

**PUBLIC COMMENT RELEASE**

PUBLIC HEALTH ASSESSMENT

**Former DuPont Barksdale Works**

Town of Barksdale, Bayfield County  
Wisconsin

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Prepared by

Wisconsin Department of Health and Family Services  
Under Cooperative Agreement with the  
Agency for Toxic Substances and Disease Registry

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## Summary

Environmental contamination from past industrial practices exists on and around the former DuPont Barksdale Works facility, located in the Town of Barksdale, Bayfield County, Wisconsin. Seventeen private wells near the former DuPont Barksdale property are contaminated with very low levels of site-related chemicals. Two chemicals found in several of these private wells were above the allowable Wisconsin groundwater standards, but the levels are not a public health hazard and do not pose a significant increased cancer risk. Treatment systems were recently installed on private wells and provide safe, clean drinking water. Ongoing sampling of private wells near the DuPont Barksdale property is important, as is the testing and servicing the treatment systems.

When explosives were produced at the DuPont Barksdale Works facility, wastes went into creeks on the property. A recent, limited investigation found contamination in these creeks, but the levels were very low and are not a public health hazard<sup>8</sup>. When the facility was operating, the levels of contamination in the creeks was probably higher and may have been harmful to wildlife and people, but no environmental sampling data are available from that time (prior to 1972). In 1982 waters of an on-site drainage ditch, which emptied into Boyd Creek, had a low pH and could have caused skin irritation in people who touched the water. Because of the very limited data, the Department of Health and Family Services (DHFS) cannot confidently conclude that contamination in Boyd Creek or other on-site creeks posed a public health hazard in the past.

A recent draft report of on-site investigations described specific soils and ponds that have substantial contamination, but the public does not have easy access to these areas. Other than off-site groundwater and off-site surface water run-off, neighbors have a very low chance of being exposed to site-related contamination that might pose a health concern. Once the on-site environmental investigation is finalized, DHFS will evaluate the environmental sampling data and prepare a public health consultation. In the meantime, people should not go onto the property without permission and knowledge of areas where contamination is known or appears to be present. The current owners of the former DuPont Barksdale property should continue to maintain the fence and “no trespassing” signs around the property perimeter.

A review of cancer and death certificate data did not find an unusual number of cancers in the Barksdale area that may be linked to site-related contamination. DHFS and the Bayfield County Health Department have spoken with residents and have not identified an unusual amount of illness or disease in the community or among people who had affected private wells. No further studies or investigations of nearby residents are currently planned. DHFS and the Bayfield County Health Department will continue meeting with concerned residents to address health concerns and issues about environmental contamination from the former DuPont Barksdale property. DHFS and the Bayfield County will conduct educational outreach to area health care providers to increase their knowledge about the health implications of environmental contamination coming from the former DuPont Barksdale property.

## **Definitions**

You may be unfamiliar with some of the technical words and abbreviations used in this public health assessment. Definitions of selected words and abbreviations are in the Glossary, which is in Appendix A and starts on page 32. When a word in the Glossary first appears in this report, it is marked with this character: “§”, which is called an “ampersand”.

## **Public Health Assessment: It's Purpose and Health Issues to Be Addressed**

In 1995, the Agency for Toxic Substances and Disease Registry (ATSDR<sup>§</sup>) released a public health consultation<sup>§</sup> on the former DuPont Barksdale property (*I*) which was prepared under a ATSDR cooperative agreement by the Wisconsin Department of Health & Family Services (DHFS<sup>§</sup>). The health consultation reported that prior environmental investigations at the property had found contamination. Given the decades of large scale of past industrial activities at the facility, these environmental investigations were very limited (refer to page 5). Due to the lack of environmental sampling data, DHFS was not able to determine whether contamination was more widespread, or evaluate the potential impacts on nearby private drinking water wells at that time. The report recommended testing of these nearby private wells and for an investigation of the creek that flowed through the property. Also, DuPont was asked to provide all documentation of closure and cleanup activities performed at the Barksdale facility after it was shut down in 1971.

Since 1995, contaminated groundwater migrating away from the former DuPont Barksdale property has been found in seventeen private drinking water wells. The purpose of this public health assessment<sup>§</sup> is to report on an evaluation of the human health implications of contaminant past, present, and future exposures<sup>§</sup> experienced by Barksdale residents and to address the health questions and concerns that they have raised. The report also examines whether further public health actions or studies are needed to evaluate or prevent human exposures or health effects.

## **Community Health Concerns**

Community members who live near the former DuPont Barksdale property have recently expressed various concerns about health issues to DHFS and the Bayfield County Health Department. These concerns are summarized below, as well as where the issues are addressed in this public health assessment report.

1. Should the levels of disease among Barksdale area residents be studied? What health issues have been found at other contaminated sites where the public has been exposed to Dinitrotoluene (DNT<sup>§</sup>)? Should area residents undergo medical tests to learn whether their health is being hurt by contamination?

See discussions on page 17, titled “*Other Health Investigations of Exposures to DNT in Drinking Water*” and page 18, titled “*Evaluation of a Health Study of Barksdale Area Residents.*”

2. Should DHFS consider conducting a health study of former workers of the former DuPont Barksdale Works Plant?

See discussions on page 19, beneath the heading “*Evaluation of a Health Study of Barksdale Area Residents.*”

3. How was the current Wisconsin Groundwater Quality Enforcement Standard<sup>s</sup> (NR140) derived for dinitrotoluene? When people drink water with mixtures of chemicals, how can it affect their health?

See the discussion on page 17, under the “*Toxicological Evaluation*”.

4. Is it safe to live in a home where the drinking water is safe, but contamination exists in groundwater beneath the property?

See the discussion on page 13, under the title “*Exposure: Groundwater*”.

5. When an area resident dies, should an autopsy be performed to determine whether the death was caused by site-related contamination ?

See discussions on page 19, beneath the heading “*Evaluation of a Health Study of Barksdale Area Residents.*”

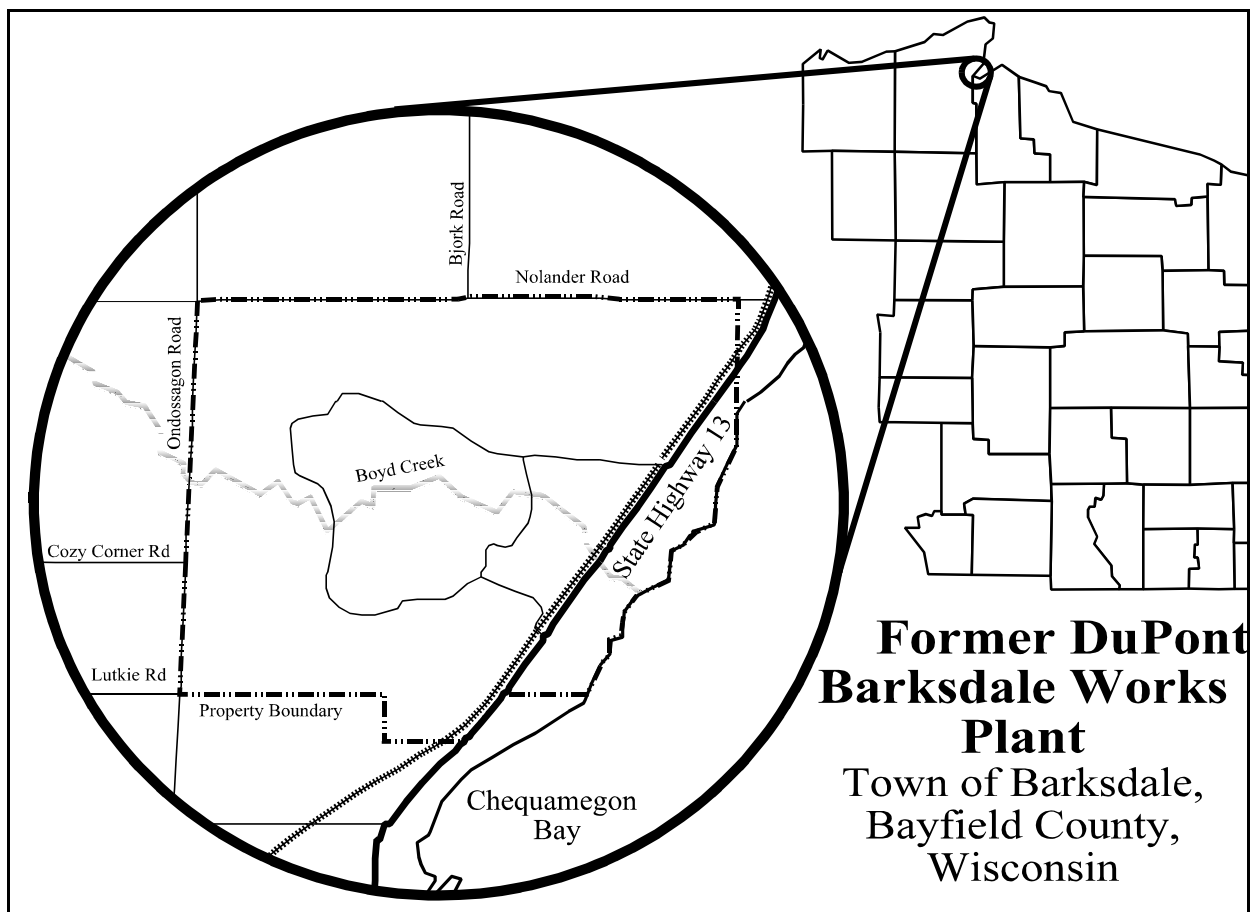
## **Background**

### **A. Site Description and History**

The E.I. du Pont de Nemours and Company (DuPont) opened the 1,800-acre Barksdale plant in May 1905 for the purpose of producing explosives. Located in northeastern Bayfield County, south of Washburn, the plant was situated on Chequamegon Bay, Lake Superior, between rich iron and copper deposits found in the Gogebic range of Michigan’s Upper Peninsula and those in the Mesabi range of northern Minnesota. Being on Lake Superior, the site provided access to large amounts of water needed in the manufacturing of explosives (Figure 1).

Dynamite and trinitrotoluene<sup>s</sup> (TNT) were the primary explosive products manufactured at the former DuPont Barksdale Works plant. Dynamite was manufactured from the opening of the plant until 1961, with the highest annual production level of 27 million

pounds occurring in 1927, and the lowest production level of 4.5 million pounds produced in 1933 (2). During World War I the DuPont Barksdale Works plant was also the world's largest source of TNT, producing 130 million pounds of the explosive between 1913 and 1918. At that time the Barksdale plant had a 6,000 person workforce, with 2,000 workers living in barracks on the property and 1,000 people commuting daily by train from nearby Washburn. Production was downscaled substantially after the war and again during the Depression, but was increased during World War II, with an estimated 226 million pounds of TNT produced for the war effort (3). During the war, the production of nitroglycerin and dynamite continued, and an extra TNT production line was added. Once the war ended, the production of explosives, particularly TNT, was once again decreased at the Barksdale plant. Other explosive materials produced at the DuPont Barksdale Works plant include trinitroxylene, trivelene, nitramon, soda amatol, and nitromex. Chemical wastes commonly generated from the production and environmental degradation of these explosives include: sulfuric acid, sulfites, nitric acid, ammonium nitrates, nitrates and nitrites, soda ash, toluene, nitroazoxytoluenes, nitroanilines, nitrobenzene, nitrotoluene, dinitrotoluene (DNT) and TNT. Wastes were disposed at various locations on-site, including sites where explosive wastes underwent



**Figure 1:** Former DuPont Barksdale Works Property.

open-air burning. During the lifetime of operations at the former DuPont Barksdale Works facility, more than a billion pounds of commercial, industrial, and military grade explosives were manufactured.

DuPont halted manufacturing activities at the Barksdale plant in 1971. From 1971 to 1987, DuPont conducted a number of periodic decommissioning and decontaminating activities at the DuPont Barksdale property. The purpose of DuPont's decommissioning actions was to address the physical and chemical hazards that remained at the Barksdale property. These activities included: 1) demolishing buildings, manufacturing equipment, and the burning of soils, equipment remains, and building debris known or suspected to contain explosives and related residues; 2) excavating and igniting materials from ditches and drains that captured or transported explosives and related wastes; 3) excavating and neutralizing soils impacted by corrosive agents used in production; excavation and on-site cleaning and re-disposal of barrel dumps; 4) clay capping of several production areas after top soils were burned; and 5) removal and off-site disposal of transformers with coolants that possibly contained polychlorinated biphenyls (PCBs) (3). Very limited environmental sampling and analysis were conducted during these activities. While such actions may have been appropriate and "state-of-the-art" in 1971, under current federal and state laws and requirements, as well as contemporary industrial standards and practices, much more extensive and thorough investigations and remediation are required. Additionally, laboratory analytical techniques to detect these compounds have become much more sensitive, now allowing for detection of very low concentrations. In 1986, DuPont sold the Barksdale property to a development corporation for use as a private game preserve and storage.

Currently, the 1,800 acre property is bordered by roads on the north and west side, with the southern boundary marked solely by a fence that was the southern edge of the former DuPont Barksdale facility. The property is bordered to the east by Chequamegon Bay, Lake Superior, with Wisconsin State Highway 13 running northeast across the eastern portion of the property. The portions of the property where most of the industrial production occurred has a perimeter fence and is posted with no trespassing signs.

## **B. Demographics, Land Use, and Natural Resource Use**

### Demographics

The former DuPont Barksdale property is within a predominantly rural area, but is three miles south from the city of Washburn. Within one-quarter mile of the property boundary are approximately 68 private homes with an estimated 180 residents. The 2000 U.S. Census (4) reported the town of Barksdale had a population of 801 individuals living in 303 households (average household size of 2.64). Of these Barksdale residents, 98.1% were white and 1.0% were American Indian or Alaska Native. The median age was 40.3 years, with 19.6% of the population less than 14 years old. The median annual household

income was \$45,714. For the Wisconsin population, the median age is 36.0 years, with 21.0% of the population under the age of 14, and a median household annual income of \$43,791 (5).

### Land and Natural Resource Use

Currently, the former DuPont Barksdale property is privately owned and is used primarily as a game preserve. Most of the former DuPont Barksdale property is zoned “forestry” and “agricultural.” The portion of the former property east of State Highway 13 and up to the shoreline of Chequamegon Bay, Lake Superior, is zoned “residential.” A 196-acre central portion of the property, where acids and TNT were manufactured, has a “deed restriction that only allows for hunting, stocking small game, or plant of groundcover. Agricultural, livestock breeding, playground, sporting, recreational, or public park use is prohibited”(3). The areas surrounding the former DuPont Barksdale property are mostly zoned for “agricultural,” with some areas zoned “forestry.”

## **Nature and Extent of Contamination**

### **A. On-Site Contamination**

#### Sediments and Surface Water

When the DuPont Barksdale Works facility was in operation, a wide range of industrial wastes were apparently disposed of into creeks on the property, principally Boyd Creek. A DuPont narrative of TNT manufacturing processes at the Barksdale plant indicated that “red water” waste (from TNT production) was typically disposed of into a drainage ditch on the Barksdale property (3). A 1970 Department of Natural Resources (DNR<sup>s</sup>) report described Boyd Creek as devoid of aquatic life and with “a deep red color caused by wastes” from the production of explosives (6). Photographs taken at the facility in the 1960s showed waste water with a deep red color flowing into Boyd Creek (Figure 2a). Such “red water” was not an uncommon waste during the production of TNT. In 1982, during a limited DNR investigation (7), two surface water samples were collected from a drainage ditch that may have drained into Boyd Creek or the central drainage area. These samples had elevated levels of sulfates and a pH between 3.5 and 4.3. Sediments from Boyd Creek were not sampled at that time.

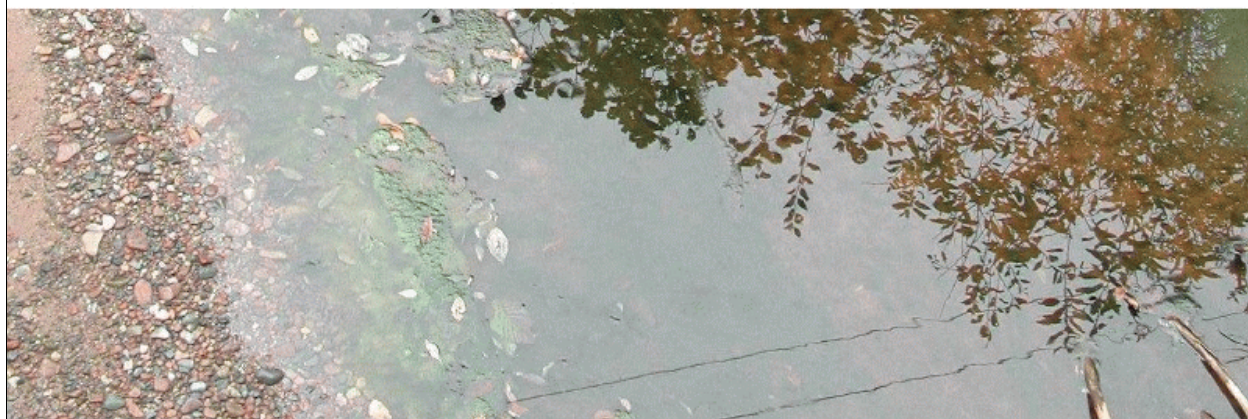
In 1998, consultants hired by DuPont, following DNR’s recommendation, conducted an investigation of Boyd Creek sediments and surface water to determine whether contamination existed in the creek from past industrial activities at the former DuPont Barksdale Works facility. Boyd Creek flows easterly and bisects the property (Figure 1). The purpose of the investigation was to “determine if nitroaromatic compounds are migrating from the site to Chequamegon Bay at concentrations of concern” (8). Sediment



samples were collected from 11 locations on Boyd Creek, and one sample was collected from an intermittent creek on the former DuPont Barksdale property that later enters Boyd Creek near Chequamegon Bay. Two Boyd Creek sediment sample locations from upper portions of the former DuPont Barksdale property had TNT at 12.0 and 1.4 milligrams per kilogram (mg/kg) and 2,4-DNT at 0.29 and 0.47 mg/kg, with 2,6-DNT at 0.27 and 0.2 mg/kg. Evidence of TNT and DNT traces were also found in sediment samples from two other Boyd Creek locations. The sediment sample from the intermittent creek had 2,4-DNT at 0.45 mg/kg, and traces of TNT and 2,6-DNT. Surface water samples were collected from three locations on Boyd Creek. While TNT and 2,4-DNT were not detected in any water samples, 2,6-DNT was found in every water sample, ranging from 0.016 to 1.1 micrograms per liter ( $\mu\text{g/L}$ ).



a: Boyd Creek, *circa 1967*



b: Boyd Creek, *October 1991*.

**Figure 2:** Photographic Comparison of Past and Current Boyd Creek.

The consultants concluded that “TNT and DNT isomers<sup>s</sup> are not migrating from the site at concentrations of ecological concern,” and that the contaminants in Boyd Creek were not at “levels of ecological concern.” A DNR review did not disagree with the findings of the report, though DNR noted that only a limited number of samples were collected

from Boyd Creek (9). Later, DNR's stream ecologist conducted a walk-through of the Boyd Creek valley, did not observe evidence of chemical waste or any discoloration in the creek, and reported that the stream conditions appeared to contain a healthy aquatic ecosystem. Figure 2b shows a photograph of recent conditions in Boyd Creek at State Highway 13.

Groundwater

In 1997, DNR found site-related contamination in a private well near the former DuPont Barksdale property (refer to page 10 for more information about private well investigations). In follow-up to this discovery, on-site groundwater investigations were initiated by DuPont in December 1998 (10). Water samples were collected from five permanent groundwater monitoring wells and four direct-push probe sample locations (geoprobess). Laboratory analyses detected nitroaromatic (explosives-related) chemicals in the water samples. Of the chemicals detected, only the two forms of DNT (2,4-dinitrotoluene and 2,6-dinitrotoluene) were above a health-based comparison values§ (Table 1).

**Table 1: Contaminants in On-Site Groundwater**  
 December 1998  
 Former DuPont Barksdale Property  
 Bayfield County, Wisconsin  
 All concentrations in micrograms per liter (µg/L)

Chemical	Highest Level Detected	Lowest Level Detected	Frequency of Detection	Health Comparison Value§
1,3-dinitrobenzene	0.08	0.02	3/9	1.0 <sup>a</sup>
2,4-dinitrotoluene	12.0*	0.2*	5/9	0.05 <sup>b</sup>
2,6-dinitrotoluene	2.6*	0.32*	5/9	0.05 <sup>b</sup>
2,4,6-trinitrotoluene	0.24	0.02	4/9	2.2 <sup>a</sup>
2-amino 4,6-dinitrotoluene	2.0	0.2	5/9	2.2 <sup>c</sup>
4-amino 2,6-dinitrotoluene	0.25	0.16	3/9	2.2 <sup>c</sup>

\*- Exceeds health-based comparison value  
 Drinking Water Comparison Value§ Source:  
 a - Lifetime Health Advisory  
 b - Wisconsin NR140 Groundwater Quality Public Health Enforcement Standard  
 c - EPA's Region III Provisional Health Value for Drinking Water

In 1999, DuPont continued an on-site groundwater investigation at the former DuPont Barksdale property. In addition to quarterly re-sampling of groundwater monitoring

wells, water sampling was initiated from recently installed, deeper, specialized groundwater monitoring wells (piezometer<sup>s</sup>). A review by a DuPont consultant of laboratory data concluded that: 1) nitroaromatic compounds were found in groundwater at various locations on the property; 2) these nitroaromatic compounds were not uniformly distributed in groundwater; and 3) the levels of contaminants at each sample location did not vary with time, which suggested that contaminant conditions in groundwater were stable (11). To date, the October and December sampling rounds were the most complete data available monitoring and piezometer wells. These groundwater results for 17 samples are summarized in Table 2.

**Table 2: On-Site Groundwater Contaminants**

October and December 1999  
Former DuPont Barksdale Property  
Bayfield County, Wisconsin

All concentrations in micrograms per liter (µg/L)

Chemical	Highest Level Detected	Lowest Level Detected	Frequency of Detection	Health Comparison Value <sup>s</sup>
1,3-dinitrobenzene	61.0*	0.01	3/17	1.0 <sup>a</sup>
2,4-dinitrotoluene	1,200.0*	0.02	7/17	0.05 <sup>b</sup>
2,6-dinitrotoluene	500.0*	0.03	7/17	0.05 <sup>b</sup>
2,4,6-trinitrotoluene	180.0*	0.09	2/17	2.2 <sup>a</sup>
1,3,5-trinitrobenzene	1.4	0.02	2/17	1,100.0 <sup>c</sup>
nitrobenzene	2.5	-	1/17	3.5 <sup>e</sup>
2- & 4-nitrotoluene	17.0	0.16	4/17	61.0 <sup>d</sup>
3-nitrotoluene	7.6	-	1/17	120.0 <sup>c</sup>
2-amino 4,6-dinitrotoluene	65.0*	0.11	5/17	2.2 <sup>c</sup>
4-amino 2,6-dinitrotoluene	34.0*	0.02	7/17	2.2 <sup>c</sup>
nitroglycerin	2.5	-	1/17	5.0 <sup>a</sup>
RDX	0.05	-	1/17	0.6 <sup>f</sup>

\*- Exceeds health-based comparison value

Drinking Water Comparison Value Source:

a - Lifetime Health Advisory

b - Wisconsin NR140 Groundwater Quality Public Health Enforcement Standard

c - EPA's Region III Provisional Health Value for Drinking Water

d - EPA's Reference Dose Value for Drinking Water - *withdrawn for review by EPA*

e - EPA's Reference Dose Value for Drinking Water

f - EPA's Cancer Risk Evaluation Guideline (1 in 1,000,000)

Water samples from one piezometer (PZ-1D) consistently had the highest levels of contaminants, much higher than other wells on the property (this piezometer is located on the eastern portion of the site, along State Highway 13). For example, in 1999, the level of 2,4-DNT measured in a water sample from piezometer PZ-1D was 1,200 µg/L. When constructed, this piezometer was screened at a depth of 61 to 67 feet below the ground surface. The highest level of DNT found in any other well was 27.0 µg/L (from MW-3).

#### Other On-Site Environmental Media<sup>§</sup>

During the preparation of this public health assessment in 2002, the early stages of an initial on-site environmental investigations had begun at the former DuPont Barksdale property. The findings of a June 2002 draft report indicate that several of the former manufacturing areas had levels of site-related contamination (metals, solvents, and nitro aromatic compounds) in soil and pond surface water and sediment that exceed health-based screening values. Further investigation will be needed to determine the full extent of contamination at the property. Once these environmental data becomes available,

DHFS will evaluate the public health implications of the on-site contamination. Until those data are finalized, DHFS recommends that people not go onto the property without permission and knowledge of areas where contamination is known or appears to be present. There are several reports of people who in the past made unauthorized entries onto the DuPont property. DuPont and the property owners should continue maintaining the fence and “no trespassing” placards placed around the perimeter of the property. However, other than groundwater and off-site surface water run-off, at this time it appears that neighbors have an extremely low chance of being exposed to site-related contamination at levels that might pose a health concern.

### **B. Off-Site Contamination**

#### Private Wells

Groundwater quality at the former DuPont Barksdale property first became a concern in 1997 when the DNR sampled three adjacent private wells along State Highway 13 and found low levels of four explosive-related chemicals in one well (12). Two of the chemicals found in well water, 2,4-dinitrotoluene (2,4-DNT) and 2,6-dinitrotoluene (2,6-DNT), were above their respective Wisconsin Public Health Groundwater Quality Enforcement Standards (13). The Enforcement Standards for 2,4-DNT and 2,6-DNT are the same, which is 0.05 µg/L. Enforcement Standards are not available for the other chemicals found in this private well (1,3,5-dinitrobenzene and 2-amino 4,6-dinitrotoluene), but these were below other health-based comparison values<sup>§</sup> and are not a health concern. Follow-up sampling of this private well in August 1997 confirmed the

June results (14). DNR also notified DuPont about the discovery of contamination in this private well.

In follow-up to the 1997 discovery by DNR of contamination in a private well near the former DuPont Barksdale property, DuPont soon began testing the water quality of nearby private wells (15). In 1999, DuPont sampled seven nearby drinking water wells, of which four had site-related contaminants (16). Seven additional wells were sampled by DuPont in 2000, with site-related contamination detected in two of these wells. In 2001, DuPont sampled another 49 nearby private wells, and found site-related contamination in 8 of these wells. In May 2002, 58 private wells were tested again, with site-related contamination shown in 10 wells (17).

**Table 3: Contaminants in Private Well Water**

Town of Barksdale  
Bayfield County, Wisconsin

All concentrations in micrograms per liter (µg/L)

Compound	Highest Level Detected in Private Wells	Wisconsin Groundwater Enforcement Standard (NR140)	Other Drinking Water Comparison Values <sup>§</sup>
2,4-dinitrotoluene (2,4-DNT)	0.3*	0.05	70.0 <sup>a,b</sup>
2,6-dinitrotoluene (2,6-DNT)	3.1*	0.05	40.0 <sup>c</sup>
1,3,5-trinitrobenzene (TNB)	0.039	n/a	1,100.0 <sup>a</sup>
2,4,6-trinitrotoluene (TNT)	0.043	n/a	2.2 <sup>d</sup>
2-amino, 4,6-dinitrotoluene	1.6	n/a	2.2 <sup>e</sup>
4-amino, 2,6-dinitrotoluene	1.4	n/a	2.2 <sup>e</sup>
2-nitrotoluene	0.095	n/a	61.0 <sup>f</sup>
3-nitrotoluene	0.035	n/a	120.0 <sup>e</sup>
4-nitrotoluene	0.037	n/a	61.0 <sup>f</sup>
nitroglycerin	0.28	n/a	5.0 <sup>d</sup>

\* - Exceeds health-based drinking water guidelines

n/a - Wisconsin Enforcement Standard has not been established

Drinking Water Comparison Value Source:

a - EPA's Reference Dose Value for Drinking Water

b - ATSDR's Chronic Minimal Risk Level for Drinking Water

c - ATSDR's Intermediate Minimal Risk Level for Drinking Water

d - Lifetime Health Advisory

e - EPA's Region III Provisional Health Value for Drinking Water

f - EPA's Reference Dose Value for Drinking Water - *withdrawn*

As of June 2002, DuPont has tested drinking water from 72 private wells near the Barksdale property. Overall, investigations have found site-related contamination in 17 private wells. These site-related contaminants are primarily 10 different compounds that are associated with the production or degradation of explosives. Of the compounds detected in drinking water wells, only 2,4-DNT and 2,6-DNT have been measured at levels above health-based comparison values. One or both of these DNT isomers have been found above the comparison value in 11 private wells. Table 3 summarizes the highest levels of site-related contamination found in private drinking water wells and compares this concentration with an appropriate health-based comparison value.

Affected private wells (and selected adjacent private wells) have also been tested for contaminants other than explosives. DuPont tested these private wells for a number of volatile organic compounds (VOCs<sup>s</sup>) and inorganic compounds. One VOC, 1,1,1-trichloroethane (TCA), has frequently been detected at very low levels in a private well on State Highway 13. A trace of TCA was also recently found in another private well next door to the well where TCA was previously found. The levels of TCA detected are well below levels that pose a health concern. Currently, there is no indication that TCA in these wells is coming from the former DuPont Barksdale property. TCA is a chlorinated solvent that is commonly used in industrial and commercial cleaning products, such as decreasing agents, paints, glues, dry cleaning fluid, and household cleaning products.

## **Discussion**

### **A. Pathways of Human Exposure<sup>s</sup>**

#### **Boyd Creek Sediments and Surface Water**

In 1998, site-related contamination was found in sediments and surface water of the creeks that flow across the former DuPont Barksdale property; however the levels measured are not a health hazard for people who may regularly enter the creek and come in contact with affected sediments and surface water (8). Furthermore, there are no reports that people are currently entering these creeks on a regular basis, such as once per day or week.

During times when the former DuPont Barksdale Works facility was in full operation or soon after closing, environmental conditions and water quality in Boyd Creek was likely quite different than today. It is possible that contaminants in the creek exceeded current standards that protect public health and the environment, and may even have been harmful to wildlife and people. Even though environmental data from this era is not available, the reports and photographs of past conditions in Boyd Creek suggest that substantial contamination was present in Boyd creek on the former DuPont Barksdale

property, and possibly downstream from the property and where it emptied into Lake Superior. People could have developed skin irritation if they had lengthily, direct contact or entered surface water with a pH of 3.5. However, in 1982 DNR measured this pH in the water of an on-site drainage ditch, and not surface water in the creek. DHFS has received anecdotal reports about youth who often played both in Boyd Creek and where the creek entered Lake Superior, even at times when “red water” wastes were also observed in the creek. DHFS has not received reports that these youth or other people developed health problems after they were in or near the creek. However, given the very limited environmental data on contaminants possibly in Boyd Creek in the past, at this time DHFS is not able to fully assess the human health implications of past exposures to contaminants in the creek. As a result, DHFS is not able to confidently conclude whether or not these conditions were a health hazard in the past.

### Groundwater

For many years in the Barksdale area, groundwater from private wells has been the primary source of drinking water. A number of households have been drinking groundwater that contains contamination coming from the former DuPont Barksdale property. Groundwater migrating away from the former DuPont Barksdale property has contaminants that are related to the manufacture of explosives.

Once contamination was first detected in a private well near the former DuPont Barksdale property, to immediately halt continued exposures, residents were provided, first by DNR and then DuPont, with a supply of bottled water for their cooking and drinking needs.

To halt drinking water exposures, DuPont placed treatment systems on private wells when site-related contamination was found in a water sample from the well. These treatment systems were typically installed 1 to 3 months after contamination was discovered in the private well. As a precautionary measure, DuPont also placed treatment systems on unaffected private wells that are downgradient from the site and when contamination has been found in another private well that is next door. Treatment systems have been installed on 28 private drinking water wells in the Barksdale area. These treatment systems use activated carbon, which effectively removes any measurable levels of contamination from the water. Each treatment system is regularly tested. Treatment systems were also placed on two drinking water wells located on the former DuPont Barksdale property, but contamination has not been found in these wells.

At a nearby Boy Scout Camp along Lake Superior, which near an affected private well, one of two drinking water wells was sampled in October 1997 and no site-related contamination was found. Both of these wells were abandoned in October 1998. Also, two on-site but unused drinking water wells and one used drinking water well at DuPont’s former “Beach Club” were abandoned in the fall of 2001. Site-related contaminants were not detected in these three on-site wells before they are abandoned.

Concerns are sometimes raised about whether it is safe to live on a property when groundwater beneath the ground is contaminated, but no one is drinking the water. Under unusual circumstances unhealthy conditions can occur when very high levels of volatile solvents are in shallow groundwater, directly beneath a building where people unsuspectingly work or live. The solvents in groundwater then change to a vapor form, leaving the groundwater, migrate up through soils, enter the building through cracks in a basement or the sump, and unsafe levels of vapors reach indoor air and are breathed by residents. Fortunately, around the former DuPont Barksdale property conditions are such that such an exposure to site-related contamination is not a concern. First, the physical properties of DNT does not enable the chemical to evaporate or volatilize very easily. Secondly, DNT concentrations in groundwater near homes is very low concentrations.

## **B. Public Health Implications – Toxicological Evaluation**

This section examines how chemicals are known to affect animal and human health and then evaluates the implications for people who were exposed to the levels measured in their drinking water. Because only the isomers<sup>§</sup> of dinitrotoluene were above a health-based comparison values<sup>§</sup>, only this compound is further discussed.

In summary, DNT concentrations in some private wells were above the Wisconsin Groundwater Quality Enforcement Standard. Despite being above a groundwater standard, the highest concentrations found in private wells are not likely to cause adverse health effects among people who drank the water for many years. Treatment systems were installed by DuPont on affected private wells and selected unaffected private wells. These treatment systems are effective at removing contaminants and provide clean drinking water.

### Dinitrotoluene

Dinitrotoluene (DNT), in its various forms or isomers, is a synthetic or man-made chemical that has a number of industrial and commercial uses, including the production of foams, dyes, ammunition, gunpowder, and explosives, but the main use today of DNT is in making polyurethane or foam (18). At the former DuPont Barksdale property, DNT was apparently created as an intermediate in the production of trinitrotoluene (TNT), a widely used explosive. DNT does not tend to accumulate in the environment, nor does it accumulate in plant or animal tissues. When DNT enters people and animals, most of the chemical is rapidly excreted through urine or feces. DNT is rapidly degraded by sunlight and bacteria. But, when DNT reaches groundwater, it undergoes very little degradation (19).

A number of residents near the former DuPont Barksdale property have been drinking water that contains as many as 10 different contaminants related to explosives manufacturing. The only chemicals found in drinking water wells above a health-based comparison value or Wisconsin Groundwater Enforcement Standard were two forms of



DNT, the isomers 2,6-DNT and 2,4-DNT. Other isomers of DNT may be present in the environment at the former DuPont Barksdale property. The 2,4-DNT and 2,6-DNT isomers are two of the six possible forms of DNT. However, the 2,4- and 2,6- isomers comprise 95 percent of technical-grade DNT (76% and 19%, respectively) with the other four isomers making up the remaining 5 percent (19).

DNT has a number of known toxic effects on the health of both people and animals, but these harmful effects occur at levels that are many times higher than the levels in private well water near the former DuPont Barksdale property.

### *Noncancer health effects*

Studies of laboratory animals exposed to high concentrations of DNT have shown increased adverse health effects on the blood, nervous system, liver, kidney, and the male reproductive systems. Acute or short-term health effects appear shortly after an exposure to a high concentration of DNT. Long-term or chronic health effects sometimes take many months or years to appear, and are caused by repeated, daily exposures to low concentrations of DNT. Laboratory studies that examine chronic health effects of a chemical are useful because they help us understand when a long-term exposure becomes unacceptable.

Laboratory studies of animals chronically exposed (over 12 months) to DNT show that adverse health effects start appearing when a dose<sup>s</sup> is above 1.0 milligrams of DNT per kilogram body weight per day (mg/kg/day). In one study, groups of beagle dogs were fed various doses of DNT. A group of 12 beagles dosed at 1.5 mg/kg/day of 2,4-DNT for 24 months developed neurotoxic effects, as well as changes to the liver and kidneys. Such effects were not noticed in another group of 12 beagles dose 2,4-DNT at 0.2 mg/kg/day (20). Taking into account many other laboratory studies of 2,4-DNT, both the U.S. Environmental Protection Agency (EPA<sup>s</sup>) and ATSDR concluded that 1.5 mg/kg/day was the lowest known chronic exposure to result in an adverse health effect, and 0.2 mg/kg/day was the threshold for a “no observed adverse effect level” (NOAEL<sup>s</sup>). This NOAEL is the basis for determining both the ATSDR “Minimal Risk Level” (MRL<sup>s</sup>) and EPA’s “Reference Dose<sup>s</sup>” (RfD) for 2,4-DNT (21). Using a 100-fold safety factor, 0.002 mg/kg/day was established for chronic oral exposure to 2,4-DNT. This converts to a 2,4-DNT concentration in water of 70 µg/L for an adult and 20 µg/L for a child. EPA has not established a RfD for either 2,6-DNT or mixtures of DNT isomers. For 2,6-DNT, ATSDR has only established an “intermediate” health effect MRL, which is 0.004 mg/kg/day, or equivalent to 100 µg/L for an adult and 40 µg/L for a child (22).

Workers, not from Barksdale, have become ill or developed health effects related to their exposures to DNT. These workers may have handled high concentrations or pure forms of DNT. Such workers typically were involved in the manufacture of ammunition or

explosives and they were exposed by either inhaling DNT particles or touching materials with high levels or pure forms of DNT. Studies of chemical plant workers did not consistently find lowered sperm counts among males who were exposed to DNT (18). Occupational studies of workers exposed to high levels of DNT have found increased rates of heart disease (23), hematological or blood problems, and adverse effects with the central nervous system. The subjects of these epidemiological studies were workers who were exposed to DNT during the 1940s and 1950s. Since then, there has been a substantial increase in protective measures to reduce DNT exposures in workers.

The highest level of combined DNT isomers that has been found in any drinking water well near the former DuPont Barksdale property was 3.5 µg/L. Based on the ATSDR MRLs and EPA RfD, drinking water over a long term with the highest level of DNT is not expected to result in a non-cancer health effect.

### ***Cancer***

DNT causes certain cancers in laboratory animals, but has not been clearly linked to causing cancer in humans. A study of more than 450 workers who used DNT in making polyurethane foam did not show an increased death rate from any cancers, though the death rate from heart disease was significantly higher than comparison populations (23). Another study of 4,989 munition plant workers exposed to high levels of DNT found a higher than expected number of deaths attributed to liver cancer (n=6), but the number of cancer deaths, including liver cancer, was not significant. With the exception of a slightly elevated number of lymph system cancers, the number of deaths among munition plant workers from all other cancers was less than expected (24). A 1998 study of 500 German miners (who worked frequently with DNT, including bare-handling of explosive charges) found an elevated number of urinary tract cancers (n=6) and renal cell cancers (n=14). The urinary tract cancers were among miners who had the highest exposures to DNT. Other types of cancers in these miners were not above expected rates, including liver cancer. This study did not provide statistical analysis of whether the numbers of these cancers were significantly higher among miners than the general population (25). It should be noted that the subjects in these occupational studies were mostly males.

Laboratory bioassay and animal studies often found that 2,4-DNT caused kidney cancer and that mixtures of 2,4-DNT and 2,6-DNT caused liver cancers. For example, in one study, rats fed only 2,4-DNT for 2 years later developed liver cancer, but two other studies did not find liver cancer when different laboratory rats were similarly fed DNT over 2 years. Significant increases in liver cancer were found in several studies of rats fed 2,4-DNT or 2,6-DNT for at least 1 year. Another laboratory study of rats dosed with 2,4-DNT did not show an increase of any cancers, but there was an increase in the numbers of benign tumors of the skin and mammary glands, though the increase was not significant.

Studies suggests that when the two DNT isomers are present, their combined ability to increase cancer risk is more than just additive, and may be synergistic<sup>8</sup> or multiplicative (22, 26). Laboratory animal studies indicate that 2,6-DNT acts as both a tumor promoter and initiator, while 2,4-DNT functions as a tumor promoter. Laboratory rats were dosed over 1 year with mixtures of 2,4-DNT and 2,6-DNT (in proportions similar to technical-grade DNT) and in each study, a significant increase in liver cancer was observed (22). As a result, the EPA cancer slope factor for mixtures of 2,4- and 2,6-DNT takes into account this effect and, when applied to the derivation of a cancer-based risk factor exposure guideline, results in an even more protective concentration than either isomer individually or added together. Currently, the EPA only classifies mixtures of the 2,4-DNT and 2,6-DNT isomers as a “B2” or “probable human carcinogen<sup>8</sup>.” No individual DNT isomer is classified by the EPA as a carcinogen. The “B2” classification is based on “insufficient human carcinogenicity data” and “sufficient animal carcinogenicity data” (21,27).

The current Wisconsin Groundwater Quality Public Health Enforcement Standard (ES) for DNT is 0.05 µg/L (13), and is based on the EPA cancer slope factor for DNT mixtures (27). Wisconsin’s Enforcement Standards are designed to provide safeguards and to be protective of public health and welfare when using groundwater as a drinking water source. The highest combined level of DNT observed in private wells near the former DuPont Barksdale property was 3.5 µg/L. While this level of DNT is above the ES, people who drank such water over a lifetime have a very low increased risk of developing liver cancers<sup>a</sup>.

#### Other Health Investigations of Exposures to DNT in Drinking Water

DHFS searched available resources for information about other communities that have been exposed to low levels of DNT in drinking water. This search found only one case of DNT detected in a number of drinking water wells, which at the Cornhusker Army Ammunition Plant (CAAP), in Grand Island Nebraska. In 1992, ATSDR completed a public health assessment on the site, which reported that site-related contaminants were

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<sup>a</sup> When Wisconsin establishes an Groundwater ES for a carcinogen, the concentration is generally equivalent to a 1 in 1,000,000 excess lifetime increased cancer risk. This theoretical cancer risk means that if 1,000,000 people were to drink about 2 quarts of water with 0.05 µg/L of DNT, per day, every day for 70 years, this would result in 1 additional case of cancer. Considering the highest levels of DNT isomers found in private wells near the former DuPont Barksdale property, and using the EPA cancer slope factor for mixtures of DNT, if, for 70 years, 1,000,000 people drank 2 quarts per day of water with 3.4 µg/L of DNT, approximately an additional 66 cancers would be seen in the 1,000,000 people who were exposed. Such an increased lifetime excess cancer risk is not significant.

found in over 460 private wells (28). However, this situation is different from the DuPont Barksdale area because many different contaminants were found in private well water, as well as a slightly higher level of DNT. The highest levels of explosive contaminants found in private well water near CAAP was 445 µg/L for TNT, 371 µg/L for RDX (an explosive), 114 µg/L for TNB (trinitrobenzene), and 11 µg/L for both DNT isomers. Contamination was discovered in private wells in 1983. The ATSDR report did not estimate when contaminants first reached most private wells, but some people may have drunk contaminated well water for as long as 25 years. Based on the levels of RDX & TNT found in drinking water wells, ATSDR concluded that this situation posed a public health hazard for people who drank contaminated groundwater. ATSDR did not find that DNT in drinking water was a public health hazard.

To address the health concerns expressed by residents, ATSDR conducted a symptom and disease with biomarkers health study of selected Grand Island residents and reported the results in 1996 (29). In this study, ATSDR compared the self-reported symptoms and diseases of 300 residents who likely drank contaminated well water (target area) with 300 residents from a nearby neighborhood who did not have contaminated drinking water (comparison area). Overall, 77 percent of residents of the target and comparison area neighborhoods participated in the study. Study participants in the target area reported 8 cases of cancer compared to 16 cases reported for the comparison area. For breast cancer, there was one case in the target area, compared to three cases in the comparison area. When statistical analysis was conducted, no significant difference was found between the number of specific cancer cases for the target and comparison areas. There was also no significant difference in reproductive histories of women from the target and comparison areas. ATSDR found target area residents were twice as likely than comparison area residents to self-report the occurrence of seven health outcomes: neurological problems; weakness or paralysis of limbs not due to stroke; urinary tract disease; numbness or tingling sensation in toes or fingers; trouble sleeping; trouble remembering; and irritated eyes. A longer residence in the target area was not associated with an increase of self-reported health outcomes.

In order to clinically evaluate whether the health of target area residents was adversely affected, ATSDR also collected urine and blood specimens from both target area and comparison area residents. Specimens underwent a battery of laboratory tests for organ damage or dysfunction of the immune, renal (kidney), hepatic (liver), and hematopoietic (blood) systems. No difference was found when the test results of target area residents were compared against established reference levels. When results for the target area were compared against results for the comparison area, only two differences were found: comparison residents had higher levels of a urinary protein and a blood protein than target area residents. A battery of neurobehavioral tests was administered on 76 target area residents and 77 comparison area residents and did not find a difference between the two areas.

## Evaluation of a Health Study of Barksdale Area Residents

DHFS has examined the merits of conducting a health study to determine if Barksdale area residents who drank contaminated water are experiencing a greater amount of adverse health effects. Based on the current toxicological and epidemiological science that was presented above, DHFS has concluded that the levels of exposure to contaminated groundwater is not likely to cause adverse health effects among people who drank the water for many years. DHFS has studied the available biomedical screening methods and determined that there is no accepted method for testing of elevated levels of DNT and related metabolites in human body tissues or fluids. DNT is quickly metabolized and does not bioaccumulate in any tissues, organs or fluids. DHFS also examined available screening tests of organ function that would directly or indirectly demonstrate specific adverse impacts specifically attributable to DNT exposures experienced by residents. DHFS has concluded that laboratory tests that only examine damage specific to DNT exposures are not available. A number of biomedical tests are available that can test for the reduction of or damage to organ function. However, such tests cannot distinguish between impacts caused by exposure to DNT and other common diseases or medications.

DHFS and the Bayfield County Health Department have sought information from residents to learn or discover whether they are experiencing any unusual health effects. DHFS and the Bayfield County Health Department have offered to meet individually with residents to hear about their specific health concerns, but only one resident with an affected well was interested and met with health officials. This individual did not have specific health concerns related to contamination in private well water.

At this time DHFS is not considering a health study that specifically targets the people who worked at the former DuPont Barksdale Works facility. As stated previously, the purpose of this public health assessment is to evaluate how environmental contamination coming from the DuPont Barksdale property may be affecting the health people who live around the property. For many years a number of Barksdale residents were unaware that they drank groundwater with very low levels of site-related contamination. DHFS has a sufficient amount of private well data to properly evaluate recent drinking water exposures, but has no information or data that would allow an evaluation of potential exposures that workers may have had many decades ago. Furthermore, it is beyond the scope and capability of DHFS and ATSDR to conduct such an occupational health study.

It was recommended to the Bayfield County coroner by an individual that the most appropriate way to survey the health of the Barksdale community was to perform an autopsy when a resident died. This individual stated that, regarding chemical exposures, "each causative agent fingerprint is stored within the tissue" (30). DHFS does not agree with this statement. Based on all available environmental data for the Barksdale area and the present toxicological and epidemiological body of knowledge, there is no scientific

basis that supports conducting such a tissue study (31). The Bayfield County coroner also concluded that such a study would not likely reveal useful information (32). DHFS defers to each county's coroner to make decisions on when to conduct an autopsy based on their current professional guidelines and policies.

### **C. Review of Health Outcome Data**

DHFS reviewed all available health outcome data for any indication that of an unusual amount of cancer among Barksdale area residents. DHFS did not find any evidence or signs of an unusual amount of cancer among Barksdale area residents that may be attributed to drinking groundwater that contains site-related contamination. At this time, DHFS concludes a more intensive and rigorous health outcome data review or investigation would not be useful.

These following reviews of cancer death and incident data are called “descriptive” or “ecological” epidemiology<sup>8</sup>. This is a quick review to determine whether additional studies or investigations may be needed. However, many times an ecological data review can raise more questions than the answers it provides. One of the problems with this data review is other than the specific cancers or diseases being examined, information is usually not available about the causes of other diseases. For example, while laboratory studies show DNT causes bladder or liver cancer in mice, no studies have found DNT is linked with breast cancer. Also, no other chemicals have been found to cause breast cancer. Finally, the design of ecological data review does not allow us to determine that an exposure to a certain chemical was the cause of any certain cancer or group of cancers. The design and results of this type of an ecological analysis provides insight to whether the number of certain cancers are greater or less than expected, whether that difference is significant, and whether future studies would be useful. In conducting this health outcome data review, DHFS relied on available cancer incidence and death data reported to the State of Wisconsin. DHFS did not review detailed medical information, such as individual medical charts or records.

#### Liver, Kidney and Bladder Cancers

Toxicological studies of laboratory animals and epidemiological studies of workers suggest that high exposure to DNT may increase the risk of developing liver, kidney, and bladder cancers (refer to the previous discussion on page 16). DHFS staff examined death certificate data for Barksdale area residents who died between 1989 and 2000 and where liver, kidney and bladder cancer were listed as the cause or an underlying cause of death. DHFS staff also inspected data from the Wisconsin Cancer Reporting System for Barksdale area residents who were diagnosed with liver, kidney, or bladder cancers and reported to the State of Wisconsin for the period 1979 to 1998 (the Wisconsin Cancer Reporting System was first started in 1976).

Overall, the age-adjusted<sup>§</sup> death rates for Bayfield County of bladder, liver, and kidney cancers are not above rates for Wisconsin (Table 4).

Data from the death certificates and cancer registry did not find any cases of liver or kidney cancer among residents in the immediate vicinity of the former DuPont Barksdale property.

Cases of bladder cancer was reported in two nearby residents, with one case diagnosed in 1982 and another in 1988. Neither individual is currently living. While the individuals lived in different residences, site-related contamination was found at least once in drinking water from each respective private well. However, the levels of DNT found in each of these wells were lower than the Wisconsin Enforcement Standard.

**Table 4: Age-Adjusted<sup>§</sup> Death Rates and Number of Deaths for Bladder, Liver and Kidney Cancers**  
State of Wisconsin and Bayfield County  
1979 to 1998

Type of Cancer	Age-Adjusted Death Rate (per 100,000 deaths)		Number of Deaths	
	Wisconsin	Bayfield County	Wisconsin	Bayfield County
Bladder	4.8	3.4*	4,662	12
Liver	3.3	3.0*	3,142	10
Kidney	4.9	4.9*	4,688	17

Notes: \* - Due to small numbers this is an unstable rate "Unreliable"  
Source: CDC Wonder: Compressed Mortality File Summary 1979-1998

It is notable that two cases of bladder cancer occurred within the last 20 years among residents who drank groundwater with site-related contaminants. However, given the small Barksdale population and only two bladder cancer cases, it would be inappropriate for DHFS to use statistical analysis to determine whether this is a "cancer cluster" or an unusual number of bladder cancers. Furthermore, because of the limited information by which this data is collected DHFS is unable to rule out that these bladder cancer cases were due to random chance or whether these persons were genetically predisposed to developing this cancer. It must also be noted that the death certificate for one of these cases identified the occupation as a large-engine mechanic. In the past, such mechanics commonly had daily and frequent exposures to high levels of certain solvents that are

linked to an increased risk of bladder cancer. The occupation of the other individual was not identified.

DHFS is also unable to conclude that these two cases of bladder cancer were caused by exposure to contamination in their respective well water. Certainly, drinking water over a lifetime with the highest level of DNT found in a Barksdale private well can increase a person's theoretical risk of developing liver cancer; however, DHFS regards the increased cancer risk from a lifetime of drinking water with the highest measured level of DNT as very low and not significant.

Breast Cancer

Questions have been raised by residents about the amount of breast cancer in the Barksdale area. DHFS did not find a sign of an unusual number of breast cancer case among residents who were possibly or actually exposed to site-related contamination. Studies by others have not found any evidence that DNT increases the risk to breast cancer in humans or laboratory animals.

**Table 5: Reported and Expected Breast Cancer Cases and Deaths**  
 Selected Wisconsin Counties & Zip Codes  
 1989 through 1995

Location of Residence	Number of Reported Cases	Expected Number of Cases	Number of Deaths	Expected Number of Deaths
Bayfield County	65	83	20	25
Washburn (54891)	17	19	6	5
Ashland County	80	98	27	26
Ashland (54806)	48 *	72	17	19

Note: \* - difference between observed and expected is significant (p < 0.05)

In 1998, DHFS reported on breast cancer incidence and mortality for Wisconsin (33), with data examined for the period 1989 to 1995, by county and zip code. For Washburn and Ashland zip codes, as well as their respective counties, there was not an unusual number of breast cancer cases or deaths (Table 5). The number of breast cancer cases were fewer than expected for 1) the Washburn zip code, 2) Bayfield County, 3) the Ashland zip code, and 4) Ashland County. For the Washburn zip code, there were 17 cases, with 19 expected. For the Ashland zip code, 48 cases were reported, with 72



expected, with the difference being significant. Regarding breast cancer deaths, the number of deaths were fewer than expected for Bayfield County and the Ashland zip code. The number of breast cancer deaths were more than expected for the Washburn zip code (6 observed and 5 expected) and Ashland County (27 observed and 26 expected), but these differences were not significant. The report also noted that the Wisconsin age-adjusted breast cancer mortality rate was ranked 15<sup>th</sup> among the 50 states, slightly above the U.S. age-adjusted rate, but the difference was not significant.

DHFS next reviewed breast cancer cases reported between 1979 and 2002 to the Wisconsin Cancer Reporting System (CRS). CRS data identified five cases of breast cancer in the immediate vicinity of the former DuPont Barksdale property. The reported residences for two cases were outside of the areas where site-related contamination has been found in private well water. The other three breast cancer cases cited addresses where site-related contaminants were found at least once in private well water. At one of these wells, DNT was found only once and at a level below its Wisconsin Enforcement Standard. For the other two affected wells, the levels of DNT have been regularly found above the Wisconsin Enforcement Standard. As discussed previously, these DNT levels are not a health hazard and do not pose a significant, increased cancer risk.

Other Cancers

Several community members noted that they knew of neighbors who had pancreatic cancer and cancers of the digestive tract. DHFS did not find any indication of an unusual amount of these cancers among Barksdale area residents who are may have been or were exposed to site-related contamination. It should be noted that toxicological and epidemiologic studies have not found any evidence that DNT increases the risk of these specific cancers. The known risk factors for stomach and colorectal cancers are related to diet. There are no known environmental risk factors for pancreatic cancer.

**Table 6: Age-adjusted<sup>s</sup> Death Rates and Number of Deaths for Pancreas, Stomach, & Colon Cancers**  
State of Wisconsin & Bayfield County  
1979 to 1998

Type of Cancer	Age-Adjusted Death Rate (per 100,000 deaths)		Number of Deaths	
	Wisconsin	Bayfield County	Wisconsin	Bayfield County
Pancreas	10.4	14.0	10,050	50
Stomach	5.9	6.5	5,659	23
Colon	20.7	20.5	19,935	71

Source: CDC Wonder: Compressed Mortality File Summary 1979-1998

For pancreatic, stomach, and colon cancers, DHFS reviewed available age-adjusted death rates for Bayfield County (Table 6). When compared against rates for Wisconsin, the Bayfield County death rates for stomach and colon cancer were not unusual. However, the Bayfield County death rate for pancreatic cancer of 14.0 per 100,000 was higher than the state rate of 10.4 per 100,000.

In follow-up, DHFS next reviewed data reported between 1979 and 2002 to the Wisconsin Cancer Reporting System (CRS) for cases of pancreatic cancer, and cancers of the digestive tract. DHFS did not find any indications that suggests there is an unusual number or occurrence of these cancers in the vicinity of the former DuPont Barksdale property. For pancreatic cancer, one case was reported in the Barksdale area, but contamination has not been detected in drinking water from this individual's reported residence, nor is this home in an area where groundwater has been impacted or threatened by site-related contamination. For colorectal cancers, CRS identified four cases in the Barksdale area. For three of these cases, the reported residences are not in areas where groundwater has been impacted nor threatened by site-related contamination (one of these individuals once worked at the DuPont Barksdale Works plant, but in duties where they were probably not exposed to explosive chemicals). For the fourth case of colorectal cancer, contamination has not been found in the drinking water well at the reported residence, but a treatment system has been installed because of contamination in adjacent private wells. Finally, DHFS received a verbal report about a fifth Barksdale resident who was diagnosed with colorectal cancer. As with the fourth case, contamination has not been found at this individual's home, but a treatment system was installed because of other nearby affected private wells. DuPont's installation of drinking water treatment systems on private wells in the Barksdale area was a to either prevent a site-related exposure or, with selected unaffected wells, as a protective measure. None of the treatment systems were installed in response to the occurrence of a specific illnesses or health problem in a residence.

### **Child Health Issues**

DHFS recognizes that children are often more sensitive than adults to some contaminants and, as a result, DHFS considers child health issues when evaluating exposures to environmental contamination. Site-related contamination was in the drinking water of a number of private wells around the former DuPont Barksdale property. Children and adults drank this water, but neither were exposed to contaminants in drinking water at levels that are expected to cause adverse health effects.

## **Conclusions**

1. A number of private wells around the former DuPont Barksdale property are contaminated with low levels of site-related chemicals. Once contamination was discovered, bottled water was quickly provided and carbon treatment systems were installed on all affected drinking water wells within several months of discovery. Treatment systems were also installed on selected private wells where contamination has not been found. The treatment systems remove contaminants and provide safe drinking water.
2. Two isomers or forms of the chemical dinitrotoluene (DNT) were the only contaminants found in private wells that were above Wisconsin's groundwater Enforcement Standards. The highest levels of DNT found in private well water are not a public health hazard and do not pose a significant increased cancer risk.
3. Low levels of contamination found in the sediments and waters of creeks that flow across the former DuPont Barksdale property, however the levels found do not pose a public health hazard.
4. When the former DuPont Barksdale Works facility was fully operating, the levels of contamination in on-site creeks were probably much higher than that found in the past five years. It is possible that the previous conditions in creek sediments and surface water may have posed a unacceptable risk to people and wildlife. DHFS received reports of people who entered these creeks, even when colored waste water was present. DHFS has not received reports that these people developed health problems after they were in or near the creek. However, because of the lack of data, DHFS unable to determine whether past contamination in creeks did or did not pose a human health hazard.
5. The findings of a June 2002 draft environmental investigation report on the former DuPont Barksdale property indicate substantial contamination in soils and surface water of some former production areas that exceeds health-based screening values. The property is posted and, currently, the public does not have easy access to these areas. Other than off-site groundwater and off-site surface water run-off, at this time neighbors have little chance of being exposed to site-related contamination at levels or durations that might pose a health concern.
6. Some residents have expressed concerns that environmental contamination is causing increased health problems in the community. DHFS reviewed available cancer and death certificate data and did not find an unusual number of cancers in the community that could be associated with site-related contamination. DHFS and the Bayfield County Health Department have also spoken with residents and have not identified an unusual amount of illnesses or disease among people who had affected private wells. DHFS is

not currently planning to conduct a health study of residents in the vicinity of the former DuPont Barksdale Works property.

### **Recommendations**

1. DHFS and the Bayfield County Health Department recommend that people not go onto the property without permission and knowledge of areas where contamination is known or appears to be present. The property owners should continue to maintain the “no trespassing” placards and the existing fence around the property perimeter. Once the on-site environmental investigation is finalized, DHFS will evaluate the environmental sampling data and prepare a public health consultation<sup>§</sup>.
2. DHFS and the Bayfield County Health Department recommend and support continued sampling of private wells in the vicinity of the former DuPont Barksdale property, including the testing and servicing of treatment systems installed on private wells.
3. As data from upcoming on-site and off-site investigations are finalized and available, DHFS will evaluate the human health implications of these findings.
4. DHFS and the Bayfield County Health Department will continue meeting with concerned residents to listen to and address health concerns and issues about environmental contamination from the former DuPont Barksdale property.
5. DHFS and the Bayfield County will provide informational and educational materials for health care providers of residents to increase their understanding and knowledge about the human health implications of environmental contamination coming from the former DuPont Barksdale property.

### **Public Health Action Plan**

The following actions either have been or will be performed to meet the needs expressed by the recommendations of this public health assessment. The Wisconsin Department of Health and Family Services, in cooperation with ATSDR, will:

1. Continue to consult with the Bayfield County Health Department, the Wisconsin DNR, DuPont, and interested community members on environmental health issues that might arise as any action or new information becomes available about the former DuPont Barksdale property, particularly related to ongoing results from private wells and future investigations.

2. Once on-site environmental sampling data is finalized, prepare a public health consultation regarding the human health implications of on-site contamination.
3. Provide continuing health education to residents as new information or data becomes available concerning public health issues related to the former DuPont Barksdale property.
4. Continue to seek out and address the health concerns of Barksdale residents, in coordination with the Wisconsin DNR and the Bayfield County Health Department.
5. Continue to cooperate with the Wisconsin DNR and Bayfield County Health Department in addressing environmental health and public health issues that pertain to the former DuPont Barksdale property and the community.
6. Offer professional education opportunities to practicing health care providers about the public health issues related to the former DuPont Barksdale property.

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## **Appendix A – Glossary**

**Age-Adjusted Rate:** A measure of the number of diseases or deaths in one population, that is adjusted by the age structure of that population, and will allow the comparison with the disease or death rates of another population that has a different age structure.

**ATSDR:** Agency for Toxic Substances and Disease Registry – A federal health agency, based in Atlanta, Georgia, that deals with hazardous substance and waste site issues. ATSDR gives people information about harmful chemicals in their environment and tells people how to protect themselves from coming into contact with chemicals.

**Cancer:** A group of diseases which occur when cells in the body become abnormal and grow, or multiply, out of control.

**Carcinogen:** Any substance shown to cause tumors or cancer in experimental studies.

**Comparison Value:** Concentrations or the amount of substances in air, water, food, and soil that are unlikely, upon exposure, to cause adverse health effects. Comparison values are used by health assessors to select which substances and environmental media (air, water, food and soil) need additional evaluation while health concerns or effects are investigated.

**DHFS:** The Wisconsin Department of Health and Family Services. One of the largest Wisconsin state agencies that includes the Division of Public Health.

**Dose:** The amount of a substance to which a person may be exposed, usually on a daily basis. Dose is often explained as “amount of substance(s) per body weight per day”.

**DNR:** Wisconsin Department of Natural Resources – The lead state agency for implementing the laws of the state and, where applicable, the laws of the federal government that protect and enhance the natural resources of our state.

**Dinitrotoluene (DNT):** Any of five isomeric compounds, with a yellow to red crystalline appearance, that are intermediates in the making of trinitrotoluene. At certain concentrations of DNT can be toxic. DNT causes certain cancers in laboratory animals, but has not been clearly linked to causing cancer in humans.

**EPA:** U.S. Environmental Protection Agency – The federal agency that develops and enforces environmental laws to protect the environment and the public’s health.

**Epidemiology:** The study of the different factors that determine how often, in how many people, and in which people will disease occur.

**Exposure:** Coming into contact with a chemical substance. There are three exposure routes: 1) breathing; 2) ingestion, or eating and drinking; and, 3) touching or dermal contact.

**Exposure Pathway:** A description of how a chemical can move from its source (where it began) to where and how people can come into contact with (or get exposed to) the chemical.

**Geoprobe:** A hydraulic groundwater and soil sample collection probe that is advanced by direct pushing, rather than drilling, down through the ground and into water-bearing rock and soils.

**Isomers:** Different structural forms of the same chemical molecule.

**LOAEL:** Lowest Observed Adverse Effect Level – The lowest dose of a chemical in a study, or group of studies, that has caused harmful health effects in people or animals.

**Media:** Soil, water, air, plants, animals, or any other parts of the environment that can contain contaminants.

**MRL:** Minimal Risk Level – An estimate of daily human exposure – by a specified route and length of time – to a dose of chemical that is likely to be without a measurable risk of adverse, noncancerous effects. A MRL does not predict when adverse health effects will occur.

**NOAEL:** No Observed Adverse Effect Level – The highest dose of a chemical in a study, or group of studies, that did not cause harmful health effects in people or animals.

**Piezometer:** A specialized type of groundwater monitoring well drilled deeper into aquifers that examines various characteristics of groundwater flow.

**Public Health Assessment (PHA):** A report that is a comprehensive evaluation of chemical contamination at a hazardous waste site and assesses the past, current or future impact on the health of people who live and work nearby. The report also examines whether further public health actions or studies are needed to evaluate or prevent human exposures or health effects.

**Public Health Consultation:** A brief report that addresses a specific question or request related to a hazardous substance or facility. The report sometimes addresses a time-critical element that may require a rapid response. Therefore, a public health consultation is often more limited in scope than a public health assessment.

**Public Health Hazard:** The presence of certain physical features or potential for exposure to levels of site-related chemicals that could result in adverse health effects.

**Reference Dose (RfD):** An EPA established value that is an estimate, with built in safety factors, of the maximum daily, life-time exposure to a chemical that is not likely to cause harmful health effects.

**Statistics:** A branch of the math process of collecting, looking at, and summarizing data or information.

**Synergistic effect:** A health effect from an exposure to more than one chemical, where one of the chemicals worsens the effect of another chemical. The combined effect of the chemicals acting together are greater than the effects of the chemicals acting by themselves.

**Toxicology:** The study of the harmful effects of chemicals on humans or animals.

**Trichloroethane, 1,1,1- (TCA):** A chlorinated volatile organic compound, commonly used in industrial and commercial cleaning products, such as degreasing agents, paints, glues, dry cleaning fluid, and household cleaning products. Not known or suspected of causing cancer in humans.

**Trinitrobenzene (TNB):** A yellow, crystalline compound that is a byproduct from the production of trinitrotoluene. At certain concentrations TNB can be toxic, but is not known to cause cancer in humans.

**Trinitrotoluene, -2,4,6 (TNT):** A yellow, crystalline compound that is widely used as a high explosive. At certain concentrations TNT can be toxic, but is not known to cause cancer in humans.

**Volatile Organic Compounds (VOCs):** A large number of low-molecular weight carbon-hydrogen compounds that are liquids at room temperature, but have a low vapor pressure and easily become vapors or gases. Many VOCs are commonly used as solvents.

**Wisconsin Cancer Reporting System (CRS):** Located with DHFS, A population-based registry guided by statutory mandate to collect, manage, and analyze cancer data on Wisconsin residents. The registry reports the occurrence of new cancers (incidence) and death rates (mortality) for the state and local areas.

**Wisconsin Groundwater Quality Enforcement Standard (ES):** As detailed under Wisconsin Administrative Code NR140, the numerical concentration of a polluting substance in groundwater that provides adequate safeguards to protect public health, yet at which action is needed to prevent human exposure.