



Screening for Contaminants of Emerging Concern in Surface Waters of the Great Lakes Network Parks

2016–2017

Natural Resource Data Series NPS/GLKN/NRDS—2018/1189



ON THE COVER

Biological technician Josh Dickey collects a water sample from Coffee Creek in Chesterton, Indiana (Indiana Dunes National Lakeshore).

NPS photo/Ali Olsen

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Abstract

During 2016 and 2017, surface water samples were collected from five national parks in the Great Lakes Inventory and Monitoring Network. These samples were analyzed for 73 pesticides and 141 pharmaceuticals and personal care products (collectively, contaminants of emerging concern, or CECs). Sites sampled included remote inland lakes, streams, ditches, Lake Superior bays, a wetland, and a spring. Atrazine and DEET were consistently the most frequently detected chemicals at more remote parks with concentrations ranging from 13.6 nanograms per liter (ng/L) (Grand Portage National Monument) to 28.2 ng/L (Voyageurs National Park). In addition to DEET, several herbicide and herbicide degradates were detected in remote lakes at Voyageurs National Park. A couple of pharmaceuticals were detected in remote lakes at Pictured Rocks National Lakeshore (gabapentin, an anticonvulsant) and Sleeping Bear Dunes National Lakeshore (metformin, an antidiabetic). The most CECs detected at any park was 42 at Indiana Dunes National Lakeshore, with maximum concentrations ranging from 40.2 ng/L (valsartan, an antihypertensive) to 1,050 ng/L (metolachlor ESA, an herbicide degradate). Concentrations of detected CECs were below available screening values, indicating a low hazard to human health and aquatic organisms. Though more research is needed to fully understand the long-term consequences of CEC exposure in the environment. The data collected from this effort provide a baseline for occurrence and magnitude of CECs in Midwestern national parks and can be used to inform future management activities and monitoring efforts.

Acknowledgments

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Introduction

The National Park Service (NPS) Great Lakes Inventory and Monitoring Network (GLKN) consists of nine national park units in the upper Midwest: Voyageurs National Park (VOYA), Mississippi National River and Recreation Area (MISS), St. Croix National Scenic Riverway (SACN), Apostle Islands National Lakeshore (APIS), Grand Portage National Monument (GRPO), Isle Royale National Park (ISRO), Indiana Dunes National Lakeshore (INDU), Pictured Rocks National Lakeshore (PIRO), and Sleeping Bear Dunes National Lakeshore (SLBE) (Figure 1). All nine park units include important recreational, commercial, and ecological freshwater resources.

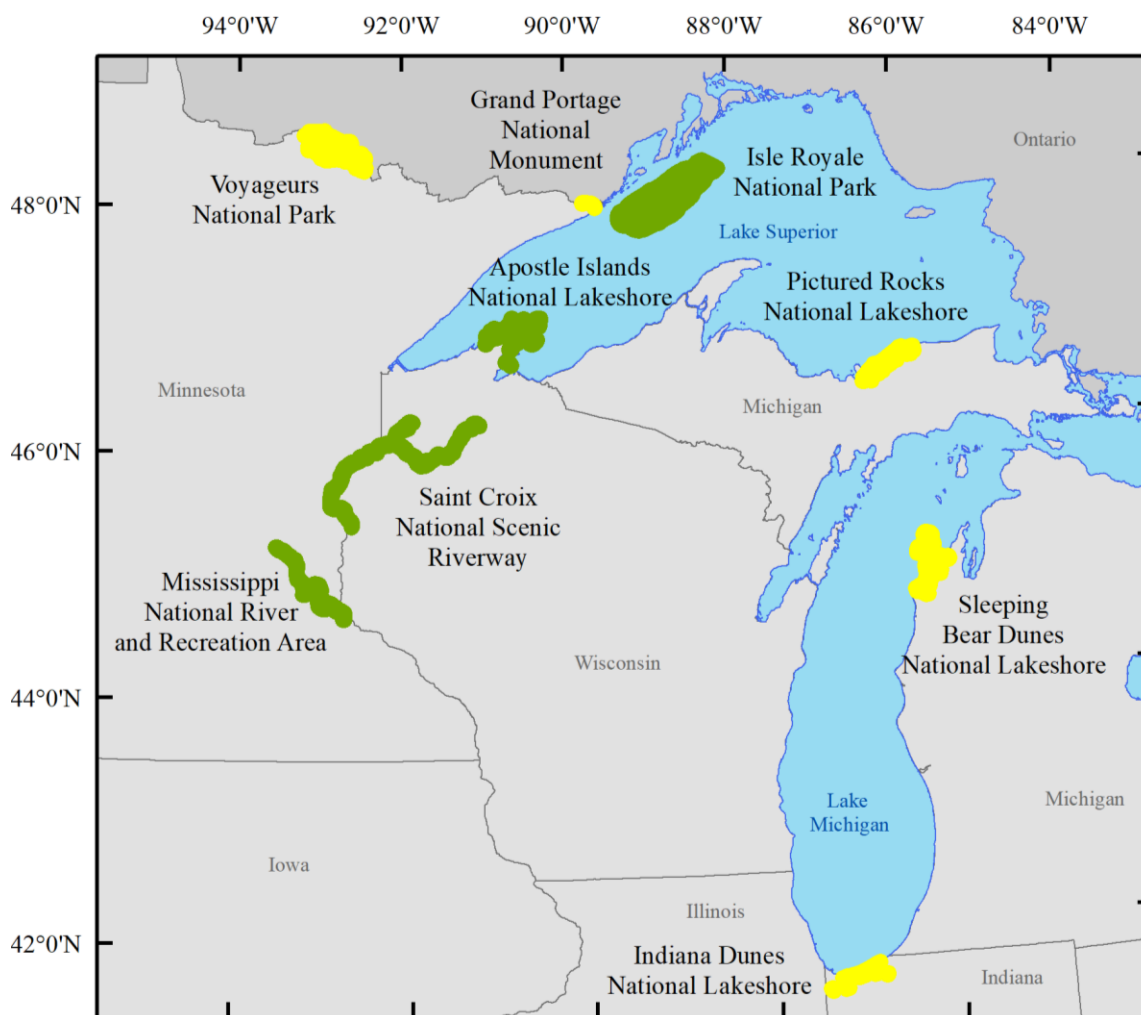


Figure 1. Locations of nine national parks in the Great Lakes Inventory and Monitoring Network. Surface waters were collected in 2016 and 2017 from parks highlighted in yellow.

Previous contaminants monitoring in aquatic systems at these parks has mainly been through short-term projects that primarily focused on legacy contaminants in aquatic biota such as DDT, PCBs, and other industrial chemicals (Lafrancios and Glase 2005). In the mid-2000s GLKN initiated a monitoring program focused on contaminants that are persistent, bioaccumulative, and toxic, by

sampling sentinel species, including larval dragonflies, fish, and bald eagles (Wiener et al. 2016, Route et al. 2009). Two of the six contaminant classes—perfluorinated compounds and polybrominated diphenyl ethers—are considered contaminants of emerging concern (CECs). Beginning in 2016, GLKN’s contaminants in biota monitoring efforts were modified to focus only on mercury, which is pervasive in the upper Midwest. Larval dragonflies were monitored annually, and fish were monitored on a five-year rotation at all network parks.

To add to the knowledge base, surface waters across the network parks have been sampled and analyzed since 2013 in collaboration with the U.S. Environmental Protection Agency Region 8 analytical laboratory (Golden, Colorado) for wastewater indicators, pesticides, pharmaceuticals, and personal care products, collectively referred to as CECs. The purpose of the study is to screen park surface waters to develop a baseline dataset of CECs in those waters. If high concentrations of CECs are found, follow up studies with additional and potentially more detailed monitoring may be warranted.

From 2013 through 2015, a variety of CECs were detected at MISS and INDU, while fewer chemicals and lower concentrations were detected at APIS and ISRO (Elliott and VanderMeulen 2017, VanderMeulen 2015). During 2016–2017, samples were collected from VOYA, GRPO, INDU, PIRO, and SLBE to characterize the presence of CECs (excluding wastewater indicators) in the network’s more remote parks, and to obtain additional data for INDU, where the most CECs have been detected in this study. Some research has been conducted to characterize the presence of CECs, such as current-use pesticides in remote areas. While these studies have shown the presence of current-use pesticides in (mostly) high altitude areas (Mast et al. 2007, 2011), few studies have focused on other remote areas of the country. The purpose of this report is to describe results from the 2016–2017 sampling effort. For more details on background and previous results see Elliott and VanderMeulen (2017) and VanderMeulen (2015).

Methods

Site Selection

A total of 31 sites throughout five parks were selected for CEC sampling in 2016 and 23 in 2017 (Table 1). Primarily inland lakes were targeted for sampling, although other surface waters such as streams, ditches, and nearshore large lake sites were also sampled.

Voyageurs National Park

Six remote lakes and two large, more heavily visited lakes were sampled in VOYA during 2017 (Figure 2). Most of the chosen sites are current long-term water quality sites that are monitored three times each summer for nutrients and other water quality parameters. The remote lakes include Cruiser, Shoepack, Ek, Ryan, Locator, and Little Trout. Cruiser and Shoepack lakes are the most remote and do not have any obvious point sources. Ek and Ryan Lakes were sampled by the USGS and NPS for several CECs in 2012. Data from 2012 for Ek and Ryan Lakes are available in the USGS National Water Information System and can be searched using station numbers 482812092500801 and 483109092422601, respectively (USGS 2018). These lakes were chosen for sampling to expand the baseline of CEC data at the lakes. Locator gets moderate visitor use and integrates upstream lakes, potentially integrating chemicals originating from upstream sources. Little Trout gets low visitor use and is a cold, deep lake. The remaining sites consisted of one nearshore site in the Black Bay Narrows on Rainy Lake adjacent to a moderately developed shoreline and two sites (one off shore, one near shore) on Lake Kabetogama. A previous study on Lake Kabetogama identified the presence of numerous CECs in the nearshore, close to houses that use on-site systems for wastewater treatment (Writer et al. 2010).

Table 1. Sites sampled during 2016 and 2017 for pesticides, pharmaceuticals, and personal care products in the Great Lakes Inventory and Monitoring Network parks. Latitude and longitude given in decimal degrees. Park acronyms are previously described. Dashed lines (--) indicate that no site ID was assigned.

Year	Park	Site ID	Site name	Latitude	Longitude	Water body type	Number of samples collected
4	INDU	INDU029	Peterson Ditch	41.6204	-87.0914	ditch	2
	INDU	INDU082	Kintzele Ditch	41.7013	-86.9402	ditch	2
	INDU	INDU144	Dunes Creek	41.6435	-87.0428	stream	2
	INDU	INDU164	Dunes Creek	41.6508	-87.0431	stream	2
	INDU	INDU243	Brown Ditch	41.6849	-86.9548	ditch	2
	INDU	INDU262	Derby Ditch	41.6679	-86.9957	ditch	2
	INDU	INDU328	Derby Ditch	41.6713	-86.9879	ditch	2
	INDU	INDU405	Derby Ditch	41.6855	-86.9994	ditch	2
	INDU	INDU459	East Branch Little Calumet River	41.6238	-86.9807	river	2
	INDU	INDU475	East Branch Little Calumet River	41.6273	-86.9525	river	2
	INDU	INDU503	East Branch Little Calumet River	41.6222	-87.0877	river	2
	INDU	INDU539	East Branch Little Calumet River	41.6223	-87.0937	river	2
	INDU	INDU900	Samuelson Ditch	41.6124	-87.1471	ditch	2
	INDU	INDU901	Carver Ditch	41.6297	-86.9418	ditch	2
	INDU	INDU902	Coffee Creek	41.6088	-87.0496	stream	2
	INDU	INDU903	Reynolds Creek	41.6172	-86.9419	ditch	2
	INDU	INDU904	Pope O'Connor Ditch	41.5997	-87.0483	ditch	2
	INDU	INDU905	Sand Creek	41.6169	-87.0323	stream	2

Table 1 (continued). Sites sampled during 2016 and 2017 for pesticides, pharmaceuticals, and personal care products in the Great Lakes Inventory and Monitoring Network parks. Latitude and longitude given in decimal degrees. Park acronyms are previously described. Dashed lines (--) indicate that no site ID was assigned.

Year	Park	Site ID	Site name	Latitude	Longitude	Water body type	Number of samples collected
2016 (contt)	INDU	INDU906	Coffee Creek	41.6172	-87.0502	stream	2
	PIRO	PIRO01	Grand Sable Lake	46.6492	-86.0326	lake	3
	PIRO	PIRO02	Trappers Lake	46.5872	-86.3150	lake	3
	PIRO	PIRO03	Legion Lake	46.5263	-86.3610	lake	3
	PIRO	PIRO04	Beaver Lake	46.5722	-86.3348	lake	3
	PIRO	PIRO06	Chapel Lake	46.5283	-86.4514	lake	3
	PIRO	PIRO08	Miners Lake	46.4808	-86.5383	lake	3
	SLBE	SLBE01	Manitou Lake	45.1259	-86.0247	lake	3
	SLBE	SLBE02	Florence Lake	45.0106	-86.1203	lake	3
	SLBE	SLBE04	Shell Lake	44.9476	-85.9004	lake	3
	SLBE	SLBE05	Bass Lake	44.9222	-85.8833	lake	3
	SLBE	SLBE09	North Bar Lake	44.8435	-86.0666	lake	3
	SLBE	SLBE10	Loon Lake	44.7074	-86.1293	lake	3
2017	VOYA	VOYA01	Locator Lake	48.5406	-93.0046	lake	3
	VOYA	VOYA05	Shoepack Lake	48.4975	-92.8878	lake	3
	VOYA	VOYA09	Ek Lake	48.4698	-92.8347	lake	3
	VOYA	VOYA16	Cruiser Lake	48.4989	-92.8132	lake	3
	VOYA	VOYA17	Ryan Lake	48.5190	-92.7077	lake	3

Table 1 (continued). Sites sampled during 2016 and 2017 for pesticides, pharmaceuticals, and personal care products in the Great Lakes Inventory and Monitoring Network parks. Latitude and longitude given in decimal degrees. Park acronyms are previously described. Dashed lines (--) indicate that no site ID was assigned.

Year	Park	Site ID	Site name	Latitude	Longitude	Water body type	Number of samples collected
2017 (cont.)	VOYA	VOYA21	Little Trout Lake	48.3986	-92.5248	lake	3
	VOYA	SITE1	Rainy River	48.5901	-93.1561	river	3
	VOYA	SITE45	Lake Kabetogama	48.4581	-92.9651	lake	3
	VOYA	A1	Sullivan Bay, Lake Kabetogama	48.4283	-92.8269	lake	3
	GRPO	--	Pigeon River	48.0022	-89.5929	river	3
	GRPO	--	Swamp Lake	47.9499	-89.8559	lake	3
	GRPO	--	Grand Portage Creek	47.9636	-89.6837	creek	3
	GRPO	--	Taylor Lake	47.9354	-89.8244	lake	2
	GRPO	--	Trout Lake	47.9486	-89.8502	lake	2
	GRPO	--	Pigeon Bay, Lake Superior	48.0045	-89.5477	bay	2
	GRPO	--	Grand Portage Bay, Lake Superior	47.9588	-89.6721	bay	2
	GRPO	--	Hollow Rock Creek	47.9178	-89.7449	creek	2
	GRPO	--	Poplar Creek	48.0057	-89.7048	creek	1
	GRPO	--	Mt. Maude	47.9726	-89.7383	impoundment	1
	GRPO	--	Teal Lake	47.9914	-89.6577	lake	1
	GRPO	--	NPS Boardwalk	48.0038	-89.7837	wetland	1
	GRPO	--	Wausaugoning Bay, Lake Superior	47.9911	-89.6162	bay	2
	GRPO	--	Grand Portage Spring	47.9445	-89.7630	spring	2

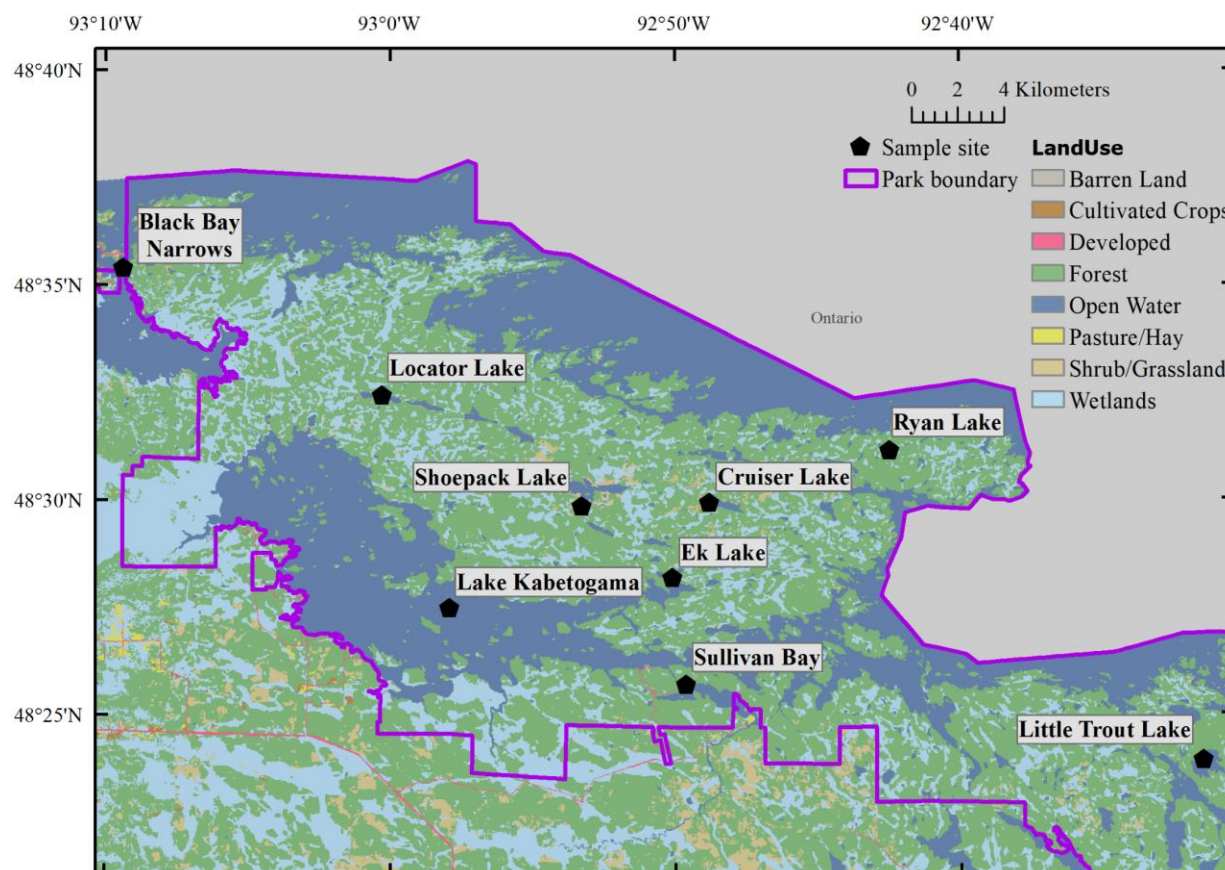


Figure 2. Locations of surface-water sites sampled for contaminants of emerging concern in Voyageurs National Park in 2017.

Grand Portage National Monument

A variety of water bodies were sampled in and around GRPO in 2017, including four rivers/creeks, four lakes, three bays on Lake Superior, one impoundment, one wetland, and one spring (Figure 3). Most sites were chosen because they are current long-term water quality sites that are sampled regularly. Most of these sites are in watersheds with a moderate amount of anthropogenic disturbance and are used for wild rice harvest, waterfowl, and fisheries. The three bays in Lake Superior are important subsistence fisheries. Grand Portage and Pigeon Bays are affected by anthropogenic activities that influence the quality of stormwater runoff entering the bays. Grand Portage Spring and Wauswaugoning Bay are both sources of drinking water for the local Grand Portage community. The NPS boardwalk site is heavily visited by park users. Lastly, the sites were chosen for comparability with previous and concurrently collected CEC data in Grand Portage and surrounding areas by the Grand Portage Band of Lake Superior Chippewa, University of Minnesota, Minnesota Pollution Control Agency, and USEPA (E.J. Isaac, Grand Portage Band of Lake Superior Chippewa, personal communication).

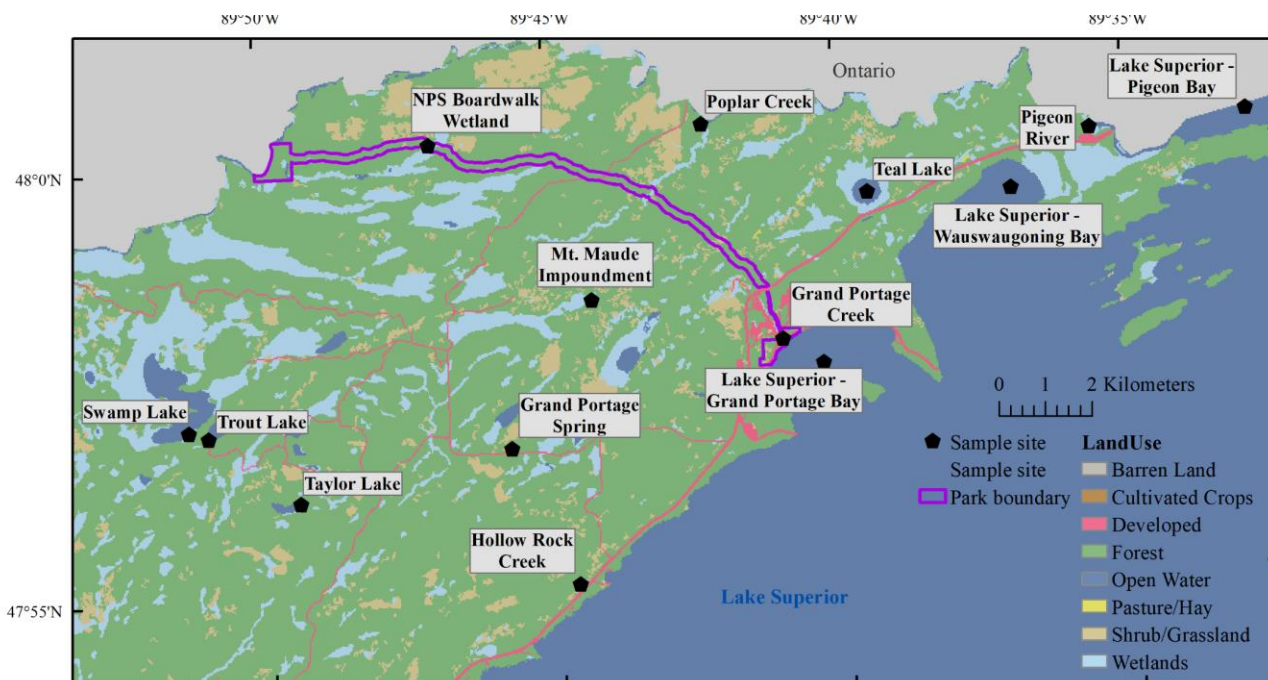


Figure 3. Locations of surface-water sites sampled for contaminants of emerging concern in and around Grand Portage National Monument in 2017.

Indiana Dunes National Lakeshore

A total of 19 stream, river, or ditch sites were sampled in and around INDU in 2016 (Figure 4). Complete site descriptions and rationale are provided in VanderMeulen (2015). Briefly, 12 of the sites were selected because they are part of ongoing monitoring of the East Branch of the Little Calumet River. Data related to fish, macroinvertebrates, water chemistry, stream flow, and sediment transport have been collected at these sites. The other seven sites were selected because they are independent of the East Branch of the Little Calumet River and feed directly into Lake Michigan. These sites are also regularly monitored for fish and water chemistry. Although some of the sites fall outside of the park boundaries, the surface waters they represent potentially influence surface waters within the park.

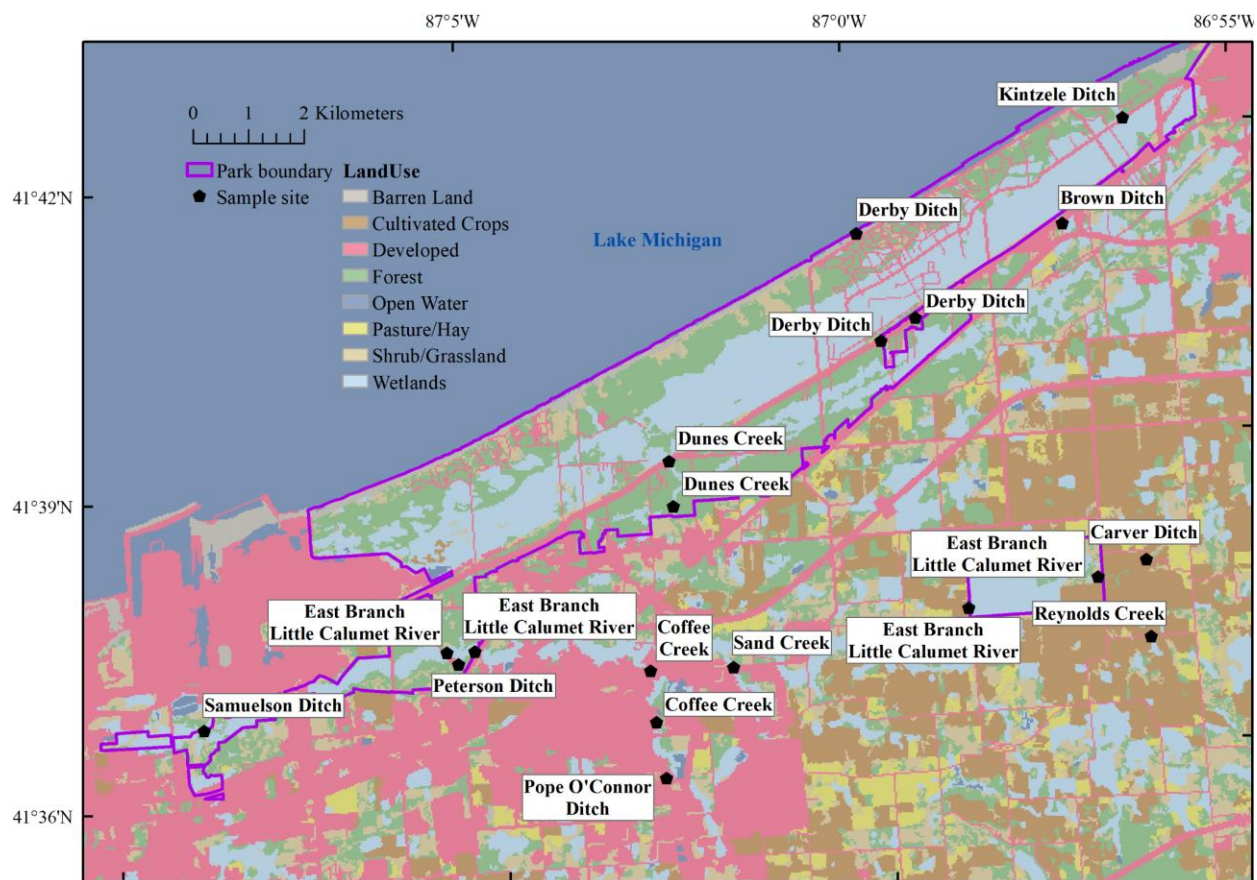


Figure 4. Locations of surface-water sites sampled for contaminants of emerging concern in and around Indiana Dunes National Lakeshore in 2016.

Pictured Rocks National Lakeshore

Six inland lakes (Miners, Chapel, Legion, Beaver, Trappers, and Grand Sable) were sampled at PIRO in 2016 (Figure 5). All the sites are current long-term water quality sites that are monitored three times in the summer for nutrients and a variety of other water quality parameters. Of these lakes, Grand Sable is the only one where gas-powered boat motors are allowed, and that receives moderate visitor use. The other lakes are more remote and are less frequently visited.

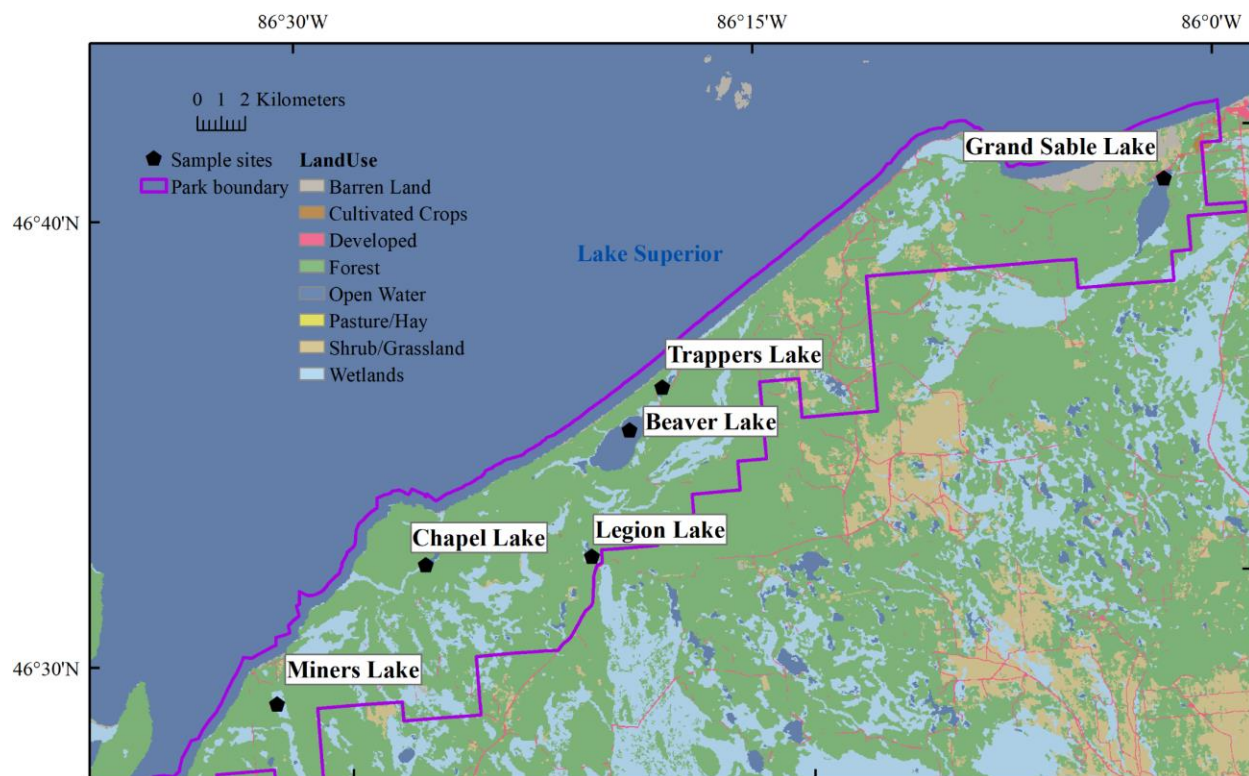


Figure 5. Locations of surface-water sites sampled for contaminants of emerging concern in Pictured Rocks National Lakeshore in 2016.

Sleeping Bear Dunes National Park

Similar to PIRO, six inland lakes (Bass [Leelanau County], Florence, Loon, Manitou, North Bar, and Shell) were sampled at SLBE in 2016 (Figure 6). All are current long-term water quality sites that are monitored three times in the summer for nutrients and a variety of other parameters. Manitou and Florence Lakes are located on North and South Manitou Islands, respectively, where visitor use is limited. The remaining lakes on the mainland receive moderate to heavy visitor use.

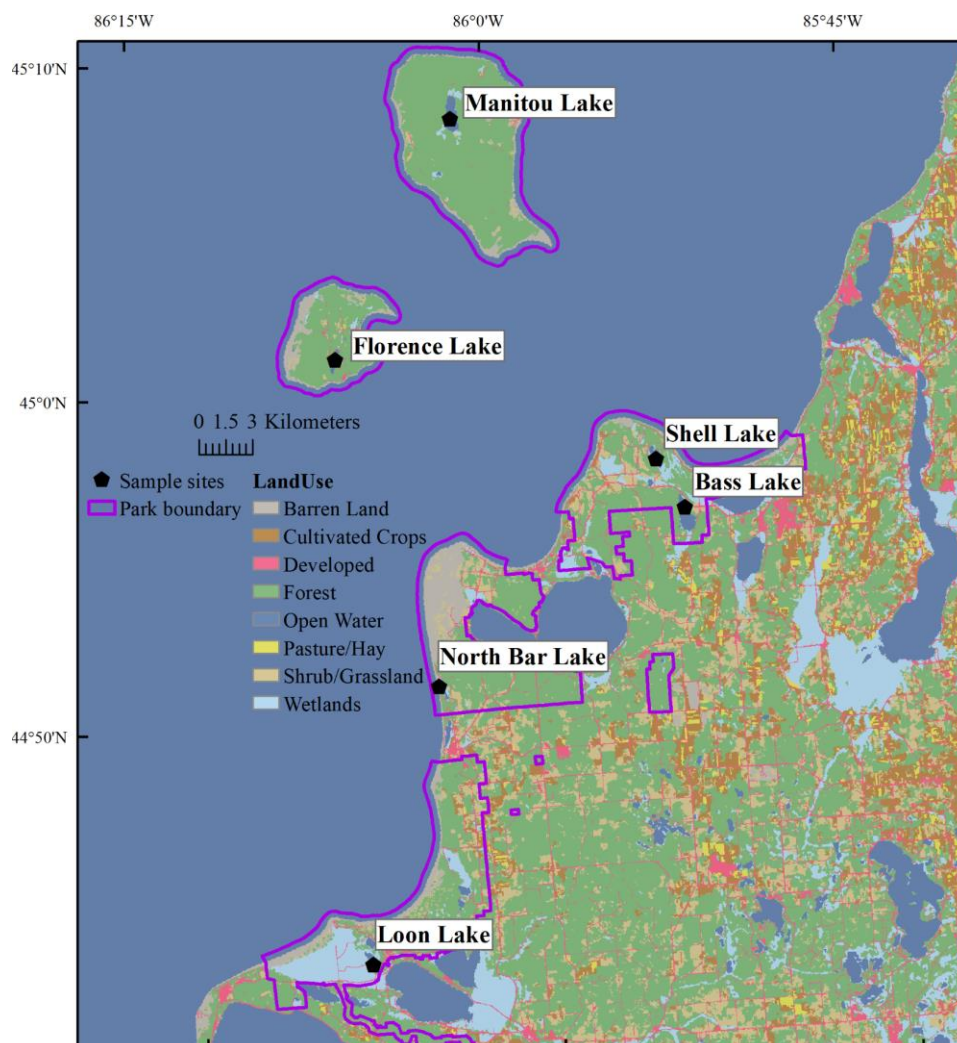


Figure 6. Locations of surface-water sites sampled for contaminants of emerging concern in Sleeping Bear Dunes National Park in 2016.

Field Sampling

In 2016, a total of 74 samples were collected from INDU, PIRO, and SLBE. One sample was collected at each of the 19 INDU sites in April and November. The six inland lakes at PIRO were sampled in June, July, and August, as were the six inland lakes at SLBE. Exceptions were Loon and North Bar Lakes (SLBE), which were sampled in September instead of August due to logistical constraints.

In 2017, a total of 52 samples were collected from VOYA and GRPO. Each of the nine VOYA sites were sampled in June, July, and August. At GRPO, samples were collected from Pigeon River and Swamp Lake in May, July, and October; Grand Portage Creek in July, August, and October; Taylor Lake, Trout Lake, Pigeon Bay, Grand Portage Bay, and Hollow Rock Creek in June and September; Poplar Creek, Mt. Maude, Teal Lake, and NPS Boardwalk in August; and Wauswaugoning Bay and Grand Portage Spring in July and October.

All samples were collected for analysis of pesticides, pharmaceuticals, and personal care products using procedures described in the Quality Assurance Project Plan (NPS 2016). Grab-samples were collected in 40 milliliter glass amber vials supplied by the EPA laboratory. Bottles were rinsed twice with native water prior to sample collection. After rinsing, bottles were dipped approximately 15 centimeters below the water surface and capped underwater, when possible. Samples were then kept on ice, refrigerated to 4°C, and shipped overnight to the EPA laboratory as soon as possible. Prior to and during sample collection, field personnel minimized the use of personal care products such as caffeine, insect repellants, and fragrances to reduce potential for contamination.

Field Quality Assurance/Quality Control

Field-blank and field-replicate samples were collected concurrently with some of the environmental samples. No field-blank samples were collected during 2016, but five field-replicate samples were collected from INDU, three from PIRO, and two from SLBE. In 2017, one field-blank and three field-replicate samples were collected at VOYA, and five field-blank and seven field-replicate samples were collected at GRPO.

Laboratory Analysis

Upon receipt at the EPA Region 8 Laboratory in Golden, Colorado, samples were processed and analyzed for determination of 73 pesticides and 141 pharmaceuticals/personal care products. Pesticides and pharmaceuticals/personal care products (PPCP) were extracted from samples using solid-phase extraction methods and determined by liquid chromatography/mass spectrometry following EPA methods 8321B (USEPA 2007a) and 1694 (USEPA 2007b). A list of all CECs analyzed, along with respective detection and reporting limits are shown in Appendix A. To improve readability, the most commonly used chemical names and/or abbreviations are used in this report. Complete chemical names are given in the analytical method references and the Chemical Abstracts Service Registry Numbers shown in Appendix 1.

Laboratory Quality Assurance/Quality Control

Several quality control measures were used during environmental sample analysis to ensure the quality of the data. These quality control measures included laboratory matrix spike, matrix spike duplicate, blank, and control samples. These quality control measures were used to assess the occurrence of contamination resulting from sample preparation and analysis, and to monitor the performance of the analytical methods.

Data Management and Analysis

Environmental and laboratory quality control data were reviewed by GLKN and U.S. Geological Survey (USGS) staff. Sample metadata including site information and sample date were provided to the NPS Water Resources Division (WRD), who then imported the data and site metadata into the NPS's relational water quality database, NPSTORET. Data was then transferred from NPSTORET to the EPA STORET Data Warehouse for archival.

Detections of CECs in laboratory-blank samples were compared against relevant environmental data. In instances when the environmental concentration was <3-times the blank-sample concentration, the environmental sample was determined to be potentially affected by contamination and changed to a

non-detect. Percent recovery of CECs in laboratory matrix spike, control, and calibration samples was assessed to identify any CECs that may not be accurately recovered by the analytical method. For this analysis, acceptable recovery ranged from 60% to 120%.

Field-blank samples were screened for detection of any CECs as an indication of possible contamination that occurred during sample collection and handling in the field. In instances when an environmental concentration was <3-times the blank-sample concentration, the environmental sample was determined to be potentially affected by contamination and changed to a non-detect. To assess how representative the environmental samples were of the system being sampled, relative percent difference (RPD) was calculated between environmental and field-replicate samples. The RPD was calculated by dividing the absolute difference between environmental and replicate samples by the average of the two concentrations and multiplying by 100. The RPD was only calculated when results above the reporting level were reported for both the environmental and field replicate samples.

The number of CECs and detection frequency for each detected CEC were summarized for each park and individual sample. When appropriate, descriptive statistics such as minimum, median, and maximum concentrations were calculated. Atrazine was included in both the pesticide and PPCP analytical schedules. To eliminate double counting detections, only atrazine values from the pesticide schedule were used when calculating descriptive statistics.

Results

Laboratory Quality Assurance/Quality Control

In general, results from the laboratory quality control samples indicated little contamination but good method performance for determination of the CECs of interest. Recovery of target CECs in matrix spike, matrix spike duplicate, and control samples fell within the range of 60% to 120% for most chemicals, in most samples. Although recoveries of some CECs were <60% or >120% in some quality control samples, few consistent deviations were observed. Most CECs with high recoveries were not detected in environmental samples. Several CECs were detected in laboratory-blank samples above the reporting limit. However, most of these CECs were not detected in environmental samples. Summaries of laboratory quality control data are provided in Appendix C.

Field Quality Assurance/Quality Control

DEET (insect repellant) was the only CEC detected among the six field-blank samples collected in 2017 (20.1 nanograms per liter [ng/L], VOYA). All environmental data collected from VOYA were screened against this value; thus, 11 environmental data points were changed to censored values (i.e., below reporting limit) because the associated concentration was <3-times the field-blank concentration.

Generally, there was good agreement between environmental and field-replicate sample pairs. Of the 62 sample pairs, there were consistent detections (i.e., CEC detected in both samples) in 53. In most instances of inconsistent detections, concentrations were near the reporting limit. RPDs ranged from 0 (2,4-D, herbicide) to 39 (lamotrigine, anticonvulsant). RPDs were >20 for five CECs in the sample pair collected at INDU503 on 14 April 2016, and for 2,4-D in the sample pair collected at SLBE05 on 21 June 2016.

Environmental Data

Voyageurs National Park

Seven CECs were detected among the 27 samples collected at VOYA (Table 2). The two most frequently detected chemicals were atrazine and DEET with 89% and 56% detection frequencies, respectively. Four of the seven detected chemicals were herbicide or herbicide degradates. Caffeine (stimulant), methylparaben (antifungal used in personal care products), and 2,4,5-TP (herbicide) were each detected in one sample. Concentrations of detected CECs ranged from 10.2 (DEET) to 207 (2,4-D) ng/L.

Table 2. Statistical summary of detected chemicals in surface water collected from Voyageurs National Park, June through August 2017. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. “n” = number of samples; “ng/L” = nanograms per liter; “bdl” = below detection limit; “[1]” = estimated value because of failure of one or more laboratory quality assurance/quality control measures; “J” = estimated value; “na” = not applicable.

Chemical	Chemical class	Detection frequency (n=27)	Minimum concentration (ng/L)	Median concentration (ng/L)	Maximum concentration (ng/L)
Atrazine	Herbicide	89	10.5 [1] J	16.7	28.2 [1] J
DEET	Insect repellent	55	74.7	10.8	133 [1] J
2,4-D	Herbicide	11	11.2 [1] J	bdl	207 [1] J
Atrazine de-ethyl	Herbicide degradate	7.4	24.1 [1] J	bdl	27.3 [1] J
2,4,5-TP	Herbicide	3.7	na	na	10 [1] J
Caffeine	Stimulant	3.7	na	na	58.8 [1] J
Methylparaben	Preservative	3.7	na	na	38.3 [1] J

Grand Portage National Monument

Five CECs were detected among the 27 samples collected at GRPO (Table 3). All detected CECs were present in <20% of samples. The CECs detected were atrazine (herbicide), DEET, caffeine, atenolol (beta blocker), and metformin (antidiabetic). Metformin was present only at Grand Portage Bay and atenolol at Swamp Lake. Concentrations of detected CECs ranged from 10.5 (atrazine) to 15.2 (atenolol) ng/L. All concentrations were relatively close to the reporting limit.

Table 3. Statistical summary of detected chemicals in surface water collected from Grand Portage National Monument during May through October 2017. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. “n” = number of samples; “ng/L” = nanograms per liter; “J” = estimated value; “bdl” = below detection limit; “na” = not applicable.

Chemical	Chemical class	Detection frequency (n=27)	Minimum concentration, ng/L	Median concentration, ng/L	Maximum concentration, ng/L
Atrazine	Herbicide	11	10.5	bdl	13.6 J
DEET	Insect repellent	11	11.5 J	bdl	13.6 J
Caffeine	Stimulant	7.4	11.8	bdl	13.2 J
Atenolol	Pharmaceutical	3.7	na	na	15.2
Metformin	Pharmaceutical	3.7	na	na	11.7

Indiana Dunes National Lakeshore

Forty-two CECs were detected among the 38 samples collected at INDU (Table 4). Concentrations ranged from 10.3 (gabapentin) to 3,190 (methylparaben) ng/L. More than 50% (23) of the detected

CECs were pharmaceuticals and pharmaceutical metabolites. Gabapentin and metformin were detected in 74% and 34% of samples, respectively, representing the most frequently detected pharmaceuticals among all samples. The most frequently detected herbicides were metolachlor and acetochlor degradates, as well as 2,4-D. The number of CECs detected at individual sites ranged from 1 (INDU903, 14 April 2016) to 21 (INDU503, 14 November 2016) (Figure 7). Generally, more CECs were detected in samples collected during November than during April.

Table 4. Statistical summary of detected chemicals in surface water collected from Indiana Dunes National Lakeshore in April and November 2016. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. “n” = number of samples; “ng/L” = nanograms per liter; “J” = estimated value; “bdl” = below detection limit; “na” = not applicable.

Chemical	Chemical class	Detection frequency (n=38)	Minimum concentration (ng/L)	Median concentration (ng/L)	Maximum concentration (ng/L)
Metolachlor ESA	Herbicide degradate	95	22.2 J	94.3	1,050 J
Gabapentin	Pharmaceutical	74	10.3	18.2	529 J
Acetochlor OA	Herbicide degradate	71	20.5	29.8	142 J
2,4-D	Herbicide	50	10.5	10.2	266 J
Metformin	Pharmaceutical	34	11.4	bdl	114
DEET	Insect repellent	26	11.9	bdl	222
Atrazine	Herbicide	21	12.3	bdl	47.1 J
Methylparaben	Preservative	21	13.9	bdl	3,190 J
Lamotrigine	Pharmaceutical	16	10.9 J	bdl	74.4 J
Atrazine de-ethyl	Herbicide degradate	13	20.3	bdl	34.4
Venlafaxine	Pharmaceutical	13	13.7	bdl	34.3
10,11-dihydro-10-hydroxycarbamazepine	Pharmaceutical metabolite	10	18.4 J	bdl	30.3
Desmethylvenlafaxine	Pharmaceutical metabolite	10	42.7	bdl	64.9
Hydrochlorothiazide	Pharmaceutical	10	55 J	bdl	91.3
Hydroxybupropion	Pharmaceutical metabolite	10	20.2	bdl	29.8
Lidocaine	Pharmaceutical	10	11.2 J	bdl	18.7
Sotalol	Pharmaceutical	10	35.6 J	bdl	55.4
Tebuthiuron	Herbicide	10	25.8 J	bdl	99.8
Tramadol	Pharmaceutical	10	25.3 J	bdl	41.4
Meprobamate	Pharmaceutical	8	14.9 J	bdl	17.7

Table 4 (continued). Statistical summary of detected chemicals in surface water collected from Indiana Dunes National Lakeshore in April and November 2016. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. “n” = number of samples; “ng/L” = nanograms per liter; “J” = estimated value; “bdl” = below detection limit; “na” = not applicable.

Chemical	Chemical class	Detection frequency (n=38)	Minimum concentration (ng/L)	Median concentration (ng/L)	Maximum concentration (ng/L)
Sulfamethoxazole	Pharmaceutical	8	12	bdl	16.7 J
Triclopyr	Herbicide	8	29	bdl	2,870 J
Acetaminophen	Pharmaceutical	5	10.3 J	bdl	17.5 J
Dextrophan	Pharmaceutical	5	11.6	bdl	17.3
Furosemide	Pharmaceutical	5	19.1	bdl	21.4
MCP	Illicit drug	5	30.8 J	bdl	57.7 J
Metolachlor	Herbicide	5	16.6 J	bdl	18.4 J
Trimethoprim	Pharmaceutical	5	13.4 J	bdl	14.3 J
Atrazine de-isopropyl	Herbicide degradate	3	na	na	42.6
Bromacil	Herbicide	3	na	na	113 J
Caffeine	Stimulant	3	na	na	53.3
Carbamazepine	Pharmaceutical	3	na	na	11.8
Dimethenamid ESA	Herbicide degradate	3	na	na	33.6 J
Imazethapyr	Herbicide	3	na	na	23.4 J
Metoprolol	Pharmaceutical	3	na	na	15.2
Monuron	Herbicide	3	na	na	97.7 J
Naproxen	Pharmaceutical	3	na	na	34
Oxcarbazepine	Pharmaceutical metabolite	3	na	na	11.5
Pregabalin	Pharmaceutical	3	na	na	17.8
Prometon	Herbicide	3	na	na	22.3 J
Simazine	Herbicide	3	na	na	78.5
Valsartan	Pharmaceutical	3	na	na	40.2

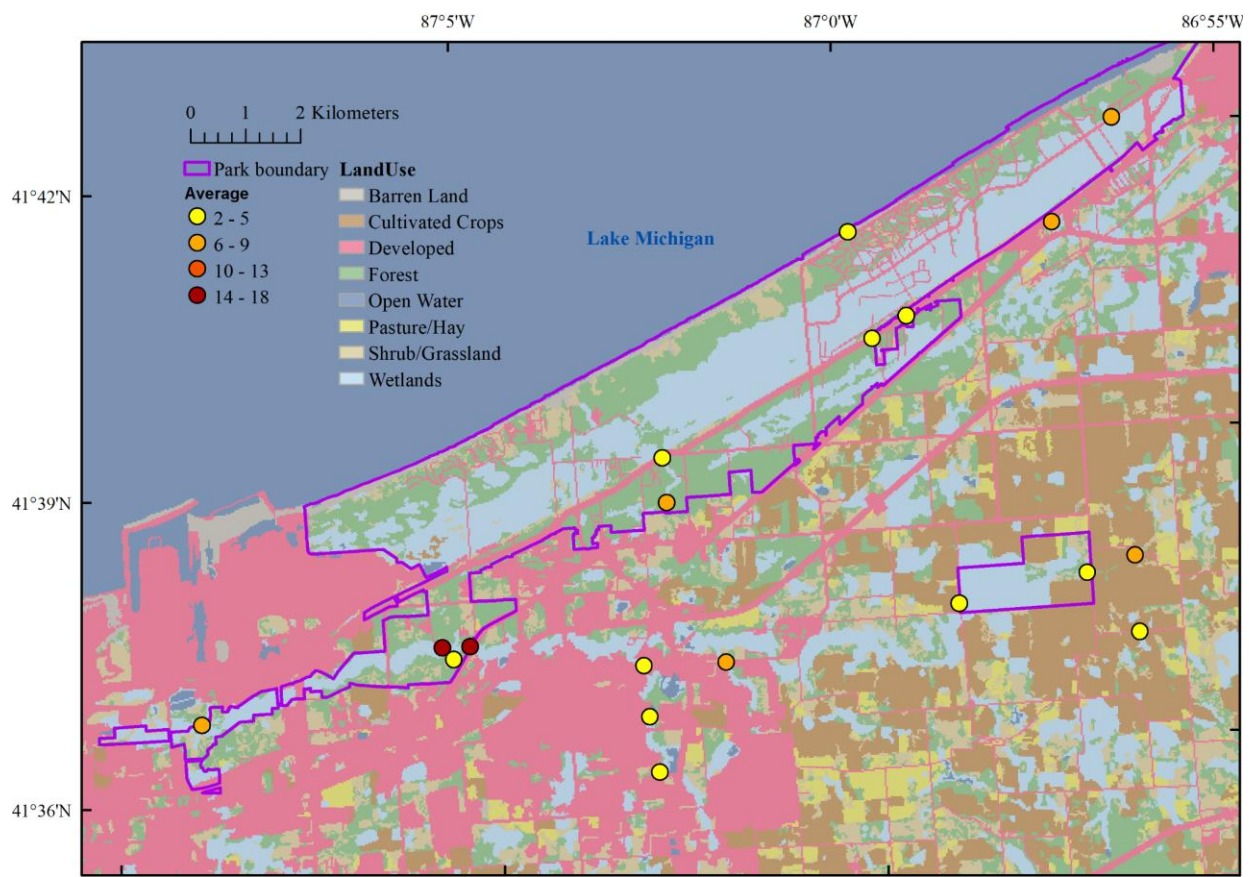


Figure 7. Average number of contaminants of emerging concern detected at Indiana Dunes National Lakeshore sites sampled in April and November 2016.

Pictured Rocks National Lakeshore

Three CECs were detected among the 18 samples collected at PIRO (Table 5). DEET was detected in >50% of all samples. Atrazine and gabapentin were both detected once, in separate samples. Atrazine was detected in PIRO02 in July, while gabapentin was detected in PIRO08 in June. Concentrations ranged from 10.9 (DEET) to 115 (DEET) ng/L.

Table 5. Statistical summary of detected chemicals in surface water collected from Pictured Rocks National Lakeshore during June through August 2016. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. “n” = number of samples; “ng/L” = nanograms per liter; “[1]” = estimated value because of failure of one or more laboratory quality assurance/quality control measures; “J” = estimated value; “na” = not applicable.

Chemical	Chemical class	Detection frequency (n=18)	Minimum concentration, ng/L	Median concentration, ng/L	Maximum concentration, ng/L
DEET	Insect repellant	55	10.9 [1] J	11	115 [1] J
Atrazine	Herbicide	5.6	na	na	10 [1] J
Gabapentin	Pharmaceutical	5.6	na	na	14.5 [1] J

Sleeping Bear Dunes National Lakeshore

Four CECs were detected among the 18 samples collected at SLBE (Table 6). Three of the four detected CECs were present in at least 50% of samples; metformin was detected in only 11% (2) of samples. Concentrations ranged from 10.9 (DEET) to 78.2 (DEET) ng/L. Both detections of metformin occurred at the same site on different dates (SLBE09 August and September). Both concentrations were relatively close to the detection limit.

Table 6. Statistical summary of detected chemicals in surface water collected from Sleeping Bear Dunes National Park during June through September 2016. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. “n” = number of samples; “ng/L” = nanograms per liter; “[1]” = estimated value because of failure of one or more laboratory quality assurance/quality control measures; “J” = estimated value; “bdl” = below detection limit.

Chemical	Chemical class	Detection frequency (n=18)	Minimum concentration, ng/L	Median concentration, ng/L	Maximum concentration, ng/L
DEET	Insect repellant	94	10.9	35.7	78.2 [1] J
Atrazine	Herbicide	72	14 [1] J	15.3	24.6 [1] J
2,4-D	Herbicide	50	11.1 [1] J	10.5	22.8 [1] J
Metformin	Pharmaceutical	11	11.2 [1] J	bdl	13.8

Discussion

Overall, atrazine and DEET were the most frequently detected chemicals. Both chemicals were detected in at least 10% of samples collected in all parks except PIRO, where atrazine was detected in only 5.6% of samples. This is consistent with other studies that have documented the ubiquitous presence of these chemicals in surface waters (Baldwin et al. 2016, Ryberg et al. 2010, Sandstrom et al. 2005). Concentrations of atrazine were relatively low (close to the reporting limit) and maximum concentrations were <50 ng/L. Similarly, typical concentrations of DEET were low; although, maximum concentrations reached >100 ng/L. These results are consistent with previous sampling in Isle Royale National Park and Apostle Islands National Lakeshore in 2014 and 2015, respectively (Elliott and VanderMeulen 2017), in which atrazine and DEET were consistently detected in surface water samples.

Two pharmaceuticals—gabapentin and metformin—were detected in surface waters collected from at least two parks. Previous sampling in other GLKN parks commonly detected gabapentin and metformin, mostly in relation to wastewater-impacted sites, albeit at greater concentrations (Elliott and VanderMeulen 2017, VanderMeulen 2015). Of interest, is the occurrence of gabapentin and metformin in relatively remote lakes in PIRO and SLBE. Some pharmaceuticals (e.g., sulfamethoxazole, ciprofloxacin) have been detected in precipitation and/or airborne particulates (Ferrey et al. 2018), indicating that atmospheric transport may be an unrecognized source of CECs to surface waters. More research needs to be conducted to fully understand this transport mechanism.

The 19 INDU sites have been sampled four times (November 2014, November 2015, April 2016, and November 2016), allowing for comparison of detected CECs across multiple years. The greatest number of CECs was consistently detected at INDU503, which is directly downstream from a wastewater treatment plant. Conversely, INDU903 was the only site to consistently have <5 CECs detected in samples across the years. INDU903 is one of the few sites located furthest from areas of urbanized land use within the park. At any given site, samples collected in April 2016 most often had the fewest CECs detected, while samples collected in November 2014 often had the most CECs detected. Concentrations of four commonly ($\geq 30\%$) detected CECs at INDU were comparable among the four samples collected (Figure 8).

Concentrations of CECs were compared to available human-health and aquatic-life screening values, none of which were exceeded. Data were also compared to concentrations identified from in-vitro testing suspected of eliciting some biological response. Generally, CEC concentrations were at least an order of magnitude less than available human-health screening values, indicating a relatively low hazard to humans. Environmental data were generally substantially lower than those concentrations, indicating low hazard to aquatic organisms, but more research is warranted to fully understand the hazard to aquatic organisms exposed to CECs. Many more CECs were detected at INDU, the only urban park sampled in 2016–2017, consistent with previous findings in GLKN parks (Elliott and VanderMeulen 2017).

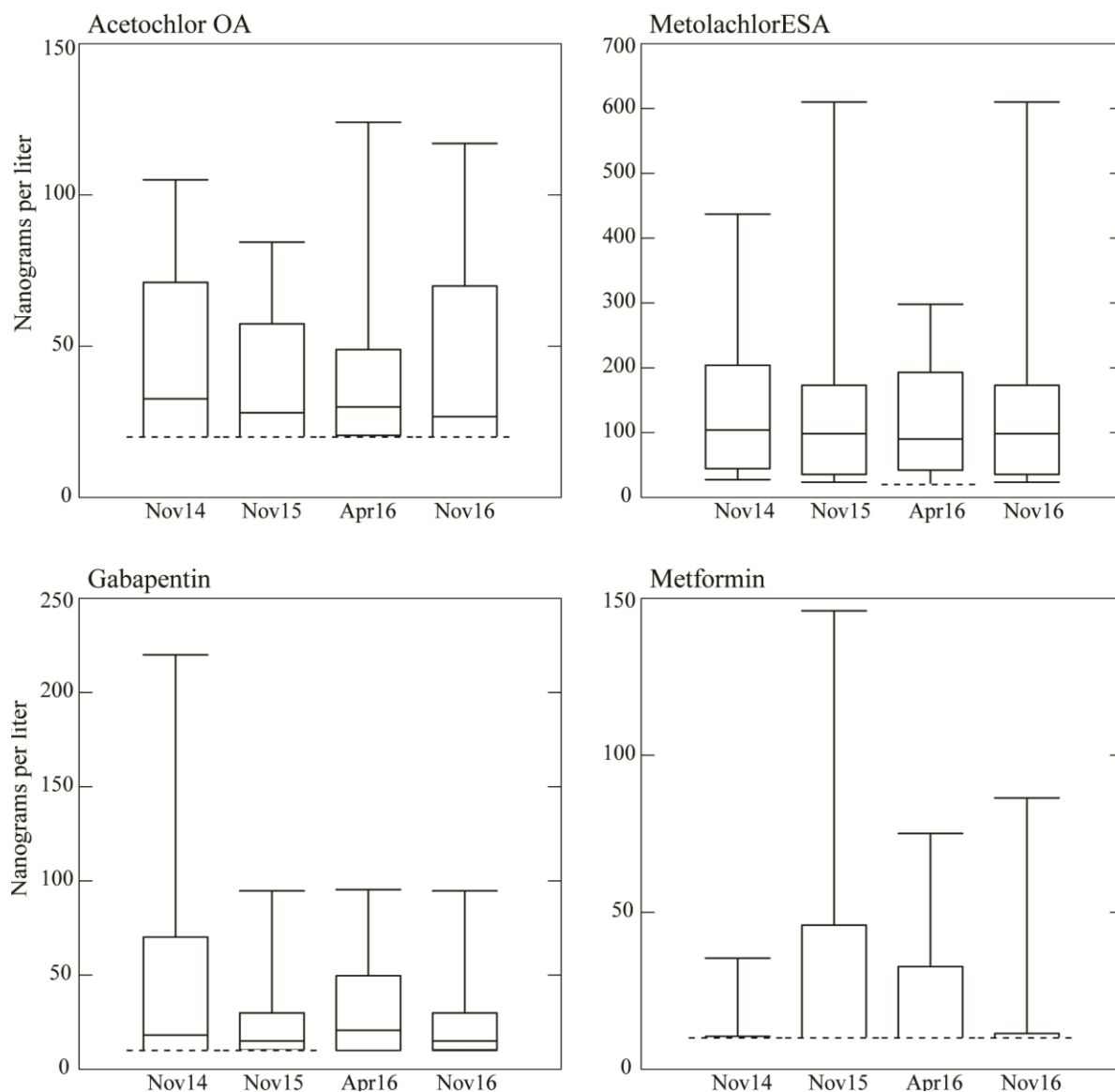


Figure 8. Boxplot summaries of concentrations of acetochlor OA (pesticide degradate), metolachlor ESA (pesticide degradate), gabapentin (pharmaceutical), and metformin (pharmaceutical) detected at Indiana Dunes National Lakeshore during 2014–2016. Middle line of boxplot indicates median concentration; whiskers extend to the 10th and 90th percentiles. Dashed horizontal lines indicate reporting limit, statistics below the reporting limit were not estimated. Sample sizes were 19.

Summary

A broad suite of CECs was tested in surface waters collected within and around Midwestern national parks. The most CECs and highest concentrations were detected at INDU, where the park is influenced by urban, industrial, and agricultural land uses. Commonly detected CECs at all parks included atrazine, DEET, metformin, and gabapentin. Detected concentrations were generally low (<100 ng/L) and below available human-health and aquatic-life screening values, indicating low hazard to aquatic life inhabiting waters within the parks and humans using park waters for recreation. Although hazards to CEC exposure appear low, further monitoring should be conducted to more fully understand the CEC loading to park waters, especially near urban areas.

Literature Cited

- Baldwin, A. K., S. R. Corsi, L. A. DeCicco, P. L. Lenaker, M. A. Lutz, D. J. Sullivan, and K. D. Richards. 2016. Organic contaminants in Great Lakes tributaries: Prevalence and potential aquatic toxicity. *Science of the Total Environment* 554:42–52. Available at: [doi:10.1016/j.scitotenv.2016.02.137](https://doi.org/10.1016/j.scitotenv.2016.02.137).
- Elliott, S. M., and D. D. VanderMeulen. 2017. A regional assessment of chemicals of concern in surface waters of four Midwestern United States national parks. *Science of the Total Environment* 579:1726–1735. Available at: [doi:10.1016/j.scitotenv.2016.11.114](https://doi.org/10.1016/j.scitotenv.2016.11.114).
- Ferrey, M. L., M. C. Hamilton, W. J. Backe, and K. E. Anderson. 2018. Pharmaceuticals and other anthropogenic chemicals in atmospheric particulates and precipitation. *Science of the Total Environment* 612:1488–1497. Available at: [doi:10.1016/j.scitotenv.2017.06.201](https://doi.org/10.1016/j.scitotenv.2017.06.201).
- Lafrancois, B. M., and J. Glase. 2005. Aquatic studies in national parks of the upper Great Lakes States: Past efforts and future directions. Water Resources Division Technical Report NPS/NRWRD/NRTR—2005/334. National Park Service, Denver, Colorado.
- Mast, M. A., W. T. Foreman, and S. V. Skaates. 2007. Current-use pesticides and organochlorine compounds in precipitation and lake sediment from two high-elevation national parks in the western United States. *Archives of Environmental Contamination and Toxicology* 52:294–305. Available at: [doi:10.1007/s00244-006-0096-1](https://doi.org/10.1007/s00244-006-0096-1).
- Mast, M. A., D. A. Alvarez, and S. D. Zaugg. 2011. Deposition and accumulation of airborne organic contaminants in Yosemite National Park, California. *Environmental Toxicology and Chemistry* 31:524–533. Available at: [doi:10.1002/etc.1727](https://doi.org/10.1002/etc.1727).
- NPS (National Park Service). 2016. Quality assurance project plan for surface water sampling for pesticides, pharmaceuticals, and personal care products in the National Park Service’s Inventory and Monitoring Networks. Unpublished report. National Park Service, Fort Collins, Colorado.
- Route, B., W. Bowerman, and K. Kozie. 2009. Protocol for monitoring environmental contaminants in bald eagles, version 1.2: Great Lakes Inventory and Monitoring Network. Natural Resource Report NPS/GLKN/NRR—2009/092. National Park Service, Fort Collins, Colorado.
- Ryberg, K. R., A. V. Vecchia, J. D. Martin, and R. J. Gilliom. 2010. Trends in pesticide concentrations in urban streams in the United States, 1992–2008. U.S. Geological Survey Scientific Investigations Report 2010-5139. Available at: <https://pubs.usgs.gov/sir/2010/5139/>.
- Sandstrom, M. W., D. W. Kolpin, E. M. Thurman, and S. D. Zaugg. 2005. Widespread detection of *N,N*-diethyl-*m*-toluamide in U.S. streams: Comparison with concentrations of pesticides, personal care products, and other organic wastewater compounds. *Environmental Toxicology and Chemistry* 24(5):1029–1034. Available at: [doi:10.1897/04-297R.1](https://doi.org/10.1897/04-297R.1).

- USEPA (U.S. Environmental Protection Agency). 2007a. Method 8321B: Solvent-extractable nonvolatile compounds by high-performance liquid chromatography/thermospray/mass spectrometry (HPLC/TS/MS) or ultraviolet (UV) detection. Test methods for evaluating solid waste, physical/chemical methods. Washington, DC. Available at: <https://www.epa.gov/hw-sw846/sw-846-test-method-8321b-solvent-extractable-nonvolatile-compounds-high-performance-liquid>.
- USEPA (U.S. Environmental Protection Agency). 2007b. Method 1694: Pharmaceuticals and personal care products in water, soil, sediment, and biosolids by HPLC/MS/MS. EPA-821-R-08-002. Washington, DC. Available at: https://www.epa.gov/sites/production/files/2015-10/documents/method_1694_2007.pdf.
- USGS (U.S. Geological Survey). 2018. Water data for the nation: National Water Information System (USGS Water Data for the Nation). Available at: <http://waterdata.usgs.gov/mn/nwis/> (accessed 15 January 2018).
- VanderMeulen, D. 2015. Screening for contaminants of emerging concern in surface waters of the Great Lakes Network parks: 2013–14. Natural Resource Data Series NPS/GLKN/NRDS—2015/786. National Park Service, Fort Collins, Colorado.
- Wiener, J. G., R. J. Haro, K. R. Rolfhus, M. B. Sandheinrich, S. W. Bailey, R. M. Northwick, and T. J. Gostomski. 2016. Bioaccumulative contaminants in aquatic food webs in six national park units of the western Great Lakes region: 2008–2012. Natural Resource Report NPS/GLKN/NRR—2016/1302. National Park Service, Fort Collins, Colorado.
- Writer, J. H., L. B. Barber, G. K. Brown, H. E. Taylor, R. L. Kiesling, M. L. Ferrey, N. D. Jahns, S. E. Bartell, and H. L. Schoenfuss. 2010. Anthropogenic tracers, endocrine disrupting chemicals, and endocrine disruption in Minnesota lakes. *Science of the Total Environment* 409:100–111. Available at: [doi:10.1016/j.scitotenv.2010.07.018](https://doi.org/10.1016/j.scitotenv.2010.07.018).

Appendix A. List of all analytes and associated reporting limits.

Table A-1. Chemicals analyzed in surface-water samples collected during 2016 and 2017 for pesticides using EPA Region 8 SOP Analysis Method ORGM-550 and EPA 8321B method for pesticides in water by light chromatography-mass spectrometry. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. CASRN = Chemical Abstracts Service Registry Number. Dashed lines (--) indicate no data.

Chemical	CASRN	Reporting level (ng/L)
2,4,5-T	93-76-5	10
2,4,5-TP	93-72-1	10
2,4-D	94-75-7	10
2,4-DB	94-82-6	10
3-Hydroxycarbofuran	16655-82-6	10
Acetochlor	34256-82-1	20
Acetochlor OA	194992-44-4	20
Alachlor	15972-60-8	20
Alachlor OA	171262-17-2	50
Aldicarb	116-06-3	10
Aldicarb sulfone	1646-88-4	20
Aldicarb sulfoxide	1646-87-3	10
Atraton	1610-17-9	10
Atrazine	1912-24-9	10
Atrazine de-ethyl	6190-65-4	20
Azoxystrobin	131860-33-8	20
Bentazon	25057-89-0	10
Bromacil	314-40-9	50
Bromoxynil	1689-84-5	10
Butachlor ESA	--	10
Carbaryl	63-25-2	10
Carbofuran	1563-66-2	10
Chlorimuron ethyl	90982-32-4	20

Table A-1 (continued). Chemicals analyzed in surface-water samples collected during 2016 and 2017 for pesticides using EPA Region 8 SOP Analysis Method ORGM-550 and EPA 8321B method for pesticides in water by light chromatography-mass spectrometry. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. CASRN = Chemical Abstracts Service Registry Number. Dashed lines (--) indicate no data.

Chemical	CASRN	Reporting level (ng/L)
Chlorsulfuron	64902-72-3	20
Clothianidin	210880-92-5	20
Cyanazine	21725-46-2	10
Dacthal monoacid	887-54-7	20
Diazinon	333-41-5	20
Dichloroprop	120-36-5	10
Dimethachlor	50563-36-5	10
Dimethenamid	87674-68-8	10
Dimethenamid ESA	205939-58-8	20
Disulfoton sulfone	6/5/2497	50
Diuron	330-54-1	20
Diuron metabolite	3567-62-2	20
EPTC	759-94-4	20
Ethoprop	13194-48-4	40
Fipronil	120068-37-3	20
Fipronil sulfide	120067-83-6	10
Fipronil sulfone	120068-36-2	10
Foramsulfuron	173159-57-4	20
Hexazinone	51235-04-2	10
Imazaquin	81335-37-7	20
Imazethapyr	81335-77-5	20
Imidacloprid	138261-41-3	20
Linuron	330-55-2	20
Malathion	121-75-5	50
MCPP	7085-19-0	20
Metalaxyl	57837-19-1	10

Table A-1 (continued). Chemicals analyzed in surface-water samples collected during 2016 and 2017 for pesticides using EPA Region 8 SOP Analysis Method ORGM-550 and EPA 8321B method for pesticides in water by light chromatography-mass spectrometry. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. CASRN = Chemical Abstracts Service Registry Number. Dashed lines (--) indicate no data.

Chemical	CASRN	Reporting level (ng/L)
Methiocarb	2032-65-7	20
Methomyl	16752-77-5	20
Metolachlor	51218-45-2	10
Metolachlor ESA	947601-85-6	20
Metribuzin	21087-64-9	20
Monuron	150-68-5	10
Neburon	555-37-3	50
Oryzalin	19044-88-3	20
Oxamyl	23135-22-0	20
Prometon	1610-18-0	20
Propachlor	1918-16-7	10
Propachlor ESA	947601-88-9	20
Propachlor OA	70628-36-3	20
Propazine	139-40-2	20
Propiconazole	60207-90-1	50
Propoxur	114-26-1	10
Simazine	122-34-9	50
Sulfometuron methyl	74222-97-2	50
Tebuconazole	107534-96-3	50
Tebuthiuron	34014-18-1	10
Terbuthylazine	5915-41-3	10
Thiamethoxam	153719-23-4	20
Triclopyr	55335-06-3	20

Table A-2. Chemicals analyzed in surface-water samples collected during 2016 and 2017 for pharmaceuticals and personal care products (PPCP) using EPA method 1694 for PPCPs in water by LCMS. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. CASRN = Chemical Abstracts Service Registry Number. Dashed lines (--) indicate no data.

Chemical	CASRN	Reporting level (ng/L)
(+/-)11-nor-9-carboxy-delta-THC	104874-50-2	10
10,11-dihydro-10-hydroxycarbamazepine	29331-92-8	10
6-acetylmorphine	2784-73-8	10
AB-PINACA 4-hydroxypentyl	--	10
Acebutolol	34381-68-5	10
Acetaminophen	103-90-2	25
Aripiprazole	129722-12-9	10
Atenolol	29122-68-7	10
Benzoylecgonine	519-09-5	10
Bezafibrate	41859-67-0	10
Buprenorphine	53152-21-9	10
Bupropion	34841-39-9	10
Caffeine	58-08-2	10
Carbamazepine	298-46-4	10
Carbamazepine 10,11 epoxide	36507-30-9	10
Carisoprodol	78-44-4	10
Celecoxib	169590-42-5	10
Chloramphenicol	56-75-7	10
Cocaine	53-21-4	10
Codeine	76-57-3	10
Cotinine	486-56-6	10
DEET	134-62-3	10
Dehydroaripiprazole	1008531-60-9	10
Desmethylocitalopram	1008531-60-9	10

Table A-2 (continued). Chemicals analyzed in surface-water samples collected during 2016 and 2017 for pharmaceuticals and personal care products (PPCP) using EPA method 1694 for PPCPs in water by LCMS. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. CASRN = Chemical Abstracts Service Registry Number. Dashed lines (--) indicate no data.

Chemical	CASRN	Reporting level (ng/L)
Desmethylenlafaxine	93413-62-8	10
Dextromethorphan	125-69-9	10
Dextrorphan	143-98-6	10
Diclofenac	15307-86-5	10
Diclofenac 4-hydroxy	64118-84-9	25
Diltiazem	33286-22-5	10
Diphenhydramine	58-73-1	10
Disopyramide	3737-09-5	10
EDDP	66729-78-0	10
Erythromycin	114-07-8	10
Erythromycin-anhydro	23893-13-2	10
Escitalopram	128196-01-0	10
Famotidine	76824-35-6	10
Fenbufen	36330-85-5	25
Fluconazole	86386-73-4	10
Fluoxetine	59333-67-4	10
Fluticasone propionate	80474-14-2	10
Furosemide	54-31-9	25
Gabapentin	60142-96-3	10
Gemfibrozil	25812-30-0	10
Glyburide	10238-21-8	10
Hydrochlorothiazide	58-93-5	10
Hydrocodone	34195-34-1	10
Hydromorphone	71-68-1	10
Hydroxybupropion	92264-81-8	10
Ibuprofen	15687-27-1	10

Table A-2 (continued). Chemicals analyzed in surface-water samples collected during 2016 and 2017 for pharmaceuticals and personal care products (PPCP) using EPA method 1694 for PPCPs in water by LCMS. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. CASRN = Chemical Abstracts Service Registry Number. Dashed lines (--) indicate no data.

Chemical	CASRN	Reporting level (ng/L)
Ketoconazole	65277-42-1	10
Ketoprofen	22071-15-4	10
Lamotrigine	84057-84-1	10
Lidocaine	137-58-6	10
Lorazepam	846-49-1	10
MDA	4764-17-4	10
MDEA	82801-81-8	10
MDMA	42542-10-9	10
Mefenamic acid	61-87-7	10
Meperidine	57-42-1	10
Meproamate	57-53-4	10
Metaxalone	1665-48-1	10
Metformin	657-24-9	10
Methadone	1095-90-5	10
Methamphetamine	51-57-0	10
Methylparaben	99-76-3	10
Methylphenidate	113-45-1	10
Metoprolol	37350-58-6	10
Mevastatin	73573-88-3	10
m-Hydroxybenzoylecgonine	129944-99-6	10
Modafinil	68693-11-8	25
Modafinil acid	112111-45-2	25
Monocrotaline	315-22-0	10
Monocrotaline N-oxide	35337-98-5	10
Monoethylglycinexylidide	7728-40-7	10
Montelukast	158966-92-8	10

Table A-2 (continued). Chemicals analyzed in surface-water samples collected during 2016 and 2017 for pharmaceuticals and personal care products (PPCP) using EPA method 1694 for PPCPs in water by LCMS. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. CASRN = Chemical Abstracts Service Registry Number. Dashed lines (--) indicate no data.

Chemical	CASRN	Reporting level (ng/L)
Morphine	57-27-2	10
Naproxen	22204-53-1	10
n-Butylparaben	94-26-8	10
Nevirapine	129618-40-2	10
Norfentanyl	1609-66-1	10
Normeperidine	77-17-8	10
Norquetiapine	753475-15-9	10
Norsertaline	91797-58-9	10
Norverapamil	67812-42-4	10
Omeprazole	73590-58-6	10
Oryzalin	19044-88-3	10
Oxazepam	604-75-1	10
Oxcarbazepine	28721-07-5	10
Oxycodone	76-42-6	10
Oxymorphone	76-1-5	10
Perfluorononanoic acid	375-95-1	10
Perfluorooctanesulfonate	4021-47-0	10
Perfluorooctanoic acid	335-67-1	10
Phenmetrazine	134-49-6	10
Phenobarbital	50-06-6	10
Phentermine	122-09-8	10
Phenylpropanolamine	154-41-6	10
Phenytoin	57-41-0	10
Pioglitazone	111025-46-8	10
Pravastatin	81131-70-6	10
Pregabalin	148553-50-8	10

Table A-2 (continued). Chemicals analyzed in surface-water samples collected during 2016 and 2017 for pharmaceuticals and personal care products (PPCP) using EPA method 1694 for PPCPs in water by LCMS. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. CASRN = Chemical Abstracts Service Registry Number. Dashed lines (--) indicate no data.

Chemical	CASRN	Reporting level (ng/L)
Primidone	125-33-7	10
Propranolol	525-66-6	10
Pseudoephedrine	90-82-4	10
Quetiapine	111974-72-2	10
Retrorsine	480-54-6	10
Retrorsine N-oxide	15503-86-3	10
Ritalinic acid	19395-41-6	10
Ritonavir	155213-67-5	10
Senecionine	130-01-8	10
Senecionine N-oxide	13268-67-2	25
Sertraline	79617-96-2	10
Sildenafil	171599-83-0	10
Simvastatin	79902-63-9	10
Sotalol	959-24-0	10
Sulfamethazine	57-68-1	10
Sulfamethoxazole	723-46-6	10
Sumatriptan	103628-48-4	10
Tadalafil	171596-29-5	10
Temazepam	846-50-4	10
Thiabendazole	148-79-8	10
Tramadol	27203-92-5	10
Trazodone	19794-93-5	10
Triamterene	396-01-0	10
Triclocarban	101-20-2	10
Triclosan	3380-34-5	10
Trimethoprim	738-70-5	10

Table A-2 (continued). Chemicals analyzed in surface-water samples collected during 2016 and 2017 for pharmaceuticals and personal care products (PPCP) using EPA method 1694 for PPCPs in water by LCMS. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. CASRN = Chemical Abstracts Service Registry Number. Dashed lines (--) indicate no data.

Chemical	CASRN	Reporting level (ng/L)
Tylosin	1401-69-0	25
Valsartan	137862-53-4	10
Venlafaxine	93413-44-6	10
Verapamil	52-53-9	10
Warfarin	81-81-2	10
Zolpidem	99294-93-6	10
Zolpidem phenyl-4-carboxylic acid	109461-65-6	10

Appendix B. Concentrations in field replicate and associated environmental samples.

Table B-1. Relative percent difference (RPD) between field replicate and associated environmental sample results. The RPD was calculated as the absolute difference between replicate and environmental concentrations, divided by the average concentration and multiplied by 100. Atrazine was analyzed as part of the pesticide and pharmaceutical and personal care product (PPCP) schedules, those marked with an asterisk (*) were part of the PPCP schedule. Dashed lines (--) indicate those for which a RPD could not be calculated.

Park	Site	Sample date	Chemical	Field replicate result (ng/L)	Environmental sample result (ng/L)	RPD
INDU	INDU029	4/14/2016	2,4-D	57.2	53.6	6.5
	INDU029	4/14/2016	Atrazine*	10.1	<10	--
	INDU029	4/14/2016	Metolachlor	73.7	75.1	1.9
	INDU503	4/14/2016	10,11-dihydro-10-hydroxycarbamazepine	18.5	18.4	0.5
	INDU503	4/14/2016	2,4-D	124	124	0
	INDU503	4/14/2016	Acetochlor OA	36	43.3	18
	INDU503	4/14/2016	Atrazine	10.9	<10	--
	INDU503	4/14/2016	Atrazine*	10.1	<10	--
	INDU503	4/14/2016	Desmethylvenlafaxine	51.8	60.2	15
	INDU503	4/14/2016	Dextrorphan	10.1	<10	--
	INDU503	4/14/2016	Gabapentin	90.4	77.1	16
	INDU503	4/14/2016	Hydrochlorothiazide	49.7	55	10
	INDU503	4/14/2016	Hydroxybupropion	19.6	26	28
	INDU503	4/14/2016	Lamotrigine	50	74.4	39

Table B-1 (continued). Relative percent difference (RPD) between field replicate and associated environmental sample results. The RPD was calculated as the absolute difference between replicate and environmental concentrations, divided by the average concentration and multiplied by 100. Atrazine was analyzed as part of the pesticide and pharmaceutical and personal care product (PPCP) schedules, those marked with an asterisk (*) were part of the PPCP schedule. Dashed lines (--) indicate those for which a RPD could not be calculated.

Park	Site	Sample date	Chemical	Field replicate result (ng/L)	Environmental sample result (ng/L)	RPD
INDU (continued)	INDU503	4/14/2016	Lidocaine	10.5	11.2	6.4
	INDU503	4/14/2016	Metformin	80.1	75.1	6.4
	INDU503	4/14/2016	Metolachlor ESA	199	189	5.1
	INDU503	4/14/2016	Sotalol	41.6	35.9	15
	INDU503	4/14/2016	Sulfamethoxazole	20.3	15.2	29
	INDU503	4/14/2016	Tramadol	33.2	25.3	27
	INDU503	4/14/2016	Trimethoprim	14.2	13.4	5.8
	INDU503	4/14/2016	Venlafaxine	14.2	14.6	2.8
	INDU900	4/14/2016	2,4-D	19	17.7	7.1
	INDU900	4/14/2016	Acetaminophen	11.3	10.3	9.3
	INDU900	4/14/2016	Atrazine	39.2	38.7	1.3
	INDU900	4/14/2016	Atrazine*	40.3	38.9	3.5
	INDU900	4/14/2016	Atrazine de-ethyl	30	34.4	14
	INDU900	4/14/2016	DEET	17.5	<10	--
	INDU900	4/14/2016	Gabapentin	35.8	34.3	4.3
	INDU900	4/14/2016	Lamotrigine	<10	10.9	2.9
	INDU900	4/14/2016	Metformin	74.3	72.2	12

Table B-1 (continued). Relative percent difference (RPD) between field replicate and associated environmental sample results. The RPD was calculated as the absolute difference between replicate and environmental concentrations, divided by the average concentration and multiplied by 100. Atrazine was analyzed as part of the pesticide and pharmaceutical and personal care product (PPCP) schedules, those marked with an asterisk (*) were part of the PPCP schedule. Dashed lines (--) indicate those for which a RPD could not be calculated.

Park	Site	Sample date	Chemical	Field replicate result (ng/L)	Environmental sample result (ng/L)	RPD
INDU (continued)	INDU900	4/14/2016	Metolachlor ESA	34.2	30.3	12
	INDU905	4/14/2016	2,4-D	57.3	56.2	1.9
	INDU905	4/14/2016	Acetochlor OA	27.6	29.8	7.7
	INDU905	4/14/2016	Atrazine	11.1	12.3	10
	INDU905	4/14/2016	Atrazine*	12.2	11.2	8.5
	INDU905	4/14/2016	Atrazine de-isopropyl	41.3	42.6	3.1
	INDU905	4/14/2016	Gabapentin	32.6	37	13
	INDU905	4/14/2016	Metformin	33.9	32.7	3.6
	INDU905	4/14/2016	Metolachlor ESA	122	127	4
	INDU905	4/14/2016	Simazine	66.5	78.5	16
	INDU262	11/14/2016	Acetochlor OA	68.1	69.9	2.6
	INDU262	11/14/2016	DEET	42.3	36.5	15
	INDU262	11/14/2016	Gabapentin	67.2	56.7	17
	INDU262	11/14/2016	Methylparaben	24.2	<10	--
	INDU262	11/14/2016	Metolachlor	<10	16.6	--
	INDU262	11/14/2016	Metolachlor ESA	510	610	18
PIRO	PIRO08	8/31/2016	DEET	11.1	10.9	1.8

Table B-1 (continued). Relative percent difference (RPD) between field replicate and associated environmental sample results. The RPD was calculated as the absolute difference between replicate and environmental concentrations, divided by the average concentration and multiplied by 100. Atrazine was analyzed as part of the pesticide and pharmaceutical and personal care product (PPCP) schedules, those marked with an asterisk (*) were part of the PPCP schedule. Dashed lines (--) indicate those for which a RPD could not be calculated.

Park	Site	Sample date	Chemical	Field replicate result (ng/L)	Environmental sample result (ng/L)	RPD
SLBE	SLBE05	6/21/2016	2,4-D	16.2	20.9	25
	SLBE05	6/21/2016	Atrazine*	18.7	18.2	2.7
	SLBE05	6/21/2016	Atrazine	18.6	19.6	5.2
	SLBE09	8/1/2016	DEET	53.8	61.8	14
	SLBE09	8/1/2016	Metformin	14.3	13.8	3.6
VOYA	VOYA01	7/10/2017	Atrazine*	13.2	14	5.9
	VOYA01	7/10/2017	Atrazine	14.3	13.9	2.8
	VOYA09	6/5/2017	Atrazine	11.6	10.9	6.2
	VOYA09	6/5/2017	Atrazine*	13.4	14.2	5.8
	VOYA09	8/16/2017	Atrazine*	14.1	14.3	1.4
	VOYA09	8/16/2017	Atrazine	24.6	23.6	4.1
GRPO	Swamp Lake	5/23/2017	Atrazine	11.1	10.8	2.7
	Trout Lake	6/7/2017	Atenolol	<10	15.2	--
	Grand Portage Bay (Lake Superior)	9/12/2017	Metformin	<10	11.7	--

Appendix C. Concentrations of detected contaminants of emerging concern in environmental samples, by park.

Table C-1. Pesticides, pharmaceuticals, and personal care products detected at *Voyageurs National Park* in 2017. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. Atrazine was included in the pesticide and pharmaceutical and personal care products schedules; those marked with an asterisk resulted from the pharmaceutical and personal care products schedule. CASRN = Chemical Abstracts Service Registry Number. [1] = estimated value because of failure of one or more laboratory quality assurance/quality control measures. J = estimated value.

Site ID	Sample date	Chemical	CASRN	Result (ng/L)
A1	6/6/2017	2,4-D	94-75-7	207 [1] J
	7/18/2017	Atrazine*	1912-24-9	11.6 [1] J
	7/18/2017	Atrazine	1912-24-9	14.4 [1] J
	7/18/2017	2,4-D	94-75-7	16.4 [1] J
	8/16/2017	Atrazine*	1912-24-9	10.8 [1] J
	8/16/2017	Atrazine	1912-24-9	19.1 [1] J
Site 1	6/5/2017	2,4-D	94-75-7	11.2 [1] J
	6/5/2017	Atrazine*	1912-24-9	12.6 [1] J
	7/19/2017	Atrazine*	1912-24-9	10.6 [1] J
	7/19/2017	Atrazine	1912-24-9	13.6 [1] J
	8/21/2017	Atrazine*	1912-24-9	10.5 [1] J
	8/21/2017	Atrazine	1912-24-9	19.4 [1] J
	8/21/2017	Methylparaben	99-76-3	38.3 [1] J
	8/21/2017	Caffeine	58-08-2	58.8 [1] J
Site 45	6/7/2017	Atrazine*	1912-24-9	14.4 [1] J
	7/19/2017	Atrazine	1912-24-9	13.4 [1] J
	7/19/2017	Atrazine*	1912-24-9	14.8 [1] J
	8/16/2017	Atrazine*	1912-24-9	14.7 [1] J
	8/16/2017	Atrazine	1912-24-9	21.8 [1] J
VOYA-01	6/7/2017	Atrazine	1912-24-9	10.5 [1] J
	6/7/2017	Atrazine*	1912-24-9	14.5 [1] J
	7/10/2017	Atrazine	1912-24-9	13.9 [1] J

Table C-1 (continued). Pesticides, pharmaceuticals, and personal care products detected at **Voyageurs National Park** in 2017. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. Atrazine was included in the pesticide and pharmaceutical and personal care products schedules; those marked with an asterisk resulted from the pharmaceutical and personal care products schedule. CASRN = Chemical Abstracts Service Registry Number. [1] = estimated value because of failure of one or more laboratory quality assurance/quality control measures. J = estimated value.

Site ID	Sample date	Chemical	CASRN	Result (ng/L)
VOYA-01	7/10/2017	Atrazine*	1912-24-9	14 [1] J
	8/15/2017	Atrazine*	1912-24-9	12.3 [1] J
	8/15/2017	Atrazine	1912-24-9	22.6 [1] J
VOYA-05	6/12/2017	Atrazine*	1912-24-9	14.3
	6/12/2017	Atrazine	1912-24-9	15.8
	6/12/2017	DEET	134-62-3	74.7
	7/21/2017	Atrazine*	1912-24-9	14.7 [1] J
	7/21/2017	Atrazine	1912-24-9	14.9 [1] J
	8/17/2017	2,4,5-TP	93-72-1	10 [1] J
	8/17/2017	Atrazine*	1912-24-9	12.1 [1] J
	8/17/2017	Atrazine	1912-24-9	21.9 [1] J
VOYA-09	6/5/2017	Atrazine	1912-24-9	10.9 [1] J
	6/5/2017	Atrazine*	1912-24-9	14.2 [1] J
	7/11/2017	Atrazine*	1912-24-9	15.2 [1] J
	7/11/2017	Atrazine	1912-24-9	17.7 [1] J
	8/16/2017	Atrazine*	1912-24-9	14.3 [1] J
	8/16/2017	Atrazine	1912-24-9	23.6 [1] J
VOYA-16	6/12/2017	Atrazine	1912-24-9	17.6
	6/12/2017	Atrazine*	1912-24-9	24.5
	7/19/2017	Atrazine*	1912-24-9	15.2 [1] J
	7/19/2017	Atrazine	1912-24-9	16.6 [1] J
	8/23/2017	Atrazine*	1912-24-9	14.7 [1] J
	8/23/2017	Atrazine de-ethyl	6190-65-4	24.1 [1] J
	8/23/2017	Atrazine	1912-24-9	24.6 [1] J
VOYA-17	6/9/2017	Atrazine	1912-24-9	12.4 [1] J
	6/9/2017	Atrazine*	1912-24-9	13.3 [1] J

Table C-1 (continued). Pesticides, pharmaceuticals, and personal care products detected at **Voyageurs National Park** in 2017. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. Atrazine was included in the pesticide and pharmaceutical and personal care products schedules; those marked with an asterisk resulted from the pharmaceutical and personal care products schedule. CASRN = Chemical Abstracts Service Registry Number. [1] = estimated value because of failure of one or more laboratory quality assurance/quality control measures. J = estimated value.

Site ID	Sample date	Chemical	CASRN	Result (ng/L)
VOYA-17	6/9/2017	DEET	134-62-3	76.8 [1] J
	7/13/2017	Atrazine	1912-24-9	17.7 [1] J
	7/13/2017	Atrazine*	1912-24-9	18 [1] J
	8/25/2017	Atrazine*	1912-24-9	17.3 [1] J
	8/25/2017	Atrazine	1912-24-9	25.3 [1] J
	8/25/2017	DEET	134-62-3	75 [1] J
VOYA-21	6/8/2017	Atrazine*	1912-24-9	16.2 [1] J
	6/8/2017	Atrazine	1912-24-9	16.7 [1] J
	7/20/2017	Atrazine*	1912-24-9	17.6 [1] J
	7/20/2017	Atrazine	1912-24-9	21.2 [1] J
	7/20/2017	DEET	134-62-36	133 [1] J
	8/23/2017	Atrazine*	1912-24-9	19.7 [1] J
	8/23/2017	Atrazine de-ethyl	6190-65-4	27.3 [1] J
	8/23/2017	Atrazine	1912-24-9	28.2 [1] J

Table C-2. Pesticides, pharmaceuticals, and personal care products detected at **Grand Portage National Monument** in 2017. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. CASRN = Chemical Abstracts Service Registry Number. J = estimated value.

Site ID	Sample date	Chemical	CASRN	Result (ng/L)
Swamp Lake	5/23/2017	Atrazine	1912-24-9	10.8
	7/10/2017	DEET	134-62-3	13.6 J
	7/10/2017	Atrazine	1912-24-9	13.6 J
Grand Portage Creek	7/10/2017	Caffeine	58-08-2	13.2 J
Teal Lake	8/22/2017	DEET	134-62-3	11.5 J
Grand Portage Bay (Lake Superior)	9/12/2017	Metformin	657-24-9	11.7

Table C-2 (continued). Pesticides, pharmaceuticals, and personal care products detected at **Grand Portage National Monument** in 2017. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. CASRN = Chemical Abstracts Service Registry Number. J = estimated value.

Site ID	Sample date	Chemical	CASRN	Result (ng/L)
Hollow Rock Creek	9/11/2017	DEET	134-62-3	12.4
Pigeon River	10/10/2017	Caffeine	5/-08-2	11.8
Taylor Lake	6/7/2017	Atrazine	1912-24-9	10.5
	6/7/2017	Atenolol	29122-68-7	15.2

Table C-3. Pesticides, pharmaceuticals, and personal care products detected at **Indiana Dunes National Lakeshore** in 2016. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. CASRN = Chemical Abstracts Service Registry Number. J = estimated value.

Site ID	Sample date	Chemical	CASRN	Result (ng/L)
INDU029	4/14/2016	2,4-D	94-75-7	53.6
	4/14/2016	Metolachlor ESA	947601-85-6	75.1
	11/14/2016	2,4-D	94-75-7	54 J
	11/14/2016	MCP	7085-19-0	30.8 J
	11/14/2016	Metolachlor ESA	947601-85-6	23.6 J
	11/14/2016	Monuron	150-68-5	97.7 J
INDU082	4/14/2016	2,4-D	94-75-7	19.1
	4/14/2016	Acetaminophen	103-90-2	17.5 J
	4/14/2016	Atrazine	1912-24-9	37.9
	4/14/2016	Atrazine de-ethyl	6190-65-4	21.6
	4/14/2016	Gabapentin	60142-96-3	63.6 J
	4/14/2016	Metformin	657-24-9	11.7 J
	4/14/2016	Metolachlor ESA	947601-85-6	90.2
	11/14/2016	2,4-D	94-75-7	13.1 J
	11/14/2016	Acetochlor OA	194992-44-4	117 J
	11/14/2016	DEET	134-62-3	28.9
	11/14/2016	Gabapentin	60142-96-3	60.1
	11/14/2016	Metformin	657-24-9	28.5

Table C-3 (continued). Pesticides, pharmaceuticals, and personal care products detected at **Indiana Dunes National Lakeshore** in 2016. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. CASRN = Chemical Abstracts Service Registry Number. J = estimated value.

Site ID	Sample date	Chemical	CASRN	Result (ng/L)
INDU082 (continued)	11/14/2016	Methylparaben	99-76-3	78.9
	11/14/2016	Metolachlor ESA	947601-85-6	108 J
INDU144	4/14/2016	Acetochlor OA	194992-44-4	58
	4/14/2016	Atrazine	1912-24-9	16.8
	4/14/2016	DEET	134-62-3	13.3 J
	4/14/2016	Gabapentin	60142-96-3	20.7 J
	4/14/2016	Metformin	657-24-9	54.5 J
	4/14/2016	Tebuthiuron	34014-18-1	99.8
	11/14/2016	2,4-D	94-75-7	14 J
	11/14/2016	Acetochlor OA	194992-44-4	26.7 J
	11/14/2016	Bromacil	314-40-9	113 J
	11/14/2016	Caffeine	58-08-2	53.3
	11/14/2016	Gabapentin	60142-96-3	24.9
	11/14/2016	Metolachlor ESA	947601-85-6	46.4 J
	11/14/2016	Prometon	1610-18-0	22.3 J
	11/14/2016	Tebuthiuron	34014-18-1	91.3 J
	11/14/2016	Triclopyr	55335-06-3	2870 J
INDU164	4/14/2016	Acetochlor OA	194992-44-4	24.7
	4/14/2016	Gabapentin	60142-96-3	43.5 J
	4/14/2016	Metformin	657-24-9	31.5 J
	4/14/2016	Tebuthiuron	34014-18-1	41.8
	11/14/2016	DEET	134-62-3	122
	11/14/2016	Gabapentin	60142-96-3	15
	11/14/2016	Methylparaben	99-76-3	3190 J
	11/14/2016	Metolachlor ESA	947601-85-6	22.2 J
	11/14/2016	Tebuthiuron	34014-18-1	25.8 J
	11/14/2016	Triclopyr	55335-06-3	954 J
INDU243	4/14/2016	Acetochlor OA	194992-44-4	22.9

Table C-3 (continued). Pesticides, pharmaceuticals, and personal care products detected at **Indiana Dunes National Lakeshore** in 2016. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. CASRN = Chemical Abstracts Service Registry Number. J = estimated value.

Site ID	Sample date	Chemical	CASRN	Result (ng/L)
INDU243 (continued)	4/14/2016	DEET	134-62-3	15 J
	4/14/2016	Gabapentin	60142-96-3	529 J
	4/14/2016	Meprobamate	57-53-4	14.9 J
	4/14/2016	Metolachlor ESA	947601-85-6	27.8
	11/14/2016	Acetochlor OA	194992-44-4	22.6
	11/14/2016	DEET	134-62-3	30.3
	11/14/2016	Gabapentin	60142-96-3	351
	11/14/2016	Meprobamate	57-53-4	16.4
	11/14/2016	Methylparaben	99-76-3	247
	11/14/2016	Metolachlor ESA	947601-85-6	32.7 J
INDU262	4/14/2016	2,4-D	94-75-7	10.8
	4/14/2016	Acetochlor OA	194992-44-4	34
	4/14/2016	Metolachlor ESA	947601-85-6	81.4
	11/14/2016	Metolachlor	51218-45-2	16.6 J
	11/14/2016	DEET	134-62-3	36.5
	11/14/2016	Gabapentin	60142-96-3	56.7
	11/14/2016	Acetochlor OA	194992-44-4	69.9 J
INDU328	11/14/2016	Metolachlor ESA	947601-85-6	610 J
	4/14/2016	Acetochlor OA	194992-44-4	128
	4/14/2016	Atrazine	1912-24-9	12.9
	4/14/2016	Metolachlor ESA	947601-85-6	268
	11/14/2016	Acetochlor OA	194992-44-4	30.1 J
	4/14/2016	Gabapentin	60142-96-3	19.1
INDU405	4/14/2016	Metolachlor ESA	947601-85-6	44.1 J
	4/14/2016	Acetochlor OA	194992-44-4	48.9
	4/14/2016	Gabapentin	60142-96-3	10.5 J
	4/14/2016	Metolachlor ESA	947601-85-6	126
	4/14/2016	Triclopyr	55335-06-3	29

Table C-3 (continued). Pesticides, pharmaceuticals, and personal care products detected at **Indiana Dunes National Lakeshore** in 2016. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. CASRN = Chemical Abstracts Service Registry Number. J = estimated value.

Site ID	Sample date	Chemical	CASRN	Result (ng/L)
INDU405 (continued)	11/14/2016	Acetochlor OA	194992-44-4	34.4 J
	11/14/2016	Gabapentin	60142-96-3	29.9
	11/14/2016	Lamotrigine	84057-84-1	17.5
	11/14/2016	Metolachlor ESA	947601-85-6	123 J
	11/14/2016	Pregabalin	148553-50-8	17.8
	11/14/2016	Venlafaxine	93413-44-6	34.3
INDU459	4/14/2016	2,4-D	94-75-7	225
	4/14/2016	Acetochlor OA	194992-44-4	29.9
	4/14/2016	Gabapentin	60142-96-3	13.5 J
	4/14/2016	Metolachlor ESA	947601-85-6	298
	11/14/2016	Methylparaben	99-76-3	182
	11/14/2016	Metolachlor ESA	947601-85-6	204 J
INDU475	4/14/2016	2,4-D	94-75-7	236
	4/14/2016	Acetochlor OA	194992-44-4	20.5
	4/14/2016	Metolachlor ESA	947601-85-6	221
	11/14/2016	Methylparaben	99-76-3	24.6
	11/14/2016	Metolachlor ESA	947601-85-6	173 J
INDU503	4/14/2016	10,11-dihydro-10-hydroxycarbamazepine	29331-92-8	18.4 J
	4/14/2016	2,4-D	94-75-7	124
	4/14/2016	Acetochlor OA	194992-44-4	43.3
	4/14/2016	Desmethylvenlafaxine	93413-62-8	60.2 J
	4/14/2016	Gabapentin	60142-96-3	77.1 J
	4/14/2016	Hydrochlorothiazide	58-93-5	55 J
	4/14/2016	Hydroxybupropion	92264-81-8	26 J
	4/14/2016	Lamotrigine	84057-84-1	74.4 J
	4/14/2016	Lidocaine	137-58-6	11.2 J
	4/14/2016	Metformin	657-24-9	75.1 J
	4/14/2016	Metolachlor ESA	947601-85-6	189

Table C-3 (continued). Pesticides, pharmaceuticals, and personal care products detected at **Indiana Dunes National Lakeshore** in 2016. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. CASRN = Chemical Abstracts Service Registry Number. J = estimated value.

Site ID	Sample date	Chemical	CASRN	Result (ng/L)
INDU503 (continued)	4/14/2016	Sotalol	959-24-0	35.9 J
	4/14/2016	Sulfamethoxazole	723-46-6	15.2 J
	4/14/2016	Tramadol	27203-92-5	25.3 J
	4/14/2016	Trimethoprim	738-70-5	13.4 J
	4/14/2016	Venlafaxine	93413-44-6	14.6 J
	11/14/2016	10,11-dihydro-10-hydroxycarbamazepine	29331-92-8	30.3
	11/14/2016	2,4-D	94-75-7	28.8 J
	11/14/2016	Acetochlor OA	194992-44-4	39.4 J
	11/14/2016	Carbamazepine	298-46-4	11.8
	11/14/2016	Desmethylvenlafaxine	93413-62-8	64.9
	11/14/2016	Dextrophan	143-98-6	17.3
	11/14/2016	Furosemide	54-31-9	21.4
	11/14/2016	Gabapentin	60142-96-3	24.8
	11/14/2016	Hydrochlorothiazide	58-93-5	91.3
	11/14/2016	Hydroxybupropion	92264-81-8	29.8
	11/14/2016	Lamotrigine	84057-84-1	53.1
	11/14/2016	Lidocaine	137-58-6	18.7
	11/14/2016	Meprobamate	57-53-4	17.7
	11/14/2016	Metformin	657-24-9	114
	11/14/2016	Metolachlor ESA	947601-85-6	163 J
	11/14/2016	Metoprolol	37350-58-6	15.2
	11/14/2016	Oxcarbazepine	28721-07-5	11.5
	11/14/2016	Sotalol	959-24-0	55.4
	11/14/2016	Sulfamethoxazole	723-46-6	12
	11/14/2016	Tramadol	27203-92-5	41.4
	11/14/2016	Venlafaxine	93413-44-6	18.1
INDU539	4/14/2016	10,11-dihydro-10-hydroxycarbamazepine	29331-92-8	26.4 J
	4/14/2016	2,4-D	94-75-7	111

Table C-3 (continued). Pesticides, pharmaceuticals, and personal care products detected at **Indiana Dunes National Lakeshore** in 2016. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. CASRN = Chemical Abstracts Service Registry Number. J = estimated value.

Site ID	Sample date	Chemical	CASRN	Result (ng/L)
INDU539 (continued)	4/14/2016	Acetochlor OA	194992-44-4	38.6
	4/14/2016	Desmethylvenlafaxine	93413-62-8	50.7 J
	4/14/2016	Gabapentin	60142-96-3	95.4 J
	4/14/2016	Hydrochlorothiazide	58-93-5	59.7 J
	4/14/2016	Hydroxybupropion	92264-81-8	21.4 J
	4/14/2016	Lamotrigine	84057-84-1	50.5 J
	4/14/2016	Lidocaine	137-58-6	11.2 J
	4/14/2016	Metformin	657-24-9	83.7 J
	4/14/2016	Metolachlor ESA	947601-85-6	193
	4/14/2016	Sotalol	959-24-0	35.6 J
	4/14/2016	Sulfamethoxazole	723-46-6	16.7 J
	4/14/2016	Tramadol	27203-92-5	26.4 J
	4/14/2016	Trimethoprim	738-70-5	14.3 J
	4/14/2016	Venlafaxine	93413-44-6	15.7 J
	11/14/2016	10,11-dihydro-10-hydroxycarbamazepine	29331-92-8	20.1
	11/14/2016	2,4-D	94-75-7	34.8 J
	11/14/2016	Acetochlor OA	194992-44-4	35.8 J
	11/14/2016	Desmethylvenlafaxine	93413-62-8	42.7
	11/14/2016	Dextrophan	143-98-6	11.6
	11/14/2016	Furosemide	54-31-9	19.1
	11/14/2016	Gabapentin	60142-96-3	22.6
	11/14/2016	Hydrochlorothiazide	58-93-5	67.3
	11/14/2016	Hydroxybupropion	92264-81-8	20.2
	11/14/2016	Lamotrigine	84057-84-1	53.7
	11/14/2016	Lidocaine	137-58-6	13.4
	11/14/2016	Metformin	657-24-9	86.4
	11/14/2016	Methylparaben	99-76-3	15.5
	11/14/2016	Metolachlor ESA	947601-85-6	177 J

Table C-3 (continued). Pesticides, pharmaceuticals, and personal care products detected at *Indiana Dunes National Lakeshore* in 2016. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. CASRN = Chemical Abstracts Service Registry Number. J = estimated value.

Site ID	Sample date	Chemical	CASRN	Result (ng/L)
INDU539 (continued)	11/14/2016	Sotalol	959-24-0	42.7
	11/14/2016	Tramadol	27203-92-5	30.5
	11/14/2016	Venlafaxine	93413-44-6	13.7
INDU900	4/14/2016	2,4-D	94-75-7	17.7
	4/14/2016	Acetaminophen	103-90-2	10.3 J
	4/14/2016	Atrazine	1912-24-9	38.7
	4/14/2016	Atrazine de-ethyl	6190-65-4	34.4
	4/14/2016	Gabapentin	60142-96-3	34.3 J
	4/14/2016	Lamotrigine	84057-84-1	10.9 J
	4/14/2016	Metformin	657-24-9	29.7
	4/14/2016	Metolachlor ESA	947601-85-6	30.3
	11/14/2016	Atrazine	1912-24-9	28.2 J
	11/14/2016	Atrazine de-ethyl	6190-65-4	33.5 J
	11/14/2016	Gabapentin	60142-96-3	10.4
	11/14/2016	Metformin	657-24-9	29.7
	11/14/2016	Metolachlor ESA	947601-85-6	26.2 J
INDU901	4/14/2016	2,4-D	94-75-7	20.2
	4/14/2016	Acetochlor OA	194992-44-4	124
	4/14/2016	Atrazine	1912-24-9	39.7
	4/14/2016	Atrazine de-ethyl	6190-65-4	20.3
	4/14/2016	Gabapentin	60142-96-3	49.7 J
	4/14/2016	Metformin	657-24-9	15.2 J
	4/14/2016	Metolachlor ESA	947601-85-6	568
	11/14/2016	2,4-D	94-75-7	18.8 J
	11/14/2016	Acetochlor OA	194992-44-4	113 J
	11/14/2016	Atrazine	1912-24-9	47.1 J
	11/14/2016	Atrazine de-ethyl	6190-65-4	25.8
	11/14/2016	DEET	134-62-3	11.9

Table C-3 (continued). Pesticides, pharmaceuticals, and personal care products detected at **Indiana Dunes National Lakeshore** in 2016. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. CASRN = Chemical Abstracts Service Registry Number. J = estimated value.

Site ID	Sample date	Chemical	CASRN	Result (ng/L)
INDU901 (continued)	11/14/2016	Dimethenamid ESA	205939-58-8	33.6 J
	11/14/2016	Gabapentin	60142-96-3	11.8
	11/14/2016	Imazethapyr	81335-77-5	23.4 J
	11/14/2016	Metolachlor	51218-45-2	18.4 J
	11/14/2016	Metolachlor ESA	947601-85-6	1,050 J
	11/14/2016	Valsartan	137862-53-4	40.2
INDU902	4/14/2016	Acetochlor OA	194992-44-4	33.6
	4/14/2016	Gabapentin	60142-96-3	21.4 J
	4/14/2016	Metolachlor ESA	947601-85-6	81.6
	11/14/2016	Acetochlor OA	194992-44-4	23.2 J
	11/14/2016	DEET	134-62-3	222
	11/14/2016	Gabapentin	60142-96-3	13.8
	11/14/2016	Methylparaben	99-76-3	158
	11/14/2016	Metolachlor ESA	947601-85-6	71.4
INDU903	4/14/2016	Metolachlor ESA	947601-85-6	42.2
	11/14/2016	Methylparaben	99-76-3	13.9
	11/14/2016	Metolachlor ESA	947601-85-6	35.6 J
INDU904	4/14/2016	2,4-D	94-75-7	10.5
	4/14/2016	Acetochlor OA	194992-44-4	94.4
	4/14/2016	Metolachlor ESA	947601-85-6	106
	11/14/2016	2,4-D	94-75-7	16.1 J
	11/14/2016	Acetochlor OA	194992-44-4	142 J
	11/14/2016	DEET	134-62-3	31.4
	11/14/2016	Gabapentin	60142-96-3	94.7
	11/14/2016	Metolachlor ESA	947601-85-6	98.4 J
	11/14/2016	Naproxen	22204-53-1	34
INDU905	4/14/2016	2,4-D	94-75-7	56.2
	4/14/2016	Acetochlor OA	194992-44-4	29.8

Table C-3 (continued). Pesticides, pharmaceuticals, and personal care products detected at *Indiana Dunes National Lakeshore* in 2016. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. CASRN = Chemical Abstracts Service Registry Number. J = estimated value.

Site ID	Sample date	Chemical	CASRN	Result (ng/L)
INDU905 (continued)	4/14/2016	Atrazine	1912-24-9	12.3
	4/14/2016	Atrazine de-isopropyl	1007-28-9	42.6
	4/14/2016	Gabapentin	60142-96-3	37 J
	4/14/2016	Metformin	657-24-9	32.7 J
	4/14/2016	Metolachlor ESA	947601-85-6	127
	4/14/2016	Simazine	122-34-9	78.5
	11/14/2016	2,4-D	94-75-7	266 J
	11/14/2016	Acetochlor OA	194992-44-4	70.9 J
	11/14/2016	DEET	134-62-3	17.9
	11/14/2016	Gabapentin	60142-96-3	13.6
	11/14/2016	MCPP	7085-19-0	57.7 J
	11/14/2016	Metformin	657-24-9	11.4
	11/14/2016	Metolachlor ESA	947601-85-6	100 J
INDU906	4/14/2016	Acetochlor OA	194992-44-4	26.6
	4/14/2016	Gabapentin	60142-96-3	17.4 J
	4/14/2016	Metolachlor ESA	947601-85-6	81.9
	11/14/2016	Gabapentin	60142-96-3	10.3
	11/14/2016	Metolachlor ESA	947601-85-6	62.3 J

Table C-4. Pesticides, pharmaceuticals, and personal care products detected at ***Pictured Rocks National Lakeshore*** in 2016. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. Atrazine was included in the pesticide and pharmaceutical and personal care products schedules; those marked with an asterisk resulted from the pharmaceutical and personal care products schedule. CASRN = Chemical Abstracts Service Registry Number. [1] = estimated value because of failure of one or more laboratory quality assurance/quality control measures. J = estimated value.

Site ID	Sample date	Chemical	CASRN	Result (ng/L)
PIRO02	6/21/2016	DEET	134-62-3	46.3 [1] J
	7/19/2016	Atrazine*	1912-24-9	10 [1] J
	7/19/2016	DEET	134-62-3	66.6 [1] J
	8/25/2016	DEET	134-62-3	115 [1] J
PIRO03	7/21/2016	DEET	134-62-3	49.8 [1] J
PIRO04	8/25/2016	DEET	134-62-3	11.1 [1] J
PIRO06	6/17/2016	DEET	134-62-3	12.5 [1] J
	7/20/2016	DEET	134-62-3	43.4 [1] J
	8/26/2016	DEET	134-62-3	47.6 [1] J
PIRO08	6/15/2016	Gabapentin	60142-96-3	14.5 [1] J
	7/18/2016	DEET	134-62-3	22.9 [1] J
	8/31/2016	DEET	134-62-3	10.9 [1] J

Table C-5. Pesticides, pharmaceuticals, and personal care products detected at ***Sleeping Bear Dunes National Lakeshore*** in 2016. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. Atrazine was included in the pesticide and pharmaceutical and personal care products schedules; those marked with an asterisk resulted from the pharmaceutical and personal care products schedule. CASRN = Chemical Abstracts Service Registry Number. [1] = estimated value because of failure of one or more laboratory quality assurance/quality control measures. J = estimated value.

Site ID	Sample date	Chemical	CASRN	Result (ng/L)
SLBE01	6/23/2016	2,4-D	94-75-7	14.2 [1] J
	6/23/2016	Atrazine*	1912-24-9	13.0 [1] J
	6/23/2016	Atrazine	1912-24-9	19.6 [1] J
	6/23/2016	DEET	134-62-3	41.3 [1] J
	7/25/2016	2,4-D	94-75-7	15.6 [1] J
	7/25/2016	Atrazine*	1912-24-9	12.8 [1] J

Table C-5 (continued). Pesticides, pharmaceuticals, and personal care products detected at ***Sleeping Bear Dunes National Lakeshore*** in 2016. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. Atrazine was included in the pesticide and pharmaceutical and personal care products schedules; those marked with an asterisk resulted from the pharmaceutical and personal care products schedule. CASRN = Chemical Abstracts Service Registry Number. [1] = estimated value because of failure of one or more laboratory quality assurance/quality control measures. J = estimated value.

Site ID	Sample date	Chemical	CASRN	Result (ng/L)
SLBE01 (continued)	7/25/2016	Atrazine	1912-24-9	17.8 [1] J
	7/25/2016	DEET	134-62-3	58.2 [1] J
	9/14/2016	2,4-D	94-75-7	11.1 [1] J
	9/14/2016	Atrazine*	1912-24-9	14.8 [1] J
	9/14/2016	Atrazine	1912-24-9	14.2 [1] J
	9/14/2016	DEET	134-62-3	61.6 [1] J
SLBE02	6/22/2016	2,4-D	94-75-7	16.0 [1] J
	6/22/2016	Atrazine*	1912-24-9	19.7 [1] J
	6/22/2016	Atrazine	1912-24-9	23.6 [1] J
	6/22/2016	DEET	134-62-3	35.0 [1] J
	7/26/2016	Atrazine*	1912-24-9	19.3 [1] J
	7/26/2016	Atrazine	1912-24-9	19.5 [1] J
	7/26/2016	DEET	134-62-3	49.8 [1] J
	9/15/2016	Atrazine*	1912-24-9	11.6 [1] J
	9/15/2016	Atrazine	1912-24-9	15.3 [1] J
	9/15/2016	DEET	134-62-3	47.6 [1] J
SLBE04	6/21/2016	2,4-D	94-75-7	22.8 [1] J
	6/21/2016	Atrazine*	1912-24-9	19.2 [1] J
	6/21/2016	Atrazine	1912-24-9	24.6 [1] J
	6/21/2016	DEET	134-62-3	15.5 [1] J
	7/28/2016	2,4-D	94-75-7	13.0 [1] J
	7/28/2016	Atrazine*	1912-24-9	23.3 [1] J
	7/28/2016	Atrazine	1912-24-9	20.1 [1] J
	7/28/2016	DEET	134-62-3	78.2 [1] J
	9/9/2016	Atrazine*	1912-24-9	13.4 [1] J
	9/9/2016	Atrazine	1912-24-9	15.0 [1] J
	9/9/2016	DEET	134-62-3	46.2 [1] J

Table C-5 (continued). Pesticides, pharmaceuticals, and personal care products detected at ***Sleeping Bear Dunes National Lakeshore*** in 2016. Samples were analyzed at the US Environmental Protection Agency Region 8 Laboratory in Golden, Colorado. Atrazine was included in the pesticide and pharmaceutical and personal care products schedules; those marked with an asterisk resulted from the pharmaceutical and personal care products schedule. CASRN = Chemical Abstracts Service Registry Number. [1] = estimated value because of failure of one or more laboratory quality assurance/quality control measures. J = estimated value.

Site ID	Sample date	Chemical	CASRN	Result (ng/L)
SLBE05	6/21/2016	2,4-D	94-75-7	20.9 [1] J
	6/21/2016	Atrazine*	1912-24-9	18.2 [1] J
	6/21/2016	Atrazine	1912-24-9	19.6 [1] J
	7/27/2016	Atrazine*	1912-24-9	16.4 [1] J
	7/27/2016	Atrazine	1912-24-9	17.2 [1] J
	7/27/2016	DEET	134-62-3	13.3 [1] J
	9/9/2016	Atrazine*	1912-24-9	12.0 [1] J
	9/9/2016	Atrazine	1912-24-9	14.0 [1] J
	9/9/2016	DEET	134-62-3	19.4 [1] J
SLBE09	6/27/2016	Atrazine*	1912-24-9	13.2 [1] J
	6/27/2016	Atrazine	1912-24-9	15.3 [1] J
	6/27/2016	DEET	134-62-3	21.8 [1] J
	8/1/2016	DEET	134-62-3	61.8
	8/1/2016	Metformin	657-24-9	13.8
	9/12/2016	DEET	134-62-3	36.5 [1] J
	9/12/2016	Metformin	657-24-9	11.2 [1] J
SLBE10	6/27/2016	2,4-D	94-75-7	15
	6/27/2016	DEET	134-62-3	10.9
	8/1/2016	DEET	134-62-3	30.6
	9/12/2016	2,4-D	94-75-7	12.2 [1] J
	9/12/2016	DEET	134-62-3	16.0 [1] J

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