

Investigation of Perfluorinated and Polyfluorinated Compound Contamination in
the Lake Huron-Au Sable River Plume
Iosco County

2019

Background

Perfluorinated compounds are a group of organic chemicals in which all the carbon atoms in the molecular backbone are fluorinated, and they are a subset of a large class of chemicals known as polyfluoroalkyl and perfluoroalkyl substances (PFAS). These are anthropogenic compounds and have been synthesized for over 50 years. Many PFAS are persistent, some of the compounds bioaccumulate in the environment, and several have proven to be toxic to birds and mammals in laboratory testing. In addition, epidemiological studies indicate links between exposure to perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) and several human diseases.

PFAS are used in a wide variety of consumer products and several of the compounds are key ingredients in fire-fighting foams. Historically PFAS containing fire-fighting foams were used extensively in regular training exercises as well as in crash site fire suppression at the former Wurtsmith Air Force Base (AFB) in Oscoda, Michigan. Subsequent groundwater contamination has impacted nearby surface waters including the Au Sable River. Extremely high levels of PFAS have been measured in Clark's Marsh, a series of ponds nearest the Wurtsmith AFB fire suppression training area (Figure 1).

Surface water samples taken in 2014 from the Au Sable River near and downstream of Clark's Marsh had total PFAS concentrations ranging from 9 to 150 ng/L (geometric mean = 22 ng/L). PFOS concentrations ranged from 1 to 16 ng/L (geometric mean = 4 ng/L); PFOA concentrations ranged from 1 to 7 ng/L (geometric mean = 2 ng/L).

Several species of fish have been collected from the Au Sable River and analyzed for PFAS. Based on the concentrations of PFOS in smallmouth bass, rock bass, and bluegill the Department of Health and Human Services issued a Do Not Eat advisory for non-migratory, "resident" species of fish such as those listed above. The elevated levels in fish provides good evidence that contamination from the Wurtsmith AFB is a chronic condition.

Contaminated Au Sable River water has the potential to impact drinking water intakes in Lake Huron. The Au Sable River empties into Lake Huron at Oscoda, roughly 6 miles downstream of groundwater and surface water inputs from Clark's Marsh. Currents in Lake Huron generally rotate in a counter-clockwise direction (<https://www.glerl.noaa.gov/res/glcfs/currents/>), consistently carrying the Au Sable discharge in a southerly direction along the shoreline toward Tawas City (the Au Sable River plume is often visible in satellite images). In addition, the current generally continues to follow the shoreline southwesterly to the vicinity of the city of Au Gres before heading east across Saginaw Bay (Figure 2).

The Huron Shore Regional Utility Authority (HSRUA) operates a water treatment facility with a Lake Huron intake approximately 11 miles south of the Au Sable River mouth (Figure 2), providing drinking water to a population of over 14,000 people in the cities of East Tawas, Tawas City, and in Baldwin, Au Sable, and Oscoda Townships. The intake is approximately 1.4 km (4,600 ft) offshore at a depth of 6 m (20 ft). The Michigan Department of Environment, Great Lakes, and Energy (EGLE), formerly Michigan Department of Environmental Quality (MDEQ),

began sampling the HSRUA raw water in December 2015 and has sampled monthly since June 2016. The sampling has found measurable concentrations of PFOS and PFOA and total PFAS levels as high as 48 ppt.

The Sims-Whitney Utilities Authority (SWUA) operates a drinking water intake roughly 23 miles south of the Au Sable River mouth and serves a population of over 5,700 in Arenac county. The intake is approximately 2.7 km (9,000 ft) offshore at a depth of 11 m (36 ft). Raw water from the intake was sampled in November 2018; PFOS and PFOA were not detected but total PFAS was measured at 11 ppt.

There are 10 other public water supply intakes in Lake Huron near the Michigan shore, and each of the intakes has been sampled for PFAS. In contrast to results for samples from the HSRUA and SWUA intakes, PFAS concentrations in samples of raw water from the other intakes have all been below the detection level.

Lastly, there are a few potential PFAS sources in the Tawas City area, including two plating facilities.

Objective

The objective of this sampling plan is to determine the extent of measurable PFAS contamination in nearshore Lake Huron south of the Au Sable River mouth.

Sampling Plan

Sampling sites were selected to assess PFAS concentrations in the Au Sable River, in Lake Huron directly north and south of the river mouth, and in Lake Huron in the vicinity of East Tawas, both north and south of the HSRUA intake.

Surface water samples will be collected from the Au Sable River near the river mouth in Oscoda and from nearshore Lake Huron. Samples will be collected in accordance with the MDEQ General and Surface Water PFAS Sampling Guidance documents (MDEQ, 2018a and 2018b, respectively). In order to account for variability in concentrations due to weather related conditions we plan to conduct four sampling events. A total of 56 ambient, 2 equipment blank, 1 field blank, 3 duplicate, and 3 replicate samples will be collected during each sampling event, as follows.

One sample will be collected at each of two sites on the Au Sable River (Table 1; Figure 3) to characterize PFAS concentrations in the river for comparisons with Lake Huron samples. Depth-composite sub-surface samples will be collected in the main flow of the river using a depth-integrating water sampler from a boat (upstream of the boat) or from a bridge.

Lake Huron samples will be collected at each end and the mid-point of each of six transects (Table 1; Figures 3 & 4) with the intention of monitoring the river plume south along the shoreline to near Tawas City. Each transect will begin approximately 300 m (980 ft) from the shore and extend approximately 1.2 km (3,900 ft) perpendicular to shore. Four transects will be near Oscoda: two transects to the north of the Au Sable River mouth (ON1 & ON2) and two transects south of the river mouth. Two transects will be near Tawas City (TN1 & TN2), one north and one south of the HSRUA (Tawas) drinking water intake.

Individual Lake Huron samples will be collected at the selected sites at 1-meter below the surface, mid-depth, and 1-meter off lake bottom using a Van Dorn or Kemmerer sampler. Nine samples will be collected along each transect for a total of 54 Lake Huron samples.

Each sample will be dispensed from the water sampler into two 250 ml high-density polyethylene bottles (certified PFAS-free bottles to be provided by TestAmerica), alternating between both bottles. All personnel handling sample bottles will use nitrile gloved hands.

Ancillary data to be collected at each sample site using a YSI model EXO1 water quality sonde will include water temperature, water depth, depth at sample, pH, turbidity, and conductivity. Conductivity and turbidity are particularly important because data collected by MDEQ and EPA indicates a significant difference in those parameters between the Au Sable River and open waters of Lake Huron. By comparing the measurements of key parameters between sampling sites we may be able to determine the zone of influence of the Au Sable River plume.

All samples will be collected in one day if possible and either shipped directly to a Eurofins-TestAmerica laboratory (Sacramento, CA or Lancaster, PA) via overnight delivery, or delivered to the TestAmerica office in Brighton, Michigan to be shipped by their staff. Samples will be analyzed for selected PFAS, as described in the Quality Assurance Project Plan (QAPP; MDEQ 2018c) and listed in Table 2. Expected turnaround time is 20 days. Analytical results will be transmitted electronically to MDEQ-Water Resources Division (WRD).

Status Reports and Quality Assurance Reports

A report summarizing the sampling results, quality assurance analysis and outlining recommended next steps will be produced by EGLE-WRD staff.

Quality Assurance/Quality Control (QA/QC)

QA/QC procedures are presented in the Michigan Surface Water PFAS Investigation 2018 QAPP (MDEQ 2018c).

References

MDEQ. (2018a). General PFAS Sampling Guidance.

https://www.michigan.gov/documents/pfasresponse/General_PFAS_Sampling_Guidance

MDEQ. (2018b). Surface Water PFAS Sampling Guidance.

https://www.michigan.gov/documents/pfasresponse/Surface_Water_PFAS_Sampling_Guidance

MDEQ. (2018c). Michigan Surface Water Perfluoroalkyl and Polyfluoroalkyl Compound (PFAS) Investigation: Quality Assurance Project Plan (QAPP).

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April 23, 2019

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Date: 7/15/2019

Table 1. Au Sable River and Lake Huron surface water sample collection locations, May 2019.

Site Code	Description	Latitude	Longitude
<u>Au Sable River</u>			
AS001	at US-23	44.40731	-83.32459
AS002	at Mill St.	44.4154	-83.3308
<u>Lake Huron</u>			
ON1a-S,M,B	Oscoda North 1, Site a; Surface, Mid-depth, Bottom	44.40866	-83.31673
ON1b-S,M,B	Oscoda North 1, Site b; Surface, Mid-depth, Bottom	44.40946	-83.30894
ON1c-S,M,B	Oscoda North 1, Site c; Surface, Mid-depth, Bottom	44.41034	-83.30124
ON2a-S,M,B	Oscoda North 2, Site a; Surface, Mid-depth, Bottom	44.42114	-83.32191
ON2b-S,M,B	Oscoda North 2, Site b; Surface, Mid-depth, Bottom	44.42113	-83.31461
ON2c-S,M,B	Oscoda North 2, Site c; Surface, Mid-depth, Bottom	44.42115	-83.3065
OS1a-S,M,B	Oscoda South 1, Site a; Surface, Mid-depth, Bottom	44.40425	-83.31707
OS1b-S,M,B	Oscoda South 1, Site b; Surface, Mid-depth, Bottom	44.403	-83.31016
OS1c-S,M,B	Oscoda South 1, Site c; Surface, Mid-depth, Bottom	44.40162	-83.3023
OS2a-S,M,B	Oscoda South 2, Site a; Surface, Mid-depth, Bottom	44.39185	-83.32234
OS2b-S,M,B	Oscoda South 2, Site b; Surface, Mid-depth, Bottom	44.39001	-83.31543
OS2c-S,M,B	Oscoda South 2, Site c; Surface, Mid-depth, Bottom	44.38799	-83.30795
TN1a-S,M,B	Tawas North 1, Site a; Surface, Mid-depth, Bottom	44.25608	-83.43578
TN1b-S,M,B	Tawas North 1, Site b; Surface, Mid-depth, Bottom	44.25262	-83.43004
TN1c-S,M,B	Tawas North 1, Site c; Surface, Mid-depth, Bottom	44.24902	-83.42414
TN2a-S,M,B	Tawas North 2, Site a; Surface, Mid-depth, Bottom	44.28076	-83.41761
TN2b-S,M,B	Tawas North 2, Site b; Surface, Mid-depth, Bottom	44.27896	-83.41095
TN2c-S,M,B	Tawas North 2, Site c; Surface, Mid-depth, Bottom	44.27698	-83.40355

Table 2. Perfluoroalkyl and polyfluoroalkyl substances to be analyzed in Au Sable and Lake Huron surface water samples, May 2019.

Compound	Abbreviation	CAS Number
Perfluorobutanoic acid	PFBA	375-22-4
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorooctane sulfonic acid	PFOS	1763-23-1
Perfluoropentanoic acid	PFPeA	2706-90-3
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluorononanoic acid	PFNA	375-95-1
Perfluorodecanoic acid	PFDA	335-76-2
Perfluoroundecanoic acid	PFUnA	2058-94-8
Perfluorododecanoic acid	PFDoA	307-55-1
Perfluorotridecanoic acid	PFTriA	72629-94-8
Perfluorotetradecanoic acid	PFTeA	376-06-7
Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluorohexanesulfonic acid	PFHxS	355-46-4
Perfluoroheptanesulfonic acid	PFHpS	375-92-8
Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluorooctanesulfonamide	FOSA	754-91-6
Perfluoropentanesulfonic acid	PFPeS	2706-91-4
Perfluoronananesulfonic acid	PFNS	68259-12-1
N-methyl perfluorooctane sulfonamidoacetic acid	NMeFOSAA	2355-31-9
N-ethyl perfluorooctane sulfonamidoacetic acid	NEtFOSAA	2991-50-6
Fluorotelomer sulphonic acid 4:2	4:2 FTS	757124-72-4
Fluorotelomer sulphonic acid 6:2	6:2 FTS	27619-97-2
Fluorotelomer sulphonic acid 8:2	8:2 FTS	39108-34-4

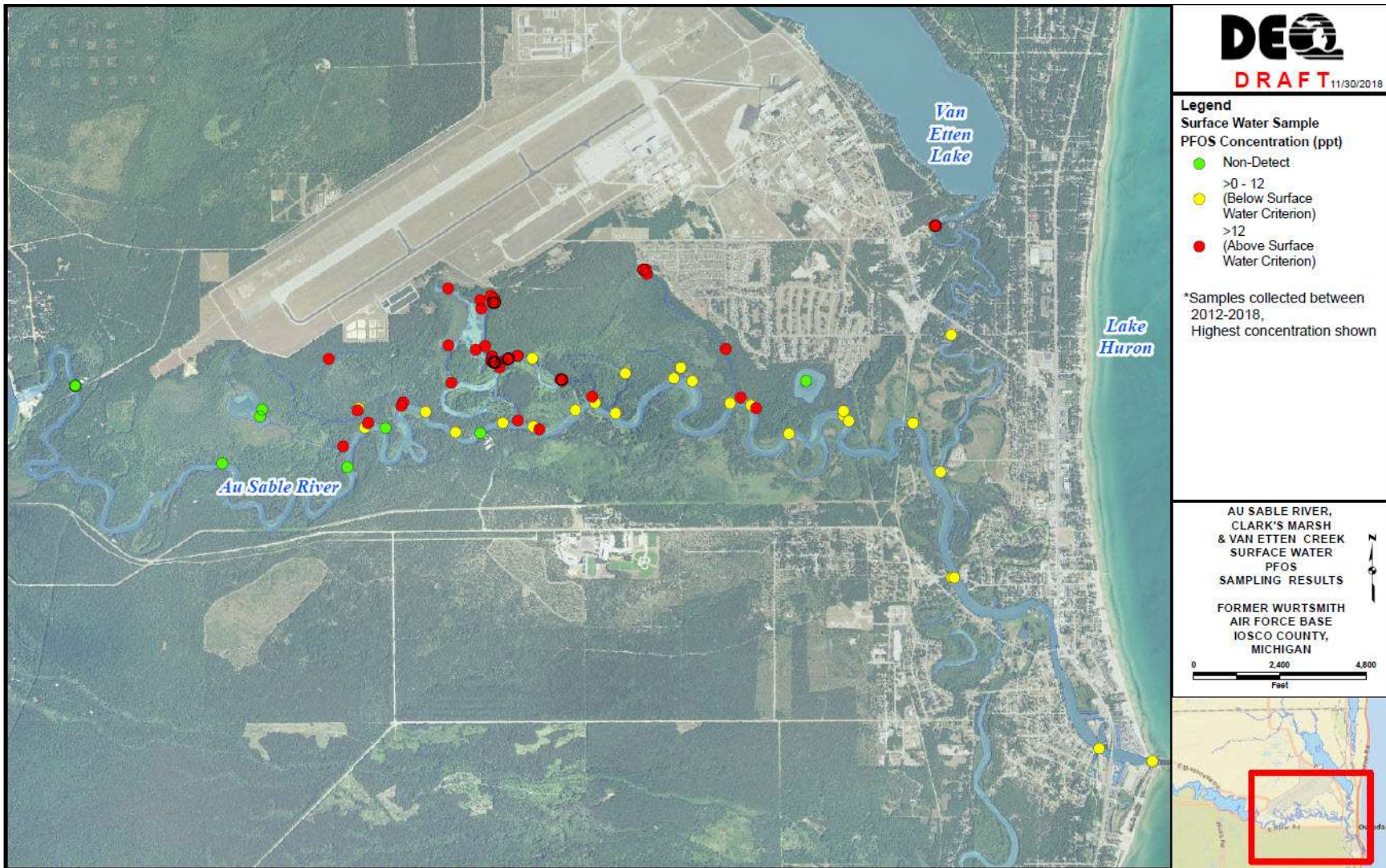


Figure 1. Overview of the lower Au Sable River near the former Wurtsmith Air Force Base in Oscoda showing relative concentrations of PFOS in surface water samples collected between 2012 and 2018.

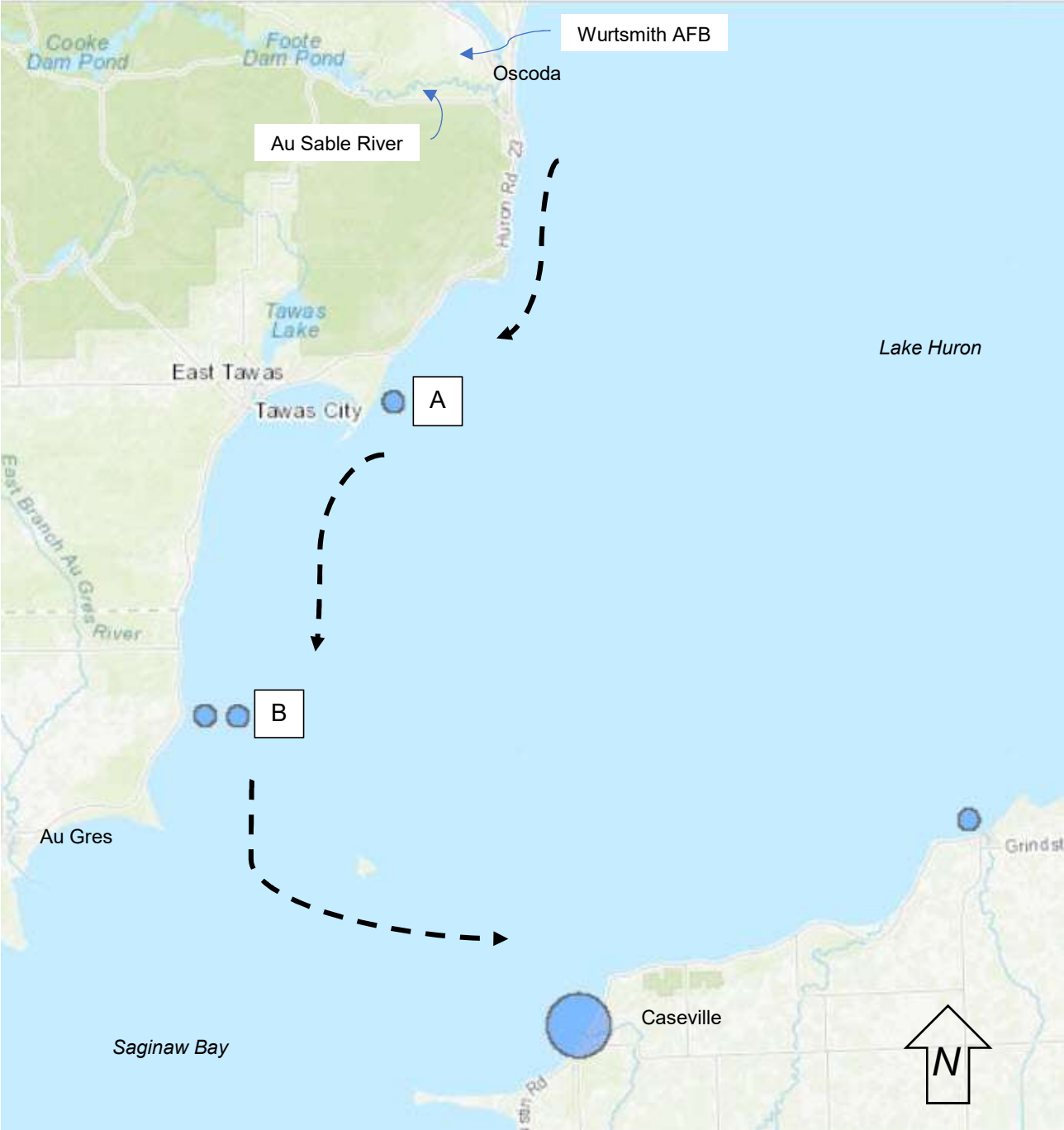


Figure 2. Lake Huron in the vicinity of Oscoda and Tawas City showing approximate locations of the HSRUA and SWUA drinking water intakes (A & B, respectively). Prevailing lake currents are indicated by black arrows.



Figure 3. Au Sable River and Oscoda area Lake Huron sampling sites.

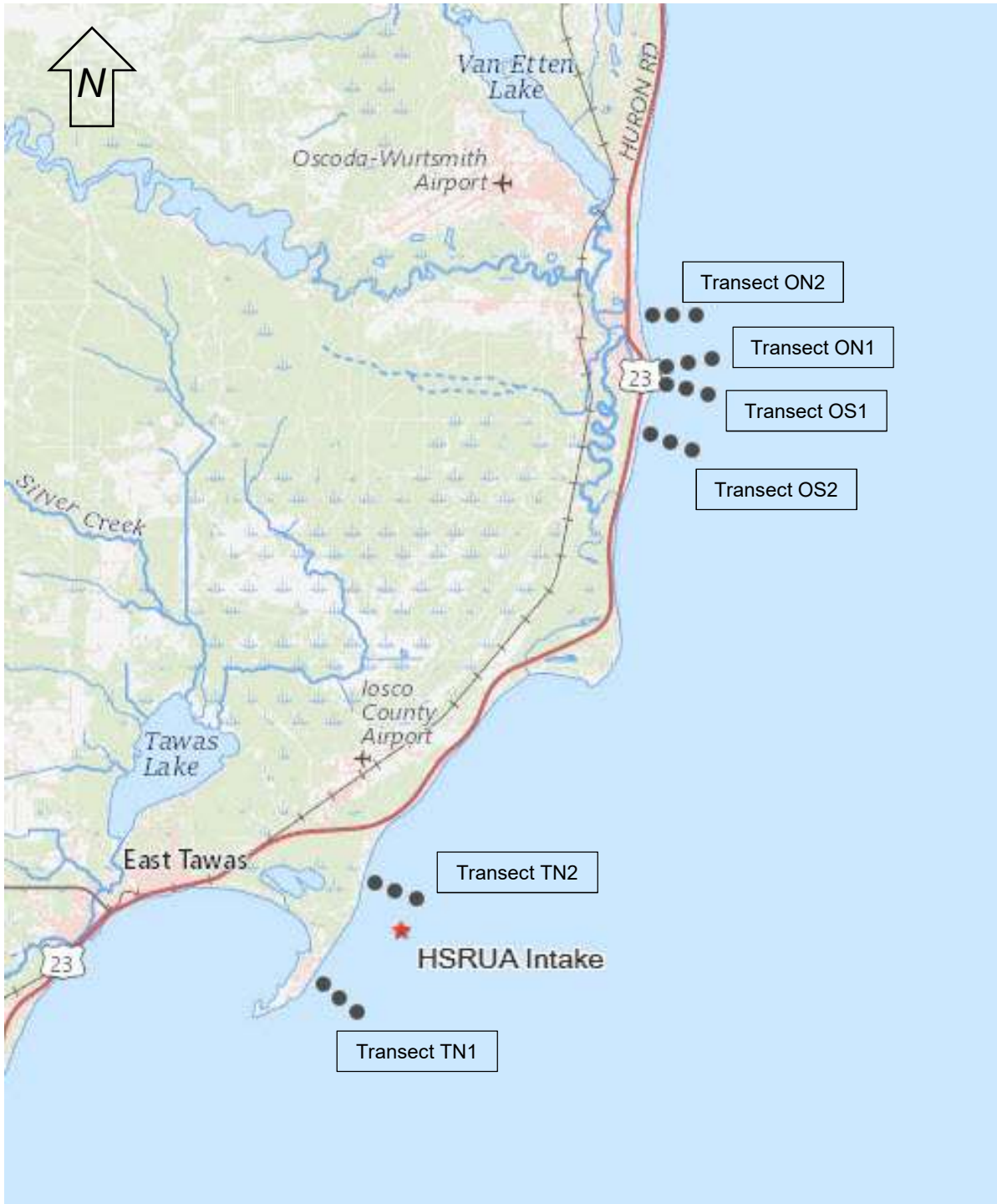


Figure 4. Approximate location of Lake Huron surface water sampling transects.