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Memorandum

Date: February 16, 2007

To: Tim Drexler and Ed Karecki/USEPA

From: Dave Mitchell, Ph.D., and Christine Archer

Subject: Pines Area of Investigation
Dioxin/Furan Screening Levels

Distribution: Lisa Bradley/ENSR; Dan Sullivan / NiSource; Val Blumenfeld / Brown Inc.

This memo is a follow-up to the discussion held on December 6, 2006 between USEPA Region 5 (T. Drexler, E. Karecki) and ENSR risk assessors (L. Bradley, D. Mitchell, C. Archer) regarding appropriate sediment screening levels for dioxins/furans for assessing sediment quality in Brown Ditch and other relevant aquatic habitats within the Pines (IN) Area of Investigation. As part of that discussion, ENSR agreed to prepare a technical memorandum recommending dioxin/furan screening values for USEPA review. This memorandum would potentially be incorporated as an addendum to the Pines RI/FS workplan - Vol. 6 Ecological Risk Workplan [Pines AOC II for RI/FS Docket No. V-W-'04-C-784].

This issue was first identified in USEPA comments on the ENSR April 2006 draft report entitled Evaluation of Polycyclic Aromatic Hydrocarbon, Polychlorinated Dibenzodioxin/Polychlorinated Dibenzofuran, and Radionuclide Data from Yard 520 ("Yard 520 Evaluation draft report"). Specifically, dioxin/furan concentrations in two of the ten samples containing coal combustion byproducts (CCBs) taken from Yard 520 exceeded the USEPA Region 5 soil ecological screening level (ESL) of 0.199 ng/kg. In response to USEPA comments, the Respondents agreed to collect sediment samples from the West Branch of Brown Ditch both upstream and downstream of Yard 520 and analyze them for dioxins and furans. They also indicated their intention to (1) apply site-specific factors when considering and interpreting the results of this sediment sampling with regard to further investigation of dioxin at the Pines Area of Investigation, and (2) present USEPA with appropriate sediment screening values other than the Region 5 sediment ESL value of 0.121 ng/kg. Both of these matters are discussed below.

Application of Site-specific Factors

The basis of the Equilibrium Partitioning (EqP) theory for deriving sediment screening values is that partitioning between solid and aqueous phases occurs in sediments. The surface water screening value, the carbon matter partition coefficient (K_{oc}), and the fraction organic carbon in the sediment are used to derive the sediment screening value. The USEPA Region 5 sediment ESL was derived from a wildlife-based surface water screening value using EqP approach and an assumption of 1% total organic carbon (TOC). Therefore, a site-specific sediment screening value can be derived through application of a site-specific TOC value.

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Following the December 6, 2006 teleconference, USEPA (E. Karecki) investigated the use of site-specific factors such as sediment total organic carbon (TOC) to establish the sediment screening value. Mr. Karecki confirmed the appropriateness of the approach in an e-mail communication dated January 10, 2007, as indicated by the information in the footnotes of the Region 5 ESL table.

Accordingly, based on recent USEPA guidance (USEPA, 1999; USEPA, 2005), a default sediment TOC level of 4% was applied to the Region 5 sediment ESL to derive a site-specific sediment screening value of 0.480 ng/kg. The 4% TOC value is used based on the mid-point of the range of values for bottom sediments (3% to 5% TOC) identified in a literature search by USEPA (1993a). USEPA (1998) states that the organic carbon content in bottom sediments is higher than the organic carbon content in soils because (1) erosion favors lighter-textured soils with higher organic carbon contents, and (2) bottom sediments are partially comprised of detritus materials. The use of this default TOC value is supported by field observations made during the field investigation conducted on November 1, 2005 attended by USEPA. Visual observations of sediments (obtained with the Russian peat borer) within Brown Ditch downstream of Yard 520 indicate that sediment material is often found to a depth of greater than 10 inches. Also, several locations were described as highly organic (See notes regarding sediment depth and composition in *Sediment Sample Locations 11-2005* pdf document sent to Tim Drexler on November 18, 2005). These more highly organic sediments reduce the bioavailable fraction of organic compounds such as dioxins and furans and warrant an increase in the associated ecological screening values.

Alternative Sediment Screening Levels

A review of the source of the Region 5 sediment ESL of 0.121 ng/kg indicates that it is likely too conservative for application to Brown Ditch. Therefore, appropriate sediment screening values other than the Region 5 sediment ESL were identified.

The surface water screening value (3×10^{-9} ug/L) used in derivation of the Region 5 sediment ESL was developed to be protective of piscivorous avian and mammalian wildlife and considered impacts to eagle, kingfisher, herring gull, mink, and otter. The ESL documentation does not indicate which species the surface water screening values applies to, but the Indiana Water Quality Standards in the Indiana Administrative Code (327 IAC 2-1.5-15) indicate that the lower of the geometric means of the values for birds and mammals is selected. This methodology is consistent with the Michigan Water Quality Standards (MCL R 323.1041-1117) which is considered the source document for this methodology.

Application of values based on these receptors, while appropriate for the Great Lakes open water environment, is too conservative for Brown Ditch. For example, the diet assumed for three of these receptors (otter, herring gull, and eagle) include consumption of from 18-20% trophic level four (TL-4) fish. Brown Ditch provides *de minimis* habitat to TL-4 fish (i.e., piscivorous predators like lake trout, walleye or largemouth bass). TL-4 fish will experience a larger fraction of a bioaccumulative constituent (like dioxin) due to a greater food chain multiplier (FCM) than fish actually found in Brown Ditch, and so the resulting assumed exposure is conservative for Brown Ditch. In addition, the potentially impacted sediments within Brown Ditch represent only a small fraction of the potential home range of the piscivorous wildlife receptors considered in the derivation of the sediment ESL.

An applicable reference for potential impacts to benthic receptors in the USEPA's *Interim Report on Data and Methods for Assessment of 2,3,7,8-Tetrachlorodibenzo-p-dioxin Risks to Aquatic Life and Associated Wildlife* (USEPA, 1993), which is listed as a source of benchmarks on Region 5's website (http://www.epa.gov/region5/superfund/ecology/html/screenguide.htm#tcdd). This document presents fish- and wildlife-based sediment concentrations that are derived from no-effect thresholds for reproductive effects. These values were compared against the avian, mammalian, and fish TCDD-TEQs. All of the Yard 520 TCDD-TEQs were well below all of the sediment concentrations presented

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by USEPA (1993) indicating that ecological receptors are unlikely to be at risk due to exposure to dioxins and furans (See Table 2, attached).

Comparison of the fish TEQ against a fish-based sediment screening value also indicates that aquatic receptors are unlikely to be at risk. USEPA guidance (1999) derived a sediment screening value for 2,3,7,8-TCDD from a fish-based surface water screening value using the EqP approach and an assumption of 4% total organic carbon. The surface water screening value (3.8×10^{-6} ug/L) was based on a chronic low observed effect concentration for rainbow trout. All fish TEQs were well below the USEPA (1999) fish-based sediment screening level of 410 ng/kg, indicating that potential impacts to aquatic receptors are unlikely (see Table 2).

Conclusions

The screening evaluation of sediment dioxin data for Brown Ditch should utilize the site-specific screening level and the alternative screening levels presented in this memo. The findings of this memorandum are summarized below:

- Based on consensus with USEPA Region 5, the application of a 4% TOC to establish a site-specific sediment screening level for Brown Ditch is appropriate. This would result in a site-specific screening level of 0.480 ng/kg;
- The food web modeling used as the basis of the USEPA Region 5 surface water ESL, which in turn is the basis of the sediment ESL, includes inherent uncertainties and conservative assumptions (e.g., large home ranges, top-level piscivorous receptors) which are not appropriate for Brown Ditch;
- Alternative TCDD screening values are available (i.e., USEPA values for sediment) that are more applicable for screening for potential sediment risk to the receptors in Brown Ditch.
- The screening of sediments in Brown Ditch should take into account the entire spectrum of available and appropriate screening levels.

REFERENCES

USEPA. 1993. Interim Report on Data and Methods for Assessment of 2,3,7,8-Tetrachlorodibenzo-p-dioxin Risks to Aquatic Life and Associated Wildlife. Office of Research and Development. EPA/600/R-93/055.

USEPA. 1998. Methodology for Assessing Health Risks Associated with Multiple Pathways of Exposure to Combustor Emissions (MPE). Update to EPA/600/6-90/003. Office of Research and Development, National Center for Environmental Assessment, U.S. EPA. EPA/600/R-98/137. December.

USEPA, 1999. Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities. EPA/530/D-99/001A. December, 1999.

USEPA. 2005. Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. EPA/530/R-05/006. September, 2005.

TABLE 2
VALIDATED RESULTS OF YARD 520 SAMPLING FOR DIOXINS AND FURANS
COMPARED TOSEDIMENT-BASED ECOLOGICAL SCREENING VALUES

CAS No	Chemical Name			GP004 9/23/2005 GP004ICB092305S CCB ng/kg		GP005 9/23/2005 GP005ICB092305S CCB ng/kg		GP006 9/23/2005 GP006ICB092305S CCB ng/kg		GP007 9/23/2005 GP007ICB092305S CCB ng/kg		GP008 9/23/2005 GP008ICB092305S CCB ng/kg	
35822-46-9	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN			1.915	J	2.551	J	1.696	J	1.271	J	3.545	J
67562-39-4	1,2,3,4,6,7,8-HpCDF			0.266	J	0.266	J	0.057	U	0.264	J	0.247	JK
55673-89-7	1,2,3,4,7,8,9-HpCDF			0.044	U	0.08	U	0.074	U	0.08	U	0.091	U
39227-28-6	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN			0.048	U	0.033	U	0.064	U	0.046	U	0.063	U
70648-26-9	1,2,3,4,7,8-HxCDF			0.142	J	0.088	JK	0.148	J	0.218	J	0.159	J
57653-85-7	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN			0.043	U	0.03	U	0.057	U	0.041	U	0.06	U
57117-44-9	1,2,3,6,7,8-HxCDF			0.036	U	0.017	U	0.022	U	0.033	U	0.038	U
19408-74-3	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN			0.044	U	0.031	U	0.059	U	0.043	U	0.06	U
72918-21-9	1,2,3,7,8,9-HxCDF			0.042	U	0.021	U	0.026	U	0.039	U	0.047	U
57117-41-6	1,2,3,7,8-PENTACHLORODIBENZOFURAN			0.021	U	0.025	U	0.038	U	0.038	U	0.031	U
40321-76-4	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN			0.029	U	0.029	U	0.044	U	0.041	U	0.041	U
60851-34-5	2,3,4,6,7,8-HxCDF			0.071	J	0.019	U	0.023	U	0.035	U	0.041	U
57117-31-4	2,3,4,7,8-PeCDF			0.02	U	0.023	U	0.036	U	0.035	U	0.03	U
1746-01-6	2,3,7,8-TCDD			0.032	U	0.031	U	0.043	U	0.039	U	0.056	U
51207-31-9	2,3,7,8-TETRACHLORODIBENZOFURAN			0.056	U	0.051	U	0.064	U	0.064	U	0.076	U
3268-87-9	OCDD			22.643	U	66.103		15.822	U	5.28	U	24.665	UJ
39001-02-0	OCDF			0.483	J	0.443	J	0.46	J	0.355	J	0.58	JK
		Ecological											
		Screening											
		Value											
		(ng/kg											
	TCDD-TEQ - Bird (a)	0.48	(b)	0.04		0.08		0.03		0.04		0.04	
	TCDD-TEQ - Mammal (a)	0.48	(b)	0.05		0.05		0.04		0.05		0.07	
	TCDD-TEQ - Bird (a)	21	(c)	0.04		0.08		0.03		0.04		0.04	
	TCDD-TEQ - Mammal (a)	2.5	(c)	0.05		0.05		0.04		0.05		0.07	
	TCDD-TEQ - Fish (a)	60	(c)	0.04		0.03		0.04		0.04		0.04	

Notes:
CCB -Coal Combustion By-Product.
U: The analyte was analyzed for, but not detected.
J: Estimated value.
B: Analyte found in associated blank.
K: Estimated Matximum Potential Concentration.
TCDD-TEQ - 2,3,7,8-tetrachlorodibenzo-p-dioxin toxic equivalence concentration.
(a) - Calculated per Human Health and/or Ecological Work Plan.
(b) - USEPA Region 5 Ecological Screening Level for Sediment
Updated August 22, 2003. (http://www.epa.gov/reg5rcra/ca/ESL.pdf)
Sediment screening value based on surface water impacts to wildlife.
Wildlife based surface water screening value converted to sediment screening
and adjusted to 4% TOC.
(c) - USEPA low risk sediment concentration (USEPA, 1993)
presented in Interim Report on Data and Methods for
Assessment of 2,3,7,8-Tetrachlorodibenzo-p-dioxin Risks to Aquatic Life
and Associated Wildlife

Highlighting indicates that TCDD-TEQ is greater than the screening level.

TABLE 2
VALIDATED RESULTS OF YARD 520 SAMPLING FOR DIOXINS AND FURANS
COMPARED TOSEDIMENT-BASED ECOLOGICAL SCREENING VALUES

CAS No	Chemical Name			GP008 9/23/2005 GP008ICB092305D CCB ng/kg		GP009 9/23/2005 GP009ICB092305S CCB ng/kg		GP010 9/23/2005 GP010ICB092305S CCB ng/kg		GP011 9/23/2005 GP011ICB092305S CCB ng/kg		GP012 9/23/2005 GP012ICB092305S CCB ng/kg		GP013 9/23/2005 GP013ICB092305S CCB ng/kg	
35822-46-9	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN			0.644	J	10.509		2.358	J	3.683	J	87.582		19.079	
67562-39-4	1,2,3,4,6,7,8-HpCDF			0.128	JK	0.099	U	0.129	U	0.33	J	5.142		1.904	J
55673-89-7	1,2,3,4,7,8,9-HpCDF			0.049	U	0.128	U	0.167	U	0.077	U	0.487	JK	0.082	U
39227-28-6	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN			0.048	U	0.069	U	0.076	U	0.166	J	1.015	J	0.225	J
70648-26-9	1,2,3,4,7,8-HxCDF			0.124	J	0.054	U	0.064	U	0.162	J	0.432	J	0.193	J
57653-85-7	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN			0.047	U	0.397	J	0.068	U	0.251	J	3.222		0.79	J
57117-44-9	1,2,3,6,7,8-HxCDF			0.03	U	0.054	U	0.064	U	0.022	U	0.25	JK	0.061	U
19408-74-3	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN			0.046	U	0.25	J	0.071	U	0.313	J	2.475	JK	0.421	JK
72918-21-9	1,2,3,7,8,9-HxCDF			0.036	U	0.064	U	0.076	U	0.031	U	0.13	U	0.075	U
57117-41-6	1,2,3,7,8-PENTACHLORODIBENZOFURAN			0.033	U	0.04	U	0.076	U	0.039	U	0.059	U	0.039	U
40321-76-4	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN			0.049	U	0.114	U	0.134	U	0.055	U	0.08	U	0.063	U
60851-34-5	2,3,4,6,7,8-HxCDF			0.032	U	0.057	U	0.068	U	0.026	U	0.112	U	0.065	U
57117-31-4	2,3,4,7,8-PeCDF			0.032	U	0.037	U	0.071	U	0.04	U	0.06	U	0.037	U
1746-01-6	2,3,7,8-TCDD			0.055	U	0.112	U	0.106	U	0.05	U	0.078	U	0.066	U
51207-31-9	2,3,7,8-TETRACHLORODIBENZOFURAN			0.099	U	0.132	U	0.123	U	0.059	U	0.105	U	0.11	U
3268-87-9	OCDD			4.273	UJ	25.926	UJ	11.459	UJ	58.181	J	424.803	J	108.247	
39001-02-0	OCDF			0.395	JK	0.238	UJ	0.281	UJ	0.647	J	9.944	J	1.615	J
		Ecological Screening Value (ng/kg													
	TCDD-TEQ - Bird (a)	0.48	(b)	0.02		0.06		0.03		0.13		**0.97**		0.23	
	TCDD-TEQ - Mammal (a)	0.48	(b)	0.03		0.18		0.05		0.14		**1.72**		0.39	
	TCDD-TEQ - Bird (a)	21	(c)	0.02		0.06		0.03		0.13		0.97		0.23	
	TCDD-TEQ - Mammal (a)	2.5	(c)	0.03		0.18		0.05		0.14		1.72		0.39	
	TCDD-TEQ - Fish (a)	60	(c)	0.03		0.04		0.03		0.12		0.83		0.20	

Notes:
CCB -Coal Combustion By-Product.
U: The analyte was analyzed for, but not detected.
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B: Analyte found in associated blank.
K: Estimated Matximum Potential Concentration.
TCDD-TEQ - 2,3,7,8-tetrachlorodibenzo-p-dioxin toxic equivalence conc
(a) - Calculated per Human Health and/or Ecological Work Plan.
(b) - USEPA Region 5 Ecological Screening Level for Sediment
Updated August 22, 2003. (http://www.epa.gov/reg5rcra/ca/ESL.pdf)
Sediment screening value based on surface water impacts to wildlife
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and adjusted to 4% TOC.
(c) - USEPA low risk sediment concentration (USEPA, 1993)
presented in Interim Report on Data and Methods for
Assessment of 2,3,7,8-Tetrachlorodibenzo-p-dioxin Risks to Aquatic
and Associated Wildlife

Highlighting indicates that TCDD-TEQ is greater than the screening leve