CORRESPONDENCE/MEMORANDUM STATE OF WISCONSIN

DATE: August 28, 1995

TO: Amy Parkinson - DNR, SW/3

FROM: Chuck Warzecha - WDOH

SUBJECT: CM Christiensen Pole Dipping Site Public Health Consultation

---

The C.M. Christiansen site is the location of a former pole dipping operation, where western red cedar poles were treated with a pentachlorophenol (PCP) and fuel oil mixture as a preservative. I have reviewed the available sample results for the site. The primary contaminants of concern are dioxins, PCP, and polycyclic aromatic hydrocarbons (PAHs). The primary environmental exposure pathways of concern are food chain, and surface soil (inhalation and ingestion). Short-term exposures to site contaminants do not pose a public health hazard. However, long-term exposure to the contaminants of concern mentioned above may pose a public health hazard.

BACKGROUND

The site is located on the edge of North Twin Lake, near the Village of Phelps, in northeastern Vilas County. The operation consisted of submersing the poles in a tank filled with 5% PCP and 95% #2 fuel oil. The poles were removed from the tank and allowed to drip dry in an area next to the tank. The dip tank was 10 feet by 48 feet and approximately 4 feet deep. It was located approximately 120 feet from Military Creek. The drying area was located immediately south of the dip tank. Groundwater is within four feet of the surface in this area[1].

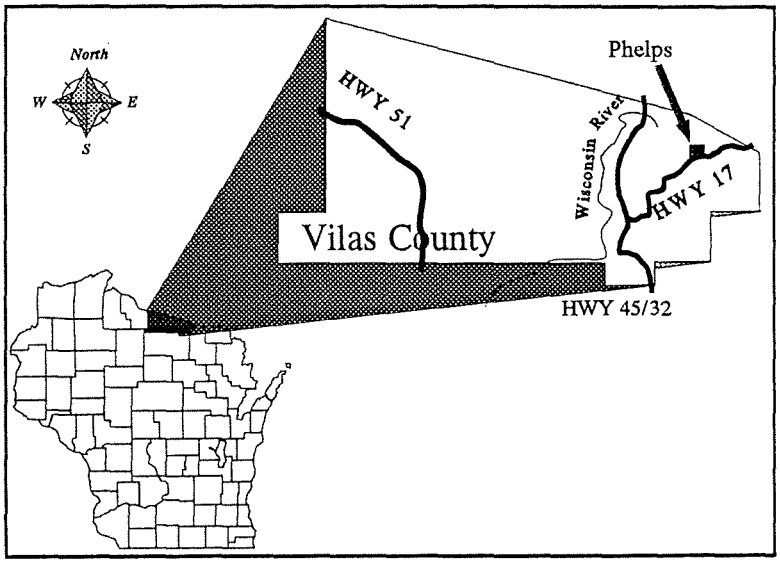

Figure 1: The Village of Phelps, Vilas County, Wisconsin.

The area is sparsely populated, rural residential to the north. There is a mixture of recreational and seasonal cottages in the area as well. The Village of Phelps is about a half mile south of the site. Phelps is unincorporated, though there is a hospital and a school in the village. The site itself is located on a parcel of C.M. Christiansen property on the northeastern edge of North Twin Lake. County Highway "E" divides the property into two industrial areas. The portion on the lakeshore side of the road was used as a saw mill, with the pole dipping operation located across the road to the northeast. The site consists of a grassy open area near the access road that narrows to about 50 yards either side of a trail. The trail begins at the access road to the site from CTY "E" and passes through the site to the northeast approximately

parallel to Military Creek. At the northeast end of the site it meets a trail from the Nicolet National Forest. The property is heavily wooded to the north and northeast beyond the open area. The terrain slopes to the southeast towards Military Creek. The site is bordered to the south and southeast by a large wetland associated with Military Creek. Military Creek drains the site to the southwest and ultimately to North Twin Lake. This creek has been classified as a Class 1 trout stream by the WDNR. Site features associated with the pole dipping operation are no longer present on-site. The suspected locations of the dip tank and drying area are just to the north of Military Creek. It is not clear what activities took place on other portions of the site. There are likely to be other storage and drying areas. Wood debris and waste treatment materials can be seen along the perimeter of the site.

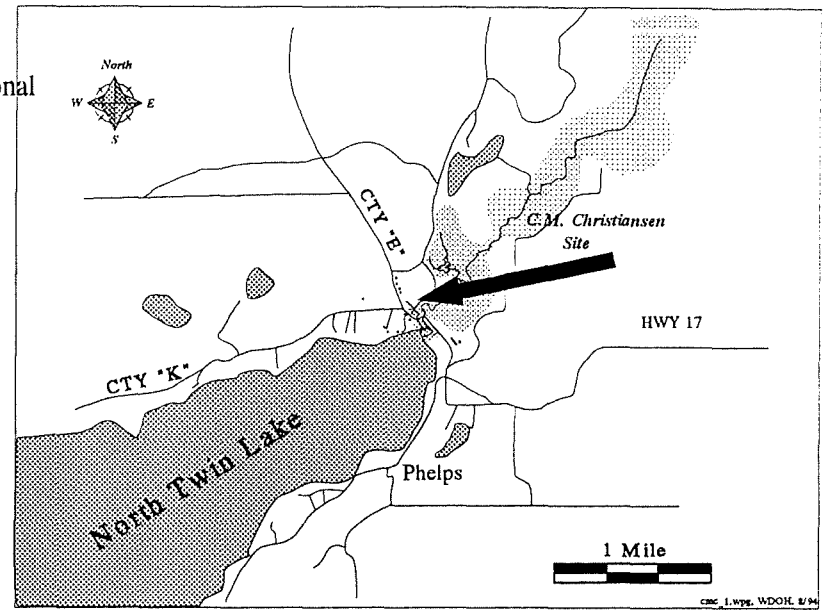

Figure 2: C.M. Christiansen Site, Phelps, Wisconsin.

Sampling at the site has been limited and has taken place over the course of several years. Samples of fish tissue were first taken in 1985 by the DNR Water Resources Management Program. Since then, samples have been taken of soil borings, surface soils, sediments, on-site monitoring wells, off-site private wells, and additional fish tissue.

SOIL SAMPLING

The first soil samples were taken in December of 1987 by the consultant to the owner of the site (White Water and Associates). Samples were taken from two locations. Both locations were thought to be in a drying area where the dipped poles were taken to drain off the excess PCP and fuel oil mixture and then dry. Two samples were taken at each of these locations at depths of 18"-24" and 60"-66/72" respectively. One duplicate sample was taken. These samples were analyzed for PCP and #2 fuel oil. The results were reported in μg/l and mg/l respectively, which is not standard for soil sample results. The units may have been misprinted or the results reported may have been for a liquid extraction from the soils. For this reason, these sample results can only be used qualitatively unless the reporting method can be clarified. These samples indicated that there was PCP in the soils at each depth analyzed. #2 fuel oil was not detected in any of the samples down to a detection limit of 0.01 mg/l[2].

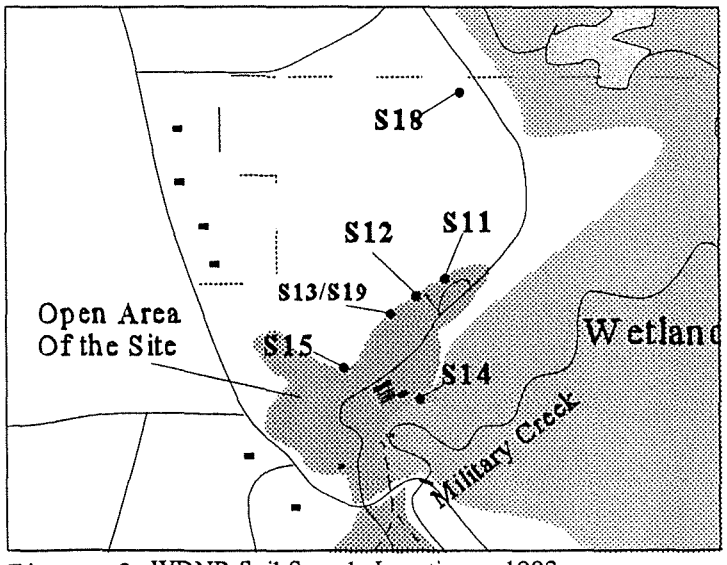

Figure 3: WDNR Soil Sample Locations - 1993.

In September, 1993, as part of the Superfund Site Assessment program, samples were taken from surface soils during a WDNR site inspection. The soil samples were selected in areas with stressed vegetation and stained soils. Figure 3 shows the general locations of the soils samples. Sample S18 is a background sample that did not exhibit stressed vegetation or staining. The soil samples were taken from four to six inches in depth. Samples were analyzed for VOCs, SVOCs, pesticides/PCBs, and inorganic parameters. Tables 1A and 1B contain a summary of those sample results.

Table 1A
September 28, 1993 VOC Soil Sample Results (μg/Kg)

VOC	S11	S12	S13	S14	S15	S18	S19	Comparison Value
Acetone	*	160	56	150	130	34	63	5,000,000[r]
Methylene Chloride	*		32	35	24	31	41	3,000,000[r]
2- Butanone (MEK)	*	6	2	5	4		2	30,000,000[r]

[r] - RMEG, Reference dose media evaluation guide, derived from EPA's RfD.

Three VOCs were detected fairly consistently in the soil samples. Two of these VOCs (acetone and methylene chloride) are common lab contaminants, and were also detected in the background soil sample[3]. However, these VOCs were also detected in other media on-site. For these reasons evidence of VOC contamination exists but is not strong. The concentrations detected are below the respective comparison values in each case.

Table 1B
September 28, 1993 SVOC Soil Sample Results (μg/Kg)

SVOC	S11	S12	S13	S14	S15	S18	S19	Comparison Value
Acenapthene		1900	1100				970	3,000,000[r]
Fluorene							360	2,000,000[r]
N-Nitrosodiphenylamine		42000	29000	1800			19000	100,000[c]
Pentachlorophenol (PCP)	**87000000**	**300000**	**1400000**	**2300000**	**36000**	**11000**		**6,000[c]**
Phenanthrene	2100000						690	NA
Fluoranthene		1200	26000	9000	11000		22000	2,000,000[r]
Pyrene		6900	21000	17000	19000		16000	2,000,000[r]
Benzo(a)anthracene		770	3000				2600	NA
Chrysene		2100	6800	5700	6000		6000	NA
Bis(2-ethylhexyl)phthalate		1500	800	14000			490	50,000[c]
Benzo(b)Fluoranthene			3000	3300	2100		2400	NA
Benzo(k)Fluoranthene			2500		1200		2000	NA

[r] - RMEG, Reference dose media evaluation guide, derived from EPA's RfD.
[c] - CREG, Cancer risk evaluation guide, developed from EPA's cancer slope factor.

SVOC analysis of surface soils found extremely high concentrations of PCP and PAHs. These results are consistent with the type of operation that took place on-site. PCP was also detected in the background soil sample at 11 parts per million[4]. Because the pole dipping operation took place over several decades, it is likely that PCP concentrations in nearby surface soils have been elevated from local air deposition. PAHs

are found in the #2 fuel oil which was the carrier for the PCP in the treatment process. Heating the PCP/fuel oil mixture, as is thought to have been the practice, would also create additional PAHs.

Several pesticides were detected in on-site soil samples. WDNR review of lab QC information identified a number of problems that may indicate an analytical problem within the lab[5]. Due to the nature of the site operations it is likely that some pesticides would be found. However, the pesticide sample results are suspect, and may not accurately reflect actual pesticide concentrations in surface soils. For this reason a summary of those results are not included in this text.

Inorganics analysis of surface soils did not find inorganics significantly elevated above background concentrations[6]. A summary of those results are not included in this document.

Surface soil contamination has been found at the site. The soil samples taken likely represent "hot spots" of contamination at the site, as they were selected based on staining, odor, and stressed vegetation. Much of the on-site area did not exhibit these characteristics and may be less contaminated or not contaminated. By the same token, many additional "hot spots" likely exist. The type of operations that took place at the site make it likely that there is also significant soil contamination at depth.

SEDIMENT SAMPLING

Sediment samples were taken by WDNR Water Resources Management staff in September of 1992. Four samples were taken in Military Creek. Three of the samples were taken downstream of the site and one was taken upgradient of what was believed to be the pole yard drying area. Figure 4 shows approximate locations of those samples in the creek. The sample results are summarized in Table 2. At the time of sampling it was noted that "...aquatic macroinvertibrates and trout numbers from this stretch of creek are lower that you would expect to find."Each downgradient sample found PCP ranging from 30 to 640 ppb (μg/g, dry). No PCP was detected at the upgradient sample location. In addition to PCP each sample was also analyzed for 2,4,5 and 2,4,6 trichlorophenol. Trichlorophenols were not detected at any of the sample locations[7]. The PCP concentrations correlate more closely with sediment particle size than with proximity to the pole dipping operation.

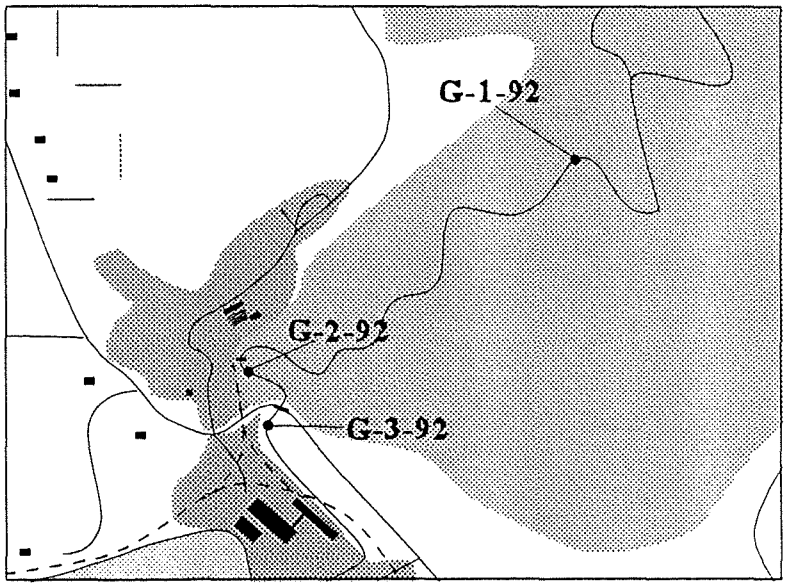

Figure 4: WDNR Sediment Sample Locations - 1992

Table 2
Military Creek
September, 1992 Sediment Sample Results (μg/g, dry)[8]

Parameter	G-1-92 Background	G-2-92	G-3-92	G-4-92
PCP	<0.02	0.05	0.64	0.03
2,4,5 Trichlorophenol	<0.10	<0.10	<0.10	<0.10
2,4,6 Trichlorophenol	<0.10	<0.10	<0.10	<0.10
Soil texture	clay loam	sand	silt loam	sand

During the September 28, 1993 WDNR site inspection six sediment samples were taken from Military Creek. Of those samples one was a background sample (S20), one was a duplicate (S25), and one was taken at the mouth of the creek where it enters North Twin Lake (S20). Figure 5 shows the general location of those samples. Tables 3A,B,&C are summaries of those sample results for VOCs, SVOCs, and dioxins respectively. Refer to the original data summaries for descriptions of the data qualifiers used in the following tables.

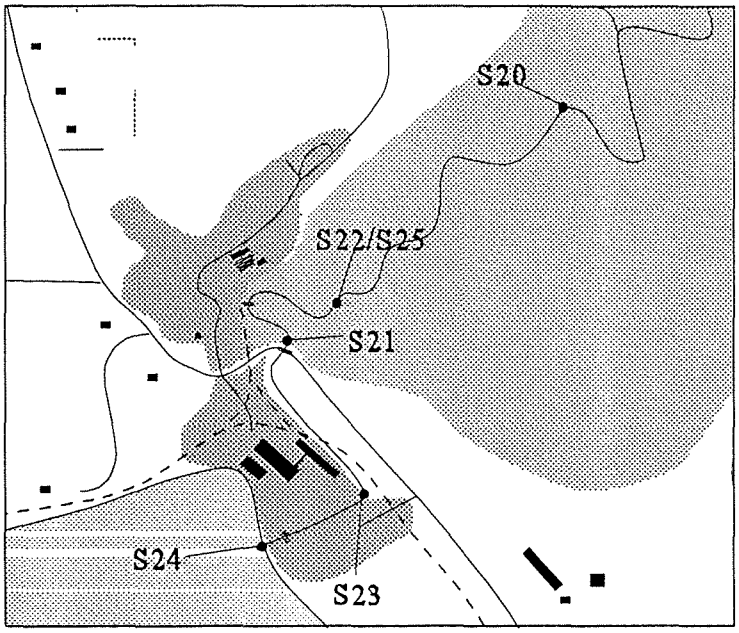

Figure 5: Sediment Sample Locations - 1993

Table 3A
September 28, 1993 VOC Sediments Sample Results (μg/Kg)

VOC	S20 Background	S21	S22	S23	S24	S25 Dup. of S22
Acetone	660B	300J	95B	96B	230B	90B
Methylene Chloride	180B					
2- Butanone (MEK)		83J	13J			
Tetrachloroethylene	52JB	12JB			70B	
Toluene					15J	

Table 3B
September 28, 1993 SVOC Sediment Sample Results (μg/Kg)

SVOC	S20	S21	S22	S23	S24	S25
4-Methylphenol	320J	200J		150J		
Naphthalene	390J	76J		98J		
2-Methylnaphthalene			120J	48J		120J
Fluorene			98J	43J		85J
Pentachlorophenol		1400J	1300J	70J		1600J
Phenanthrene	270J	320J	640	230J		560J
Acenapthene	300J	67J	56J	43J		72J
Fluoranthene		590	220J	390J		240J
Pyrene	190J	630J	370J	350J		340J
Benzo(a)anthracene		290J	110J	100J		100J
Chrysene		390J	200J	290J		230J
Benzo(b)Fluoranthene		540J	98J	290J		180J
Benzo(k)Fluoranthene			160J			
Benzo(a)pyrene	480J	270J	150J	180J	120J	170J
Ideno(1,2,3-cd)pyrene		210J	95J	100J	130J	72J
Benzo(g,h,i)perylene		230J	170J	180J	190J	80J

Table 3C
September 28, 1993 Dioxin/Furan Sediment Sample Results (μg/Kg)

Analyte	S21	S22	S23	S24	S25	S20
123478-HxCDF	0.3J	1.5J			0.83J	
123678-HxCDF	0.1J	0.45J			0.29J	
123478-HxCDD		0.23J			0.15J	
123678-HxCDD	0.31	1.4J			0.83J	
123789-HxCDD	0.12	0.52J			0.35J	
234678-HxCDF	0.17	0.45J			0.39J	
123789-HxCDF		0.43J			0.19J	
1234678-HpCDF	3.2	14	0.34J	0.2J	8.5	
1234678-HpCDD	8.1	37	0.91J	0.32J	20	
1234789-HpCDF	0.34J	1.8J			0.97J	
OCDD	83	420DE	9.6	3.6J	260DE	
OCDF	17	66	1.8J	0.8J	44	
Total TEF*	0.32	1.49	0.024	0.0096	0.90	0.00

**There are many congeners of dioxin that are discussed as a group of dioxins. The most toxic of which is thought to be 2,3,7,8 tetrachlorodibenzo-p-dioxin (2,3,7,8 TCDD). When comparing sample result for dioxins, the concentration of each congener is translated to an equivalent concentration of the more toxic 2,3,7,8 TCDD. This translation is called a toxicity equivalency factor. Human exposure to dioxin has been linked to a severe dermatitis called chloracne as well as to fetal toxicity. Numerous other effects have been observed in laboratory animals at very low*

doses. In animal studies, dioxin has been found to be one of the most potent carcinogens known. In 1987 EPA estimated the lifetime cancer risk of $1x10^{-5}$ to be equal to 1 ppt dioxin in fish using conservative assumptions about diet. The FDA used 25 ppt as their standard for limiting fish consumption. The state currently does not have surface soil standards for dioxin. Advisory guidelines have been set for land application of paper mill sludge on agricultural fields based on conservative estimates of food consumption (1.2 ppt)[9]. However, those guidelines are derived primarily from the consumption of vegetables grown on those fields. Guidelines developed by the Division of Health represent a one in one million increased cancer risk. All of the concentrations discussed are based on total dioxin equivalents which are derived from the TCDD toxicity equivalency factors (TEF) associated with each homolog (i.e. octa, hepta, hexa, penta). The congeners of each homolog are usually assumed to have the same relative toxicity.

FISH SAMPLING

In June of 1986 fish tissue samples were analyzed for PCP and PCBs. Five fish species were sampled from Military Creek adjacent to the site. The sample results indicated PCP contamination of two fish species in the creek. Table 4 is a summary of those sample results.

Table 4
1986 Fish Tissue Sample Results[10]

Parameter	Yellow Perch	Burbot	Creek Chub	Common Shiner	Burbot(dup.)
PCP	0.25	0.25	<0.12	<0.11	<0.30
PCBs	<0.20	<0.20	---	---	---

MONITORING WELLS

Four monitoring wells were installed on the site to enable groundwater sampling during a September, 1993 WDNR site inspection. The locations of the monitoring wells are identified in Figure 6. Water from monitoring well MW4 was clear and smelled of fuel oil during sampling. This well is downgradient of former site activities adjacent to Military Creek. The other wells were more turbid, though no fuel oil odor was noted in them[11]. A duplicate sample was taken from MW3. Table 5 contains a summary of the monitoring well sample results.

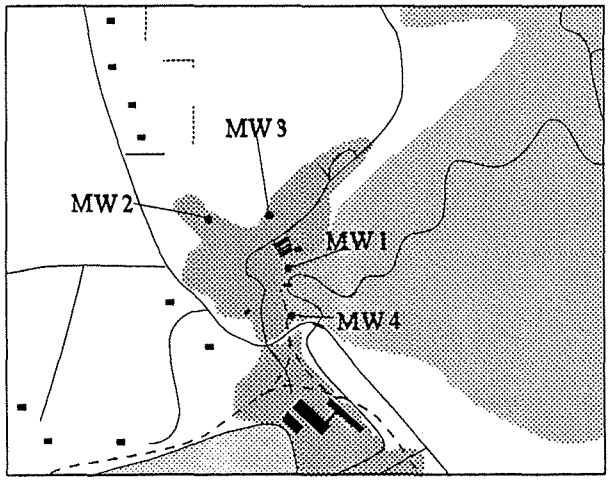

Figure 6: Monitoring Well Locations

Table 5
September 28, 1993 Monitoring Well Sample Results (µg/l)

Parameters	MW1	MW2 Background	MW3	MW4	MW3-Dup.
VOCs					
2-Hexanone	8J				
Xylenes (total)	2J				
SVOCs					
1,3 Dichlorobenzene		0.4J		0.5J	
Naphthalene	15				
2 Methylnaphthalene	51				
Acenapthene	3J				
Dibenzofuran	3J				
Fluorene	3J				
Pentachlorophenol	12J				
bis(2-ethylhexyl)phthalate		1200JD	33		71

PRIVATE WELLS

Samples were taken of three private wells near the site during a September, 1993 WDNR site inspection. These samples were analyzed for VOCs, SVOCs, pesticides/PCBs, and metals. No VOCs or pesticides/PCBs were detected in the samples. Some inorganics were found at levels that would indicate poor aesthetic quality and lead was detected near its Preventative Action Limit. Two SVOCs were detected at levels below their respective quantitation limits. These SVOCs are common laboratory contaminants. WDNR notified the residents of their sample results and explained the significance of those results[12,13,14]. In summary, no site related contamination has been found in the private wells sampled[15].

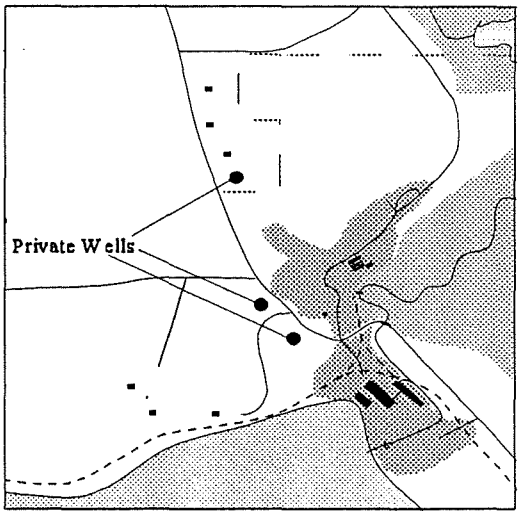

Figure 7: Private Well Locations

DISCUSSION

Most contamination at the site is in on-site soils and stream sediments adjacent to and downgradient of the site. Groundwater contamination has also been found, as well as contamination in fish tissue. Of the contaminants detected at the site, dioxin, PAHs, and PCP were found at concentrations that may pose a public health hazard in surface soils or stream sediments. Multiple exposure routes can cumulatively contribute to human exposure to these compounds. Each are believed to be present in surface soils on-site and in stream sediments. Both dioxin and PCP tend to bioaccumulate in fish, and sampling has confirmed that pathway exists.

SURFACE SOILS

Hot spot areas contain PAHs and PCP at concentrations that pose a public health hazard for long term exposures. Long term exposures to these soils represents an increased cancer risk. Dioxin analysis was not performed on surface soil samples. However, information about site activities and results of sediment sampling indicate that dioxins would also be present with the PCP and PAHs in the surface soils. Such dioxin contamination could also pose a public health hazard for long term exposures.

SEDIMENTS

Analysis of sediment samples has found VOC, PAH, PCP, and dioxin contamination. Because of their volatility and rapid degradation in surface waters, the detection of VOC contaminants in surface water sediments is not common so long after disposal. The detections at this site could indicate that a significant amount of VOCs are present in the contaminated sediments at the site, or they may be an indication that groundwater discharging to the creek is contaminated with VOCs.

PAH concentrations in the creek indicate significant and widespread contamination of creek sediments. However the concentrations are not high enough to pose a public health hazard. PCP and dioxin concentrations are also unlikely to pose a public health hazard based on direct contact with, or incidental ingestion of sediments. Results of fish tissue analysis from the creek indicate that the food chain is susceptible to uptake and bioaccumulation of these contaminants. This pathway could pose public health hazard based on long term fish consumption in the future.

GROUNDWATER

Monitoring well samples have been found to contain VOCs and SVOCs. The detected concentrations were generally quite low. One detected compound bis(2-ethylhexyl)phthalate was detected at a very high concentration (1200ppb). This compound is a common laboratory contaminant. In addition, it is rarely found at high concentrations in the environment absent other SVOCs. If it is assumed that the compound exists at this concentration, groundwater would pose a public health hazard for drinking water uses on-site.

Private well sampling results found two SVOCs below their respective quantitation limits. These concentrations, if actually present in the private well samples, do not pose a public health hazard for any domestic uses. It is unlikely that these compounds have migrated to the private well from the site, as groundwater from the site likely discharges to the creek. The private well containing both compounds is expected to be upgradient from the site.

CONCLUSIONS

On-site soils, sediments, and groundwater have been found to be contaminated with PCP, PAHs, and dioxins. Long-term exposure to these compounds poses an increased cancer risk to people who frequently go on-site. Short term exposures to these compounds may cause a number of acute health effects, such as skin irritation or, possibly, chloracne. More sampling data is needed to characterize the degree and extent of contamination. Vegetation covers much of the site, limiting the amount of surface soil erosion. However, there are several areas with stressed vegetation or no vegetation at all. These areas are also the areas with the highest levels of contamination. Therefore, erosion from rain water runoff would be increased in areas with high contaminant levels. Site access is unrestricted and no notice is provided to nearby residents that entering the site could result in exposure to contamination. This fact is complicated by the existence of a national forest trail entering the site from the north.

Site features have been removed along with the features that could help to identify possible contaminant source areas. Contaminated materials from the site may have been improperly disposed at other locations. These other locations would pose similar public health hazards.

Sediment sampling has found contamination at discreet sampling points. Because the contaminant releases from the site likely occurred over several decades, sediment contamination at different sediment depths may vary. Therefore, the potential exists for "hot spots" of contamination to be found in deeper sediments in the stream bed. Sample data for VOCs and pesticides is not conclusive. However, the VOC results could indicate a significant groundwater to surface water impact.

Fish in the stream and the lake are susceptible to contamination by PCP and dioxins. Fish samples have confirmed that susceptibility. The site is currently contributing these contaminants to the aquatic ecosystem and without remediation could continue indefinitely. Fish consumption could be a concern in the future if the mass loading of these contaminants into the stream and lake continues.

Groundwater contamination at the site does not appear to threaten existing private wells.

RECOMMENDATIONS

Based on the existing information for the site WDOH makes the following recommendations:

1. Contamination of on-site soils should be better characterized for dioxins, PCP, and PAHs to support the evaluation of remedial alternatives.

2. Contamination from the site should be prevented from continued migration to the aquatic ecosystem. Current contamination in the stream should be better characterized in order to determine the degree and extent of contamination and support the evaluation of remedial alternatives. This characterization should include grain size analysis on sediment samples.

3. Fish dioxin and PCP concentrations should continue to be monitored in Military Creek and North Twin Lake.

4. Public access to contamination hot spots on the site should be restricted.

REFERENCES

1. White Water Associates. "Results of Soil Analysis for Pentachlorophenol (PCP) and Fuel Oil at Site of Pole-Dipping Operation in Phelps, Wisconsin." January 4, 1988.

2. White Water Associates. "C. M. Christiansen Sampling Analysis Summary." December 14, 1987.

3. Khazae, Charlene, WDNR. C.M. Christiansen Data Summaries. March 21, 1994.

4. Khazae, Charlene, WDNR. C.M. Christiansen Data Summaries. March 21, 1994.

5. Khazae, Charlene, WDNR. C.M. Christiansen Data Summaries. March 21, 1994.

6. Khazae, Charlene, WDNR. C.M. Christiansen Data Summaries. March 21, 1994.

7. WDNR. "Military Creek, Sediment Sample Summary." January, 1993?.

8. State Laboratory of Hygiene. Sediment Sample Results for Waterbody 1623900. January 26, 1993.

9. Goldring, Jay Ph.D.. ▒Assessment of Potential Health Impacts of Dioxin and Furan Contaminated Sludge Amended to Soils▒. Wisconsin Department of Health and Social Services. December, 1992.

10. WDNR. Military Creek Fish Sampling Data: Storet = 645045. Data for Northcentral District. Collected June 11, 1986.

11. Jerow, Tom (WDNR). " Monitoring Well Sampling Data Sheet, C.M. Christiansen Site." September 28, 1993.

12. Parkinson, Amy, WDNR. Private Water Supply Well Sampling Results. Letter to Mr. Luger. April 15, 1994.

13. Parkinson, Amy, WDNR. Private Water Supply Well Sampling Results. Letter to Gwen Hendrickson. April 15, 1994.

14. Parkinson, Amy, WDNR. Private Water Supply Well Sampling Results. Letter to Patrick and Brandy Findlay. April 15, 1994.

15. Khazae, Charlene. WDNR Memo to Amy Parkinson. "C.M. Christiansen Residential Well Data." January 20, 1994.