

Assumptions		Site-Specific	
Assumed Average MW of NAPL	250 (g/mol)	Pipe Diameter	0.5 (ft)
Assumed NAPL Temperature in Subsurface	15 (°C)	Pipe Length	150 (ft)
Assumed Time to Remove Pipe	4 (hr)	Cut Length (ft)	15 (ft)
Assumed Pipe % Filled with NAPL	10%	Bottom of Excavation Surface Area	9 (ft ²)
Assumed Volume of Pipe HeadSpace	0.74 (m ³)	Pile Surface Area (Assume 2.5'x2.5')	4 (m ²)
Assumed Time to Excavate Volume of Soil	20 (hr)	Time per Section (6-minute Segment)	360 (s)
Assumed NAPL Temperature in Pipe	60 (°C)	Emitting Surface Area	0.11 (m ²)
		Excavation Depth	4 (ft)
		Excavation Depth	1.2 (m)
		Volume of Soil Moved	0.50 (ft ³)
		Volume of Soil Moved	0.0032 (m ³)

Site-Specific	
TOC of Soil	0.006 (g OC/g soil)
Excavation Rate	8.85E-06 (m ³ /s)

Conversion Factors		Constants	
cm ³ /m ³	1E+06	Typical Bulk Density	1.5 (g/cm ³)
cm ² /m ²	1E+04	R	8.21E-05 (m ³ atm/K/mol)
g/ug	1E+06	R	8.31E-03 (kJ/K/mol)
ft/m	3.3	R	62.381 (mm Hg*cm ³ /mol/K)
s/yr	31,536,000	Soil Gas to Atmosphere Exchange Constant (Wet Soils)	0.1 (%/100)
mm Hg/atm	760	Air-Filled Porosity (Wet or Compacted Soils)	0.35
ft/m	3.3	Total Porosity	0.625 Eklund 1997 Default
hr/yr	8,760	Gas-Phase Mass Transfer Coefficient	0.15 cm/s Eklund 1997 Default
g/lb	454	Time since Start of Excavation of Soil of Interest	60 s Eklund 1997 Default
Convert to Kelvin	273.15		

Analyte	MW (g/mol)	Vapor Pressure @ 25°C (mm Hg)	Diffusivity in Air (cm ² /s)	Average Measured Concentration in NAPL (mg/kg)	Average Measured Concentration in Soil (ug/g)	Calculated Concentration in NAPL in Soil ² (mg/kg)	ΔHvap Enthalpy of Vaporization (kJ/mol)	Calculated Vapor Pressure of Pure Component @ NAPL Temperature in Pipe ³ (atm)	Calculated Vapor Pressure of Pure Component @ NAPL Temperature in Subsurface ³ (atm)	Moles in 1 kg of Mixture in Pipe	Mole Fraction in NAPL in Pipe	Pipe Partial Pressure ⁴ (atm)	mol/m ³ from Ideal Gas Law	Calculated Concentration in Pipe HeadSpace (mg/m ³)	Total Emissions from Pipe (lb)	Moles in 1 kg of Mixture in Soil	Mole Fraction in NAPL in Soil	Soil Partial Pressure ⁵ (atm)	Equilibrium Coefficient	Effective Diffusivity in Air ⁶ (cm ² /s)	Mass Loading in Soil (g/cm ³)	Total Mass of Contaminant in Soil (g)	Total Excavation Emissions Potential (lb)	Soil Porosity Emissions (g)	Diffusion Emissions (g)	Excavation Emissions (g)	Excavation Emissions ⁵ (lb)	Total Emission (lb)	RIDEM Annual Minimum Quantity (lb)
Naphthalene	128.19	2.30E-02	5.90E-02	1.930	0.85	146	70.85	6.10E-04	1.12E-05	1.51E-02	3.76E-03	2.29E-06	8.39E-05	11	1.75E-05	1.14E-03	2.85E-04	3.20E-09	4.79E-06	4.58E-03	1.27E-06	4.0E-03	8.90E-06	1.93E-09	8.26E-07	8.28E-07	1.83E-09	1.75E-05	3
Benzene	78.12	9.52E+01	9.32E-02	23.7	0.13	22	30.72	4.61E-01	8.15E-02	3.03E-04	7.59E-05	3.49E-05	1.28E-03	100	1.62E-04	2.84E-04	7.11E-05	5.79E-06	3.47E-02	7.23E-03	1.93E-07	6.1E-04	1.35E-06	2.13E-06	7.82E-05	8.03E-05	1.77E-07	1.62E-04	10
Carbon Tetrachloride	153.82	1.13E+02	6.32E-02	<15.0	0.07	11	32	5.77E-01	9.50E-02	4.88E-05	1.22E-05	7.03E-06	2.57E-04	40	6.44E-05	7.45E-05	1.86E-05	1.77E-06	4.05E-02	4.91E-03	9.94E-08	3.2E-04	6.98E-07	1.28E-06	3.64E-05	3.77E-05	8.32E-08	6.44E-05	8
Ethylbenzene	106.16	1.00E+01	7.50E-02	6.9	0.09	15	35.57	5.94E-02	8.00E-03	6.50E-05	1.62E-05	9.65E-07	3.53E-05	3.7	6.10E-06	1.44E-04	3.60E-05	2.88E-07	3.41E-03	5.82E-03	1.33E-07	4.2E-04	9.32E-07	1.44E-07	1.33E-05	1.35E-05	2.97E-08	6.13E-06	9,000
Toluene	92.14	3.00E+01	8.70E-02	45.9	0.28	49	53.09	3.75E-01	1.88E-02	4.98E-04	1.25E-04	4.66E-05	1.71E-03	157	2.56E-04	5.27E-04	1.32E-04	2.47E-06	8.01E-03	6.75E-03	4.22E-07	1.3E-03	2.96E-06	1.07E-06	7.39E-05	7.49E-05	1.65E-07	2.56E-04	3,000
Styrene	104.15	7.30E+00	8.70E-02	39	<50	4,322	43.5	6.07E-02	5.22E-03	3.74E-04	9.36E-05	5.68E-06	2.08E-04	22	3.52E-05	4.15E-02	1.04E-02	5.42E-05	2.23E-03	6.75E-03	3.75E-05	1.2E-01	2.63E-04	2.66E-05	3.09E-03	3.12E-03	6.88E-06	4.21E-05	3,000
m&p-Xylene ¹	106.2	8.75E+00	3.50E-02	33.9	0.41	71	41	6.54E-02	6.48E-03	3.19E-04	7.98E-05	5.22E-06	1.91E-04	20	3.30E-05	6.64E-04	1.66E-04	1.08E-06	2.77E-03	2.72E-03	6.12E-07	1.9E-03	4.30E-06	5.39E-07	3.96E-05	4.01E-05	8.84E-08	3.31E-05	1,000
o-Xylene	106.2	7.00E+00	8.70E-02	15	0.28	48	41	5.24E-02	5.19E-03	1.41E-04	3.53E-05	1.85E-06	6.76E-05	7.2	1.17E-05	4.54E-04	1.14E-04	5.89E-07	2.21E-03	6.75E-03	4.19E-07	1.3E-03	2.94E-06	2.95E-07	3.44E-05	3.47E-05	7.64E-08	1.18E-05	

- Notes:
- All constants for m&p-xylene are the average of the individual constants for m-xylene and p-xylene.
 - Concentration in NAPL is calculated by dividing the Concentration in Soil by the total organic carbon in the soil.
 - The Vapor Pressure of the Pure Component at the given temperature was calculated using the Clausius-Clapeyron Equation.
 - The Partial Pressure was calculated using Raoult's Law.
 - If the calculated Excavation Emissions exceeds the Total Excavation Emissions Potential, the Total Excavation Emissions Potential was used to calculate the Total Emission.
 - Only detected analytes with RIDEM minimum quantity values are shown. If an analyte was not detected in the soil, but was detected in the NAPL or vice versa, half the RL of the lowest RL was used to calculate the associated emissions.
 - Concentration units are in mg/kg and ug/g, both of which are equal to ppm.
 - MW = molecular weight; atm = atmosphere; kJ = kilojoules; mol = moles; NAPL = non-aqueous phase liquid; ppm = parts per million; mm Hg = millimeter mercury; cm = centimeter; m = meter; g = gram; ug = microgram; ft = feet; lb = pound; s = second; yr = year; hr = hour; < = less than the reporting limit (RL).
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 - Yellow Highlighting indicates model inputs.
 - Blue Highlighting indicates the calculated Excavation Emissions Rate exceeds the Total Excavation Emissions Rate Potential.
 - Red Highlighting indicates the Emissions Rate exceeds the Rhode Island Department of Environmental Management (RIDEM) Minimum Quantity.