



Calculating Soil RCLs for PAHs

Wis. Admin. Code § NR 722.11 (1)

Purpose

The purpose of this document is to provide direction on using the modified RCL spreadsheet to assess the non-industrial direct contact risk posed by certain carcinogenic PAH compounds on a cumulative, not individual, basis.

Related Documents

- [RR-890 – Soil Residual Contaminant Level Determinations Using the U.S. EPA Regional Screening Level Web Calculator](#)
- [RR-079 - Risk Assessment Approach for Calculating cPAH Non-Industrial Direct Contact RCLs - Wis. Admin. Code § NR 722.11 \(1\)](#)
- [4400-237 – Technical Assistance and Environmental Liability Clarification Request form](#)

Other Resources

Questions regarding this document should be directed to Paul Grittner at paul.grittner@wisconsin.gov or (608)-266-0941.

Introduction

The Department of Natural Resources (DNR) uses a spreadsheet to determine whether contaminant concentrations detected in soil samples exceed either a specific Wis. Admin. Code § NR 720 residual contaminant level (RCL), the hazard quotient, or the cumulative cancer risk. A modified version of the non-industrial direct contact spreadsheet that calculates the cumulative cancer risk posed by seven carcinogenic polycyclic aromatic hydrocarbons (cPAHs) is now available.

The spreadsheet compares the calculated cancer risk value to a threshold of 5×10^{-6} to assess non-industrial direct contact risk. Concentrations of the seven, cPAHs in the modified spreadsheet will not be compared to a compound-specific RCL. The Wisconsin Department of Health Services determined that cumulative rather than compound specific assessment of the seven cPAHs was appropriate and protective because the cPAH compounds are always found in a mixture and they have similar health effects. The development of the modified spreadsheet is explained by the DNR guidance document RR-079, *Risk Assessment Approach for Calculating cPAH Non-Industrial Direct Contact RCLs - Wis. Admin. Code § NR 722.11 (1)*.

Using the modified spreadsheet is considered a risk assessment that may be used to develop alternate environmental standards with approval from the DNR. Wis. Admin Code § NR 722.11 (1) allows a responsible party to request to use a risk assessment to determine alternate environmental standards when attaining compliance with the RCLs is not practicable. As obtaining the non-industrial direct contact RCL for the seven cPAHs is frequently not practicable, the DNR will generally approve of the use of the modified spreadsheet. A request to use the modified spreadsheet can be incorporated into any fee-based submittal as summarized in Appendix 1 below. A request may also be submitted to the DNR independently as a 'Request for Technical Assistance' using Form 4400-237.

If contaminants exceed the non-industrial direct contact RCL for one or more of the seven cPAHs using the standard RCL spreadsheet, the use of the modified spreadsheet with cumulative assessment could be considered. The modified spreadsheet may interpret soil contaminant concentrations to not pose a risk based on a cumulative analysis, even if concentrations of the seven cPAHs exceed their compound specific RCLs. The cumulative assessment process allows for cPAH concentrations to be identified that are protective and may reduce the areas that would need to be capped or remediated at response action sites.

The modified spreadsheet is not appropriate for use at sites where industrial, direct contact RCLs are used to assess risk as it is generally considered practicable to obtain compliance with the industrial standards. In addition, use of the modified spreadsheet does not remove the need to compare sample data to the RCLs for the protection of groundwater.

Data Entry into the Modified Spreadsheet

Directions on using the original spreadsheet are included in the DNR publication RR-890, *Soil RCL Determinations Using the US EPA Regional Screening Level Web Calculator*. These instructions generally apply to completing the modified spreadsheet as well. A summary of those instructions follows.

Steps to use the Modified Spreadsheet:

- 1) Open the “Modified Spreadsheet” found at <http://dnr.wi.gov/topic/brownfields/professionals.html>, under the tab ‘Soil RCLs.’
- 2) Enter all analytical data from a given soil sampling location into the spreadsheet. Each spreadsheet reflects the results for a single sampling location. The “overview” tab, which is also on the original calculator, is meant to illustrate an example of a compilation of soil sample results from many sample locations to provide a comprehensive table of concentrations and risks.
 - a. Include the sample results for all compounds tested for (metals, volatile organic compounds, etc.) to assess whether a direct contact RCL for non-cPAH compounds, the hazard index, or the cumulative cancer risk is exceeded.
 - b. Enter the detection limit in the spreadsheet as the reported concentration if a compound was analyzed for but not detected.
 - c. A numeric value must always be entered for each PAH compound analyzed for (substituting the detection limit for each non-detected sample).
 - d. A group of non-PAH compounds may be excluded from the spreadsheet if the sample analysis did not identify *any* concentrations of those compounds above the detection limit and those compounds are not expected to have been discharged at the sample location.
 - e. Sample results between the detection level and the level of qualification must be entered into the spreadsheet (J-values).
 - f. The highest concentration of a specific compound reported multiple times during the same sampling event (such as naphthalene detected in samples analyzed for volatile organic compounds and PAHs or any compound analyzed in a duplicate sample) should be entered in the spreadsheet.
 - g. A value does not have to be entered in the table for compounds that were not analyzed.
 - h. If compounds are expected at a location, but the compounds were not included in the analyses completed, the results produced by the modified spreadsheet may not be considered valid.
- 3) Once data is entered, click on ‘Get Summary’ at the bottom of the spreadsheet.
- 4) Review the results on the tab labeled ‘Summary_Soil_DC_Data’. If there are no individual exceedances for compounds other than the cPAHs, the cumulative cPAH cancer risk (DC) is less than 5×10^{-6} , the hazard index is less than 1, and the cumulative cancer risk is less than 1×10^{-5} , then the contamination present in the soil sample does not pose a direct contact risk.
- 5) Print a copy of the summary page and include it with the analytical data when submitting these results to the DNR to indicate that you are requesting the use of the modified spreadsheet as part of a Wis. Admin. Code § NR 722.11 risk assessment.
- 6) Enter the sample data and the results of the spreadsheet analysis into a summary data table that meets applicable requirements of Wis. Admin. Code § NR 716 (see the “results of the modified RCL spreadsheet” example below), Wis. Admin. Code § NR 722.13, and [DNR Form 4400-202](#), *Case Closure*. Just like the original spreadsheet, the modified spreadsheet will indicate the number of individual RCLs exceeded and whether the cumulative hazard index or cancer risk (for all compounds) is exceeded. In addition, it will also indicate whether the cumulative cPAH cancer risk used to assess the seven cPAH compounds is exceeded.

- 7) Per Wis. Admin. Code § NR 722.11(1)(b), use of this PAH-related, risk assessment requires DNR approval. A request to use the modified RCL spreadsheet may be provided as a separate submittal or may be incorporated into one of the documents listed in Appendix 1. The appropriate Wis. Admin. Code § NR 749 fee must be provided with each submittal. Include all copies of the summary pages and data tables, generated as described above, with the request. The DNR will review the request and will either approve, modify, or deny it per Wis. Admin. Code § NR 722 .11(3).

Examples

In the following examples, two soil samples were analyzed for PAHs. Sample results were first entered into the original RCL spreadsheet and then the modified spreadsheet to assess direct contact risk.

Results of Original RCL Spreadsheet

Boring #	B-1	B-2	Soil RCLs	
Depth to water table (ft BGS)	5	5		
Date Collected	05/01/2017	05/01/2017		
Depth (ft BGS)	3-4	3-4		
Soil Type	clay	clay		
	(mg/kg)		non-industrial direct contact	Soil to groundwater
Acenaphthene	0.230	0.630	3,590	NS
Acenaphthylene	0.240	0.360	NS	NS
Anthracene	0.350	0.150	17,900	NS
Benz[a]anthracene	0.320	0.340	1.14	NS
Benzo[a]pyrene	0.245	0.230	0.115	470
Benzo[b]fluoranthene	0.240	0.340	1.15	480
Benzo[g,h,i]perylene	0.260	0.240	NS	NS
Benzo[k]fluoranthene	0.240	0.290	11.5	NS
Chrysene	0.240	0.360	115	145
Dibenz[a,h]anthracene	0.240	0.280	0.115	NS
Fluoranthene	0.250	0.270	2,390	NS
Fluorene	0.360	0.290	2,390	14,815
Indeno[1,2,3-cd]pyrene	0.240	0.260	1.15	NS
Methylnaphthalene, 1-	0.360	0.340	17.6	658
Methylnaphthalene, 2-	0.350	0.120	239	NS
Naphthalene	0.120	0.380	5.52	54,473
Phenanthrene	0.270	0.270	NS	NS
Pyrene	0.280	0.280	1,790	NS
Results of Original RCL Spreadsheet				
No. of Individual Exceedances (DC)	2	2		
cumulative hazard index	0.0165	0.0218		
cumulative cancer risk	5×10^{-6}	5.70×10^{-6}		

Results of Modified RCL Spreadsheet

Boring #	B-1	B-2	Soil RCLs	
Depth to water table (ft BGS)	5	5		
Date Collected	05/01/2017	05/01/2017		
Depth (ft BGS)	3-4	3-4		
Soil Type	clay	clay		
	(mg/kg)		non-industrial direct contact*	Soil to groundwater
Acenaphthene	0.230	0.630	3,590	NS
Acenaphthylene	0.240	0.360	NS	NS
Anthracene	0.350	0.150	17,900	NS
Benz[a]anthracene	0.320	0.340	cPAH	NS
Benzo[a]pyrene	0.245	0.230	cPAH	470
Benzo[b]fluoranthene	0.240	0.340	cPAH	480
Benzo[g,h,i]perylene	0.260	0.240	NS	NS
Benzo[k]fluoranthene	0.240	0.290	cPAH	NS
Chrysene	0.240	0.360	cPAH	145
Dibenz[a,h]anthracene	0.240	0.280	cPAH	NS
Fluoranthene	0.250	0.270	2,390	NS
Fluorene	0.360	0.290	2,390	14,815
Indeno[1,2,3-cd]pyrene	0.240	0.260	cPAH	NS
Methylnaphthalene, 1-	0.360	0.340	17.6	658
Methylnaphthalene, 2-	0.350	0.120	239	NS
Naphthalene	0.120	0.380	5.52	54,473
Phenanthrene	0.270	0.270	NS	NS
Pyrene	0.280	0.280	1,790	NS
Results of Modified RCL Spreadsheet				
cumulative cPAHs Cancer Risk (DC)	4.90x10 ⁻⁶	5.30x10⁻⁶		
No. of Individual Exceedances (DC)*	0	0		
cumulative hazard index	0.0168	0.0218		
cumulative cancer risk	5x10 ⁻⁶	5.70x10 ⁻⁶		

* Direct contact RCLs for seven cPAHs are not considered on the modified spreadsheet. Only the cumulative cPAH cancer risk is calculated for these compounds.

Sample B-1: The original RCL calculator indicated that concentrations of benzo(a)pyrene and dibenz[a,h]anthracene exceed the direct contact RCL. When this data is entered into the modified spreadsheet, these two compounds are not compared to a compound specific RCL but are included in the cumulative cancer risk analysis calculated for seven cPAHs. The modified calculator identified zero individual exceedances, and

calculated the cumulative cPAH cancer risk to be below the acceptable limit of 5×10^{-6} . Contaminant concentrations measured in this sample do not indicate a direct contact risk.

Sample B-2: As for sample B-1 above, the original RCL calculator indicated that concentrations of benzo(a)pyrene and dibenz[a,h]anthracene exceed the direct contact RCL. When the data is entered into the modified calculator, zero individual exceedances are identified in this sample. However, the cumulative cPAH cancer risk calculated for the seven cPAHs is greater than the acceptable limit of 5×10^{-6} . Contaminant concentrations measured in this sample do pose direct contact risk.

Suggested Process to Assess Large Data Sets

When assessing sites with a large number of samples (e.g., greater than 15) it may be beneficial to follow the process outlined below to determine which sample results may need to be entered into the modified spreadsheet. This process will identify a break point that indicates which samples will or will not exceed the cumulative 5×10^{-6} excess cancer risk threshold. This should only be used for data exclusively impacted by PAH contamination as it will not assess risk posed by other compounds.

- 1) For each sample analyzed for PAHs, on a separate Excel spreadsheet compile the concentrations of all seven cPAHs and sum to provide totals.
- 2) Sort the data based on the total concentrations, from lowest to highest. Make sure to sort all the results (i.e., total and individual compound values remained tied).
- 3) Plot the tabulated data as depicted on Figure 1 using total concentrations and the concentrations of compounds most likely to drive direct contact risk. In the example, benzo(a)pyrene and dibenzo(a,h)anthracene are the drivers. Plot PAH concentrations on the y-axis and sample name (or number) on the x-axis.
- 4) Use the graph to pick a “cumulative risk analysis window” that will focus on sample results most useful for defining the cumulative cPAH risk threshold ‘break point’ (Figure 1). For many sites an effective window will use benzo(a)pyrene concentrations between approximately 0.1 mg/kg and 0.6 mg/kg.
- 5) Enter the PAH results for each sample within the window into the modified RCL spreadsheet to determine the cumulative cPAH cancer risk value.
- 6) Plot the calculated cumulative risk values as depicted on Figure 2, with cumulative cancer risk on the y-axis and sample name (or number) on the x-axis. Highlight the cumulative cancer risk threshold value (5×10^{-6}). A break point (Figure 2) should be apparent between those samples that exceed the cumulative threshold value and those that do not. If a break point is not present, the “cumulative risk analysis window” must be widened to include either lower or higher PAH values.
- 7) Assuming a break point is present, samples that are ranked higher than the analysis window on Figure 1 would be expected to exceed the cumulative cPAH cancer risk; those ranked lower mostly likely would not. However, some samples ranked below the analysis window may still pose a direct contact risk if compound specific RCLs for compounds other than the seven cPAHs assessed cumulatively (i.e., naphthalene and 2-methylnaphthalene) are exceeded or if a cPAH other than those plotted is driving risk.

Provide the tabulated data, charts, and copies of the modified RCL spreadsheets that were completed to assess the breaking point and which samples would be expected to exceed the cumulative cPAH cancer risk within a deliverable listed in Appendix 1.

Figure 1

PAH Compound Concentrations

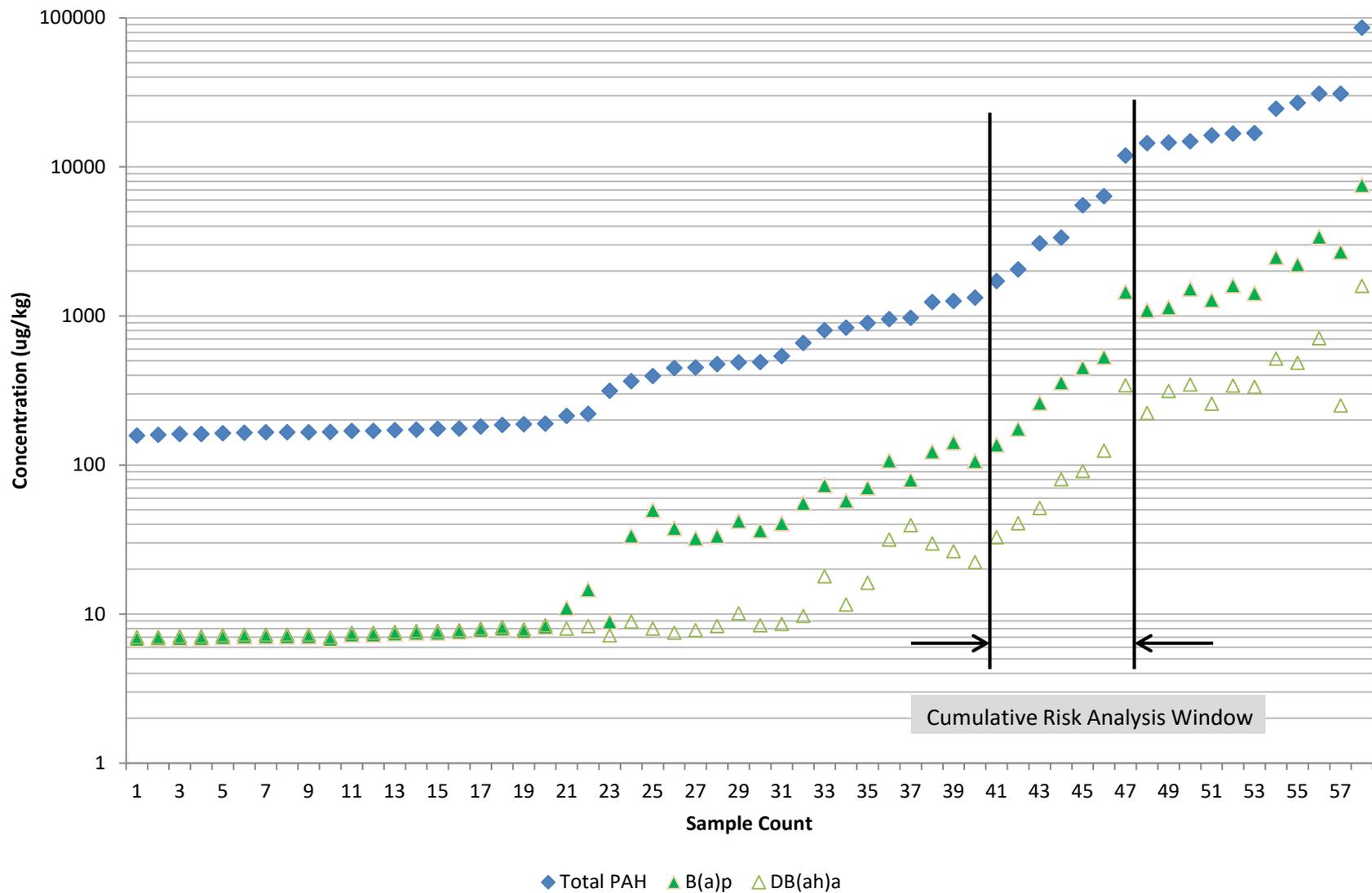
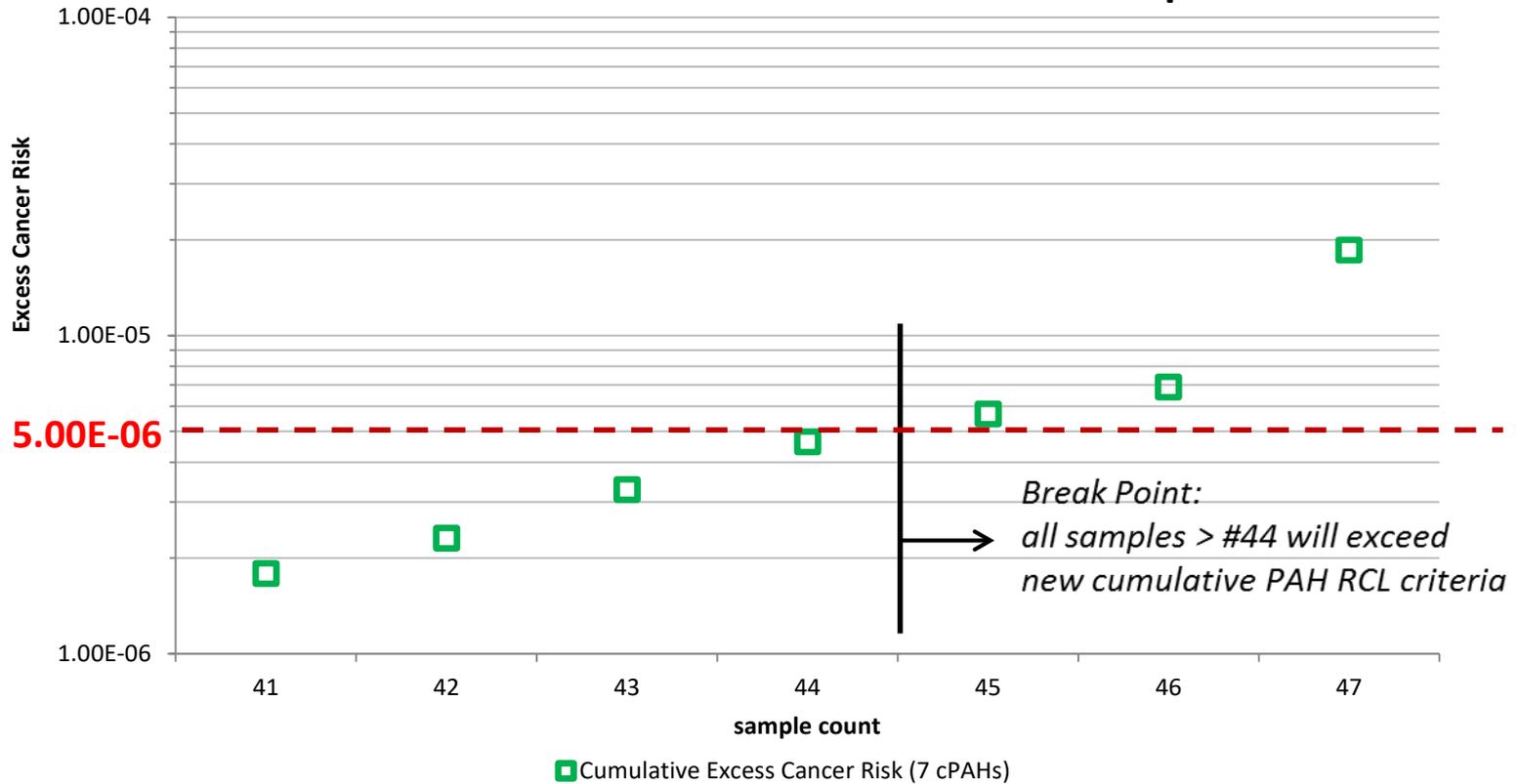


Figure 2
Cumulative 5×10^{-6} Cancer Risk for Select Samples



Appendix 1
NR 700 Submittals That May Include a Request to Conduct a PAH-related Wis. Admin. Code § NR 722.11 (1) (b) Risk Assessment

The DNR will review and provide written response to the RP for deliverables submitted with the appropriate review fee, per Wis. Admin. Code § NR 749.

ITEM	WIS. ADMIN. CODE § NR	SUMMARY
Notification	706.05(1)	Notification of a hazardous substance discharge discovered through soil analysis must be submitted to the DNR. A request to use the modified spreadsheet can accompany the notification as a technical assistance request if it appears that attaining compliance with the RCLs will not be practicable. The DNR will consider the risk posed by the identified contamination when deciding whether or not to require a site investigation.
Documentation of an Immediate Actions	708.05(6)	Written documentation describing an immediate action must be submitted to the DNR within 45 days of the hazardous discharge notification. If the immediate action did not obtain compliance with RCLs, and attaining compliance is not practicable, the documentation may request that modified spreadsheet be used to determine alternate environmental standards.
No Further Action Request	708.09	A final report documenting the completion of an immediate response action must be submitted when demonstrating that no further action is required to address identified contamination. If residual PAH contamination remains at the completion of the immediate action at concentrations greater than RCLs, and further action to attain compliance with the RCLs is not practicable, the report may request that the modified spreadsheet be used to calculate alternative standards to demonstrate that no further action is needed.
Interim Action Report	708.15	A report must be submitted to the DNR to describe completed interim actions if not submitted as part of the remedial action report or site investigation report. A request to use the modified spreadsheet to calculate alternative environment standards may be included with this report to demonstrate the effectiveness of the interim action.
No Action Required Request	716.05	A responsible party may request that no action be required to address identified contamination when the factors in Wis. Admin. Code §§ NR 708.09 (1) (a) to (n) and (2) (a) to (c) are considered. If obtaining compliance with the RCLs appears to not be practicable based on site conditions a request to use the modified spreadsheet can be included with this request to demonstrate that the soil contamination poses little or no risk.
Site Investigation Work Plan	716.09	A site investigation work plan must be submitted to the DNR within 60 days of receiving notification that an investigation is required. A request to use the modified spreadsheet can be included if with this report if it appears that attaining compliance with the RCLs will not be practicable.
Notification of Sample Results	716.14	Soil sampling results must be reported to the DNR within 10 business days of receiving the results. A request to use the modified spreadsheet can accompany the data as a technical assistance request if it appears that attaining compliance with the RCLs will not be practicable.
Site Investigation Report	716.15	A site investigation report must be submitted to the DNR within 60 days after completion of the field investigation and receipt of laboratory data. A request to use the modified spreadsheet can be included if with this report if it appears that attaining compliance with the RCLs will not be practicable.
Request to Manage Contaminated Soil	718.12	A request for an exemption from the solid waste rules to manage contaminated soil with a NR 718 exemption may include a request to use the modified spreadsheet if the proposed management will not remove all soil with concentrations greater than an RCL and attaining these standards site-wide would not be practicable.
Soil Cleanup Standards /Reports	720	A request to develop site specific soil standards may include a request to use the modified spreadsheet if it appears that attaining compliance with the RCLs will not be practicable.
Remedial Action Options Report	722.13	A remedial action options report must be submitted to the DNR within 60 days of submitting the site investigation report to document the evaluation and selection of a remedial action. If attaining the RCLs by the proposed actions is not practicable the report may include a request to the use the modified spreadsheet to define areas where PAH contamination will pose a risk and must be addressed.
Remedial or Interim Design Report	724.09	A design report for all remedial and interim actions must be submitted to the DNR. This report may include a request to the use the modified spreadsheet to determine areas where a direct contact risk is present if it is not practicable for the proposed action to attain compliance with the RCLs.
Documentation of Remedial or Interim Action	724.15	A construction documentation report must be submitted to the DNR within 60 days of the completion of the remedial or interim action. If attaining the RCLs was not practicable the report may include a request to use the modified spreadsheet to demonstrate the effectiveness of the remedial action for addressing the direct contact risk.

Appendix 1
NR 700 Submittals That May Include a Request to Conduct a PAH-related Wis. Admin. Code § NR 722.11 (1) (b)
Risk Assessment

The DNR will review and provide written response to the RP for deliverables submitted with the appropriate review fee, per Wis. Admin. Code § NR 749.

ITEM	WIS. ADMIN. CODE § NR	SUMMARY
Completion		
Closure Request	726.09	If the cleanup of PAH contaminated soil with concentrations greater than an RCL was found to not be practicable a request to use the modified spreadsheet can be included with a closure request to demonstrate that residual contamination will not pose a direct contact risk under current conditions.
Post Closure Modification Request	727	A request to use the modified spreadsheet can be included with a post-modification request if attaining the RCLs is not practicable and this will affect how continuing obligations are applied at a site.

This document is intended solely as guidance and does not contain any mandatory requirements except where requirements found in statute or administrative rule are referenced. This guidance does not establish or affect legal rights or obligations and is not finally determinative of any of the issues addressed. This guidance does not create any rights enforceable by any party in litigation with the State of Wisconsin or the Department of Natural Resources. Any regulatory decisions made by the Department of Natural Resources in any matter addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts.

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