TECHNICAL MEMORANDUM

Evaluation of Vapor Intrusion Pathway at Containment Area 1 in Deadhorse, Alaska

PREPARED FOR:	Alaska Department of Environmental Conservation
PREPARED BY:	CH2M HILL, Inc. (CH2M)
DATE:	June 28, 2017

Introduction

Sampling activities were conducted in July 2016 at Containment Area 1 and Containment Area 2 in Deadhorse, Alaska, because the Alaska Department of Environmental Conservation (ADEC) had requested that CH2M further delineate the extent of petroleum, oil, and lubricants contamination. The results were reported in *Follow-on Soil Sampling at Containment Area 1 and Containment Area 2 in Deadhorse, Alaska* (CH2M, 2016).

At one step-out sample location at Containment Area 1 (SB18), approximately 6 inches of supra-permafrost water had developed in location SB18, which exhibited evidence of contamination during the field effort; therefore, one supra-permafrost water sample was collected. The reported concentrations in the one supra-permafrost water sample included diesel-range organics (4,900 micrograms per liter [µg/L]), gasoline-range organics (3,200 µg/L), residual-range organics (790 µg/L), benzene (12 µg/L), toluene (150 µg/L), ethylbenzene (91 µg/L), naphthalene (92 µg/L), and total xylenes (910 µg/L).

Because concentrations exceed the ADEC vapor intrusion (VI) target levels for groundwater (ADEC, 2012) and because contamination is within 30 feet of the Beige Building and the Green Service Bays Building, the VI exposure pathway is potentially complete for site workers. Therefore, potential risks to site workers through the VI exposure pathway was further evaluated. The results are presented in this technical memorandum.

Evaluation of Potential Risks Through the Vapor Intrusion Exposure Pathway

The United States Environmental Protection Agency (EPA) online screening level version of the Johnson and Ettinger (J&E) VI model (Johnson and Ettinger, 1991) was used to evaluate site-specific groundwater screening levels. The EPA online calculator (EPA, 2017) implements the J&E simplified model to evaluate the VI pathway into buildings. The model was used to evaluate site-specific supra-permafrost water screening levels for benzene, toluene, ethylbenzene, xylenes (BTEX), and naphthalene. The screening levels represent water concentrations which can lead to significant VI exposure to workers in the buildings. The screening levels are then compared to the actual water concentrations to see if there is possibility for such exposure.

For the evaluation, only the industrial land use scenario was considered. The EPA Office of Solid Waste and Emergency Response-recommended exposure parameters (EPA, 2014) and toxicity values (EPA, 2016) were used in the model, which are those used by ADEC in risk evaluation (ADEC, 2016). The calculated screening levels for groundwater are based on a target risk of 1×10^{-5} for carcinogens and a target hazard quotient of 1 for noncarcinogens.

The following site-specific inputs were entered into the model:

- Soil Type: sand
- Depth to Contaminated Water: 3.5 feet below ground surface
- Average Groundwater Temperature: 8 degrees Celsius (2016 pad porewater measurements Prudhoe Bay, Alaska [Environmental Resources Management, 2017])
- Building Dimensions: 10 by 15 meters (approximate footprint of the Beige Building)
- Building Type: slab on grade foundation, no basement
- EPA default exposure parameters for industrial scenarios (EPA, 2014)

The remaining model inputs are the J&E model default values. The J&E model inputs and results for each constituent evaluated are provided in the Attachment. The results are summarized in Table 1.

Also shown in Table 1, concentrations of BTEX and naphthalene detected in the supra-permafrost water sample collected at location SB18 are below the calculated site-specific supra-permafrost water screening levels. Therefore, exposure of site workers to contaminants in the supra-permafrost water at Containment 1 through the VI pathway is not considered significant.

Table 1. Groundwater Screening Levels for Vapor Intrusion Pathway, Industrial Scenario
Evaluation of Vapor Intrusion Pathway at Containment Area 1 in Deadhorse, Alaska

Analyte	Concentration in Supra-permafrost Water (µg/L)	Site-specific Screening Levels (µg/L)[a]	Toxicity Values[b]	
			IUR $(\mu g/m3)^{-1}$	RFC_i (mg/m3)
Benzene	12	43.9	7.80E-06	3.00E-02
Toluene	150	57,260	--	5
Ethylbenzene	91	132.3	2.50E-06	1
m-Xylenes	*	1,343	--	0.1
p-Xylenes	*	1,205	--	0.1
m,p -Xylenes	550	1,205	--	--
o-Xylene	360	1,658	--	0.1
Naphthalene	92	219.4	3.40E-05	3.00E-03

[a] EPA On-line Tools for Site Assessment Calculation. Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model, EPA. Based on a target cancer risk of 1E-5 and a target hazard quotient of 1. https://www3.epa.gov/ceampubl/learn2model/part-two/onsite/JnE_lite.html.

[b] EPA, 2016. Regional Screening Levels for Chemical Contaminants at Superfund Sites. May. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-may-2016.

Notes:

* = results reported for combined m,p-Xylenes and are compared with target concentration of 1,809 µg/L for each compound.

-- = not applicable

IUR = inhalation unit risk

RFC_i = inhalation reference concentration

Summary and Recommendations

Based on the site-specific VI evaluation presented in this technical memorandum, the VI exposure pathway at Containment Area 1 is considered de minimis. Delineation of residual contamination in soil has been completed at Containment Areas 1 and 2, and all potential exposure pathways to soil are

incomplete based on ADEC's Method Two, Tables B1 and B2. Therefore, no further action is recommended at either Containment Area 1 or 2.

Therefore, no further action is recommended at either Containment Area 1 or 2.

References

Alaska Department of Environmental Conservation (ADEC). 2016. *Procedures for Calculating Cumulative Risk*. September.

Alaska Department of Environmental Conservation (ADEC). 2012. *Vapor Intrusion Guidance.* Division of Spill Prevention and Response, Contaminated Sites Program. October.

CH2M HILL, Inc. (CH2M). 2016. *Follow-on Soil Sampling at Containment Area 1 and Containment Area 2 in Deadhorse, Alaska*. Prepared for Alaska Department of Environmental Conservation. December.

Johnson, P. C., and R. A. Ettinger. 1991. "Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors Into Buildings." *Environ. Sci. Technol.* 25:1445-1452.

U.S. Environmental Protection Agency (EPA). 2017. EPA On-line Tools for Site Assessment Calculation. Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model, EPA. https://www3.epa.gov/ceampubl/learn2model/part-two/onsite/JnE_lite.html. Accessed June 9, 2017.

U.S. Environmental Protection Agency (EPA). 2016. Regional Screening Levels for Chemical Contaminants at Superfund Sites. May. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-may-2016.

U.S. Environmental Protection Agency (EPA). 2014. Memorandum. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February 6.

Environmental Resources Management. 2017. 2016 Interim Measurements Termination Pilot Study Report, Former Tuboscope Site, Prudhoe Bay Unit. BP Exploration (Alaska) Inc. March 4.

Attachment
Constituent Model Inputs and Results

TARGET MEDIA CONCENTRATION RESULTS

Screening-Level Johnson and Ettinger Model

Site Name: Deadhorse, AK
Report Date: Fri Jun 09 2017 11:56:17 GMT-0700 (Pacific Daylight Time)
Report Generated From: https://www3.epa.gov/ceampubl/learn2model/part-two/onsite/JnE_lite.htm
Depth to contamination from bottom of foundation: 3.5ft +/- 1ft
Average ground water temperature: 8C

CHEMICAL PROPERTIES
Chemical of Concern: Benzene CAS Number: 71432
Molecular Weight: 78.11[g/mole] Henrys Constant: 0.104545[unitless]
Diffusivity in Air: 8.800e-2[cm^2/sec] Diffusivity in Water: 9.800e-6[cm^2/sec]
Unit Risk Factor: 0.0000078[$(\mu g/m^3)^{-1}$] Reference Concentration: 0.03[mg/m^3]

SOIL PROPERTIES
Soil Type: Sand Total Porosity: 0.375
Unsaturated Zone Moisture Content:
low= 0.053 best estimate= 0.054 high= 0.055
Capillary Zone Moisture Content: 0.253 Height of Capillary Rise: 0.17[m]
Soil-Gas Flow Rate into Building: 5 [L/min]

BUILDING PROPERTIES
Building Type: Slab-on-Grade Air Exchange Rate: 0.25[hr^{-1}]
Building Mixing Height: 2.44[m] Building Footprint Area: 150[m^2]
Subsurface Foundation Area: 160[m^2] Building Crack Ratio: 0.00038[unitless]
Foundation Slab Thickness: 0.1[m]

EXPOSURE PARAMETERS
Exposure Duration: carcinogens 25 [years] non-carcinogens: 25 [years]
Exposure Frequency: carcinogens 250 [days/year] non-carcinogens: 250 [days/year]
Averaging Time: carcinogens 70 [years] non-carcinogens: 25 [years]
Risk Factor for carcinogens: 1E-5 Target Hazard Quotient for non-carcinogens: 1

JOHNSON & ETTINGER SIMULATION RESULTS
Effective Diffusion Coefficients:
Unsaturated Zone(D_{eff}): 0.01423[cm^2/s]
Unsaturated Zone + Capillary Zone (D^T_{eff}): 0.002972[cm^2/s]

Soil Gas Attenuation Factor (α_{SG}): 0.002358
Ground Water Attenuation Factor (α_{GW}): 0.001142
Target Concentrations are based on CANCER risk.
Target Indoor Air Concentration: 5.241[$\mu g/m^3$] or 1.642[ppbv]

[1]Less Protective Target Concentrations
Soil Gas: 2410.[$\mu g/m^3$] or 754.7[ppbv]; Ground Water: 45.66[$\mu g/L$]

Best Estimate Target Concentrations
Soil Gas: 2223.[$\mu g/m^3$] or 696.2[ppbv]; Ground Water: 43.88[$\mu g/L$]

[2]More Protective Target Concentrations
Soil Gas: 2040.[$\mu g/m^3$] or 638.9[ppbv]; Ground Water: 42.14[$\mu g/L$]

Based on parameter analysis: Advection is the dominant mechanism across foundation.

[1]"Less Protective" concentrations produced with HIGHEST moisture content and DEEPEST depth to contamination.
[2]"More Protective" concentrations produced with LOWEST moisture content and SHALLOWEST depth to contamination.

Exposure Frequency for carcinogens has been changed from default value of 350 days/year.
Exposure Duration for carcinogens has been changed from default value of 30 years.
Exposure Frequency for non-carcinogens has been changed from default value of 365 days/year.

TARGET MEDIA CONCENTRATION RESULTS

Screening-Level Johnson and Ettinger Model

Site Name: Deadhorse, AK
Report Date: Fri Jun 09 2017 11:58:53 GMT-0700 (Pacific Daylight Time)
Report Generated From: https://www3.epa.gov/ceampubl/learn2model/part-two/onsite/JnE_lite.htm
Depth to contamination from bottom of foundation: 3.5ft +/- 1ft
Average ground water temperature: 8C

CHEMICAL PROPERTIES
Chemical of Concern: Ethylbenzene CAS Number: 100414
Molecular Weight: 106.17[g/mole] Henrys Constant: 0.120589[unitless]
Diffusivity in Air: 7.500e-2[cm^2/sec] Diffusivity in Water: 7.800e-6[cm^2/sec]
Unit Risk Factor: 0.0000025[$(\mu g/m^3)^{-1}$] Reference Concentration: 1[mg/m^3]

SOIL PROPERTIES
Soil Type: Sand Total Porosity: 0.375
Unsaturated Zone Moisture Content:
low= 0.053 best estimate= 0.054 high= 0.055
Capillary Zone Moisture Content: 0.253 Height of Capillary Rise: 0.17[m]
Soil-Gas Flow Rate into Building: 5 [L/min]

BUILDING PROPERTIES
Building Type: Slab-on-Grade Air Exchange Rate: 0.25[hr^{-1}]
Building Mixing Height: 2.44[m] Building Footprint Area: 150[m^2]
Subsurface Foundation Area: 160[m^2] Building Crack Ratio: 0.00038[unitless]
Foundation Slab Thickness: 0.1[m]

EXPOSURE PARAMETERS
Exposure Duration: carcinogens 25 [years] non-carcinogens: 25 [years]
Exposure Frequency: carcinogens 250 [days/year] non-carcinogens: 250 [days/year]
Averaging Time: carcinogens 70 [years] non-carcinogens: 25 [years]
Risk Factor for carcinogens: 1E-5 Target Hazard Quotient for non-carcinogens: 1

JOHNSON & ETTINGER SIMULATION RESULTS
Effective Diffusion Coefficients:
Unsaturated Zone(D_{eff}): 0.01212[cm^2/s]
Unsaturated Zone + Capillary Zone (D^T_{eff}): 0.002528[cm^2/s]

Soil Gas Attenuation Factor (α_{SG}): 0.002248
Ground Water Attenuation Factor (α_{GW}): 0.001025
Target Concentrations are based on CANCER risk.
Target Indoor Air Concentration: 16.35[$\mu g/m^3$] or 3.768[ppbv]

[1]Less Protective Target Concentrations
Soil Gas: 7957.[$\mu g/m^3$] or 1834.[ppbv]; Ground Water: 137.9[$\mu g/L$]

Best Estimate Target Concentrations
Soil Gas: 7273.[$\mu g/m^3$] or 1676.[ppbv]; Ground Water: 132.3[$\mu g/L$]

[2]More Protective Target Concentrations
Soil Gas: 6603.[$\mu g/m^3$] or 1522.[ppbv]; Ground Water: 126.7[$\mu g/L$]

Based on parameter analysis: Advection is the dominant mechanism across foundation.

[1]"Less Protective" concentrations produced with HIGHEST moisture content and DEEPEST depth to contamination.
[2]"More Protective" concentrations produced with LOWEST moisture content and SHALLOWEST depth to contamination.

Exposure Frequency for carcinogens has been changed from default value of 350 days/year.
Exposure Duration for carcinogens has been changed from default value of 30 years.
Exposure Frequency for non-carcinogens has been changed from default value of 365 days/year.

TARGET MEDIA CONCENTRATION RESULTS

Screening-Level Johnson and Ettinger Model

Site Name: Deadhorse, AK
Report Date: Fri Jun 09 2017 12:13:52 GMT-0700 (Pacific Daylight Time)
Report Generated From: https://www3.epa.gov/ceampubl/learn2model/part-two/onsite/JnE_lite.htm
Depth to contamination from bottom of foundation: 3.5ft +/- 1ft
Average ground water temperature: 8C

CHEMICAL PROPERTIES
Chemical of Concern: m-Xylene CAS Number: 108383
Molecular Weight: 106.17[g/mole] Henrys Constant: 0.1111809[unitless]
Diffusivity in Air: 7.000e-2[cm^2/sec] Diffusivity in Water: 7.800e-6[cm^2/sec]
Unit Risk Factor: 0[$(\mu g/m^3)^{-1}$] Reference Concentration: 0.1[mg/m^3]

SOIL PROPERTIES
Soil Type: Sand Total Porosity: 0.375
Unsaturated Zone Moisture Content:
low= 0.053 best estimate= 0.054 high= 0.055
Capillary Zone Moisture Content: 0.253 Height of Capillary Rise: 0.17[m]
Soil-Gas Flow Rate into Building: 5 [L/min]

BUILDING PROPERTIES
Building Type: Slab-on-Grade Air Exchange Rate: 0.25[hr^{-1}]
Building Mixing Height: 2.44[m] Building Footprint Area: 150[m^2]
Subsurface Foundation Area: 160[m^2] Building Crack Ratio: 0.00038[unitless]
Foundation Slab Thickness: 0.1[m]

EXPOSURE PARAMETERS
Exposure Duration: carcinogens 25 [years] non-carcinogens: 25 [years]
Exposure Frequency: carcinogens 250 [days/year] non-carcinogens: 250 [days/year]
Averaging Time: carcinogens 70 [years] non-carcinogens: 25 [years]
Risk Factor for carcinogens: 1E-5 Target Hazard Quotient for non-carcinogens: 1

JOHNSON & ETTINGER SIMULATION RESULTS
Effective Diffusion Coefficients:
Unsaturated Zone(D_{eff}): 0.01132[cm^2/s]
Unsaturated Zone + Capillary Zone (D^T_{eff}): 0.002362[cm^2/s]

Soil Gas Attenuation Factor (α_{SG}): 0.002199
Ground Water Attenuation Factor (α_{GW}): 0.0009781
Target Concentrations are based on NON-CANCER risk.
Target Indoor Air Concentration: 146[$\mu g/m^3$] or 33.64[ppbv]

[1]Less Protective Target Concentrations
Soil Gas: 7.293e4[$\mu g/m^3$] or 1.681e4[ppbv]; Ground Water: 1401.[µg/L]

Best Estimate Target Concentrations
Soil Gas: 6.639e4[$\mu g/m^3$] or 1.530e4[ppbv]; Ground Water: 1343.[µg/L]

[2]More Protective Target Concentrations
Soil Gas: 5.999e4[$\mu g/m^3$] or 1.382e4[ppbv]; Ground Water: 1285.[µg/L]

Based on parameter analysis: Advection is the dominant mechanism across foundation.

[1]"Less Protective" concentrations produced with HIGHEST moisture content and DEEPEST depth to contamination.
[2]"More Protective" concentrations produced with LOWEST moisture content and SHALLOWEST depth to contamination.

Exposure Frequency for carcinogens has been changed from default value of 350 days/year.
Exposure Duration for carcinogens has been changed from default value of 30 years.
Exposure Frequency for non-carcinogens has been changed from default value of 365 days/year.

TARGET MEDIA CONCENTRATION RESULTS

Screening-Level Johnson and Ettinger Model

Site Name: Deadhorse, AK
Report Date: Fri Jun 09 2017 11:54:01 GMT-0700 (Pacific Daylight Time)
Report Generated From: https://www3.epa.gov/ceampubl/learn2model/part-two/onsite/JnE_lite.htm
Depth to contamination from bottom of foundation: 3.5ft +/- 1ft
Average ground water temperature: 8C

CHEMICAL PROPERTIES
Chemical of Concern: Naphthalene CAS Number: 91203
Molecular Weight: 128.18[g/mole] Henrys Constant: 0.005579765[unitless]
Diffusivity in Air: 5.900e-2[cm^2/sec] Diffusivity in Water: 7.500e-6[cm^2/sec]
Unit Risk Factor: 0.000034[$(\mu g/m^3)^{-1}$] Reference Concentration: 0.003[mg/m^3]

SOIL PROPERTIES
Soil Type: Sand Total Porosity: 0.375
Unsaturated Zone Moisture Content:
low= 0.053 best estimate= 0.054 high= 0.055
Capillary Zone Moisture Content: 0.253 Height of Capillary Rise: 0.17[m]
Soil-Gas Flow Rate into Building: 5 [L/min]

BUILDING PROPERTIES
Building Type: Slab-on-Grade Air Exchange Rate: 0.25[hr^{-1}]
Building Mixing Height: 2.44[m] Building Footprint Area: 150[m^2]
Subsurface Foundation Area: 160[m^2] Building Crack Ratio: 0.00038[unitless]
Foundation Slab Thickness: 0.1[m]

EXPOSURE PARAMETERS
Exposure Duration: carcinogens 25 [years] non-carcinogens: 25 [years]
Exposure Frequency: carcinogens 250 [days/year] non-carcinogens: 250 [days/year]
Averaging Time: carcinogens 70 [years] non-carcinogens: 25 [years]
Risk Factor for carcinogens: 1E-5 Target Hazard Quotient for non-carcinogens: 1

JOHNSON & ETTINGER SIMULATION RESULTS
Effective Diffusion Coefficients:
Unsaturated Zone(D_{eff}): 0.009538[cm^2/s]
Unsaturated Zone + Capillary Zone (D^T_{eff}): 0.002376[cm^2/s]

Soil Gas Attenuation Factor (α_{SG}): 0.002072
Ground Water Attenuation Factor (α_{GW}): 0.000982
Target Concentrations are based on CANCER risk.
Target Indoor Air Concentration: 1.202[$\mu g/m^3$] or 0.2295[ppbv]

[1]Less Protective Target Concentrations
Soil Gas: 644.2[$\mu g/m^3$] or 123.0[ppbv]; Ground Water: 230.8[$\mu g/L$]

Best Estimate Target Concentrations
Soil Gas: 580.3[$\mu g/m^3$] or 110.8[ppbv]; Ground Water: 219.4[$\mu g/L$]

[2]More Protective Target Concentrations
Soil Gas: 517.7[$\mu g/m^3$] or 98.82[ppbv]; Ground Water: 208.3[$\mu g/L$]

Based on parameter analysis: Advection is the dominant mechanism across foundation.

[1]"Less Protective" concentrations produced with HIGHEST moisture content and DEEPEST depth to contamination.
[2]"More Protective" concentrations produced with LOWEST moisture content and SHALLOWEST depth to contamination.

Exposure Frequency for carcinogens has been changed from default value of 350 days/year.
Exposure Duration for carcinogens has been changed from default value of 30 years.
Exposure Frequency for non-carcinogens has been changed from default value of 365 days/year.

TARGET MEDIA CONCENTRATION RESULTS

Screening-Level Johnson and Ettinger Model

Site Name: Deadhorse, AK
Report Date: Fri Jun 09 2017 12:15:16 GMT-0700 (Pacific Daylight Time)
Report Generated From: https://www3.epa.gov/ceampubl/learn2model/part-two/onsite/JnE_lite.htm
Depth to contamination from bottom of foundation: 3.5ft +/- 1ft
Average ground water temperature: 8C

CHEMICAL PROPERTIES
Chemical of Concern: o-Xylene CAS Number: 95476
Molecular Weight: 106.17[g/mole] Henrys Constant: 0.07743612[unitless]
Diffusivity in Air: 8.700e-2[cm^2/sec] Diffusivity in Water: 1.000e-5[cm^2/sec]
Unit Risk Factor: 0[$(\mu g/m^3)^{-1}$] Reference Concentration: 0.1[mg/m^3]

SOIL PROPERTIES
Soil Type: Sand Total Porosity: 0.375
Unsaturated Zone Moisture Content:
low= 0.053 best estimate= 0.054 high= 0.055
Capillary Zone Moisture Content: 0.253 Height of Capillary Rise: 0.17[m]
Soil-Gas Flow Rate into Building: 5 [L/min]

BUILDING PROPERTIES
Building Type: Slab-on-Grade Air Exchange Rate: 0.25[hr^{-1}]
Building Mixing Height: 2.44[m] Building Footprint Area: 150[m^2]
Subsurface Foundation Area: 160[m^2] Building Crack Ratio: 0.00038[unitless]
Foundation Slab Thickness: 0.1[m]

EXPOSURE PARAMETERS
Exposure Duration: carcinogens 25 [years] non-carcinogens: 25 [years]
Exposure Frequency: carcinogens 250 [days/year] non-carcinogens: 250 [days/year]
Averaging Time: carcinogens 70 [years] non-carcinogens: 25 [years]
Risk Factor for carcinogens: 1E-5 Target Hazard Quotient for non-carcinogens: 1

JOHNSON & ETTINGER SIMULATION RESULTS
Effective Diffusion Coefficients:
Unsaturated Zone(D_{eff}): 0.01406[cm^2/s]
Unsaturated Zone + Capillary Zone (D^T_{eff}): 0.002949[cm^2/s]

Soil Gas Attenuation Factor (α_{SG}): 0.00235
Ground Water Attenuation Factor (α_{GW}): 0.001137
Target Concentrations are based on NON-CANCER risk.
Target Indoor Air Concentration: 146[$\mu g/m^3$] or 33.64[ppbv]

[1]Less Protective Target Concentrations
Soil Gas: 6.738e4[$\mu g/m^3$] or 1.553e4[ppbv]; Ground Water: 1726.[µg/L]

Best Estimate Target Concentrations
Soil Gas: 6.212e4[$\mu g/m^3$] or 1.432e4[ppbv]; Ground Water: 1658.[µg/L]

[2]More Protective Target Concentrations
Soil Gas: 5.697e4[$\mu g/m^3$] or 1.313e4[ppbv]; Ground Water: 1592.[µg/L]

Based on parameter analysis: Advection is the dominant mechanism across foundation.

[1]"Less Protective" concentrations produced with HIGHEST moisture content and DEEPEST depth to contamination.
[2]"More Protective" concentrations produced with LOWEST moisture content and SHALLOWEST depth to contamination.

Exposure Frequency for carcinogens has been changed from default value of 350 days/year.
Exposure Duration for carcinogens has been changed from default value of 30 years.
Exposure Frequency for non-carcinogens has been changed from default value of 365 days/year.

TARGET MEDIA CONCENTRATION RESULTS

Screening-Level Johnson and Ettinger Model

Site Name: Deadhorse, AK
Report Date: Fri Jun 09 2017 12:12:39 GMT-0700 (Pacific Daylight Time)
Report Generated From: https://www3.epa.gov/ceampubl/learn2model/part-two/onsite/JnE_lite.htm
Depth to contamination from bottom of foundation: 3.5ft +/- 1ft
Average ground water temperature: 8C

CHEMICAL PROPERTIES
Chemical of Concern: p-Xylene CAS Number: 106423
Molecular Weight: 106.17[g/mole] Henrys Constant: 0.1161068[unitless]
Diffusivity in Air: 7.690e-2[cm^2/sec] Diffusivity in Water: 8.440e-6[cm^2/sec]
Unit Risk Factor: 0[$(\mu g/m^3)^{-1}$] Reference Concentration: 0.1[mg/m^3]

SOIL PROPERTIES
Soil Type: Sand Total Porosity: 0.375
Unsaturated Zone Moisture Content:
low= 0.053 best estimate= 0.054 high= 0.055
Capillary Zone Moisture Content: 0.253 Height of Capillary Rise: 0.17[m]
Soil-Gas Flow Rate into Building: 5 [L/min]

BUILDING PROPERTIES
Building Type: Slab-on-Grade Air Exchange Rate: 0.25[hr^{-1}]
Building Mixing Height: 2.44[m] Building Footprint Area: 150[m^2]
Subsurface Foundation Area: 160[m^2] Building Crack Ratio: 0.00038[unitless]
Foundation Slab Thickness: 0.1[m]

EXPOSURE PARAMETERS
Exposure Duration: carcinogens 25 [years] non-carcinogens: 25 [years]
Exposure Frequency: carcinogens 250 [days/year] non-carcinogens: 250 [days/year]
Averaging Time: carcinogens 70 [years] non-carcinogens: 25 [years]
Risk Factor for carcinogens: 1E-5 Target Hazard Quotient for non-carcinogens: 1

JOHNSON & ETTINGER SIMULATION RESULTS
Effective Diffusion Coefficients:
Unsaturated Zone(D_{eff}): 0.01243[cm^2/s]
Unsaturated Zone + Capillary Zone (D^T_{eff}): 0.002594[cm^2/s]

Soil Gas Attenuation Factor (α_{SG}): 0.002266
Ground Water Attenuation Factor (α_{GW}): 0.001043
Target Concentrations are based on NON-CANCER risk.
Target Indoor Air Concentration: 146[$\mu g/m^3$] or 33.64[ppbv]

[1]Less Protective Target Concentrations
Soil Gas: 7.039e4[$\mu g/m^3$] or 1.622e4[ppbv]; Ground Water: 1256.[$\mu g/L$]

Best Estimate Target Concentrations
Soil Gas: 6.443e4[$\mu g/m^3$] or 1.485e4[ppbv]; Ground Water: 1205.[$\mu g/L$]

[2]More Protective Target Concentrations
Soil Gas: 5.860e4[$\mu g/m^3$] or 1.350e4[ppbv]; Ground Water: 1155.[$\mu g/L$]

Based on parameter analysis: Advection is the dominant mechanism across foundation.

[1]"Less Protective" concentrations produced with HIGHEST moisture content and DEEPEST depth to contamination.
[2]"More Protective" concentrations produced with LOWEST moisture content and SHALLOWEST depth to contamination.

Exposure Frequency for carcinogens has been changed from default value of 350 days/year.
Exposure Duration for carcinogens has been changed from default value of 30 years.
Exposure Frequency for non-carcinogens has been changed from default value of 365 days/year.

TARGET MEDIA CONCENTRATION RESULTS

Screening-Level Johnson and Ettinger Model

Site Name: Deadhorse, AK
Report Date: Fri Jun 09 2017 12:02:34 GMT-0700 (Pacific Daylight Time)
Report Generated From: https://www3.epa.gov/ceampubl/learn2model/part-two/onsite/JnE_lite.htm
Depth to contamination from bottom of foundation: 3.5ft +/- 1ft
Average ground water temperature: 8C

CHEMICAL PROPERTIES
Chemical of Concern: Toluene CAS Number: 108883
Molecular Weight: 92.14[g/mole] Henrys Constant: 0.1125536[unitless]
Diffusivity in Air: 8.700e-2[cm^2/sec] Diffusivity in Water: 8.600e-6[cm^2/sec]
Unit Risk Factor: 0[$(\mu g/m^3)^{-1}$] Reference Concentration: 5[mg/m^3]

SOIL PROPERTIES
Soil Type: Sand Total Porosity: 0.375
Unsaturated Zone Moisture Content:
low= 0.053 best estimate= 0.054 high= 0.055
Capillary Zone Moisture Content: 0.253 Height of Capillary Rise: 0.17[m]
Soil-Gas Flow Rate into Building: 5 [L/min]

BUILDING PROPERTIES
Building Type: Slab-on-Grade Air Exchange Rate: 0.25[hr^{-1}]
Building Mixing Height: 2.44[m] Building Footprint Area: 150[m^2]
Subsurface Foundation Area: 160[m^2] Building Crack Ratio: 0.00038[unitless]
Foundation Slab Thickness: 0.1[m]

EXPOSURE PARAMETERS
Exposure Duration: carcinogens 25 [years] non-carcinogens: 25 [years]
Exposure Frequency: carcinogens 250 [days/year] non-carcinogens: 250 [days/year]
Averaging Time: carcinogens 70 [years] non-carcinogens: 25 [years]
Risk Factor for carcinogens: 1E-5 Target Hazard Quotient for non-carcinogens: 1

JOHNSON & ETTINGER SIMULATION RESULTS
Effective Diffusion Coefficients:
Unsaturated Zone(D_{eff}): 0.01406[cm^2/s]
Unsaturated Zone + Capillary Zone (D^T_{eff}): 0.002933[cm^2/s]

Soil Gas Attenuation Factor (α_{SG}): 0.00235
Ground Water Attenuation Factor (α_{GW}): 0.001133
Target Concentrations are based on NON-CANCER risk.
Target Indoor Air Concentration: 7300[$\mu g/m^3$] or 1938[ppbv]

[1]Less Protective Target Concentrations
Soil Gas: 3.369e6[$\mu g/m^3$] or 8.946e5[ppbv]; Ground Water: 5.958e4[$\mu g/L$]

Best Estimate Target Concentrations
Soil Gas: 3.106e6[$\mu g/m^3$] or 8.248e5[ppbv]; Ground Water: 5.726e4[$\mu g/L$]

[2]More Protective Target Concentrations
Soil Gas: 2.848e6[$\mu g/m^3$] or 7.563e5[ppbv]; Ground Water: 5.498e4[$\mu g/L$]

Based on parameter analysis: Advection is the dominant mechanism across foundation.

[1]"Less Protective" concentrations produced with HIGHEST moisture content and DEEPEST depth to contamination.
[2]"More Protective" concentrations produced with LOWEST moisture content and SHALLOWEST depth to contamination.

Exposure Frequency for carcinogens has been changed from default value of 350 days/year.
Exposure Duration for carcinogens has been changed from default value of 30 years.
Exposure Frequency for non-carcinogens has been changed from default value of 365 days/year.