Appendix W

Air Emissions Information

Appendix W

Air Emissions Information

Criteria Pollutant and Greenhouse Gas Emissions Analysis: Methodology

Construction activities associated with the proposed Project would result in short-term increases in air emissions as a result of the combustion of fossil fuels in construction equipment and vehicles, and from the fugitive dust emissions associated with site ground disturbance. In addition, the clearing of the ROW would require clearing of forest lands. Deforestation is another source of carbon dioxide (CO_2) to the atmosphere, because removing forests releases most of the stored carbon sink, either through burning or decay.

Construction of the proposed Project would take approximately four years, but activities would not occur at a single construction location for more than a year. Because specific scheduling and construction documentation have not yet been developed, annual emissions of criteria pollutants from construction of the proposed Project have been estimated using an average emissions per mile for typical construction based on a hypothetical 50-mile ROW project site, 1,000 acres of forest clearing, and a 20-acre substation (See Table 1.2). Assumptions for equipment use by activity are provided in Tables 4.1, 4.2, and 4.3. Construction emissions for the hypothetical project activities are provided for non-road equipment (See Tables 5.1, 5.2, 5.3, 5.4); on-road equipment (See Tables 6.1, 6.2, 6.3, 6.4, 7); and helicopter operations (See Table 8). A summary of total emissions by activity and average emission values for the hypothetical project is provided in Table 3.

The Applicant would use large equipment to clear trees and other vegetation and to level construction areas. Large cranes and flatbed trucks would be used to place transmission lines and substation components. Helicopters may be used to place lines and structures. Temporary concrete batch plants may be utilized to supply concrete for foundations. Equipment and material deliveries, the removal of waste, and worker activities and commuting would produce indirect emissions on paved and unpaved roads within the region of influence (ROI). Criteria pollutant and greenhouse gas (GHG) emission factors are based on the size and type of equipment, developed using the EPA's MOVES2014 modeling program for on-road and non-road equipment (See Tables 9 and 10 for emission factors). Helicopter emissions have been calculated using US Air Force helicopter emission factors (See Table 11). Fugitive dust emissions have been calculated using AP-42 Section 13.2 (See Tables 12.1 and 12.2). Concrete batch plant emissions have been calculated using AP-42 Section 11.12, Table 11.12-2 (See Table 12.3).

Total proposed Project construction emissions of nitrogen oxides (NO_x), volatile organic compounds (VOCs), carbon monoxide (CO), sulfur dioxide (SO_2), PM_{10}, $PM_{2.5}$ and CO_2 have been calculated for the West, Central, and East sections and for each variation using the total mileage and forest removal areas for both the Proposed Blue Route and Proposed Orange Route (See Tables 1.1, 2, 2.1 and 2.2). The sum of each proposed route within a section is greater than the sum of the Proposed Blue Route and Route Orange Route, as a whole route, because there is some overlap between the sections.

The loss of carbon sink that results from the removed forest has been estimated using *Methods for Calculating Forest Ecosystem and Harvested Carbon with Standard Estimates for Forest Types of the United States* (See Table 13). The calculations assume the removal of "Northern Lake States Spruce-balsam Pine"

forests that are an average of 55 years old. Carbon sink is defined and reported as the total amount of carbon, in metric tons, and in the equivalent amount of CO_2 in metric tons, calculated using the atomic weight ratio of 12 for Carbon to 44 for CO_2. In addition to the loss of existing carbon sink, removal of forested land eliminates the CO_2 sink that would be provided by continued growth of trees in the forest.

Appendix W Construction Emission Calculations Great Northern Transmission Line, MN	
Table No.	**Title**
Table 1.1	Total Project Construction Emissions
Table 1.2	Summary of Construction Types Used to Estimate Construction Emissions
Table 2	Total Project Construction Emissions, By Route Variation
Table 2.1	Construction Emissions from Placement of Line and Structures on Existing or Cleared ROW
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Table 4.1	Site Construction Equipment - Replacement of Line and Structures on Existing ROW (50 Mile ROW Example)
Table 4.2	Site Construction Equipment - Clearing Forest (1000 acres example)
Table 4.3	Site Construction Equipment - Substation(40 acre example)
Table 5.1	Nonroad Equipment Exhaust Emissions - Replacement of Line and Structures on Existing ROW (50 Mile ROW Example)
Table 5.2	Nonroad Equipment Exhaust Emissions - Clearing Forest (1000 acres example)
Table 5.3	Nonroad Equipment Exhaust Emissions - Converter Station Construction
Table 5.4	Nonroad Equipment Exhaust Emissions - Concrete Batch Plant
Table 6.1	On Road Construction Equipment - Replacement of Line and Structures on Existing ROW (50 Mile ROW Example)
Table 6.2	On Road Construction Equipment - Clearing Forest (1000 acres example)
Table 6.3	On-Road Construction Equipment Exhaust Emissions - Converter Station Construction
Table 6.4	On-Road Construction Equipment Exhaust Emissions - Concrete Batch Plant
Table 7	On-Road Vehicle (Commuter Vehicles) Exhaust Emissions
Table 8	Helicopter Exhaust Emissions - Transmission Line Segment Construction
Table 9	Nonroad Equipment Exhaust Emission Factors - Koochiching County MN
Table 10	On-Road Vehicle Exhaust Emission Factors
Table 11	Helicopter Exhaust Emission Factors
Table 12.1	Fugitive Dust Emissions - Roads
Table 12.2	Fugitive Dust Emissions - General Construction Activities
Table 12.3	Fugitive Dust Emissions - Concrete Batch Plant
Table 13	Forest Carbon Sink Removed and Loss of Average Annual CO2 uptake emissions , All Route Variations

Table 1.1 Total Project Construction Emissions									
			Emissions (tons)						Emissions (metric tons)
Route	Miles of ROW	Acres of Forest Removal	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
West Section									
Proposed Blue/Orange Route	108.4	1736.0	129.9	12.3	77.3	2.2	499.5	82.5	39626.2
Central Section									
Proposed Blue Route	109.8	1770.0	131.6	12.4	78.3	2.3	507.0	83.7	40147.0
Proposed Orange Route	105.4	1751.0	127.0	12.0	75.5	2.2	492.2	81.2	38708.4
East Section									
Proposed Blue Route	61.7	686.0	70.5	6.7	42.1	1.3	252.4	42.2	21635.2
Proposed Orange Route	66.5	682.0	75.4	7.1	45.1	1.4	266.1	44.6	23157.6
Total Route									
Proposed Blue Route	219.0	4829.0	277.2	26.1	164.1	4.5	1147.8	187.2	83981.2
Proposed Orange Route	220.0	4883.4	278.8	26.3	165.0	4.6	1156.5	188.5	84461.3
Substations		30.0	15.1	1.4	12.1	0.0	19.3	2.9	4589.1

Notes: The Sum of Section Route totals are greater than Total Route Totals because Section Routes overlap.

Emissions have been calculated using EPA's MOVES2014 Nonroad and Onroad emission factors for Koochiching, MN, 2018

Average emissions per mile or per acre for forest clearing are estimated using a hypothetical 50-mile ROW construction site. Refer to Appendix X.

Table 1.2 Summary of Construction Types Used to Estimate Construction Emissions Great Northern Transmission Line, MN			
Type of Construction	**Parameters**	**Total**	**Units**
Placement of Line and Structures on Existing or Cleared ROW (50 miles example project). Includes equipment material delivery, site preparation, tower foundations, tower placement, line placement, maintenance, and commuting vehicles	Total Mileage (for Construction Assumptions)	50.00	Miles
	Width of Construction (expanded and disturbed) ROW	200.00	feet
	Area of Impact	1209.12	acres
	Concrete Batch Plants	1.00	#
	Estimated Construction Time	12.00	months
Clearing of Forest. Includes forest removal equipment delivery and use, site preparation, removal of timber and debris, and communiting vehicles	Estimated length of ROW (assuming all forest cover)	42.00	Miles
	Width of Construction (New and disturbed) ROW	200.00	feet
	Area of Impact (Forest removal)	1000.00	acres
	Estimated Construction Time	12.00	months
Substation. Includes equipment material delivery, site preparation, equipment placement, line placement, maintenance, and commuting vehicles	Area of Impact	20.00	acres
	Estimated Construction Time	12.00	months

Table 2
Total Project Construction Emissions, By Route Variation

		Route Variation	Base Length	Total Forest	Construction Emissions							Construction GHG Emissions
		Unit	(mi)	Area (ac)	(tons)							(metric tons)
Section	**Sect. #**	**Buffer (ft.)**	**100**	**100**	**NO_x**	**VOC**	**CO**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CO_2**
West	1.1.1	Border Crossing Proposed Route	25.0	354	29.5	2.8	17.6	0.5	110.4	18.3	9929.3	9007.9
West	1.1.1	Border Crossing Pine Creek Variation	25.7	313	29.7	2.8	17.7	0.5	108.1	18.0	10029.1	9098.4
West	1.1.1	Border Crossing Hwy 310 Variation	18.6	239	21.7	2.0	12.9	0.4	79.6	13.3	7313.4	6634.7
West	1.1.1	Border Crossing 500kV Variation	10.1	143	11.8	1.1	7.1	0.2	44.4	7.4	3989.6	3619.4
West	1.1.1	Border Crossing 230kV Variation	8.2	99	9.4	0.9	5.6	0.2	34.3	5.7	3183.1	2887.7
West	1.1.2	Roseau Lake WMA Proposed Route	30.7	443	36.3	3.4	21.6	0.6	136.4	22.6	12218.0	11084.2
West	1.1.2	Roseau Lake WMA Variation 1	44.1	121	46.3	4.4	27.9	0.9	141.8	24.5	15847.9	14377.2
West	1.1.2	Roseau Lake WMA Variation 2	37.5	219	40.7	3.8	24.4	0.8	132.7	22.6	13855.5	12569.7
West	1.1.3	Cedar Bend WMA Proposed Route	24.7	433	30.0	2.8	17.8	0.5	117.6	19.4	10063.1	9129.2
West	1.1.3	Cedar Bend WMA Variation	19.6	209	22.3	2.1	13.4	0.4	79.3	13.3	7557.9	6856.5
West	1.1.3	Cedar Bend WMA Variation Hop 1	0.7	13	0.8	0.1	0.5	0.0	3.3	0.5	277.4	251.6
West	1.1.3	Cedar Bend WMA Variation Hop 2	1.2	25	1.5	0.1	0.9	0.0	6.2	1.0	509.4	462.2
West	1.1.3	Cedar Bend WMA Variation Hop 3	0.9	19	1.2	0.1	0.7	0.0	4.7	0.8	388.2	352.1
West	1.1.4	Beltrami North Proposed Route	16.5	295	20.1	1.9	11.9	0.3	79.1	13.0	6730.7	6106.1
West	1.1.4	Beltrami North Variation 1	15.8	283	19.2	1.8	11.4	0.3	75.9	12.5	6456.6	5857.4
West	1.1.4	Beltrami North Variation 2	19.7	356	24.0	2.3	14.3	0.4	94.9	15.6	8051.9	7304.7
West	1.1.4	Beltrami North Variation Hop 1	1.0	19	1.2	0.1	0.7	0.0	4.8	0.8	395.2	358.5
West	1.1.4	Beltrami North Variation Hop 2	0.9	19	1.2	0.1	0.7	0.0	4.7	0.8	388.2	352.1
West	1.1.5	Beltrami North Central Proposed Route	11.6	211	14.1	1.3	8.4	0.2	55.9	9.2	4738.6	4298.8
West	1.1.5	Beltrami North Central Variation Hop	3.5	46	4.1	0.4	2.4	0.1	15.0	2.5	1366.4	1239.6
West	1.1.5	Beltrami North Central Variation 1	13.7	219	16.4	1.5	9.7	0.3	63.0	10.4	5503.7	4993.0
West	1.1.5	Beltrami North Central Variation 2	12.6	225	15.3	1.4	9.1	0.3	60.4	9.9	5138.3	4661.4
West	1.1.5	Beltrami North Central Variation 3	12.2	184	14.5	1.4	8.6	0.3	55.0	9.1	4870.4	4418.4
West	1.1.5	Beltrami North Central Variation 4	13.5	193	16.0	1.5	9.5	0.3	59.9	9.9	5376.2	4877.3
West	1.1.5	Beltrami North Central Variation 5	15.0	227	17.8	1.7	10.6	0.3	67.8	11.2	6002.8	5445.7
Central	1.2.1	Pine Island Proposed Blue Route	109.8	1770	131.6	12.4	78.3	2.3	507.0	83.7	44253.7	40147.0
Central	1.2.1	Pine Island Proposed Orange Route	105.4	1751	127.0	12.0	75.5	2.2	492.2	81.2	42667.9	38708.4
Central	1.2.2	Beltrami South Central Proposed Route	1.2	29	1.6	0.1	0.9	0.0	6.6	1.1	522.6	474.1
Central	1.2.2	Beltrami South Central Variation	1.7	37	2.2	0.2	1.3	0.0	9.0	1.5	731.0	663.2
Central	1.2.3	Beltrami South Proposed Route	5.6	119	7.0	0.7	4.2	0.1	28.9	4.7	2348.9	2130.9
Central	1.2.3	Beltrami South Variation	7.5	148	9.3	0.9	5.5	0.2	37.6	6.2	3123.6	2833.8
Central	1.2.4	North Black River Proposed Route	8.4	156	10.3	1.0	6.1	0.2	40.9	6.7	3447.6	3127.7
Central	1.2.4	North Black River Variation	9.2	148	11.0	1.0	6.6	0.2	42.4	7.0	3701.4	3357.9
Central	1.2.5	C2 Proposed Route	32.8	541	39.5	3.7	23.5	0.7	152.9	25.2	13279.2	12046.9
Central	1.2.5	C2 Variation	46.0	919	57.1	5.4	33.9	0.9	231.1	37.8	19130.8	17355.5

		Route Variation	Base Length	Total Forest	Construction Emissions							Construction GHG Emissions
		Unit	(mi)	Area (ac)	(tons)							(metric tons)
Section	**Sect. #**	**Buffer (ft.)**	**100**	**100**	**NO_x**	**VOC**	**CO**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CO_2**
Central	1.2.6	J2 Proposed Route	42.2	531	49.0	4.6	29.2	0.9	179.3	29.9	16531.0	14996.9
Central	1.2.6	J2 Variation	45.2	414	50.7	4.8	30.4	0.9	175.7	29.6	17186.2	15591.4
Central	1.2.7	Northome Proposed Route	3.7	18	4.0	0.4	2.4	0.1	12.8	2.2	1368.9	1241.8
Central	1.2.7	Northome Variation	4.0	15	4.3	0.4	2.6	0.1	13.4	2.3	1464.1	1328.2
Central	1.2.8	Cutfoot Proposed Route	4.2	69	5.1	0.5	3.0	0.1	19.6	3.2	1704.7	1546.5
Central	1.2.8	Cutfoot Variation	4.8	51	5.4	0.5	3.2	0.1	19.3	3.2	1831.1	1661.2
East	1.3.1	Effie Proposed Blue Route	41.1	505	47.5	4.5	28.4	0.8	173.2	28.9	16049.8	14560.4
East	1.3.1	Effie Proposed Orange Route	44.6	478	50.7	4.8	30.4	0.9	180.6	30.2	17176.1	15582.2
East	1.3.1	Effie Variation	49.8	607	57.6	5.4	34.4	1.0	209.5	34.9	19445.8	17641.3
East	1.3.2	East Bear Lake Proposed Route	8.9	113	10.4	1.0	6.2	0.2	38.0	6.3	3498.8	3174.1
East	1.3.2	East Bear Lake Variation	10.5	111	12.0	1.1	7.2	0.2	42.4	7.1	4049.0	3673.2
East	1.3.3	Balsam Proposed Blue Route	12.9	94	14.2	1.3	8.5	0.3	47.7	8.1	4837.0	4388.1
East	1.3.3	Balsam Proposed Orange Route	13.7	109	15.2	1.4	9.1	0.3	51.5	8.7	5148.9	4671.1
East	1.3.3	Balsam Variation	17.8	168	20.0	1.9	12.0	0.4	69.8	11.7	6796.2	6165.6
East	1.3.4	Dead Man's Pond Proposed Route	2.2	17	2.4	0.2	1.5	0.0	8.2	1.4	826.3	749.6
East	1.3.4	Dead Man's Pond Variation	2.3	11	2.4	0.2	1.5	0.0	7.8	1.3	834.6	757.1
East	1.3.5	Blackberry Proposed Blue Route	5.4	70	6.3	0.6	3.8	0.1	23.3	3.9	2135.2	1937.1
East	1.3.5	Blackberry Proposed Orange Route	6.1	78	7.0	0.7	4.2	0.1	25.9	4.3	2375.1	2154.7
Central	1.4.2.1	Silver Creek WMA Alignment Modification		26	0.3	0.0	0.2	0.0	2.7	0.4	85.3	77.3
Central	1.4.2.2	Airstrip Alignment Modification		38	0.4	0.0	0.2	0.0	4.0	0.6	125.0	113.4
Central	1.4.2.3	Mizpah Alignment Modification		67	0.8	0.1	0.4	0.0	7.0	1.0	220.7	200.2
Central	1.4.2.4	Gravel Pit Alignment Modification		29	0.3	0.0	0.2	0.0	3.1	0.5	96.0	87.1
East	1.4.3.1	Bass Lake Alignment Modification		60	0.7	0.1	0.4	0.0	6.3	0.9	196.6	178.3
East	1.4.3.2	Wilson Lake Alignment Modification		59	0.7	0.1	0.4	0.0	6.2	0.9	193.8	175.8
East	1.4.3.3	Grass Lake Alignment Modification		32	0.4	0.0	0.2	0.0	3.3	0.5	104.7	95.0
East	1.4.3.4	Dead Man's Pond Alignment Modification		35	0.4	0.0	0.2	0.0	3.7	0.5	115.0	104.3
East	1.4.3.5	Trout Lake Alignment Modification		26	0.3	0.0	0.2	0.0	2.7	0.4	85.5	77.6
Total		**Proposed Blue Route**	**219.0**	**4829**	**277.2**	**26.1**	**164.1**	**4.5**	**1147.8**	**187.2**	**92571.9**	**83981.2**
Total		**Proposed Orange Route**	**220.0**	**4883**	**278.8**	**26.3**	**165.0**	**4.6**	**1156.5**	**188.5**	**93101.1**	**84461.3**
Substation		Iron Range 500 kV Substation		23	11.6	1.1	9.3	0.0	14.6	2.2	3871.5	3512.2
Substation		500 kV Series Compensation Station		6	3.0	0.3	2.4	0.0	4.1	0.6	1017.5	923.1
Substation		(3) Regeneration Stations		1	0.5	0.0	0.4	0.0	0.7	0.1	169.6	153.8
Substation		**Substations total**		**30**	**15.1**	**1.4**	**12.1**	**0.0**	**19.3**	**2.9**	**5058.6**	**4589.1**

Table 2.1
Construction Emissions from Placement of Line and Structures on Existing or Cleared ROW

		Route Variation	Base Length	Total Forest	Construction Emissions							Construction GHG Emissions
		Unit	(mi)	Area (ac)	(tons)							(metric tons)
Section	**Sect. #**	**Buffer (ft.)**	**100**	**100**	**NO_x**	**VOC**	**CO**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CO_2**
West	1.1.1	Border Crossing Proposed Route	25.0	354	25.5	2.4	15.4	0.5	73.2	12.8	8765.0	7951.6
West	1.1.1	Border Crossing Pine Creek Variation	25.7	313	26.2	2.5	15.8	0.5	75.2	13.2	8999.6	8164.4
West	1.1.1	Border Crossing Hwy 310 Variation	18.6	239	19.0	1.8	11.5	0.4	54.5	9.5	6527.3	5921.6
West	1.1.1	Border Crossing 500kV Variation	10.1	143	10.2	1.0	6.2	0.2	29.4	5.1	3519.3	3192.7
West	1.1.1	Border Crossing 230kV Variation	8.2	99	8.3	0.8	5.0	0.2	23.9	4.2	2857.5	2592.3
West	1.1.2	Roseau Lake WMA Proposed Route	30.7	443	31.3	3.0	18.9	0.6	89.9	15.7	10761.0	9762.4
West	1.1.2	Roseau Lake WMA Variation 1	44.1	121	45.0	4.2	27.2	0.9	129.1	22.6	15449.9	14016.1
West	1.1.2	Roseau Lake WMA Variation 2	37.5	219	38.2	3.6	23.1	0.8	109.7	19.2	13135.2	11916.3
West	1.1.3	Cedar Bend WMA Proposed Route	24.7	433	25.1	2.4	15.2	0.5	72.2	12.6	8638.9	7837.2
West	1.1.3	Cedar Bend WMA Variation	19.6	209	20.0	1.9	12.1	0.4	57.4	10.0	6870.5	6232.9
West	1.1.3	Cedar Bend WMA Variation Hop 1	0.7	13	0.7	0.1	0.4	0.0	2.0	0.3	234.6	212.8
West	1.1.3	Cedar Bend WMA Variation Hop 2	1.2	25	1.2	0.1	0.8	0.0	3.6	0.6	427.2	387.6
West	1.1.3	Cedar Bend WMA Variation Hop 3	0.9	19	0.9	0.1	0.6	0.0	2.7	0.5	325.7	295.4
West	1.1.4	Beltrami North Proposed Route	16.5	295	16.8	1.6	10.1	0.3	48.1	8.4	5760.4	5225.9
West	1.1.4	Beltrami North Variation 1	15.8	283	16.1	1.5	9.7	0.3	46.2	8.1	5525.8	5013.0
West	1.1.4	Beltrami North Variation 2	19.7	356	20.0	1.9	12.1	0.4	57.5	10.1	6881.0	6242.5
West	1.1.4	Beltrami North Variation Hop 1	1.0	19	1.0	0.1	0.6	0.0	2.8	0.5	332.7	301.8
West	1.1.4	Beltrami North Variation Hop 2	0.9	19	0.9	0.1	0.6	0.0	2.7	0.5	325.7	295.4
West	1.1.5	Beltrami North Central Proposed Route	11.6	211	11.8	1.1	7.1	0.2	33.8	5.9	4044.6	3669.2
West	1.1.5	Beltrami North Central Variation Hop	3.5	46	3.5	0.3	2.1	0.1	10.2	1.8	1215.1	1102.4
West	1.1.5	Beltrami North Central Variation 1	13.7	219	13.9	1.3	8.4	0.3	40.0	7.0	4783.4	4339.5
West	1.1.5	Beltrami North Central Variation 2	12.6	225	12.8	1.2	7.7	0.3	36.7	6.4	4398.2	3990.1
West	1.1.5	Beltrami North Central Variation 3	12.2	184	12.4	1.2	7.5	0.2	35.6	6.2	4265.2	3869.4
West	1.1.5	Beltrami North Central Variation 4	13.5	193	13.8	1.3	8.3	0.3	39.6	6.9	4741.4	4301.4
West	1.1.5	Beltrami North Central Variation 5	15.0	227	15.3	1.4	9.3	0.3	43.9	7.7	5256.2	4768.4
Central	1.2.1	Pine Island Proposed Blue Route	109.8	1770	111.8	10.6	67.7	2.2	321.1	56.2	38432.1	34865.6
Central	1.2.1	Pine Island Proposed Orange Route	105.4	1751	107.4	10.1	65.0	2.1	308.4	54.0	36908.8	33483.7
Central	1.2.2	Beltrami South Central Proposed Route	1.2	29	1.2	0.1	0.8	0.0	3.6	0.6	427.2	387.6
Central	1.2.2	Beltrami South Central Variation	1.7	37	1.8	0.2	1.1	0.0	5.1	0.9	609.3	552.8
Central	1.2.3	Beltrami South Proposed Route	5.6	119	5.7	0.5	3.4	0.1	16.4	2.9	1957.5	1775.8
Central	1.2.3	Beltrami South Variation	7.5	148	7.7	0.7	4.6	0.2	22.0	3.9	2636.8	2392.1
Central	1.2.4	North Black River Proposed Route	8.4	156	8.5	0.8	5.2	0.2	24.5	4.3	2934.5	2662.2
Central	1.2.4	North Black River Variation	9.2	148	9.4	0.9	5.7	0.2	26.9	4.7	3214.6	2916.3

		Route Variation	Base Length	Total Forest	Construction Emissions							Construction GHG Emissions
		Unit	(mi)	Area (ac)	(tons)							(metric tons)
Section	**Sect. #**	**Buffer (ft.)**	**100**	**100**	**NO_x**	**VOC**	**CO**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CO_2**
Central	1.2.5	C2 Proposed Route	32.8	541	33.5	3.2	20.2	0.7	96.1	16.8	11499.9	10432.7
Central	1.2.5	C2 Variation	46.0	919	46.9	4.4	28.4	0.9	134.6	23.5	16108.2	14613.4
Central	1.2.6	J2 Proposed Route	42.2	531	43.0	4.1	26.0	0.9	123.5	21.6	14784.5	13412.5
Central	1.2.6	J2 Variation	45.2	414	46.0	4.3	27.9	0.9	132.2	23.1	15824.6	14356.0
Central	1.2.7	Northome Proposed Route	3.7	18	3.8	0.4	2.3	0.1	10.9	1.9	1309.7	1188.1
Central	1.2.7	Northome Variation	4.0	15	4.1	0.4	2.5	0.1	11.8	2.1	1414.7	1283.4
Central	1.2.8	Cutfoot Proposed Route	4.2	69	4.3	0.4	2.6	0.1	12.3	2.2	1477.8	1340.6
Central	1.2.8	Cutfoot Variation	4.8	51	4.8	0.5	2.9	0.1	13.9	2.4	1663.3	1509.0
East	1.3.1	Effie Proposed Blue Route	41.1	505	41.9	4.0	25.3	0.8	120.2	21.0	14388.8	13053.6
East	1.3.1	Effie Proposed Orange Route	44.6	478	45.4	4.3	27.5	0.9	130.4	22.8	15604.0	14155.9
East	1.3.1	Effie Variation	49.8	607	50.8	4.8	30.7	1.0	145.8	25.5	17449.4	15830.1
East	1.3.2	East Bear Lake Proposed Route	8.9	113	9.1	0.9	5.5	0.2	26.1	4.6	3127.1	2836.9
East	1.3.2	East Bear Lake Variation	10.5	111	10.7	1.0	6.5	0.2	30.8	5.4	3683.9	3342.0
East	1.3.3	Balsam Proposed Blue Route	12.9	94	13.2	1.2	8.0	0.3	37.8	6.6	4527.8	4107.6
East	1.3.3	Balsam Proposed Orange Route	13.7	109	13.9	1.3	8.4	0.3	40.0	7.0	4790.4	4345.9
East	1.3.3	Balsam Variation	17.8	168	18.2	1.7	11.0	0.4	52.2	9.1	6243.7	5664.3
East	1.3.4	Dead Man's Pond Proposed Route	2.2	17	2.2	0.2	1.4	0.0	6.4	1.1	770.4	698.9
East	1.3.4	Dead Man's Pond Variation	2.3	11	2.3	0.2	1.4	0.0	6.7	1.2	798.4	724.3
East	1.3.5	Blackberry Proposed Blue Route	5.4	70	5.5	0.5	3.4	0.1	15.9	2.8	1905.0	1728.2
East	1.3.5	Blackberry Proposed Orange Route	6.1	78	6.2	0.6	3.7	0.1	17.7	3.1	2118.6	1922.0
Central	1.4.2.1	Silver Creek WMA Alignment Modification		26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Central	1.4.2.2	Airstrip Alignment Modification		38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Central	1.4.2.3	Mizpah Alignment Modification		67	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Central	1.4.2.4	Gravel Pit Alignment Modification		29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
East	1.4.3.1	Bass Lake Alignment Modification		60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
East	1.4.3.2	Wilson Lake Alignment Modification		59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
East	1.4.3.3	Grass Lake Alignment Modification		32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
East	1.4.3.4	Dead Man's Pond Alignment Modification		35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
East	1.4.3.5	Trout Lake Alignment Modification		26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total		**Proposed Blue Route**	**219.0**	**4829**	**223.1**	**21.1**	**135.0**	**4.4**	**640.7**	**112.1**	**76689.1**	**69572.3**
Total		**Proposed Orange Route**	**220.0**	**4883**	**224.2**	**21.2**	**135.6**	**4.4**	**643.7**	**112.6**	**77039.3**	**69890.0**
Substation		Iron Range 500 kV Substation	0.0	23	11.4	1.0	9.2	0.0	13.1	2.0	3824.8	3469.9
Substation		500 kV Seriec Compensation Station		6	3.0	0.3	2.4	0.0	3.4	0.5	997.8	905.2
Substation		(3) Regeneration Stations		1	0.5	0.0	0.4	0.0	0.6	0.1	166.3	150.9
Substation		**Substations total**		**30**	**14.9**	**1.4**	**12.0**	**0.0**	**17.1**	**2.6**	**4988.9**	**4525.9**

Table 2.2 Construction Emissions from Clearing Forest												
		Route Variation	Base Length	Total Forest	Construction Emissions							Construction GHG Emissions
		Unit	(mi)	Area (ac)	(tons)							(metric tons)
Section	**Sect. #**	**Buffer (ft.)**	**100**	**100**	**NO_x**	**VOC**	**CO**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CO_2**
West	1.1.1	Border Crossing Proposed Route	25.0	354	4.0	0.37	2.13	0.01	37.2	5.5	1164.3	1056.3
West	1.1.1	Border Crossing Pine Creek Variation	25.7	313	3.5	0.33	1.88	0.01	32.9	4.9	1029.5	933.9
West	1.1.1	Border Crossing Hwy 310 Variation	18.6	239	2.7	0.25	1.44	0.01	25.1	3.7	786.1	713.1
West	1.1.1	Border Crossing 500kV Variation	10.1	143	1.6	0.15	0.86	0.00	15.0	2.2	470.3	426.7
West	1.1.1	Border Crossing 230kV Variation	8.2	99	1.1	0.10	0.60	0.00	10.4	1.5	325.6	295.4
West	1.1.2	Roseau Lake WMA Proposed Route	30.7	443	5.0	0.47	2.67	0.01	46.5	6.9	1457.0	1321.8
West	1.1.2	Roseau Lake WMA Variation 1	44.1	121	1.4	0.13	0.73	0.00	12.7	1.9	398.0	361.0
West	1.1.2	Roseau Lake WMA Variation 2	37.5	219	2.4	0.23	1.32	0.00	23.0	3.4	720.3	653.5
West	1.1.3	Cedar Bend WMA Proposed Route	24.7	433	4.8	0.45	2.61	0.01	45.5	6.7	1424.2	1292.0
West	1.1.3	Cedar Bend WMA Variation	19.6	209	2.3	0.22	1.26	0.00	21.9	3.2	687.4	623.6
West	1.1.3	Cedar Bend WMA Variation Hop 1	0.7	13	0.1	0.01	0.08	0.00	1.4	0.2	42.8	38.8
West	1.1.3	Cedar Bend WMA Variation Hop 2	1.2	25	0.3	0.03	0.15	0.00	2.6	0.4	82.2	74.6
West	1.1.3	Cedar Bend WMA Variation Hop 3	0.9	19	0.2	0.02	0.11	0.00	2.0	0.3	62.5	56.7
West	1.1.4	Beltrami North Proposed Route	16.5	295	3.3	0.31	1.78	0.01	31.0	4.6	970.3	880.2
West	1.1.4	Beltrami North Variation 1	15.8	283	3.2	0.30	1.70	0.01	29.7	4.4	930.8	844.4
West	1.1.4	Beltrami North Variation 2	19.7	356	4.0	0.37	2.14	0.01	37.4	5.5	1170.9	1062.2
West	1.1.4	Beltrami North Variation Hop 1	1.0	19	0.2	0.02	0.11	0.00	2.0	0.3	62.5	56.7
West	1.1.4	Beltrami North Variation Hop 2	0.9	19	0.2	0.02	0.11	0.00	2.0	0.3	62.5	56.7
West	1.1.5	Beltrami North Central Proposed Route	11.6	211	2.4	0.22	1.27	0.00	22.2	3.3	694.0	629.6
West	1.1.5	Beltrami North Central Variation Hop	3.5	46	0.5	0.05	0.28	0.00	4.8	0.7	151.3	137.3
West	1.1.5	Beltrami North Central Variation 1	13.7	219	2.4	0.23	1.32	0.00	23.0	3.4	720.3	653.5
West	1.1.5	Beltrami North Central Variation 2	12.6	225	2.5	0.24	1.35	0.01	23.6	3.5	740.0	671.4
West	1.1.5	Beltrami North Central Variation 3	12.2	184	2.1	0.19	1.11	0.00	19.3	2.9	605.2	549.0
West	1.1.5	Beltrami North Central Variation 4	13.5	193	2.2	0.20	1.16	0.00	20.3	3.0	634.8	575.9
West	1.1.5	Beltrami North Central Variation 5	15.0	227	2.5	0.24	1.37	0.01	23.8	3.5	746.6	677.3
Central	1.2.1	Pine Island Proposed Blue Route	109.8	1770	19.8	1.86	10.65	0.04	185.9	27.5	5821.6	5281.4
Central	1.2.1	Pine Island Proposed Orange Route	105.4	1751	19.6	1.84	10.54	0.04	183.9	27.2	5759.1	5224.7
Central	1.2.2	Beltrami South Central Proposed Route	1.2	29	0.3	0.03	0.17	0.00	3.0	0.5	95.4	86.5
Central	1.2.2	Beltrami South Central Variation	1.7	37	0.4	0.04	0.22	0.00	3.9	0.6	121.7	110.4
Central	1.2.3	Beltrami South Proposed Route	5.6	119	1.3	0.12	0.72	0.00	12.5	1.9	391.4	355.1
Central	1.2.3	Beltrami South Variation	7.5	148	1.7	0.16	0.89	0.00	15.5	2.3	486.8	441.6
Central	1.2.4	North Black River Proposed Route	8.4	156	1.7	0.16	0.94	0.00	16.4	2.4	513.1	465.5
Central	1.2.4	North Black River Variation	9.2	148	1.7	0.16	0.89	0.00	15.5	2.3	486.8	441.6
Central	1.2.5	C2 Proposed Route	32.8	541	6.1	0.57	3.26	0.01	56.8	8.4	1779.4	1614.2
Central	1.2.5	C2 Variation	46.0	919	10.3	0.96	5.53	0.02	96.5	14.3	3022.6	2742.1
Central	1.2.6	J2 Proposed Route	42.2	531	5.9	0.56	3.20	0.01	55.8	8.3	1746.5	1584.4

		Route Variation	Base Length	Total Forest	Construction Emissions							Construction GHG Emissions
		Unit	(mi)	Area (ac)	(tons)							(metric tons)
Section	**Sect. #**	**Buffer (ft.)**	**100**	**100**	**NO_x**	**VOC**	**CO**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CO_2**
Central	1.2.6	J2 Variation	45.2	414	4.6	0.43	2.49	0.01	43.5	6.4	1361.7	1235.3
Central	1.2.7	Northome Proposed Route	3.7	18	0.2	0.02	0.11	0.00	1.9	0.3	59.2	53.7
Central	1.2.7	Northome Variation	4.0	15	0.2	0.02	0.09	0.00	1.6	0.2	49.3	44.8
Central	1.2.8	Cutfoot Proposed Route	4.2	69	0.8	0.07	0.42	0.00	7.2	1.1	226.9	205.9
Central	1.2.8	Cutfoot Variation	4.8	51	0.6	0.05	0.31	0.00	5.4	0.8	167.7	152.2
East	1.3.1	Effie Proposed Blue Route	41.1	505	5.6	0.53	3.04	0.01	53.0	7.9	1661.0	1506.8
East	1.3.1	Effie Proposed Orange Route	44.6	478	5.3	0.50	2.88	0.01	50.2	7.4	1572.2	1426.3
East	1.3.1	Effie Variation	49.8	607	6.8	0.64	3.65	0.01	63.7	9.4	1996.5	1811.2
East	1.3.2	East Bear Lake Proposed Route	8.9	113	1.3	0.12	0.68	0.00	11.9	1.8	371.7	337.2
East	1.3.2	East Bear Lake Variation	10.5	111	1.2	0.12	0.67	0.00	11.7	1.7	365.1	331.2
East	1.3.3	Balsam Proposed Blue Route	12.9	94	1.1	0.10	0.57	0.00	9.9	1.5	309.2	280.5
East	1.3.3	Balsam Proposed Orange Route	13.7	109	1.2	0.11	0.66	0.00	11.4	1.7	358.5	325.2
East	1.3.3	Balsam Variation	17.8	168	1.9	0.18	1.01	0.00	17.6	2.6	552.6	501.3
East	1.3.4	Dead Man's Pond Proposed Route	2.2	17	0.2	0.02	0.10	0.00	1.8	0.3	55.9	50.7
East	1.3.4	Dead Man's Pond Variation	2.3	11	0.1	0.01	0.07	0.00	1.2	0.2	36.2	32.8
East	1.3.5	Blackberry Proposed Blue Route	5.4	70	0.8	0.07	0.42	0.00	7.4	1.1	230.2	208.9
East	1.3.5	Blackberry Proposed Orange Route	6.1	78	0.9	0.08	0.47	0.00	8.2	1.2	256.5	232.7
Central	1.4.2.1	Silver Creek WMA Alignment Modification		26	0.3	0.03	0.16	0.00	2.7	0.4	85.3	77.3
Central	1.4.2.2	Airstrip Alignment Modification		38	0.4	0.04	0.23	0.00	4.0	0.6	125.0	113.4
Central	1.4.2.3	Mizpah Alignment Modification		67	0.8	0.07	0.40	0.00	7.0	1.0	220.7	200.2
Central	1.4.2.4	Gravel Pit Alignment Modification		29	0.3	0.03	0.18	0.00	3.1	0.5	96.0	87.1
East	1.4.3.1	Bass Lake Alignment Modification		60	0.7	0.06	0.36	0.00	6.3	0.9	196.6	178.3
East	1.4.3.2	Wilson Lake Alignment Modification		59	0.7	0.06	0.35	0.00	6.2	0.9	193.8	175.8
East	1.4.3.3	Grass Lake Alignment Modification		32	0.4	0.03	0.19	0.00	3.3	0.5	104.7	95.0
East	1.4.3.4	Dead Man's Pond Alignment Modification		35	0.4	0.04	0.21	0.00	3.7	0.5	115.0	104.3
East	1.4.3.5	Trout Lake Alignment Modification		26	0.3	0.03	0.16	0.00	2.7	0.4	85.5	77.6
Total		**Proposed Blue Route**	**219.0**	**4829**	**54.0**	**5.07**	**29.06**	**0.11**	**507.1**	**75.1**	**15882.8**	**14408.9**
Total		**Proposed Orange Route**	**220.0**	**4883**	**54.6**	**5.13**	**29.39**	**0.11**	**512.8**	**75.9**	**16061.8**	**14571.3**
Substation		Iron Range 500 kV Substation	0.0	14	0.2	0.01	0.09	0.00	1.5	0.2	46.7	42.4
Substation		500 kV Series Compensation Station		6	0.1	0.01	0.04	0.00	0.6	0.1	19.7	17.9
Substation		(3) Regeneration Stations		1	0.0	0.00	0.01	0.00	0.1	0.0	3.3	3.0
Substation		**Substations total**		**21**	**0.2**	**0.02**	**0.13**	**0.00**	**2.2**	**0.3**	**69.7**	**63.3**

Table 3
Construction Emissions by Activity, By Type of Construction Example
Great Northern Transmission Line Project

Activity		Emissions (tons)							GHG Emissions (metric tons)	Reference
Miles or Acres	**Emission Source**	**NO_x**	**VOC**	**CO**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CO_2**	**Table**
Placement of Line and Structures on Existing or Cleared ROW (50 miles example project)	Exhaust Emissions - Nonroad Equipment	30.07	3.17	17.11	0.05	2.07	1.83	8345.81	7571.32	T5.1
	Exhaust Emissions - On-Road Vehicle (Construction Vehicles)	4.39	0.23	1.60	0.01	0.14	0.13	1552.72	1408.63	T6.1
	Exhaust Emissions - On-Road Vehicles (Commuter Vehicles)	0.38	0.07	3.58	0.00	0.01	0.01	476.65	432.41	T7
	Exhaust Emissions - Helicopters	13.84	1.06	6.78	0.94	4.01	4.01	6640.17	6023.96	T8
	Fugitive Dust Emissions - Work Site	-	-	-	-	102.29	15.67	-	-	T12.1
	Fugitive Dust Emissions - Roads	-	-	-	-	36.36	3.69	-	-	T12.2
	Concrete Batch Plant: Exhaust Emissions - Nonroad Equipment	2.06	0.28	1.71	0.00	0.24	0.14	423.39	384.10	T5.4
	Concrete Batch Plant: Exhaust Emissions - On-Road Vehicles	0.21	0.01	0.05	0.00	0.01	0.01	70.19	63.67	T6.4
	Concrete Batch Plant: Fugitive Dust Emissions - Plant	-	-	-	-	0.20	0.02	-	-	T12.3
	Concrete Batch Plant: Fugitive Dust Emissions - Roads	-	-	-	-	0.94	0.09	-	-	T12.1
	Total	**50.94**	**4.81**	**30.83**	**1.01**	**146.29**	**25.60**	**17508.93**	**15884.10**	
50.0	**per Mile**	**1.02**	**0.10**	**0.62**	**0.02**	**2.93**	**0.51**	**350.18**	**317.68**	
Clearing of Forest.	Exhaust Emissions - Nonroad Equipment	7.91	0.87	3.69	0.01	0.61	0.49	2083.28	1889.95	T5.2
	Exhaust Emissions - On-Road Vehicle (Construction Vehicles)	3.14	0.15	0.99	0.01	0.10	0.09	1027.45	932.11	T6.2
	Exhaust Emissions - On-Road Vehicles (Commuter Vehicles)	0.14	0.03	1.34	0.00	0.01	0.00	178.31	161.77	T7.2
	Exhaust Emissions - Helicopters	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Fugitive Dust Emissions - Work Site					84.60	12.96			T12.2
	Fugitive Dust Emissions - Roads					19.69	1.99			T12.1
	Total	**11.19**	**1.05**	**6.02**	**0.02**	**105.01**	**15.55**	**3289.05**	**2983.82**	
1000.0	**per Acre**	**0.01**	**0.00**	**0.01**	**0.00**	**0.11**	**0.02**	**3.29**	**2.98**	
Converter Station	Exhaust Emissions - Nonroad Equipment	7.17	0.73	5.17	0.01	0.44	0.43	2178.53	1976.36	T5.3
	Exhaust Emissions - On-Road Vehicle (Construction Vehicles)	2.63	0.15	1.70	0.01	0.08	0.08	999.93	907.13	T6.3
	Exhaust Emissions - On-Road Vehicles (Commuter Vehicles)	0.12	0.02	1.11	0.00	0.00	0.00	147.45	133.77	T7.3
	Fugitive Dust Emissions - Work Site	-	-	-	-	1.69	0.26	-	-	T12.2
	Fugitive Dust Emissions - Roads	-	-	-	-	9.19	0.95	-	-	T12.1
	Total	**9.91**	**0.90**	**7.98**	**0.02**	**11.41**	**1.72**	**3325.91**	**3017.26**	
20.00	**per Acre**	**0.50**	**0.05**	**0.40**	**0.00**	**0.57**	**0.09**	**166.30**	**150.86**	

Table 4.1

Site Construction Equipment - Replacement of Line and Structures on Existing ROW (50 Mile ROW Example)

Equipment Type	Equipment Description	ROW Clearing	Access Roads & Pads	Foundation Constr.	Tower Lacing (assembly)	Tower Setting (erection)	Wire Stringing	Restoration	Supervision	Materials Mngmt	Mechanic & Equipment Mngmt	Refueling	Watering & Dust Control	Blasting	Construction Insp.	Materials Testing	ENV Compliance	Surveyors	Sanitation/ Cleanup	Total
		No. of Crews:																		
		2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	2	2	2	-
		Quantity of Equipment:																		
Non-Road Equipment	3-Drum Puller (Heavy)						2													**2**
	3-Drum Puller (Medium)						2													**2**
	Air Compressor				2						2									**4**
	All Terrain Vehicle (ATV)																	2		**2**
	Backhoe		2																2	**4**
	Bobcat		2	2																**4**
	Bulldozer (D-8 Cat or Equivalent)	2	2				2													**6**
	Chipper	2																		**2**
	Crane (30-ton)						2													**2**
	Crane (Rubber-Tired)				2															**2**
	(Heavy)						2													**2**
	Double Bull-Wheel Tensioner (Light)						2													**2**
	Drill Rig			2																**2**
	Excavator	2	2	0																**4**
	Feller Buncher	2																		**2**
	Flail mower or Bush hog	2																		**2**
	Fork Lift									2										**2**
	Generator			1	2	1														**4**
	Hydra-Ax or Mulcher	2																		**2**
	Loader	2	1	1				2												**6**
	Motor Grader		2					2												**4**
	Office Trailer								2											**2**
	Plate Compactor			2																**2**
	Road Sweeper																		2	**2**
	Roller Compactor		2																	**2**
	Scraper		2																	**2**
	Single-Drum Puller (Large)						2													**2**
	Skidder	2																		**2**
	Wagon Drill																			**0**
	Wire Reel Trailer																			**0**
	Total Non-road																			**76**
On-Road Vehicles	Boom Truck									2										**2**
	Concrete Truck			2																**2**
	Crane (20-ton)			2		2	2													**6**
	Cranes (120- to 300-ton)					0														**0**
	Dump Truck		1	1						1									2	**5**
	Fuel Truck											2								**2**
	Mechanics' Truck										2									**2**
	Pick-up Truck	2	2	2	2	2	2	2	2	2				0	2	2	2	2	2	**28**
	Splicing Truck						2													**2**
	Steel Haul Truck									2										**2**
	Truck (1-ton)			1		1	1													**3**
	Truck (2-ton)				1	1	1													**3**
	Truck (5-ton)						0													**0**
	Water Truck		2										2							**4**
	Total On-road																			**61**
Helicopters	Helicopter (Small)						1													**1**
	Helicopter (Large)					1														**1**
	Total All Equipment	18	20	16	9	8	23	6	4	9	4	2	2	0	2	2	2	4	8	**139**

Table 4.2

Site Construction Equipment - Clearing Forest (1000 acres example)

Equipment Type	Equipment Description	ROW Clearing	Access Roads & Pads	Foundation Const.	Tower Lacing (assembly)	Tower Setting (erection)	Wire Stringing	Restoration	Supervision	Materials Mngmt	Mechanic & Equipment Mngmt	Refueling	Watering & Dust Control	Blasting	Construction Insp.	Materials Testing	ENV Comp.	Surveyors	Sanitation / Cleanup	Total
		No. of Crews:																		
		2	2	2	2	2	2	2	2	2	2	2	2	0	5	5	3	3	5	-
		Quantity of Equipment:																		
Non-Road Equipment	3-Drum Puller (Heavy)																			**0**
	3-Drum Puller (Medium)																			**0**
	Air Compressor										2									**2**
	All Terrain Vehicle (ATV)																	2		**2**
	Backhoe																		2	**2**
	Bobcat																			**0**
	Equivalent)	1																		**1**
	Chipper	1																		**1**
	Crane (30-ton)																			**0**
	Crane (Rubber-Tired)																			**0**
	Tensioner (Heavy)																			**0**
	Tensioner (Light)																			**0**
	Drill Rig																			**0**
	Excavator	1																		**1**
	Feller Buncher	1																		**1**
	Flail mower or Bush hog	1																		**1**
	Fork Lift									2										**2**
	Generator																			**0**
	Hydra-Ax or Mulcher	1																		**1**
	Loader	1																		**1**
	Motor Grader																			**0**
	Office Trailer								2											**2**
	Plate Compactor																			**0**
	Road Sweeper																		2	**2**
	Roller Compactor																			**0**
	Scraper																			**0**
	Single-Drum Puller (Large)																			**0**
	Skidder	1																		**1**
	Wagon Drill																			**0**
	Wire Reel Trailer																			**0**
	Total Non-road																			**20**
On-Road Vehicles	Boom Truck									2										**2**
	Concrete Truck																			**0**
	Crane (20-ton)																			**0**
	Cranes (120- to 300-ton)																			**0**
	Dump Truck									2									2	**4**
	Fuel Truck											2								**2**
	Mechanics' Truck										2									**2**
	Pick-up Truck	1							2	2				0	2	2	2	2	2	**15**
	Splicing Truck																			**0**
	Steel Haul Truck									5										**5**
	Truck (1-ton)																			**0**
	Truck (2-ton)																			**0**
	Truck (5-ton)																			**0**
	Water Truck												2							**2**
	Total On-road																			**32**
Helicopters	Helicopter (Small)																			**0**
	Helicopter (Large)																			**0**
	Total All Equipment	**9**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**13**	**4**	**2**	**2**	**0**	**2**	**2**	**2**	**4**	**8**	**52**

Table 4.3

Site Construction Equipment - Substation(40 acre example)

Equipment Type	Equipment Description	Site Mngmt	Surveyors	Site Develop.	Fence Installation	Equipment Footings	Cable Trench, Conduits, Grounding	Steel Structures, Electrical Equip.	Control Bldg. and Wiring	Traffic Control	Construction Insp.	Materials Testing	Total
		Quantity of Equipment:											
Non-Road Equipment	Air Compressor				0	1	0	1	1				**3**
	All Terrain Vehicle (ATV)	1											**1**
	Bobcat\Skid Loader				1	1	0	0					**2**
	Boom Lift							2	2				**4**
	Bulldozer (D-8 Cat or Equivalent)			1	1								**2**
	Bulldozer (D-4 Cat or Equivalent)			1	1								**2**
	Concrete Line Pump				1	1							**2**
	Excavator Mini					1	1						**2**
	Excavator 100 Series			1		1	1						**3**
	Excavator 300 Series			1		1	1						**3**
	Forklift (Telescopic)				3	1		1					**5**
	Generator	1				1		1					**3**
	Wheel Loader (5 CY)			3		1							**4**
	Loader Backhoe	1		1	1	1	1						**5**
	Motor Grader			1		1	1						**3**
	Office Trailer	5		0		0		0					**5**
	Plate Compactor			1		1	1						**3**
	Road Sweeper			1									**1**
	Scraper			1									**1**
	Trencher						1		1				**2**
	Articulated Dump Truck			1									**1**
	Vibratory Compactor			1		1	1						**3**
	Total Off-Road												**60**
On-Road Vehicles	Concrete Truck				1	1							**2**
	Concrete Pump Truck					1							**1**
	Crane (15-ton Boom Truck)					0		1					**1**
	Crane (30-ton)					0		1					**1**
	Crane (120- to 300-ton)					1		1	1				**3**
	Dump Truck			1		1							**2**
	Fuel Truck			1		1		0					**2**
	Welder Truck							1					**1**
	Lowboy Truck			1		1							**2**
	Mechanics' Truck			1		1							**2**
	Pick-up Truck	1	1	3	1	1	1	1	1	1	1	1	**13**
	Splicing Truck								1				**1**
	Truck (1-ton)				1	1	1	1		1			**5**
	Truck (2-ton)						1	1	1				**3**
	Utility Van		1	1					1				**3**
	Water Truck			1									**1**
	Total On-road												**43**
	Total	**9**	**2**	**23**	**11**	**22**	**11**	**12**	**9**	**2**	**1**	**1**	**103**

Table 5.1

Nonroad Equipment Exhaust Emissions - Replacement of Line and Structures on Existing ROW (50 Mile ROW Example)

Equipment Type	Fuel Type	Total No. of Units	Daily Operation per Unit (hrs/day)	Total Working Days per Unit	Equipment Engine Size (hp)	Load Factor	Total Equipment Hourly Usage (hrs)	Emissions (tons)							Emission Factor Reference
								NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2	
3-Drum Puller (Heavy)	Diesel	2	8	260	240	21%	4,160	0.4	0.0	0.1	0.0	0.0	0.0	120.7	Other Construction Equipment
3-Drum Puller (Medium)	Diesel	2	8	260	160	21%	4,160	0.3	0.0	0.1	0.0	0.0	0.0	71.1	Other Construction Equipment
Air Compressor	Diesel	4	7	260	197	59%	7,280	2.1	0.2	0.5	0.0	0.1	0.1	611.1	Air Compressors
All Terrain Vehicle (ATV)	Diesel	2	8	260	22	21%	4,160	0.1	0.0	0.1	0.0	0.0	0.0	14.2	Specialty Vehicle Carts
Backhoe	Diesel	4	9	260	106	59%	9,360	2.0	0.4	2.6	0.0	0.4	0.2	390.2	Tractors/Loaders/Backhoes
Bobcat	Diesel	4	7	260	49	59%	7,280	0.9	0.1	0.5	0.0	0.1	0.1	147.8	Skid Steer Loaders
Bulldozer (D-8 Cat or Equivalent)	Diesel	6	6	260	305	59%	9,360	4.3	0.4	1.8	0.0	0.3	0.3	1388.6	Crawler Tractors/Dozers
Chipper	Diesel	2	8	260	85	59%	4,160	0.8	0.1	0.4	0.0	0.1	0.1	134.6	Chippers/Stump Grinders
Crane (30-ton)	Diesel	2	8	260	152	43%	4,160	0.4	0.0	0.1	0.0	0.0	0.0	151.9	Cranes
Crane (Rubber-Tired)	Diesel	2	8	260	235	43%	4,160	0.7	0.1	0.1	0.0	0.0	0.0	248.7	Cranes
Double Bull-Wheel Tensioner (Heavy)	Diesel	2	8	260	130	21%	4,160	0.3	0.0	0.1	0.0	0.0	0.0	71.1	Other Construction Equipment
Double Bull-Wheel Tensioner (Light)	Diesel	2	8	260	85	21%	4,160	0.2	0.0	0.2	0.0	0.0	0.0	48.3	Other Construction Equipment
Drill Rig	Diesel	2	8	260	325	43%	4,160	3.2	0.2	0.9	0.0	0.1	0.1	467.5	Bore/Drill Rigs
Excavator	Diesel	4	8	260	159	59%	8,320	0.7	0.1	0.3	0.0	0.1	0.1	399.3	Excavators
Feller Buncher	Diesel	2	8	260	243	59%	4,160	1.1	0.1	0.4	0.0	0.1	0.1	339.1	Feller/Bunch/Skidders
Flail mower or Bush hog	Diesel	2	6	260	50	21%	3,120	0.1	0.0	0.0	0.0	0.0	0.0	19.1	Front Mowers
Fork Lift	Diesel	2	8	260	300	59%	4,160	1.0	0.1	0.3	0.0	0.1	0.1	332.4	Rough Terrain Forklifts
Generator	Diesel	4	10	260	43	59%	10,400	1.3	0.1	0.4	0.0	0.1	0.1	180.1	Generator Sets
Hydra-Ax or Mulcher	Diesel	2	8	260	210	59%	4,160	1.1	0.1	0.4	0.0	0.1	0.1	339.1	Other Construction Equipment
Loader	Diesel	6	9	260	369	21%	14,040	2.9	0.2	1.2	0.0	0.2	0.2	731.0	Rubber Tire Loaders
Motor Grader	Diesel	4	10	260	297	59%	10,400	1.6	0.2	0.5	0.0	0.1	0.1	838.7	Graders
Office Trailer	Diesel	2	18	260	43	59%	9,360	1.2	0.1	0.4	0.0	0.1	0.1	162.1	Generator Sets
Plate Compactor	Gasoline	2	8	260	7.9	43%	4,160	0.0	0.1	4.4	0.0	0.0	0.0	17.0	Plate Compactors
Road Sweeper	Diesel	2	6	260	50	43%	3,120	0.2	0.0	0.0	0.0	0.0	0.0	38.1	Sweepers/Scrubbers
Roller Compactor	Diesel	2	8	260	133	43%	4,160	0.4	0.0	0.2	0.0	0.0	0.0	139.8	Rollers
Scraper	Diesel	2	6	260	407	59%	3,120	1.5	0.1	0.6	0.0	0.1	0.1	459.8	Scrapers
Single-Drum Puller (Large)	Diesel	2	10	260	210	21%	5,200	0.5	0.1	0.2	0.0	0.0	0.0	150.9	Other Construction Equipment
Skidder	Diesel	2	8	260	182	59%	4,160	0.8	0.1	0.3	0.0	0.1	0.1	333.7	Rubber Tire Loaders
Wagon Drill	Diesel	0	6	260	450	43%	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Bore/Drill Rigs
Wire Reel Trailer	Diesel	0	2	260	450	21%	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Other Construction Equipment
Total		**76**						**30**	**3**	**17**	**0.05**	**2.1**	**1.8**	**8,346**	**-**

Note:Conservatively assumes all equipment works each day, 5 days per week for a year

Table 5.2
Nonroad Equipment Exhaust Emissions - Clearing Forest (1000 acres example)

Equipment Type	Fuel Type	Total No. of Units	Daily Operation per Unit (hrs/day)	Total Working Days per Unit	Equipment Engine Size (hp)	Load Factor	Total Equipment Hourly Usage (hrs)	Emissions (tons)							Emission Factor Reference
								NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2	
3-Drum Puller (Heavy)	Diesel	0	8	260	240	21%	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Other Construction Equipment
3-Drum Puller (Medium)	Diesel	0	8	260	160	21%	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Other Construction Equipment
Air Compressor	Diesel	2	7	260	197	59%	3,640	1.0	0.1	0.2	0.0	0.0	0.0	305.5	Air Compressors
All Terrain Vehicle (ATV)	Diesel	2	8	260	22	21%	4,160	0.1	0.0	0.1	0.0	0.0	0.0	14.2	Specialty Vehicle Carts
Backhoe	Diesel	2	9	260	106	59%	4,680	1.0	0.2	1.3	0.0	0.2	0.1	195.1	Tractors/Loaders/Backhoes
Bobcat	Diesel	0	7	260	49	59%	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Skid Steer Loaders
Bulldozer (D-8 Cat or Equivalent)	Diesel	1	6	260	305	59%	1,560	0.7	0.1	0.3	0.0	0.0	0.0	231.4	Crawler Tractors/Dozers
Chipper	Diesel	1	8	260	85	59%	2,080	0.4	0.0	0.2	0.0	0.0	0.0	67.3	Chippers/Stump Grinders
Crane (30-ton)	Diesel	0	8	260	152	43%	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Cranes
Crane (Rubber-Tired)	Diesel	0	8	260	235	43%	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Cranes
Double Bull-Wheel Tensioner (Light)	Diesel	0	8	260	130	21%	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Other Construction Equipment
Drill Rig	Diesel	0	8	260	85	21%	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Other Construction Equipment
Excavator	Diesel	0	8	260	325	43%	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Bore/Drill Rigs
Feller Buncher	Diesel	1	8	260	159	59%	2,080	0.2	0.0	0.1	0.0	0.0	0.0	99.8	Excavators
Flail mower or Bush hog	Diesel	1	8	260	243	59%	2,080	0.6	0.1	0.2	0.0	0.0	0.0	169.5	Feller/Bunch/Skidders
Fork Lift	Diesel	1	6	260	50	21%	1,560	0.1	0.0	0.0	0.0	0.0	0.0	9.5	Front Mowers
Generator	Diesel	2	8	260	300	59%	4,160	1.0	0.1	0.3	0.0	0.1	0.1	332.4	Rough Terrain Forklifts
Hydra-Ax or Mulcher	Diesel	0	10	260	43	59%	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Generator Sets
Loader	Diesel	1	8	260	210	59%	2,080	0.6	0.1	0.2	0.0	0.0	0.0	169.5	Other Construction Equipment
Motor Grader	Diesel	1	9	260	369	21%	2,340	0.5	0.0	0.2	0.0	0.0	0.0	121.8	Rubber Tire Loaders
Office Trailer	Diesel	0	10	260	297	59%	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Graders
Plate Compactor	Diesel	2	18	260	43	59%	9,360	1.2	0.1	0.4	0.0	0.1	0.1	162.1	Generator Sets
Road Sweeper	Gasoline	0	8	260	7.9	43%	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Plate Compactors
Roller Compactor	Diesel	2	6	260	50	43%	3,120	0.2	0.0	0.0	0.0	0.0	0.0	38.1	Sweepers/Scrubbers
Scraper	Diesel	0	8	260	133	43%	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Rollers
Single-Drum Puller (Large)	Diesel	0	6	260	407	59%	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Scrapers
Skidder	Diesel	0	10	260	210	21%	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Other Construction Equipment
Wagon Drill	Diesel	1	8	260	182	59%	2,080	0.4	0.0	0.1	0.0	0.0	0.0	166.9	Rubber Tire Loaders
Wagon Drill	Diesel	0	6	260	450	43%	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Bore/Drill Rigs
Wire Reel Trailer	Diesel	0	2	260	450	21%	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Other Construction Equipment
Total		**20**						**8**	**1**	**4**	**0.01**	**0.6**	**0.5**	**2,083**	**-**

Note: Conservatively assumes all equipment works each day, 5 days per week for a year

Table 5.3
Nonroad Equipment Exhaust Emissions - Converter Station Construction

Equipment Type	Fuel Type	Total No. of Units	Daily Operation per Unit (hrs/day)	Total Working Days per Unit	Equipment Engine Size (hp)	Load Factor	Total Equipment Hourly Usage (hrs)	Emissions (tons)							Emission Factor Reference
								NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2	
Air Compressor	Diesel	3	6	130	197	59%	2,340	0.66	0.07	0.15	0.00	0.03	0.03	196.42	Air Compressors
All Terrain Vehicle (ATV)	Diesel	1	5	130	22	21%	650	0.02	0.00	0.02	0.00	0.00	0.00	2.21	Specialty Vehicle Carts
Bobcat\Skid Loader	Diesel	2	6	130	49	59%	1,560	0.19	0.02	0.11	0.00	0.02	0.02	31.66	Skid Steer Loaders
Boom Lift	Diesel	4	6	130	110	43%	3,120	0.20	0.02	0.07	0.00	0.01	0.01	66.62	Rough Terrain Forklifts
Bulldozer (D-8 Cat or Equivalent)	Diesel	2	8	130	305	59%	2,080	0.96	0.09	0.39	0.00	0.06	0.06	308.57	Crawler Tractors/Dozers
Bulldozer (D-4 Cat or Equivalent)	Diesel	2	8	130	85	59%	2,080	0.27	0.02	0.11	0.00	0.02	0.02	86.00	Crawler Tractors/Dozers
Concrete Line Pump	Diesel	2	6	130	40	59%	1,560	0.07	0.01	0.02	0.00	0.00	0.00	21.19	Other Construction Equipment
Excavator Mini	Diesel	2	8	130	20	59%	2,080	0.02	0.00	0.01	0.00	0.00	0.00	12.56	Excavators
Excavator 100 Series	Diesel	3	8	130	81	59%	3,120	0.13	0.02	0.05	0.00	0.01	0.01	76.29	Excavators
Excavator 300 Series	Diesel	3	8	130	115	59%	3,120	0.19	0.03	0.08	0.00	0.02	0.02	108.31	Excavators
Forklift (Telescopic)	Diesel	5	8	130	100	59%	5,200	0.41	0.04	0.14	0.00	0.03	0.03	138.50	Rough Terrain Forklifts
Generator	Diesel	3	6	130	43	59%	2,340	0.29	0.02	0.10	0.00	0.02	0.02	40.52	Generator Sets
Wheel Loader (5 CY)	Diesel	4	8	130	300	59%	4,160	1.97	0.15	0.81	0.00	0.11	0.11	494.74	Rubber Tire Loaders
Loader Backhoe	Diesel	5	8	130	80	21%	5,200	0.22	0.02	0.09	0.00	0.01	0.01	72.02	Tractors/Loaders/Backhoes
Motor Grader	Diesel	3	6	130	297	59%	2,340	0.35	0.05	0.11	0.00	0.02	0.02	188.72	Graders
Office Trailer	Diesel	5	10	130	43	21%	6,500	0.29	0.02	0.10	0.00	0.02	0.02	40.07	Generator Sets
Plate Compactor	Gasoline	3	6	130	7.9	43%	2,340	0.02	0.05	2.47	0.00	0.00	0.00	9.55	Plate Compactors
Road Sweeper	Diesel	1	4	130	50	43%	520	0.03	0.00	0.00	0.00	0.00	0.00	6.35	Sweepers/Scrubbers
Scraper	Diesel	1	8	130	407	59%	1,040	0.49	0.04	0.20	0.00	0.03	0.03	153.27	Scrapers
Trencher	Diesel	2	8	130	80	21%	2,080	0.07	0.01	0.02	0.00	0.00	0.00	20.11	Other Construction Equipment
Roller Compactor	Diesel	3	8	130	133	43%	3,120	0.29	0.03	0.12	0.00	0.03	0.03	104.85	Rollers
Total		**59**						**7.17**	**0.73**	**5.17**	**0.01**	**0.44**	**0.43**	**2178.53**	**-**

Note: Conservatively assumes all equipment works each day, 5 days per week for 1/2 a year

Table 5.4
Nonroad Equipment Exhaust Emissions - Concrete Batch Plant

Equipment Type	Fuel Type	Total No. of Units	Daily Operation per Unit (hrs/day)	Total Working Days per Unit	Equipment Engine Size (hp)	Load Factor	Total Equipment Hourly Usage (hrs)	Emissions (tons)							Emission Factor Reference
								NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2	
Generator	Diesel	1	6	260	43	59%	1,560	0.20	0.02	0.06	0.00	0.01	0.01	27.02	Generator Sets
Wheel Loader (5 CY)	Diesel	1	6	260	300	59%	1,560	0.74	0.06	0.30	0.00	0.04	0.04	185.53	Rubber Tire Loaders
Office Trailer	Diesel	1	6	260	43	21%	1,560	0.07	0.01	0.02	0.00	0.00	0.00	9.62	Generator Sets
Backhoe	Diesel	1	6	260	450	43%	1,560	1.05	0.20	1.32	0.00	0.19	0.08	201.23	Tractors/Loaders/Backhoes
Total								**2.06**	**0.280**	**1.71**	**0.0027**	**0.245**	**0.140**	**423**	**-**

Note: Conservatively assumes all equipment works each day, 5 days per week for one year

Table 6.1

On Road Construction Equipment - Replacement of Line and Structures on Existing ROW (50 Mile ROW Example)

Vehicle	Fuel	Equipment Engine Size (hp)	Load (%)	No. of Units	Round Trips per Day per Unit	Total Round Trips per Day	Travel Distance per Roundtrip		Total Working Days per Unit	Total VMT for Construction Period			Emissions (tons)						
							Paved Roads	Unpaved Roads		Paved Roads	Unpaved Roads	Total	NOx	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
Boom Truck	Diesel	355	21	2	2	4	22.5	7.5	260	23,400	7,800	31,200	0.17	0.01	0.04	0.0005	0.005	0.005	56
Concrete Truck	Diesel	450	59	2	4	8	45	15	260	93,600	31,200	124,800	0.67	0.03	0.15	0.0020	0.020	0.018	224
Crane (20-ton)	Diesel	235	43	6	1	6	22.5	7.5	260	35,100	11,700	46,800	0.25	0.01	0.06	0.0007	0.007	0.007	84
Cranes (120- to 300-ton)	Diesel	245	43	0	1	0	0.05	0.45	260	0	0	0	0.00	0.00	0.00	0.0000	0.000	0.000	0
Dump Truck	Diesel	455	21	5	4	20	22.5	7.5	260	117,000	39,000	156,000	0.84	0.03	0.19	0.0024	0.025	0.023	279
Fuel Truck	Diesel	450	21	2	4	8	30	10	260	62,400	20,800	83,200	0.45	0.02	0.10	0.0013	0.013	0.012	149
Mechanics' Truck	Diesel	400	43	2	2	4	26.25	8.75	260	27,300	9,100	36,400	0.04	0.01	0.07	0.0002	0.002	0.002	22
Pick-up Truck	Diesel	400	43	28	1	28	30	10	260	218,400	72,800	291,200	0.31	0.04	0.46	0.0016	0.012	0.011	189
Splicing Truck	Diesel	400	21	2	1	2	0.1	0.9	260	52	468	520	0.001	0.0001	0.001	0.00000	0.00003	0.00002	0
Steel Haul Truck	Diesel	455	43	2	4	8	30	10	260	62,400	20,800	83,200	0.56	0.02	0.13	0.0014	0.019	0.017	157
Truck (1-ton)	Diesel	400	43	3	4	12	22.5	7.5	260	70,200	23,400	93,600	0.10	0.02	0.17	0.0005	0.005	0.004	57
Truck (2-ton)	Diesel	400	43	3	4	12	22.5	7.5	260	70,200	23,400	93,600	0.50	0.02	0.11	0.0015	0.015	0.014	168
Truck (5-ton)	Diesel	325	43	0	4	0	22.5	7.5	260	0	0	0	0.00	0.00	0.00	0.0000	0.000	0.000	0
Water Truck	Diesel	325	21	4	6	24	7.5	7.5	260	46,800	46,800	93,600	0.50	0.02	0.11	0.0015	0.015	0.014	168
Total				**61**						**826,852**	**307,268**	**1,134,120**	**4**	**0.23**	**1.6**	**0.01**	**0.14**	**0.13**	**1,553**

Note: Conservatively assumes all equipment works each day, 5 days per week

Totals for paved and unpaved roads used for fugitive dust calculations in Table 12.1

Table 6.2
On Road Construction Equipment - Clearing Forest (1000 acres example)

Vehicle	Fuel	Equipment Engine Size (hp)	Load (%)	No. of Units	Round Trips per Day per Unit	Total Round Trips per Day	Travel Distance per Roundtrip		Total Working Days per Unit	Total VMT for Construction Period			Emissions (tons)						
							Paved Roads	Unpaved Roads		Paved Roads	Unpaved Roads	Total	NOx	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
Boom Truck	Diesel	355	21	2	2	4	22.5	7.5	260	23,400	7,800	31,200	0.17	0.01	0.04	0.0005	0.005	0.005	56
Concrete Truck	Diesel	450	59	0	4	0	45	15	260	0	0	0	0.00	0.00	0.00	0.0000	0.000	0.000	0
Crane (20-ton)	Diesel	235	43	0	1	0	22.5	7.5	260	0	0	0	0.00	0.00	0.00	0.0000	0.000	0.000	0
Cranes (120- to 300-ton)	Diesel	245	43	0	1	0	0.05	0.45	260	0	0	0	0.00	0.00	0.00	0.0000	0.000	0.000	0
Dump Truck	Diesel	455	21	4	4	16	22.5	7.5	260	93,600	31,200	124,800	0.67	0.03	0.15	0.0020	0.020	0.018	224
Fuel Truck	Diesel	450	21	2	4	8	30	10	260	62,400	20,800	83,200	0.45	0.02	0.10	0.0013	0.013	0.012	149
Mechanics' Truck	Diesel	400	43	2	2	4	26.25	8.75	260	27,300	9,100	36,400	0.04	0.01	0.07	0.0002	0.002	0.002	22
Pick-up Truck	Diesel	400	43	15	1	15	30	10	260	117,000	39,000	156,000	0.17	0.02	0.25	0.0009	0.006	0.006	101
Splicing Truck	Diesel	400	21	0	1	0	0.1	0.9	260	0	0	0	0.000	0.0000	0.000	0.00000	0.00000	0.00000	0
Steel Haul Truck	Diesel	455	43	5	4	20	30	10	260	156,000	52,000	208,000	1.40	0.06	0.32	0.0034	0.047	0.043	392
Truck (1-ton)	Diesel	400	43	0	4	0	22.5	7.5	260	0	0	0	0.00	0.00	0.00	0.0000	0.000	0.000	0
Truck (2-ton)	Diesel	400	43	0	4	0	22.5	7.5	260	0	0	0	0.00	0.00	0.00	0.0000	0.000	0.000	0
Truck (5-ton)	Diesel	325	43	0	4	0	22.5	7.5	260	0	0	0	0.00	0.00	0.00	0.0000	0.000	0.000	0
Water Truck	Diesel	325	21	2	6	12	7.5	7.5	260	23,400	23,400	46,800	0.25	0.01	0.06	0.0007	0.007	0.007	84
Total				**32**						**503,100**	**183,300**	**686,400**	**3**	**0.15**	**1.0**	**0.01**	**0.10**	**0.09**	**1,027**

Note: Conservatively assumes all equipment works each day, 5 days per week

Totals for paved and unpaved roads used for fugitive dust calculations in Table 12.1

Table 6.3

On-Road Construction Equipment Exhaust Emissions - Converter Station Construction

Vehicle	Fuel	Equipment Engine Size (hp)	Load (%)	No. of Units	Round Trips per Day per Unit	Total Round Trips per Day	Travel Distance per Roundtrip		Total Working Days per Unit	Total VMT for Construction Period			Emissions (tons)						
							Paved Roads	Unpaved Roads		Paved Roads	Unpaved Roads	Total	NOx	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
Concrete Truck	Diesel	450	59%	2	5	10	28.5	1.5	260	74,100	3,900	78,000	0.419	0.017	0.096	0.00122	0.01244	0.01144	140
Concrete Pump Truck	Diesel	450	59%	1	1	1	28.5	1.5	260	7,410	390	7,800	0.042	0.0017	0.010	0.00012	0.00124	0.00114	14.0
Crane (15-ton Boom Truck)	Diesel	215	43%	1	1	1	28.5	1.5	260	3,705	195	3,900	0.021	0.0009	0.005	0.00006	0.00062	0.00057	7.0
Crane (30-ton)	Diesel	235	43%	1	1	1	28.5	1.5	260	3,705	195	3,900	0.021	0.0009	0.005	0.00006	0.00062	0.00057	7.0
Crane (120- to 300-ton)	Diesel	245	43%	3	1	3	28.5	1.5	260	22,230	1,170	23,400	0.126	0.0052	0.0287	0.00037	0.00373	0.00343	41.9
Dump Truck	Diesel	455	21%	2	6	12	28.5	1.5	260	88,920	4,680	93,600	0.502	0.0208	0.115	0.00146	0.01492	0.01373	167.7
Fuel Truck	Diesel	450	21%	2	2	4	28.5	1.5	260	29,640	1,560	31,200	0.167	0.007	0.038	0.00049	0.00497	0.00458	56
Welder Truck	Diesel	300	43%	1	2	2	28.5	1.5	260	14,820	780	15,600	0.017	0.0026	0.028	0.00008	0.00077	0.00071	9.6
Lowboy Truck	Diesel	455	21%	2	6	12	28.5	1.5	260	88,920	4,680	93,600	0.502	0.021	0.115	0.00146	0.01492	0.01373	168
Mechanics' Truck	Diesel	400	43%	2	2	4	28.5	1.5	260	29,640	1,560	31,200	0.035	0.0051	0.056	0.00017	0.00153	0.00141	19.2
Pick-up Truck	Gasoline	400	43%	13	2	26	28.5	1.5	260	192,660	10,140	202,800	0.083	0.015	0.724	0.00058	0.00247	0.00219	87
Splicing Truck	Diesel	400	21%	1	1	1	28.5	1.5	260	7,410	390	7,800	0.009	0.0013	0.014	0.00004	0.00038	0.00035	4.8
Truck (1-ton)	Diesel	300	43%	5	4	20	28.5	1.5	260	148,200	7,800	156,000	0.173	0.026	0.282	0.00084	0.00767	0.00706	95.8
Truck (2-ton)	Diesel	400	43%	3	2	6	28.5	1.5	260	44,460	2,340	46,800	0.251	0.0104	0.057	0.00073	0.00746	0.00686	83.8
Utility Van	Diesel	300	43%	3	2	6	28.5	1.5	260	44,460	2,340	46,800	0.052	0.008	0.084	0.00025	0.00230	0.00212	28.7
Water Truck	Diesel	400	21%	1	5	5	28.5	1.5	260	37,050	1,950	39,000	0.209	0.0087	0.048	0.00061	0.00622	0.00572	69.9
Total										**837,330**	**44,070**	**881,400**	**2.6**	**0.15**	**1.7**	**0.009**	**0.08**	**0.08**	**1,000**

Note: Conservatively assumes all equipment works each day, 5 days per week

Totals for paved and unpaved roads used for fugitive dust calculations in Table 12.1

Table 6.4
On-Road Construction Equipment Exhaust Emissions - Concrete Batch Plant

Vehicle	Fuel	Equipment Engine Size (hp)	No. of Units	Round Trips per Day per Unit	Total Round Trips per Day	Travel Distance per Roundtrip		Total Working Days per Unit	Total VMT for Construction Period			Emissions (tons)						
						Paved Roads	Unpaved Roads		Paved Roads	Unpaved Roads	Total	NOx	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
Concrete Redi-Mix Truck	Diesel	400	4	1	4	45	15	120	21,600	7,200	28,800	0.15	0.006	0.035	0.0005	0.0046	0.0042	52
Dump Truck	Diesel	450	1	1	1	22.5	7.5	120	2,700	900	3,600	0.02	0.001	0.004	0.00006	0.0006	0.0005	6
Pick-up Truck	Diesel	400	1	1	1	30	10	120	3,600	1,200	4,800	0.01	0.001	0.008	0.00003	0.0002	0.0002	3
Bulk Cement Tanker Truck	Diesel	450	1	1	1	30	10	120	3,600	1,200	4,800	0.03	0.001	0.007	0.00008	0.0011	0.0010	9
Total									**31,500**	**10,500**	**42,000**	**0.21**	**0.009**	**0.055**	**0.0006**	**0.006**	**0.006**	**70**

Note: Conservatively assumes all equipment works each day, 5 days per week

Totals for paved and unpaved roads used for fugitive dust calculations in Table 12.1

Table 7
On-Road Vehicle (Commuter Vehicles) Exhaust Emissions

Construction Activity	Total Days	# Workers	VMT/ worker/ day	Daily Totals (VMT/day)		Construction Totals (VMT)			Emissions[a] (tons)						
				Paved Roads	Unpaved Roads	Paved Roads	Unpaved Roads	TOTAL	NOx	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
Replacement of Line and Structures on Existing ROW (50 Mile ROW Example)	260	139	35	4622	243	1,201,655	63,245	1,264,900	0.383	0.067	3.58	0.0032	0.0139	0.0123	477
Site Construction Equipment - Clearing Forest (1000 acres example)	260	52	35	1729	91	449,540	23,660	473,200	0.143	0.025	1.34	0.0012	0.0052	0.0046	178
Converter Station Construction	260	43	35	1430	75	371,735	19,565	391,300	0.119	0.021	1.11	0.0010	0.0043	0.0038	147

Notes: Commuter vehicles include 50% passenger cars and 50% passenger trucks.
One worker, one commute per piece of equipment estimated in Table 4.1-4,3, 5 days per week for a year
5% of commute will be on unpaved roads for fugitive dust calculations in Table 12.1

Table 8
Helicopter Exhaust Emissions - Transmission Line Segment Construction

Aircraft	Engine	No. of Engines	Days of Operation	Mode	Engine Setting	Mode Duration (hrs/day)	Total Emissions (tons)					
							NO_x	VOC	CO	SO_2	PM	CO_2
Helicopter (Small)	T400-CP-400	1	260	Idle Out	Ground Idle	0.058	0.003	0.011	0.031	0.001	0.002	4
				Climb Out	Cruise	0.11	0.006	0.017	0.062	0.001	0.003	7
				Work	Military	7.67	1.383	0.051	0.745	0.147	0.626	1035
				Approach	Cruise	0.11	0.039	0.001	0.004	0.003	0.015	21
				Idle In	Ground Idle	0.058	0.003	0.011	0.031	0.001	0.002	4
				Subtotal		**8.00**	**1.434**	**0.091**	**0.873**	**0.152**	**0.647**	**1071**
Helicopter (Large)	T700-GE-700	2	260	Idle Out	Ground Idle	0.058	0.006	0.114	0.107	0.001	0.003	7
				Climb Out	Flight Max	0.11	0.106	0.005	0.074	0.007	0.018	52
				Work	Overspeed	9.67	12.113	0.726	5.553	0.770	3.288	5430
				Approach	Flight Max	0.11	0.171	0.008	0.061	0.010	0.052	73
				Idle In	Ground Idle	0.058	0.006	0.114	0.107	0.001	0.003	7
				Subtotal		**10.00**	**12.402**	**0.967**	**5.903**	**0.790**	**3.363**	**5569**
Total						**-**	**14**	**1**	**7**	**1**	**4**	**6,640**

Table 9
Nonroad Equipment Exhaust Emission Factors - Koochiching County MN

Equipment Type	Fuel Type	Equipment Engine Size (hp)	Emission Factor (gm/hp-hr per hour)							Emission Factor Reference
			NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2	
3-Drum Puller (Heavy)	Diesel	240	1.72	0.17	0.58	0.003	0.11	0.11	522	Other Construction Equipment
3-Drum Puller (Medium)	Diesel	160	1.65	0.17	0.68	0.003	0.15	0.15	461	Other Construction Equipment
Air Compressor	Diesel	197	2.20	0.22	0.49	0.004	0.10	0.09	655	Air Compressors
All Terrain Vehicle (ATV)	Diesel	22	5.74	1.50	6.27	0.005	0.89	0.86	668	Specialty Vehicle Carts
Backhoe	Diesel	100	3.16	0.61	3.97	0.004	0.56	0.25	605	Tractors/Loaders/Backhoes
Bobcat	Diesel	49	3.92	0.45	2.16	0.004	0.36	0.34	637	Skid Steer Loaders
Bulldozer (D-8 Cat or Equivalent)	Diesel	305	2.33	0.21	0.95	0.004	0.14	0.14	748	Crawler Tractors/Dozers
Chipper	Diesel	85	3.44	0.37	1.92	0.004	0.33	0.32	585	Chippers/Stump Grinders
Crane (30-ton)	Diesel	152	1.48	0.16	0.42	0.003	0.10	0.10	507	Cranes
Crane (Rubber-Tired)	Diesel	235	1.45	0.16	0.32	0.003	0.06	0.06	537	Cranes
Double Bull-Wheel Tensioner (Heavy)	Diesel	130	2.04	0.21	0.84	0.003	0.19	0.18	568	Other Construction Equipment
Double Bull-Wheel Tensioner (Light)	Diesel	85	2.23	0.23	2.08	0.004	0.27	0.26	590	Other Construction Equipment
Drill Rig	Diesel	325	4.97	0.34	1.45	0.004	0.22	0.21	729	Bore/Drill Rigs
Excavator	Diesel	159	0.81	0.13	0.33	0.003	0.07	0.07	464	Excavators
Feller Buncher	Diesel	243	1.70	0.17	0.58	0.003	0.11	0.11	516	Other Construction Equipment
Flail mower or Bush hog	Diesel	50	3.04	0.15	0.55	0.003	0.08	0.08	528	Other Construction Equipment
Fork Lift	Diesel	300	1.22	0.13	0.41	0.002	0.08	0.08	410	Rough Terrain Forklifts
Generator	Diesel	43	4.49	0.36	1.47	0.005	0.28	0.27	619	Generator Sets
Hydra-Ax or Mulcher	Diesel	210	1.97	0.20	0.67	0.003	0.13	0.12	597	Other Construction Equipment
Loader	Diesel	369	2.43	0.19	0.99	0.004	0.14	0.14	610	Rubber Tire Loaders
Motor Grader	Diesel	297	0.78	0.11	0.24	0.002	0.04	0.04	418	Graders
Office Trailer	Diesel	43	4.49	0.36	1.47	0.005	0.28	0.27	619	Generator Sets
Plate Compactor	Gasoline	7.9	2.61	5.43	282.28	0.015	0.12	0.11	1,090	Plate Compactors
Road Sweeper	Diesel	50	2.73	0.12	0.24	0.003	0.03	0.03	515	Sweepers/Scrubbers
Roller Compactor	Diesel	133	1.47	0.17	0.63	0.003	0.15	0.14	533	Rollers
Scraper	Diesel	407	1.79	0.16	0.73	0.003	0.11	0.10	557	Scrapers
Single-Drum Puller (Large)	Diesel	210	1.97	0.20	0.67	0.003	0.13	0.12	597	Other Construction Equipment
Skidder	Diesel	182	1.72	0.20	0.58	0.004	0.11	0.10	678	Rubber Tire Loaders
Wagon Drill	Diesel	450	3.59	0.25	1.05	0.003	0.16	0.15	527	Bore/Drill Rigs
Wire Reel Trailer	Diesel	450	2.69	0.19	1.15	0.003	0.16	0.15	527	Other Construction Equipment

Source: Emission Factors from MOVES2014, NONROAD modeling of Koochinching County, MN, 2018

Notes: Nonroad only outputs THC, so THC assumed equivalent to VOC

Table 10 On-Road Vehicle Exhaust Emission Factors								
		Emission Factor[1] (g/VMT)						
Vehicle Type	**Fuel Type**	**NO_x**	**VOC**	**CO**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**
Passenger Car	Gasoline	0.18	0.03	1.89	0.002	0.01	0.01	293.16
Passenger Truck	Gasoline	0.37	0.07	3.24	0.003	0.01	0.01	390.55
Passenger Truck	Diesel	0.96	0.13	1.45	0.005	0.04	0.03	588.17
Light Commercial Truck	Diesel	1.01	0.15	1.64	0.005	0.04	0.04	557.29
Combination Short-Haul Truck	Diesel	4.87	0.20	1.11	0.014	0.14	0.13	1625.08
Combination Long-Haul Truck	Diesel	6.09	0.26	1.40	0.015	0.20	0.19	1708.15

(1) Emission factors for EPA MOVES2014, modeling of Koochinching County, MN, 2018

Table 11
Helicopter Exhaust Emission Factors

Engine	Engine Setting	Fuel Flow (lb/hr)	Emission Factor (lb/1000 lb of fuel) (1), (2), (3)						Emission Factor (lb/hr)					
			NO_x	VOC	CO	SO_2	PM	CO_2	NO_x	VOC	CO	SO_2	PM	CO_2
T400-CP-400	Ground Idle	138	3.05	10.42	29.78	0.52	1.48	3667	0.42	1.438	4.11	0.072	0.20	506
	Flight Idle	143	3.08	8.65	30.71	0.52	1.26	3667	0.44	1.237	4.39	0.074	0.18	524
	Cruise	283	4.90	0.18	2.64	0.52	2.22	3667	1.39	0.051	0.75	0.147	0.63	1038
	Military	412	6.68	0.13	0.75	0.52	2.60	3667	2.75	0.054	0.31	0.214	1.07	1511
T700-GE-700	Ground Idle	133	2.78	56.67	53.18	0.52	1.48	3667	0.37	7.537	7.07	0.069	0.20	488
	Flight Idle	500	7.56	0.37	5.25	0.52	1.26	3667	3.78	0.185	2.63	0.260	0.63	1833
	Flight Max	589	8.18	0.49	3.75	0.52	2.22	3667	4.82	0.289	2.21	0.306	1.31	2160
	Overspeed	706	8.61	0.39	3.09	0.52	2.60	3667	6.08	0.275	2.18	0.367	1.84	2589

Source: United States Air Force IERA. 2002. Air Emissions Inventory Guidance Document for Mobile Sources at Air Force Installations. IERA-RS-BR-SR-2001-0010. January.

(1) SO2 emission factor calculated by assuming sulfur content of fuel of 0.026% by weight.

(2) PM and HAP emission factors for T400-CP-400 engine based on PM and HAP emission factors listed for T700-GE-700 engine.

(3) CO2 emission factors calculated by multiplying ratio of CO2 to C (44/12) by 1,000.

Table 12.1 Fugitive Dust Emissions - Roads							
				Emission Factor[1] (lb/VMT)		Emissions (tons)	
Construction Activity	**Vehicle Type**	**Road Type**	**Total Mileage (VMT)**	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Placement of Line and Structures on Existing or Cleared ROW	Construction Vehicles	Paved	826,852	0.0068	0.0007	2.8	0.3
		Unpaved	307,268	0.16	0.016	24.4	2.4
	Commuter Vehicles	Paved	1,201,655	0.0068	0.0007	4.1	0.4
		Unpaved	63,245	0.16	0.016	5.0	0.5
	Total					**36.4**	**3.7**
Clearing Forest	Construction Vehicles	Paved	503,100	0.01	0.001	1.7	0.2
		Unpaved	183,300	0.16	0.016	14.6	1.5
	Commuter Vehicles	Paved	449,540	0.01	0.001	1.5	0.2
		Unpaved	23,660	0.16	0.016	1.9	0.2
	Total					**19.7**	**2.0**
Converter Station	Construction Vehicles	Paved	837,330	0.0068	0.0007	2.9	0.3
		Unpaved	44,070	0.16	0.016	3.5	0.3
	Commuter Vehicles	Paved	371,735	0.0068	0.0007	1.3	0.1
		Unpaved	19,565	0.16	0.016	1.6	0.2
	Total					**9.2**	**1.0**
Concrete Batch Plant	-	Paved	31,500	0.01	0.001	0.1	0.0
		Unpaved	10,500	0.16	0.016	0.83	0.08
	Total					**0.9**	**0.1**

(1) Derivation table below.

Paved Roads - Emission Factor Derivation Table

E = (k(s/12)0.65(W/3)1.5-C)	AP-42 Section 13.2.1 (11/06 version)			
where: E = particulate emission factor (lb/VMT) k = particle size multiplier sL = road surface silt loading (g/m2) W = average vehicle weight (tons) C = emission factor for 1980's vehicle fleet exhaust, break wear and tire wear				
Parameter	**Units**	**PM_{10}**	**$PM_{2.5}$**	**Reference**
Mean Vehicle Weight	tons	3	3	Assumption
k factor	lb/VMT	0.016	0.0024	Table 13.2-1.1
Silt Loading, sL	g/m2	0.6	0.6	Table 13.2.1-3
Emission factor, C	lb/VMT	0.00047	0.00036	Table 13.2.1-2

Unpaved Roads - Emission Factor Derivation

E = k(s/12)a(W/3)b	AP-42 Section 13.2.2 (11/06 version)			
Controlled E = E * ((100-CE)/100) where: E = particulate emission factor (lb/VMT) k, a, b = empirical constants for industrial roads s = surface material silt content (%) W = average vehicle weight (tons)				
Parameter	**Units**	**PM_{10}**	**$PM_{2.5}$**	**Reference**
Mean Vehicle Weight	**tons**	4	4	Assumption
Constant, k	lb/VMT	1.5	0.15	Table 13.2.2-2
Constant, a		0.9	0.9	Table 13.2.2-2
Constant, b		0.45	0.45	Table 13.2.2-2
Silt content, s	%	4	4	Unpaved Road Surface Material Silt Content Values Used in the 1999 NEI
Control Efficiency, CE	**%**	75	75	Assumption based on regular watering

Table 12.2 Fugitive Dust Emissions - General Construction Activities						
Construction Activity	Disturbance[1] (acres)	Duration of Activity (months)	Emission Factor[2] (ton/acre/month)		Emissions (tons)	
			PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Placement of Line and Structures on Existing or Cleared ROW	60.46	12	0.141	0.0216	102.3	15.7
Cleared Forest	50.00	12	0.141	0.0216	84.6	13.0
Converter Station	1.00	12	0.141	0.0216	1.7	0.3

(1) Area of disturbance is listed as estimated average disturbance area, assumed to be 5% of total disturbed area

(2) See emission factor derivation table below.

Emission Factor Derivation Table

Parameter			Units	TSP [3]	PM_{10} [4]	$PM_{2.5}$ [5]
Uncontrolled Emission Factor [3] (based on 30 days/month)			ton/acre/month	1.2	0.56	0.086
Controlled Emission Factor [6] (based on 30 days/month)			ton/acre/month	0.3	0.141	0.0216

(3) Emission factor from AP-42 Section 13.2.3 for TSP.

(4) PM10 emission factor calculated by multiplying TSP emission factor by 0.42 (ratio of PM10 to PM30 in AP-42 Section 13.2.4)

(5) PM2.5 emission factor calculated by multiplying TSP emission factor by 0.072 (ratio of PM2.5 to PM30 in AP-42 Section 13.2.4)

(6) Assume 75% dust control factor based on watering.

Table 12.3 Fugitive Dust Emissions - Concrete Batch Plant					
Emission Source	Material	Material Throughput (tons)	PM_{10} Emission Factor[1] (lb/ton)	Emissions[2] (tons)	
				PM_{10}	$PM_{2.5}$
Cement Unloading to Silo	Cement	3,030	0.00034	0.0005	0.000052
Cement Supplement Unloading to Silo	Cement Supplement	450	0.0049	0.0011	0.00011
Mixer Loading	Cement & Cement Supplement	3,480	0.0184	0.032	0.0032
Truck Loading	Cement & Cement Supplement	3,480	0.098	0.1705	0.01705
TOTAL				**0.20**	**0.020**

(1) Emission Factors from AP-42 Section 11.12, Table 11.12-2. Assuming Default Emission controls per AP-42 Section 11.12

(2) PM2.5 emissions assumed to be 10% of PM10 emissions.

Material Data

Parameter	Material Throughput (tons)
Concrete[3]	24,832
Course Aggregate[4]	11,509
Sand[4]	8,812
Cement[4]	3,030
Cement Supplement[4]	450

(3) Based on production of 12,800 cubic yards of concrete and wet concrete density of 1.94 tons/cubic yard (2,300 kg/m3).

(4) Based on average material composition in AP-42 Section 11.12.

Table 13
Forest Carbon Sink Removed and Loss of Average Annual CO2 uptake emissions , All Route Variations
Great Northern Transmission Line Project

Route Variation	Total Acres Forest within 1500 ft Buffer (only within 100 ft will be removed)	Acres of Forest Land Removed 100ft Buffer	% Removed	C/CO_2e Sink Removed Calculations			Average Annual CO_2 uptake emission factors (CO_2)/acre[2]	Annual Reduction in CO2 uptake (MT CO_2/ year)
				Mean Carbon density (Total nonsoil) at age of forest years (Average MT/acre)[1]	Total Carbon Sink Removed MT Carbon	Total Carbon Sink Removed MT CO_2		
Border Crossing Proposed Route	5836.74	354	6.07%	45.3	16,036.2	58,853	2.37	838
Border Crossing Pine Creek Variation	5249.16	313	5.96%	45.3	14,178.9	52,037	2.37	741
Border Crossing Hwy 310 Variation	4455.97	239	5.36%	45.3	10,826.7	39,734	2.37	566
Border Crossing 500kV Variation	2796.1	143	5.11%	45.3	6,477.9	23,774	2.37	339
Border Crossing 230kV Variation	1896	99	5.22%	45.3	4,484.7	16,459	2.37	234
Roseau Lake WMA Proposed Route	7340.2	443	6.04%	45.3	20,067.9	73,649	2.37	1,049
Roseau Lake WMA Variation 1	2615.04	121	4.63%	45.3	5,481.3	20,116	2.37	286
Roseau Lake WMA Variation 2	4259.87	219	5.14%	45.3	9,920.7	36,409	2.37	518
Cedar Bend WMA Proposed Route	8033.66	433	5.39%	45.3	19,614.9	71,987	2.37	1,025
Cedar Bend WMA Variation	4176.5	209	5.00%	45.3	9,467.7	34,746	2.37	495
Cedar Bend WMA Variation Hop 1	405.82	13	3.20%	45.3	588.9	2,161	2.37	31
Cedar Bend WMA Variation Hop 2	604.54	25	4.14%	45.3	1,132.5	4,156	2.37	59
Cedar Bend WMA Variation Hop 3	502.12	19	3.78%	45.3	860.7	3,159	2.37	45
Beltrami North Proposed Route	5961.19	295	4.95%	45.3	13,363.5	49,044	2.37	698
Beltrami North Variation 1	5392.49	283	5.25%	45.3	12,819.9	47,049	2.37	670
Beltrami North Variation 2	7189.81	356	4.95%	45.3	16,126.8	59,185	2.37	843
Beltrami North Variation Hop 1	507.94	19	3.74%	45.3	860.7	3,159	2.37	45
Beltrami North Variation Hop 2	502.12	19	3.78%	45.3	860.7	3,159	2.37	45
Beltrami North Central Proposed Route	4305.51	211	4.90%	45.3	9,558.3	35,079	2.37	499
Beltrami North Central Variation Hop	1421.43	46	3.24%	45.3	2,083.8	7,648	2.37	109
Beltrami North Central Variation 1	5005.19	219	4.38%	45.3	9,920.7	36,409	2.37	518
Beltrami North Central Variation 2	4653.29	225	4.84%	45.3	10,192.5	37,406	2.37	533
Beltrami North Central Variation 3	4460.42	184	4.13%	45.3	8,335.2	30,590	2.37	436
Beltrami North Central Variation 4	4674.42	193	4.13%	45.3	8,742.9	32,086	2.37	457
Beltrami North Central Variation 5	5219.19	227	4.35%	45.3	10,283.1	37,739	2.37	537
Pine Island Proposed Blue Route	38203.29	1770	4.63%	45.3	80,181.0	294,264	2.37	4,190
Pine Island Proposed Orange Route	37684.73	1751	4.65%	45.3	79,320.3	291,106	2.37	4,145
Beltrami South Central Proposed Route	599	29	4.84%	45.3	1,313.7	4,821	2.37	69
Beltrami South Central Variation	778.03	37	4.76%	45.3	1,676.1	6,151	2.37	88
Beltrami South Proposed Route	2185.38	119	5.45%	45.3	5,390.7	19,784	2.37	282
Beltrami South Variation	2887.65	148	5.13%	45.3	6,704.4	24,605	2.37	350
North Black River Proposed Route	3190.65	156	4.89%	45.3	7,066.8	25,935	2.37	369
North Black River Variation	3296.35	148	4.49%	45.3	6,704.4	24,605	2.37	350
C2 Proposed Route	11921.63	541	4.54%	45.3	24,507.3	89,942	2.37	1,281
C2 Variation	16120.7	919	5.70%	45.3	41,630.7	152,785	2.37	2,175
J2 Proposed Route	15110.07	531	3.51%	45.3	24,054.3	88,279	2.37	1,257
J2 Variation	15860.45	414	2.61%	45.3	18,754.2	68,828	2.37	980
Northome Proposed Route	1417.5	18	1.27%	45.3	815.4	2,993	2.37	43
Northome Variation	1553.8	15	0.97%	45.3	679.5	2,494	2.37	36
Cutfoot Proposed Route	1651.52	69	4.18%	45.3	3,125.7	11,471	2.37	163
Cutfoot Variation	1875.06	51	2.72%	45.3	2,310.3	8,479	2.37	121
Effie Proposed Blue Route	14722.47	505	3.43%	45.3	22,876.5	83,957	2.37	1,195
Effie Proposed Orange Route	15801.32	478	3.03%	45.3	21,653.4	79,468	2.37	1,131
Effie Variation	17696.3	607	3.43%	45.3	27,497.1	100,914	2.37	1,437
East Bear Lake Proposed Route	3382.14	113	3.34%	45.3	5,118.9	18,786	2.37	267
East Bear Lake Variation	3909.32	111	2.84%	45.3	5,028.3	18,454	2.37	263
Balsam Proposed Blue Route	4540.96	94	2.07%	45.3	4,258.2	15,628	2.37	223
Balsam Proposed Orange Route	4828.18	109	2.26%	45.3	4,937.7	18,121	2.37	258
Balsam Variation	6189.32	168	2.71%	45.3	7,610.4	27,930	2.37	398
Dead Man's Pond Proposed Route	903.82	17	1.88%	45.3	770.1	2,826	2.37	40
Dead Man's Pond Variation	924.75	11	1.19%	45.3	498.3	1,829	2.37	26
Blackberry Proposed Blue Route	2004.22	70	3.49%	45.3	3,171.0	11,638	2.37	166
Blackberry Proposed Orange Route	1982.51	78	3.93%	45.3	3,533.4	12,968	2.37	185
Silver Creek WMA Alignment Modification	538.17	26	4.83%	45.3	1,177.8	4,323	2.37	62
Airstrip Alignment Modification	712.91	38	5.33%	45.3	1,721.4	6,318	2.37	90
Mizpah Alignment Modification	1047.23	67	6.40%	45.3	3,035.1	11,139	2.37	159
Gravel Pit Alignment Modification	582.97	29	4.97%	45.3	1,313.7	4,821	2.37	69
Bass Lake Alignment Modification	1045.95	60	5.74%	45.3	2,718.0	9,975	2.37	142
Wilson Lake Alignment Modification	1023.82	59	5.76%	45.3	2,672.7	9,809	2.37	140
Grass Lake Alignment Modification	546.32	32	5.86%	45.3	1,449.6	5,320	2.37	76
Dead Man's Pond Alignment Modification	684.1	35	5.12%	45.3	1,585.5	5,819	2.37	83
Trout Lake Alignment Modification	525.03	26	4.95%	45.3	1,177.8	4,323	2.37	62
Proposed Blue Route	71398.45	4828.5	6.76%	45.3	218,731.1	802,743	2.37	11,430
Proposed Orange Route	72228.92	4883.4	6.76%	45.3	221,218.0	811,870	2.37	11,560

(1) Smith et al. 2006, Spruce-Balsam Pine Northern Lake States, Table A11

(2) Net annual stock change in live tree carbon between year 25 and 45, which is from the difference in stocks divided by the length of the interval between stocks x total acres