

2 SITE CHARACTERISTICS

2.1 Site Geology and Hydrogeology

The following summary of the regional and local geology and hydrogeology is provided as an overview for reference purposes. Details are provided in the reports issued related to the Upland OU and River OU, summarized in the reference section of the Technical Letter Reports (NRT, April and March, 2007). Information obtained from the 2008 investigation activities is incorporated, as appropriate.

2.1.1 Regional Setting

Near surface geology of Sheboygan County consists of unconsolidated glacial drift comprised of unsorted till as ground and end moraines, outwash as sorted and stratified sand and gravel, and glacial lake deposits as organic materials and stratified clays, silt and sand. Low permeable soils are indicative of the high clayey tills and lake bed deposits which blanket the majority of Sheboygan County. Moderate and high permeable soils are typically associated with the less clayey till, outwash and end moraine. The glacial drift is Pleistocene to Recent in age and ranges in thickness from 50 to 200 feet (Skinner and Borman, 1973).

Regionally, unconsolidated deposits in the area are generally less than one hundred feet thick (Skinner and Borman, 1973). Based on available logs for wells within approximately one-half mile of the Site, unconsolidated deposits in the area range in thickness from approximately 50 to 95 feet.

Bedrock geology beneath the glacial drift consists of Silurian and Ordovician aged sedimentary dolomite, shale and sandstone, and Cambrian sandstones overlying Precambrian crystalline rock. The Silurian aged dolomite is generally undifferentiated and comprised predominantly of the Niagara dolomite. This dolomite is fine to medium grained containing sandy chert nodules. These dolomites lie approximately 100 feet below ground surface (bgs) in the Sheboygan County area and are approximately 750 feet thick.

Three aquifer systems exist beneath the Site area and are (from shallowest to deepest): the sand and gravel, the Niagara, and the sandstone. Skinner and Borman's (1973) description of these units is presented below.

The sand and gravel aquifer in the Site area consists of buried highly permeable glacial sand and gravel and is most significant where thicknesses are greater than 50 feet. Local glacial sands and gravel may yield significant amounts of water for local use. Thicknesses range from 0 to 300 feet. The top of this aquifer ranges from 0 to 140 feet bgs.

The Niagara aquifer is the principal aquifer overlying the Maquoketa shale and consists of Silurian aged dolomites approximately 300 feet thick. The majority of the aquifer is under artesian conditions due to the overlying confining clayey till. In areas where the clayey till is not present, the aquifer is hydraulically connected with the overlying sand and gravel aquifer. The main source of recharge for the Niagara aquifer is from infiltration through the sand and gravel aquifer or through the overlying glacial outwash and till. Natural discharge occurs into Lake Michigan, nearby rivers and through wells. The Niagara aquifer is used for local domestic wells.

The sandstone aquifer is approximately 600 feet thick beneath Sheboygan County and includes Ordovician and Cambrian units beneath the confining Maquoketa shale and above the Precambrian crystalline rock. This aquifer is approximately 600 feet bgs, beneath Sheboygan County (Skinner and Borman, 1973). Local use of the sandstone aquifer for drinking water is low to moderate.

2.1.2 Local Setting

Surficial sediments in the Sheboygan River are dominated by fine-grained materials with varying amounts of organic material. These soft/loose sediments are organic silt/clay to organic sand deposits. Sandy deposits are common in the upstream portions of the investigation area. The soft/loose sediments are organic silt/clay to organic sand deposits that overlie silt and clay soils. The soft/loose sediments ranged in thickness from approximately 5 to 89 inches. In some areas, the soft sediment was overlain by 5 to 18 inches of loose, well-graded medium sand. Much of this sand was likely deposited during regional flooding that occurred in June 2008. The soft/loose sediment layer was encountered from sample location BKG6 at the upstream end of the investigation area (Figure 5), downstream to the last transect sampled (T16) located approximately 800 feet downstream of the Pennsylvania Avenue Bridge.

Upstream of BKG-6 sample location, the majority of the river bed is composed of coarse sand and gravel which could not be penetrated with the vibrocore.

Underlying the soft/loose sediments are soils, generally comprised of clay and silt with varying amounts of sand and gravel (referred to as parent material). A laterally continuous layer of clay, interpreted as glacial diamicton, underlies the parent material and upland soils.

Flow in the shallow groundwater is generally to the west-southwest, mimicking ground surface contours with a general flow direction toward the Sheboygan River. As part of the Upland OU remedial action (refer to Appendix B and NRT, 2003), a state-of-the-art Waterloo® barrier system was installed to provide a barrier with a hydraulic conductivity of 1×10^{-7} cm/sec or less. Therefore, localized shallow groundwater does not discharge directly to the Sheboygan River. The deeper groundwater flow is also generally west-southwest.

2.2 Site Topography and Drainage

Based on the United States Geologic Survey (USGS) Sheboygan North Quadrangle, photo revised 1973, relief within one mile of the Site is approximately 95 feet, ranging from approximately 580 feet mean sea level (msl) at Lake Michigan to approximately 675 feet msl northwest of the Site in the City of Sheboygan. The low water datum for Lake Michigan at Sheboygan is 578 feet msl. [It is assumed that the msl datum referenced on the USGS maps is actually the North American Vertical Datum of 1988 (NAVD88). NAVD88 is the datum reference used for the remainder of this Report, unless otherwise noted.]

The ground surface elevation for the majority of existing Site groundwater monitoring wells ranges between elevation 588 and 591. The upland Site slopes downward from Water Street to the Sheboygan River. The elevation of the Sheboygan River adjacent to the Site varies depending on seasonal fluctuations and the level of Lake Michigan.

2.3 Climate

The Site is located in eastern Wisconsin, which has a continental climate characterized by moderate winters and warm summers. Climate conditions for the Sheboygan area were gathered by Weather

Station 477725 of the Wisconsin State Climatology office (<http://www.aos.wisc.edu/~sco/>). The weather station is located at latitude 43°45'N, longitude 87°43'W at elevation 648 in Sheboygan, Sheboygan County. The monthly average temperatures for the period of record 1971 through 2000 in the Sheboygan area are summarized in the table below.

Temperature Summary

Station ID: 477725 SHEBOYGAN, WI

1971-2000 Averages

Element	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Max °F	28.6	33.0	42.0	52.7	64.7	75.6	81.4	79.7	71.9	59.4	45.0	33.1	55.6
Min °F	13.2	18.1	26.6	35.8	45.2	54.5	61.4	61.3	53.6	42.7	31.3	19.3	38.6
Mean °F	20.9	25.6	34.3	44.3	55.0	65.1	71.4	70.5	62.8	51.1	38.2	26.2	47.1

Annual precipitation averages approximately 31.90 inches per year with the average snowfall being 48.3 inches per year. The monthly average precipitation and snowfall rates for the period of record 1971 through 2000 are summarized in the tables below.

Precipitation Summary

Station ID: 477725 SHEBOYGAN, WI

1971-2000 Averages

Element	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Precip (in)	1.76	1.33	2.25	2.99	2.90	3.28	3.19	4.08	3.29	2.51	2.43	1.89	31.90

2.4 Sheboygan River Characteristics

The Sheboygan River is classified a Class C surface water by the WDNR. Class C surface waters are not suitable as drinking water sources; however, they are suitable for fishing and fish propagation. Class C waters are also designated for primary (e.g., swimming) and secondary (e.g., boating) contact recreation. The River OU is within a portion of the Sheboygan River classified as a warm water sport fish community (WWSF). (A WWSF community includes surface waters capable of supporting a community of warm water sport fish or serving as a spawning area for warm water sport fish.)

The Sheboygan River drains 427 square miles (mi²), with its headwaters located in Fond du Lac County. Near Lake Michigan, the Sheboygan River is a gaining stream that receives groundwater and surface water from the Sheboygan area and discharges into Lake Michigan. Near the Site, the river varies in width from approximately 180 feet on either the east or west side of Boat Island to 300 feet just upstream of Boat Island. Boat Island is in the approximate center of the river resulting in an east and a west channel adjacent to the Upland OU. A gauging station active from October 1993 through September 1995 recorded an average flow rate of 177 cubic feet per second (cfs) at the mouth of the river (approximately one mile downstream from the Upland OU).

The river bed elevation within the River OU ranges from approximately elevation 569 to 577 based on the 2008 RI sediment sampling data. Water depths within the River OU ranged from approximately 1.5 to 9.5 feet at the time. The river water elevation, measured from the Site staff gauge (Figure 2) during RI sediment poling, ranged from 578.4 to 578.8.

Flow of the Sheboygan River is generally easterly, toward the lake, but southerly past the Site, and is controlled by upstream dams located at Sheboygan Falls and Kohler. The USGS operated two automated stream gauging stations: one near Interstate Highway I-43 (currently operational) and the other near the river mouth (no longer in operation). The stream flow data discussed below was collected from Hydrologic Station # 040860041, located at “Sheboygan River at Mouth at Sheboygan, WI.” The station was located over one mile downstream of the WPSC Site, with conditions similar to those of the river at the Site.

Daily mean discharge data between October 1993 and September 1995 are summarized below:

Summary of Flow Conditions	Flow (cfs)	Date
Daily Average for 2 year Record	177	---
Daily Maximum for 2 year Record	1,440	Mar. 23, 1994
Daily Minimum for 2 year Record	32	Sept. 15, 1995

In addition, the monthly average stream flow for this two-year period is set forth below:

Month	Mean Daily Discharge (in cfs)	Month	Mean Daily Discharge (in cfs)
January	81	July	63
February	212	August	74
March	581	September	50
April	409	October	113
May	206	November	131
June	81	December	120

During 1993 to 1995, highest average daily flow rate (581 cfs) occurred in March. The lowest average daily flow rate (50 cfs) occurred in September. The variability in water levels and stream flow in the Sheboygan River is the result of both snowfall accumulation (and the resulting spring run off) and precipitation during late spring/early summer.

The 1991 FEMA map indicates the 100 year floodplain is at elevation 584 msl.

Real-time water data collected at USGS's gauging station 04086000, located on the Sheboygan River at Sheboygan, WI, approximately 0.5 miles upstream of the State Highway 28 Bridge and 3.9 miles upstream of the mouth of the Sheboygan River are included in Appendix C. The data include conditions 30 days prior to the sediment poling activities through the completion of the sediment and surface water sampling activities. Although this gauging station is located upstream from the site, it does provide a relative comparison of river conditions.

As summarized in Appendix C for the USGS staff gage located 3.9 miles upstream from the mouth of the Sheboygan River, heavy rainfalls and resulting river flows were recorded in the Sheboygan area in early June 2008. As a result, the fourth highest flood stage on record occurred at a crest of 11.08 feet. A river stage of 11.8 feet is considered the 25 year flood. The highest crest on record is 12.02 feet, just below the 50 year flood. A crest stage of 10 feet indicates "Moderate Flood Stage" and a stage of 12 feet indicates "Major Flood Stage". The flow on June 9, 2008 was 5,970 cfs, significantly higher than flow in May which ranged from 109 to 238 cfs (i.e., normal conditions). The increased flow resulted in deeper water (allowing for better access during early June 2008 bathymetric surveys immediately following the storm events), and damage to docks (e.g., pushed aside) and boats (e.g., tipped) in the area. Increased flow was observed through the end of June. As noted in Section 3, RI field sediment sampling activities were performed following these early June flood flows, as river flow returned to seasonal conditions.

The May 2000 Record of Decision for the Sheboygan River and Harbor Superfund Site indicated that boat propeller wash may cause localized scour of up to 1 foot of sediment in water 5 feet or more in depth, based on historic observations of bathymetry and hydrodynamic modeling. In USEPA's selection of remedial alternatives to address PCBs, localized scour from boat propeller wash was anticipated to be no more than 2 feet in water depths less than 5 feet.

2.5 Population and Land Use

The County of Sheboygan includes approximately 514 square miles of area, with agricultural land use being the dominant classification. The population of Sheboygan County is approximately 112,646 people (2000 Census), with the majority of people residing in incorporated areas. The greatest concentrations of people are located in the City of Sheboygan, Sheboygan Falls, Kiel and the Village of Kohler.

The City of Sheboygan encompasses 14.5 square miles. The population base in Sheboygan is 50,792 (2000 Census). The City of Sheboygan has a mixture of agricultural, residential, and industrial land use, with residential use being dominant.

The Upland OU is now within Riverside Park with landscaped lawn, recreational areas, seating, and sidewalks. The Park generally extends from the river on the west to 10th Street/North Water Street on the east, and from the extension of Center Avenue on the south to Wisconsin Avenue on the north. The Park footprint includes the former MGP property and abandoned right-of-ways for North Water Street, Center Street, and New York Avenue.

An asphalt parking lot is located on the north side of the Park, with access from Wisconsin Avenue. A small building constructed adjacent to this parking lot is shared by the Outboard Club and WPSC. WPSC's use is related to the remediation work in the Upland OU, while the Outboard Club uses it to store equipment. The adjacent parking lot provides access to shoreline boat docks as well as additional docks on Boat Island. North of the Park adjacent to the river is the former toy factory building, which has been rehabilitated into multi-tenant housing.

South of the Park is a narrow parcel with a condominium unit at the northwest corner of Water Street and Pennsylvania Avenue. The Pennsylvania Avenue Bridge crosses the river just downstream of the Park and former MGP. North Commerce Street parallels the river on its west side, with industrial/commercial buildings located between the street and river.

Alternative Programs School, Jefferson School, Longfellow Elementary School, Sheboygan Area District School, Sheridan Elementary School, and Trinity Lutheran School are located within one half mile of the former MGP facility.

2.6 Cultural and Natural Resources

Appendix C of the RI/FS Work Plan (NRT, December 2008) provides documentation on the Cultural and Natural Resources.

A review of the Natural Heritage Inventory (NHI) Database for Township 15 Range 23 North Section 23 was performed by IBS. No federal or state threatened or endangered species or state species of special concern were identified during the review.

A similar review of the state Wisconsin Historic Preservation Database (WHPD), a resource for accessing archaeological and historical information, was performed by IBS. No archaeological sites were identified during the review.