Appendix 23

Human Health Risk Assessment

Screening Tables

Table 23.1 Human Health Screening for Chemicals in Soil
Human Health and Ecological Risk Assessment
Former Northwest Point Military Site, Northwest Point, NL
Stantec Project No. 121410105

Constituent	Maximum Concentration in Surface Soil (mg/kg) (Sample ID)		Selected Soil Quality Guidelines - Residential/ Parkland (mg/kg)	Max > Guideline (or was a substance with no guideline detected)?	EPC	Is EPC> Screening Guideline (or was a substance with no guideline detected)?	Is element major mineral forming element or nutrient of low inherent toxicity?	Carried forward in HHRA?
BTEX/TPH								
Benzene	5	SF-TP1	390 [1]	NO	-	-	-	NO
Toluene	8.4	WG-TP11	12000 [1]	NO	-	-	-	NO[10]
Ethylbenzene	22	SF-TP31	7000 [1]	NO	-	-	-	NO[10]
Xylenes	39	SF-TP31	120000 [1]	NO	-	-	-	NO[10]
TPH	31,000	09-TP22BS2	5300 [1]	YES	7751	YES	NO	YES
PAHs								
Non-Carcinogenic								
1-Methylnaphthalene	5.9	09-MW27DSS1	72 [2]	NO	-	-	-	NO
2-Methylnaphthalene	10	09-MW27DSS1			-	-	-	NO
Acenaphthene	42	09-MW27DSS1	5300 [3]	NO	-	-	-	NO
Acenaphthylene	0.4	09-MW27DSS1	7.8 [2]	NO	-	-	-	NO
Anthracene	57	09-MW27DSS1	24000 [3]	NO	-	-	-	NO
Fluoranthene	230	09-MW27DSS1	3500 [3]	NO	-	-	-	NO
Fluorene	31	09-MW27DSS1	2700 [3]	NO	-	-	-	NO
Naphthalene	36	09-MW27DSS1	1800 [3]	NO	-	-	-	NO
Perylene	33.4	LD-TP4	7.8 [2,4]	YES	4.3	NO	NO	NO
Pyrene	180	09-MW27DSS1	2100 [3]	NO	-	-	-	NO
Carcinogenic								
Benz[a]anthracene	90	09-MW27DSS1	N/A	YES	-	-	-	YES
Benzo[a]pyrene	81	09-MW27DSS1	N/A		-	-	-	
Benzo[b]fluoranthene	71	09-MW27DSS1	N/A		-	-	-	
Benzo[k]fluoranthene	71	09-MW27DSS1	N/A		-	-	-	
Benzo[g,h,i]perylene	38	09-MW27DSS1	N/A		-	-	-	
Chrysene	94	09-MW27DSS1	N/A		-	-	-	
Dibenz[a,h]anthracene	13	LD-TP1	N/A		-	-	-	
Indeno[1,2,3-cd]pyrene	72	LD-TP1	N/A		-	-	-	
Phenanthrene	210	09-MW27DSS1	7.8					
Benzo(a)pyrene (TPE)	126	calculated	5.3 [5,6]		35	YES	NO	
Other								
PCBs	3.1	09-SS33	22 [3]	NO	-	-	-	NO

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Former Northwest Point Military Site, Northwest Point, NL
Stantec Project No. 121410105

Constituent	Maximum Concentration in Surface Soil (mg/kg) (Sample ID)		Selected Soil Quality Guidelines - Residential/ Parkland (mg/kg)		Max > Guideline (or was a substance with no guideline detected)?	EPC	Is EPC> Screening Guideline (or was a substance with no guideline detected)?	Is element major mineral forming element or nutrient of low inherent toxicity?	Carried forward in HHRA?
Inorganics									
Aluminium	26,900	LD-TP7	15,400	7	YES	6464	NO	YES	NO[8]
Antimony	2	09-SS44	7.5	2	NO	-	-	-	NO
Arsenic	0.4	SF-TP6	12	5	NO	-	-	-	NO
Barium	250	LD-TP1	3,800	2	NO	-	-	-	NO
Beryllium	0.6	LD-TP7, LD-TP8	38	2	NO	-	-	-	NO
Bismuth	0.4	SF-TP6	N/A		NO	-	-	-	NO
Boron	8	09-TP66BS1	3,200	7	NO	-	-	-	NO
Cadmium	5.9	WG-TP12	14	5	NO	-	-	-	NO
Chromium (Total)	46	LD-TP7	220	5	NO	-	-	-	NO
Cobalt	40	EG-TP3	22	2	YES	11.3	NO	NO	NO
Copper	302	LD-TP1	1,100	5	NO	-	-	-	NO
Iron	39,600	LD-TP1	11,000	7	YES	11412	YES	YES	NO[8]
Lead	210	09-SS55	140	5	YES	32	NO	NO	NO
Lithium	8	09-MW27DSS1	32	7	NO	-	-	-	NO
Manganese	443	LD-TP7	360	7	YES	114	NO	NO	NO
Mercury	0.2	09-SS10	6.6	5	NO	-	-	-	NO
Molybdenum	7	LD-TP1	110	2	NO	-	-	-	NO
Nickel	29	LD-TP7	330	2	NO	-	-	-	NO
Rubidium	19	09-MW27DSS1	N/A		YES	7.7	YES	NO	NO[9]
Selenium	<2	-	80	5	NO	-	-	-	NO
Silver	<5	-	77	2	NO	-	-	-	NO
Strontium	971	P-TP22	9,400	7	NO	-	-	-	NO
Thallium	0.1	09-SS15, 09-SS25	1	3	NO	-	-	-	NO
Tin	20	09-SS33	9,400	7	NO	-	-	-	NO
Uranium	1.9	09-SS55	23	5	NO	-	-	-	NO
Vanadium	61	LD-TP7	39	2	YES	17.9	NO	NO	NO
Zinc	163	LD-TP1	5,600	2	NO	-	-	-	NO

Notes:

1. Atlantic PIRI (2007) PSSL for residential sites with non-potable groundwater, coarse grained soil and fuel oil or lube oil impacts (Soil Ingestion)
2. Ontario Ministry of Environment (OMOE) Rationale for the Development of Soil and Ground Water Standards for Use at Contaminated Sites in Ontario, Soil Components for Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition, Residential Land Use, soil contact human-health guideline (OMOE, 2009)
3. Alberta Tier I Surface Soil Guidelines for Residential Land Use (AENV, 2009) - Direct soil contact human health guidelines
4. There are no applicable guidelines for perylene or phenanthrene; therefore, the most stringent of the non-carcinogenic PAH guidelines (Acenaphthylene) has been selected for comparison purposes.
5. CCME (2009) Soil Quality Guidelines for the Protection of Environmental and Human Health - Residential land use, non-potable groundwater, direct contact human-health guidelines (note: where no CCME human health guideline exists, AENV, then OMOE, then US EPA have been consulted).
6. As per current CCME guidance, the carcinogenic PAHs are assumed to act cumulatively and; therefore, the entire group is carried forward and is assessed based on a Total Potency Equivalents (TPE) basis, relative to
7. US EPA (Oak Ridge National Laboratory) Regional Screening Levels for Chemical Contaminants at Superfund Sites (May 2010). Residential land use. As per current Health Canada guidance, concentrations of non-carcinogens have been multiplied by 0.2.
8. Iron and Aluminum are considered to be elements of low inherant toxicity.
9. There are no applicable guidelines (*i.e.,* CCME, OMOE, US EPA) for rubidium or bismuth. Both are typically associated with seawater spray. Seawater spray is not expected at the site. Concentrations of rubidium and bismuth were not detected; therefore they are not considered to be a concern.
10. Toluene, ethylbenzene and xylenes did not exceed screening guidelines however they were included into the TPH fractionnation results within the HHRA.

ND = not detected above laboratory detection limits
N/A = no human-health-based guideline available

ProUCL Output

Potential UCL to Use Use 95% Chebyshev (Mean, Sd) UCL 11412

Manganese

General Statistics

Number of Valid Observations 87 Number of Distinct Observations 56

Raw Statistics

Minimum	19
Maximum	443
Mean	100.2
Median	75
SD	88.87
Coefficient of Variation	0.887
Skewness	2.484

Log-transformed Statistics

Minimum of Log Data	2.944
Maximum of Log Data	6.094
Mean of log Data	4.344
SD of log Data	0.696

Relevant UCL Statistics

Normal Distribution Test

Lilliefors Test Statistic	0.216
Lilliefors Critical Value	0.095

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Lilliefors Test Statistic	0.0666
Lilliefors Critical Value	0.095

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 116

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL	118.6
95% Modified-t UCL	116.4

Assuming Lognormal Distribution

95% H-UCL	114
95% Chebyshev (MVUE) UCL	132.8
97.5% Chebyshev (MVUE) UCL	148
99% Chebyshev (MVUE) UCL	177.8

Gamma Distribution Test

k star (bias corrected)	1.989
Theta Star	50.36
MLE of Mean	100.2
MLE of Standard Deviation	71.02
nu star	346.1
Approximate Chi Square Value (.05)	304
Adjusted Level of Significance	0.0472
Adjusted Chi Square Value	303.4
Anderson-Darling Test Statistic	1.982
Anderson-Darling 5% Critical Value	0.764
Kolmogorov-Smirnov Test Statistic	0.115
Kolmogorov-Smimov 5% Critical Value	0.0971

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	114
95% Adjusted Gamma UCL	114.3

Data Distribution

Data appear Lognormal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	115.8
95% Jackknife UCL	116
95% Standard Bootstrap UCL	115.8
95% Bootstrap-t UCL	120.8
95% Hall's Bootstrap UCL	119.6
95% Percentile Bootstrap UCL	117
95% BCA Bootstrap UCL	118.4
95% Chebyshev(Mean, Sd) UCL	141.7
97.5% Chebyshev(Mean, Sd) UCL	159.7
99% Chebyshev(Mean, Sd) UCL	195

Potential UCL to Use Use 95% H-UCL 114

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Perylene

General Statistics

Number of Valid Data	31	Number of Detected Data	14
Number of Distinct Detected Data	13	Number of Non-Detect Data	17
		Percent Non-Detects	54.84%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.006	Minimum Detected	-5.116
Maximum Detected	33.4	Maximum Detected	3.509
Mean of Detected	4.584	Mean of Detected	-1.277
SD of Detected	10.25	SD of Detected	2.752
Minimum Non-Detect	0.005	Minimum Non-Detect	-5.298
Maximum Non-Detect	0.005	Maximum Non-Detect	-5.298

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.512	Shapiro Wilk Test Statistic	0.931
5% Shapiro Wilk Critical Value	0.874	5% Shapiro Wilk Critical Value	0.874
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	2.072	Mean	-3.862
SD	7.133	SD	2.995
95% DL/2 (t) UCL	4.246	95% H-Stat (DL/2) UCL	35.34
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-5.803
		SD in Log Scale	5.046
		Mean in Original Scale	2.071
		SD in Original Scale	7.133
		95% t UCL	4.245
		95% Percentile Bootstrap UCL	4.341
		95% BCA Bootstrap UCL	5.402
		95% H-UCL	3280970

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	0.247	Data Follow Appr. Gamma Distribution at 5% Significance Level
Theta Star	18.59	
nu star	6.904	

A-D Test Statistic	0.989
5% A-D Critical Value	0.851
K-S Test Statistic	0.851
5% K-S Critical Value	0.25

Data follow Appr. Gamma Distribution at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	0.000001
Maximum	33.4
Mean	2.07
Median	0.000001
SD	7.134
k star	0.105
Theta star	19.73
Nu star	6.505
AppChi2	1.903
95% Gamma Approximate UCL	7.076
95% Adjusted Gamma UCL	7.616

Note: DL/2 is not a recommended method.

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	2.074
SD	7.017
SE of Mean	1.308
95% KM (t) UCL	4.293
95% KM (z) UCL	4.225
95% KM (jackknife) UCL	4.242
95% KM (bootstrap t) UCL	23.94
95% KM (BCA) UCL	4.54
95% KM (Percentile Bootstrap) UCL	4.28
95% KM (Chebyshev) UCL	7.774
97.5% KM (Chebyshev) UCL	10.24
99% KM (Chebyshev) UCL	15.09

Potential UCLs to Use

95% KM (t) UCL	4.293

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

General UCL Statistics for Full Data Sets

User Selected Options

From File	P:\Jobs_BidJobs\JW Numbers\1044857\Risk Assessment\HHRA\Metals for ProUCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Aluminum

General Statistics

Number of Valid Observations 87

Number of Distinct Observations 52

Raw Statistics

Minimum	1100
Maximum	26900
Mean	4523
Median	3360
SD	4154
Coefficient of Variation	0.919
Skewness	3.404

Log-transformed Statistics

Minimum of Log Data	7.003
Maximum of Log Data	10.2
Mean of log Data	8.193
SD of log Data	0.606

Relevant UCL Statistics

Normal Distribution Test

Lilliefors Test Statistic	0.26
Lilliefors Critical Value	0.095

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Lilliefors Test Statistic	0.0975
Lilliefors Critical Value	0.095

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 5263

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL	5429
95% Modified-t UCL	5290

Assuming Lognormal Distribution

95% H-UCL	4927
95% Chebyshev (MVUE) UCL	5661
97.5% Chebyshev (MVUE) UCL	6235
99% Chebyshev (MVUE) UCL	7362

Gamma Distribution Test

k star (bias corrected)	2.315
Theta Star	1954
MLE of Mean	4523
MLE of Standard Deviation	2972
nu star	402.8
Approximate Chi Square Value (.05)	357.3
Adjusted Level of Significance	0.0472
Adjusted Chi Square Value	356.5
Anderson-Darling Test Statistic	3.365
Anderson-Darling 5% Critical Value	0.762
Kolmogorov-Smirnov Test Statistic	0.151
Kolmogorov-Smirnov 5% Critical Value	0.0969

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

95% CLT UCL	5255
95% Jackknife UCL	5263
95% Standard Bootstrap UCL	5232
95% Bootstrap-t UCL	5632
95% Hall's Bootstrap UCL	5498
95% Percentile Bootstrap UCL	5303
95% BCA Bootstrap UCL	5475
95% Chebyshev(Mean, Sd) UCL	6464
97.5% Chebyshev(Mean, Sd) UCL	7304
99% Chebyshev(Mean, Sd) UCL	8954

95% Approximate Gamma UCL 5099
95% Adjusted Gamma UCL 5109

Potential UCL to Use Use 95% Chebyshev (Mean, Sd) UCL 6464

Iron

General Statistics

Number of Valid Observations 85 Number of Distinct Observations 63

Raw Statistics

Minimum 2000
Maximum 39600
Mean 7967
Median 6000
SD 7286
Coefficient of Variation 0.914
Skewness 3.128

Log-transformed Statistics

Minimum of Log Data 7.601
Maximum of Log Data 10.59
Mean of log Data 8.76
SD of log Data 0.603

Relevant UCL Statistics

Normal Distribution Test

Lilliefors Test Statistic 0.277
Lilliefors Critical Value 0.0961
Data not Normal at 5% Significance Level

Lognormal Distribution Test

Lilliefors Test Statistic 0.124
Lilliefors Critical Value 0.0961
Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 9281

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 9553
95% Modified-t UCL 9326

Assuming Lognormal Distribution

95% H-UCL 8667
95% Chebyshev (MVUE) UCL 9965
97.5% Chebyshev (MVUE) UCL 10978
99% Chebyshev (MVUE) UCL 12967

Gamma Distribution Test

k star (bias corrected) 2.319
Theta Star 3435
MLE of Mean 7967
MLE of Standard Deviation 5232
nu star 394.2
Approximate Chi Square Value (.05) 349.2
Adjusted Level of Significance 0.0472
Adjusted Chi Square Value 348.5

Anderson-Darling Test Statistic 4.16
Anderson-Darling 5% Critical Value 0.762
Kolmogorov-Smirnov Test Statistic 0.183
Kolmogorov-Smirnov 5% Critical Value 0.098
Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL 8994
95% Adjusted Gamma UCL 9013

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

95% CLT UCL 9267
95% Jackknife UCL 9281
95% Standard Bootstrap UCL 9257
95% Bootstrap-t UCL 9720
95% Hall's Bootstrap UCL 9591
95% Percentile Bootstrap UCL 9347
95% BCA Bootstrap UCL 9586
95% Chebyshev(Mean, Sd) UCL 11412
97.5% Chebyshev(Mean, Sd) UCL 12902
99% Chebyshev(Mean, Sd) UCL 15830

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	P:\Jobs_BidJobs\JW Numbers\1044857\Risk Assessment\HHRA\Metals for ProUCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Lead

General Statistics

Number of Valid Data	87	Number of Detected Data	72
Number of Distinct Detected Data	54	Number of Non-Detect Data	15
		Percent Non-Detects	17.24%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.6	Minimum Detected	-0.511
Maximum Detected	210	Maximum Detected	5.347
Mean of Detected	19.04	Mean of Detected	1.885
SD of Detected	37.56	SD of Detected	1.401
Minimum Non-Detect	5	Minimum Non-Detect	1.609
Maximum Non-Detect	5	Maximum Non-Detect	1.609

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.312	Lilliefors Test Statistic	0.0742
5% Lilliefors Critical Value	0.104	5% Lilliefors Critical Value	0.104
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	16.19	Mean	1.718
SD	34.7	SD	1.325
95% DL/2 (t) UCL	22.37	95% H-Stat (DL/2) UCL	19.82
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	1.662
		SD in Log Scale	1.399
		Mean in Original Scale	16.15
		SD in Original Scale	34.72
		95% Percentile Bootstrap UCL	22.72
		95% BCA Bootstrap UCL	24.57

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**
k star (bias corrected)	0.569	Data appear Lognormal at 5% Significance Level
Theta Star	33.44	
nu star	81.97	
A-D Test Statistic	3.196	**Nonparametric Statistics**
5% A-D Critical Value	0.809	Kaplan-Meier (KM) Method

K-S Test Statistic	0.809	Mean	16.1
5% K-S Critical Value	0.111	SD	34.54
Data not Gamma Distributed at 5% Significance Level		SE of Mean	3.73
		95% KM (t) UCL	22.3
Assuming Gamma Distribution		95% KM (z) UCL	22.24
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	22.3
Minimum	1E-09	95% KM (bootstrap t) UCL	25.49
Maximum	210	95% KM (BCA) UCL	23.2
Mean	16.63	95% KM (Percentile Bootstrap) UCL	22.25
Median	5.7	95% KM (Chebyshev) UCL	32.36
SD	34.67	97.5% KM (Chebyshev) UCL	39.39
k star	0.239	99% KM (Chebyshev) UCL	53.21
Theta star	69.67		
Nu star	41.54	Potential UCLs to Use	
AppChi2	27.76	95% KM (Chebyshev) UCL	32.36
95% Gamma Approximate UCL	24.88		
95% Adjusted Gamma UCL	25.05		

Note: DL/2 is not a recommended method.

Rubidium

General Statistics

Number of Valid Data	67	Number of Detected Data	58
Number of Distinct Detected Data	13	Number of Non-Detect Data	9
		Percent Non-Detects	13.43%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	2	Minimum Detected	0.693
Maximum Detected	19	Maximum Detected	2.944
Mean of Detected	6.31	Mean of Detected	1.669
SD of Detected	3.743	SD of Detected	0.605
Minimum Non-Detect	2	Minimum Non-Detect	0.693
Maximum Non-Detect	2	Maximum Non-Detect	0.693

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.174	Lilliefors Test Statistic	0.189
5% Lilliefors Critical Value	0.116	5% Lilliefors Critical Value	0.116
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	5.597	Mean	1.445
SD	3.928	SD	0.803
95% DL/2 (t) UCL	6.398	95% H-Stat (DL/2) UCL	6.099
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	5.413	Mean in Log Scale	1.485
SD	4.199	SD in Log Scale	0.737

95% MLE (t) UCL	6.269
95% MLE (Tiku) UCL	6.258

Mean in Original Scale	5.65
SD in Original Scale	3.868
95% Percentile Bootstrap UCL	6.47
95% BCA Bootstrap UCL	6.452

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	2.893
Theta Star	2.182
nu star	335.5
A-D Test Statistic	1.298
5% A-D Critical Value	0.758
K-S Test Statistic	0.758
5% K-S Critical Value	0.118

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	1E-09
Maximum	19
Mean	5.589
Median	5
SD	3.95
k star	0.516
Theta star	10.82
Nu star	69.21
AppChi2	51.06
95% Gamma Approximate UCL	7.576
95% Adjusted Gamma UCL	7.627

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	5.731
SD	3.752
SE of Mean	0.462
95% KM (t) UCL	6.503
95% KM (z) UCL	6.492
95% KM (jackknife) UCL	6.502
95% KM (bootstrap t) UCL	6.55
95% KM (BCA) UCL	6.493
95% KM (Percentile Bootstrap) UCL	6.493
95% KM (Chebyshev) UCL	7.747
97.5% KM (Chebyshev) UCL	8.619
99% KM (Chebyshev) UCL	10.33

Potential UCLs to Use

95% KM (Chebyshev) UCL	7.747

General UCL Statistics for Full Data Sets

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Chromium

General Statistics

Number of Valid Observations 87

Number of Distinct Observations 22

Raw Statistics

Minimum	3
Maximum	46
Mean	10.26
Median	8
SD	7.538
Std. Error of Mean	0.808
Coefficient of Variation	0.734
Skewness	2.777

Log-transformed Statistics

Minimum of Log Data	1.099
Maximum of Log Data	3.829
Mean of log Data	2.15
SD of log Data	0.569

Relevant UCL Statistics

Normal Distribution Test

Lilliefors Test Statistic	0.187
Lilliefors Critical Value	0.095

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Lilliefors Test Statistic	0.0878
Lilliefors Critical Value	0.095

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	11.61

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	11.85
95% Modified-t UCL (Johnson-1978)	11.65

Assuming Lognormal Distribution

95% H-UCL	11.33
95% Chebyshev (MVUE) UCL	12.94
97.5% Chebyshev (MVUE) UCL	14.17
99% Chebyshev (MVUE) UCL	16.61

Gamma Distribution Test

k star (bias corrected)	2.865
Theta Star	3.583
MLE of Mean	10.26
MLE of Standard Deviation	6.064
nu star	498.5
Approximate Chi Square Value (.05)	447.7
Adjusted Level of Significance	0.0472
Adjusted Chi Square Value	446.9
Anderson-Darling Test Statistic	1.794
Anderson-Darling 5% Critical Value	0.759
Kolmogorov-Smirnov Test Statistic	0.13
Kolmogorov-Smirnov 5% Critical Value	0.0966

Data not Gamma Distributed at 5% Significance Level

Data Distribution

Data appear Lognormal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	11.59
95% Jackknife UCL	11.61
95% Standard Bootstrap UCL	11.57
95% Bootstrap-t UCL	12.06
95% Hall's Bootstrap UCL	12.02
95% Percentile Bootstrap UCL	11.61
95% BCA Bootstrap UCL	11.92
95% Chebyshev(Mean, Sd) UCL	13.79
97.5% Chebyshev(Mean, Sd) UCL	15.31

Assuming Gamma Distribution

95% Approximate Gamma UCL 11.43

95% Adjusted Gamma UCL 11.45

99% Chebyshev(Mean, Sd) UCL 18.31

Potential UCL to Use

Use 95% H-UCL 11.33

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Vanadium

General Statistics

Number of Valid Observations 87

Number of Distinct Observations 28

Raw Statistics

Minimum	5
Maximum	61
Mean	16.14
Median	14
SD	10.01
Std. Error of Mean	1.073
Coefficient of Variation	0.62
Skewness	2.48

Log-transformed Statistics

Minimum of Log Data	1.609
Maximum of Log Data	4.111
Mean of log Data	2.647
SD of log Data	0.494

Relevant UCL Statistics

Normal Distribution Test

Lilliefors Test Statistic	0.208
Lilliefors Critical Value	0.095

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Lilliefors Test Statistic	0.0929
Lilliefors Critical Value	0.095

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 17.92

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 18.21

95% Modified-t UCL (Johnson-1978) 17.97

Assuming Lognormal Distribution

95% H-UCL 17.59

95% Chebyshev (MVUE) UCL 19.79

97.5% Chebyshev (MVUE) UCL 21.46

99% Chebyshev (MVUE) UCL 24.75

Gamma Distribution Test

k star (bias corrected)	3.768
Theta Star	4.283
MLE of Mean	16.14
MLE of Standard Deviation	8.313
nu star	655.7
Approximate Chi Square Value (.05)	597.3
Adjusted Level of Significance	0.0472

Data Distribution

Data appear Lognormal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL 17.9

Adjusted Chi Square Value 596.3	95% Jackknife UCL 17.92
	95% Standard Bootstrap UCL 17.92
Anderson-Darling Test Statistic 1.864	95% Bootstrap-t UCL 18.65
Anderson-Darling 5% Critical Value 0.756	95% Hall's Bootstrap UCL 18.36
Kolmogorov-Smirnov Test Statistic 0.131	95% Percentile Bootstrap UCL 18.02
Kolmogorov-Smirnov 5% Critical Value 0.0963	95% BCA Bootstrap UCL 18.21
Data not Gamma Distributed at 5% Significance Level	95% Chebyshev(Mean, Sd) UCL 20.82
	97.5% Chebyshev(Mean, Sd) UCL 22.84
Assuming Gamma Distribution	99% Chebyshev(Mean, Sd) UCL 26.82
95% Approximate Gamma UCL 17.72	
95% Adjusted Gamma UCL 17.74	
Potential UCL to Use	Use 95% Student's-t UCL 17.92
	or 95% Modified-t UCL 17.97
	or 95% H-UCL 17.59

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	P:\Jobs_BidJobs\JW Numbers\1044857\Risk Assessment\HHRA\tph FOR pROucl.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

tph

General Statistics

Number of Valid Data	143	Number of Detected Data	85
Number of Distinct Detected Data	73	Number of Non-Detect Data	58
		Percent Non-Detects	40.56%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.2	Minimum Detected	-1.609
Maximum Detected	31000	Maximum Detected	10.34
Mean of Detected	6842	Mean of Detected	7.348
SD of Detected	8031	SD of Detected	2.544
Minimum Non-Detect	0.022	Minimum Non-Detect	-3.817
Maximum Non-Detect	20	Maximum Non-Detect	2.996

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	64
Number treated as Detected	79
Single DL Non-Detect Percentage	44.76%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Lilliefors Test Statistic	0.21	Lilliefors Test Statistic	0.12
5% Lilliefors Critical Value	0.0961	5% Lilliefors Critical Value	0.0961
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	4068	Mean	3.913
SD	7037	SD	4.778
95% DL/2 (t) UCL	5042	95% H-Stat (DL/2) UCL	9011686
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	250.7	Mean in Log Scale	5.166
SD	10815	SD in Log Scale	3.454
95% MLE (t) UCL	1748	Mean in Original Scale	4074
95% MLE (Tiku) UCL	2004	SD in Original Scale	7033
		95% Percentile Bootstrap UCL	5043
		95% BCA Bootstrap UCL	5135

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	0.43	Data do not follow a Discernable Distribution (0.05)
Theta Star	15912	
nu star	73.1	

A-D Test Statistic	0.862
5% A-D Critical Value	0.834
K-S Test Statistic	0.834
5% K-S Critical Value	0.103

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data

Minimum	1E-09
Maximum	31000
Mean	5127
Median	1952
SD	6744
k star	0.243
Theta star	21072
Nu star	69.59
AppChi2	51.38
95% Gamma Approximate UCL	6943
95% Adjusted Gamma UCL	6965

Note: DL/2 is not a recommended method.

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	4067
SD	7013
SE of Mean	589.9
95% KM (t) UCL	5044
95% KM (z) UCL	5037
95% KM (jackknife) UCL	5041
95% KM (bootstrap t) UCL	5128
95% KM (BCA) UCL	5006
95% KM (Percentile Bootstrap) UCL	5065
95% KM (Chebyshev) UCL	6638
97.5% KM (Chebyshev) UCL	7751
99% KM (Chebyshev) UCL	9936

Potential UCLs to Use

97.5% KM (Chebyshev) UCL	7751

General UCL Statistics for Full Data Sets

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

BAPTPE

General Statistics

Number of Valid Observations 42

Number of Distinct Observations 29

Raw Statistics

Minimum	0.004
Maximum	120.9
Mean	5.071
Median	0.041
SD	19.54
Coefficient of Variation	3.852
Skewness	5.447

Log-transformed Statistics

Minimum of Log Data	-5.521
Maximum of Log Data	4.795
Mean of log Data	-2.651
SD of log Data	2.845

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.299
Shapiro Wilk Critical Value	0.942

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.824
Shapiro Wilk Critical Value	0.942

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	10.14

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL	12.74
95% Modified-t UCL	10.57

Assuming Lognormal Distribution

95% H-UCL	35.63
95% Chebyshev (MVUE) UCL	10.6
97.5% Chebyshev (MVUE) UCL	14
99% Chebyshev (MVUE) UCL	20.7

Gamma Distribution Test

k star (bias corrected)	0.179
Theta Star	28.33
MLE of Mean	5.071
MLE of Standard Deviation	11.99
nu star	15.03
Approximate Chi Square Value (.05)	7.285
Adjusted Level of Significance	0.0443
Adjusted Chi Square Value	7.093
Anderson-Darling Test Statistic	5.722
Anderson-Darling 5% Critical Value	0.919
Kolmogorov-Smirnov Test Statistic	0.328
Kolmogorov-Smirnov 5% Critical Value	0.152

Data not Gamma Distributed at 5% Significance Level

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

95% CLT UCL	10.03
95% Jackknife UCL	10.14
95% Standard Bootstrap UCL	9.735
95% Bootstrap-t UCL	23.57
95% Hall's Bootstrap UCL	26.36
95% Percentile Bootstrap UCL	10.31
95% BCA Bootstrap UCL	13.61
95% Chebyshev(Mean, Sd) UCL	18.21
97.5% Chebyshev(Mean, Sd) UCL	23.9
99% Chebyshev(Mean, Sd) UCL	35.06

Assuming Gamma Distribution

95% Approximate Gamma UCL 10.47

95% Adjusted Gamma UCL 10.75

Potential UCL to Use Use 99% Chebyshev (Mean, Sd) UCL 35.06

95% H-UCL 2.208E+10

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.304
Theta Star	533.1
nu star	2.435
A-D Test Statistic	0.414
5% A-D Critical Value	0.679
K-S Test Statistic	0.679
5% K-S Critical Value	0.409

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data

Minimum	0.000001
Maximum	440
Mean	23.18
Median	0.000001
SD	89.2
k star	0.0771
Theta star	300.6
Nu star	4.317
AppChi2	0.851
95% Gamma Approximate UCL	117.6
95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Normal at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	30.04
SD	85.81
SE of Mean	18.72
95% KM (t) UCL	61.93
95% KM (z) UCL	60.84
95% KM (jackknife) UCL	56.14
95% KM (bootstrap t) UCL	70.54
95% KM (BCA) UCL	440
95% KM (Percentile Bootstrap) UCL	207.9
95% KM (Chebyshev) UCL	111.7
97.5% KM (Chebyshev) UCL	147
99% KM (Chebyshev) UCL	216.3

Potential UCLs to Use

95% KM (t) UCL	61.93
95% KM (Percentile Bootstrap) UCL	207.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

F2

General Statistics

Number of Valid Data	28	Number of Detected Data	22
Number of Distinct Detected Data	21	Number of Non-Detect Data	6
		Percent Non-Detects	21.43%

Raw Statistics

Minimum Detected	26
Maximum Detected	5189
Mean of Detected	810.4
SD of Detected	1335
Minimum Non-Detect	15
Maximum Non-Detect	15

Log-transformed Statistics

Minimum Detected	3.258
Maximum Detected	8.554
Mean of Detected	5.584
SD of Detected	1.557
Minimum Non-Detect	2.708
Maximum Non-Detect	2.708

UCL Statistics

Normal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.628
5% Shapiro Wilk Critical Value	0.911

Data not Normal at 5% Significance Level

Lognormal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.955
5% Shapiro Wilk Critical Value	0.911

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

DL/2 Substitution Method

Mean	638.4
SD	1224
95% DL/2 (t) UCL	1032

Maximum Likelihood Estimate(MLE) Method

Mean	427.3
SD	1416
95% MLE (t) UCL	883.1
95% MLE (Tiku) UCL	877.7

Assuming Lognormal Distribution

DL/2 Substitution Method

Mean	4.819
SD	2.027
95% H-Stat (DL/2) UCL	4474

Log ROS Method

Mean in Log Scale	4.791
SD in Log Scale	2.097
Mean in Original Scale	638.5
SD in Original Scale	1224
95% t UCL	1033
95% Percentile Bootstrap UCL	1033
95% BCA Bootstrap UCL	1177
95% H UCL	5527

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.514
Theta Star	1576
nu star	22.63
A-D Test Statistic	0.913
5% A-D Critical Value	0.799
K-S Test Statistic	0.799
5% K-S Critical Value	0.195

Data follow Appr. Gamma Distribution at 5% Significance Level

Assuming Gamma Distribution

Data Distribution Test with Detected Values Only

Data Follow Appr. Gamma Distribution at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	642.3
SD	1200
SE of Mean	232.1
95% KM (t) UCL	1038
95% KM (z) UCL	1024

Gamma ROS Statistics using Extrapolated Data	
Minimum	0.000001
Maximum	5189
Mean	636.8
Median	120
SD	1225
k star	0.16
Theta star	3982
Nu star	8.956
AppChi2	3.3
95% Gamma Approximate UCL	1728
95% Adjusted Gamma UCL	1845

Note: DL/2 is not a recommended method.

95% KM (jackknife) UCL	1035
95% KM (bootstrap t) UCL	1419
95% KM (BCA) UCL	1091
95% KM (Percentile Bootstrap) UCL	1058
95% KM (Chebyshev) UCL	1654
97.5% KM (Chebyshev) UCL	2092
99% KM (Chebyshev) UCL	2952

Potential UCLs to Use

95% KM (Chebyshev) UCL	1654

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

F3

General Statistics

Number of Valid Data	28	Number of Detected Data	26
Number of Distinct Detected Data	26	Number of Non-Detect Data	2
		Percent Non-Detects	7.14%

Raw Statistics

Minimum Detected	19
Maximum Detected	4107
Mean of Detected	844.7
SD of Detected	1062
Minimum Non-Detect	15
Maximum Non-Detect	15

Log-transformed Statistics

Minimum Detected	2.944
Maximum Detected	8.32
Mean of Detected	5.887
SD of Detected	1.427
Minimum Non-Detect	2.708
Maximum Non-Detect	2.708

UCL Statistics

Normal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.757
5% Shapiro Wilk Critical Value	0.92

Data not Normal at 5% Significance Level

Lognormal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.96
5% Shapiro Wilk Critical Value	0.92

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

DL/2 Substitution Method

Mean	784.9
SD	1045
95% DL/2 (t) UCL	1121

Maximum Likelihood Estimate(MLE) Method

Mean	739.1
SD	1083
95% MLE (t) UCL	1088
95% MLE (Tiku) UCL	1067

Assuming Lognormal Distribution

DL/2 Substitution Method

Mean	5.611
SD	1.708
95% H-Stat (DL/2) UCL	3641

Log ROS Method

Mean in Log Scale	5.646
SD in Log Scale	1.636
Mean in Original Scale	785.2
SD in Original Scale	1045
95% t UCL	1122
95% Percentile Bootstrap UCL	1122
95% BCA Bootstrap UCL	1171
95% H UCL	3081

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.652
Theta Star	1295
nu star	33.93
A-D Test Statistic	0.876
5% A-D Critical Value	0.788
K-S Test Statistic	0.788
5% K-S Critical Value	0.179

Data follow Appr. Gamma Distribution at 5% Significance Level

Assuming Gamma Distribution

Data Distribution Test with Detected Values Only

Data Follow Appr. Gamma Distribution at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	785.7
SD	1026
SE of Mean	197.7
95% KM (t) UCL	1122
95% KM (z) UCL	1111

Gamma ROS Statistics using Extrapolated Data	
Minimum	0.000001
Maximum	4107
Mean	784.3
Median	245
SD	1046
k star	0.304
Theta star	2583
Nu star	17
AppChi2	8.674
95% Gamma Approximate UCL	1537
95% Adjusted Gamma UCL	1605

Note: DL/2 is not a recommended method.

95% KM (jackknife) UCL	1121
95% KM (bootstrap t) UCL	1201
95% KM (BCA) UCL	1090
95% KM (Percentile Bootstrap) UCL	1111
95% KM (Chebyshev) UCL	1647
97.5% KM (Chebyshev) UCL	2020
99% KM (Chebyshev) UCL	2753
Potential UCLs to Use	
95% KM (Chebyshev) UCL	1647

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

PCP

General Statistics

Number of Valid Data	21	Number of Detected Data	13
Number of Distinct Detected Data	12	Number of Non-Detect Data	8
		Percent Non-Detects	38.10%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.06	Minimum Detected	-2.813
Maximum Detected	210	Maximum Detected	5.347
Mean of Detected	42.49	Mean of Detected	0.929
SD of Detected	77.36	SD of Detected	3.066
Minimum Non-Detect	0.05	Minimum Non-Detect	-2.996
Maximum Non-Detect	0.05	Maximum Non-Detect	-2.996

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.602	Shapiro Wilk Test Statistic	0.884
5% Shapiro Wilk Critical Value	0.866	5% Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	26.31	Mean	-0.83
SD	63.54	SD	3.304
95% DL/2 (t) UCL	50.23	95% H-Stat (DL/2) UCL	12088
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.377	Mean in Log Scale	-2.088
SD	85.5	SD in Log Scale	4.797
95% MLE (t) UCL	32.56	Mean in Original Scale	26.3
95% MLE (Tiku) UCL	36	SD in Original Scale	63.54
		95% t UCL	50.22
		95% Percentile Bootstrap UCL	50.49
		95% BCA Bootstrap UCL	61.26
		95% H UCL	237800000

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	0.245	Data appear Gamma Distributed at 5% Significance Level
Theta Star	173.6	
nu star	6.365	

A-D Test Statistic	0.781
5% A-D Critical Value	0.848
K-S Test Statistic	0.848
5% K-S Critical Value	0.259

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	0.000001
Maximum	210
Mean	26.3
Median	0.12
SD	63.54
k star	0.119
Theta star	221
Nu star	4.999
AppChi2	1.152
95% Gamma Approximate UCL	114.2
95% Adjusted Gamma UCL	129.1

Note: DL/2 is not a recommended method.

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	26.33
SD	62
SE of Mean	14.08
95% KM (t) UCL	50.61
95% KM (z) UCL	49.49
95% KM (jackknife) UCL	50.22
95% KM (bootstrap t) UCL	101
95% KM (BCA) UCL	50.5
95% KM (Percentile Bootstrap) UCL	51.73
95% KM (Chebyshev) UCL	87.71
97.5% KM (Chebyshev) UCL	114.3
99% KM (Chebyshev) UCL	166.4

Potential UCLs to Use

95% KM (BCA) UCL	50.5

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

As

General Statistics

Number of Valid Data	14	Number of Detected Data	13
Number of Distinct Detected Data	8	Number of Non-Detect Data	1
		Percent Non-Detects	7.14%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	3	Minimum Detected	1.099
Maximum Detected	33	Maximum Detected	3.497
Mean of Detected	10	Mean of Detected	1.947
SD of Detected	10.03	SD of Detected	0.827
Minimum Non-Detect	2	Minimum Non-Detect	0.693
Maximum Non-Detect	2	Maximum Non-Detect	0.693

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.702	Shapiro Wilk Test Statistic	0.875
5% Shapiro Wilk Critical Value	0.866	5% Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	9.357	Mean	1.808
SD	9.935	SD	0.95
95% DL/2 (t) UCL	14.06	95% H-Stat (DL/2) UCL	19.54
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	9.004	Mean in Log Scale	1.806
SD	10.04	SD in Log Scale	0.954
95% MLE (t) UCL	13.76	Mean in Original Scale	9.355
95% MLE (Tiku) UCL	13.49	SD in Original Scale	9.937
		95% t UCL	14.06
		95% Percentile Bootstrap UCL	14
		95% BCA Bootstrap UCL	15.43
		95% H UCL	19.69

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	1.246	Data Follow Appr. Gamma Distribution at 5% Significance Level
Theta Star	8.028	
nu star	32.39	

A-D Test Statistic	0.883
5% A-D Critical Value	0.75
K-S Test Statistic	0.75
5% K-S Critical Value	0.241

Data follow Appr. Gamma Distribution at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data

Minimum	0.000001
Maximum	33
Mean	9.286
Median	5
SD	10
k star	0.407
Theta star	22.8
Nu star	11.4
AppChi2	4.836
95% Gamma Approximate UCL	21.89
95% Adjusted Gamma UCL	24.72

Note: DL/2 is not a recommended method.

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	9.5
SD	9.462
SE of Mean	2.632
95% KM (t) UCL	14.16
95% KM (z) UCL	13.83
95% KM (jackknife) UCL	14.15
95% KM (bootstrap t) UCL	21.7
95% KM (BCA) UCL	14.14
95% KM (Percentile Bootstrap) UCL	13.79
95% KM (Chebyshev) UCL	20.97
97.5% KM (Chebyshev) UCL	25.94
99% KM (Chebyshev) UCL	35.69

Potential UCLs to Use

95% KM (Chebyshev) UCL	20.97

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Pro-Rating Tables

Table 23.2 Pro-Rated Soil TPH Fractionation Chemistry for RBCA
Former Northwest Point Military Site
Stantec Project No. 121410105

7,751

TPH	EQL (mg/kg)	TP1BS3	Mass Fraction	EPC
TPH by Fractionation				
Aromatics				
>C7-C8	0.025	-		8.4
>C8-C10	0.1	32	0.0027	82
>C10-C12	4	460	0.038	297
>C12-C16	15	1600	0.133	1033
>C16-C21	15	680	0.057	439
>C21-C32	15	60	0.005	39
Aliphatics				
>C6-C8	0.1	130	0.011	84
>C8-C10	0.4	970	0.081	627
>C10-C12	8	1600	0.133	1033
>C12-C16	15	4700	0.392	3036
>C16-C21	15	1500	0.125	969
>C21-C32	15	73	0.006	47
Modified TPH		12000	1.0	7695
Toluene	0.025	0.08	-	8.4
Ethylbenzene	0.025	2.5	-	22.4
Xylenes	0.050	5	-	38.7

Notes:
Aromatics >C7-C8 = toluene
Aromatics >C8-C10 = fraction range + ethylbenzene & xylenes
Benzene, Toluene, Ethylbenzene and Xylene = maximum

Table 23.3 Pro-Rated Sediment TPH Fractionation Chemistry for RBCA
Former Northwest Point Military Site
Stantec Project No. 121410105

690

TPH	EQL (mg/kg)	TP1BS3	Mass Fraction	EPC
TPH by Fractionation				
Aromatics				
>C7-C8	0.025	-		0.015
>C8-C10	0.1	32	0.0027	2
>C10-C12	4	460	0.038	26
>C12-C16	15	1600	0.133	92
>C16-C21	15	680	0.057	39
>C21-C32	15	60	0.005	3
Aliphatics				
>C6-C8	0.1	130	0.011	7
>C8-C10	0.4	970	0.081	56
>C10-C12	8	1600	0.133	92
>C12-C16	15	4700	0.392	270
>C16-C21	15	1500	0.125	86
>C21-C32	15	73	0.006	4
Modified TPH		12000	1.0	679
Toluene	0.025	0.08	-	0.015
Ethylbenzene	0.025	2.5	-	0.015
Xylenes	0.050	5	-	0.025

Notes:
Aromatics >C7-C8 = toluene
Aromatics >C8-C10 = fraction range + ethylbenzene & xylenes
Toluene, Ethylbenzene and Xylene = 1/2 EQL

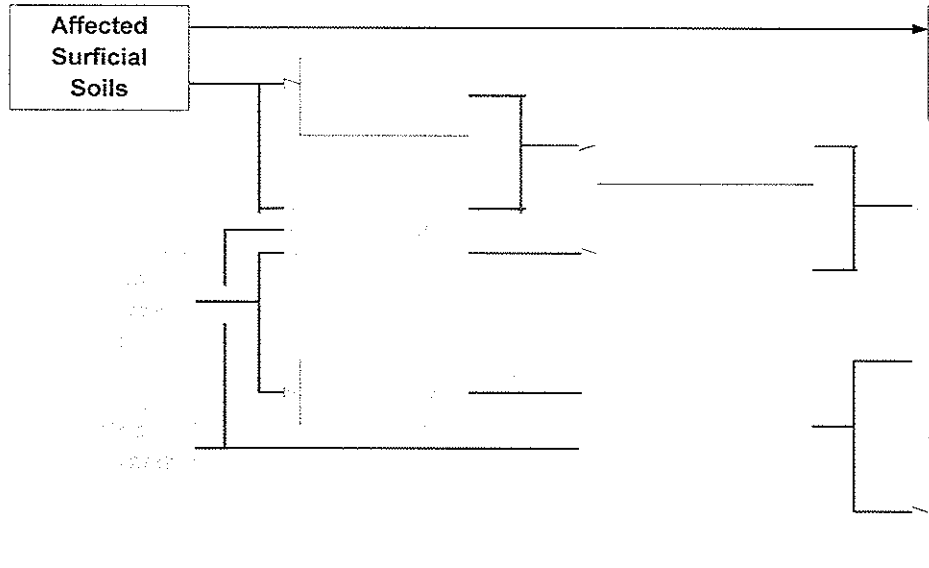
Risk Assessment Results

RBCA Model Output - Petroleum Hydrocarbons in Soil

Exposure Pathway Flowchart

Site Name: Northwest Point
Location: Northwesy Point Soil
Compl. By: Kelly Johnson

Job ID: 1044857
Date: 31-Mar-10



Receptors	On-site	Off-site1	Off-site2
	Residential	*NA*	*NA*
	None	None	None
	None	NA	NA
	None	None	None
	NA	NA	NA

SOURCE → TRANSPORT → RECEPTOR

Commands and Options

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RBCA SITE ASSESSMENT

Input Parameter Summary

Site Name: Northwest Point
Site Location: Northwesy Point Soil

Completed By: Kelly Johnson
Date Completed: 31-Mar-10

Job ID: 1044857

Exposure Parameters		Residential			Commercial/Industrial	
		Adult	Age 1-4 yrs.	Age 5-11 yrs.	Adult	Construc.
AT_c	Averaging time for carcinogens (yr)	78				
AT_n	Averaging time for non-carcinogens (yr)	25	4	7	25	1
BW	Body weight (kg)	70.7	16.5	33	70.7	
ED	Exposure duration (yr)	25	4	7	25	1
t	Averaging time for vapour flux (yr)	25			25	1
EF	Exposure frequency (days/yr)	*78*			*78*	*78*
EF_D	Exposure frequency for dermal exposure	*78*			*78*	
IR_w	Ingestion rate of water (L/day)	1.5	0.8	0.9	1.5	
IR_s	Ingestion rate of soil (mg/day)	20	80	20	20	100
SA	Skin surface area (dermal) (cm^2)	3400	3000	5000	3400	3400
M	Soil to skin adherence factor	0.1				
ET_{swim}	Swimming exposure time (hr/event)	1				
EV_{swim}	Swimming event frequency (events/yr)	12	12	12		
IR_{swim}	Water ingestion while swimming (L/hr)	0.05	0.5	0.5		
SA_{swim}	Skin surface area for swimming (cm^2)	23000	4400	8100		
IR_{fish}	Ingestion rate of fish (kg/yr)	0.05				
FI_{fish}	Contaminated fish fraction (unitless)	1				

Complete Exposure Pathways and Receptors	On-site	Off-site 1	Off-site 2
Groundwater:			
Groundwater Ingestion	None	None	None
Soil Leaching to Groundwater Ingestion	None	None	None
Applicable Surface Water Exposure Routes:			
Swimming			NA
Fish Consumption			NA
Aquatic Life Protection			NA
Soil:			
Direct Ingestion and Dermal Contact	Residential		
Outdoor Air:			
Particulates from Surface Soils	None	None	None
Volatilization from Soils	None	None	None
Volatilization from Groundwater	None	None	None
Indoor Air:			
Volatilization from Subsurface Soils	None		
Volatilization from Groundwater	None		

Receptor Distance from Source Media	On-site	Off-site 1	Off-site 2	(Units)
Groundwater receptor: Distance downgradient	NA	NA	NA	(m)
Lateral distance off centreline	NA	NA	NA	(m)
Vertical distance below top of water-bearing unit	NA	NA	NA	(m)
Soil leaching to groundwater receptor: Dist. downgradient	NA	NA	NA	(m)
Lateral distance off centreline	NA	NA	NA	(m)
Vertical distance below top of water-bearing unit	NA	NA	NA	(m)
Outdoor air inhalation receptor: downwind distance	NA	NA	NA	(m)

Target Health Risk Values		Individual	Cumulative
TR_{ab}	Target Risk (class A&B carcinogens)	1.0E-5	1.0E-5
TR_c	Target Risk (class C carcinogens)	1.0E-5	
THQ	Target Hazard Quotient (non-carcinogenic risk)	1.0E+0	1.0E+0

Modelling Options	
RBCA tier	Tier 2 or 3
Calculation option	Individual & Cumulative Risks
Outdoor air volatilization model	NA
Indoor air volatilization model	NA
Soil leaching model	NA
Use soil attenuation model (SAM) for leachate?	NA
Air dilution factor	NA
Groundwater dilution-attenuation factor	NA

NOTE: NA = Not applicable; ***Bold italic*** font indicates value differs from Tier 1 default value.

Surface Parameters		General	Construction	(Units)
A	Soil source zone area	NA	NA	(m^2)
W	Length of source-zone area parallel to wind	NA	NA	(m)
W_{gw}	Length of source-zone area parallel to GW flow	NA		(m)
U_{air}	Ambient air velocity in mixing zone	NA		(m/s)
δ_{air}	Air mixing zone height	NA		(m)
P_a	Areal particulate emission rate	NA		(g/cm^2/s)
L_{ss}	Thickness of affected surface soils	NA		(m)

Surface Soil Column Parameters		Value			(Units)
h_{cap}	Capillary zone thickness	NA			(m)
h_v	Vadose zone thickness	NA			(m)
ρ_s	Soil bulk density	NA			(g/cm^3)
f_{oc}	Fraction organic carbon	NA			(-)
θ_T	Soil total porosity	NA			(-)
K_{vs}	Vertical hydraulic conductivity	NA			(cm/s)
k_v	Vapour permeability	NA			(m^2)
L_{gw}	Depth to groundwater	NA			(m)
L_s	Depth to top of affected soils	NA			(m)
L_{base}	Depth to base of affected soils	NA			(m)
L_{subs}	Thickness of affected soils	NA			(m)
pH	Soil/groundwater pH	NA			(-)
		capillary	vadose	foundation	
θ_w	Volumetric water content	NA	NA	NA	(-)
θ_a	Volumetric air content	NA	NA	NA	(-)

Building Parameters		Residential	Commercial	(Units)
L_b	Building volume/area ratio	NA	NA	(m)
A_b	Foundation area	NA	NA	(m^2)
X_{crk}	Foundation perimeter	NA	NA	(m)
ER	Building air exchange rate	NA	NA	(1/s)
L_{crk}	Foundation thickness	NA	NA	(m)
Z_{crk}	Depth to bottom of foundation slab	NA	NA	(m)
η	Foundation crack fraction	NA	NA	(-)
dP	Indoor/outdoor differential pressure	NA	NA	(g/cm/s^2)
Q_s	Convective air flow through slab	NA	NA	(m^3/s)

Groundwater Parameters		Value	(Units)
δ_{gw}	Groundwater mixing zone depth	NA	(m)
I_f	Net groundwater infiltration rate	NA	(cm/yr)
U_{gw}	Groundwater Darcy velocity	NA	(cm/s)
V_{gw}	Groundwater seepage velocity	NA	(cm/s)
K_s	Saturated hydraulic conductivity	NA	(cm/s)
i	Groundwater gradient	NA	(-)
S_w	Width of groundwater source zone	NA	(m)
S_d	Depth of groundwater source zone	NA	(m)
θ_{eff}	Effective porosity in water-bearing unit	NA	(-)
f_{oc-sat}	Fraction organic carbon in water-bearing unit	NA	(-)
pH_{sat}	Groundwater pH	NA	(-)
	Biodegradation considered?	NA	

Transport Parameters		Off-site 1	Off-site 2	Off-site 1	Off-site 2	(Units)
Lateral Groundwater Transport		Groundwater Ingestion		Soil Leaching to GW		
α_x	Longitudinal dispersivity	NA	NA	NA	NA	(m)
α_y	Transverse dispersivity	NA	NA	NA	NA	(m)
α_z	Vertical dispersivity	NA	NA	NA	NA	(m)
Lateral Outdoor Air Transport		Soil to Outdoor Air Inhal.		GW to Outdoor Air Inhal.		
σ_y	Transverse dispersion coefficient	NA	NA	NA	NA	(m)
σ_z	Vertical dispersion coefficient	NA	NA	NA	NA	(m)
ADF	Air dispersion factor	NA	NA	NA	NA	(-)

Surface Water Parameters		Off-site 2	(Units)
Q_{sw}	Surface water flowrate	NA	(m^3/s)
W_{pl}	Width of GW plume at SW discharge	NA	(m)
δ_{pl}	Thickness of GW plume at SW discharge	NA	(m)
DF_{sw}	Groundwater-to-surface water dilution factor	NA	(-)

RBCA SITE ASSESSMENT | User-Specified COC Data

REPRESENTATIVE COC CONCENTRATIONS IN SOURCE MEDIA

CONSTITUENT	Representative COC Concentration			
	Groundwater		Soils (0 - 3 m)	
	value (mg/L)	note	value (mg/kg)	note
TPH - Aliph >C06-C08			8.4E+1	EPC
TPH - Aliph >C08-C10			6.3E+2	EPC
TPH - Aliph >C10-C12			1.0E+3	EPC
TPH - Aliph >C12-C16			3.0E+3	EPC
TPH - Aliph >C16-C21			9.7E+2	EPC
TPH - Aliph >C21-C34			4.7E+1	EPC
TPH - Arom >C07-C08			8.4E+0	EPC
TPH - Arom >C08-C10			8.2E+1	EPC
TPH - Arom >C10-C12			3.0E+2	EPC
TPH - Arom >C12-C16			1.0E+3	EPC
TPH - Arom >C16-C21			4.4E+2	EPC
TPH - Arom >C21-C35			3.9E+1	EPC

Site Name: Northwest Point
Site Location: Northwesy Point Soil
Completed By: Kelly Johnson

Date Completed: 31-Mar-10
Job ID: 1044857

RBCA SITE ASSESSMENT

Site Name: Northwest Point | Site Location: Northwesy Point Soil | Completed By: Kelly Johnson | Date Completed: 31-Mar-10 | *1 OF 1*

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

SOIL EXPOSURE PATHWAY ■ (CHECKED IF PATHWAY IS ACTIVE)

SURFACE SOILS OR SEDIMENTS:
ON-SITE INGESTION AND
DERMAL CONTACT

Constituents of Concern	1) Source/Exposure Medium	2) Exposure Multiplier (IR+SAxMxRAF)xEFxED/(BWxAT) (kg/kg/day)		3) Average Daily Intake Rate (mg/kg/day) (1) x (2)	
	Surface Soil Conc. (mg/kg)	Residential	Construction Worker	Residential	Construction Worker
TPH - Aliph >C06-C08	8.4E+1	3.0E-6		2.5E-4	
TPH - Aliph >C08-C10	6.3E+2	3.0E-6		1.9E-3	
TPH - Aliph >C10-C12	1.0E+3	3.0E-6		3.1E-3	
TPH - Aliph >C12-C16	3.0E+3	3.0E-6		9.0E-3	
TPH - Aliph >C16-C21	9.7E+2	3.0E-6		2.9E-3	
TPH - Aliph >C21-C34	4.7E+1	3.0E-6		1.4E-4	
TPH - Arom >C07-C08	8.4E+0	3.0E-6		2.5E-5	
TPH - Arom >C08-C10	8.2E+1	3.0E-6		2.4E-4	
TPH - Arom >C10-C12	3.0E+2	3.0E-6		8.8E-4	
TPH - Arom >C12-C16	1.0E+3	3.0E-6		3.1E-3	
TPH - Arom >C16-C21	4.4E+2	3.0E-6		1.3E-3	
TPH - Arom >C21-C35	3.9E+1	3.0E-6		1.2E-4	

NOTE: RAF = Relative absorption factor (-) | AT = Averaging time (days) | ED = Exposure duration (yrs) | IR = Soil ingestion rate (mg/day)
M = Adherence factor (mg/cm^2) | BW = Body weight (kg) | EF = Exposure frequencey (days/yr) | SA = Skin exposure area (cm^2/day)

RBCA SITE ASSESSMENT

TIER 2 PATHWAY RISK CALCULATION

SOIL EXPOSURE PATHWAY ■ (CHECKED IF PATHWAY IS ACTIVE)

TOXIC EFFECTS

Constituents of Concern	(4) Total Toxicant Intake Rate (mg/kg/day)				(5) Oral Reference Dose (mg/kg-day)		(6) Individual COC Hazard Quotient	
	(a) via Ingestion	(b) via Dermal Contact	(c) via Ingestion	(d) via Dermal Contact	(a) Oral	(b) Dermal	(4a)/(5a) + (4b)/(5b)	(4c)/(5a) + (4d)/(5b)
	Residential		Construction Worker				Residential	Construction Worker
TPH - Aliph >C06-C08	8.7E-5	1.6E-4			5.0E+0	5.0E+0*	5.0E-5	
TPH - Aliph >C08-C10	6.5E-4	1.2E-3			1.0E-1	1.0E-1*	1.9E-2	
TPH - Aliph >C10-C12	1.1E-3	2.0E-3			1.0E-1	1.0E-1*	3.1E-2	
TPH - Aliph >C12-C16	3.1E-3	5.9E-3			1.0E-1	1.0E-1*	9.0E-2	
TPH - Aliph >C16-C21	1.0E-3	1.9E-3			2.0E+0	2.0E+0*	1.4E-3	
TPH - Aliph >C21-C34	4.9E-5	9.1E-5			2.0E+0	2.0E+0*	7.0E-5	
TPH - Arom >C07-C08	8.7E-6	1.6E-5			2.0E-1	2.0E-1*	1.3E-4	
TPH - Arom >C08-C10	8.5E-5	1.6E-4			4.0E-2	4.0E-2*	6.1E-3	
TPH - Arom >C10-C12	3.1E-4	5.8E-4			4.0E-2	4.0E-2*	2.2E-2	
TPH - Arom >C12-C16	1.1E-3	2.0E-3			4.0E-2	4.0E-2*	7.7E-2	
TPH - Arom >C16-C21	4.5E-4	8.5E-4			3.0E-2	3.0E-2*	4.4E-2	
TPH - Arom >C21-C35	4.0E-5	7.6E-5			3.0E-2	3.0E-2*	3.9E-3	

* No dermal reference dose available--oral reference dose used.

Total Pathway Hazard Index = **2.9E-1**

Site Name: Northwest Point
Site Location: Northwesy Point Soil
Completed By: Kelly Johnson

Date Completed: 31-Mar-10
Job ID: 1044857

RBCA SITE ASSESSMENT

Site Name: Northwest Point | Completed By: Kelly Johnson | Job ID: 1044857

Site Location: Northwesy Point Soil | Date Completed: 31-Mar-10

SOIL (0 - 3 m) SSTL VALUES

Target Risk (Class A & B): 1.0E-5
Target Risk (Class C): 1.0E-5
Target Hazard Quotient: 1.0E+0

Source Depletion Option: No
Time to Future Exposure: 0 years

SSTL Results For Complete Exposure Pathways ("X" if Complete)

CONSTITUENTS OF CONCERN		Representative Concentration	Soil Leaching to Groundwater Ingestion / Discharge to Surface Water			Soil Vol. to Indoor Air	Soil Volatilization and Surface Soil Particulates to Outdoor Air				X Surface Soil Ingestion and Dermal Contact		Applicable SSTL	SSTL Exceeded ?	Required CRF
			On-site (0 m)	Off-site 1 (0 m)	Off-site 2 (0 m)	On-site (0 m)	On-site (0 m)		Off-site 1 (0 m)	Off-site 2 (0 m)	On-site (0 m)				Only if "yes" left
CAS No.	Name	(mg/kg)	None	None	None	None	None	Construction Worker	None	None	Residential	Construction Worker	(mg/kg)	"⊠" if yes	
106-08-0	TPH - Aliph >C06-C08	8.4E+1	NA	NA	NA	NA	NA	NA	NA	NA	1.0E+6	NA	1.0E+6	☐	<1
108-10-0	TPH - Aliph >C08-C10	6.3E+2	NA	NA	NA	NA	NA	NA	NA	NA	3.0E+4	NA	3.0E+4	☐	<1
110-12-0	TPH - Aliph >C10-C12	1.0E+3	NA	NA	NA	NA	NA	NA	NA	NA	3.4E+4	NA	3.4E+4	☐	<1
112-16-0	TPH - Aliph >C12-C16	3.0E+3	NA	NA	NA	NA	NA	NA	NA	NA	3.4E+4	NA	3.4E+4	☐	<1
116-21-0	TPH - Aliph >C16-C21	9.7E+2	NA	NA	NA	NA	NA	NA	NA	NA	6.7E+5	NA	6.7E+5	☐	<1
121-34-0	TPH - Aliph >C21-C34	4.7E+1	NA	NA	NA	NA	NA	NA	NA	NA	6.7E+5	NA	6.7E+5	☐	<1
207-08-0	TPH - Arom >C07-C08	8.4E+0	NA	NA	NA	NA	NA	NA	NA	NA	6.6E+4	NA	6.6E+4	☐	<1
208-10-0	TPH - Arom >C08-C10	8.2E+1	NA	NA	NA	NA	NA	NA	NA	NA	1.0E+4	NA	1.0E+4	☐	<1
210-12-0	TPH - Arom >C10-C12	3.0E+2	NA	NA	NA	NA	NA	NA	NA	NA	1.3E+4	NA	1.3E+4	☐	<1
212-16-0	TPH - Arom >C12-C16	1.0E+3	NA	NA	NA	NA	NA	NA	NA	NA	1.3E+4	NA	1.3E+4	☐	<1
216-21-0	TPH - Arom >C16-C21	4.4E+2	NA	NA	NA	NA	NA	NA	NA	NA	1.0E+4	NA	1.0E+4	☐	<1
221-35-0	TPH - Arom >C21-C35	3.9E+1	NA	NA	NA	NA	NA	NA	NA	NA	1.0E+4	NA	1.0E+4	☐	<1

">" indicates risk-based target concentration greater than constituent residual saturation value. NA = Not applicable. NC = Not calculated.

RBCA SITE ASSESSMENT

TPH Criteria SSTL Worksheet

Site Name: Northwest Point
Site Location: Northwesy Point Soil

Completed By: Kelly Johnson
Date Completed: 31-Mar-10

Job ID: 1044857

SSTL VALUES FOR TPH

Target Hazard Index: 1.0E+0

Source Depletion Option: No
Time to Future Exposure: 0 years

CONSTITUENTS OF CONCERN		Mass Fractions		Representative Concentrations		Calculated Concentration Limits		Applicable SSTL Values	
		Soil	Groundwater	Soil	Groundwater	Residual Soil Concentration	Solubility	Soils (0 - 3 m)	Groundwater
CAS No.	Name	(-)	(-)	(mg/kg)	(mg/L)	(mg/kg)	(mg/L)	(mg/kg)	(mg/L)
106-08-0	TPH - Aliph >C06-C08	1.1E-2		8.4E+1		1.5E+2		1.0E+6	
108-10-0	TPH - Aliph >C08-C10	8.1E-2		6.3E+2		7.4E+1		3.0E+4	
110-12-0	TPH - Aliph >C10-C12	1.3E-1		1.0E+3		4.3E+1		3.4E+4	
112-16-0	TPH - Aliph >C12-C16	3.9E-1		3.0E+3		1.9E+1		3.4E+4	
116-21-0	TPH - Aliph >C16-C21	1.3E-1		9.7E+2		7.9E+0		6.7E+5	
121-34-0	TPH - Aliph >C21-C34	6.1E-3		4.7E+1		1.3E+5		6.7E+5	
207-08-0	TPH - Arom >C07-C08	1.1E-3		8.4E+0		7.1E+2		6.6E+4	
208-10-0	TPH - Arom >C08-C10	1.1E-2		8.2E+1		5.2E+2		1.0E+4	
210-12-0	TPH - Arom >C10-C12	3.9E-2		3.0E+2		3.2E+2		1.3E+4	
212-16-0	TPH - Arom >C12-C16	1.3E-1		1.0E+3		1.5E+2		1.3E+4	
216-21-0	TPH - Arom >C16-C21	5.7E-2		4.4E+2		5.2E+1		1.0E+4	
221-35-0	TPH - Arom >C21-C35	5.1E-3		3.9E+1		4.2E+0		1.0E+4	
Total		1.0E+0	0.0E+0	7.7E+3	0.0E+0				
							Total TPH SSTL	2.6E+4	

">" indicates risk-based target concentration greater than constituent residual saturation value. NC = Not calculated.

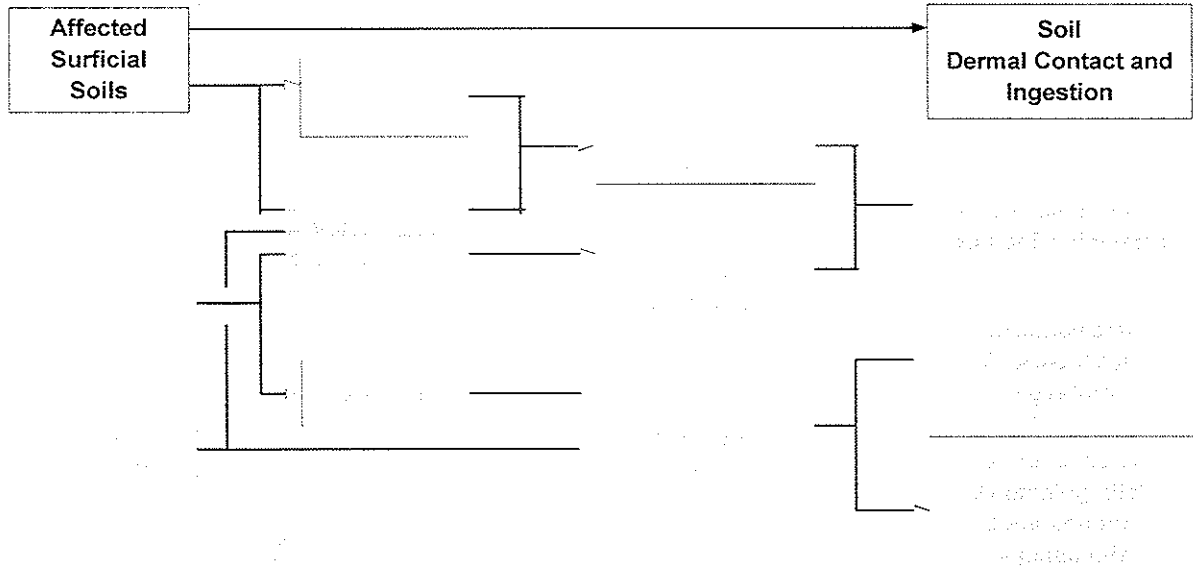
Risk Assessment Results

RBCA Model Output - Petroleum Hydrocarbons in Sediment

Exposure Pathway Flowchart

Site Name: Northwest Point
Location: Northwest Point
Compl. By: Kelly Johnson

Job ID: 1044857
Date: 31-Mar-10



Receptors	On-site	Off-site1	Off-site2
	Residential	*NA*	*NA*
	None	None	None
	None	NA	NA
	None	None	None
	NA	NA	NA

SOURCE → TRANSPORT → RECEPTOR

Commands and Options

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RBCA SITE ASSESSMENT

Input Parameter Summary

Site Name: Northwest Point
Site Location: Northwest Point

Completed By: Kelly Johnson
Date Completed: 31-Mar-10

Job ID: 1044857

Exposure Parameters		Residential			Commercial/Industrial	
		Adult	Age 1-4 yrs.	Age 5-11 yrs.	Adult	Construc.
AT_c	Averaging time for carcinogens (yr)	78				
AT_n	Averaging time for non-carcinogens (yr)	25	4	7	25	1
BW	Body weight (kg)	70.7	16.5	33	70.7	
ED	Exposure duration (yr)	25	4	7	25	1
τ	Averaging time for vapour flux (yr)	25			25	1
EF	Exposure frequency (days/yr)	*39*			*39*	*39*
EF_D	Exposure frequency for dermal exposure	*39*			*39*	
IR_w	Ingestion rate of water (L/day)	1.5	0.6	0.9	1.5	
IR_s	Ingestion rate of soil (mg/day)	20	80	20	20	100
SA	Skin surface area (dermal) (cm^2)	3400	3000	5000	3400	3400
M	Soil to skin adherence factor	0.1				
ET_{swim}	Swimming exposure time (hr/event)	1				
EV_{swim}	Swimming event frequency (events/yr)	12	12	12		
IR_{swim}	Water ingestion while swimming (L/hr)	0.05	0.5	0.5		
SA_{swim}	Skin surface area for swimming (cm^2)	23000	4400	8100		
IR_{fish}	Ingestion rate of fish (kg/yr)	0.05				
FI_{fish}	Contaminated fish fraction (unitless)	1				

Complete Exposure Pathways and Receptors	On-site	Off-site 1	Off-site 2
Groundwater:			
Groundwater Ingestion	None	None	None
Soil Leaching to Groundwater Ingestion	None	None	None
Applicable Surface Water Exposure Routes:			
Swimming			NA
Fish Consumption			NA
Aquatic Life Protection			NA
Soil:			
Direct Ingestion and Dermal Contact	Residential		
Outdoor Air:			
Particulates from Surface Soils	None	None	None
Volatilization from Soils	None	None	None
Volatilization from Groundwater	None	None	None
Indoor Air:			
Volatilization from Subsurface Soils	None		
Volatilization from Groundwater	None		

Receptor Distance from Source Media	On-site	Off-site 1	Off-site 2	(Units)
Groundwater receptor: Distance downgradient	NA	NA	NA	(m)
Lateral distance off centreline	NA	NA	NA	(m)
Vertical distance below top of water-bearing unit	NA	NA	NA	(m)
Soil leaching to groundwater receptor: Dist. downgradient	NA	NA	NA	(m)
Lateral distance off centreline	NA	NA	NA	(m)
Vertical distance below top of water-bearing unit	NA	NA	NA	(m)
Outdoor air inhalation receptor: downwind distance	NA	NA	NA	(m)

Target Health Risk Values		Individual	Cumulative
TR_{ab}	Target Risk (class A&B carcinogens)	1.0E-5	1.0E-5
TR_c	Target Risk (class C carcinogens)	1.0E-5	
THQ	Target Hazard Quotient (non-carcinogenic risk)	1.0E+0	1.0E+0

Modelling Options	
RBCA tier	Tier 2 or 3
Calculation option	Individual & Cumulative Risks
Outdoor air volatilization model	NA
Indoor air volatilization model	NA
Soil leaching model	NA
Use soil attenuation model (SAM) for leachate?	NA
Air dilution factor	NA
Groundwater dilution-attenuation factor	NA

NOTE: NA = Not applicable; ***Bold italic*** font indicates value differs from Tier 1 default value.

Surface Parameters		General	Construction	(Units)
A	Soil source zone area	NA	NA	(m^2)
W	Length of source-zone area parallel to wind	NA	NA	(m)
W_{gw}	Length of source-zone area parallel to GW flow	NA		(m)
U_{air}	Ambient air velocity in mixing zone	NA		(m/s)
δ_{air}	Air mixing zone height	NA		(m)
P_a	Areal particulate emission rate	NA		(g/cm^2/s)
L_{cc}	Thickness of affected surface soils	NA		(m)

Surface Soil Column Parameters		Value			(Units)
h_{cap}	Capillary zone thickness	NA			(m)
h_v	Vadose zone thickness	NA			(m)
ρ_s	Soil bulk density	NA			(g/cm^3)
f_{oc}	Fraction organic carbon	NA			(-)
θ_T	Soil total porosity	NA			(-)
K_{vs}	Vertical hydraulic conductivity	NA			(cm/s)
k_v	Vapour permeability	NA			(m^2)
L_{gw}	Depth to groundwater	NA			(m)
L_s	Depth to top of affected soils	NA			(m)
L_{base}	Depth to base of affected soils	NA			(m)
L_{subs}	Thickness of affected soils	NA			(m)
pH	Soil/groundwater pH	NA			(-)
		capillary	vadose	foundation	
θ_w	Volumetric water content	NA	NA	NA	(-)
θ_a	Volumetric air content	NA	NA	NA	(-)

Building Parameters		Residential	Commercial	(Units)
L_b	Building volume/area ratio	NA	NA	(m)
A_b	Foundation area	NA	NA	(m^2)
X_{crk}	Foundation perimeter	NA	NA	(m)
ER	Building air exchange rate	NA	NA	(1/s)
L_{crk}	Foundation thickness	NA	NA	(m)
Z_{crk}	Depth to bottom of foundation slab	NA	NA	(m)
η	Foundation crack fraction	NA	NA	(-)
dP	Indoor/outdoor differential pressure	NA	NA	(g/cm/s^2)
Q_{soil}	Convective air flow through slab	NA	NA	(m^3/s)

Groundwater Parameters		Value	(Units)
δ_{gw}	Groundwater mixing zone depth	NA	(m)
I_f	Net groundwater infiltration rate	NA	(cm/yr)
U_{gw}	Groundwater Darcy velocity	NA	(cm/s)
V_{gw}	Groundwater seepage velocity	NA	(cm/s)
K_s	Saturated hydraulic conductivity	NA	(cm/s)
i	Groundwater gradient	NA	(-)
S_w	Width of groundwater source zone	NA	(m)
S_d	Depth of groundwater source zone	NA	(m)
θ_{eff}	Effective porosity in water-bearing unit	NA	(-)
f_{oc-sat}	Fraction organic carbon in water-bearing unit	NA	(-)
pH_{sat}	Groundwater pH	NA	(-)
	Biodegradation considered?	NA	

Transport Parameters		Off-site 1	Off-site 2	Off-site 1	Off-site 2	(Units)
Lateral Groundwater Transport		Groundwater Ingestion		Soil Leaching to GW		
α_x	Longitudinal dispersivity	NA	NA	NA	NA	(m)
α_y	Transverse dispersivity	NA	NA	NA	NA	(m)
α_z	Vertical dispersivity	NA	NA	NA	NA	(m)
Lateral Outdoor Air Transport		Soil to Outdoor Air Inhal.		GW to Outdoor Air Inhal.		
σ_y	Transverse dispersion coefficient	NA	NA	NA	NA	(m)
σ_z	Vertical dispersion coefficient	NA	NA	NA	NA	(m)
ADF	Air dispersion factor	NA	NA	NA	NA	(-)

Surface Water Parameters		Off-site 2	(Units)
Q_{sw}	Surface water flowrate	NA	(m^3/s)
W_p	Width of GW plume at SW discharge	NA	(m)
δ_p	Thickness of GW plume at SW discharge	NA	(m)
DF_{sw}	Groundwater-to-surface water dilution factor	NA	(-)

RBCA SITE ASSESSMENT | **User-Specified COC Data**

REPRESENTATIVE COC CONCENTRATIONS IN SOURCE MEDIA

CONSTITUENT	Representative COC Concentration			
	Groundwater		Soils (0 - 3 m)	
	value (mg/L)	note	value (mg/kg)	note
TPH - Aliph >C06-C08			7.0E+0	EPC
TPH - Aliph >C08-C10			5.6E+1	EPC
TPH - Aliph >C10-C12			9.2E+1	EPC
TPH - Aliph >C12-C16			2.7E+2	EPC
TPH - Aliph >C16-C21			8.6E+1	EPC
TPH - Aliph >C21-C34			4.0E+0	EPC
TPH - Arom >C07-C08			1.5E-2	EPC
TPH - Arom >C08-C10			2.0E+0	EPC
TPH - Arom >C10-C12			2.6E+1	EPC
TPH - Arom >C12-C16			9.2E+1	EPC
TPH - Arom >C16-C21			3.9E+1	EPC
TPH - Arom >C21-C35			3.0E+0	EPC

Site Name: Northwest Point
Site Location: Northwest Point
Completed By: Kelly Johnson

Date Completed: 31-Mar-10
Job ID: 1044857

RBCA SITE ASSESSMENT

Site Name: Northwest Point | Site Location: Northwest Point | Completed By: Kelly Johnson | Date Completed: 31-Mar-10 | *1 OF 1*

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

SOIL EXPOSURE PATHWAY ■ (CHECKED IF PATHWAY IS ACTIVE)

SURFACE SOILS OR SEDIMENTS:
ON-SITE INGESTION AND
DERMAL CONTACT

Constituents of Concern	1) Source/Exposure Medium	2) Exposure Multiplier (IR+SAxMxRAF)xEFxED/(BWxAT) (kg/kg/day)		3) Average Daily Intake Rate (mg/kg/day) (1) x (2)	
	Surface Soil Conc. (mg/kg)	Residential	Construction Worker	Residential	Construction Worker
TPH - Aliph >C06-C08	7.0E+0	1.5E-6		1.0E-5	
TPH - Aliph >C08-C10	5.6E+1	1.5E-6		8.3E-5	
TPH - Aliph >C10-C12	9.2E+1	1.5E-6		1.4E-4	
TPH - Aliph >C12-C16	2.7E+2	1.5E-6		4.0E-4	
TPH - Aliph >C16-C21	8.6E+1	1.5E-6		1.3E-4	
TPH - Aliph >C21-C34	4.0E+0	1.5E-6		6.0E-6	
TPH - Arom >C07-C08	1.5E-2	1.5E-6		2.2E-8	
TPH - Arom >C08-C10	2.0E+0	1.5E-6		3.0E-6	
TPH - Arom >C10-C12	2.6E+1	1.5E-6		3.9E-5	
TPH - Arom >C12-C16	9.2E+1	1.5E-6		1.4E-4	
TPH - Arom >C16-C21	3.9E+1	1.5E-6		5.8E-5	
TPH - Arom >C21-C35	3.0E+0	1.5E-6		4.5E-6	

NOTE: RAF = Relative absorption factor (-) | AT = Averaging time (days) | ED = Exposure duration (yrs) | IR = Soil ingestion rate (mg/day)
M = Adherence factor (mg/cm^2) | BW = Body weight (kg) | EF = Exposure frequencey (days/yr) | SA = Skin exposure area (cm^2/day)

RBCA SITE ASSESSMENT

TIER 2 PATHWAY RISK CALCULATION

SOIL EXPOSURE PATHWAY ■ (CHECKED IF PATHWAY IS ACTIVE)

TOXIC EFFECTS

Constituents of Concern	(4) Total Toxicant Intake Rate (mg/kg/day) (a) via Ingestion (Residential)	(b) via Dermal Contact (Residential)	(c) via Ingestion (Construction Worker)	(d) via Dermal Contact (Construction Worker)	(5) Oral Reference Dose (mg/kg-day) (a) Oral	(b) Dermal	(6) Individual COC Hazard Quotient (4a)/(5a) + (4b)/(5b) Residential	(4c)/(5a) + (4d)/(5b) Construction Worker
TPH - Aliph >C06-C08	3.6E-6	6.8E-6			5.0E+0	5.0E+0*	2.1E-6	
TPH - Aliph >C08-C10	2.9E-5	5.4E-5			1.0E-1	1.0E-1*	8.3E-4	
TPH - Aliph >C10-C12	4.8E-5	8.9E-5			1.0E-1	1.0E-1*	1.4E-3	
TPH - Aliph >C12-C16	1.4E-4	2.6E-4			1.0E-1	1.0E-1*	4.0E-3	
TPH - Aliph >C16-C21	4.5E-5	8.4E-5			2.0E+0	2.0E+0*	6.4E-5	
TPH - Aliph >C21-C34	2.1E-6	3.9E-6			2.0E+0	2.0E+0*	3.0E-6	
TPH - Arom >C07-C08	7.8E-9	1.5E-8			2.0E-1	2.0E-1*	1.1E-7	
TPH - Arom >C08-C10	1.0E-6	1.9E-6			4.0E-2	4.0E-2*	7.4E-5	
TPH - Arom >C10-C12	1.3E-5	2.5E-5			4.0E-2	4.0E-2*	9.7E-4	
TPH - Arom >C12-C16	4.8E-5	8.9E-5			4.0E-2	4.0E-2*	3.4E-3	
TPH - Arom >C16-C21	2.0E-5	3.8E-5			3.0E-2	3.0E-2*	1.9E-3	
TPH - Arom >C21-C35	1.6E-6	2.9E-6			3.0E-2	3.0E-2*	1.5E-4	

* No dermal reference dose available--oral reference dose used.

Total Pathway Hazard Index = **1.3E-2**

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RBCA SITE ASSESSMENT

Site Name: Northwest Point
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Completed By: Kelly Johnson
Date Completed: 31-Mar-10

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SOIL (0 - 3 m) SSTL VALUES

Target Risk (Class A & B): 1.0E-5
Target Risk (Class C): 1.0E-5
Target Hazard Quotient: 1.0E+0

Source Depletion Option: No
Time to Future Exposure: 0 years

SSTL Results For Complete Exposure Pathways ("X" if Complete)

CONSTITUENTS OF CONCERN		Representative Concentration	Soil Leaching to Groundwater Ingestion / Discharge to Surface Water			Soil Vol. to Indoor Air	Soil Volatilization and Surface Soil Particulates to Outdoor Air				X Surface Soil Ingestion and Dermal Contact		Applicable SSTL	SSTL Exceeded ?	Required CRF
			On-site (0 m)	Off-site 1 (0 m)	Off-site 2 (0 m)	On-site (0 m)	On-site (0 m)		Off-site 1 (0 m)	Off-site 2 (0 m)	On-site (0 m)				Only if "yes" left
CAS No.	Name	(mg/kg)	None	None	None	None	None	Construction Worker	None	None	Residential	Construction Worker	(mg/kg)	"■" if yes	
106-08-0	TPH - Aliph >C06-C08	7.0E+0	NA	NA	NA	NA	NA	NA	NA	NA	1.0E+6	NA	1.0E+6	☐	<1
108-10-0	TPH - Aliph >C08-C10	5.6E+1	NA	NA	NA	NA	NA	NA	NA	NA	6.0E+4	NA	6.0E+4	☐	<1
110-12-0	TPH - Aliph >C10-C12	9.2E+1	NA	NA	NA	NA	NA	NA	NA	NA	6.7E+4	NA	6.7E+4	☐	<1
112-16-0	TPH - Aliph >C12-C16	2.7E+2	NA	NA	NA	NA	NA	NA	NA	NA	6.7E+4	NA	6.7E+4	☐	<1
116-21-0	TPH - Aliph >C16-C21	8.6E+1	NA	NA	NA	NA	NA	NA	NA	NA	1.0E+6	NA	1.0E+6	☐	<1
121-34-0	TPH - Aliph >C21-C34	4.0E+0	NA	NA	NA	NA	NA	NA	NA	NA	1.0E+6	NA	1.0E+6	☐	<1
207-08-0	TPH - Arom >C07-C08	1.5E-2	NA	NA	NA	NA	NA	NA	NA	NA	1.3E+5	NA	1.3E+5	☐	<1
208-10-0	TPH - Arom >C08-C10	2.0E+0	NA	NA	NA	NA	NA	NA	NA	NA	2.1E+4	NA	2.1E+4	☐	<1
210-12-0	TPH - Arom >C10-C12	2.6E+1	NA	NA	NA	NA	NA	NA	NA	NA	2.7E+4	NA	2.7E+4	☐	<1
212-16-0	TPH - Arom >C12-C16	9.2E+1	NA	NA	NA	NA	NA	NA	NA	NA	2.7E+4	NA	2.7E+4	☐	<1
216-21-0	TPH - Arom >C16-C21	3.9E+1	NA	NA	NA	NA	NA	NA	NA	NA	2.0E+4	NA	2.0E+4	☐	<1
221-35-0	TPH - Arom >C21-C35	3.0E+0	NA	NA	NA	NA	NA	NA	NA	NA	2.0E+4	NA	2.0E+4	☐	<1

">" indicates risk-based target concentration greater than constituent residual saturation value. NA = Not applicable. NC = Not calculated.

RBCA SITE ASSESSMENT

TPH Criteria SSTL Worksheet

Site Name: Northwest Point
Site Location: Northwest Point

Completed By: Kelly Johnson
Date Completed: 31-Mar-10

Job ID: 1044857

SSTL VALUES FOR TPH

Target Hazard Index: 1.0E+0

Source Depletion Option: No
Time to Future Exposure: 0 years

CONSTITUENTS OF CONCERN		Mass Fractions		Representative Concentrations		Calculated Concentration Limits		Appilcable SSTL Values	
		Soil	Groundwater	Soil	Groundwater	Residual Soil Concentration	Solubility	Soils (0 - 3 m)	Groundwater
CAS No.	Name	(-)	(-)	(mg/kg)	(mg/L)	(mg/kg)	(mg/L)	(mg/kg)	(mg/L)
106-08-0	TPH - Aliph >C06-C08	1.0E-2		7.0E+0		1.5E+2		1.0E+6	
108-10-0	TPH - Aliph >C08-C10	8.3E-2		5.6E+1		7.4E+1		6.0E+4	
110-12-0	TPH - Aliph >C10-C12	1.4E-1		9.2E+1		4.3E+1		6.7E+4	
112-16-0	TPH - Aliph >C12-C16	4.0E-1		2.7E+2		1.9E+1		6.7E+4	
116-21-0	TPH - Aliph >C16-C21	1.3E-1		8.6E+1		7.9E+0		1.0E+6	
121-34-0	TPH - Aliph >C21-C34	5.9E-3		4.0E+0		1.3E+5		1.0E+6	
207-08-0	TPH - Arom >C07-C08	2.2E-5		1.5E-2		7.1E+2		1.3E+5	
208-10-0	TPH - Arom >C08-C10	3.0E-3		2.0E+0		5.2E+2		2.1E+4	
210-12-0	TPH - Arom >C10-C12	3.8E-2		2.6E+1		3.2E+2		2.7E+4	
212-16-0	TPH - Arom >C12-C16	1.4E-1		9.2E+1		1.5E+2		2.7E+4	
216-21-0	TPH - Arom >C16-C21	5.8E-2		3.9E+1		5.2E+1		2.0E+4	
221-35-0	TPH - Arom >C21-C35	4.4E-3		3.0E+0		4.2E+0		2.0E+4	
	Total	1.0E+0	0.0E+0	6.8E+2	0.0E+0			Total TPH SSTL	5.2E+4	

">" indicates risk-based target concentration greater than constituent residual saturation value. NC = Not calculated.

Risk Assessment Results

Carcinogenic PAHs

Site-Specific Target Levels for Human Health (Non-Threshold Substances) - Northwest Point Lifetime

Northwest Point - Soil Exposure Pathways

Receptor: **Lifetime** **Northwest Point**

$$\text{SSTL Lifetime} = \frac{TR \times LE}{(AF_{gut} \times SIR_{adj} \times ET_{ing} \times SF_o) + (AF_{lung} \times IR_{soil\ adj} \times ET_{inh} \times SF_i) + (AF_{skin} \times SDR_{adj} \times ET_{derm} \times SF_o)} + BSC$$

$$\text{ILCR Lifetime} = \frac{C_s \times [(AF_{gut} \times SIR_{adj} \times ET_{ing} \times SF_o) + (AF_{lung} \times IR_{soil\ adj} \times ET_{inh} \times SF_i) + (AF_{skin} \times SDR_{adj} \times ET_{derm} \times SF_o)]}{LE}$$

Compound	SF_o $(mg/kg\text{-}d)^{-1}$	SF_i $(mg/kg\text{-}d)^{-1}$	BSC (mg/kg)	AF_{gut}	AF_{lung}	AF_{skin}	SSTL - Lifetime (mg/kg)	EPC (mg/kg)	ILCR (unitless)
B(a)P TPE	2.3	0.137	0	1	1	0.148	23.2	35	1.5E-05

Time on site:		
Hours per day (inhalation)	24	
Days per Week	3	
Weeks per Year	26	
Years Exposed	80	Health Canada (2009a)
Life Expectancy	80	Health Canada (2009a)

Parameter	Definition (units)	Default Value	Reference
SF_o =	oral slope factor [1/(mg/kg-day)]	chemical specific	Health Canada (2009b)
SF_i =	inhalation slope factor [1/(mg/kg-day)]	chemical specific	Health Canada (2009b)
C_S =	concentration in soil (mg/kg)	site specific	calculated Exposure Point Concentration (EPC)
TR =	target risk	1.00E-05	Health Canada (2009a)
BSC =	background soil concentration	chemical specific	
AF_{gut} =	absorption factor for gut (unitless)	chemical specific	Assumed
AF_{lung} =	absorption factor for lung (unitless)	chemical specific	Assumed
AF_{skin} =	absorption factor skin (unitless)	chemical specific	Health Canada (2009b)
SIR_{adj} =	soil ingestion rate (kg soil-yr/kg bw-day)	4.69E-05	Health Canada (2009a) - Lifetime
$IR_{soil\ adj}$ =	soil inhalation rate (kg soil -yr/kg bw-day) = CRP (kg/m^3) x IR_{air} (m^3 air-yr/kg bw-day)	5.42E-06	calculated
SDR_{adj} =	soil dermal contact rate (kg soil- yr/kg bw-day) = (SA_{hands} x M_{hands}) + (SA_{body} x M_{body}) x 10^{-6} (kg/mg)	1.54E-04	calculated
ET_{ing} =	exposure term for soil ingestion pathway (unitless)	0.214	Site Specific [24 Hours per Day, 3 Days per Week, 26 Weeks per Year]
ET_{inh} =	exposure term for soil inhalation pathway (unitless)	0.214	Site Specific [24 Hours per Day, 3 Days per Week, 26 Weeks per Year]
ET_{derm} =	exposure term for soil dermal contact pathway (unitless)	0.214	Site Specific [24 Hours per Day, 3 Days per Week, 26 Weeks per Year]
CRP =	concentration of respirable particles (kg/m^3)	2.50E-07	Health Canada (2009a) - Unpaved roads with vehicle traffic
$IR_{air\ adj}$ =	daily inhalation rate (m^3 air-yr/kg bw-day)	21.7	Health Canada (2009a) - Lifetime
$SA_{hands\ adj}$ =	skin surface area - hands (cm^2-yr/kg bw-day)	1125	Health Canada (2009a) - Lifetime
$SA_{body\ adj}$ =	skin surface area - arms (cm^2-yr/kg bw-day)	4181	Health Canada (2009a) - Lifetime
M_{hands} =	soil to skin adherence factor - hands (mg/cm^2)	0.1	Health Canada (2009a) - Lifetime
M_{body} =	soil to skin adherence factor - rest of body (mg/cm^2)	0.01	Health Canada (2009a) - Lifetime