DRAFT DRAINAGE SAMPLING REPORT FORMER DUPONT BARKSDALE FACILITY BARKSDALE, WISCONSIN

Date: April 28, 2003 Project No.: 7431

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An Alliance between
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1.0 INTRODUCTION

This report documents the results of a screening level characterization and evaluation of sediment and surface water at the former DuPont Barksdale Works Facility (site) (see Figure 1). Ten drainage locations were sampled approximately at the site boundaries with all the samples being collected on the DuPont Property (see Figure 2).

The objective of this sampling program was to determine whether site-related constituents are present in sediment and surface water at each drainage location at the approximate site boundary, and if so, do they pose any risk to human health and the environment. The results will be used to prioritize future on-site investigations where appropriate.

1.1 Background

Site investigation activities were initiated when groundwater samples collected by the Wisconsin Department of Natural Resources (WDNR) in June 1997 from a drinking water well located at a residence adjacent to the site showed detectable concentrations of 2,4-dinitrotoluene (2,4-DNT) and 2,6-DNT. In response, the WDNR and E.I. DuPont de Nemours and Company, Inc. (DuPont) met and agreed upon investigative and remedial objectives for the site.

From 1997 to 2000, various groundwater and residential water sampling events occurred to evaluate groundwater and drinking water quality. Also, in 1998, a surface water and sediment study along Boyd Creek was conducted by Exponent (Bellevue, WA) to evaluate the potential for offsite transport of DNT, trinitrotoluene (TNT) and nitroglycerin (NG) at levels of ecological concern. This investigation concluded that DNT isomers were present in the creek's sediments, but that the concentrations of these constituents were below published and calculated ecological effect concentrations.

During 2001, an extensive onsite investigation program was conducted. This investigation primarily focused on evaluation of groundwater conditions. However, a screening level evaluation of surface soils in production and operation areas also occurred. These evaluations indicated the presence of site-related compounds at depths that could potentially be eroded by storm water run-off.

Following the 2001 investigation, DuPont developed the following overall site objectives.

- ❏ Continue to provide drinking water that meets appropriate Wisconsin regulatory standards for all site-related constituents.
- ❏ Develop a plan for a long-term drinking water supply and implement as appropriate.
- ❏ Evaluate material leaving the site and determine if any potential risks are present, and if so, take appropriate action.

The sampling program documented in this report addresses the third objective.

1.2 Document Organization

This document is organized into eight sections. Section 1.0 contains site background information. Section 2.0 contains investigation area location information. Section 3.0 contains field activity information. Section 4.0 contains analytical result discussions. Sections 5 and 6 discuss the risk to human health and the environment. Section 7 summarizes the results and conclusions of this report. Section 8 contains the bibliography.

2.0 INVESTIGATION AREAS

As mentioned in Section 1.0, ten site surface water drainage locations were investigated on May 22, 2002. This investigation included the collection of surface water and sediment samples at each location. All samples were collected on DuPont property prior to point where these drainage features exit the site (Figure 2). Photos of the sample locations are included in Appendix A.

- Location 1: Ditch along the northern site boundary that receives dispersed surface water drainage from the site's northwestern area. The surface water than exits the site and flows in a ditch along Nolander Road. Surface water in this ditch discharges to Bono Creek and eventually Lake Superior. Surface water was collected from a ponded area about 3-ft inside the site fence. Sediment was collected immediately below the fencing itself.
- Location 2: 12-in diameter clay tile culvert located at the northeast corner of the site fence. Surface water discharged from this culvert empties into a ditch that runs along Nolander Road. Surface water then moves along the roadside ditch until it reaches the culvert adjacent to 72700 Highway 13 where it then flows to Lake Superior. Surface water and sediment were collected from a ponded area at the downstream end of the clay tile culvert.
- Location 3: 36-in diameter, riveted-steel culvert below the ATV road along the eastern site boundary. This culvert receives surface water flow from the site's northeastern area. Surface water leaves the culvert and flows along a roadside ditch until it reaches the culvert adjacent to 72700 Highway 13 where it then flows to Lake Superior. Surface water and sediment were sampled at a ponded area 20-ft west of the inlet end of the culvert. The actual culvert end was not sampled due to the presence of discarded rail ties in the channel along the ATV road.
- Location 4: Ditch at the site's front gate on Highway 13 that receives overland flow. Surface water at this location moves along a roadside ditch until it reaches the culvert adjacent to 72700 Highway 13 where it then flows to Lake Superior. Surface water and sediment were collected at a ponded area at the northwest quadrant of the intersection of the road leading to PZ-09 and the main site drive.
- Location 5: 48-in. box culvert along the eastern site boundary that receives water from the site's Central Drainage. Surface water at this location flows to Boyd Creek and eventually Lake Superior. Surface water and sediment were sampled at a ponded area directly below the fencing 10-ft west of the culvert inlet.
- Location 6: Boyd Creek (along the eastern site boundary). Boyd Creek discharges to Lake Superior and possesses year round base flow. Surface water and sediment were sampled at a ponded area directly below the fence line.
- Location 7: Mission Springs Creek (along the eastern site boundary). Mission Springs Creek discharges to Lake Superior and possesses year round base flow.

Surface water and sediment were sampled 10-ft downstream of a culvert beneath the PZ-35 access road approximately 20-ft upstream of the fence line.

- Location 8: Culvert along the northeastern site boundary (first culvert passing under the ATV trail going south from the intersection of Nolander Road and State Highway 13). Surface water flow at this location moves along a roadside ditch until it reaches the culvert adjacent to 72700 Highway 13 where it then flows to Lake Superior. Surface water and sediment were sampled at a ponded area 20-ft west of the inlet end of the culvert. The actual culvert end was not sampled due to the presence of discarded rail ties in the channel.
- Location 9: Area of dispersed flow along the northern site boundary (opposite residence 30300 Nolander Road. Surface water at this location moves along a roadside ditch until it reaches a culvert adjacent to 72700 Highway 13 where it then flows to Lake Superior. Sediment was sampled at the fence line. Surface water was sampled 10-ft downstream in a ponded area.
- Location 10: Culvert along the eastern site boundary (first culvert going south from the truck gate onto State Highway 13 south of Boyd Creek). Surface water at this location drains to Mission Springs Creek and then flows to Lake Superior. Surface water and sediment were sampled 10-ft downstream of the culvert about 10-ft upstream of the fence.

3.0 FIELD ACTIVITIES

Surface water and sediment were sampled on May 22, 2002. All sampling activities were conducted in accordance with the Quality Assurance Project Plan (QAPP) dated September 2001. The sampling was conducted approximately 72-hours after the last rainfall event and flow likely included snowmelt from a prior recent snowfall. At the time of sampling surface water flow was decreasing at all locations. Four of the locations were stagnant at the time of sampling. In all cases, sufficient water was present to collect the proposed sample set. Sediment samples were collected approximately at the site boundary with sample locations biased toward the site. Water sampling locations were chosen where water was deep enough to directly fill bottles without use of transfer containers. Typically these locations were within 20 feet of the fence line or designated culverts. Figure 2 depicts the sampling locations.

3.1 Sampling Methods

3.1.1 Sediment and Sampling

Sediment was present in each of the locations at the time of sample collection. A decontaminated stainless steel bowl and stainless spoon was used to collect sediment samples. Typically, sample jars were filled to the rim directly from the spoon, jar threads were wiped clear and the jars were capped at the filling site. At locations SW1, SW8, and SW9 the stainless bowl was used to accumulate sediment which was then picked free of roots and other vegetation before transfer to the jars. Once the sample containers were filled, they were placed immediately into a cooler and chilled to < 4°C with ice. Sediment was present in each of the locations at the time of sample collection. A decontaminated stainless steel bowl and stainless spoon was used to collect sediment samples. Typically, sample jars were filled to the rim directly from the spoon, jar threads were wiped clear and the jars were capped at the filling site. At locations SW1, SW8, and SW9 the stainless bowl was used to accumulate sediment which was then picked free of roots and other vegetation before transfer to the jars. Once the sample containers were filled, they were placed immediately into a cooler and chilled to < 4°C with ice.

Since all bottom samples consisted of sediment, no EnCore® sampling was required as discussed in the sampling plan.

3.1.2 Surface Water Sampling

A decontaminated Teflon® dipper was used to retrieve water samples from the drainage channels at locations SW1, SW2 and SW4. At other locations, bottles were filled directly from the flow stream. Aliquots for metals analyses, were collected with the dipper and pumped from the dipper reservoir into the sample containers using a peristaltic pump outfitted with fresh tubing. Dissolved metals aliquots were passed through a new, unused 4.5-micron filter. Total metals aliquots were pumped to the bottles without a filter on the tubing. Once the sample containers were filled, they were placed immediately into a cooler and chilled to < 4°C with ice.

3.2 Flow Characteristics and Field Parameters

The physical characteristics of each sampling area are documented in Appendix A. Table 1 summarizes the physical channel and flow characteristics (depth, width, velocity, sediment, sheen or other non-aqueous features).

Drainages SW3, SW5, SW6, SW7, SW8, and SW10 exhibited a well-defined flow channel and average water depth was greater than 3 inches. Here, surface water velocity was measured using a Marsh-McBurney Flowmate 2000 electronic velocity meter at spacings of no more than 18-inches across the wetted stream cross-section. At the remaining locations there was no flow in the channel or the channel was not well defined.

Turbidity, temperature, dissolved oxygen, conductivity, redox potential and pH were measured at the mid-depth in the flow channel using a Horiba U-122 Water Quality meter calibrated using the manufacturer's instructions.

3.3 Analytical Methods

3.3.1 Field Parameters

For each surface water sample, the following parameters were evaluated in the field using the HoribaU-122:

- ❏ pH
- ❏ Turbidity
- ❏ Dissolved Oxygen (DO)
- ❏ Specific Conductivity
- ❏ Temperature

3.3.2 Laboratory Parameters

All surface water and sediment samples were submitted to Severn Trent Laboratories (STL) for the following analyses.

- ❏ Metals (surface water was quantified for total and dissolved metals)
- ❏ Nitroaromatics/nitramines (method 8321)
- ❏ Semivolatile organic constituents (SVOCs, method 8270)
- ❏ Volatile organic compounds (VOCs, method 8260)

Since the purpose of this sampling program is characterization, comprehensive analytical lists were selected to allow a thorough evaluation of sediment and surface water quality. In addition, all nitroaromatic/nitramine analyses were submitted for independent data validation in accordance with guidance from the *National Functional Guidelines for Organic Data Review*, U.S. EPA, 2/94 and 10/99 updates.

Chain of Custody

The laboratory initiated the chain-of-custody (COC) at the time the sample containers were prepared for shipment to the site. COC's accompanied the containers to and from the site. The following information was recorded on the COC prior to shipping samples from the site to the laboratory.

- ❏ Collector's name
- ❏ Sample collection dates and times
- ❏ Sample identification numbers
- ❏ Number of containers for each sample aliquot (if not already indicated)
- ❏ Container size/type (if not already indicated)
- ❏ Type of preservation (including ice)
- ❏ Parameters (analytes from each sample aliquot)
- ❏ Turn-around requirements
- ❏ Special handling instructions
- ❏ Destination of samples
- ❏ Name, date, time and signature of each individual possessing the samples

The COC was signed by each individual responsible for custody of the sample containers. The original signed COC accompanied the samples to the laboratory and was returned as part of the final data package to DuPont.

3.3.3 QA/QC Samples

The following QA/QC samples were collected:

- ❏ One trip blank in the cooler with the VOC vials (filled at the lab).
- ❏ One equipment blank for water (passed though the Teflon dipper and the tygon pump tubing) and one for sediment samples (passed over the spoons and bowls used).
- ❏ One field duplicate from location SW6.
- ❏ One Matrix Spike/Matrix Spike Duplicate (MS/MSD) sample from location SW6.

3.4 H&S/Waste Management

All field activities were conducted as per the site specific Health and Safety Plan (HASP) and Waste Management Plan (WMP).

4.0 ANALYTICAL RESULTS

Results of the analyses conducted on surface water and sediment samples are presented in Tables 2 and 3 and on Figures 3 and 4. Analytical laboratory reports for each sample are attached in Appendix B.

4.1 Surface Water

The analytical results for the surface water sampling (Figure 3) indicate the following constituents were detected above the Wisconsin Groundwater Enforcement Standard (WGES):

- 2,4-Dinitrotoluene (WGES of 0.05 ug/l) was detected in 2 of the 10 samples at concentrations ranging from 0.23 ug/l to 0.35 ug/l. This compound was detected at locations 5SW1 and 6SW1.
- 2,6-Dinitrotoluene (WGES of 0.05 ug/l) was detected in 2 of the 10 samples at concentrations ranging from 0.20 ug/l to 0.36 ug/l. This compound was detected at locations 5SW1 and 6SW1.
- 2,4,6-Trinitrotoluene (WGES of 2.2 ug/l) was detected in 1 of the 10 samples at a concentration of 5.1 ug/l. This compound was detected at location 5SW1.
- 2-amino-4,6-Dintitrotoluene (WGES of 2.2 ug/l) was detected in one of the ten samples at a concentration of 4.9 ug/l. This compound was detected at location 5SW1.
- 2-amino-2,6-Dintitrotoluene (WGES of 2.2 ug/l) was detected in one of the 10 samples at a concentration of 9.4 ug/l. This compound was detected at location 5SW1.
- Lead - total (WGES of 0.015 mg/l) was detected two of the 10 samples at concentrations ranging from 0.017 mg/l to 0.0294 ug/l. This compound was detected at locations 4SW1 and 5SW1. Lead was not detected above the WGES in the dissolved phase.
- Vanadium – total (WGES of 0.03 mg/l) was detected in one of the 10 samples at a concentration of 0.0314 mg/l. This compound was detected in sample 4SW1. Vanadium was not detected above the WGES in the dissolved phase.

4.2 Sediment

The analytical results for the sediment samples (Figure 4) indicate the following constituents were above the Wisconsin Direct Contact Non-Industrial Screening Values (WDCNISV):

- Arsenic (WDCNISV of 0.039 mg/kg) was detected in all 10 sediment samples above the WCDNISV at concentrations ranging from 0.52 mg/kg (location 6SD1) to 25.2 mg/kg (location 10SD1).

- Chromium (WDCNISV of 14 mg/kg) was detected in 5 of the 10 sediment samples above the WDCNISV at concentrations ranging from 20.6 mg/kg (location 9SD1) to 33.9 mg/kg (location 8SD1).
- Lead (WDCNISV of 50 mg/kg) was detected in one of the 10 samples above the WDCNISV at a concentration of 70.7 mg/kg (location 1SD1).

5.0 RISK EVALUATION – HUMAN HEALTH

In order to interpret the results of the surface water and sediment analysis, risk-based screening criteria corresponding to a residential exposure scenario were developed. The ten surface water and sediment samples were collected from locations along the northern and eastern perimeter of the site. These samples were analyzed for nitroaromatic/nitramine compounds , semi-volatile organic compounds (SVOCs), volatile organic compounds (VOCs), and metals. Using standard EPA risk assessment methods, risk-based screening criteria corresponding to a residential exposure scenario were developed.

This assessment:

- Calculates risk based concentrations (RBCs) for detected chemicals, corresponding to a hazard quotient (HQ) of 1.0 for non-carcinogenic chemicals and a target risk of 1E-06 for carcinogenic chemicals, and
- Compares the maximum measured surface water and sediment chemical concentrations to the surface water and sediment RBCs and notes any exceedances.

5.1 Exposure Pathway

In general, the surface water and sediment samples were not collected from named surface water bodies such as streams, rivers, lakes, ponds, etc. Rather, they were collected from ditch-like features variously described as areas of "dispersed overland flow", "channelized flow", and "overland flow". Two exceptions are the surface water and sediment samples collected from Boyd's Creek (sample location No. 6) and Mission Springs (sample location No. 7). Accordingly, these two locations represent potential recreational exposure. The remaining locations are best described as ditches and/or areas of observed standing water (i.e. puddles). Since these areas are created from overland flow after rain and thaw events, they are dry most of the year.

However, there are no barriers that preclude public access to the sampled locations or contact with the surface water or sediments once outside the site security fence. Accordingly, this assessment assumes children and adults may contact the surface water and sediment and become dermally exposed to associated chemicals.

5.2 Risk Based Concentrations

Table 4 presents the equations used to derive the surface water and sediment RBCs. These equations were derived from the equations presented in EPA (2001). There are six basic situations for which separate equations are necessary to derive dermal surface water and sediment RBCs:

- Carcinogenic organic chemicals in water,
- Carcinogenic inorganic chemicals in water,

- ❑ Non-carcinogenic organic chemicals in water,
- ❑ Non-carcinogenic organic chemicals in water,
- ❑ Carcinogenic organic and inorganic chemicals in sediment, and
- ❑ Non-carcinogenic organic and inorganic chemicals in sediment.

These basic situations are summarized below (see Table 4 RBC):

	Water		Sediment
	Organics	**Inorganics**	**Organics and Inorganics**
Carcinogenic:	RBC_1: Eq. 1 and Eq. 2	RBC_2: Eq. 3	RBC_5: Eq. 7
Non-carcinogenic:	RBC_3: Eq. 4 and Eq. 5	RBC_4: Eq. 6	RBC_6: Eq. 8

For organics in water, two equations are available to calculate RBCs, depending on the relative values of t_{event} and t^*, as discussed in EPA (2001). Accordingly, a total of eight RBC equations are presented in Table 4.

Several of the variables associated with the Table 4 equations are derived using additional (secondary) equations. The seven secondary equations (equations 9 through 15) are presented in Table 5. The variables associated with the Table 4 and 5 equations are summarized in Table 6, including information such as variable descriptions, values, and units.

Table 6 variables that are a function of the site-specific exposure scenario include the skin surface area available for contact for both the child and the adult (SA_c and SA_a), exposure frequency (EF), Exposure Duration (ED), Event Frequency (EV), and Event Duration (t_{event}).

Skin Surface Area (SA) The skin surface area for the child SA_c and the adult SA_a are estimated to be 4,471 cm^2 and 6,074 cm^2, respectively. These estimates are based on EPA data (EPA, 2001; pages C-3 and C-4) and assume exposure of the following body parts to SW/SED: face, forearms, hands, legs, and feet.

Exposure Frequency (EF) An exposure frequency of 214 days/year is assumed, corresponding to daily exposure during the relatively warmer months when non-protected exposure to surface water and sediment is most likely (all months except November through March).

Exposure Duration (ED) An exposure duration of 30 years is assumed (corresponding to an EPA default residential exposure duration), with twelve of those years as a child aged 7 through 18, and the remainder (30 – 12 = 18 years) as an adult. The child age range of 7 through 18 matches the age period for which EPA (EPA, 2001) presents skin surface area data for children (RAGS Part E, pages C-3 and C-4).

Event Frequency (EV) An event frequency of 1 is assumed, corresponding to one event per day.

Event Duration (t_{event}) An event duration of 1 hour per event is assumed.

Overall, the above assumptions are conservative. For example it is assumed that:

- ❑ The same person repeatedly visits the locations of the subject surface water and sediment every day during most days of the year,

- During such visits, the person is assumed to contact both the surface water and the sediment with relatively large surface body areas consisting not only of hands and feet but also face, forearms, and legs,
- This same person is repeatedly exposed, year after year after year, for a total of 30 years,
- There is no attenuation of the chemical concentrations at any time during the 30-year time period,

Many of the variable values necessary to calculate the RBCs are chemical-specific, consisting of toxicity data and physical and chemical properties data. Tables 7 and 8 present the toxicity data and physical and chemical properties data, respectively, for all detected chemicals. For some chemicals either toxicity data, physical and chemical properties data, or both are not available, in which case an RBC is not calculated.

5.3 Data Evaluation, Discussion and Conclusions

Data evaluation consisted of comparing the site monitoring data to the calculated RBCs. Table 9 presents the maximum detected chemical concentrations in surface water (ug/l) and sediment (ug/kg) and the corresponding RBCs, also in units of ug/l and ug/kg, respectively. None of the RBC values are exceeded for either surface water or sediment, with the exception of arsenic in sediment RBC. This exceedance is driven by:

- The very high soil adherence factor used in the present assessment, corresponding to the geometric mean value of 21 mg/cm^2-event which EPA (EPA, 2001; Exhibit 3-3 on page 3-17) considers applicable to children playing in mud;
- The relatively large oral slope factor and relatively low oral reference dose for arsenic; and
- Arsenic occurs naturally in uncontaminated background soil (and sediment by association) at concentrations that are high relative to the arsenic sediment RBC.

Review of the arsenic sediment analytical results reveals that samples 1 through 9 represent a concentration range (0.52 to 3 mg/kg). This range is within the natural background range for arsenic in soil in Wisconsin (Shacklette and Boerngen, 1981). For example, Shacklette and Boerngen (1981) analyzed 27 background soil samples collected from throughout Wisconsin and detected arsenic in all of the samples except one, at concentrations ranging from 1.4 to 10 mg/kg.

The arsenic result for the 10th site sample (25.2 mg/kg) appears to be at the upper end or slightly above typical background ranges. However, when considered together with the other nine sediment sample arsenic results, an average sediment arsenic concentration of 4.0 mg/kg is indicated. This is well within the background concentration range cited above, indicating no impacts from FDBS.

It is unlikely that it represents arsenic derived from site. The present assessment reveals that the concentrations of chemicals found at the perimeter of the site in the surface water and sediment are below levels of concern.

6.0 RISK EVALUATION – ECOLOGICAL

The primary objectives of the ecological screening are as follows:

- ❏ To identify appropriate ecological screening values for surface water and sediment samples collected at the site.
- ❏ To assess surface water and sediment quality using ecological screening values.

6.1 Screening Value Protocol

6.1.1 Surface Water

To describe surface water quality the measured maximum concentrations of the constituents in the surface water samples were compared to the following conservative ecologically based screening concentrations.

- ❏ Results of the 1998 Sediment and Surface Water Investigation at the Former Barksdale Works, Ashland, Wisconsin (Exponent, 1998).
- ❏ Surface Water Quality Criteria and Secondary Values for Toxic Substances (Wisconsin Administrative Code, 1997.
- ❏ Nitroaromatic Munition Compounds: Environmental Effects and Screening Values (Talmage *et al*., 1999).
- ❏ Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter & Tsao, 1996).

Though water hardness was not analyzed in the 2002 surface water samples, the water hardness data based on water samples collected in 1998 (Exponent, 1998) along Boyd's Creek were applied to calculate hardness dependent screening values for this report. The average of the five water hardness values from the 1998 study (252 mg/l $CACO_3$) was used to calculate copper, cadmium, chromium, lead, nickel and zinc ecological screening values using the formulae provided in the Wisconsin Administrative Code 105.05(3) and 105.06(4) (Table 10).

6.1.2 Sediment

Maximum detected concentrations of SVOCs, VOCs and metals in the sediment samples were compared to the following conservative ecologicallybased screening concentrations to describe sediment quality.

- ❏ Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota (Jones *et al*., 1997).
- ❏ Results of the 1998 Sediment and Surface Water Investigation at the Former Barksdale Works, Ashland, Wisconsin (Exponent, 1998).

Though total organic carbon (TOC) was not analyzed in the 2002 sediment samples, an average TOC concentration of 1% was applied to TOC dependent screening values,

based on sediment samples collected in 1998 along Boyd's Creek (Exponent, 1998). For the nitroaromatic/nitramine compounds (2, 4-dinitrotoluene and 2,6-dinitrotoluene), Exponent (1998) derived two ecological screening values (19 mg/kg for cold water communities and 400 mg/kg for limited aquatic life). The conservative cold water community value of 19 mg/kg was used as the ecological screening value in this study.

In order to provide a meaningful assessment of metal concentrations in site sediments, regional sediment metal concentrations from extensive metal surveys conducted throughout the USGS Ashland Quadrangle by the National Uranium Resource Evaluation (NURE) program were compiled (Smith, 2001). Further information regarding this program can be found at the following Internet sites; http://pubs.usgs.gov/of/1997/ofr-97-0492/state/nure_wim.htm and http://pubs.usgs.gov/of/1997/ofr-97-0492/nure_man.htm.

Metal abundance values from the Ashland Quadrangle were derived from 336 lake and stream-sediment samples collected in Wisconsin. These values provide a second source of information to which the site constituent values were compared and are listed in Table 11.

6.2 Screening Results

6.2.1 Surface Water

Based on a comparison of maximum detected concentrations of constituents in the surface water samples from the ten stations to ecological screening values for surface water, no detected nitroaromatic/nitramine compounds (1-methyl-2-nitrobenzene, 2, 4-dinitrotoluene, 2,4,6-trinitrotoluene, 2,6-dinitrotoluene, 2-amino-4,6-dinitrotoluene and 4-amino-2,6-dinitrotoluene), SVOCs (Bis (2-ethylhexyl) phthalate) or VOCs (acetone and toluene) were detected above their respective screening value (Table 12). No constituents are identified for site surface water samples as potential constituents of concern.

One surface water sample in the vicinity of the site front gate (4SW1) contained a detectable concentration of total recoverable copper that exceeded the ecological screening value for surface water (Table 12). However, the dissolved fraction of copper in the same sample did not exceed the screening value (0.025 mg/l compared to 0.0245 mg/l at 4SW1). With the exception of the detection for total recoverable copper at 4SW1, all metals concentrations (both dissolved and total fractions) were below the chronic ecological screening values provided in Table 12. Since it is the dissolved metals fraction in surface water that interacts directly with the aquatic biota (plants and animals) and there is no permanent aquatic community identified at 4SW1 no metal constituents are identified for site surface water samples as potential constituents of concern.

6.2.2 Sediments

Comparison of the constituents measured in the sediment samples from the 10 stations to the conservative ecological screening values for sediments indicates that concentrations of the detected nitroaromatic/nitramine compounds (2,4-dinitrotoluene and 2,6-dinitrotoluene) were below the sediment screening values (Table 13). The SVOC detection (pyrene) was also well below the ecological screening value for sediment. Of

the detected VOCs, concentrations of 1,1,1-trichloroethane, 1,2-dichoroethane and methylene chloride were below the ecological screening values for sediments. Sediment concentrations of acetone in three of the samples (4SD1, 8SD1 and 10SD1) and toluene in one sample (8SD1) were slightly higher than their ecological screening value (Table 13).

Low concentrations and infrequent detections of VOCs in sediments located in intermittent areas (i.e. ditches and puddles) are generally not considered a potential concern to aquatic life because:

- The half-lives of VOCs are very short, ranging from just a couple of hours to a few days.
- VOCs break down and/or volatilize very rapidly and should not persist in wetted sediments that repeatedly dry out.
- Permanent aquatic communities are not exposed to substrates from intermittently wet habitats (i.e. ditches and puddles).
- VOCs do not readily bioconcentrate or bioaccumulate in food chains and therefore are unlikely to accumulate to any great extent in wildlife that may contact these areas.

Several other lines of evidence also support this conclusion regarding VOCs in sediments. VOC screening values are based on the assumption that the TOC of the sediments is at least 1%. Since the sampling stations 4SD1, 8SD1 and 10SD1 are located in low-lying wet areas and the associated sediments were described as being "black and mucky". This assumption is likely conservative. TOC of the sediments at these sampling stations is likely higher than the assumed 1%. Higher TOC in these samples would result in a higher screening level. Collectively, the information supports the conclusion that sediment VOC exceedances are not a potential concern to wildlife.

No screening values were available for barium, beryllium, cobalt, selenium, silver, thallium, tin and vanadium. Detected concentrations of barium, beryllium, cobalt, selenium, silver, and vanadium were within the reported range of the NURE dataset (silver was not detected in NURE samples at a detection limit of 2.0 mg/kg which is higher than the range of site data; Table 13). Thallium and tin were not analyzed in NURE samples, however, site detections are similar across samples indicating no likely potential on-site sources for these metals. These metals are not considered potential constituents of concern.

Maximum concentrations of copper and mercury detected in the sediments at the site were above their respective ecological screening values (Table 13). Copper concentrations at 1SD1 and 4SD1 slightly exceeded the ecological screening value of 28 mg/kg (41.4 and 40.7 mg/kg at 1SD1and 4SD1 respectively. However, the values were well within the reported range of the NURE elemental concentrations for the Ashland Quadrangle (3-398 mg/kg; Tables 11 and 13). Mercury at one station, 9SD1, only slightly exceeded the screening value by 0.01 µg/kg. Based on these results, copper and mercury are not considered potential constituents of concern.

Maximum concentrations of arsenic and lead detected in the sediments at the Site were above their respective ecological screening values (Table 13). Lead concentrations at

1SD1 and 4SD1 were higher than the screening value; and lead was not included in the NURE samples. Arsenic concentrations from 1SD1-9SD1 were all lower than the screening value, however, the arsenic level at 10SD1 exceeded both the ecological screening value and the maximum value provided in the NURE dataset. Literature based soil screening values for invertebrates for arsenic and lead are 60 mg/kg and 500 mg/kg respectively (Efroymson et al. 1997). The screening values indicate that there is little potential for arsenic or lead to effect this community. Arsenic was found at a maximum concentration of 25.2 mg/kg and lead was found at a maximum concentration of 70.7 mg/kg. Since these samples were collected in locations proximate to roadsides, in ditches, areas with limited habitat and potential wildlife exposure arsenic and lead are not considered potential constituents of concern.

6.3 Screening Conclusions

Based on the data screening results and the physical habitats surrounding the sample locations, several conclusions can be reached regarding surface water and sediment quality.

- No detected concentrations of nitroaromatic/nitramine compounds, SVOCs, VOCs and dissolved metals in surface water samples exceeded ecological screening values.
- No detected concentrations of nitroaromatic/nitramine compounds, SVOCs, VOCs and metals in surface water or sediment in samples collected in Boyd's Creek or Mission Springs exceeded ecological screening values.
- Metals and VOCs were detected in the sediments slightly above their respective ecological screening values at several stations located within intermittent aquatic habitats (ditches) near roadways; these exceedances are not likely to pose a threat to wildlife.
- Physical habitats surrounding sample locations combined with data screening results, suggest that overland migration of site-related constituents is not a substantial off-site transport pathway and the potential for effects to ecological communities, particularly aquatic based communities, is negligible.

7.0 CONCLUSIONS AND RECOMMENDATIONS

The present assessment reveals that the concentrations of chemicals found at the perimeter of the DuPont Barksdale site in the surface water and sediment are below levels of concern as supported by the following:

- None of the risk-based screening values protective of human health are exceeded for either surface water or sediment, with the exception of arsenic in sediment RBC.
- Arsenic sediment analytical results reveal that samples 1 through 9 represent a concentration range (0.52 to 3 mg/kg within the natural background range for arsenic in soil in Wisconsin (Shacklette and Boerngen, 1981).
- The arsenic result for the 10^{th} site sample (25.2 mg/kg) appears to be at the upper end or slightly above typical background ranges. It is unlikely that it represents arsenic derived from the site.
- No detected concentrations of nitroaromatic compounds, SVOCs, VOCs and dissolved metals in surface water samples exceeded ecological screening values.
- No detected concentrations of nitroaromatic compounds, SVOCs, VOCs and metals in surface water or sediment in samples collected in Boyd's Creek or Mission Springs exceeded ecological screening values.
- Metals and VOCs were detected in the sediments slightly above their respective ecological screening values at several stations located within intermittent aquatic habitats (ditches) near roadways; these exceedances are not likely to pose a threat to wildlife.
- Physical habitats surrounding sample locations combined with data screening results, suggest that overland migration of site-related constituents is not a substantial off-site transport pathway and the potential for effects to ecological communities, particularly aquatic based communities, is negligible.
- Results found during this study are consistent with the results of the 1998 study conducted by Exponent in their report entitled *Results of the Sediment and Surface Water Investigation at the Former Barksdale Works, Ashland, WI.* 1998.

Based on the conclusions above, site surface water and sediment should remain as a low priority for site investigation purposes. There is no indication that investigation activities need to be accelerated at areas of the site where surface water exists or originates during precipitation events.

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TABLES

Table 1 - Flow Characteristics

MEASUREMENT	LOCATION									
	SW01	SW02	SW03	SW04	SW05	SW06	SW07	SW08	SW09	SW10
Flow Measuring Point State Plane North	535205	535160	532865	531911	530767	529279	527702	533793	535189	528541
Flow Measuring Point State Plane East	1729208	1733612	1734790	1734043	1733223	1732244	1731010	1735462	1731888	1731608
Flow (cfs)	0.000	0.000	0.011	0.000	0.042	0.966	0.033	0.001	0.000	0.003
Depth (ft)	0.42	0.25	0.50	0.17	0.33	0.58	0.29	0.07	0.67	0.50
Width (ft)	2.67	0.83	0.25	1.00	1.71	2.21	0.38	0.92	1.00	1.00
Velocity (ft/s)	0	0	0.085	0	0.073	0.75	0.3	0.015	0	0.005
pH (SU)	5.86	5.20	5.76	5.83	5.89	6.95	7.49	5.72	4.87	6.34
Temp (C)	13.8	12.2	11.8	23.8	15.7	18.6	16.0	17.4	13.5	17.8
Conductivity (mS/cm)	0.069	0.033	0.033	0.104	0.196	0.258	0.121	0.047	0.085	0.050
Dissolved Oxygen (mg/L)	5.3	4.8	6.1	6.2	8.4	8.0	8.3	4.3	4.5	6.3
Redox Potential (mV)	50	183	98	91	87	13	0	30	223	50
Turbidity (NTU)	300	85	576	84	63	25	134	407	66	820
Color	Brown	Clear	Brown	Yellow	Brown	Clear	Gray	Yellow	Clear	Clear
Odor	Decayed vegetation	None	Decayed vegetation	Decayed vegetation	None	None	None	Decayed vegetation	None	None
Bottom type	Black silt w/ roots	Silty clay	Silt	Silty clay	Gravelly sand	Silty sand	Silty sand	Silt	Clayey silt	Silt

Table 2 - Surface Water Analytical Detections

LOCATION	Ecological Benchmark Concentration	Wisconsin Groundwater Enforcement Standard	Detected?	CAS Number	1SW1	2SW1	3SW1	4SW1	5SW1	6SW1	6SW1[(1)]	7SW1	8SW1	9SW1	10SW1
ORGANICS															
Explosives: Method 8321 (ug/l)															
1-METHYL-2-NITROBENZENE		61	Yes	88722	ND (0.026) UJ	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	0.091 J	0.094 J	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)
2,4-DINITROTOLUENE		0.05	Yes	121142	0.027 J	ND (0.026)	ND (0.026)	ND (0.026)	0.35	0.23	0.23	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)
2,4,6-TRINITROTOLUENE	130	2.2	Yes	118967	ND (0.021) UJ	ND (0.021)	ND (0.021)	ND (0.021)	5.1	ND (0.021)	ND (0.021)	ND (0.021)	ND (0.021)	ND (0.021)	ND (0.021)
2,6-DINITROTOLUENE		0.05	Yes	606202	ND (0.022) UJ	ND (0.022)	ND (0.022)	ND (0.022)	0.36	0.20	0.22	ND (0.022)	ND (0.022)	ND (0.022)	ND (0.022)
2-AMINO-4,6-DINITROTOLUENE	20	2.2	Yes	35572782	ND (0.036) UJ	ND (0.036)	ND (0.036)	ND (0.036)	4.9	0.80	0.76	ND (0.036)	ND (0.036)	ND (0.036)	ND (0.036)
4-AMINO-2,6-DINITROTOLUENE		2.2	Yes	19406510	ND (0.020) UJ	ND (0.020)	ND (0.020)	ND (0.020)	9.4	1.5	1.4	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)
SVOCs: Method 8270 (ug/l)															
BIS(2-ETHYLHEXYL)PHTHALATE			Yes	117817	ND (1.9)	ND (1.9)	ND (1.9)	ND (1.9)	ND (1.9)	ND (1.9)	ND (1.9)	ND (1.9)	ND (1.9)	3.0 J B	ND (1.9)
VOCs: Method 8260 (ug/l)															
ACETONE		1000	Yes	67641	ND (2.9)	ND (2.9)	3.3 J	6.6 J	ND (2.9)	3.4 J	3.4 J	ND (2.9)	3.2 J	3.0 J	ND (2.9)
TOLUENE	10	1000	Yes	108883	ND (0.26)	ND (0.26)	ND (0.26)	0.71 J	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)
INORGANICS															
Metals (mg/l)															
ARSENIC		0.05	Yes	7440382	0.0022 B	0.00085 B	0.00039 B	0.0027 B	0.002 B	0.00062 B	0.00060 B	0.00037 B	0.0004 B	0.00013 B	0.0006 B
ARSENIC (D)		0.05	Yes	7440382	0.00079 B	0.0006 B	0.00044 B	0.0015 B	0.0017 B	0.00053 B	0.00053 B	0.00037 B	0.00031 B	0.00016 B	0.00033 B
BARIUM		2	Yes	7440393	0.0406	0.0642	0.0242	0.143	0.0467	0.037	0.036	0.0298	0.0317	0.0336	0.0179
BARIUM (D)		2	Yes	7440393	0.0117	0.0293	0.017	0.0604	0.0408	0.028	0.0294	0.0168	0.0143	0.0331	0.01
BERYLLIUM		0.004	Yes	7440417	ND (0.00056)	ND (0.00056)	ND (0.00056)	0.00069 B	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)
BERYLLIUM (D)		0.004	No	7440417	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)
CHROMIUM		1	Yes	7440473	0.0037 B	0.0103	0.0018 B	0.0166	0.0012 B	0.00088 B	ND (0.00074)	0.0021 B	0.0018 B	ND (0.00074)	0.0013 B
CHROMIUM (D)		1	Yes	7440473	ND (0.00074)	0.0039 B	ND (0.00074)	0.0047 B	ND (0.00074)	ND (0.00074)	ND (0.00074)	ND (0.00074)	ND (0.00074)	ND (0.00074)	ND (0.00074)
COBALT		0.04	Yes	7440484	0.0017 B	0.0028 B	ND (0.00092)	0.0094 B	ND (0.00092)	ND (0.00092)	ND (0.00092)	ND (0.00092)	0.0022 B	ND (0.00092)	ND (0.00092)
COBALT (D)		0.04	Yes	7440484	ND (0.00092)	0.0014 B	ND (0.00092)	0.0011 B	ND (0.00092)	ND (0.00092)	ND (0.00092)	ND (0.00092)	ND (0.00092)	ND (0.00092)	ND (0.00092)
COPPER		1.3	Yes	7440508	0.0073 B	0.0124	0.002 B	0.0899	0.0191	0.0031 B	0.0137	0.0035 B	0.0013 B	0.0019 B	0.0011 B
COPPER (D)		1.3	Yes	7440508	0.0033 B	0.0078 B	0.0029 B	0.0245	0.014	0.0036 B	0.0042 B	0.0034 B	0.0022	0.004 B	0.0024 B
LEAD		0.015	Yes	7439921	0.0074	0.0103	0.0011	0.0294	0.017	0.0013	0.0014	0.00083 B	0.0012	0.0005 B	0.0015
LEAD (D)		0.015	Yes	7439921	0.0011	0.0047	0.00095 B	0.0079	0.0056	0.00048 B	0.00031 B	0.00044 B	0.00043 B	0.00047 B	0.00088 B
MERCURY		0.002	Yes	7439976	0.000074 B	0.000049 B	ND (0.000028)	0.00004 B	0.000097 B	ND (0.000028)	ND (0.000028)	ND (0.000028)	0.000029 B	ND (0.000028)	ND (0.000028)
MERCURY (D)		0.002	No	7439976	ND (0.000028)	ND (0.000028)	ND (0.000028)	ND (0.000028)	ND (0.000028)	ND (0.000028)	ND (0.000028)	ND (0.000028)	ND (0.000028)	ND (0.000028)	ND (0.000028)
NICKEL		0.1	Yes	7440020	0.0047 B	0.0076 B	ND (0.0017)	0.0223 B	0.0027 B	ND (0.0017)	ND (0.0017)	0.0024 B	0.0023 B	0.0023 B	ND (0.0017)
NICKEL (D)		0.1	Yes	7440020	ND (0.0017)	0.0044 B	0.0023 B	0.0053 B	0.0027 B	ND (0.0017)	ND (0.0017)	ND (0.0017)	ND (0.0017)	0.0027 B	ND (0.0017)
SELENIUM		0.05	Yes	7782492	0.00036 B	0.00032 B	ND (0.00019)	0.00051 B	0.00092 B	0.00019 B	0.00023 B	ND (0.00019)	ND (0.00019)	ND (0.00019)	ND (0.00019)
SELENIUM (D)		0.05	Yes	7782492	0.00026 B	0.00025 B	ND (0.00019)	0.00024 B	0.0011 B	ND (0.00019)	ND (0.00019)	ND (0.00019)	ND (0.00019)	ND (0.00019)	ND (0.00019)
THALLIUM		0.002	Yes	7440280	0.000038 B	0.000078 B	ND (0.000015)	0.00012 B	0.000029 B	0.000018 B	0.000016 B	0.000017 B	0.000023 B	ND (0.000015)	0.000017 B
THALLIUM (D)		0.002	Yes	7440280	ND (0.000015)	0.000044 B	ND (0.000015)	0.000016 B	0.000015 B	ND (0.000015)	ND (0.000015)	ND (0.000015)	ND (0.000015)	ND (0.000015)	ND (0.000015)
VANADIUM		0.03	Yes	7440622	0.0109	0.0139	0.0029 B	0.0314	0.0016 B	0.0031 B	0.0029 B	0.0036 B	0.0028 B	ND (0.00061)	0.0021 B
VANADIUM (D)		0.03	Yes	7440622	0.0015 B	0.0059 B	0.0013 B	0.0054 B	ND (0.00061)	0.0017 B	0.0018 B	0.0012 B	ND (0.00061)	ND (0.00061)	0.00081 B
ZINC		5	Yes	7440666	0.0326	0.0339	0.0145 B	0.126	0.178	0.0153 B	0.0422	0.0162 B	0.0144 B	0.0174 B	0.11
ZINC (D)		5	Yes	7440666	0.0147 B	0.0212	0.0144 B	0.0466	0.171	ND (0.0068)	ND (0.0068)	0.0332	0.0094 B	0.0334	0.093

(1): Duplicate

B (organics only): Blank Contamination

B (metals only): Estimated Concentration

J: Estimated Concentration

ND/U: Not Detected

Analyte listed if detected or concentration was missing.

Table 3 Sediment Analytical Detections

LOCATION	Ecological Benchmark Concentration	Direct Contact Non-Industrial Screening Values	Detected?	CAS Number	1SD1	2SD1	3SD1	4SD1	5SD1	6SD1	6SD1(1)	7SD1	8SD1	9SD1	10SD1
ORGANICS															
Explosives: Method 8321 (ug/kg)															
2,4-DINITROTOLUENE		940	Yes	121142	ND (21)	ND (11)	ND (19)	ND (16)	ND (10)	ND (10)	ND (10)	ND (9.5)	ND (260)	ND (140)	560
2,6-DINITROTOLUENE		940	Yes	606202	ND (24)	ND (13)	ND (22)	ND (18)	ND (12)	ND (12)	ND (12)	ND (11)	ND (270)	ND (13)	62 J
SVOCs: Method 8270 (ug/kg)															
PYRENE		2,300,000	Yes	129000	ND (100)	ND (56)	ND (94)	ND (78)	ND (51)	ND (52)	ND (51)	ND (47)	ND (110)	57 J	ND (79)
VOCs: Method 8260 (ug/kg)															
1,1,1-TRICHLOROETHANE	200		Yes	71556	ND (2.5)	ND (1.4)	ND (2.3)	3.2 J	ND (1.2)	ND (1.3)	ND (1.2)	ND (1.2)	ND (2.7)	ND (1.4)	ND (1.9)
1,2-DICHLOROETHANE	300		Yes	107062	ND (2.6)	ND (1.4)	ND (2.3)	16	ND (1.3)	3.3 J	2.7 J	ND (1.2)	ND (2.7)	ND (1.4)	ND (2.0)
ACETONE		7,800,000	Yes	67641	ND (12)	ND (6.5)	ND (11)	14 J	ND (5.8)	ND (6.0)	ND (5.9)	ND (5.4)	21 J	ND (6.5)	16 J
CARBON DISULFIDE		7,800,000	Yes	75150	ND (2.4)	ND (1.3)	2.8 J	ND (1.8)	ND (1.2)	ND (1.2)	ND (1.2)	ND (1.1)	ND (2.5)	ND (1.3)	ND (1.8)
METHYLENE CHLORIDE		85,000	Yes	75092	3.2 J B	1.4 J B	3.0 J B	3.6 J B	1.5 J B	1.7 J B	1.3 J B	1.1 J B	3.0 J B	1.4 J B	1.8 J B
TOLUENE	50	16,000,000	Yes	108883	ND (2.0)	ND (1.1)	ND (1.8)	40	ND (0.99)	ND (1.0)	ND (0.99)	ND (0.92)	69	ND (1.1)	ND (1.5)
INORGANICS															
Metals (mg/kg)															
ARSENIC		0.039	Yes	7440382	3.0	1.1	1.7	1.4	1.4	0.52 B	0.61 B	0.96	1.8	2.1	25.2
BARIUM		5,500	Yes	7440393	134	39.9	85.0	73.9	8.9	9.7	10.3	25.1	167	39.1	91.9
BERYLLIUM		160	Yes	7440417	0.81 B	0.27 B	0.60 B	0.24 B	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.10)	0.78 B	0.12 B	0.46 B
CHROMIUM		14	Yes	7440473	28.3	13.9	23.5	11.0	2.1	4.2	4.6	8.8	33.9	20.6	29.5
COBALT		1,600	Yes	7440484	7.5	4.9	7.3	6.8	1.3	2.0	2.2	4.3	15.4	6.0	11.0
COPPER		3,100	Yes	7440508	41.4	12.1	20.0	40.7	3.6	3.1	2.8	5.4	23.1	15.7	19.6
LEAD		50	Yes	7439921	70.7 J	11.4 J	33.7 J	37.6 J	33.9 J	2.7 J	2.7 J	0.88 J	14.0 J	12.3 J	16.7 J
MERCURY		23	Yes	7439976	0.16	0.018 B	0.039 B	ND (0.0049)	0.020 B	ND (0.0033)	ND (0.0032)	ND (0.0030)	0.071 B	0.21	0.023 B
NICKEL		1,600	Yes	7440020	19.6	8.8	15.3	13.5	3.6 B	3.1 B	3.3 B	8.2	23.4	10.6	18.9
SELENIUM		390	Yes	7782492	1.0 B	0.39 B	0.74 B	0.44 B	0.094 B	0.13 B	0.15 B	0.15 B	0.87 B	0.25 B	0.50 B
SILVER		390	Yes	7440224	0.33 B	0.11 B	0.20 B	0.26 B	0.10 B	0.11 B	0.1 B	0.12 B	0.48 B	0.18 B	0.22 B
THALLIUM		5.5	Yes	7440280	0.24 B	0.062 B	0.24	0.050 B	0.011 B	0.042 B	0.013 B	0.0074 B	0.24 B	0.066 B	0.15 B
TIN		47,000	Yes	7440315	4.1 B J	1.5 B J	3.3 B J	1.3 B J	4.7 B J	1.8 B J	1.8 B J	1.7 B J	3.0 B J	1.3 B J	1.6 B J
VANADIUM		550	Yes	7440622	32.4	21.6	30.2	23.9	7.6	21.1	24.8	19.6	40.1	44.3	42.4
ZINC		23,000	Yes	7440666	128	27.8	54.0	110	85.4	10.6	11.2	14.6	104	22.3	54.3

(1): Duplicate

B (organics only): Blank Contamination

B (metals only): Estimated Concentration

J: Estimated Concentration

ND/U: Not Detected

Analyte listed if detected or concentration was missing.

Table 4
Primary Equations Used to Calculate the Surface Water and Sediment RBCs

	Water		Sediment
	Organics	**Inorganics**	**Organics and Inorganics**
Carcinogenic:	RBC_1: Eq. 1 and Eq. 2	RBC_2: Eq. 3	RBC_5: Eq. 7
Non-carcinogenic:	RBC_3: Eq. 4 and Eq. 5	RBC_4: Eq. 6	RBC_6: Eq. 8

If $(t_{event} \le t^*)$, then:

$$RBC_1 = \frac{TR * AT_c}{SF_{ABS} * 2 * FA * K_p * \left(\frac{\sqrt{6 * \tau_{event} * t_{event}}}{3.14}\right) * EV * EF * SA_{adj}} \quad \text{(Eq. 1)}$$

If $(t_{event} > t^*)$, then :

$$RBC_1 = \frac{TR * AT_c}{SF_{ABS} * FA * K_p * \left[\frac{t_{event}}{1+B} + 2 * \tau_{event}\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right] * EV * EF * SA_{adj}} \quad \text{(Eq. 2)}$$

$$RBC_2 = \frac{TR * AT_c}{K_p * t_{event} * EV * EF * SF_{ABS} * SA_{adj}} \quad \text{(Eq. 3)}$$

If $(t_{event} \le t^*)$, then:

$$RBC_3 = \frac{HQ * RfD_{ABS} * AT_{nc}}{2 * FA * K_p * \frac{\sqrt{6 * \tau_{event} * t_{event}}}{3.14} * EV * EF * SA_{adj}} \quad \text{(Eq. 4)}$$

If $(t_{event} > t^*)$, then:

$$RBC_3 = \frac{HQ * AT_{nc} * RfD_{ABS}}{FA * K_p * \left[\frac{t_{event}}{1+B} + 2 * \tau_{event} * \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right] * EV * EF * SA_{adj}} \quad \text{(Eq. 5)}$$

$$RBC_4 = \frac{HQ * RfD_{ABS} * AT_{nc}}{K_p * t_{event} * EV * EF * SA_{adj}} \quad \text{(Eq. 6)}$$

$$RBC_5 = \frac{TR * AT_c}{SF_{ABS} * CF * ABS_d * EF * EV * SAAF_{adj}} \quad \text{(Eq. 7)}$$

$$RBC_6 = \frac{HQ * RfD_{ABS} * AT_{nc}}{CF * ABS_d * EF * EV * SAAF_{adj}} \quad \text{(Eq. 8)}$$

Table 5
Secondary Equations Associated with the Calculation of Surface Water and Sediment RBCs

$$B = Kp * \left(\frac{\sqrt{MW}}{2.6} \right) \quad \text{(Eq. 9)}$$

$$\tau_{event} = 0.105 * 10^{(0.0056 * MW)} \quad \text{(Eq. 10)}$$

$$\text{If } B \leq 0.6, \text{ then : } \quad t^* = 2.4 * \tau_{event} \quad \text{(Eq. 11)}$$

$$\text{if } B > 0.6 \text{ then } \quad t^* = 6 * \tau_{event} * \left(b - \sqrt{\left(b^2 - c^2 \right)} \right) \quad \text{(Eq. 12)}$$

$$b = \frac{\left(2 * (1+B)^2 \right)}{3.14} - c \quad \text{(Eq. 13)}$$

$$c = \frac{1 + 3B + 3b^2}{B(1+B)} \quad \text{(Eq. 14)}$$

$$K_p = -2.8 + 0.66 * \log K_{ow} - 0.0056 * MW \quad \text{(Eq. 15)}$$

Table 6
Variable Descriptions, Values, and Units

Variable	Description	Value	Reference	Units
ABS_d	Dermal absorption fraction from soil	Chemical-specific	RAGS Part E, page 3-19	unitless
ABS_{GI}	Gastro-intestinal absorption	Chemical-specific	RAGS Part E, page 4-6	unitless
AF_a	Soil adherence factor--adult	0.6	RAGS Part E; Exhibit 3-3	mg / cm^2-event
AF_c	Soil adherence factor--child	21	RAGS Part E; Exhibit 3-3	mg / cm^2-event
AT_c	Averaging time-carcinogens	25550	RAGS Part A, Exhibit 6-11	days
AT_{nc}	Averaging time-noncarcinogens	ED_{tot} * 365	RAGS Part A, Exhibit 6-11	days
B	Ratio of permeability coefficient of chemical through stratum corneum vs same for viable epidermis	Chemical-specific	RAGS Part E, Equation A.1	unitless
b	Correlation coefficient fitted to Flynn data	Chemical-specific	RAGS Part E, Equation A.7	unitless
c	Correlation coefficient fitted to Flynn data	Chemical-specific	RAGS Part E, Equation A.8	unitless
CF	Conversion factor	1.00E-06	RAGS Part E, Equation 3.12	kg / mg
ED_a	Exposure duration--adult	30 - ED_c = 18	Portion of 30-year exposure duration when the receptor is not a child	years
ED_c	Exposure duration--child	12	Age 7 to 18, corresponding to the SA_c data in RAGS Part E; pages C-3 and C-4	years
EDtot	Exposure duration--total	ED_c + ED_a = 30	Calculated	years
EF_{dermal}	Exposure frequency	214	Site-specific	days / year
$EF_{ingestion}$	Exposure frequency	214	Site-specific	days / year
EV	Event frequency	1	Site-specific	events / day
FA	Fraction absorbed water	Chemical Specific	RAGS Part E: Exhibit B-3	unitless
HQ	Target hazard quotient		Risk Management Decision	unitless
ϑ_{event}	Lag time per event	Chemical Specific	RAGS Part E, Equation A.4 or Exhibit B-3	hr / event
K_{ow}	Octanol/water partition coefficient of the non-ionized species	Chemical-specific	Chemical-specific Part E, Exhibit B-2	unitless
K_p	Dermal permeability coefficient in water	Chemical Specific	RAGS Part E, Equation 3.8 or Exhibit B-2	cm / hr
MW	Molecular weight	Chemical -Specific	Chemical-specific Part E, Exhibit B-2	g / mole
RfD_{ABS}	Absorption-adjusted feference dose	Chemical-specific (RfD_o x ABS_{GI})	IRIS and RAGS Part E Equation 4.3	mg / kg-day
RfD_o	Oral Reference Dose	Chemical-specific	IRIS	mg / kg-day
SA_a	Skin surface area available for contact-adult	6074	RAGS Part E; pages C-3 and C-4	cm^2
SA_{adj}	Age-adjusted skin surface area available for contact	Calculated (ED_c * SA_c / BW_c) + ((ED_{tot} - ED_c) * SA_a / BW_a)	By analogy to EPA approach discussed on page 21 of EPA Region 9's PRG User's Guide	yr-cm^2 / kg
$SAAF_{adj}$	Age-adjusted skin surface area available for contact and soil adherence factor	Calculated: (ED_c * SA_c * AF_c / BW_c) + (($EDtot$ - ED_c) * SA_a * AF_a / BW_a)	By analogy to EPA approach discussed on page 21 of EPA Region 9's PRG User's Guide	yr-mg / event-kg
SA_c	Skin surface area available for contact-child	4471	RAGS Part E; pages C-3 and C-4	cm^2
SF_{ABS}	Absorption-adjusted slope factor	Chemical-specific (SF_o / AB_{SGI})	IRIS and RAGS Part E Equation 4.2	(mg / kg-day)-1
SF_o	Oral slope factor	Chemical-specific	IRIS	(mg / kg-day)-1
t*	Time to reach steady-state	Chemical-specific	Equations A.5 through A.8	hr
t*	Time to reach steady-state	Chemical-specific	Equations A.5 through A.8	hr
t_{event}	Event duration; dermal contact	1	Site-specific	hr / event
TR	Target risk	1.00E-06	Risk Management Decision	unitless
ET	Exposure time; incidental ingestion	1	Site-specific	hr / event
BWc	Body weight—child	15	RAGS Part E; page D-3	kg
BWa	Body weight—adult	70	RAGS Part E; page D-3	kg
IRsw-child	Incidental surface water ingestion rate	0.002	(a)	liters / hour
IRsw-adult	Incidental surface water ingestion rate	0.002	(a)	liters / hour
IRsw-adj	Incidental surface water ingestion rate--age-adjusted	0.002	Calculated: (EDc * IRsw-child / BWc) + (EDa * IRsw-adult / BWa)	yr-liters / hr-kg

(a) Precedence from Lower Fox site in Wisconsin: 20 ml / day, occurring 1 out of ten fishing trips = .02 liter * 0.1 = .002 (http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/ra/section5.pdf)

Table 7
Toxicity Data.

CHEMICAL	CAS NUMBER	SF $(mg/kg/day)^{-1}$	RFD (mg/kg/day)	Adjust for GI? (a)	ABS_{GI} (unitless) (a)	SF_{ABS} $(mg/kg/day)^{-1}$	RFD_{ABS} (mg/kg/day)
ORGANICS							
1-METHYL-2-NITROBENZENE	88722	- -	1.00E-02	No	1.00E+00	- -	1.00E-02
2,4-DINITROTOLUENE	121142	- -	2.00E-03	No	1.00E+00	- -	2.00E-03
2,4,6-TRINITROTOLUENE	118967	3.00E-02	5.00E-04	No	1.00E+00	3.00E-02	5.00E-04
2,6-DINITROTOLUENE	606202	- -	1.00E-03	No	1.00E+00	- -	1.00E-03
2-AMINO-4,6-DINITROTOLUENE	35572782	- -	6.0E-05	No	1.00E+00	- -	6.0E-05
4-AMINO-2,6-DINITROTOLUENE	19406510	- -	6.0E-05	No	1.00E+00	- -	6.0E-05
BIS(2-ETHYLHEXYL)PHTHALATE	117817	1.40E-02	2.00E-02	No	1.00E+00	1.40E-02	2.00E-02
ACETONE	67641	- -	1.00E-01	No	1.00E+00	- -	1.00E-01
TOLUENE	108883	- -	2.00E-01	No	1.00E+00	- -	2.00E-01
PYRENE	129000	- -	3.00E-02	No	1.00E+00	- -	3.00E-02
1,1,1-TRICHLOROETHANE	71556	- -	2.80E-01	No	1.00E+00	- -	2.80E-01
1,2-DICHLOROETHANE	107062	9.10E-02	3.00E-02	No	1.00E+00	9.10E-02	3.00E-02
CARBON DISULFIDE	75150	- -	1.00E-01	No	1.00E+00	- -	1.00E-01
METHYLENE CHLORIDE	75092	7.50E-03	6.00E-02	No	1.00E+00	7.50E-03	6.00E-02
INORGANICS							
ARSENIC	7440382	1.50E+00	3.00E-04	No	1.00E+00	1.50E+00	3.00E-04
BARIUM	7440393	- -	7.00E-02	YES	7.00E-02	- -	4.90E-03
BERYLLIUM	7440417	- -	2.00E-03	YES	7.00E-03	- -	1.40E-05
CHROMIUM (III)	16065831	- -	1.50E+00	YES	1.30E-02	- -	1.95E-02
CHROMIUM (VI)	18540299	- -	3.00E-03	YES	2.50E-02	- -	7.50E-05
COBALT	7440484	- -	2.00E-02	- -	1.00E+00	- -	2.00E-02
COPPER	7440508	- -	4.00E-02	No	1.00E+00	- -	4.00E-02
LEAD	7439921	- -	- -	- -	- -	- -	- -
MERCURY	7487947 (b)	- -	3.00E-04	YES	7.00E-02	- -	2.10E-05
NICKEL	7440020	- -	2.00E-02	YES	4.00E-02	- -	8.00E-04
SELENIUM	7782492	- -	5.00E-03	No	1.00E+00	- -	5.00E-03
SILVER	7440224	- -	5.00E-03	YES	4.00E-02	- -	2.00E-04
THALLIUM	7440280	- -	6.60E-05	No	1.00E+00	- -	6.60E-05
TIN	7440315	- -	6.00E-01	No	1.00E+00	- -	6.00E-01
VANADIUM	7440622	- -	7.00E-03	YES	2.60E-02	- -	1.82E-04
ZINC	7440666	- -	3.00E-01	No	1.00E+00	- -	3.00E-01

(a) Per Exhibit 4-1 of RAGS Part E.
(b) Assumes "Mercury & Compounds" per EPA Region 9 and tox data are selected accordingly. However, for purpose of F&T data (GI_{abs} and K_p), CAS Number 33631639 corresponding to +2 Mercuric Chloride (other soluble salts) is assumed.

Table 8
Physical and Chemical Properties Data

CHEMICAL	CAS NUMBER	Kp (cm/hr)	Log Kow (unitless)	MW (g/mole)	FA (unitless)	B (unitless)	c (unitless)	b (unitless)	ϑ_{event} (hrs/event)	t* (hr)	ABS_d (unitless)
ORGANICS											
1-METHYL-2-NITROBENZENE	88722	8.91E-03 (c)	2.30E+00 (e)	1.37E+02 --	-- (f)	4.01E-02 (i)	3.90E-01 (j)	2.99E-01 (k)	6.15E-01 (L)	1.48E+00 (m)	[redacted] (n)
2,4-DINITROTOLUENE	121142	3.10E-03 (b)	-- (d)	1.82E+02 --	1.00E+00 (g)	1.61E-02 (i)	3.55E-01 (j)	3.02E-01 (k)	1.10E+00 (L)	2.64E+00 (m)	1.00E-01 (o)
2,4,6-TRINITROTOLUENE	118967	9.64E-04 (c)	1.60E+00 (e)	2.27E+02 --	-- (f)	5.59E-03 (i)	3.41E-01 (j)	3.03E-01 (k)	1.96E+00 (L)	4.71E+00 (m)	[redacted] (n)
2,6-DINITROTOLUENE	606202	2.10E-03 (b)	-- (d)	1.82E+02 --	1.00E+00 (g)	1.09E-02 (i)	3.48E-01 (j)	3.03E-01 (k)	1.10E+00 (L)	2.64E+00 (m)	1.00E-01 (o)
2-AMINO-4,6-DINITROTOLUENE	35572782	2.04E-03 (c)	1.84E+00 (e)	1.97E+02 --	-- (f)	1.10E-02 (i)	3.48E-01 (j)	3.03E-01 (k)	1.33E+00 (L)	3.20E+00 (m)	[redacted] (n)
4-AMINO-2,6-DINITROTOLUENE	19406510	2.04E-03 (c)	1.84E+00 (d)	1.97E+02 --	-- (f)	1.10E-02 (i)	3.48E-01 (j)	3.03E-01 (k)	1.33E+00 (L)	3.20E+00 (m)	[redacted] (n)
BIS(2-ETHYLHEXYL)PHTHALATE	117817	2.50E-02 (b)	-- (d)	3.91E+02 --	8.00E-01 (g)	1.90E-01 (i)	6.66E-01 (j)	2.36E-01 (k)	1.62E+01 (L)	3.90E+01 (m)	[redacted] (n)
ACETONE	67641	5.20E-04 (c)	-2.40E-01 (e)	5.81E+01 --	-- (f)	1.53E-03 (i)	3.35E-01 (j)	3.04E-01 (k)	2.22E-01 (L)	5.33E-01 (m)	-- (o)
TOLUENE	108883	3.10E-02 (b)	-- (d)	9.21E+01 --	1.00E+00 (g)	1.14E-01 (i)	5.14E-01 (j)	2.77E-01 (k)	3.44E-01 (L)	8.26E-01 (m)	-- (o)
PYRENE	129000	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	1.30E-01 (o)
1,1,1-TRICHLOROETHANE	71556	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	-- (o)
1,2-DICHLOROETHANE	107062	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	-- (o)
CARBON DISULFIDE	75150	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	-- (o)
METHYLENE CHLORIDE	75092	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	-- (o)
INORGANICS											
ARSENIC	7440382	1.00E-03 (b)	-- (d)	-- (d)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	3.00E-02 (o)
BARIUM	7440393	1.00E-03 (b)	-- (d)	-- (d)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (o)
BERYLLIUM	7440417	1.00E-03 (b)	-- (d)	-- (d)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (o)
CHROMIUM (III)	16065831	1.00E-03 (b)	-- (d)	-- (d)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (o)
CHROMIUM (VI)	18540299	2.00E-03 (b)	-- (d)	-- (d)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (o)
COBALT	7440484	4.00E-04 (b)	-- (d)	-- (d)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (o)
COPPER	7440508	1.00E-03 (b)	-- (d)	-- (d)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (o)
LEAD	7439921	1.00E-04 (b)	-- (d)	-- (d)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (o)
MERCURY	7487947 (p)	1.00E-03 (b)	-- (d)	-- (d)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (o)
NICKEL	7440020	2.00E-04 (b)	-- (d)	-- (d)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (o)
SELENIUM	7782492	1.00E-03 (b)	-- (d)	-- (d)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (o)
SILVER	7440224	(a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	-- (o)
THALLIUM	7440280	1.00E-03 (b)	-- (d)	-- (d)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (o)
TIN	7440315	(a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	[redacted] (a)	-- (o)
VANADIUM	7440622	1.00E-03 (b)	-- (d)	-- (d)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (o)
ZINC	7440666	1.00E-03 (b)	-- (d)	-- (d)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (h)	-- (o)

(a) A value is not necessary for this chemical because this chemical was not detected in any surface water samples.
(b) Values from RAGS Part E, Exhibit 3-1.
(c) Value calculated using Equation 15.
(d) Value not necessary because Kp for this chemical is from RAGS Part E, Exhibit 3-1 and was not calculated.
(e) SOURCE: http://risk.lsd.ornl.gov/cgi-bin/tox/TOX_select?select=csf
(f) This assessment conservatively assumes a value of 1 if RAGS Part E, Exhibit B-3 does not address this chemical.
(g) From RAGS Part E, Exhibit B-3.
(h) Value not necessary because all equations involving this variable are not applicable to inorganics.
(i) Assumes stratum corneum thickness of 0.001 cm and then calculated using Equation 9.
(j) Calculated using Equation 14.
(k) Calculated using Equation 13.
(L) Calculated using equation 10.
(m) Alternatively calculated using Equations 11 and 12, depending on the value of the variable B.
(n) A value is not necessary for this chemical because this chemical was not detected in any sediment samples.
(o) From RAGS Part E, Exhibit 3-4. any chemical not presented in this exhibit is assumed to not be dermally absorbed. The discussion on page 3-19 of RAGs Part E notes that ABS_d values for other chemicals will be derived by EPA as further research becomes available. Exhibit 3-4 of RAGs Part E includes an entire class of chemicals referred to as "semivolatile organic compounds" for which ABS_d is 0.1. For the purpose of the present assessment a chemical is considered a semivolatile organic compound if it is not an inorganic or a volatile organic compound. Volatile organic compounds are those identified as such in the EPA Region 9 PRG tables (http://www.epa.gov/region09/waste/sfund/prg/files/02prgstable.XLS). This approach creates a conflict for pyrene because it is both volatile and a PAH. For the present assessment its PAH status takes precedence and an ABS_d value of 0.1 is assumed.
(p) Assumes "Mercury & Compounds" per EPA Region 9 and tox data are selected accordingly. However, for purpose of F&T data (GIabs and Kp), CAS Number 33631639 corresponding to +2 Mercuric Chloride (other soluble salts) is assumed.

Table 9
Surface Water and Sediment Risk-based Concentrations (RBCs) and Maximum Detected concentrations.

CHEMICAL	CAS NUMBER	Medium Chemical Detected in:		Maximum Detected Concentration		Surface water RBC (ug/l)			Sediment RBC (ug/kg)		
		Surface Water	Sediment	Surface Water (ug/l)	Sediment (ug/kg)	Cancer	NonCancer	Minimum	Cancer	NonCancer	Minimum
ORGANICS											
1-METHYL-2-NITROBENZENE	88722	X		0.094	--	--	5.15E+03	5.15E+03			
2,4-DINITROTOLUENE	121142	X	X	0.35	560	--	3.14E+02	3.14E+02	--	1.16E+04	1.16E+04
2,4,6-TRINITROTOLUENE	118967	X		5.1	--	2.07E+02	1.33E+03	2.07E+02			
2,6-DINITROTOLUENE	606202	X	X	0.36	62	--	3.20E+02	3.20E+02	--	5.41E+03	5.41E+03
2-AMINO-4,6-DINITROTOLUENE	35572782	X		4.9	--	--	9.16E+01	9.16E+01			
4-AMINO-2,6-DINITROTOLUENE	19406510	X		9.4	--	--	9.16E+01	9.16E+01			
BIS(2-ETHYLHEXYL)PHTHALATE	117817	X		3	--	7.45E+00	8.94E+02	7.45E+00			
ACETONE	67641	X	X	6.6	21	--	1.33E+06	1.33E+06	--	--	- -
TOLUENE	108883	X	X	0.71	69	--	3.86E+04	3.86E+04	--	--	- -
PYRENE	129000		X	--	57				--	1.55E+05	1.55E+05
1,1,1-TRICHLOROETHANE	71556		X	--	3.2				--	--	- -
1,2-DICHLOROETHANE	107062		X	--	16				--	--	- -
CARBON DISULFIDE	75150		X	--	2.8				--	--	- -
METHYLENE CHLORIDE	75092		X	--	3.6				--	--	- -
INORGANICS											
ARSENIC	7440382	X	X	2.7	25,200	4.76E+00	9.18E+02	4.76E+00	2.42E+03	4.66E+03	2.42E+03
BARIUM	7440393	X	X	143	167,000	- -	4.88E+04	4.88E+04	--	--	- -
BERYLLIUM	7440417	X	X	0.69	810	- -	1.39E+02	1.39E+02	--	--	- -
CHROMIUM (III)	16065831	X	X	16.6	33,900	- -	1.94E+05	1.94E+05	--	--	- -
CHROMIUM (VI)	18540299	X	X	16.6	33,900	- -	3.73E+02	3.73E+02	--	--	- -
COBALT	7440484	X	X	9.4	15,400	- -	4.98E+05	4.98E+05	--	--	- -
COPPER	7440508	X	X	89.9	41,400	- -	3.98E+05	3.98E+05	--	--	- -
LEAD	7439921	X	X	29.4	70,700	- -	- -	- -	--	--	- -
MERCURY	7487947 (d)	X	X	0.097	210	- -	2.09E+02	2.09E+02	--	--	- -
NICKEL	7440020	X	X	22.3	23,400	- -	3.98E+04	3.98E+04	--	--	- -
SELENIUM	7782492	X	X	1.1	1,000	- -	4.98E+04	4.98E+04	--	--	- -
SILVER	7440224		X	--	480				--	--	- -
THALLIUM	7440280	X	X	0.12	240	- -	6.57E+02	6.57E+02	--	--	- -
TIN	7440315		X	--	4,700				--	--	- -
VANADIUM	7440622	X	X	31.4	44,300	- -	1.81E+03	1.81E+03	--	--	- -
ZINC	7440666	X	X	178	128,000	- -	2.99E+06	2.99E+06	--	--	- -

(a) For inorganics, concentration is maximum of dissolved or filtered.
(b) "--" indicates PRG not calculated due to no toxicity data. Grey shading indicates chemical not detected in surface water. Yellow shading indicates PRG is exceeded.
(c) "--" indicates PRG not calculated due to no toxicity data or because EPA says exposure by dermal route is not important. Grey shading indicates chemical not detected in surface water. Yellow shading indicates PRG is exceeded.
(d) Assumes "Mercury & Compounds" per EPA Region 9 and tox data are selected accordingly. However, for purpose of F&T data (GIabs and Kp), CAS Number 33631639 corresponding to +2 Mercuric Chloride (other soluble salts) is assumed.

Table 10
Surface Water Hardness Derivation, Boyd's Creek

Sample	Ca (Mg/L)	Ca as CaCO3	Mg (Mg/L)	Mg as CaCO3	Hardness (Mg/L)
Site B1, Replicate 1	50.1	125.25	30.1	123.8683128	249.1183
Site B1, Replicate 2	48.3	120.75	28.6	117.6954733	238.4455
Site B1, Replicate 3	47.8	119.5	27.6	113.5802469	233.0802
Site B4	73.8	184.5	57.5	236.6255144	421.1255
Site B7	31.8	79.5	9.8	40.32921811	119.8292
Mean	**51.4**	**128.6**	**32**	**131.8**	**252.3**

Notes:

All data taken from Exponent, 1998.

Table 11
Lake and Stream Sediments and Elemental Concentrations, Ashland Quadrangle, Wisconsin

Analyte	Total Number of Sediment Samples	Concentration Range (ppm)		Average (ppm)
		Min	Max	
Arsenic	336	0.6	11	2.7
Barium	336	130	610	379
Beryllium	335	N.D. (1.0)	9	1.6
Cobalt	334	N.D. (4.0)	50	20
Chromium	335	11	167	34
Copper	335	3	398	16
Lead	0	--	--	--
Mercury	0	--	--	--
Nickel	335	5	34	14
Selenium	335	N.D. (0.099)	3.9	0.5
Silver	335	N.D. (2.0)	N.D. (2.0)	--
Tin	0	--	--	--
Vanadium	335	23	198	70
Zinc	335	N.D. (2.0)	172	40

Notes:

All data taken from Smith, 2001.

Table 12
Screening Results: Surface Water

LOCATION	Surface Water Screening Values[1]	SW1	SW2	SW3	SW4	SW5	SW6	SW6(2)	SW7	SW8	SW9	SW10
Explosives: Method 8321	***(ug/l)***											
1-METHYL-2-NITROBENZENE	--	ND (0.026) UJ	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)	0.091 J	0.094 J	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)
2,4-DINITROTOLUENE	5.3b	0.027 J	ND (0.026)	ND (0.026)	ND (0.026)	0.35	0.23	0.23	ND (0.026)	ND (0.026)	ND (0.026)	ND (0.026)
2,4,6-TRINITROTOLUENE	90d	ND (0.021) UJ	ND (0.021)	ND (0.021)	ND (0.021)	5.1	ND (0.021)	ND (0.021)	ND (0.021)	ND (0.021)	ND (0.021)	ND (0.021)
2,6-DINITROTOLUENE	5.3b	ND (0.022) UJ	ND (0.022)	ND (0.022)	ND (0.022)	0.36	0.20	0.22	ND (0.022)	ND (0.022)	ND (0.022)	ND (0.022)
2-AMINO-4,6-DINITROTOLUENE	20d	ND (0.036) UJ	ND (0.036)	ND (0.036)	ND (0.036)	4.9	0.80	0.76	ND (0.036)	ND (0.036)	ND (0.036)	ND (0.036)
4-AMINO-2,6-DINITROTOLUENE	20d	ND (0.020) UJ	ND (0.020)	ND (0.020)	ND (0.020)	9.4	1.5	1.4	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)
SVOCs: Method 8270	***(ug/l)***											
BIS(2-ETHYLHEXYL)PHTHALATE	3.0c	ND (1.9)	ND (1.9)	ND (1.9)	ND (1.9)	ND (1.9)	ND (1.9)	ND (1.9)	ND (1.9)	ND (1.9)	3.0 J B	ND (1.9)
VOCs: Method 8260	***(ug/l)***											
ACETONE	1500c	ND (2.9)	ND (2.9)	3.3 J	6.6 J	ND (2.9)	3.4 J	3.4 J	ND (2.9)	3.2 J	3.0 J	ND (2.9)
TOLUENE	9.8c	ND (0.26)	ND (0.26)	ND (0.26)	0.71 J	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)	ND (0.26)
Metals - Total	***(mg/l)***											
ARSENIC	0.148/0.339b	0.0022 B	0.00085 B	0.00039 B	0.0027 B	0.002 B	0.00062 B	0.00060 B	0.00037 B	0.0004 B	0.00013 B	0.0006 B
BARIUM	--	0.0406	0.0642	0.0242	0.143	0.0467	0.037	0.036	0.0298	0.0317	0.0336	0.0179
BERYLLIUM	--	ND (0.00056)	ND (0.00056)	ND (0.00056)	0.00069 B	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)
CHROMIUM	0.18a	0.0037 B	0.0103	0.0018 B	0.0166	0.0012 B	0.00088 B	ND (0.00074)	0.0021 B	0.0018 B	ND (0.00074)	0.0013 B
COBALT	--	0.0017 B	0.0028 B	ND (0.00092)	0.0094 B	ND (0.00092)	ND (0.00092)	ND (0.00092)	ND (0.00092)	0.0022 B	ND (0.00092)	ND (0.00092)
COPPER	0.026a	0.0073 B	0.0124	0.002 B	0.0899	0.0191	0.0031 B	0.0137	0.0035 B	0.0013 B	0.0019 B	0.0011 B
LEAD	0.068a	0.0074	0.0103	0.0011	0.0294	0.017	0.0013	0.0014	0.00083 B	0.0012	0.0005 B	0.0015
MERCURY	0.00044b	0.000074 B	0.000049 B	ND (0.000028)	0.00004 B	0.000097 B	ND (0.000028)	ND (0.000028)	ND (0.000028)	0.000029 B	ND (0.000028)	ND (0.000028)
NICKEL	0.412a	0.0047 B	0.0076 B	ND (0.0017)	0.0223 B	0.0027 B	ND (0.0017)	ND (0.0017)	0.0024 B	0.0023 B	0.0023 B	ND (0.0017)
SELENIUM	--	0.00036 B	0.00032 B	ND (0.00019)	0.00051 B	0.00092 B	0.00019 B	0.00023 B	ND (0.00019)	ND (0.00019)	ND (0.00019)	ND (0.00019)
THALLIUM	--	0.000038 B	0.000078 B	ND (0.000015)	0.00012 B	0.000029 B	0.000018 B	0.000016 B	0.000017 B	0.000023 B	ND (0.000015)	0.000017 B
VANADIUM	--	0.0109	0.0139	0.0029 B	0.0314	0.0016 B	0.0031 B	0.0029 B	0.0036 B	0.0028 B	ND (0.00061)	0.0021 B
ZINC	0.27a	0.0326	0.0339	0.0145 B	0.126	0.178	0.0153 B	0.0422	0.0162 B	0.0144 B	0.0174 B	0.11
Metals - Dissolved	***(mg/l)***											
ARSENIC (D)	0.148f	0.00079 B	0.0006 B	0.00044 B	0.0015 B	0.0017 B	0.00053 B	0.00053 B	0.00037 B	0.00031 B	0.00016 B	0.00033 B
BARIUM (D)	--	0.0117	0.0293	0.017	0.0604	0.0408	0.028	0.0294	0.0168	0.0143	0.0331	0.01
BERYLLIUM (D)	--	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)	ND (0.00056)
CHROMIUM (D)	0.158e	ND (0.00074)	0.0039 B	ND (0.00074)	0.0047 B	ND (0.00074)	ND (0.00074)	ND (0.00074)	ND (0.00074)	ND (0.00074)	ND (0.00074)	ND (0.00074)
COBALT (D)	--	ND (0.00092)	0.0014 B	ND (0.00092)	0.0011 B	ND (0.00092)	ND (0.00092)	ND (0.00092)	ND (0.00092)	ND (0.00092)	ND (0.00092)	ND (0.00092)
COPPER (D)	0.025e	0.0033 B	0.0078 B	0.0029 B	0.0245	0.014	0.0036 B	0.0042 B	0.0034 B	0.0022	0.004 B	0.0024 B
LEAD (D)	0.054e	0.0011	0.0047	0.00095 B	0.0079	0.0056	0.00048 B	0.00031 B	0.00044 B	0.00043 B	0.00047 B	0.00088 B
MERCURY (D)	0.00037f	ND (0.000028)	ND (0.000028)	ND (0.000028)	ND (0.000028)	ND (0.000028)	ND (0.000028)	ND (0.000028)	ND (0.000028)	ND (0.000028)	ND (0.000028)	ND (0.000028)
NICKEL (D)	0.411e	ND (0.0017)	0.0044 B	0.0023 B	0.0053 B	0.0027 B	ND (0.0017)	ND (0.0017)	ND (0.0017)	ND (0.0017)	0.0027 B	ND (0.0017)
SELENIUM (D)	--	0.00026 B	0.00025 B	ND (0.00019)	0.00024 B	0.0011 B	ND (0.00019)	ND (0.00019)	ND (0.00019)	ND (0.00019)	ND (0.00019)	ND (0.00019)
THALLIUM (D)	--	ND (0.000015)	0.000044 B	ND (0.000015)	0.000016 B	0.000015 B	ND (0.000015)	ND (0.000015)	ND (0.000015)	ND (0.000015)	ND (0.000015)	ND (0.000015)
VANADIUM (D)	--	0.0015 B	0.0059 B	0.0013 B	0.0054 B	ND (0.00061)	0.0017 B	0.0018 B	0.0012 B	ND (0.00061)	ND (0.00061)	0.00081 B
ZINC (D)	0.266e	0.0147 B	0.0212	0.0144 B	0.0466	0.171	ND (0.0068)	ND (0.0068)	0.0332	0.0094 B	0.0334	0.093

Notes:

1 - Screening Value Sources

a = Wisconsin Administrative Code, 1997. Chronic values at 252.3 ppm water hardness as CaCO3

b = Wisconsin Administrative Code, 1997. Cold water chronic values unrelated to water quality.

c = Tier II Values (Secondary Chronic Values), ES/ER/TM-96/R2, 1996

d = Talmage *et al*., 1999

e = Wisconsin Administrative Code, 1997. Chronic values at 252.3 ppm water hardness as CaCO3 and expressed in dissolved form.

f = Wisconsin Administrative Code, 1997. Cold water chronic values unrelated to water quality and expressed in dissolved form.

Shaded values exceed screening values

-- No applicable screening value

2 - Duplicate

Analyte listed if detected or concentration was missing.

B (organics only): Blank Contamination

B (metals only): Estimated Concentration

J: Estimated Concentration

ND/U: Not Detected

Table 13

Screening Results: Sediment

LOCATION	Sediment Screening Values[2]	SD1	SD2	SD3	SD4	SD5	SD6	SD6[3]	SD7	SD8	SD9	SD10	NURE Values Comparison[4]
Explosives: Method 8321	***(ug/kg)***												
2,4-DINITROTOLUENE	19,000c	ND (21)	ND (11)	ND (19)	ND (16)	ND (10)	ND (10)	ND (10)	ND (9.5)	ND (260)	ND (140)	560	NA
2,6-DINITROTOLUENE	19,000c	ND (24)	ND (13)	ND (22)	ND (18)	ND (12)	ND (12)	ND (12)	ND (11)	ND (270)	ND (13)	62 J	NA
SVOCs: Method 8270)	***(ug/kg)***												
PYRENE	490a	ND (100)	ND (56)	ND (94)	ND (78)	ND (51)	ND (52)	ND (51)	ND (47)	ND (110)	57 J	ND (79)	NA
VOCs: Method 8260[1]	***(ug/kg)***												
1,1,1-TRICHLOROETHANE	30a	ND (2.5)	ND (1.4)	ND (2.3)	3.2 J	ND (1.2)	ND (1.3)	ND (1.2)	ND (1.2)	ND (2.7)	ND (1.4)	ND (1.9)	NA
1,2-DICHLOROETHANE	250a	ND (2.6)	ND (1.4)	ND (2.3)	16	ND (1.3)	3.3 J	2.7 J	ND (1.2)	ND (2.7)	ND (1.4)	ND (2.0)	NA
ACETONE	8.7a	ND (12)	ND (6.5)	ND (11)	14 J	ND (5.8)	ND (6.0)	ND (5.9)	ND (5.4)	21 J	ND (6.5)	16 J	NA
CARBON DISULFIDE	--	ND (2.4)	ND (1.3)	2.8 J	ND (1.8)	ND (1.2)	ND (1.2)	ND (1.2)	ND (1.1)	ND (2.5)	ND (1.3)	ND (1.8)	NA
METHYLENE CHLORIDE	370a	3.2 J B	1.4 J B	3.0 J B	3.6 J B	1.5 J B	1.7 J B	1.3 J B	1.1 J B	3.0 J B	1.4 J B	1.8 J B	NA
TOLUENE	50a	ND (2.0)	ND (1.1)	ND (1.8)	40	ND (0.99)	ND (1.0)	ND (0.99)	ND (0.92)	69	ND (1.1)	ND (1.5)	NA
Metals	***(mg/kg)***												
ARSENIC	12.1a	3.0	1.1	1.7	1.4	1.4	0.52 B	0.61 B	0.96	1.8	2.1	25.2	WR[5]
BARIUM	--	134	39.9	85.0	73.9	8.9	9.7	10.3	25.1	167	39.1	91.9	WR < Ave
BERYLLIUM	--	0.81 B	0.27 B	0.60 B	0.24 B	ND (0.11)	ND (0.11)	ND (0.11)	ND (0.10)	0.78 B	0.12 B	0.46 B	WR < Ave
CHROMIUM	56a	28.3	13.9	23.5	11.0	2.1	4.2	4.6	8.8	33.9	20.6	29.5	WR < Ave
COBALT	--	7.5	4.9	7.3	6.8	1.3	2.0	2.2	4.3	15.4	6.0	11.0	WR < Ave
COPPER	28a	41.4	12.1	20.0	40.7	3.6	3.1	2.8	5.4	23.1	15.7	19.6	WR > Ave
LEAD	34.2a	70.7 J	11.4 J	33.7 J	37.6 J	33.9 J	2.7 J	2.7 J	0.88 J	14.0 J	12.3 J	16.7 J	NA
MERCURY	0.2b	0.16	0.018 B	0.039 B	ND (0.0049)	0.020 B	ND (0.0033)	ND (0.0032)	ND (0.0030)	0.071 B	0.21	0.023 B	NA
NICKEL	39.6a	19.6	8.8	15.3	13.5	3.6 B	3.1 B	3.3 B	8.2	23.4	10.6	18.9	WR > Ave
SELENIUM	--	1.0 B	0.39 B	0.74 B	0.44 B	0.094 B	0.13 B	0.15 B	0.15 B	0.87 B	0.25 B	0.50 B	WR > Ave
SILVER	--	0.33 B	0.11 B	0.20 B	0.26 B	0.10 B	0.11 B	0.1 B	0.12 B	0.48 B	0.18 B	0.22 B	ND (2.0)
THALLIUM	--	0.24 B	0.062 B	0.24	0.050 B	0.011 B	0.042 B	0.013 B	0.0074 B	0.24 B	0.066 B	0.15 B	NA
TIN	--	4.1 B J	1.5 B J	3.3 B J	1.3 B J	4.7 B J	1.8 B J	1.8 B J	1.7 B J	3.0 B J	1.3 B J	1.6 B J	NA
VANADIUM	--	32.4	21.6	30.2	23.9	7.6	21.1	24.8	19.6	40.1	44.3	42.4	WR < Ave
ZINC	159a	128	27.8	54.0	110	85.4	10.6	11.2	14.6	104	22.3	54.3	WR > Ave

Notes:

1 - Assumes 1% TOC (Exponent, 1998)

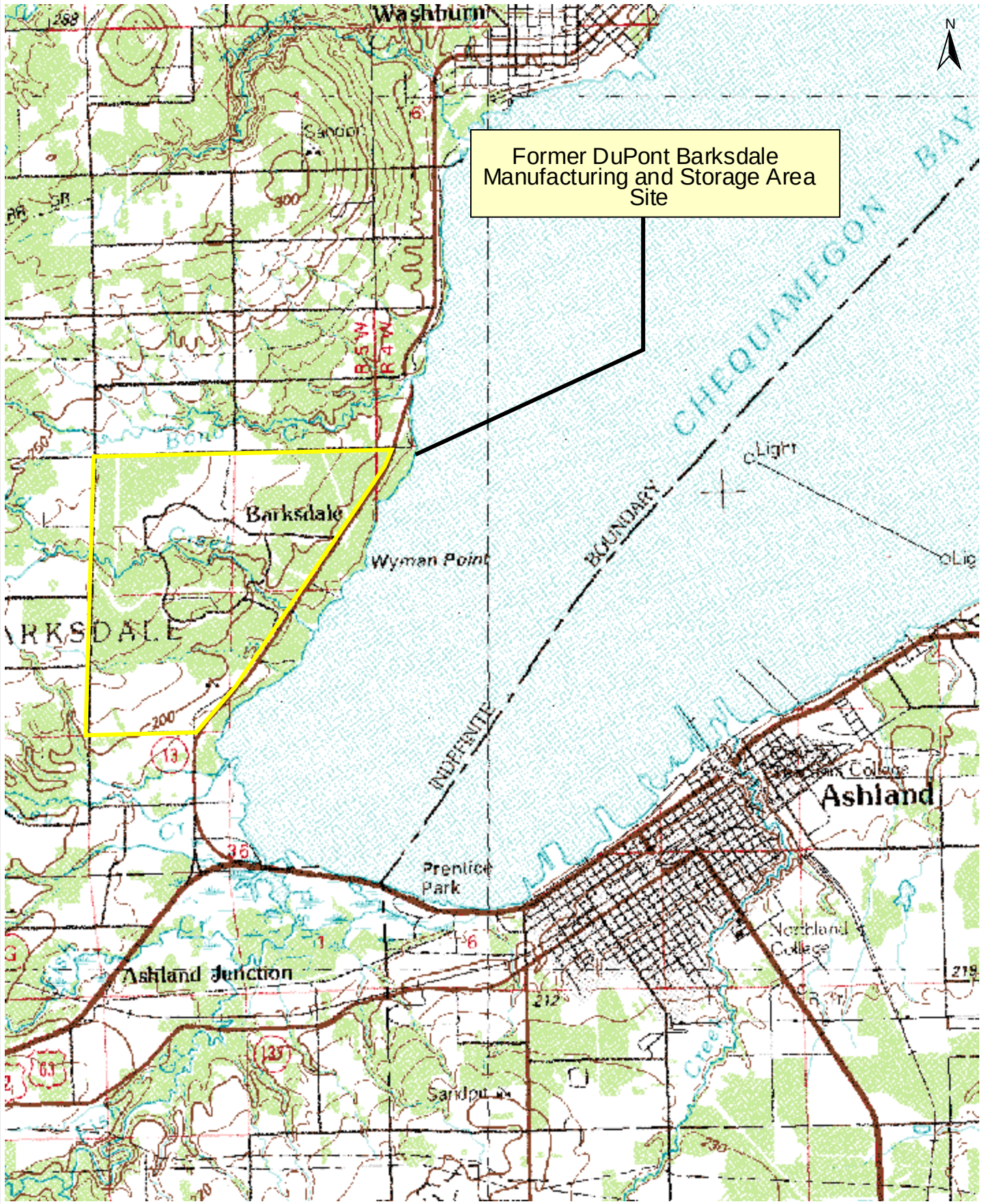
2 - Screening Value Sources
a = ARCS-TEC, ORNL-ES/ER/TM-95/R4, 1997
b = Ontario MOE, ORNL-ES/ER/TM-95/R4, 1997
c = Exponent, 1998
Shaded values exceed screening values
-- No applicable screening value

3 - Duplicate
J: Estimated Concentration
ND/U: Not Detected
B (organics only): Blank Contamination
B (metals only): Estimated Concentration

4 - WR = within range; ND = not detected; NA = Not analyzed

5 - WR except for the value reported for SD10

FIGURES

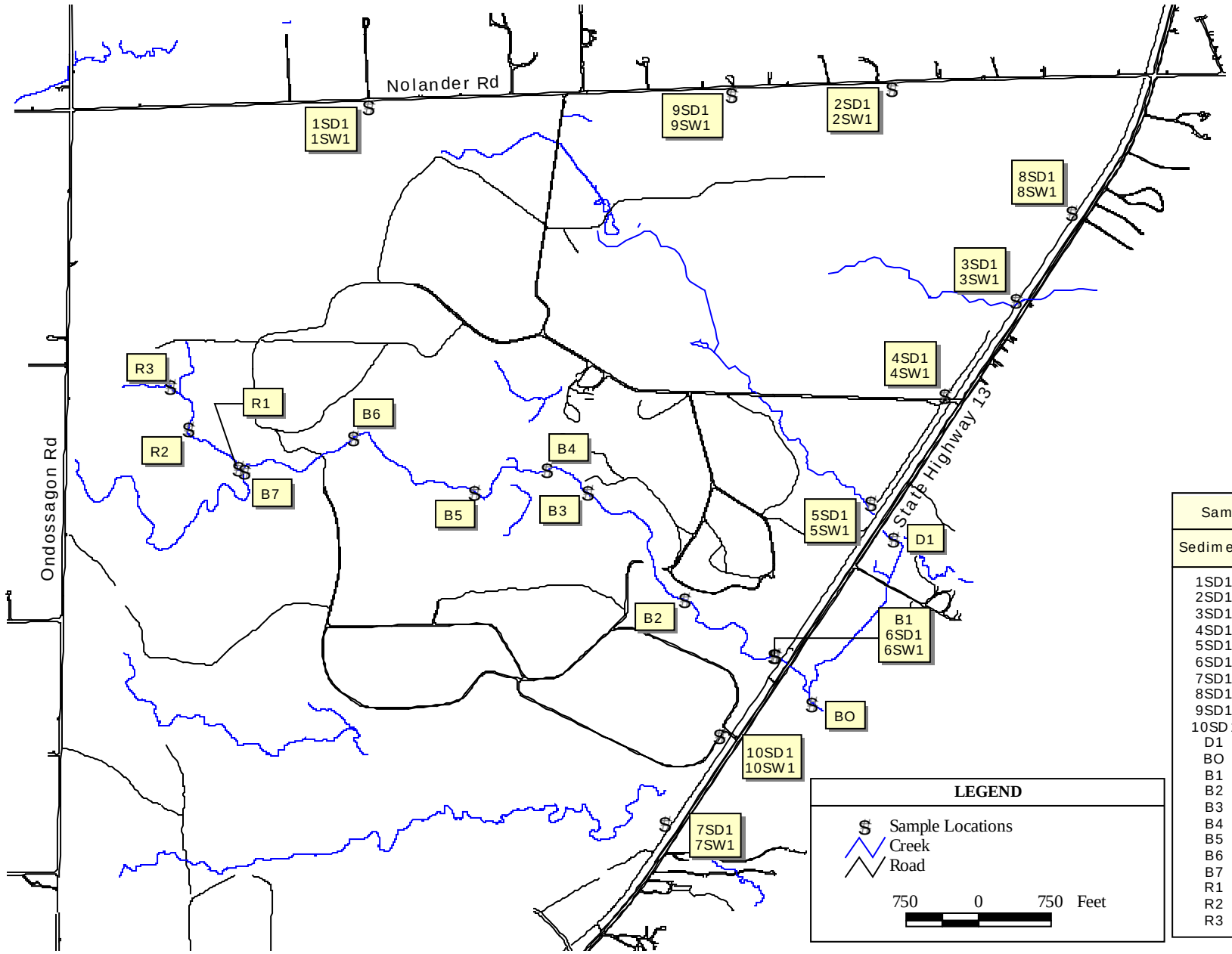


DUPONT
CORPORATE REMEDIATION GROUP
An Alliance between DuPont and URS
4200 Camp Ground Road
Louisville, Kentucky 40216

TITLE:

Sample Point Location Map
Former DuPont Barksdale Works
Barksdale, Wisconsin

DRAWN:	APPROVED:	PROJECT NO.:
KJB	CEP	7431
CHECKED:	DATE:	FIGURE NO.:
MV	11/25/2002	1
FILE NAME:	REVISION:	
Bark_SW_Report.apr	0	



Sample Locations	
Sediment	Surface Water
1SD1	1SW1
2SD1	2SW1
3SD1	3SW1
4SD1	4SW1
5SD1	5SW1
6SD1	6SW1
7SD1	7SW1
8SD1	8SW1
9SD1	9SW1
10SD1	10SW1
D1	B1
BO	B4
B1	B7
B2	
B3	
B4	
B5	
B6	
B7	
R1	
R2	
R3	

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TITLE:

Sample Point Location Map
Former DuPont Barksdale Works
Barksdale, Wisconsin

DRAWN:	APPROVED:	PROJECT NO.:
KJB	CEP	7431
CHECKED:	DATE:	FIGURE NO.:
MV	11/25/2002	2
FILE NAME:	REVISION:	
Bark_SW_Report.apr	0	

N

9SW1 Acetone T 3.0 UG/L
9SW1 Arsenic D 0.16 UG/L
9SW1 Arsenic T 0.13 UG/L
9SW1 Barium D 33.1 UG/L
9SW1 Barium T 33.6 UG/L
9SW1 Bis(2-Ethylhexyl)Phthalate T 3.0 UG/L
9SW1 Copper T 1.9 UG/L
9SW1 Copper D 4.0 UG/L
9SW1 Lead D 0.47 UG/L
9SW1 Lead T 0.50 UG/L
9SW1 Nickel D 2.7 UG/L
9SW1 Nickel T 2.3 UG/L
9SW1 Zinc T 17.4 UG/L
9SW1 Zinc D 33.4 UG/L

8SW1 Acetone T 3.2 UG/L
8SW1 Arsenic T 0.40 UG/L
8SW1 Arsenic D 0.31 UG/L
8SW1 Barium D 14.3 UG/L
8SW1 Barium T 31.7 UG/L
8SW1 Chromium T 1.8 UG/L
8SW1 Cobalt T 2.2 UG/L
8SW1 Copper T 1.3 UG/L
8SW1 Copper D 2.2 UG/L
8SW1 Lead T 1.2 UG/L
8SW1 Lead D 0.43 UG/L
8SW1 Mercury T 0.029 UG/L
8SW1 Nickel T 2.3 UG/L
8SW1 Thallium T 0.023 UG/L
8SW1 Vanadium T 2.8 UG/L
8SW1 Zinc T 14.4 UG/L
8SW1 Zinc D 9.4 UG/L

3SW1 Acetone T 3.3 UG/L
3SW1 Arsenic D 0.44 UG/L
3SW1 Arsenic T 0.39 UG/L
3SW1 Barium T 24.2 UG/L
3SW1 Barium D 17.0 UG/L
3SW1 Chromium T 1.8 UG/L
3SW1 Copper T 2.0 UG/L
3SW1 Copper D 2.9 UG/L
3SW1 Lead T 1.1 UG/L
3SW1 Lead D 0.95 UG/L
3SW1 Nickel D 2.3 UG/L
3SW1 Vanadium D 1.3 UG/L
3SW1 Vanadium T 2.9 UG/L
3SW1 Zinc D 14.4 UG/L
3SW1 Zinc T 14.5 UG/L

1SW1 2,4-Dinitrotoluene T 0.027 J UG/L
1SW1 Arsenic T 2.2 UG/L
1SW1 Arsenic D 0.79 UG/L
1SW1 Barium T 40.6 UG/L
1SW1 Barium D 11.7 UG/L
1SW1 Chromium T 3.7 UG/L
1SW1 Cobalt T 1.7 UG/L
1SW1 Copper T 7.3 UG/L
1SW1 Copper D 3.3 UG/L
1SW1 Lead D 1.1 UG/L
1SW1 Lead T 7.4 UG/L
1SW1 Mercury T 0.074 UG/L
1SW1 Nickel T 4.7 UG/L
1SW1 Selenium D 0.26 UG/L
1SW1 Selenium T 0.36 UG/L
1SW1 Thallium T 0.038 UG/L
1SW1 Vanadium T 10.9 UG/L
1SW1 Vanadium D 1.5 UG/L
1SW1 Zinc T 32.6 UG/L
1SW1 Zinc D 14.7 UG/L

2SW1 Arsenic D 0.60 UG/L
2SW1 Arsenic T 0.85 UG/L
2SW1 Barium T 64.2 UG/L
2SW1 Barium D 29.3 UG/L
2SW1 Chromium D 3.9 UG/L
2SW1 Chromium T 10.3 UG/L
2SW1 Cobalt T 2.8 UG/L
2SW1 Cobalt D 1.4 UG/L
2SW1 Copper D 7.8 UG/L
2SW1 Copper T 12.4 UG/L
2SW1 Lead D 4.7 UG/L
2SW1 Lead T 10.3 UG/L
2SW1 Mercury T 0.049 UG/L
2SW1 Nickel D 4.4 UG/L
2SW1 Nickel T 7.6 UG/L
2SW1 Selenium T 0.32 UG/L
2SW1 Selenium D 0.25 UG/L
2SW1 Thallium T 0.078 UG/L
2SW1 Thallium D 0.044 UG/L
2SW1 Vanadium D 5.9 UG/L
2SW1 Vanadium T 13.9 UG/L
2SW1 Zinc D 21.2 UG/L
2SW1 Zinc T 33.9 UG/L

B4 2,4-Dinitrotoluene T 0.19 J UG/L
B4 2,6-Dinitrotoluene T 1.1 UG/L

B7 2,6-Dinitrotoluene T 0.016 UG/L

B1 2,4-Dinitrotoluene T 0.20 J UG/L
B1 2,6-Dinitrotoluene T 0.39 UG/L

4SW1 Acetone T 6.6 J UG/L
4SW1 Arsenic T 2.7 B UG/L
4SW1 Arsenic D 1.5 B UG/L
4SW1 Barium D 60.4 UG/L
4SW1 Barium T 143 UG/L
4SW1 Beryllium T 0.69 B UG/L
4SW1 Chromium D 4.7 B UG/L
4SW1 Chromium T 16.6 UG/L
4SW1 Cobalt T 9.4 B UG/L
4SW1 Cobalt D 1.1 B UG/L
4SW1 Copper D 24.5 UG/L
4SW1 Copper T 89.9 UG/L
4SW1 Lead D 7.9 UG/L
4SW1 Lead T 29.4 UG/L
4SW1 Mercury T 0.040 B UG/L
4SW1 Nickel T 22.3 B UG/L
4SW1 Nickel D 5.3 B UG/L
4SW1 Selenium T 0.51 B UG/L
4SW1 Selenium D 0.24 B UG/L
4SW1 Thallium T 0.12 B UG/L
4SW1 Thallium D 0.016 B UG/L
4SW1 Toluene T 0.71 J UG/L
4SW1 Vanadium D 5.4 B UG/L
4SW1 Vanadium T 31.4 UG/L
4SW1 Zinc D 46.6 UG/L
4SW1 Zinc T 126 UG/L

10SW1 Arsenic D 0.33 UG/L
10SW1 Arsenic T 0.60 UG/L
10SW1 Barium D 10.0 UG/L
10SW1 Barium T 17.9 UG/L
10SW1 Chromium T 1.3 UG/L
10SW1 Copper T 1.1 UG/L
10SW1 Copper D 2.4 UG/L
10SW1 Lead T 1.5 UG/L
10SW1 Lead D 0.88 UG/L
10SW1 Thallium T 0.017 UG/L
10SW1 Vanadium D 0.81 UG/L
10SW1 Vanadium T 2.1 UG/L
10SW1 Zinc T 110 UG/L
10SW1 Zinc D 93.0 UG/L

7SW1 Arsenic T 0.37 UG/L
7SW1 Arsenic D 0.37 UG/L
7SW1 Barium D 16.8 UG/L
7SW1 Barium T 29.8 UG/L
7SW1 Chromium T 2.1 UG/L
7SW1 Copper D 3.4 UG/L
7SW1 Copper T 3.5 UG/L
7SW1 Lead T 0.83 UG/L
7SW1 Lead D 0.44 UG/L
7SW1 Nickel T 2.4 UG/L
7SW1 Thallium T 0.017 UG/L
7SW1 Vanadium T 3.6 UG/L
7SW1 Vanadium D 1.2 UG/L
7SW1 Zinc T 16.2 UG/L
7SW1 Zinc D 33.2 UG/L

6SW1 1-Methyl-2-Nitrobenzene T 0.094 J UG/L
6SW1 2,4-Dinitrotoluene T 0.23 UG/L
6SW1 2,6-Dinitrotoluene T 0.22 UG/L
6SW1 2-Amino-4,6-Dinitrotoluene T 0.80 UG/L
6SW1 4-Amino-2,6-Dinitrotoluene T 1.5 UG/L
6SW1 Acetone T 3.4 J UG/L
6SW1 Arsenic T 0.62 B UG/L
6SW1 Arsenic D 0.53 B UG/L
6SW1 Barium D 29.4 UG/L
6SW1 Barium T 37.0 UG/L
6SW1 Chromium T 0.88 B UG/L
6SW1 Copper D 4.2 B UG/L
6SW1 Copper T 13.7 UG/L
6SW1 Lead T 1.4 UG/L
6SW1 Lead D 0.48 B UG/L
6SW1 Selenium T 0.23 B UG/L
6SW1 Thallium T 0.018 B UG/L
6SW1 Vanadium D 1.8 B UG/L
6SW1 Vanadium T 3.1 B UG/L
6SW1 Zinc T 42.2 UG/L

5SW1 2,4,6-Trinitrotoluene T 5.1 UG/L
5SW1 2,4-Dinitrotoluene T 0.35 UG/L
5SW1 2,6-Dinitrotoluene T 0.36 UG/L
5SW1 2-Amino-4,6-Dinitrotoluene T 4.9 UG/L
5SW1 4-Amino-2,6-Dinitrotoluene T 9.4 UG/L
5SW1 Arsenic T 2.0 UG/L
5SW1 Arsenic D 1.7 UG/L
5SW1 Barium D 40.8 UG/L
5SW1 Barium T 46.7 UG/L
5SW1 Chromium T 1.2 UG/L
5SW1 Copper T 19.1 UG/L
5SW1 Copper D 14.0 UG/L
5SW1 Lead T 17.0 UG/L
5SW1 Lead D 5.6 UG/L
5SW1 Mercury T 0.097 UG/L
5SW1 Nickel T 2.7 UG/L
5SW1 Nickel D 2.7 UG/L
5SW1 Selenium D 1.1 UG/L
5SW1 Selenium T 0.92 UG/L
5SW1 Thallium D 0.015 UG/L
5SW1 Thallium T 0.029 UG/L
5SW1 Vanadium T 1.6 UG/L
5SW1 Zinc D 171 UG/L
5SW1 Zinc T 178 UG/L

Nolander Rd
Ondossagon Rd
State Highway 13

LEGEND

Surface Water Samples
- 1998 Site Characterization
- 2002 Drainage Plan
- Creek
- Road

750 0 750 Feet

CORPORATE REMEDIATION GROUP
An Alliance between DuPont and URS
4200 Camp Ground Road
Louisville, Kentucky 40216

TITLE:

Surface Water Detections for May 2002 and August 1998
Former DuPont Barksdale Works
Barksdale, Wisconsin

DRAWN:	APPROVED:	PROJECT NO.:
KJB	CEP	7431
CHECKED:	DATE:	FIGURE NO.:
MV	11/26/2002	3
FILE NAME:	REVISION:	
Bark_SW_Report.apr	0	

N

Wedal Rd

Nolander Rd

Ondossagon Rd

State Highway 13

9SD1 Arsenic 2.1 MG/KG
9SD1 Barium 39.1 MG/KG
9SD1 Beryllium 0.12 B MG/KG
9SD1 Chromium 20.6 MG/KG
9SD1 Cobalt 6.0 MG/KG
9SD1 Copper 15.7 MG/KG
9SD1 Lead 12.3 J MG/KG
9SD1 Mercury 0.21 MG/KG
9SD1 Methylene Chloride 1.4 J B UG/KG
9SD1 Nickel 10.6 MG/KG
9SD1 Pyrene 57 J UG/KG
9SD1 Selenium 0.25 B MG/KG
9SD1 Silver 0.18 B MG/KG
9SD1 Thallium 0.066 B MG/KG
9SD1 Tin 1.3 B J MG/KG
9SD1 Vanadium 44.3 MG/KG
9SD1 Zinc 22.3 MG/KG

2SD1 Arsenic 1.1 MG/KG
2SD1 Barium 39.9 MG/KG
2SD1 Beryllium 0.27 B MG/KG
2SD1 Chromium 13.9 MG/KG
2SD1 Cobalt 4.9 MG/KG
2SD1 Copper 12.1 MG/KG
2SD1 Lead 11.4 J MG/KG
2SD1 Mercury 0.018 B MG/KG
2SD1 Methylene Chloride 1.4 J B UG/KG
2SD1 Nickel 8.8 MG/KG
2SD1 Selenium 0.39 B MG/KG
2SD1 Silver 0.11 B MG/KG
2SD1 Thallium 0.062 B MG/KG
2SD1 Tin 1.5 B J MG/KG
2SD1 Vanadium 21.6 MG/KG
2SD1 Zinc 27.8 MG/KG

8SD1 Acetone 21 J UG/KG
8SD1 Arsenic 1.8 MG/KG
8SD1 Barium 167 MG/KG
8SD1 Beryllium 0.78 B MG/KG
8SD1 Chromium 33.9 MG/KG
8SD1 Cobalt 15.4 MG/KG
8SD1 Copper 23.1 MG/KG
8SD1 Lead 14.0 J MG/KG
8SD1 Mercury 0.071 B MG/KG
8SD1 Methylene Chloride 3.0 J B UG/KG
8SD1 Nickel 23.4 MG/KG
8SD1 Selenium 0.87 B MG/KG
8SD1 Silver 0.48 B MG/KG
8SD1 Thallium 0.24 B MG/KG
8SD1 Tin 3.0 B J MG/KG
8SD1 Toluene 69 UG/KG
8SD1 Vanadium 40.1 MG/KG
8SD1 Zinc 104 MG/KG

1SD1 Arsenic 3.0 MG/KG
1SD1 Barium 134 MG/KG
1SD1 Beryllium 0.81 B MG/KG
1SD1 Chromium 28.3 MG/KG
1SD1 Cobalt 7.5 MG/KG
1SD1 Copper 41.4 MG/KG
1SD1 Lead 70.7 J MG/KG
1SD1 Mercury 0.16 MG/KG
1SD1 Methylene Chloride 3.2 J B UG/KG
1SD1 Nickel 19.6 MG/KG
1SD1 Selenium 1.0 B MG/KG
1SD1 Silver 0.33 B MG/KG
1SD1 Thallium 0.24 B MG/KG
1SD1 Tin 4.1 B J MG/KG
1SD1 Vanadium 32.4 MG/KG
1SD1 Zinc 128 MG/KG

5SD1 Arsenic 1.4 MG/KG
5SD1 Barium 8.9 MG/KG
5SD1 Chromium 2.1 MG/KG
5SD1 Cobalt 1.3 MG/KG
5SD1 Copper 3.6 MG/KG
5SD1 Lead 33.9 J MG/KG
5SD1 Mercury 0.020 B MG/KG
5SD1 Methylene Chloride 1.5 J B UG/KG
5SD1 Nickel 3.6 B MG/KG
5SD1 Selenium 0.094 B MG/KG
5SD1 Silver 0.10 B MG/KG
5SD1 Thallium 0.011 B MG/KG
5SD1 Tin 4.7 B J MG/KG
5SD1 Vanadium 7.6 MG/KG
5SD1 Zinc 85.4 MG/KG

3SD1 Arsenic 1.7 MG/KG
3SD1 Barium 85.0 MG/KG
3SD1 Beryllium 0.60 B MG/KG
3SD1 Carbon Disulfide 2.8 J UG/KG
3SD1 Chromium 23.5 MG/KG
3SD1 Cobalt 7.3 MG/KG
3SD1 Copper 20.0 MG/KG
3SD1 Lead 33.7 J MG/KG
3SD1 Mercury 0.039 B MG/KG
3SD1 Methylene Chloride 3.0 J B UG/KG
3SD1 Nickel 15.3 MG/KG
3SD1 Selenium 0.74 B MG/KG
3SD1 Silver 0.20 B MG/KG
3SD1 Thallium 0.24 MG/KG
3SD1 Tin 3.3 B J MG/KG
3SD1 Vanadium 30.2 MG/KG
3SD1 Zinc 54.0 MG/KG

4SD1 1,1,1-Trichloroethane 3.2 J UG/KG
4SD1 1,2-Dichloroethane 16 UG/KG
4SD1 3 Or 4-Methylphenol 450 J UG/KG
4SD1 Acetone 14 J UG/KG
4SD1 Arsenic 1.4 MG/KG
4SD1 Barium 73.9 MG/KG
4SD1 Beryllium 0.24 B MG/KG
4SD1 Chromium 11.0 MG/KG
4SD1 Cobalt 6.8 MG/KG
4SD1 Copper 40.7 MG/KG
4SD1 Lead 37.6 J MG/KG
4SD1 Methylene Chloride 3.6 J B UG/KG
4SD1 Nickel 13.5 MG/KG
4SD1 Selenium 0.44 B MG/KG
4SD1 Silver 0.26 B MG/KG
4SD1 Thallium 0.050 B MG/KG
4SD1 Tin 1.3 B J MG/KG
4SD1 Toluene 40 UG/KG
4SD1 Vanadium 23.9 MG/KG
4SD1 Zinc 110 MG/KG

R1 No Nitroaromatic Compounds Detected

R3 2,4,6-Trinitrotoluene 1.4 MG/KG
R3 2,4-Dinitrotoluene 0.47 MG/KG
R3 2,6-Dinitrotoluene 0.27 MG/KG

R2 2,4,6-Trinitrotoluene 12 MG/KG
R2 2,4-Dinitrotoluene 0.29 MG/KG
R2 2,6-Dinitrotoluene 0.20 J MG/KG

B5 No Nitroaromatic Compounds Detected

B1 No Nitroaromatic Compounds Detected

B7 No Nitroaromatic Compounds Detected

B6 No Nitroaromatic Compounds Detected

B4 2,4,6-Trinitrotoluene 0.24 J MG/KG
B4 2,4-Dinitrotoluene 0.11 J MG/KG
B4 2,6-Dinitrotoluene 0.033 J MG/KG

B3 2,4,6-Trinitrotoluene 0.034 J MG/KG
B3 2,4-Dinitrotoluene 0.15 J MG/KG
B3 2,6-Dinitrotoluene 0.033 J MG/KG

B2 No Nitroaromatic Compounds Detected

D1 2,4,6-Trinitrotoluene 0.13 J MG/KG
D1 2,4-Dinitrotoluene 0.45 MG/KG
D1 2,6-Dinitrotoluene 0.082 J MG/KG

BO No Nitroaromatic Compounds Detected

6SD1 1,2-Dichloroethane 3.3 J UG/KG
6SD1 Arsenic 0.61 B MG/KG
6SD1 Barium 10.3 MG/KG
6SD1 Chromium 4.6 MG/KG
6SD1 Cobalt 2.2 MG/KG
6SD1 Copper 3.1 MG/KG
6SD1 Lead 2.7 J MG/KG
6SD1 Methylene Chloride 1.7 J B UG/KG
6SD1 Nickel 3.3 B MG/KG
6SD1 Selenium 0.15 B MG/KG
6SD1 Silver 0.11 B MG/KG
6SD1 Thallium 0.042 B MG/KG
6SD1 Tin 1.8 B J MG/KG
6SD1 Vanadium 24.8 MG/KG
6SD1 Zinc 11.2 MG/KG

10SD1 2,4-Dinitrotoluene 560 UG/KG
10SD1 2,6-Dinitrotoluene 62 J UG/KG
10SD1 Acetone 16 J UG/KG
10SD1 Arsenic 25.2 MG/KG
10SD1 Barium 91.9 MG/KG
10SD1 Beryllium 0.46 B MG/KG
10SD1 Chromium 29.5 MG/KG
10SD1 Cobalt 11.0 MG/KG
10SD1 Copper 19.6 MG/KG
10SD1 Lead 16.7 J MG/KG
10SD1 Mercury 0.023 B MG/KG
10SD1 Methylene Chloride 1.8 J B UG/KG
10SD1 Nickel 18.9 MG/KG
10SD1 Selenium 0.50 B MG/KG
10SD1 Silver 0.22 B MG/KG
10SD1 Thallium 0.15 B MG/KG
10SD1 Tin 1.6 B J MG/KG
10SD1 Vanadium 42.4 MG/KG
10SD1 Zinc 54.3 MG/KG

7SD1 Arsenic 0.96 MG/KG
7SD1 Barium 25.1 MG/KG
7SD1 Chromium 8.8 MG/KG
7SD1 Cobalt 4.3 MG/KG
7SD1 Copper 5.4 MG/KG
7SD1 Lead 0.88 J MG/KG
7SD1 Methylene Chloride 1.1 J B UG/KG
7SD1 Nickel 8.2 MG/KG
7SD1 Selenium 0.15 B MG/KG
7SD1 Silver 0.12 B MG/KG
7SD1 Thallium 0.0074 B MG/KG
7SD1 Tin 1.7 B J MG/KG
7SD1 Vanadium 19.6 MG/KG
7SD1 Zinc 14.6 MG/KG

LEGEND

Sediment Samples
- 1998 Exponent
- 2002 Drainage Plan
- Creek
- Road

750 0 750 Feet

DUPONT
CORPORATE REMEDIATION GROUP
An Alliance between DuPont and URS
4200 Camp Ground Road
Louisville, Kentucky 40216

TITLE:

Sediment Sample Detections for May 2002 and August 1998
Former DuPont Barksdale Works
Barksdale, Wisconsin

DRAWN:	APPROVED:	PROJECT NO.:
KJB	CEP	7431
CHECKED:	DATE:	FIGURE NO.:
MV	11/26/2002	4
FILE NAME:	REVISION:	
Bark_SW_Report.apr	0	

APPENDICES

APPENDIX A

Sampling Point Characteristics & Photographs

Drainage Location SW01

- Dispersed overland flow through the site fence into the ditch along the south side of the road between residences 29600 and 29890 Nolander.

UP STREAM

channel flows through broad, 100- to 150-ft wide, swale filled with reeds growing in a black silty muck.

DOWN STREAM

flow is dispersed for about 10-ft from fence in reeds similar to upstream, then follows the roadside ditch to the east.

Drainage Location SW01 (cont)

Sediment Sampling Point

bottom: dark-brown to black organic silt with roots and leaves.

Water Sampling Point

pH (SU):	5.86
temp (C):	13.8
cond. (mS/cm):	0.069
tubidity (NTU):	300
D.O. (mg/L):	5.31
redox (mV):	50
odor:	decayed vegetation
sheen/flotsam:	none

Flow Measurement Point

Shape:	trapezoidal
Width:	32” / 28”
Depth:	5”
Area:	1.04 sf
Flow Rate:	0.00 ft/s
Bottom:	grass in silty clay

Drainage Location SW02

- Channelized flow through a 12-inch clay tile under the site fence into the ditch along the south side of the road between residences at 30600 and 30700 Nolander.

UP STREAM

channel flows through a 2-ft wide, eroded ditch filled with sedge growing in a black silty muck.

DOWN STREAM

flow is dispersed for about 15-ft from fence in sedge similar to upstream, then follows the roadside ditch to the east.

Drainage Location SW02 (cont)

Sediment Sampling Point

bottom: red-brown to brown silt with trace gravel, roots and leaves.

Water Sampling Point

pH (SU):	5.20
temp (C):	12.2
cond. (mS/cm):	0.033
tubidity (NTU):	85
D.O. (mg/L):	4.80
redox (mV):	183
odor:	none
sheen/flotsam:	none

Flow Measurement Point

Shape:	round (12” diam)
Width:	10”
Depth:	3”
Area:	0.13 sf
Flow Rate:	0.00 ft/s
Bottom:	clay tile

Drainage Location SW03

- Channelized flow through the culvert under the ATV road opposite residence 72520 Hwy 13 .

UP STREAM

channel flows through eroded ravine (up to 15-ft deep). Ravine bottom is silty sand covered with marsh marigolds and reed canary grass.

DOWN STREAM

flow enters a 36-inch rivetted steel culvert under the ATV road. From the culvert flow exits to Hwy 13 ditches and passes under Hwy 13 adjacent to residence 72500.

Drainage Location SW03 (cont)

Sediment Sampling Point

bottom: red-brown to brown silt
trace roots and leaves

Water Sampling Point

pH (SU):	5.76
temp (C):	11.8
cond. (mS/cm):	0.033
tubidity (NTU):	576
D.O. (mg/L):	6.12
redox (mV):	98
odor:	decayed vegetation
sheen/flotsam:	birch catkins

Flow Measurement Point

Shape:	v-notch (at outfall)
Width:	6”
Depth:	2.75”
Area:	0.05 sf
Flow Rate:	0.085 ft/s
Bottom:	granite

Drainage Location SW04

- Overland flow crossing gravel access road south of PZ-09 at front gate.

UP STREAM

channel flows through nearly level wooded wetlands and forest to a former railgrade berm then passes through a culvert to pool up along the west side of the access road to PZ-09

DOWN STREAM

flow crosses access road then enters reed area adjacent to front gate and eventually overflows to ditch at west side of Hwy 13 crossing under the highway along the south lot line of 72380 Hwy 13.

Drainage Location SW04 (cont)

Sediment Sampling Point

bottom: red-brown silty clay
trace roots

Water Sampling Point

pH (SU):	5.83
temp (C):	23.8
cond. (mS/cm):	0.104
tubidity (NTU):	84
D.O. (mg/L):	6.17
redox (mV):	91
odor:	decayed vegetation
sheen/flotsam:	algae

Flow Measurement Point

Shape:	rectangular channel
Width:	12”
Depth:	2”
Area:	0.18 sf
Flow Rate:	0.00 ft/s
Bottom:	silty gravel

Drainage Location SW05

- Channelized flow through the wooden box culvert under the ATV road opposite the Barksdale Boyscout Camp .

UP STREAM

channel flows through eroded ravine adjacent to burning ground, then through two 24-inch corrugated steel culverts.

DOWN STREAM

flow passes through a 48-inch square wooden box culvert under the ATV road to ditches west of Hwy 13 then under the highway to the ditch system adjacent to PZ-12.

Drainage Location SW05 (cont)

Sediment Sampling Point

bottom: gravelly, silty sand

Water Sampling Point

pH (SU):	5.89
temp (C):	15.7
cond. (mS/cm):	0.196
tubidity (NTU):	63
D.O. (mg/L):	8.37
redox (mV):	87
odor:	none
sheen/flotsam:	none

Flow Measurement Point

Shape:	round (24” diam)
Width:	20.5”
Depth:	4”
Area:	0.63 sf
Flow Rate:	0.073 ft/s
Bottom:	corrugated steel

Drainage Location SW06

- Boyd Creek at the former site perimeter fence.

UP STREAM

Boyd Creek flows through a sandstone bottomed rock-cut and then a sand bottomed rectangular channel.

DOWN STREAM

flow continues in a sand bottomed rectangular channel through the highway bridge to the east.

Drainage Location SW06 (cont)

Sediment Sampling Point

bottom: brown silty sand trace gravel

Water Sampling Point

pH (SU):	6.95
temp (C):	18.6
cond. (mS/cm):	0.258
tubidity (NTU):	25
D.O. (mg/L):	8.01
redox (mV):	13
odor:	none
sheen/flotsam:	none

Flow Measurement Point

Shape:	rectangular
Width:	26.5”
Depth:	7”
Area:	1.52 sf
Flow Rate:	0.75 ft/s
Bottom:	sand, sides wood

Drainage Location SW07

- Mission Springs Creek opposite 71500 Hwy 13.

UP STREAM

the channel flows through the eroded valley along the south plant perimeter then through a 48-inch rivetted steel culvert

DOWN STREAM

water flows through a sand bottomed rectangular channel to a series of 54-inch concrete culvert pipes under the ATV road and Hwy 13.

Drainage Location SW07 (cont)

Sediment Sampling Point

bottom: red-brown silty sand
trace gravel

Water Sampling Point

pH (SU):	7.49
temp (C):	16.0
cond. (mS/cm):	0.121
tubidity (NTU):	134
D.O. (mg/L):	8.27
redox (mV):	0
odor:	none
sheen/flotsam:	none

Flow Measurement Point

Shape:	v-notch
Width:	4.5”
Depth:	3.5”
Area:	0.06 sf
Flow Rate:	0.30 ft/s
Bottom:	wood

Drainage Location SW08

- Flow through culvert opposite 72700 Hwy 13

UP STREAM

the channel flows through grassy swale adjacent to PZ-31 into a reed covered wetland

DOWN STREAM

flow leaves the wetland through a 36-inch steel pipe under the ATV road then through rip-rapped swales along Hwy 13 to culverts which pass under the road opposite residence 72700 Hwy 13.

Drainage Location SW08 (cont)

Sediment Sampling Point

bottom: brown silt with trace roots and leaves

Water Sampling Point

pH (SU):	5.72
temp (C):	17.4
cond. (mS/cm):	0.047
tubidity (NTU):	407
D.O. (mg/L):	4.31
redox (mV):	30
odor:	decayed vegetation
sheen/flotsam:	leaves and algae

Flow Measurement Point

Shape:	round (36” diam)
Width:	11”
Depth:	0.875”
Area:	0.07 sf
Flow Rate:	0.015 ft/s
Bottom:	steel

Drainage Location SW09

- Overland flow through fence opposite 30300 Nolander.

UP STREAM

the channel flows through dug ditches to the vicinity of PZ-13 then disperses into a wide grassy swale. Flow through the fence only occurs when flow is high enough to back-up in the swale over the former access road inside the plant fence.

DOWN STREAM

flow enters a shallow eroded ditch between the fence and the road then follows the roadside ditch to the east.

Drainage Location SW09 (cont)

Sediment Sampling Point

bottom: brown clayey silt trace roots and grass

Water Sampling Point

pH (SU):	4.87
temp (C):	13.5
cond. (mS/cm):	0.085
tubidity (NTU):	66
D.O. (mg/L):	4.50
redox (mV):	223
odor:	none
sheen/flotsam:	none

Flow Measurement Point

Shape:	rectangular
Width:	12”
Depth:	8”
Area:	0.75 sf
Flow Rate:	0.00 ft/s
Bottom:	gravelly clay

Drainage Location SW10

- Channelized flow through culvert south of plant truck gate onto Hwy 13 south of Boyd Creek.

UP STREAM

the channel flows through a grassy swale to the PZ-35 access road south of the truck gate. Then through a 12-inch culvert into a sand bottomed ditch.

DOWN STREAM

flow widens into a marshy area at the fence then enters concrete culverts under the ATV road to the west ditch of Hwy 13, then drains east under the highway through culverts into Mission Springs Creek.

Drainage Location SW10 (cont)

Sediment Sampling Point

bottom: brown silt trace leaves

Water Sampling Point

pH (SU):	6.34
temp (C):	17.8
cond. (mS/cm):	0.050
tubidity (NTU):	820
D.O. (mg/L):	6.31
redox (mV):	50
odor:	none
sheen/flotsam:	none

Flow Measurement Point

Shape:	round (12” diam)
Width:	12 ”
Depth:	6”
Area:	0.78 sf
Flow Rate:	0.005 ft/s
Bottom:	corrugated steel

APPENDIX B

Laboratory Results
(Please find included with this Report on CD-R)