

Tyco Fire Products LP

GREEN BAY SURFACE WATER INVESTIGATION WORK PLAN

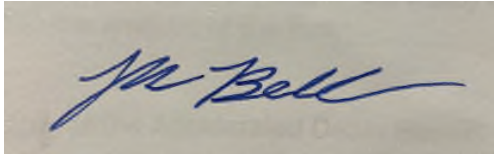
Tyco Fire Technology Center
Marinette, Wisconsin

BRRTS No. 02-38-580694

October 2019



**GREEN BAY SURFACE
WATER
INVESTIGATION WORK
PLAN**



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ACRONYMS AND ABBREVIATIONS

AFFF	aqueous film-forming foams
APE	Area of Potential Effect
ERR	Endangered Resource Reviews
ft	feet
FTC	Fire Technology Center
MS	matrix spike
MSD	matrix spike duplicate
NAD	North American Datum
NAVD	North American Vertical Datum
NTU	nephelometric turbidity unit
OTA	Outdoor Testing/Training Area
PFAS	per- and poly-fluorinated alkyl substances
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
R&D	Research and Development
RCL	Residual Contaminant Level
SPLP	Synthetic Precipitation Leaching Procedure
TOC	total organic carbon
TSS	total suspended solids
UCL	upper confidence limit
USEPA	United States Environmental Protection Agency
VAP	vertical aquifer profiling
WDNR	Wisconsin Department of Natural Resources

1 INTRODUCTION

On behalf of Tyco Fire Products LP (Tyco), Arcadis US, Inc. (Arcadis) has prepared this Green Bay Surface Water Investigation Work Plan (work plan) to continue investigation of the nature and extent of per- and poly-fluoroalkyl substances (PFAS) related to the Ansul Fire Technology Center (the Site), located at 2700 Industrial Parkway South, Marinette, Wisconsin (**Figure 1**). The investigation work proposed herein is based on evaluation of the data and in response to the Wisconsin Department of Natural Resources (WDNR) December 7, 2018 letter stating that additional investigation of PFAS must be completed in the area of the Site.

A phased approach will be used for the surface water investigation, consisting of collecting a first round of hydrodynamic data to inform future surface water sampling locations. The hydrodynamic data will be reviewed for water circulation patterns to select surface water sample location(s). Once the Ditch B Interim Measure is installed, operational, and performance monitoring data have been reviewed, then the surface water sampling and a second hydrodynamic survey will be performed. It is assumed that the hydrodynamic survey locations in the second survey will be the same as the first survey. However, locations may be modified based on the results of the first survey. Investigation activities described in this work plan will consist of surface water depth and flow measurements near the Marinette shoreline of Green Bay, which is a component of Lake Michigan, located along the eastern shore of Wisconsin, and the Upper Peninsula of Michigan.

2 SITE BACKGROUND

A description of the Site, regional and site-specific hydrodynamics, and previously completed investigation activities is provided in this section.

2.1 Site Description and History

The Site is a fire suppressant training, testing, research, and development facility built in the early 1960s. The Site occupies approximately 380 acres with approximately 9 acres used as the Outdoor Testing/Training Area (OTA). The OTA includes the Firefighting School area (where firefighting scenarios are simulated) and the Research and Development (R&D) area (where product testing occurs). The location of the OTA is presented on **Figure 2**. The remaining area of the Site is used for manufacturing, warehousing, office, classroom, parking, or is undeveloped.

The Site is bordered by industrial and commercial properties to the west and industrial, commercial, and Marinette School District property to the north. Agricultural land, a cemetery, a golf course, a community center, and undeveloped land owned by the University of Wisconsin Board of Regents and private owners border the Site to the east and south.

Aqueous film-forming foams (AFFF) historically have been used at the OTA as part of R&D, quality testing, and firefighting training activities. While the presence of multiple PFAS compounds has been included in historical and recent investigation analyses, the primary focus of the recent site investigation has been on perfluorooctanoic acid (PFOA) and/or perfluorooctanesulfonic acid (PFOS), which have

GREEN BAY SURFACE WATER SITE INVESTIGATION WORK PLAN

been present in various formulations of these foams. AFFF has not been sprayed outdoors at the OTA since November 2017.

2.2 Recent Investigation Work

The results of recent PFAS investigations have been provided previously in the following documents:

- 2016 Site Investigation Report (BRRTS No. 03-38-001345; Arcadis 2016)
- 2018 Revised Site Investigation Work Plan (BRRTS No. 02-38-580694; Arcadis 2018a)
- 2018 Site Investigation Report (BRRTS No. 02-38-580694; Arcadis 2018b)
- 2019 Data Summary Report (BRRTS No. 02-38-580694; Arcadis 2019)

2.3 Hydrodynamics

The hydrodynamics of Green Bay near the Site are summarized in the following three sections: Bathymetry, Circulation and Thermal Stratification.

Bathymetry

Lower Green Bay, defined as the portion of Green Bay from the Fox River to Peshtigo Reef Light, is relatively shallow, as shown on **Figure 3**. Water depths of Lower Green Bay near Pensaukee Shoal range between 42 to 47 feet (ft). Upper Green Bay is defined as the portion of Green Bay from the Peshtigo Reef to Lake Michigan. Water depths exceed 100 feet in the central areas of Upper Green Bay (Wisconsin Department of Natural Resources [WDNR], 2003).

The Green Bay shoreline near Marinette is shallow, with water depths adjacent to land ranging from 1 to 4 feet. Water depth grades gradually from west to east, reaching a depth of approximately 30 feet at 2 miles from the shore. An unnamed water area (shown on the inset in Figure 3) with water depths as shallow as 1 ft is bordered by West Bay Shore Street to the west, Red Arrow Park to the north, and the Menekaunee Shoal to the East. On the east side of Green Bay, along the western shoreline of the Door Peninsula, the slope of the bay bottom increases steeply to Monument Shoal (National Oceanic and Atmospheric Administration [NOAA], 2018).

Circulation

General surface water current patterns are defined by the northern and southern counterclockwise circulations in Upper and Lower Green Bay, respectively, as shown on **Figure 3**. From the northern end of Upper Green Bay, the northern rotation carries water from Lake Michigan to the western shore of Green Bay, then south towards Peshtigo Reef Light. From Peshtigo Reef Light, the current turns east towards Sturgeon Bay, and then north along the Door Peninsula to the passages between Green Bay and Lake Michigan. The southern rotation flows from the Fox River north along the Door Peninsula to Little Sturgeon Bay. From Little Sturgeon Bay, the flow turns west to Peshtigo Reef Light, then south along the western shore to the Fox River. Mixing between the northern and southern circulations occurs approximately between the Peshtigo Reef Light, Little Sturgeon Bay and Sturgeon Bay at the dividing line between Upper and Lower Green Bay (WDNR 2003).

The Menominee River discharges to the northern circulation between Menominee and Marinette. The flow from the Menominee River, and the Red Arrow Peninsula and Menekaunee Shoal are assumed to isolate the unnamed shallow water area from the northern circulation current by diverting the circulation flow to the southeast. The bay water flow direction within the unnamed shallow water area is unknown. Ditches B, C, and D discharge to Green Bay in the unnamed shallow water area (**Figure 4**).

Thermal Stratification

Thermal stratification occurs in Green Bay from spring through fall. Warm water above the thermocline is carried from southern Green Bay to Lake Michigan. Below the thermocline, cooler water is transported from Lake Michigan to the south towards the Fox River (Gottlieb, 1992). Continuous stratification occurs in depths greater than 50-66 feet during the summer season, and discontinuously in depths shallower than 50-66 feet (Bravo, 2017). During fall, the thermocline is deepened due to strong vertical mixing, until conditions are mixed throughout the water column. The mixed conditions will last into spring (Beletsky and Schwab, 2001).

3 GENERAL FIELD ACTIVITIES

The following field activities apply to all investigation events described in this work plan.

3.1 Access

Investigation locations are planned in Green Bay, which is a navigable public body of water. Access to the public water will be coordinated through public parks or private marinas near the investigation locations.

4 SURFACE WATER INVESTIGATION

Surface water activities will be performed from a boat, except where water depths are too shallow to allow access. Shallow water activities will be performed by wading from nearby shoreline. Investigation activities will include surveying the sample location, water depth and flow measurement, and collection of water quality parameters, as summarized in the following sections. The proposed investigation locations are presented on **Figure 4** and **Table 1**.

4.1 Surveying

All surface water sample locations will be surveyed using a handheld global positioning system (GPS). The water surface elevation of each location will be referenced to the North American Vertical Datum of 1988 (NAVD88) system, and the horizontal coordinates will be reported in the Wisconsin State Plane North American Datum 1983 (NAD83) – Wisconsin Central 4802 Zone system as part of the survey work.

4.2 Surface Water Depth and Flow

Surface water depth and flow measurements will be completed. Surface water depth will be measured via poling using a measuring rod, graduated pole, or via sounding using a weighted tape, depending on the depth of water. The water depth data will be used to assess surface water thickness, as well as the sediment surface elevation.

GREEN BAY SURFACE WATER SITE INVESTIGATION WORK PLAN

Surface water flow will be measured using a portable flow meter (PFM). The PFM will be attached to a pole and gradually lowered from the water surface to the sediment surface. Velocity measurements will be collected every 1-foot by gradually spinning the meter until the maximum positive flow reading is observed. The direction of the maximum positive flow measurement will be recorded using the GPS or a compass. The velocity and flow direction will be used to assess surface water flow patterns.

4.3 Surface Water Quality Parameters

Surface water quality parameters (pH, specific conductance, temperature, and turbidity) will be measured. These data will be used to assess surface water conditions at the time of sampling.

At each sample location a multi-parameter water quality meter (WQM) will be lowered below the water surface between 0 and 0.5 ft, allowed to stabilize, and the parameter results recorded in field notebook.

5 REPORTING

Field investigation information will be communicated to WDNR through interim data summaries and in a future Supplemental Site Investigation Report. Interim data summaries to the WDNR will include recommendations as to whether further characterization or monitoring work is needed. Submission of the Supplemental Site Investigation Report is not anticipated until delineation of impacts in all media of concern is sufficient to meet the requirements as detailed in Chapter NR 716 of the Wisconsin Administrative Code.

6 ANTICIPATED SCHEDULE

The anticipated schedule for field investigation and reporting is as follows:

- Field sampling:
 - Green Bay Hydrodynamic Survey: following approval, Spring 2020
- Reporting:
 - Interim data summaries will be provided to WDNR after completion of significant investigation elements.
 - Supplemental Site Investigation Report submitted to WDNR: approximately October 2020, or as adjusted, if necessary, per the considerations presented in Section 6 above.

In the event the schedule is affected by weather, access, or other factors, WDNR will be provided an updated schedule for the activities.

7 REFERENCES

Arcadis. 2016. Site Investigation Report. Ansul Fire Technology Center Site. 2700 Industrial Parkway, Marinette, Wisconsin. BRRTS No. 03-38-001345. November 22, 2016.

GREEN BAY SURFACE WATER SITE INVESTIGATION WORK PLAN

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WDNR. 2018. September 2018 Site Investigation Report Review – Site Investigation Incomplete Tyco Fire Technology Center. Letter dated December 7, 2018.

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8 NR 712.09 CERTIFICATION

I, Benjamin J Verburg hereby certify that I am a registered professional engineer in the State of Wisconsin, registered in accordance with the requirements of ch. A-E 4, Wis. Adm. Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wis. Adm. Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code.

B. Verburg, Principal Engineer, 31794

Signature, title and P.E. number



I, Christopher Peters hereby certify that I am a hydrogeologist as that term is defined in s. NR 712.03 (1), Wis. Adm. Code, am registered in accordance with the requirements of ch. GHSS 2, Wis. Adm. Code, or licensed in accordance with the requirements of ch. GHSS 3, Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code.

C. Peters 1054-013

Signature and title and P.G. number



TABLE



Table 1
Proposed Green Bay Surface Water Locations
Tyco Fire Technology Center
Marinette, Wisconsin

Proposed Location	Northing	Easting	Depth	Flow	Water Quality Parameters	Surface Water Sample
SW-B1	460238.41	2585689.29	X	X	X	X
H-GB-1	461748.32	2586629.43	X	X	X	--
H-GB-2	459975.38	2587261.55	X	X	X	--
H-GB-3	458876.45	2585566.19	X	X	X	--
H-GB-4	458504.21	2586798.43	X	X	X	--
H-GB-5	459277.05	2589039.12	X	X	X	--
H-GB-6	461029.41	2588072.84	X	X	X	--
H-GB-7	464525.32	2589495.39	X	X	X	--
H-GB-8	463077.01	2587788.46	X	X	X	--
H-GB-9	461964.92	2590478.17	X	X	X	--
H-GB-10	459973.50	2592029.93	X	X	X	--
H-GB-11	456456.18	2586340.15	X	X	X	--
H-GB-12	457801.04	2588822.96	X	X	X	--

Notes

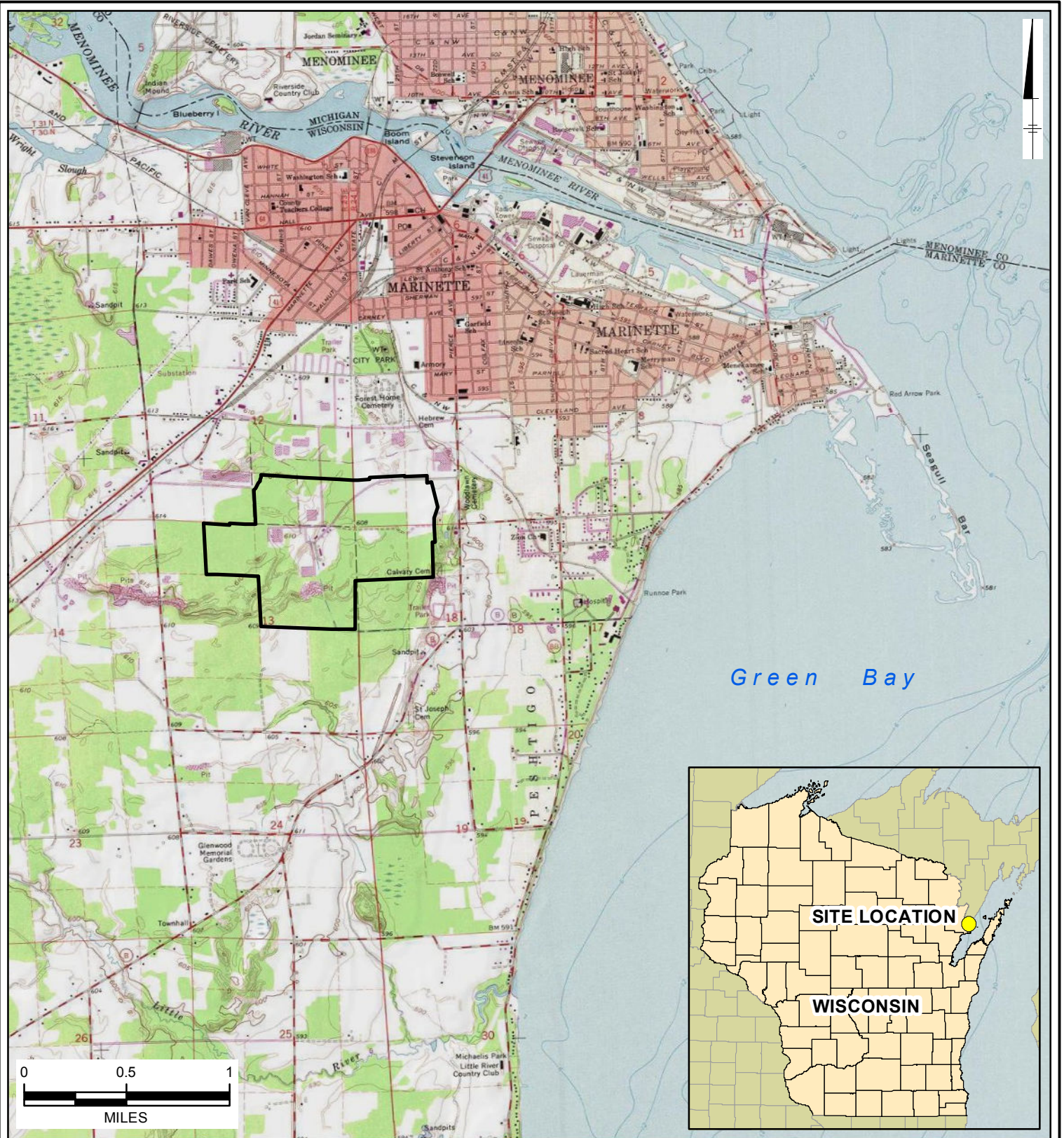
1. Northing and Easting coordinates are in NAD83 State Plane Wisconsin Central Feet.
2. Water quality parameters include pH, specific conductance, temperature, and turbidity .

Acronyms

H = Hydrodynamics
 SW = Surface Water

FIGURES





LEGEND:

 APPROXIMATE SITE PROPERTY BOUNDARY

NOTES:

1. TOPOGRAPHIC MAP SOURCE: COPYRIGHT: © 2013 NATIONAL GEOGRAPHIC SOCIETY, I-CUBED, ACCESSED OCTOBER, 2019.

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MARINETTE, WISCONSIN


SITE LOCATION

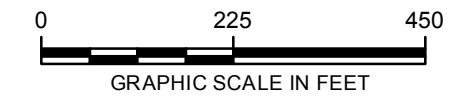
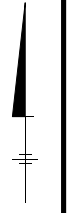


**FIGURE
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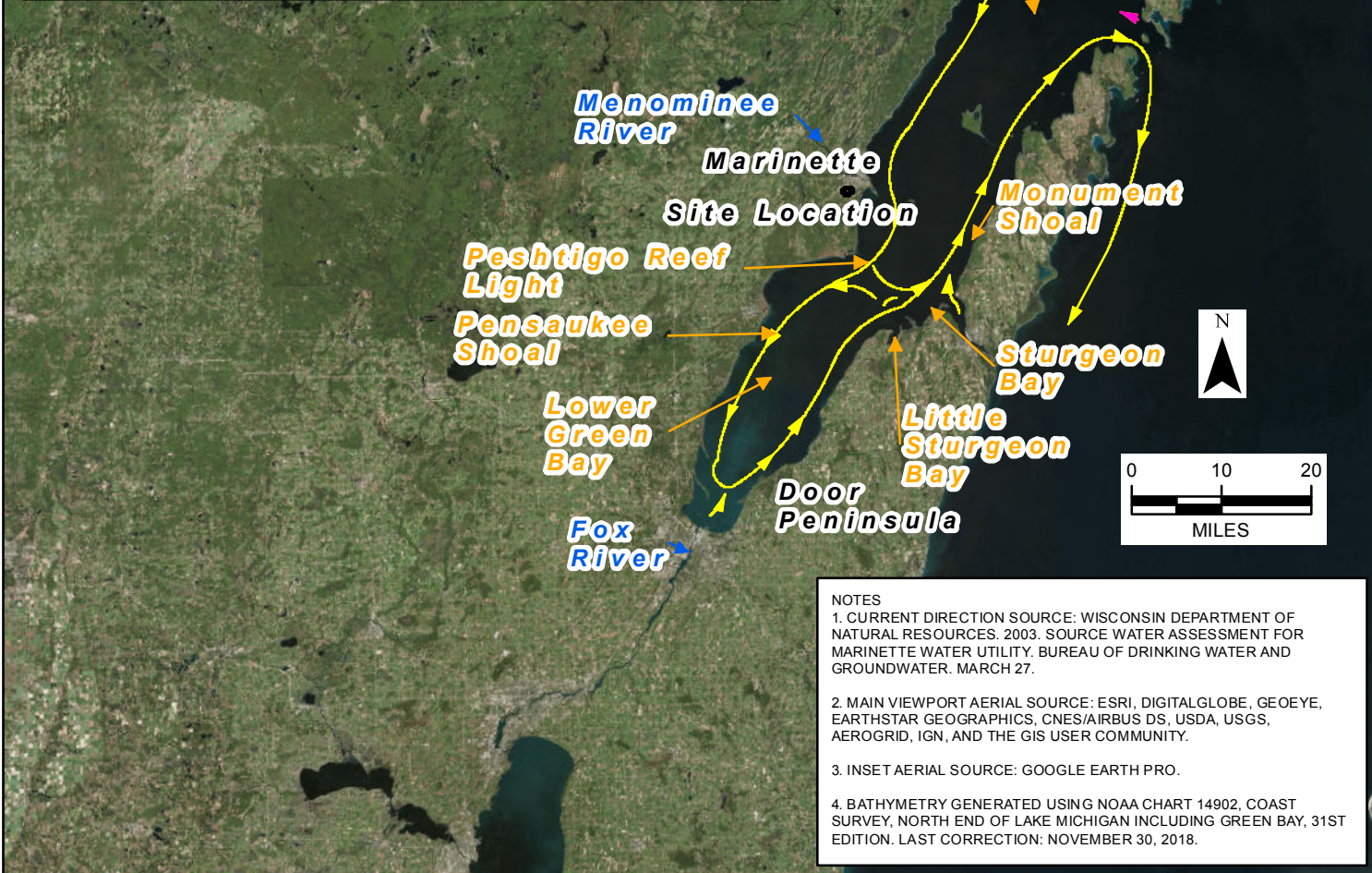
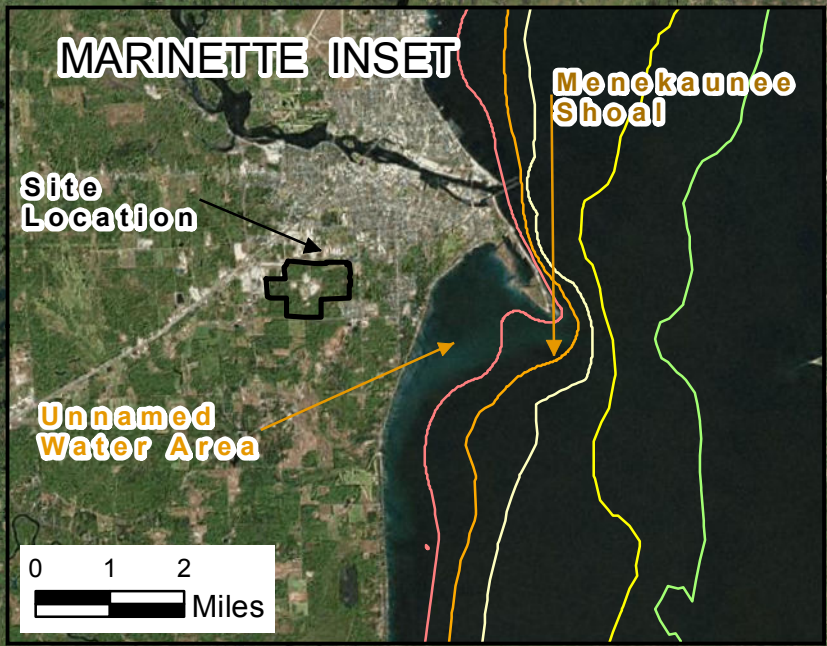
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 OUTDOOR TESTING/TRAINING AREA



NOTES:
1. IMAGERY SOURCE: 4/27/2016, DIGITALGLOBE, VIVID - USA.

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OUTDOOR TESTING/TRAINING AREA



NOTES

1. CURRENT DIRECTION SOURCE: WISCONSIN DEPARTMENT OF NATURAL RESOURCES. 2003. SOURCE WATER ASSESSMENT FOR MARINETTE WATER UTILITY. BUREAU OF DRINKING WATER AND GROUNDWATER. MARCH 27.
2. MAIN VIEWPORT AERIAL SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRIID, IGN, AND THE GIS USER COMMUNITY.
3. INSET AERIAL SOURCE: GOOGLE EARTH PRO.
4. BATHYMETRY GENERATED USING NOAA CHART 14902, COAST SURVEY, NORTH END OF LAKE MICHIGAN INCLUDING GREEN BAY, 31ST EDITION. LAST CORRECTION: NOVEMBER 30, 2018.

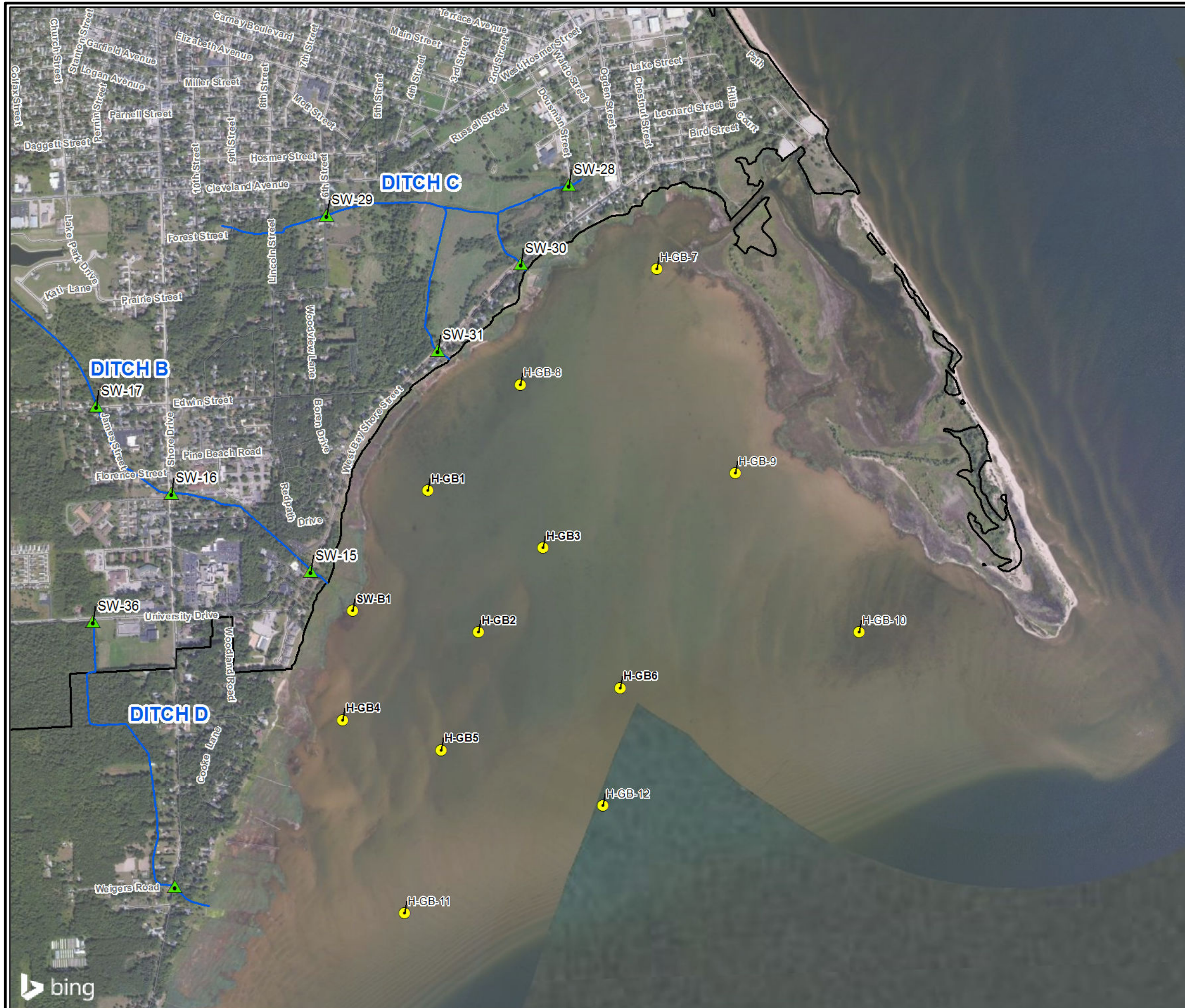
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	SUBSURFACE CURRENT DIRECTION		20
			40
			60

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MARINETTE, WISCONSIN

**GREEN BAY
HYDRODYNAMICS AND CIRCULATION**

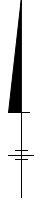
ARCADIS | **FIGURE 3**

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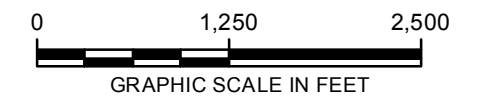
LEGEND:

- PROPOSED SURFACE WATER HYDRODYNAMICS LOCATION
- ▲ 2018 SURFACE WATER SAMPLE
- APPROXIMATE SITE PROPERTY BOUNDARY
- APPROXIMATE MARINETTE CITY BOUNDARY
- ROAD
- DITCH/STREAM



NOTES:

1. AERIAL SOURCE = GOOGLE EARTH PRO VERSION 7.1, 2019 TERRAMETRICS, 2018 GOOGLE IMAGE NOAA IMAGERY DATE: 10/10/2013, LAT 45.068006° LONG -87.602603°.



TYCO FIRE PRODUCTS, LP
 MARINETTE, WISCONSIN

**PROPOSED GREEN BAY
 SURFACE WATER LOCATIONS**



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A decorative graphic consisting of three thin orange lines. One line is horizontal, extending across the width of the page. Two other lines are diagonal, starting from the bottom left and extending towards the top right, intersecting the horizontal line.