	2,500	55	Diesel	0.484	0.3672	2.3655	4.7	0.24	Lo	0.21	1.00	1.00	1.00	1.00	1.00	0.4840	4667	> 1
Skid Steer	10	1,100	99	Diesel	0.868	0.3672	2.3655	4.7	0.24	Lo	0.21	1.00	1.00	1.00	1.00	1.00	0.8680	4667	> 1
Smooth Drum Roller	10	200	85	Diesel	0.484	0.3672	2.3655	4.7	0.24	Hi	0.59	1.00	1.00	1.00	1.00	1.00	0.4840	4667	> 1
Boom Lift	10	2,550	410	Diesel	0.868	0.1669	0.8425	4.3551	0.1316	Lo	0.21	1.00	1.00	1.00	1.00	1.00	0.8680	7000	> 1
TOTAL (Tons)																			

NOTES:

Notes 1 through 9 apply to diesel engines.

Note 1: Brake-specific fuel consumption and Zero hour steady state EF (EFss; g/hp-hr) assumed to be Tier 2 engines, from Table A2 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling-Compression-Ignition", April 2004, EPA-420-P-04-009.

Engine Size (HP)		HC	CO	NOx	PM	BSFC	Median Life
1	**11**	0.5508	4.1127	4.3	0.5	0.408	2500
12	**16**	0.438	2.161	4.4399	0.2665	0.408	2500
17	**25**	0.438	2.161	4.4399	0.2665	0.408	2500
26	**50**	0.2789	1.5323	4.7279	0.3389	0.408	4667
51	**100**	0.3672	2.3655	4.7	0.24	0.408	4667
101	**175**	0.3384	0.8667	4.1	0.18	0.367	4667
176	**300**	0.3085	0.7475	4	0.1316	0.367	7000
301	**600**	0.1669	0.8425	4.3551	0.1316	0.367	7000
601	**750**	0.1669	1.3272	4.1	0.1316	0.367	7000
751	**2500**	0.1669	0.7642	4.1	0.1316	0.367	7000

Note 2: Transient Adjustment Factors and TAF assignment and TAF from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.
Note 3: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.
Note 4: Median life is taken from Table 1 of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.
Note 5: Age factor and Deterioration factors calculated using Equation 4 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Age Factor = LF * cumulative hours / median life {Age factor is assumed to be greater than one, i.e. the equipment is approximately at the end of its useful life.

Deterioration Factor = 1 + (A * Age Factor^b), where b = 1 for desel engines and A is taken from Table A4 from source

Note 6: Adjusted Emission Factors for HC, NOx, and CO are calculated using Equation 1 (Table A4) from, "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009. Relative Deterioration factors for Tier II engines was used.

Adjusted EF = Efss * TAF * DF

Note 7: SO2 calculated from Equation 7 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

SO2=BSFC*453.6*(1-soxcnv)-HC)*0.01*soxdsl*2

where: soxcnv = 0.02247 and soxdsl = 0.05

Note 8: Adjusted Emission Factor for particulate matter is calculated using Equations 2 and 5 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Adjusted EF = Efss * TAF * DF - Spm adj

Spm adj = BSFC*453.6*7.0*soxcnv*0.01*(soxbas-soxdsl)

where: soxbas = 0.33

Note 9: Construction is proposed to occur between March 2012 and December 2012 approximately. Annual Emissions are calculated using the following calculation

(Emission factor (g/hp-hr) * horsepower * hours operated * load factor) / (2000 lb/ton * 453.6 g/lb)

Notes a through d apply to gasoline engines.

Note a: Fuel Type Gasoline only: Brake specific fuel consumption and emission factors (EFss; g/hp-hr) asssumed to be Phase 2 side-valved for < 25hp from Table 5 and Table 6 for > 25hp of "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019

Note b: Fuel Type Galosine only: Transient Adjsutment Factors assumed to be Phase 2 for >25 Hp (for <25Hp TAFs emission factors are based on unadjusted steady-state test results) from Table 20 of "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019.

Note c: Fuel Type Gasoline only: Deterioration Factors from Table 2 (Phase 2-Side valved) for <25 Hp of "Nonroad Spark-Ignition Engine Emission Deterioration Factors", December 2005, EPA420-R-05-023.

Fuel Type Gasoline only: Deterioration Factors from Table 7 for >25 Hp of "Nonroad Spark-Ignition Engine Emission Deterioration Factors", December 2005, EPA420-R-05-023.

Note d: Fuel Type Gasoline only: SO2 calculated from Sulfur Dioxide Emission Factor calculations from "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019.

SO2=BSFC*453.6*(1-soxcnv)-HC)*0.01*soxdsl*2

where: soxcnv = 0.03 and soxdsl = 0.0339

Surge Tanks Construction: Criteria Emissions from Non-Road Engines

Equipment	"A" [5]				Deterioration factor [5,c]				Adjusted EF (g/hp-hr) [6]					2011 Emissions (tons) [9]				
	HC	CO	NOx	PM	HC	CO	NOx	PM	HC	CO	NOx	SO2 [7,d]	PM [8]	HC	CO	NOx	SO2	PM
Generator					0.640	0.360	0.150	0.260	3.520	139.3	0.675	0.093	0.016	2.47	62.66	2.02	0.11	0.03
Pump					1.935	0.887	0.000	1.935	10.643	343.3	0.000	0.088	0.116	3.22	201.05	0.00	0.15	0.04
Gas Cut Off Saw					0.640	0.360	0.150	0.260	3.520	139.3	0.675	0.093	0.016	1.61	40.85	0.20	0.07	0.02
Tractor Trailers	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.02	0.09	0.27	0.01	0.01
Bulldozer	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.399	3.985	4.505	0.164	0.361	0.02	0.23	0.26	0.01	0.02
Backhoe	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.730	2.115	4.440	0.191	0.295	0.04	0.11	0.23	0.01	0.02
Sheeps Foot Roller	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.335	1.259	3.834	0.164	0.164	0.03	0.11	0.35	0.01	0.01
Scraper	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.399	3.985	4.505	0.164	0.361	0.02	0.18	0.21	0.01	0.02
Track Hoe	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.730	2.115	4.440	0.191	0.295	0.02	0.06	0.12	0.01	0.01
Tamper/compactor	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.173	0.928	4.394	0.163	0.121	0.04	0.19	0.92	0.03	0.03
Drilling Rig	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.380	2.604	4.742	0.162	0.280	0.00	0.02	0.03	0.00	0.00
Welding machine	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.660	4.336	5.247	0.213	0.887	0.00	0.02	0.02	0.00	0.00
Forklift	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.598	6.928	4.122	0.182	0.824	0.00	0.02	0.01	0.00	0.00
Plate Compactor	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.570	4.528	4.339	0.180	0.655	0.00	0.01	0.01	0.00	0.00
Mixers	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.319	0.823	4.036	0.162	0.121	0.01	0.02	0.11	0.00	0.00
Pressure Washer	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.453	2.379	4.480	0.180	0.311	0.00	0.01	0.01	0.00	0.00
RT Crane 35 tn	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.319	0.823	4.036	0.162	0.121	0.04	0.11	0.53	0.02	0.02
RT Crane 50 tn	0.034	0.101	0.009	0.473	1.034	1.101	1.009	1.473	0.319	0.823	4.036	0.162	0.121	0.01	0.04	0.17	0.01	0.01
Welding Rig	0.034	0.101	0.009	0.473	0.640	0.360	0.150	0.260	0.235	0.852	0.705	0.144	0.062	0.01	0.03	0.02	0.00	0.00
Skid Steer	0.034	0.101	0.009	0.473	1.935	0.887	0.000	1.935	0.711	2.10	0.000	0.258	0.464	0.02	0.05	0.00	0.01	0.01
Smooth Drum Roller	0.034	0.101	0.009	0.473	0.640	0.360	0.150	0.260	0.235	0.852	0.705	0.144	0.062	0.00	0.01	0.01	0.00	0.00
Boom Lift	0.034	0.101	0.009	0.473	1.935	0.887	0.000	1.935	0.323	0.747	0.000	0.259	0.255	0.08	0.18	0.00	0.06	0.06
TOTAL (Tons)														**7.68**	**306.05**	**5.51**	**0.54**	**0.30**

NOTES:

Notes 1 through 9 apply to diesel engines.

Note 1: Brake-specific fuel consumption and Zero hour steady state EF (EFss; g/hp-hr) assumed to be Tier 2 engines, from Table A2 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling-Compression-Ignition", April 2004, EPA-420-P-04-009.

Engine Size (HP)		HC	CO	NOx	PM	BSFC	Median Life
1	**11**	0.5508	4.1127	4.3	0.5	0.408	2500
12	**16**	0.438	2.161	4.4399	0.2665	0.408	2500
17	**25**	0.438	2.161	4.4399	0.2665	0.408	2500
26	**50**	0.2789	1.5323	4.7279	0.3389	0.408	4667
51	**100**	0.3672	2.3655	4.7	0.24	0.408	4667
101	**175**	0.3384	0.8667	4.1	0.18	0.367	4667
176	**300**	0.3085	0.7475	4	0.1316	0.367	7000
301	**600**	0.1669	0.8425	4.3551	0.1316	0.367	7000
601	**750**	0.1669	1.3272	4.1	0.1316	0.367	7000
751	**2500**	0.1669	0.7642	4.1	0.1316	0.367	7000

Note 2: Transient Adjustment Factors and TAF assignment and TAF from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.
Note 3: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.
Note 4: Median life is taken from Table 1 of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.
Note 5: Age factor and Deterioration factors calculated using Equation 4 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Age Factor = LF * cumulative hours / median life {Age factor is assumed to be greater than one, i.e. the equipment is approximately at the end of its useful life.

Deterioration Factor = 1 + (A * Age Factor^b), where b = 1 for desel engines and A is taken from Table A4 from source

Note 6: Adjusted Emission Factors for HC, NOx, and CO are calculated using Equation 1 (Table A4) from, "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009. Relative Deterioration factors for Tier II engines was used.

Adjusted EF = Efss * TAF * DF

Note 7: SO2 calculated from Equation 7 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

SO2=BSFC*453.6*(1-soxcnv)-HC)*0.01*soxdsl*2

where: soxcnv = 0.02247 and soxdsl = 0.05

Note 8: Adjusted Emission Factor for particulate matter is calculated using Equations 2 and 5 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-42(

Adjusted EF = Efss * TAF * DF - Spm adj

Spm adj = BSFC*453.6*7.0*soxcnv*0.01*(soxbas-soxdsl)

where: soxbas = 0.33

Note 9: Construction is proposed to occur between March 2012 and December 2012 approximately. Annual Emissions are calculated using the following calculation

(Emission factor (g/hp-hr) * horsepower * hours operated * load factor) / (2000 lb/ton * 453.6 g/lb)

Notes a through d apply to gasoline engines.

Note a: Fuel Type Gasoline only: Brake specific fuel consumption and emission factors (EFss; g/hp-hr) asssumed to be Phase 2 side-valved for < 25hp from Table 5 and Table 6 for > 25hp of "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019

Note b: Fuel Type Galosine only: Transient Adjsutment Factors assumed to be Phase 2 for >25 Hp (for <25Hp TAFs emission factors are based on unadjusted steady-state test results) from Table 20 of "Exhaust Emiss Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019.

Note c: Fuel Type Gasoline only: Deterioration Factors from Table 2 (Phase 2-Side valved) for <25 Hp of "Nonroad Spark-Ignition Engine Emission Deterioration Factors", December 2005, EPA420-R-05-023.

Fuel Type Gasoline only: Deterioration Factors from Table 7 for >25 Hp of "Nonroad Spark-Ignition Engine Emission Deterioration Factors", December 2005, EPA420-R-05-023.

Note d: Fuel Type Gasoline only: SO2 calculated from Sulfur Dioxide Emission Factor calculations from "Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition", December 2005, EPA420-R-05-019.

SO2=BSFC*453.6*(1-soxcnv)-HC)*0.01*soxdsl*2

where: soxcnv = 0.03 and soxdsl = 0.0339

Surge Tanks Construction: GHG Emissions from Non-Road Engines

Equipment	Daily Hours operated	2011 TOTAL Hours	Equipment HP	Fuel Type	BSFC	TAF Assignment	Load Factor [2]	TAF [1] BSFC	$BSFC_{adj}$	Greenhouse Gases					2011 Emissions (Tons)			
										CO_2	CH_4		N2O					
	hrs/eqpt/day	hrs	hp		lb/hp-hr					g/hp-hr [3]	[4]	lb/hp-hr	Ef (g/gal) [4]	lb/hp-hr	CO_2	CH_4	N_2O	CO_2e [5]
Generator	10	1,200	500	Gasoline	0.367	0	0.68	0.868	0.8680	1238.41	0.58	1.57E-04	0.26	7.06E-05	556.97	0.05	0.02	564.52
Pump	10	1,100	700	Gasoline	0.367	0	0.69	0.868	0.8680	1238.41	0.58	1.57E-04	0.26	7.06E-05	725.29	0.06	0.03	734.98
Gas Cut Off Saw	10	1,100	310	Gasoline	0.367	0	0.78	0.868	0.8680	1238.41	0.58	1.57E-04	0.26	7.06E-05	363.09	0.03	0.01	367.39
Tractor Trailers	10	550	200	Diesel	0.367	Hi	0.59	1.01	0.3707	534.01	0.58	6.72E-05	0.26	3.01E-05	38.20	0.00	0.00	38.79
Bulldozer	10	900	100	Diesel	0.367	Hi	0.59	1.01	0.3707	535.27	0.58	6.72E-05	0.26	3.01E-05	31.33	0.00	0.00	31.82
Backhoe	10	1,100	200	Diesel	0.367	Lo	0.21	1.18	0.4331	625.35	0.58	7.85E-05	0.26	3.52E-05	31.85	0.01	0.00	33.23
Sheeps Foot Roller	10	700	200	Diesel	0.367	Hi	0.59	1.01	0.3707	534.01	0.58	6.72E-05	0.26	3.01E-05	48.62	0.00	0.00	49.38
Scraper	10	700	100	Diesel	0.367	Hi	0.59	1.01	0.3707	535.79	0.58	6.72E-05	0.26	3.01E-05	24.39	0.00	0.00	24.77
Track Hoe	10	400	300	Diesel	0.367	Lo	0.21	1.18	0.4331	625.41	0.58	7.85E-05	0.26	3.52E-05	17.37	0.00	0.00	18.13
Tamper/compactor	10	1,100	400	Diesel	0.367	None	0.43	1.00	0.3670	528.92	0.58	6.66E-05	0.26	2.98E-05	110.31	0.01	0.01	112.65
Drilling Rig	10	150	100	Diesel	0.367	None	0.43	1.00	0.3670	529.12	0.58	6.66E-05	0.26	2.98E-05	3.76	0.00	0.00	3.84
Welding machine	10	400	40	Diesel	0.408	Lo	0.21	1.18	0.4814	662.67	0.58	8.73E-05	0.26	3.91E-05	2.45	0.00	0.00	2.57
Forklift	10	600	9	Diesel	0.408	Hi	0.59	1.01	0.4121	594.44	0.58	7.47E-05	0.26	3.35E-05	2.09	0.00	0.00	2.12
Plate Compactor	10	1,100	5	Diesel	0.408	None	0.49	1.00	0.4080	579.13	0.58	7.40E-05	0.26	3.32E-05	1.72	0.00	0.00	1.75
Mixers	10	200	300	Diesel	0.367	None	0.43	1.00	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	15.07	0.00	0.00	15.39
Pressure Washer	10	200	24	Diesel	0.408	None	0.43	1.00	0.4080	588.91	0.58	7.40E-05	0.26	3.32E-05	1.34	0.00	0.00	1.37
RT Crane 35 tn	10	1,100	250	Diesel	0.367	None	0.43	1.00	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	69.09	0.01	0.00	70.55
RT Crane 50 tn	10	300	300	Diesel	0.367	None	0.43	1.00	0.3670	530.01	0.58	6.66E-05	0.26	2.98E-05	22.61	0.00	0.00	23.09
Welding Rig	10	2,500	55	Diesel	0.484	Lo	0.21	1.00	0.4840	699.58	0.50	7.57E-05	0.22	3.33E-05	22.27	0.01	0.00	23.09
Skid Steer	10	1,100	99	Diesel	0.868	Lo	0.21	1.00	0.8680	1253.69	0.50	1.36E-04	0.22	5.97E-05	31.60	0.01	0.00	32.77
Smooth Drum Roller	10	200	85	Diesel	0.484	Hi	0.59	1.00	0.4840	699.58	0.50	7.57E-05	0.22	3.33E-05	7.73	0.00	0.00	7.84
Boom Lift	10	2,550	410	Diesel	0.868	Lo	0.21	1.00	0.8680	1254.92	0.50	1.36E-04	0.22	5.97E-05	303.72	0.07	0.03	314.88
TOTAL (Tons)															**2,430.89**	**0.28**	**0.12**	**2,474.91**

NOTES:

Note 1: Transient Adjustment Factors and TAF assignment and from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Note 2: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.

Note 3: Carbon dioxide is calculated using Equation 6 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

CO2= ((BSFC*453.6) - HC) * 0.87 * (44/12)
HC is the hydrocarbon emission factor from criteria pollutant calculation,
0.87 is the mass fraction of carbon mass in diesel and
44/12 is the molecular weight ratio of CO2 to carbon

Note 4: Emission Factors from Table 13.6 of The Climate Registry General Reporting Protocol Version 1.0, tons calculated using 7.05 lb/gal from AP-42 Appendix A and adjusted BSFC

Note 5: Carbon dioxide equivalents calculated using IPCC Second Assessment Report (SAR) Global Warming Potentials CO2 = 1, CH4 = 21, N2O = 310.

CO2e= CO2 + (CH4 * 21) + (N2O * 310)

Surge Tanks Construction: HAP Emissions from Non-Road Engines

Equipment	Daily Hours operated	2011 TOTAL Hours	Equipment Horsepower	Fuel Type	BSFC	TAF Assignment [1]	Load Factor [2]	BSFC TAF [1]	$BSFC_{adj}$	HAP Emission Factors (lb/MMBtu) [3]					
	hrs/eqpt/day	hrs	hp		lb/hp-hr					Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs
Generator	10	1,200	500	Gasoline	0.367		0.68	0.868		9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Pump	10	1,100	700	Gasoline	0.367		0.69	0.868		9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Gas Cut Off Saw	10	1,100	310	Gasoline	0.367		0.78	0.868		9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Tractor Trailers	10	550	200	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Bulldozer	10	900	100	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Backhoe	10	1,100	200	Diesel	0.367	Lo	0.21	1.18	0.4331	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Sheeps Foot Roller	10	700	200	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Scraper	10	700	100	Diesel	0.367	Hi	0.59	1.01	0.3707	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Track Hoe	10	400	300	Diesel	0.367	Lo	0.21	1.18	0.4331	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Tamper/compactor	10	1,100	400	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Drilling Rig	10	150	100	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Welding machine	10	400	40	Diesel	0.408	Lo	0.21	1.18	0.4814	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Forklift	10	600	9	Diesel	0.408	Hi	0.59	1.01	0.4121	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Plate Compactor	10	1,100	5	Diesel	0.408	None	0.49	1	0.4080	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Mixers	10	200	300	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Pressure Washer	10	200	24	Diesel	0.408	None	0.43	1	0.4080	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
RT Crane 35 tn	10	1,100	250	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
RT Crane 50 tn	10	300	300	Diesel	0.367	None	0.43	1	0.3670	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Welding Rig	10	2,500	55	Diesel	0.484	Lo	0.21	1	0.4840	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Skid Steer	10	1,100	99	Diesel	0.868	Lo	0.21	1	0.8680	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Smooth Drum Roller	10	200	85	Diesel	0.484	Hi	0.59	1	0.4840	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
Boom Lift	10	2,550	410	Diesel	0.868	Lo	0.21	1	0.8680	9.33E-04	4.09E-04	2.85E-04	2.58E-03	9.25E-05	1.68E-04
TOTAL (Tons)															

NOTES:

Note 1: Transient Adjustment Factors and TAF assignment and from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Note 2: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005. TAF Assignment of Hi/Lo is based on the Load Factor.

Note 3: Emission factors (lb/MMBtu) from AP-42 Section 3.3, Table 3.3-2. Note that HAP emission factors for gasoline fired engines are not available.

Note 4: Tons are calculated using 7.05 lb/gal from AP-42 Appendix A and 5.825 MMBtu/barrel from Table 13.1 of The Climate Registry Genral Reporting Protocol version 1.0

Surge Tanks Construction: HAP Emissions from Non-Road Engines

Equipment	HAP Emission Factors (lb/MMBtu) [3]			2011 HAP Emissions (Tons) [4]								
	1,3-Butadiene	Formaldehyde	Acetaldehyde	Benzene	Toluene	Xylenes	Propylene	Acrolein	PAHs	1,3-Butadiene	Formaldehyde	Acetaldehyde
Generator	3.91E-05	1.18E-03	7.67E-04	4.78E-03	2.10E-03	1.46E-03	1.32E-02	4.74E-04	8.61E-04	2.00E-04	6.04E-03	3.93E-03
Pump	3.91E-05	1.18E-03	7.67E-04	6.13E-03	2.69E-03	1.87E-03	1.70E-02	6.08E-04	1.10E-03	2.57E-04	7.76E-03	5.04E-03
Gas Cut Off Saw	3.91E-05	1.18E-03	7.67E-04	2.72E-03	1.19E-03	8.30E-04	7.51E-03	2.69E-04	4.89E-04	1.14E-04	3.44E-03	2.23E-03
Tractor Trailers	3.91E-05	1.18E-03	7.67E-04	3.74E-04	1.64E-04	1.14E-04	1.03E-03	3.71E-05	6.74E-05	1.57E-05	4.73E-04	3.08E-04
Bulldozer	3.91E-05	1.18E-03	7.67E-04	3.06E-04	1.34E-04	9.35E-05	8.47E-04	3.04E-05	5.51E-05	1.28E-05	3.87E-04	2.52E-04
Backhoe	3.91E-05	1.18E-03	7.67E-04	8.74E-04	3.83E-04	2.67E-04	2.42E-03	8.67E-05	1.57E-04	3.66E-05	1.11E-03	7.19E-04
Sheeps Foot Roller	3.91E-05	1.18E-03	7.67E-04	4.76E-04	2.09E-04	1.45E-04	1.32E-03	4.72E-05	8.58E-05	2.00E-05	6.02E-04	3.92E-04
Scraper	3.91E-05	1.18E-03	7.67E-04	2.38E-04	1.04E-04	7.27E-05	6.58E-04	2.36E-05	4.29E-05	9.98E-06	3.01E-04	1.96E-04
Track Hoe	3.91E-05	1.18E-03	7.67E-04	4.77E-04	2.09E-04	1.46E-04	1.32E-03	4.73E-05	8.59E-05	2.00E-05	6.03E-04	3.92E-04
Tamper/compactor	3.91E-05	1.18E-03	7.67E-04	1.48E-03	6.50E-04	4.53E-04	4.10E-03	1.47E-04	2.67E-04	6.21E-05	1.87E-03	1.22E-03
Drilling Rig	3.91E-05	1.18E-03	7.67E-04	5.05E-05	2.21E-05	1.54E-05	1.40E-04	5.01E-06	9.10E-06	2.12E-06	6.39E-05	4.15E-05
Welding machine	3.91E-05	1.18E-03	7.67E-04	7.07E-05	3.10E-05	2.16E-05	1.95E-04	7.01E-06	1.27E-05	2.96E-06	8.94E-05	5.81E-05
Forklift	3.91E-05	1.18E-03	7.67E-04	2.04E-05	8.95E-06	6.24E-06	5.65E-05	2.02E-06	3.68E-06	8.56E-07	2.58E-05	1.68E-05
Plate Compactor	3.91E-05	1.18E-03	7.67E-04	2.06E-05	9.03E-06	6.29E-06	5.69E-05	2.04E-06	3.71E-06	8.63E-07	2.60E-05	1.69E-05
Mixers	3.91E-05	1.18E-03	7.67E-04	2.02E-04	8.86E-05	6.17E-05	5.59E-04	2.00E-05	3.64E-05	8.47E-06	2.56E-04	1.66E-04
Pressure Washer	3.91E-05	1.18E-03	7.67E-04	1.80E-05	7.88E-06	5.49E-06	4.97E-05	1.78E-06	3.24E-06	7.53E-07	2.27E-05	1.48E-05
RT Crane 35 tn	3.91E-05	1.18E-03	7.67E-04	9.26E-04	4.06E-04	2.83E-04	2.56E-03	9.18E-05	1.67E-04	3.88E-05	1.17E-03	7.61E-04
RT Crane 50 tn	3.91E-05	1.18E-03	7.67E-04	3.03E-04	1.33E-04	9.26E-05	8.38E-04	3.01E-05	5.46E-05	1.27E-05	3.83E-04	2.49E-04
Welding Rig	3.91E-05	1.18E-03	7.67E-04	6.11E-04	2.68E-04	1.87E-04	1.69E-03	6.06E-05	1.10E-04	2.56E-05	7.72E-04	5.02E-04
Skid Steer	3.91E-05	1.18E-03	7.67E-04	8.67E-04	3.80E-04	2.65E-04	2.40E-03	8.60E-05	1.56E-04	3.64E-05	1.10E-03	7.13E-04
Smooth Drum Roller	3.91E-05	1.18E-03	7.67E-04	7.55E-05	3.31E-05	2.31E-05	2.09E-04	7.49E-06	1.36E-05	3.16E-06	9.55E-05	6.21E-05
Boom Lift	3.91E-05	1.18E-03	7.67E-04	8.33E-03	3.65E-03	2.54E-03	2.30E-02	8.26E-04	1.50E-03	3.49E-04	1.05E-02	6.85E-03
TOTAL (Tons)				**2.94E-02**	**1.29E-02**	**8.97E-03**	**8.12E-02**	**2.91E-03**	**5.29E-03**	**1.23E-03**	**3.71E-02**	**2.41E-02**

NOTES:

Note 1: Transient Adjustment Factors and TAF assignment and from Table A3 of "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", April 2004, EPA-420-P-04-009.

Note 2: Load factor from Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005. TAF Assignment of Hi/Lo is based on the Load Factor.

Note 3: Emission factors (lb/MMBtu) from AP-42 Section 3.3, Table 3.3-2. Note that HAP emission factors for gasoline fired engines are not available.

Note 4: Tons are calculated using 7.05 lb/gal from AP-42 Appendix A and 5.825 MMBtu/barrel from Table 13.1 of The Climate Registry Genral Reporting Protocol version 1.0

Surge Tanks Construction: Criteria and GHG Emissions from On-Road Vehicles

Equipment	Daily Hours operated	Total Hours	Vehicle Class [1]	2011 Miles traveled [2]	Fuel Type	Criteria Pollutants Emission Factor (g/VMT) [3]					Greenhouse Gasses Ef (g/mile)		
	hr/eqpt/day	for 2010				VOC	CO	NOx	SO_2	PM	CO_2 [3]	CH_4 [4]	N_2O [4]
Pick-up Trucks	10	8,450	LDGV	211,250	Diesel	0.627	12.7	0.588	0.0068	0.0249	368.1	0.0273	0.0178
TOTAL (Tons)													

NOTES:

Note 1: Vehicle Classes were taken from Mobile6.2 based on estimated gross weight of the vehicle.

Note 2: Vehicle miles traveled are based on an assumed 25 mi/hr on average/ vehicle based on arterial roads.

Note 3: Emission factors from Mobile6.2.

Note 4: Emission Factors from Table 13.4 of The Climate Registry General Reporting Protocol Version 1.1 applicable to "Diesel Heavy Duty Vehicles" all model year vehicles. Note that Efs applicable to light duty gasoline vehicles was used for the vehicle category "automobiles" (MY 2000).

Note 5: Carbon dioxide equivalents calculated using IPCC Second Assessment Report (SAR) Global Warming Potentials CO2 = 1, CH4 = 21, N2O = 310. CO2e= CO2 + (CH4 * 21) + (N2O * 310)

Surge Tanks Construction: Criteria and GHG Emissions from On-Road Vehicle

Equipment	2011 Emissions (Tons)								
	Criteria Pollutants					Greenhouse Gases			
	VOC	CO	NOx	SO_2	PM	CO_2	CH_4	N_2O	CO_2e [5]
Pick-up Trucks	0.1460	2.9574	0.1369	0.0016	0.01	85.72	6.36E-03	4.14E-03	87.14
TOTAL (Tons)	**0.146**	**2.957**	**0.137**	**0.002**	**0.006**	**85.72**	**6.36E-03**	**4.14E-03**	**87.14**

Surge Tanks Construction: HAP Emissions from On-Road Vehicles

Equipment	Daily Hours operated	Vehicle Class [1]	2011 Miles traveled/year [2]	Fuel Type	Hazardous Air Pollutants Emission Factor (mg/VMT) [3]				
	hr/eqpt/day		miles/yr		Acetaldehyde	Acrolein	Benzene	1,3-butadiene	Formaldehyde
Pick-up Trucks	10	LDGV	211,250	Diesel	4.04	0.24	16.45	2.04	4.51
TOTAL (Tons)									

NOTES:

Note 1: Vehicle Classes were taken from Mobile6.2 based on estimated gross weight of the vehicle.

Note 2: Vehicle miles traveled are based on an assumed 25 mi/hr on average/ vehicle based on arterial roads.

Note 3: HAP Emission factors taken from Mobile6.2

Surge Tanks Construction: HAP Emissions from On-Road Vehicles

Equipment	Hazardous Air Pollutants 2011 Emissions (Tons)				
	Acetaldehyde	**Acrolein**	**Benzene**	**1,3-butadiene**	**Formaldehyde**
Pick-up Trucks	9.41E-04	5.59E-05	3.83E-03	4.75E-04	1.05E-03
TOTAL (Tons)	**0.0009**	**0.0001**	**0.0038**	**0.0005**	**0.0011**

Surge Tanks Construction: Emissions from Slash/Brush Burning

Area of Prescribed Burning*			
Area disturbed/ burned	=	5	acres

* No data was available the acreage of open burning to be conducted during construction of surge tank. Therefore, a conservative assumption of 5 acres of open burning was made.

Vegetation Type Distribution		
Tree Tops/Stumps	=	50% [a]
Hay/Gass	=	50% [a]

Fuel Load Emission Factor			
Hay/grass	=	1.0	ton/acre [b]
Tree Tops and Stumps	=	9.0	ton/acre [c]

Weight of Wood/Hay Burned			
Hay/grass	=	2.50	tons
Tree Tops and Stumps	=	22.50	tons

Emission factors for wildfire, prescribed burning and slash burns calculated under dry conditions for each fuel component [d]										
Fuel Component	Emission factor (lb/ton)									
	% of total Vegetation	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2	NO_x	NH_3
Litter, Wood 0-1"	25%	52	3	6	15	8	9	3483	2.5	0.5
Wood 1-3"	25%	111	6	9	20	12	14	3373	2.5	1.1
Wood 3+"	25%	174	9	12	26	16	19	3263	2.5	1.7
Herb, Shrub	25%	249	12	16	33	21	25	3116	2.5	2.6

Emission from prescribed wood burning									
Fuel Component	**Emissions (tons)**								
	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2	NO_x	NH_3
Litter, Wood 0-1"	0.15	0.01	0.02	0.04	0.02	0.03	9.80	0.01	0.00
Wood 1-3"	0.31	0.02	0.03	0.06	0.03	0.04	9.49	0.01	0.00
Wood 3+"	0.49	0.03	0.03	0.07	0.05	0.05	9.18	0.01	0.00
Herb, Shrub	0.70	0.03	0.05	0.09	0.06	0.07	8.76	0.01	0.01
TOTAL	**1.65**	**0.08**	**0.12**	**0.26**	**0.16**	**0.19**	**37.22**	**0.03**	**0.02**

Emission factors for crop residue burning [e]									
Crop Residue	**Emission factor (lb/ton)**								
	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2 [f]	NO_x	NH_3
Hay/Grasses	204.3	6.3	32.7	17.6	17.4	16.9	-	5.1	6.7

Emissions from crop residue burning									
Crop Residue	**Emissions (tons)**								
	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2	NO_x	NH_3
Hay/Grasses	0.26	0.01	0.04	0.02	0.02	0.02	-	0.01	0.01

Emissions from prescribed burning and crop residue burning									
	CO	CH_4	NMHC	PM	$PM_{2.5}$	PM_{10}	CO_2	NO_x	NH_3
TOTAL	**1.90**	**0.09**	**0.16**	**0.29**	**0.18**	**0.21**	**37.22**	**0.03**	**0.02**

NOTES:

(a) Taken from http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_mp_e0100_1070n_08.pdf.

(b)Taken from Table 5 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(c) Fuel loading value of tree tops and stumps taken from AP-42 Table 13.1-1. Value applicable to southern region (Region 8) were used.

(d) Taken from Table 2 and 3 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(e)Taken from Table 6 of Dennis A., Fraser, M., Anderson, S., Allen, D., 2002. Air pollutant emissions associated with forest, grassland, and agricultural burning in Texas. Atmospheric Environment, 36, pp. 3779-3792.

(f) Emission factor of CO_2 for hay/grass burning was not available.

PM EMISSIONS FROM LAND DISTURBED: Surge Tank Construction in BPA Nonattainment Area

2011 Activities		
Area Name:	**Surge Tanks**	
Area of Land Disturbance over the total months of construction* (acres):	5	
Months of Construction Activity (July - December 2011) (1):	5	
	total tons (2)	tons/month
PM2.5	0.5	0.1
PM10	3.0	0.6
PM30	6.0	1.2

	Heavy Construction Operations			Notes
Emission Factor	**PM2.5**	**PM10**	**PM30**	
tons/acre/month	0.09	0.60	1.20	(3)
From AP-42, Section 13.2.3 Heavy Construction Operations:				
For construction activity operations: **E = 1.2 tons/acre/month of activity**				

NOTES:

(1) Construction is projected to occur over 5 months. It is conservatively assumed that the area of land disturbed for surge tanks construction is 5 acres.

(2) Total tons is for entire construction duration, which is expected to be over a 5 month period. PM2.5 is particulate matter less than 2.5 microns. PM10 is particulate matter less than 10 microns. PM30 is particulate matter less than 30 microns.

(3) From AP-42 Section 13.2.3.3. Note that a factor of 1.2 ton/acre/month is conservatively high for TSP since it assumes that construction occurs over 30 days of the month which is not true in this case. Particle size multiplier (k) of 0.5 and 0.075 were used to determine the fraction of PM10 and PM2.5, respectively (taken from AP-42 Section 13.2.5.3).

* No data was available the acreage of land disturbance to be conducted during construction of surge tank.
Therefore, a conservative assumption of 5 acres was made.

PERSONNEL COMMUTE-PM EMISSIONS FROM PAVED ROADS: Surge Tanks Construction

Total Number of miles for 2011	211,250	miles for 2011	(1)

Emissions = VMT roundtrip/trip * 'X' trips for the construction period / 2000

Emissions: Paved Roads			
Emissions (ton/year)	**PM2.5**	**PM10**	**PM30 (TSP)**
2011	0.01	0.15	0.98

Emission Factor: Paved Roads				Notes
Emission Factor	**PM2.5**	**PM10**	**PM30**	
lb/VMT	0.0001	0.0015	0.0092	(2)

From AP-42, Section 13.2.1 Paved Roads:

For all paved roads:

E={[k*((sL/2)^0.65)*((W/3)^1.5)] -C}*(1-P/4N)

where

E = size specific emission factor (lb/VMT)
k = particulate size multiplier
sL = road surface silt loading (g/m2)
W = mean vehicle weight (tons)
C = emission factor for 1980's vehicle fleet exhaust, brake wear, and tire wear.
P = number of wet days with at least 0.254 mm (0.01 in) of precipitation during the averaging period, and
N = number of days in the averaging period

Parameter	All Paved Roads 2011			Notes
	PM2.5	**PM10**	**PM30**	
k	0.004	0.016	0.082	(3)
sL	0.2	0.2	0.2	(4)
W	2.1	2.1	2.1	(5)
C	0.00036	0.00047	0.00047	(6)

NOTES:

(1) Number of personnel is assumed to be a constant during the entire construction schedule.
(2) Derived from equation, based on lb/VMT, P=120 from Figure 13.2.1-2, N=365
(3) From AP-42 Table 13.2-1.1 in lb/VMT.
(4) Silt content taken from AP-42 Table 13.2.1-3 for 500-5,000 ADT ubiquitous baseline.
(5) Average worker vehicle weight based on average car or light duty truck sold in the US last year 4,144 pounds from EPA. 4,144 pounds = 2.07 tons
(6) From AP-42 Table 13.2-1.2 in lb/VMT.

OPERATIONAL EMISSIONS

Surge Tank

BPA Moderate Ozone Nonattainment Area

Annual Operational Emissions from Surge Tank

	VOC (lb/hr)	VOC (tpy)	Hexane (tpy)	Benzene (tpy)	Isooctane (tpy)	Toluene (tpy)	Ethylbenzene (tpy)	Xylene (-m) (tpy)	Isopropyl Benzene (tpy)	Cyclohexane (tpy)	1,2,4-Trimethylbenzene (tpy)
Fugitive Emissions from Component Leaks	3.35	14.69	5.88E-02	8.81E-02	1.47E-02	1.47E-01	5.88E-02	2.06E-01	1.47E-02	1.03E-01	4.85E-02
Tank Emissions (Working and Standing Losses; one surge event/year)	889.32	0.11	8.45E-04	7.89E-04	6.67E-05	3.89E-04	5.56E-05	1.56E-04	1.11E-05	9.45E-04	1.11E-05
Tank Emissions (Working and Standing Losses; 12 surge events/year)	889.32	1.33	1.01E-02	9.47E-03	8.00E-04	4.67E-03	6.67E-04	1.87E-03	1.33E-04	1.13E-02	1.33E-04
Total Emissions (Fugitive + 1 surge event/year)		**14.80**	**5.96E-02**	**8.89E-02**	**1.48E-02**	**1.47E-01**	**5.88E-02**	**2.06E-01**	**1.47E-02**	**1.04E-01**	**4.85E-02**
Total Emissions (Fugitive + 12 surge events/year)		**16.02**	**6.89E-02**	**9.76E-02**	**1.55E-02**	**1.52E-01**	**5.94E-02**	**2.08E-01**	**1.48E-02**	**1.14E-01**	**4.86E-02**

Assumptions for Tanks 4.09d for one Surge Tank and one surge event

Working Volume = 10,417 barrles = 437,514 gallons
conversion = 42 gallons per barrel

Measured cone height from Worley Parsons' P&ID
diameter is 42 ft and on drawing is 2 inches.
cone height is 5/16 inch = 0.3125 inch on drawing
cone hieght = 42*0.3125/2 = 6.5625 ft

Reference : Worley Parsons' email attachment discussing activated carbon vapor recovery unit:
Flow is 39,000 cfm (6,625 m3/hr) (Based on full pipeline flow of 1,000,000 bbl/day)

Throughput was based on email from Mohsen Torkashvand dated Oct 26, 2010.
Design provided of 15 minutes of max flow 1000 kbpd
1,000,000 bpd where 42 gallons = 1 barrel
42,000,000 gallons per day 15 minute event (24 hr/day, 60 min/hr)
437,500 gallons

Tank volume was designed to be 50% larger than the maximum anticipated relief volume.
Assumed average liquid height to be 50% of shell height (45 ft). Avg liquid height = 22.5 ft.

Operational Emissions from the Surge Tank - VOC

Surge Tank Emissions - One Event/One Tank

Emissions are for one event for one tank since the second tank is for back up only.
Tanks 4.09d emissions are conservatively based on the month of July and Crude Oil RVP 5

Uncontrolled Emissions

Entire throughput for one event in July gave the following results for VOC emissions:

Standing Losses	661.23	lb/event
Working Losses	1,562.06	lb/event
Total Losses -->	2,223.30	lb/event

Since there is one surge event per year,
uncontrolled annual VOC emissions are expected to be:

2,223.30	lb/year
1.11	tons/year

Emissions After Control

Two carbon adsorption beds in series. Vendor data on control efficiency were not available.

Assume % removal by carbon beds	90	%
222.33		lb/year
0.11		tons/year

Surge Tank Emissions - Multiple Events/One Tank

Emissions are for multiple events for one tank since the second tank is back up only.
Tanks 4.09d emissions are conservatively based on the month of July and Crude Oil RVP 5

Uncontrolled Emissions

Single event per year:

Entire throughput for one event in July gave the following results for VOC emissions:

Standing Losses	661.23	lb/event
Working Losses	1,562.06	lb/event
Total Losses -->	2,223.30	lb/event

For multiple events per year:

Conservatively, assume number of surge events per year for one tank = 12

Standing Losses	7,934.78	lb/ year
Working Losses	18,744.78	lb/ year
Total Losses -->	26,679.56	lb/ year
-->	13.34	ton/year

Emissions After Control

Two carbon adsorption beds in series. Vendor data on efficiency were not available.

Assume % removal by carbon beds	90	%
2,667.96		lb/year
1.33		tons/year

Operational Emissions from the Surge Tank - HAPs

[1] Constituent Weight % in RVP 5 Vapor -->		0.76%	0.71%	0.06%	0.35%	0.05%	0.14%	0.01%	0.85%	0.01%	97.06%
# Surge Events	**VOC Emissions (tpy)**	**Hexane (tpy)**	**Benzene (tpy)**	**Isooctane (tpy)**	**Toluene (tpy)**	**Ethylbenzene (tpy)**	**Xylene (-m) (tpy)**	**Isopropyl Benzene (tpy)**	**Cyclohexane (tpy)**	**1,2,4-Trimethylbenzene (tpy)**	**Other/Unidentified**
Surge Tank Emissions - One Event/One Tank	0.11	8.45E-04	7.89E-04	6.67E-05	3.89E-04	5.56E-05	1.56E-04	1.11E-05	9.45E-04	1.11E-05	1.08E-01
Surge Tank Emissions - 12 Events/One Tank	1.33	1.01E-02	9.47E-03	8.00E-04	4.67E-03	6.67E-04	1.87E-03	1.33E-04	1.13E-02	1.33E-04	1.29E+00

(1) Constituent weight percent in vapor phase obtained from TANKS 4.09d

Component Counts

															Safety factor:
															5%
P&ID --->	**001**	**002**	**003**	**004**	**005**	**006**	**007**	**008**	**009**	**011**	**012**	**013**	**014**	**Total**	**Adjusted Total (Total + 5%)**
Valves															
Gas/Vapor								7				8	8	23	**24**
Light Liquid	74	15	54	45	52	13	21	16	54	52	13	22		431	**453**
Heavy Liquid														0	**0**
Pumps															
Light Liquid					3	2				3	2	1		11	**12**
Heavy Liquid														0	**0**
Flanges															
Gas/Vapor						2		2			2	18	11	35	**37**
Light Liquid	166	35	138	95	119	49	45	13	138	119	46	58		1021	**1072**
Heavy Liquid														0	**0**
Connectors															
Gas/Vapor														0	**0**
Light Liquid					3	2		2		2	2	2		13	**14**
Heavy Liquid														0	**0**
Compressors														0	**0**
Relief Valve (Gas/Vapor)								2				2		4	**4**
Open-ended Lines		3						1				2		6	**6**
Sampling Connections	3				2			1		2		1	1	10	**11**
Other															
Gas/Vapor														0	**0**
Light Liquid														0	**0**
Heavy Liquid														0	**0**
Process Drains				2										2	**2**

Reference: Equipment Leak Fugitives, October 2000 Draft document

Liquid relief valves count as light liquid valves (pg 14)

Screwed fittings count as flanges

Component counts based on the P&ID provided by Worley Parsons.

Oil and Gas Production Operations Factors: Heavy Oil < 20 degree API gravity, Light Oil > 20 degree API gravity (pg 11). The crude handled by the surge tank is expected to be between 30 and 40° API gravity.

The gas factors estimate total hydrocarbon emisssions; therefore, the calculated emission rates must be mutliplied by the weight percentage of C3+ compounds in the gas stream to get a total VOC rate for permitting purposes. No speciation information available for the crude handled by the surge tank.

Light Liquids are those with vapor pressure higher than 0.044 psia at 68F (pg 13). The crude has a vapor pressure of 10.9 psi at 120°F.

Fugitive Emissions Calculations - VOC

Note ---->		(1)		(2)		
Equipment/Service	**Component Count**	**Oil & Gas (Light Oil)**	**Uncontrolled Emissions (lb/hr)**	**LDAR Program**	**Controlled Emissions of VOC (lb/hr)**	**Controlled Emissions of VOC (tpy)**
Valves						
Gas/Vapor	24	0.0055	0.133		0.133	0.582
Light Liquid	453	0.0055	2.489		2.489	10.902
Heavy Liquid	0	0.0055	0.000		0.000	0.000
Pumps						
Light Liquid	12	0.02866	0.331		0.331	1.450
Heavy Liquid	0	0.02866	0.000		0.000	0.000
Flanges						
Gas/Vapor	37	0.000243	0.009		0.009	0.039
Light Liquid	1072	0.000243	0.261		0.261	1.141
Heavy Liquid	0	0.000243	0.000		0.000	0.000
Connectors						
Gas/Vapor	0	0.000243	0.000		0.000	0.000
Light Liquid	14	0.000243	0.003		0.003	0.015
Heavy Liquid	0	0.000243	0.000		0.000	0.000
Compressors	0	0.0165				
Relief Valve (Gas/Vapor)	4	0.0165	0.069		0.069	0.304
Open-ended Lines	6	0.00309	0.019		0.019	0.085
Sampling Connections	11	0.000463	0.005		0.005	0.021
Other						
Gas/Vapor	0	0.0165	0.000		0.000	0.000
Light Liquid	0	0.0165	0.000		0.000	0.000
Heavy Liquid	0	0.0165	0.000		0.000	0.000
Process Drains	2	0.0165	0.035		0.035	0.152
Total	**1634**				**3.35**	**14.69**

Reference: Equipment Leak Fugitives, October 2000 Draft document

Note:

(1) Since the crude handled is expected to be 30 - 40 °API gravity, fugitive emission factors for Oil and Gas (Light Oil) were used.

(2) To be conservative, assume that the surge tank and the associated fittings will not be subject to an LDAR program to estimate emissions.

Fugitive Emissions Calculations - HAPs

[1] Constituent Weight % in RVP 5 Liquid-->		0.40%	0.60%	0.10%	1.00%	0.40%	1.40%	0.10%	0.70%	0.33%	94.97%
Equipment / Service	**Component Count**	**Hexane (tpy)**	**Benzene (tpy)**	**Isooctane (tpy)**	**Toluene (tpy)**	**Ethylbenzene (tpy)**	**Xylene (-m) (tpy)**	**Isopropyl Benzene (tpy)**	**Cyclohexane (tpy)**	**1,2,4-Trimethylbenzene (tpy)**	**Other/Unidentified**
Valves											
Gas/Vapor	24	2.33E-03	3.49E-03	5.82E-04	5.82E-03	2.33E-03	8.14E-03	5.82E-04	4.07E-03	1.92E-03	5.53E-01
Light Liquid	453	4.36E-02	6.54E-02	1.09E-02	1.09E-01	4.36E-02	1.53E-01	1.09E-02	7.63E-02	3.60E-02	1.04E+01
Heavy Liquid	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pumps											
Light Liquid	12	5.80E-03	8.70E-03	1.45E-03	1.45E-02	5.80E-03	2.03E-02	1.45E-03	1.01E-02	4.78E-03	1.38E+00
Heavy Liquid	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Flanges											
Gas/Vapor	37	1.56E-04	2.35E-04	3.91E-05	3.91E-04	1.56E-04	5.48E-04	3.91E-05	2.74E-04	1.29E-04	3.71E-02
Light Liquid	1072	4.56E-03	6.85E-03	1.14E-03	1.14E-02	4.56E-03	1.60E-02	1.14E-03	7.99E-03	3.77E-03	1.08E+00
Heavy Liquid	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Connectors											
Gas/Vapor	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Light Liquid	14	5.81E-05	8.72E-05	1.45E-05	1.45E-04	5.81E-05	2.03E-04	1.45E-05	1.02E-04	4.79E-05	1.38E-02
Heavy Liquid	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compressors	0										
Relief Valve (Gas/Vapor)	4	1.21E-03	1.82E-03	3.04E-04	3.04E-03	1.21E-03	4.25E-03	3.04E-04	2.12E-03	1.00E-03	2.88E-01
Open-ended Lines	6	3.41E-04	5.12E-04	8.53E-05	8.53E-04	3.41E-04	1.19E-03	8.53E-05	5.97E-04	2.81E-04	8.10E-02
Sampling Connections	11	8.52E-05	1.28E-04	2.13E-05	2.13E-04	8.52E-05	2.98E-04	2.13E-05	1.49E-04	7.03E-05	2.02E-02
Other											
Gas/Vapor	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Light Liquid	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Liquid	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Process Drains	2	6.07E-04	9.11E-04	1.52E-04	1.52E-03	6.07E-04	2.12E-03	1.52E-04	1.06E-03	5.01E-04	1.44E-01
Total	**1634**	5.88E-02	8.81E-02	1.47E-02	1.47E-01	5.88E-02	2.06E-01	1.47E-02	1.03E-01	4.85E-02	1.40E+01

(1) Constituent weight percent in liquid phase obtained from TANKS 4.09d

Deshpande, Seemantini

From: Koy Howard [KoHoward@tceq.state.tx.us]
Sent: Thursday, July 09, 2009 5:05 PM
To: Deshpande, Seemantini
Subject: Re: General COnformity Determination question for the HGB andBPA nonattainment areas

We are currently reviewing your request and will get back to you soon. For the BPA area construction project, there will obviously be no problem since project emissions are well below the de minimis levels. For the HGB project, I don't believe there will be any problems. I'm verifying with our emissions inventory staff and will let you know as soon as I hear something from them. In order to start the process, a letter/report detailing the project scope and from what sources the expected emissions will come from. I'm fairly confident in saying that the emissions can be accommodated in the SIP.
Thanks.
Koy

>>> "Deshpande, Seemantini" <Seemantini.Deshpande@aecom.com> 7/7/2009 12:05 PM >>>

Hi Koy,

Thank you for getting back to me on the conformity question. As you suggested in your voice message to me, I am documenting my questions in an email.

A client is proposing construction in the HGB and BPA nonattainment areas.

For the BPA NA area, the projected construction emissions of VOC and NOx are below the 100 tpy applicability threshold and less than 10% of the regional emissions.

However, for the HGB NA area, the projected construction emissions of VOC and NOx are less than 10% of the regional emissions but exceed the 25 tpy applicability threshold for both NOx and VOC by approximately 50 tons and 7 tons, respectively for the construction year 2012. For the construction year 2011, the projected NOx emissions from construction activities exceed the threshold by ~ 27 tons.

Questions - Can all or part these exceedances be accomodated in the current SIP? If a part can be accomodated, can you tell us how much?
Does TCEQ need to be formally requested to accomodate the emissions in the SIP or is it automatic? How can we go about getting the process started?
Under what circumstances will a project be required to buy NOx and VOC offsets?

Please call me if you have any questions. Thanks in advance.

Regards,

Sim

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