Table E-5
Fate and Transport Parameters

Parameter	Symbol	Unit	Default Value	reference
ATTENUATION FACTORS FOR VAPOR INTRUSION				
Crawlspace Attenuation Factor	AF_c	unitless	1	3
Sub-Slab Soil Gas Attenuation Factor	AF_{ss}	unitless	0.03	3
Exterior Soil Gas Attenuation Factor	AF_{sg}	unitless	0.03	3
Groundwater Attenuation Factor	AF_{gw}	unitless	0.001	3
WATER VOLATILIZATION FACTOR VARIABLES FOR DOMESTIC WATER USE				
Volatilization Constant for Domestic Water Use	K	L/m^3	0.5	1
GROUNDWATER TRENCH AIR VOLATILIZATION FACTOR VARIABLES (Construction Worker):				
Area of Trench	A	m^2	2.79 (L_{trench} * W_{trench})	5
Fraction of Floor Through Which Contaminant Can Enter	F	unitless	1	4
Air Changes per Hour	ACH	h^{-1}	2	4
Volume of Trench	V	m^3	8.50 (L_{trench} * W_{trench} * D_{trench})	5
Length of Trench, (Default 8 ft)	L_{trench}	m	3.05 (10 ft*12*2.54)/100	5
Width of Trench, (Default 3 ft)	W_{trench}	m	0.91 (3 ft*12*2.54)/100	5
Depth of Trench, (Default 8 ft)	D_{trench}	m	3.05 (10 ft*12*2.54)/100	5
Ideal Gas Constant	R	atm-m^3/mol-K	8.20E-05	4
Average System Absolute Temperature, (Default 77° F)	T	K	298 ((77°F-32)*5/9))+273.15	4
Molecular Weight of O_2	MW_{O2}	g/mol	32	4
Liquid-Phase Mass Transfer Coefficient of O_2 at 25°C	$K_{i,O2}$	cm/s	0.002	4
Molecular Weight of Water	MW_{H2O}	g/mol	18	4
Gas-Phase Mass Transfer Coefficient of Water Vapor at 25°C	$K_{iG,H2O}$	cm/s	0.833	4
SOIL VOLATILIZATION FACTOR VARIABLES (Residential and Non-Residential)*				
Inverse of the Ratio of the Geometric Mean Air Concentration to the Volatilization Flux at the Center of a Square Source	Q/C_{vol}	g/m^2-s per kg/m^3	68.18	2
Exposure Interval	T	s	8.20E+08	2
Dry Soil Bulk Density	ρ_b	g/cm^3 or kg/L	1.5	2
Air-filled Soil Porosity	θ_a	L_{air}/L_{soil}	0.28 ($n-\theta_w$)	2
Total Soil Porosity	n	L_{pore}/L_{soil}	0.43 ($1-(\rho_b/\rho_s)$)	2
Water-filled Soil Porosity	θ_w	L_{water}/L_{soil}	0.15	2
Soil Particle Density	ρ_s	g/cm^3 or kg/L	2.65	2
Fraction Organic Carbon in Soil	f_{oc}	g/g	0.006	2

Table E-5
Fate and Transport Parameters

Parameter	Symbol	Unit	Default Value	reference
SOIL VOLATILIZATION FACTOR VARIABLES (Construction Worker)*				
Total Time Over Which Construction Occurs	T	s	1.09E+07	6
Dry Soil Bulk Density	ρ_b	g/cm^3 or kg/L	1.5	2
Inverse of the ratio of the 1-h Geometric Mean Air Concentration to the Volatilization Flux at the Center of a Square Source	Q/C_{sa}	g/m^2-s per kg/m^3	14.31	2
Disperson Correction Factor	F_D	unitless	0.185	2
Air-filled Soil Porosity	θ_a	L_{air}/L_{soil}	0.28 ($n-\theta_w$)	2
Total Soil Porosity	n	L_{pore}/L_{soil}	0.43 ($1-(\rho_b/\rho_s)$)	2
Water-filled Soil Porosity	θ_w	L_{water}/L_{soil}	0.15	2
Soil Particle Density	ρ_s	g/cm^3 or kg/L	2.65	2
Fraction Organic Carbon in Soil	f_{oc}	g/g	0.006	2
SOIL PARTICULATE EMISSION FACTOR VARIABLES (Residential and Non-Residential)*:				
Particulate Emission $Factor_{wind}$	PEF_w	m^3/kg	1.36E+09	2
Inverse of the Ratio of the Geometric Mean Air Concentration to the Emission Flux at the Center of Square Source	Q/C_w	g/m^2-s per kg/m^3	93.77	2
Fraction of Vegetative Cover	V	unitless	0.5	2
Mean Annual Wind Speed	U_m	m/s	4.69	2
Equivalent Threshold Value of Windspeed at 7m	U_t	m/s	11.32	2
Windspeed Distribution Function Dependent on U_m/U_t	$F_{(x)}$	unitless	0.194	2
SOIL PARTICULATE EMISSION FACTOR VARIABLES (Construction Worker-vehicle traffic)*:				
Particulate Emission $Factor_{sc}$	PEF_{sc}	m^3/kg	1.26E+06	2
Inverse of the Ratio of the 1-h Geometric Mean Air Concentration to the Emission Flux Along a Straight Road Segment Bisecting a Sqare Site	Q/C_{sr}	g/m^2-s per kg/m^3	23.02	2
Disperson Correction Factor	F_D	unitless	0.185	2
Total Time Over Which Construction Occurs	T	s	2.59E+06	6
Surface Area of Contaminated Road Segment	A_R	m^2	274.213	2
Mean Vehicle Weight	W	tons	8	2
Number of Days with at Least 0.01 Inches of Precipitation	p	days/year	110	2
Sum of Fleet Vehicle Kilometers Traveled During the Exposure	$\sum VKT$	km	121.4	2
SOIL MIGRATION TO GROUNDWATER PARAMETERS:				
Dilution Attenuation Factor	DAF	unitless	1	2
Fraction Organic Carbon in Soil	f_{oc}	g/g	0.002	2
Water-Filled Soil Porosity	θ_w	L_{water}/L_{soil}	0.3	2
Air-Filled Soil Porosity	θ_a	L_{air}/L_{soil}	0.13 ($n-\theta_w$)	2
Dry Soil Bulk Density	ρ_b	kg/L	1.5	2
Total Soil Porosity	n	L_{pore}/L_{soil}	0.43 ($1-(\rho_b/\rho_s)$)	2
Soil Particle Density	ρ_s	kg/L	2.65	2

Table E-5
Fate and Transport Parameters

Parameter	Symbol	Unit	Default Value	reference
SOIL SATURATION LIMIT VARIABLES:				
Dry Soil Bulk Density	ρ_b	g/cm^3 or kg/L	1.5	2
Fraction Organic Carbon in Soil	f_{oc}	g/g	0.006	2
Water-filled Soil Porosity	θ_w	L_{water}/L_{soil}	0.15	2
Air-filled Soil Porosity	θ_a	L_{air}/L_{soil}	0.28 ($n-\theta_w$)	2
Total Soil Porosity	n	L_{pore}/L_{soil}	0.43 ($1-(\rho_b/\rho_s)$)	2
Soil Particle Density	ρ_s	g/cm^3 or kg/L	2.65	2

*Assumes a 0.5-acre emission source

[1]U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals). Office of Emergency and Remedial Response. EPA/540/R-92/003. December 1991.

[2]U.S. EPA 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24. December 2002.

3U.S. EPA 2015. U.S. Environmental Protection Agency OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air. OSWER 9200.2-154. June 2015.

[4]VDEQ. Virginia Division of Environmental Quality Voluntary Remediation Program Risk Assessment Guidance located online at http://www.deq.virginia.gov/Programs/LandProtectionRevitalization/RemediationProgram/VoluntaryRemediationProgram/VRPRiskAssessmentGuidance.aspx

[5]Based on assumed trench dimensions

[6]Based on MRBCA default exposure time for construction exposure to soil