



Screening for Contaminants of Emerging Concern in Waters of the Northern Colorado Plateau Network

2015 Surface Water Data

Natural Resource Report NPS/NCPN/NRR—2016/1239



ON THE COVER

Colorado River, Canyonlands National Park. NPS/Claudia Castillo.

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Acronyms

CEC	contaminant of emerging concern
EPA	Environmental Protection Agency
L	liter
m	meter
mg	milligram
NCPN	Northern Colorado Plateau Network
ng	nanogram
NM	national monument
NP	national park
NPS	National Park Service
NWIS	National Water Information System
NWQL	National Water Quality Laboratory
PPCP	pharmaceuticals and personal care products
QA/QC	quality assurance/quality control
RPD	relative percent difference
USGS	U.S. Geological Survey
WSA	wilderness study area

Executive Summary

In 2015, as part of an ongoing screening program for contaminants of emerging concern (CECs) in conjunction with the Environmental Protection Agency Region 8, surface waters at 18 locations in or near seven National Park Service units within the Northern Colorado Plateau Network were sampled for nutrients, pharmaceuticals and drugs, personal care products, pesticides and pesticide degradation products, hormones and phytosterols, and other wastewater indicators. Most sites were sampled in spring (May or June) and fall (September).

The Colorado River at the Potash boat ramp site, just upstream of Canyonlands National Park, continued to show chronic contamination by caffeine, the pesticide 2,4-D, and prescription drugs (gabapentin, lamotrigine, metformin, and sulfamethoxazole). About 14 miles upstream of this long-term sampling location, samples taken at the effluent outflow pipe of the Moab wastewater treatment plant showed a high number and concentration of contaminants entering the river. Samples from the Colorado River 400 m downstream of the effluent pipe had decreased numbers and concentrations of contaminants, indicating relatively quick dilution by the river. However, some contaminants persisted at the the Potash boat ramp site downstream. The wastewater treatment plant is the nearest point source for CECs upstream of the Potash boat ramp.

Patterns of detections at other sampling locations will be explored in future reports. This is an interim report. Limited sampling will continue in 2016 at selected sites in coordination with the U.S. Geological Survey (USGS). A final report is expected upon completion of the USGS project in 2017.

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1 Introduction

1.1 Background

The Northern Colorado Plateau Network (NCPN) provides long-term monitoring and other natural resource data to 16 national park units throughout Utah, western Colorado, southern Wyoming, and northern Arizona. In 2010, in cooperation with the Environmental Protection Agency (EPA) Region 8, the NCPN began screening selected surface waters in network parks for pesticides, pesticide degradation products, and organic wastewater indicators. After a sampling hiatus in 2011, pharmaceuticals and personal care products (PPCPs) were added to the analytical suite in 2012. All of these groups of analytes, collectively known as contaminants of emerging concern (CECs), were detected in a variety of NCPN waters from 2010 to 2014 (Weissinger et al. 2013; Weissinger 2014; Weissinger 2015). CECs are trace organic compounds that are not commonly tested for during routine water quality monitoring but may have adverse effects on aquatic and terrestrial life at very low (parts per billion) concentrations (Battaglin and Kolok 2014).

In 2014, the U.S. Geological Survey (USGS) expanded the project to include testing for hormones in water and sediment, and organic waste indicators in sediment, to track the source, movement, and fate of CECs in aquatic environments. In 2015, the EPA Region 8 laboratory could not process organic wastewater indicators in water due to laboratory capacity limitations; the USGS analyzed these samples. This is an interim report on CEC results for surface-water samples col-

lected and analyzed in 2015 at either the EPA Region 8 laboratory in Golden, Colorado, or the USGS National Water Quality Laboratory (NWQL) in Lakewood, Colorado. For more details on the background of this project, see Weissinger and others (2013), Weissinger (2014), and Weissinger (2015). A report integrating surface water and sediment data is expected at the conclusion of the USGS project in 2017.

1.2 Sampling locations and dates

In 2015, eighteen sampling locations in and near seven national park units were selected for sampling, including Arches National Park (NP), Bryce Canyon NP, Canyonlands NP, Capitol Reef NP, Dinosaur National Monument (NM), Timpanogos Cave NM, and Zion NP.

Sites were selected in conjunction with park managers and USGS cooperators based on previous detections of CECs (Weissinger and others 2013; Weissinger 2014; Weissinger 2015) and the presence of potential CEC sources (e.g., park toilets, direct visitor contact, park orchards). Sample locations included diverse water types and settings, from remote springs to cave pools to large, inter-regional rivers (Figure 1-1; Table 1-1). Samples were targeted to occur during spring (May and June) and fall (September) at most locations. Based on chronic detections over several years in the Colorado River near Canyonlands National Park, two additional samples, from a wastewater treatment plant outflow pipe and 400 m downstream of the pipe in the Colorado River, were submitted in September 2015.

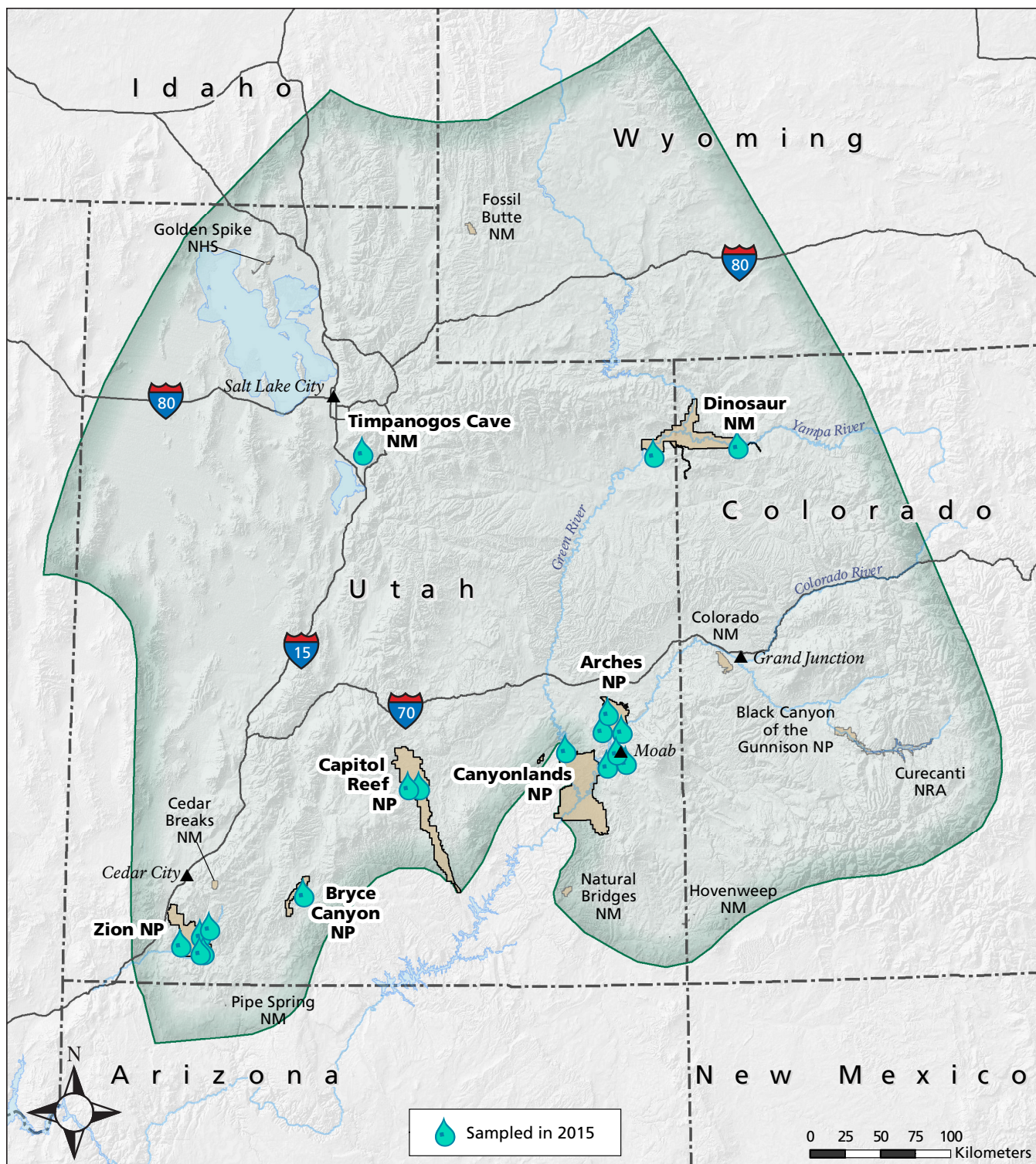


Figure 1-1. Parks and sampling locations for contaminants of emerging concern, 2015.

Table 1-1. Locations sampled for contaminants of emerging concern in and near NCPN park units, 2015.

Site name	Type	Latitude	Longitude	May	June	Sept
Arches National Park						
Lower Courthouse Wash 0.5 mile above Colorado R	intermittent stream	38.687	-109.653	X		X
Sleepy Hollow	spring	38.673	-109.640	X		X
Upper Courthouse Wash at NPS boundary	spring	38.688	-109.655	X		X
Bryce Canyon National Park						
Yellow Creek at NPS boundary	perennial stream	37.574	-112.141	X		X
Canyonlands National Park						
Colorado River at Potash boat ramp	inter-regional river	38.506	-109.660		X	X
Moab wastewater treatment plant	effluent outflow	38.577	-109.578			X
Colorado River at Mill Creek	inter-regional river	38.573	-109.577			X
Green River at Mineral Bottom	inter-regional river	38.522	-109.999		X	X
Capitol Reef National Park						
Fremont River at Hickman Bridge Trailhead	regional river	38.289	-111.235	X		X
Sulphur Creek above confluence with Fremont R	perennial stream	38.287	-111.246	X		X
Dinosaur National Monument						
Yampa River at Deerlodge Park, CO	inter-regional river	40.452	-108.525		X	
Green River at Jensen, UT bridge	inter-regional river	40.409	-109.235		X	
Timpanogogs Cave National Monument						
Middle Cave Lake at bridge	cave pool	40.438	-111.711		X	
Zion National Park						
The Grotto	spring	37.258	-112.947	X		X
North Fork Virgin River at WSA boundary	regional river	37.370	-112.883	X		X
North Fork Virgin River at Temple of Sinawava	regional river	37.284	-112.947	X		X
North Fork Virgin River near Springdale	regional river	37.210	-112.979	X		X
North Creek at planned gage	perennial stream	37.261	-113.106	X		X

2 Methods

2.1 Sampling

2.1.1 Field methods

Sample bottles and coolers were provided by the EPA Region 8 laboratory and the USGS. A new pair of nitrile gloves was used for each sample at all sites. At Timpanogos Cave NM, new, shoulder-length nylon gloves were used under new nitrile gloves to provide additional sample protection in the static (i.e., non-flowing) Middle Cave Lake setting.

2.1.1.1 EPA methods

For the two EPA methods (Table 2-1), sample collection was as follows. In flowing water (all sites except Timpanogos Cave NM and Zion NP–Grotto), the bottle was fully submerged upstream of the collector’s body and held in the flow for approximately 30 seconds, uncapped, then rinsed twice in source water by pouring off rinse water from the loosely capped bottle. The grab sample was collected by orienting the bottle mouth upstream, uncapping, filling completely, and tightly capping under the source water, without air exposure.

At Timpanogos Cave NM, the same approach was employed except the sample

bottle was moved to an undisturbed location in the lake between each step. For the Zion Grotto sample, complete submersion was not possible. The bottle was rinsed twice with spring water before the sample was collected, filled completely, and capped with minimal air exposure.

The exterior of each sample bottle was dried off and then each bottle was labeled, bagged, and immediately placed on ice. Samples were packed in ice and shipped overnight or delivered to the EPA laboratory as soon as possible after sampling, with a maximum holding time of five days to allow for sample processing at the laboratory prior to the seven-day laboratory holding limit.

2.1.1.2 USGS methods

Sample collection and handling was different for each of the three USGS methods (Table 2-2). For nutrient samples (NWQL schedule 1865), a new, 60-mL syringe was rinsed with site water three times. The rinsed syringe was then used to rinse a Pall disc filter (0.45 µm) with 25 mL of site water. The first nutrient sample bottle (125-mL brown polyethylene) was rinsed three times with 10–20 mL of filtered water before being filled with at least 100 mL of filtered water. The second nutrient sample bottle (125-mL clear polyethylene) was rinsed three times with site water, filled

Table 2-1. Analysis methods and sample requirements for the EPA Region 8 laboratory and the USGS National Water Quality Laboratory (NWQL).

Analyte groups	Analytical method	Sample volume	Container size and type
Pesticides and pesticide degradation products	Liquid Chromatography–Mass Spectrometry EPA Method 8321A, EPA R8 Lab SOP ORGM-550 (2013a)	40 mL	Sterile 40-mL amber glass volatile organic analysis (VOA) vials
PPCPs	Liquid Chromatography–Mass Spectrometry EPA Method 1694 EPA R8 Lab SOP ORGM-001 (2013b)	40 mL	Sterile 40-mL amber glass VOA vials
Nutrients	Alkaline persulfate digestion NWQL schedule 1865	250 mL total	125-mL brown polyethylene bottle and 125-mL clear polyethylene bottle
Hormones	Solid-phase extraction, derivatization, and gas chromatography with tandem mass spectrometry NWQL schedule 4434	500 mL	500-mL clear polyethylene bottle
Wastewater indicators	Liquid-liquid extraction and capillary-column gas chromatography/mass spectrometry NWQL schedule 4433	1,000 mL	1,000-mL baked amber glass bottle

to the shoulder with unfiltered water, and acidified with one vial of 4.5 N sulfuric acid.

For hormones (NWQL schedule 4434), a 500-mL clear polyethylene bottle was rinsed three times with site water, as described above for EPA samples. To sample, the observer positioned the bottle at approximately mid-depth at the center of flow, uncapped it while underwater, and filled the bottle while raising it to the surface, collecting a portion from the surface micro-layer, then lowered it again until nearly full, and recapped it with an air space of the entire neck of the bottle (samples are frozen at the NWQL).

For wastewater indicators (NWQL schedule 4433), a 1,000-mL baked amber glass bottle was used. The exterior of the bottle was rinsed, as described above for EPA samples. The bottle was then filled, without interior rinse, in the same way as the hormones sample, leaving some air space in the neck of the bottle. All sample bottles were labeled, bagged, immediately placed on ice, and shipped overnight or delivered to the NWQL for sample processing within designated laboratory holding limits.

2.1.2 Laboratory methods

The laboratory methods used for sample analyses are shown in Table 2-1. For preservation, procedures call for all samples to be iced to a temperature of 2–6°C, with a maximum holding time of seven days.

- For the EPA pesticide and PPCP samples, unfiltered water was filtered at the laboratory and the dissolved fraction analyzed. These samples were analyzed for 72 pesticides and pesticide degradation products and 141 PPCPs.
- For the USGS nutrient samples, filtered water and unfiltered water was analyzed for eight nutrients, using methods described by Patton and Kryskalla (2003).
- For the USGS hormone samples, unfiltered water was analyzed for 21 steroid hormones, sterols, and other related chemicals, using methods described by Foreman and others (2012).
- For the USGS wastewater indicators,

unfiltered water was analyzed for 69 chemicals, using methods described by Zaugg and others (2006).

For additional details on the USGS sample collection techniques and analytical methods utilized by this project, see Lee and others (2015). A table of all analytes and the laboratory reporting limit (usually 2–10× the method detection limit) for each is provided in Appendix A. Semi-quantitative (estimated) results that fell between the method detection and laboratory reporting limits are not presented here.

Samples collected at Arches, Bryce Canyon, and Capitol Reef national parks; on the North Fork Virgin River near the Wilderness Study Area (WSA) boundary in Zion NP in May; and at all locations in September were analyzed outside of their designated holding times. Microbial degradation of pesticides and PPCPs can lead to lower concentrations reported for samples that exceed holding times. These data are presented as estimated.

2.2 Quality assurance

2.2.1 Field blanks

To the extent possible, field-blank samples are processed in the same manner and using the same equipment as the environmental samples. The USGS provided pesticide-grade, organic-free water for the field-blank samples.

The purpose of a field blank is to determine whether contamination is being introduced during sample collection and handling. Field blanks are evaluated with the benchmark of no detection for every analyte. According to procedures developed for previous years' data (Weissinger et al. 2013), if a field blank has a detected level of an analyte, then the field blank is compared to the environmental samples. For the purpose of this report, any environmental sample detections within 2× the amount of the field-blank detection were not reported. An environmental detection more than 5× the amount of the field-blank detection was considered robust and the concentration was reported. An environmental detection between 2 and 5× the field-blank detection was reported as detected

without an estimated concentration.

Field blanks were submitted for 2 of 33 (6.1%) sampling trips for all samples. Both sample collectors submitted one set of field blanks each. Both field blanks from 2015 for nutrients, hormones, and organic wastewater indicator results met the QA/QC (quality assurance/quality control) goal of having no detections. Field blanks for pesticides and PPCPs submitted on September 8, 2015 met the QA/QC goal of having no detections. Field blanks submitted on May 31, 2015 had one analyte, DEET, detected. Two environmental samples collected on the same date at Zion NP (North Fork Virgin River near Springdale and North Creek) had DEET detections within 2× the level detected in the field blank. The environmental sample detections were not reported for these two sites. A third sample collected on the same date (North Fork Virgin River near Temple of Sinawava) also had DEET detected, but at more than 5× the level detected in the field blank. This DEET detection was reported as estimated.

2.2.2 Replicate samples

Replicate samples are collected concurrently with environmental samples and processed in the same lab. The purpose of a replicate is to cumulatively assess the environmental variability and the variability introduced from collection, processing, shipping, and laboratory handling. Replicate samples are evaluated with the benchmark that all detected analytes are within 30% relative percent difference (RPD) of those detected in the environmental sample. RPD is calculated as the percent difference between the detected amounts, divided by the average of the amounts: $(A-B)/((A+B)/2) \times 100$.

A non-detected analyte in the environmental sample should also be non-detected in the replicate sample. If an analyte is detected in one sample, but not the other, then the detected result should be within 30% of the reporting limit. When original samples and their replicates are entirely composed of non-detects, it is assumed that the analyses are falling within the desired precision.

Replicate samples were submitted for 2 of 33

(6.1%) sampling visits for pesticides, PPCPs, nutrients, hormones, and wastewater indicators, for a total of 622 comparisons. In 587 of 622 comparisons (94%), both the environmental and the replicate samples were non-detects and assumed to meet precision goals.

2.2.2.1 EPA methods

For the two EPA methods (213 total analytes), three analytes (2,4-D, gabapentin, and metformin) were detected in both the environmental and replicate samples, with RPD of less than 30% in each case. In addition, DEET was detected in two replicate samples but not in the associated environmental samples. In one sample, the reported detection was within 30% of the reporting limit. The RPD was higher than the desired range in the second sample and the results were reported as “RPD >30%.”

2.2.2.2 USGS methods

For the USGS nutrients method (8 total analytes), analytes were detected in both the environmental and replicate samples in 15 of 16 possible instances. For 14 of these comparisons, the RPD was less than 30%. For one comparison, total phosphorous in the Potash Boat Ramp sample, the RPD was higher than the desired range and reported as “RPD >30%.”

For the USGS hormones method (21 total analytes), analytes were detected in both the environmental and replicate samples in 2 (cholesterol in both) of 42 possible instances, with RPD of less than 30% for each.

For the USGS organic wastewater indicator method (69 total analytes), analytes were detected in both environmental and replicate samples in 11 of 138 possible comparisons. For nine of these (1-methylnaphthalene, 2-methylnaphthalene, 2,6-dimethylnaphthalene, 3-beta-coprostanol, beta-sitosterol, camphor, cholesterol, phenanthrene, and skatol) the RPD was less than 30%. For the remaining two (fluoranthene and pyrene), the RPD was greater than 30%. In addition, DEET was detected in one replicate sample but not in the associated environmental sample. The reported detection was within 30% of the reporting limit. Carbazole was detected in one environmental sample but not the associated replicate sample. The RPD in this

instance was greater than 30%, but the reported detection was semi-quantitative and below the reporting limit.

2.2.3 Laboratory measures

Laboratory QA/QC measures include laboratory (1) blanks that test for contamination during the analysis process, (2) spikes in which a known concentration of analyte is added and the percent recovery assessed,¹ and (3) duplicates to test analytical precision. For all analytes, laboratory blanks are evaluated with the benchmark of no detection. For pesticide and pesticide degradation products, matrix spike and duplicate acceptance criteria are +/- 40%. Matrix spike and duplicate acceptance criteria for PPCPs are variable by analyte but generally +/-50% or greater. Analytes may be flagged for one or a combination of reasons.

Thirty-seven of 180 detected analytes were flagged at least once for analytical reasons. For 35 of these analytes, the associated samples were taken from the effluent outflow of a wastewater treatment plant and were flagged for concentrations outside the method calibration range and/or poor recovery of internal standard(s). Effluent samples are characterized by elevated target-analyte concentrations and matrix complexity, increasing the uncertainty of reported values. These data were reported as estimated and, in general, should be interpreted as minimum estimates of the true analyte concentration in the sample. For the remaining two analytes, spike recoveries were 130–150% and the data were reported as estimated. In each case, the results were consistent with the cumulative (sample + spike) concentration, because the underlying environmental-sample analyte concentrations were significant.

¹ For example, if 50 ng/L of caffeine was added to a sample and the analyzed result was 52.3 ng/L, then the “percent recovery” would be 104.6%.

3 Results

All EPA data for this project are publicly accessible through the EPA Storage and Retrieval database (StoRet), available at <http://www.epa.gov/storet/>. To access the data, select the Organization Name: 11NPSWRD_WQX and the Project Name: NPS_3P EPA/NPS Emerging Contaminants Program (3P). All USGS data for this project are publicly accessible through the USGS National Water Information System (NWIS), available at <http://waterdata.usgs.gov/nwis> (<http://dx.doi.org/10.5066/F7P55KJN>).

3.1 Colorado River near Canyonlands National Park

For several years, the Colorado River at the Potash boat ramp, just upstream of Canyonlands National Park, has shown consistent contamination by caffeine, the pesticide 2,4-D, and several prescription drugs (gabapentin, lamotrigine, metformin, and sulfamethoxazole; Weissinger 2013, 2014). Several of the same compounds were detected in the June 2015 sample at this site (Table 3-1, next page), when a replicate sample was also collected.

The small town of Moab, Utah, sits approximately 15 river miles upstream of the Potash boat ramp on the Colorado River. Although Moab is home to only about 5,000 residents, it receives well over one million visitors every year. Moab's current wastewater treatment plant (WWTP) was built in the early 1950s, and as of 2016, the city was planning to construct a new facility. The effluent pipe from the current WWTP discharges directly into the Colorado River, and is the recognized point source of CECs nearest to the sampling site at the Potash boat ramp.

To investigate the potential contribution of the WWTP to contaminant loads in the Colorado River upstream of Canyonlands National Park, we sampled the WWTP effluent outflow pipe at the confluence with a left-bank side-channel of the Colorado River, the Colorado River at the confluence with Mill Creek (located approximately 400 m downstream of the effluent outflow pipe and approximately 50 m downstream of the

confluence of the left-bank, effluent-influenced, side-channel and the main flow of the Colorado River), and the Colorado River at Potash boat ramp on September 3, 2015 (Figure 3-1).

A total of 141 unique analytes (not including nutrients) were detected at the Moab WWTP effluent outflow pipe, many in concentrations higher than the normal quantitation ranges of EPA and USGS laboratory methods. The reported concentrations for values outside the normal quantitation range should be considered as a minimum boundary for the true concentration in the sample (K. Dahlin, personal communication). Ninety-one pharmaceuticals, drugs, or their degradation products were detected at concentrations ranging from 10.4 ng/L, for norsesertraline, to 116,000 ng/L, for metformin (Table 3-2). Seven personal care products were detected at concentrations ranging from 93.2 ng/L, for triclosan, to 33,200 ng/L, for caffeine. Six pesticides were detected, with concentrations ranging

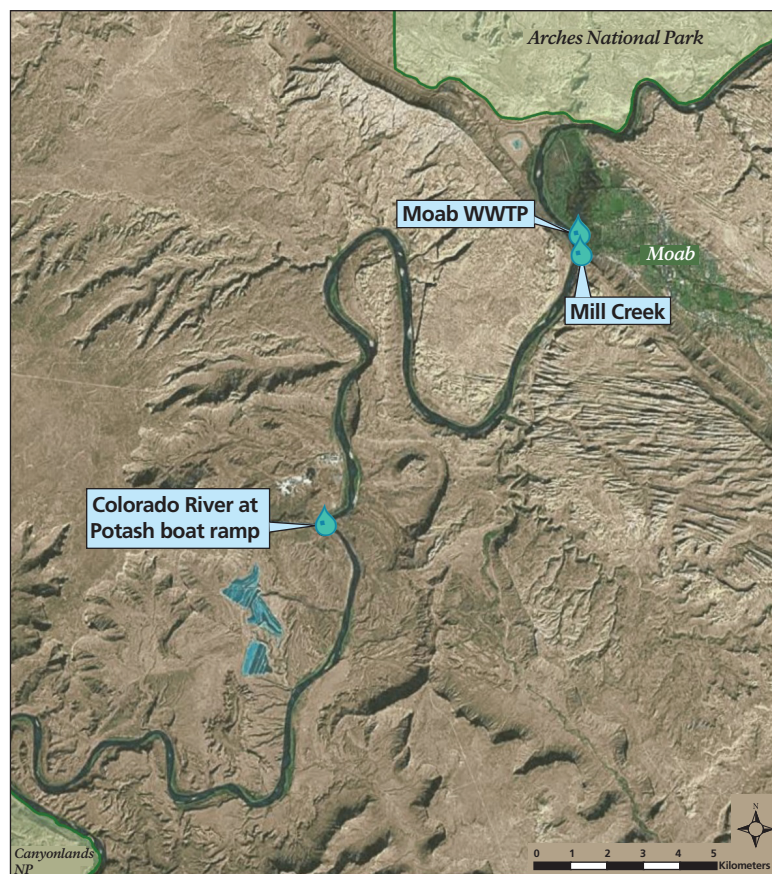


Figure 3-1. Sampling locations at the Moab wastewater treatment plant effluent outflow pipe, located in a small side channel of the Colorado River; a downstream sampling location in the Colorado River at its confluence with Mill Creek; and the Potash boat ramp.

Table 3-1. Concentrations of nutrients, pharmaceuticals, personal care products, pesticides, hormones, and other wastewater indicators detected in samples from the Colorado River at the Potash boat ramp near Canyonlands National Park, June 2015.

Analyte	Environmental sample	Replicate sample
Nutrients (mg/L)		
Phosphorous, dissolved	0.0150	0.0135
Ortho-phosphate, dissolved	0.0112	0.0111
Total phosphorus	0.988	0.540
Ammonia, dissolved	0.0244	0.0244
Nitrite, dissolved	0.0036	0.0038
Nitrite plus nitrate, dissolved	0.286	0.279
Nitrogen, dissolved	0.479	0.468
Total nitrogen	1.02	0.965
Pharmaceuticals and Drugs (ng/L)		
Gabapentin	25.2	22.6
Metformin	19.3	18.1
Personal Care Products (ng/L)		
DEET (EPA method)	17.9 R	<10
Pesticides (ng/L)		
2,4-D	14.7	16.3
Hormones and Phytosterols (ng/L)		
3-Beta-coprostanol (USGS wastewater method)	248 E	208 E
Beta-sitosterol	650 E	590 E
Cholesterol (USGS hormones method)	1350 E	1320 E
Other Wastewater Indicators (ng/L)		
1-Methylnaphthalene	10 E	10 E
2-Methylnaphthalene	12 E	13 E
2,6-dimethylnaphthalene	9	8
3-methyl-1h-indole (skatol)	4	4
Bromoform	8	8
Camphor	30 E	30 E
Fluoranthene	10	6 E
Phenanthrene	15 E	12 E
Pyrene	12	6 E

J - estimated concentration, analyzed outside of holding time limit

E - estimated concentration, other reasons

R - estimated concentration, replicate RPD>30%

from 10.3 ng/L (estimated), for propoxur, to 52.4 ng/L (estimated), for carbaryl. Ten hormones were detected, with concentrations ranging from 1.81 ng/L, for 17-alpha-estradiol, to 2,270,000 ng/L, for 3-beta-coprostanol. Twenty-seven other wastewater indicators were detected, with concentrations ranging from 27 ng/L (estimated), for 4,4'-bisphenol F, to 18,900 ng/L (estimated), for 4-nonylphenol monoethoxylate.

At the site on the Colorado River at Mill Creek (located approximately 400 m downstream of the effluent outflow pipe and approximately 50 m downstream of the confluence of the left-bank, effluent-influenced, side-channel and the main flow of the Colorado River), the number of detected analytes (31) and their concentration range decreased dramatically (see Figure 3-2 for examples). All of the analytes found in this sample were also found in the effluent outflow sample,

with the exception of metolachlor ESA, a pesticide degradate, and phenanthrene, a polycyclic aromatic hydrocarbon. Concentrations of most analytes at the downstream site were several orders of magnitude lower than concentrations from the effluent outflow sample.

The Potash boat ramp is located 14 river miles downstream from the effluent outflow pipe. The September 3 sample for this site showed an additional decrease in the number and concentration of analytes from upstream sites. Twelve analytes were detected, all of which were detected in one or both upstream sites, with the exception of 1-methylnaphthalene (Table 3-2). Concentrations of most analytes were lower than at the upstream sites, with the exceptions of 2,4-D, metolachlor ESA, triethyl citrate, and some nutrient fractions (Table 3-2, Figure 3-2).

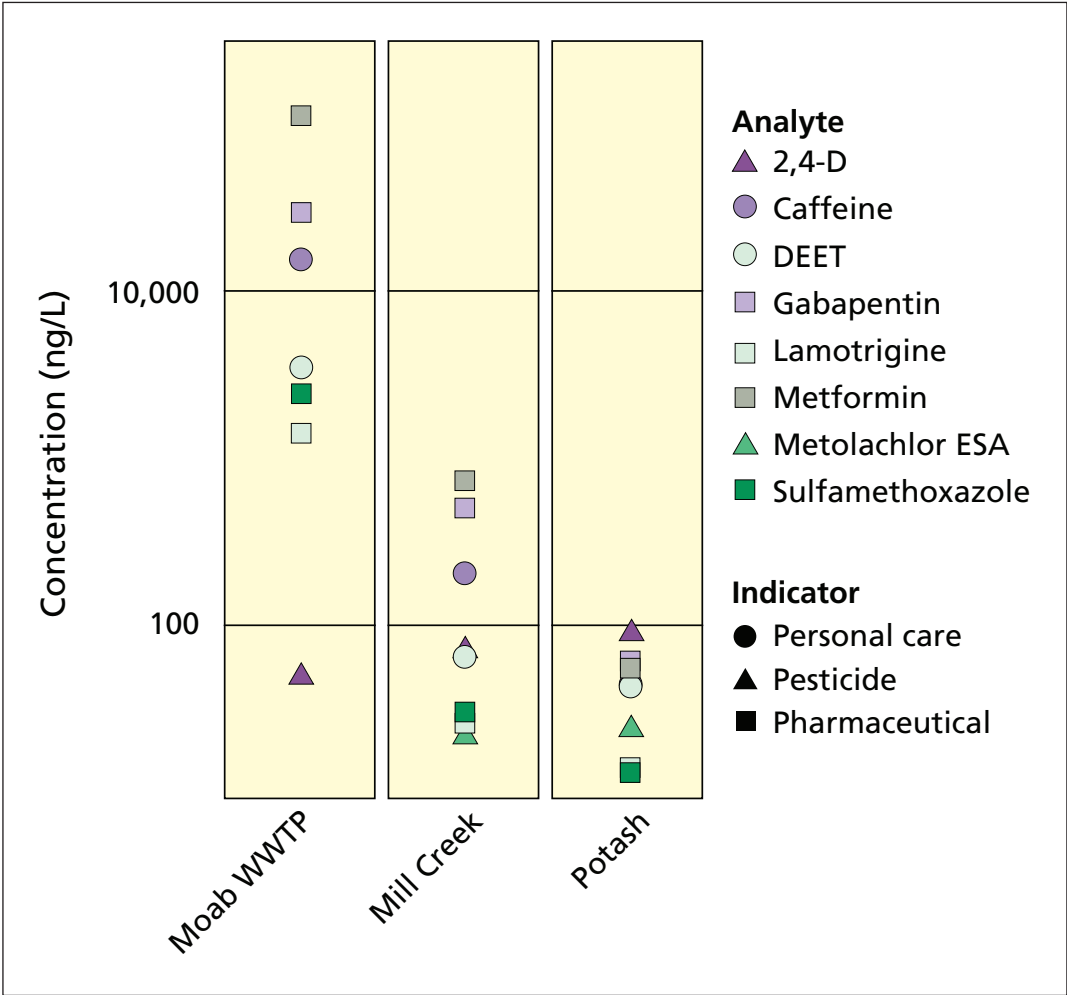


Figure 3-2. Concentrations of pharmaceuticals and personal care products decreased by orders of magnitude as samples moved downstream from the wastewater treatment plant outflow to the Colorado River at Mill Creek and to the Colorado River at the Potash boat ramp. Note the logarithmic scale on the y-axis.

Table 3-2. Concentrations of nutrients, pharmaceuticals, personal care products, pesticides, hormones, and other wastewater indicators detected in samples from the Moab wastewater treatment plant outflow, the Colorado River at Mill Creek, and the Colorado River at Potash Boat Ramp, all near Canyonlands National Park, September 3, 2015.

Analyte	Moab WWTP outflow	Colorado River at Mill Creek	Colorado River at Potash Boat Ramp
Nutrients (mg/L)			
Phosphorous, dissolved	NA	0.0631	0.0466
Ortho-phosphate, dissolved	5.37	0.0584	0.0283
Total phosphorus	7.81	0.523	1.01
Ammonia, dissolved	37.6	0.277	0.0679
Nitrite, dissolved	0.441	0.0098	0.0070
Nitrite plus nitrate, dissolved	2.97	0.756	0.760
Nitrogen, dissolved	NA	1.18	0.930
Total nitrogen	48.7	1.38	1.21
Pharmaceuticals and Drugs (ng/L)			
10,11-dihydro-10-hydroxycarbamazepine	2,070 J, a	18.4 J	<10.0
(+/-)11-nor-9-carboxy-delta-THC	30.0 J	<10.0	<10.0
Acebutolol	49.6 J	<10.0	<10.0
Acetaminophen	2,930 J, a	14.6 J	<10.0
Albuterol	24.4 J, b	<10.0	<10.0
Amitriptyline	10.9 J	<10.0	<10.0
Amitriptyline (+/-)-E-10-hydroxylated	60.5 J	<10.0	<10.0
Amphetamine	114 J	<10.0	<10.0
Atenolol	1,220 J, a, c	<10.0	<10.0
Atorvastatin	75.5 J, c	<10.0	<10.0
Benzoylcegonine	102 J	<10.0	<10.0
Bezafibrate	253 J, b	<10.0	<10.0
Bupropion	57.6 J	<25.0	<25.0
Carbamazepine	653 J	10.4 J	<10.0
Carbamazepine 10,11 epoxide	47.2 J	<10.0	<10.0
Carisoprodol	188 J	<10.0	<10.0
Chlorpheniramine	63.7 J	<10.0	<10.0
Cocaine	14.1 J	<10.0	<10.0
Codeine	128 J	<10.0	<10.0
Cotinine	2,520 J, a, c	16.3 J	<10.0
Cotinine (USGS method)	866 E	34 E	<80
Desmethyldiphenhydramine	64.5 J	<10.0	<10.0
Desmethylenlafaxine	1,250 J, a	13.3 J	<10.0
Dextromethorphan	42.2 J	<10.0	<10.0
Dextropropion	499 J	<10.0	<10.0
Diclofenac	426 J	<10.0	<10.0
Diclofenac 4-hydroxy	568 J	<10.0	<10.0
Diltiazem	34.6 J	<10.0	<10.0
Diphenhydramine	1,180 J, a	<10.0	<10.0
Disopyramide	14.0 J	<10.0	<10.0
Ecgonine Methyl Ester	40.7 J	<10.0	<10.0
EDDP	36.7 J	<10.0	<10.0

Table 3-2. Concentrations of nutrients, pharmaceuticals, personal care products, pesticides, hormones, and other wastewater indicators detected in samples from the Moab wastewater treatment plant outflow, the Colorado River at Mill Creek, and the Colorado River at Potash Boat Ramp, all near Canyonlands National Park, sampled September 3, 2015, cont.

Analyte	Moab WWTP outflow	Colorado River at Mill Creek	Colorado River at Potash Boat Ramp
Pharmaceuticals and Drugs (ng/L), cont.			
Erythromycin	43.9 J	<10.0	<10.0
Erythromycin-anhydro	37.3 J, b	<25.0	<25.0
Escitalopram	174 J	<10.0	<10.0
Famotidine	95.8 J, b	<10.0	<10.0
Fluconazole	287 J	<10.0	<10.0
Furosemide	1430 J	<10.0	<10.0
Gabapentin	29,300 J, a	474 J	57.5 J
Gemfibrozil	2,040 J, a	11.7 J	<10.0
Hydrochlorothiazide	2,130 J, a	25.3 J	<10.0
Hydrocodone	167 J	<10.0	<10.0
Hydromorphone	58.3 J	<10.0	<10.0
Hydroxybupropion	551 J	<10.0	<10.0
Ibuprofen	20,500 J, a	111 J	<10.0
Ketoprofen	92.1 J	<25.0	<25.0
Lamotrigine	1,380 J, a	23.9 J	12.7 J
Levorphanol	476 J	<10.0	<10.0
Lidocaine	358 J	<10.0	<10.0
Lorazepam	21.8 J	<10.0	<10.0
Mefenamic acid	14.7 J	<10.0	<10.0
Meprobamate	908 J	<10.0	<10.0
Metaxalone	35.6 J	<10.0	<10.0
Metformin	116,000 J, a	711 J	52.0 J
Methamphetamine	3,530 J, a	21.0 J	<10.0
Methadone	11.1 J	<10.0	<10.0
Metoprolol	902 J	<10.0	<10.0
Modafinil	35.0 J, b	<10.0	<10.0
Modafinil acid	110 J	<10.0	<10.0
Monoethylglycinexylidide	15.2 J	<10.0	<10.0
Morphine	258 J	<10.0	<10.0
Naproxen	19,300 J, a	138 J	<10.0
Norquetiapine	21.9 J	<10.0	<10.0
Norsertaline	10.4 J	<10.0	<10.0
Omeprazole	16.2 J, b	<10.0	<10.0
Oxazepam	72.7 J, b	<10.0	<10.0
Oxcarbazepine	314 J	<10.0	<10.0
Oxycodone	154 J	<10.0	<10.0
Phenobarbital	192 J	<10.0	<10.0
Phentermine	86.5 J	<10.0	<10.0
Phenytoin	151 J, b	<10.0	<10.0
Pioglitazone	33.3 J, b	<10.0	<10.0
Pravastatin	367 J	<25.0	<25.0

Table 3-2. Concentrations of nutrients, pharmaceuticals, personal care products, pesticides, hormones, and other wastewater indicators detected in samples from the Moab wastewater treatment plant outflow, the Colorado River at Mill Creek, and the Colorado River at Potash Boat Ramp, all near Canyonlands National Park, sampled September 3, 2015, cont.

Analyte	Moab WWTP outflow	Colorado River at Mill Creek	Colorado River at Potash Boat Ramp
Pharmaceuticals and Drugs (ng/L), cont.			
Pregabalin	1,670 J, a	<10.0	<10.0
Primidone	38.0 J	<10.0	<10.0
Propranolol	78.8 J	<10.0	<10.0
Pseudoephedrine	2,960 J, a	25.0 J	<10.0
Quetiapine	12.4 J	<10.0	<10.0
Ritalinic acid	177 J, c	<10.0	<10.0
Sotalol	341 J, b	10.5 J	<10.0
Sulfamethoxazole	2,370 J, a	28.0 J	12.1 J
Sumatriptan	190 J, b	<10.0	<10.0
Temazepam	224 J	<10.0	<10.0
Thiabendazole	17.3 J	<10.0	<10.0
Tramadol	1,220 J, a	17.7 J	<10.0
Trazodone	55.6 J	<10.0	<10.0
Triamterene	195 J	<10.0	<10.0
Triclocarban	76.1 J	<10.0	<10.0
Trimethoprim	516 J	<10.0	<10.0
Valsartan	3,730 J, a, b	17.4 J, b	<10.0
Venlafaxine	419 J	<10.0	<10.0
Zolpidem phenyl-4-carboxylic acid	349 J	<10.0	<10.0
Personal Care Products (ng/L)			
3-tert-butyl-4-hydroxyanisole (bha)	291 E	NA	NA
Caffeine (EPA method)	14,900 J, a	197 J	41.0 J
Caffeine (USGS method)	33,200 E	290	29
DEET (EPA method)	3,380 J, a	59.9 J	40.4 J
DEET (USGS method)	3,000	<44	<40
Hexahydrohexamethyl cyclopentabenzopyran (hhcb)	1,570	52	<40
Menthol	3,190	<320	<320
Triclosan (EPA method)	93.2 J	<10.0	<10.0
Triclosan (USGS method)	1,300	35	<320
Triethyl citrate	968	<40	2480
Pesticides (ng/L)			
2,4-D	46.7 J	64.8 J	87.9 J
3-Hydroxycarbofuran	36.5 J	<10.0	<10.0
Carbaryl	52.4 J	<10.0	<10.0
Dichloroprop	39.2 J	<10.0	<10.0
Diuron	30.7 J	<20.0	<20.0
Propoxur	10.3 J	<10.0	<10.0
Metolachlor ESA	<20.0	21.1 J	22.2 J
Hormones and Phytosterols (ng/L)			
3-beta-coprostanol (USGS wastewater method)	109,000 E	412 E	420 E
3-beta-coprostanol (USGS hormones method)	2,270,000	2090 E	<200
4-androstene-3,17-dione	36.4 E	<0.8	<0.8

Table 3-2. Concentrations of nutrients, pharmaceuticals, personal care products, pesticides, hormones, and other wastewater indicators detected in samples from the Moab wastewater treatment plant outflow, the Colorado River at Mill Creek, and the Colorado River at Potash Boat Ramp, all near Canyonlands National Park, sampled September 3, 2015, cont.

Analyte	Moab WWTP outflow	Colorado River at Mill Creek	Colorado River at Potash Boat Ramp
Hormones and Phytosterols (ng/L), cont.			
17-alpha-estradiol	1.81	<0.8	<0.8
17-beta-estradiol	3.55	<0.8	<0.8
Beta-sitosterol	17,400 E	<4,800	<4,800
Beta-stigmastanol	4,510 E	<3,400	<3,400
Cholesterol (USGS hormones method)	1,040,000	2,780	2,740
cis-androsterone	5.22	<0.8	<0.8
Estriol	65.5	<2	<2
Estrone	16.5	<0.8	<0.8
Other Wastewater Indicators (ng/L)			
1,4-dichlorobenzene	38	<80	<80
1-Methylnaphthalene	<40	<40	9
2,6-dimethylnaphthalene	31	<40	<40
3,4-dichlorophenyl-isocyanate	61 E	<320	<320
3-methyl-1h-indole (skatol)	189	<40	<40
4,4'-bisphenol F, wu	27 E	<10	<10
4-nonylphenol monoethoxylate, total	18,900 E	<1,600	<1,600
4-octylphenol monoethoxylate	1,280 E	<600	<600
4-tert-octylphenol	535 E	<400	<400
5-methyl-1h-benzotriazole	854 E	<320	<320
Acethy-hexamethyl-tetrahydro-naphthalene (ahtn)	174	<40	<40
Acetophenone	357	<400	<400
Benzophenone	650	<80	<80
3-tert-butyl-4-hydroxyanisole (bha)	7,320 E	<2,000	<2,000
Bisphenol A	139	<40	<40
Camphor	922	<80	<80
Diethoxynonylphenonls, total	5,110 E	<1.6	<1.6
Diethyl phthalate	310	<400	<400
Indole	4,300	<40	<40
Isophorone	53	<50	<50
p-Cresol	8,690	<80	<80
para-Nonylphenol, total	5,590 E	130 E	<1,600
Phenanthrene	<20	12	<20
Phenol	1,160	<160	<160
Tri(2-butoxyethyl) phosphate	9,880 E	182 E	<640
Tri(2-chloroxyethyl) phosphate	318	<160	<160
Tributyl phosphate	57	<64	<64
Triphenyl phosphate	100	<80	<80
Tris(dichloroisopropyl) phosphate	719	72	<320

J - estimated concentration, analyzed outside of holding time

E - estimated concentration, other reasons; NA – not analyzed.

a - estimated concentration, outside quantitation range

b - estimated concentration, internal standard acceptance criteria not met

c - estimated concentration, continuing calibration high

3.2 Other park results

3.2.1 Arches National Park

Three sites were sampled in Arches National Park (Table 3-3). Upper Courthouse Wash is a spring that emerges in alluvium at the northern, upstream boundary of the park. It is located just outside the park boundary fence and is frequently visited by cattle and off-highway vehicles. Sleepy Hollow is a spring that emerges as a hanging garden in a protected alcove and receives infrequent visitation from hikers. Lower Courthouse Wash is in a perennial, spring-fed stretch of an intermittent stream and is accessible by a half-mile hike from a state highway.

3.2.2 Bryce Canyon National Park

One site was sampled at Bryce Canyon National Park (Table 3-4). Yellow Creek is located on a perennial stream well downstream of backcountry campsites along a hiking trail. The sampling site is within the fenced park boundary but is occasionally visited by trespass cattle when fences are compromised.

3.2.3 Canyonlands National Park

One additional site was sampled near Canyonlands National Park, on the Green River at the Mineral Bottom boat ramp (Table 3-5). The site has an associated campground and pit toilet.

3.2.4 Capitol Reef National Park

Two sites were sampled at Capitol Reef National Park (Table 3-6). The site on the Fremont River, at Hickman Bridge Trailhead, is located at a popular park trailhead with a paved parking lot and pit toilet and is downstream of additional park infrastructure. The site on Sulphur Creek, above the confluence with the Fremont River, is located downstream of park orchards and campgrounds and adjacent to park housing and the park's septic leach field. A replicate sample was taken at the Fremont River in September.

3.2.5 Dinosaur National Monument

Two sites were sampled near Dinosaur National Monument (Table 3-7). Both sites were located at boat ramps with associated campgrounds and pit toilets along major inter-regional rivers. There were no J-flags associated with data collected at these sites.

3.2.6 Timpanogos Cave National Monument

The site in Middle Cave Lake, at Park Bridge cave pool, was sampled in June 2015 (Table 3-8). The site is located along the cave tour. Its water levels fluctuate quickly after precipitation events, suggesting rapid connection with the surface. DEET has been detected consistently at this site (Weissinger 2014; 2015).

3.2.7 Zion National Park

Five sites were sampled at Zion National Park. The North Fork Virgin River was sampled at three locations (Table 3-9). The most upstream, at the WSA boundary, is on the Narrows hike, downstream from the trailhead. The Temple of Sinawava site is at one of the most popular attractions in the park and located adjacent to a paved parking lot, several toilets, and a trailhead. During the tourist season, thousands of visitors wade in the river just upstream of this sampling location. The most downstream site, near Springdale, is located near park infrastructure, including the visitor center, paved trails, administrative buildings, and parking lots.

The Grotto is a spring that emerges as a hanging garden (Table 3-10). The site is also the source for the park's water supply and receives little park visitation. North Creek is a perennial stream (Table 3-10). Wading in the creek is popular, but occurs primarily several miles upstream of the sampling location.

Table 3-3. Concentrations of nutrients, pharmaceuticals, personal care products, pesticides, hormones, and other wastewater indicators detected in samples from Upper Courthouse Wash, Sleepy Hollow Spring, and Lower Courthouse Wash, Arches National Park.

Analyte	Upper Courthouse Wash		Sleepy Hollow		Lower Courthouse Wash	
	5/29/2015	9/4/2015	5/29/2015	9/4/2015	5/28/2015	9/3/2015
Nutrients (mg/L)						
Phosphorous, dissolved	0.0081	0.0711	<0.003	0.0042	<0.003	0.157
Ortho-phosphate, dissolved	0.0121	0.0400	<0.004	<0.004	<0.004	0.0384
Total phosphorus	0.0231	0.239	0.0057	0.0319	0.015	0.236
Ammonia, dissolved	<0.01	<0.01	<0.01	0.014	<0.01	<0.04
Nitrite, dissolved	<0.001	0.0194	0.0018	0.0048	<0.001	0.0168
Nitrite plus nitrate, dissolved	<0.01	0.741	0.239	0.120	0.013	0.739
Nitrogen, dissolved	0.087	1.03	0.342	0.227	0.093	1.00
Total nitrogen	0.117	1.14	0.363	0.404	0.127	1.26
Pharmaceuticals and Drugs (ng/L)						
Benzoylcegonine	<10.0	11.6 J	<10.0	<10.0	<10.0	<10.0
Caffeine	<25.0	<25.0	<25.0	<25.0	<25.0	34.5 J
Cocaine	<10.0	25.1 J	<10.0	<10.0	<10.0	<10.0
Personal Care Products (ng/L)						
DEET (EPA method)	<10.0	34.6 J	13.5 J	11.5 J	<10.0	15.1 J
DEET (USGS wastewater method)	9 E	<40	8 E	<40	<40	<40
Pesticides (ng/L)						
Triclopyr	<20.0	<20.0	<20.0	<20.0	<20.0	55.0 J
Hormones and Phytosterols (ng/L)						
3-beta-coprostanol (USGS wastewater method)	190 E	<1,600	236 E	<1,600	163 E	426 E
Beta-sitosterol	<4,800	680 E	500 E	550 E	<4,800	<4,800
Cholesterol (USGS hormones method)	361 E	2,300	208 E	803	438 E	1360
Other Wastewater Indicators (ng/L)						
3-methyl-1h-indole (skatol)	<40	<40	12 E	<40	<40	<40
Camphor	<80	<80	21 E	<80	<80	<80
Carbazole	<20	<20	5	<20	3	<20
Indole	<40	<40	12 E	<40	<40	<40
Isophorone	<50	<50	7	<50	7	27
p-Cresol	11 E	<80	18 E	<80	<80	<80
Phenol	60 E	<160	<160	<160	<160	<160
Tri(2-butoxyethyl) phosphate	<640	<640	<640	140 E	<640	<640
Triphenyl phosphate	<80	<80	<80	20	<80	<80
Tris(dichloroisopropyl) phosphate	22	<320	<320	81	<320	<320

J - estimated concentration, analyzed outside of holding time limit

E - estimated concentration, other reasons

Table 3-4. Concentrations of nutrients, pharmaceuticals, personal care products, and other wastewater indicators detected in samples from Yellow Creek, Bryce Canyon National Park.

Analyte	5/30/2015	9/5/2015
Nutrients (mg/L)		
Phosphorous, dissolved	<0.003	<0.003
Ortho-phosphate, dissolved	<0.004	<0.004
Total phosphorus	0.181	0.008
Ammonia, dissolved	<0.01	<0.01
Nitrite, dissolved	<0.001	0.0011
Nitrite plus nitrate, dissolved	0.010	<0.01
Nitrogen, dissolved	<0.05	<0.05
Total nitrogen	0.057	<0.05
Pharmaceuticals and Drugs (ng/L)		
Caffeine	49.8 J	<25.0
Personal Care Products (ng/L)		
DEET (EPA method)	26.1 J	28.4 J
Other Wastewater Indicators (ng/L)		
Camphor	20 E	<80

J - estimated concentration, analyzed outside of holding time limit

E - estimated concentration, other reasons

Table 3-5. Concentrations of nutrients, pharmaceuticals, personal care products, pesticides, hormones, and other wastewater indicators detected in samples from the Green River at Mineral Bottom boat ramp, Canyonlands National Park.

Analyte	6/04/2015	9/4/2015
Nutrients (mg/L)		
Phosphorous, dissolved	0.0452	0.0241
Ortho-phosphate, dissolved	0.0229	<0.008
Total phosphorus	0.904	1.24
Ammonia, dissolved	<0.01	<0.01
Nitrite, dissolved	0.0031	0.0044
Nitrite plus nitrate, dissolved	0.162	0.218
Nitrogen, dissolved	0.475	0.430
Total nitrogen	1.04	0.736
Pharmaceuticals and Drugs (ng/L)		
Gabapentin	13.1	15.5 J
Metformin	<10.0	16.2 J
Personal Care Products (ng/L)		
DEET (EPA method)	17.5	23.3 J
DEET (USGS wastewater method)	24	<40
Pesticides (ng/L)		
Triclopyr	<20.0	53.6 J
Hormones (ng/L)		
Cholesterol (USGS hormone method)	1,460	2,380
Other Wastewater Indicators (ng/L)		
1-Methylnaphthalene	6 E	19
2-Methylnaphthalene	<40	24
Camphor	<80	22
Naphthalene	<20	22
p-Cresol	24 E	<80
Phenanthrene	<20	14

J - estimated concentration, analyzed outside of holding time limit

E - estimated concentration, other reasons

Table 3-6. Concentrations of nutrients, personal care products, pesticides, hormones, and other wastewater indicators, detected in samples from the Fremont River at Hickman Bridge and Sulphur Creek, Capitol Reef National Park.

Analyte	Fremont River at Hickman Bridge			Sulphur Creek	
	5/29/2015	9/4/2015	9/4/2015 replicate	5/29/2015	9/4/2015
Nutrients (mg/L)					
Phosphorous, dissolved	0.004	0.0089	0.0099	0.0038	0.0060
Ortho-phosphate, dissolved	0.0072	0.0094	0.0091	0.0075	0.0085
Total phosphorus	0.0342	0.287	0.301	0.153	0.378
Ammonia, dissolved	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrite, dissolved	<0.001	0.0043	0.0044	0.001	0.0025
Nitrite plus nitrate, dissolved	<0.01	0.193	0.193	0.033	0.073
Nitrogen, dissolved	0.144	0.312	0.311	0.183	0.193
Total nitrogen	0.193	0.354	0.344	0.254	0.460
Personal Care Products (ng/L)					
DEET (EPA method)	25.6 J	11.1 J	<10.0 J	14.6 J	<10.0
DEET (USGS wastewater method)	<40	<40	53	<40	<40
Pesticides (ng/L)					
Triclopyr	<20.0	<20.0	<20.0	<20.0	43.0 J
Hormones (ng/L)					
3-beta-Coprostanol (USGS wastewater method)	270 E	<1,600	<1,600	<1,600	<1,600
Cholesterol (USGS hormone method)	467 E	977	924	557 E	563
Other Wastewater Indicators (ng/L)					
Bis-(2-ethylhexyl) phthalate (DEHP)	<2,000	<2,000	<2,000	650 E	<2,000
Bromoform	12	<160	<160	<160	<160
Carbazole	5	7	<20	4	<20
Isophorone	6	<50	<50	<50	<50
p-Cresol	11 E	<80	<80	<80	<80
Tris(dichloroisopropyl) phosphate	<320	<320	<320	40	<320

J - estimated concentration, analyzed outside of holding time limit

E - estimated concentration, other reasons

Table 3-7. Concentrations of nutrients, pharmaceuticals, personal care products, pesticides, hormones, and other wastewater indicators detected in samples from the Yampa River at Deerlodge Park, CO, and the Green River near Jensen, UT, both in Dinosaur National Monument.

Analyte	Yampa River at Deerlodge Park		Green River near Jensen	
	6/3/2015	9/8/2015	6/3/2015	9/8/2015
Nutrients (mg/L)				
Phosphorous, dissolved	0.0191	0.006	0.0350	0.0042
Ortho-phosphate, dissolved	0.0138	<0.004	0.0158	<0.004
Total phosphorus	0.165	0.0276	0.260	0.0203
Ammonia, dissolved	<0.01	<0.01	<0.01	<0.01
Nitrite, dissolved	0.0011	0.0011	0.0016	0.0011
Nitrite plus nitrate, dissolved	0.047	<0.01	0.043	0.012
Nitrogen, dissolved	0.270	0.248	0.286	0.192
Total nitrogen	0.762	0.377	0.575	0.197
Pharmaceuticals and Drugs (ng/L)				
Gabapentin	12.1	25.6	10.7	31.8
Metformin	13.2	36.3	12.5	24.3
Lamotrigine	<10.0	17.9	<10.0	<10.0
Personal Care Products (ng/L)				
DEET (EPA method)	10.3	<10.0	<10.0	<10.0
Pesticides (ng/L)				
Butachlor ESA	10.0	<10.0	<10.0	<10.0
Hormones (ng/L)				
Cholesterol (USGS hormone method)	892 E	704	1130 E	439
Other Wastewater Indicators (ng/L)				
1-Methylnaphthalene	7 E	<40	<40	<40
Camphor	<80	<80	<80	31
Diethyl phthalate	<400	<400	260	<400
p-Cresol	22 E	<80	<80	<80

E - estimated concentration

Table 3-8. Concentrations of nutrients, personal care products, and other wastewater indicators detected in samples from Middle Cave Lake at Park Bridge, Timpanogos Cave National Monument.

Analyte	6/02/2015
Nutrients (mg/L)	
Phosphorous, dissolved	0.0124
Ortho-phosphate, dissolved	0.0135
Total phosphorus	0.0129
Ammonia, dissolved	<0.01
Nitrite, dissolved	<0.001
Nitrite plus nitrate, dissolved	1.20
Nitrogen, dissolved	1.31
Total nitrogen	1.34
Personal Care Products (ng/L)	
DEET (EPA method)	32.5
DEET (USGS wastewater method)	19 E
Hexahydrohexamethyl cyclopentabenzopyran (hhcb)	27
Triethyl citrate	37
Other Wastewater Indicators (ng/L)	
Tri(2-butoxyethyl) phosphate	363 E
Tri(2-chloroethyl) phosphate	68

E - estimated concentration

Table 3-9. Concentrations of nutrients, pharmaceuticals, personal care products, hormones, and other wastewater indicators detected in samples from the North Fork Virgin River, Zion National Park.

Analyte	Wilderness Study Area Boundary		Temple of Sinawava		Springdale	
	5/30/2015	9/5/2015	5/31/2015	9/6/2015	5/31/2015	9/6/2015
Nutrients (mg/L)						
Phosphorous, dissolved	<0.003	<0.003	<0.003	0.0032	0.0147	0.003
Ortho-phosphate, dissolved	<0.004	<0.004	<0.004	<0.004	0.0063	<0.004
Total phosphorus	0.0144	0.170	0.0165	0.060	0.0115	0.0598
Ammonia, dissolved	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrite, dissolved	<0.001	<0.001	<0.001	0.0014	<0.001	0.0014
Nitrite plus nitrate, dissolved	<0.01	<0.01	0.058	0.110	0.024	0.065
Nitrogen, dissolved	0.076	<0.05	0.151	0.168	0.121	0.066
Total nitrogen	0.090	0.090	0.180	0.213	0.123	0.181
Pharmaceuticals and Drugs (ng/L)						
Acetaminophen	<10.0	<10.0	58.9	<10.0	<10.0	<10.0
Caffeine (EPA method)	<25.0	<25.0	25.3	<25.0	<25.0	<25.0
Caffeine (USGS method)	<80	<80	<80	35 E	<80	<80
Personal Care Products (ng/L)						
DEET (EPA method)	26.4 J	<10.0	315 B	214 J	<10.0	43.5 J
DEET (USGS wastewater method)	<40	<40	222	76 E	<40	<40
Hexahydrohexamethyl cyclopentabenzopyran (hhcb)	<40	<40	7	<40	<40	<40
Methylparaben	<10.0	<10.0	23.6	<10.0	<10.0	<10.0
Triethyl citrate	<40	4090 E	13 E	<40	<40	<40
Hormones (ng/L)						
3-beta-coprostanol (USGS wastewater method)	<1,600	<1,600	162 E	932 E	<1,600	<1,600
Cholesterol (USGS hormones method)	240 E	448	563 E	262	225 E	333
cis-Androsterone	<0.8	<0.8	4.28	<0.8	<0.8	<0.8
Other Wastewater Indicators (ng/L)						
3,4-dichlorophenyl-isocyanate	<320	32 E	<320	<320	<320	<320
5-Methyl-1h-benzotriazole	<320	628 E	<320	<320	<320	<320
Benzophenone	<80	<80	20 E	<80	<80	<80
Bisphenol A	<40	<40	20 E	<40	<40	<40
Bromoform	<160	<160	12	<160	<160	<160
Camphor	26 E	61	<80	<80	<80	<80
Carbazole	11	24	7	<20	6	11
p-Cresol	65	<80	11 E	<80	39	<80
Phenol	<160	63	<160	<160	<160	<160
Tri(2-butoxyethyl) phosphate	<640	<640	331 E	<640	<640	<640
Triphenyl phosphate	<80	<80	12	<80	<80	<80

J - estimated concentration, analyzed outside of holding time limit

E - estimated concentration, other reasons

B - estimated concentration, analyte detected in field blank sample

Table 3-10. Concentrations of nutrients, pharmaceuticals, personal care products, hormones, and other wastewater indicators detected in samples from the Grotto and North Creek, Zion National Park.

Analyte	The Grotto		North Creek	
	5/31/2015	9/6/2015	5/31/2015	9/6/2015
Nutrients (mg/L)				
Phosphorous, dissolved	<0.003	<0.003	<0.003	<0.003
Ortho-phosphate, dissolved	<0.004	<0.004	<0.004	<0.004
Total phosphorus	<0.004	<0.004	0.0043	0.0042
Ammonia, dissolved	<0.01	0.0858	<0.01	<0.01
Nitrite, dissolved	<0.001	0.0012	0.0036	0.0037
Nitrite plus nitrate, dissolved	0.177	0.175	0.481	0.794
Nitrogen, dissolved	0.211	0.151	0.595	0.837
Total nitrogen	0.205	0.201	0.563	0.891
Personal Care Products (ng/L)				
DEET (USGS method)	<40	<40	9 E	<40
Hormones (ng/L)				
Cholesterol (USGS hormone method)	<200	<200	314 E	405
Other Wastewater Indicators (ng/L)				
Bis-(2-ethylhexyl) phthalate (dehp)	<2,000	<2,000	333 E	<2,000
Bromoform	10	<160	<160	<160
Camphor	<80	<80	<80	38
Carbazole	<20	<20	5	<20
Diethyl phthalate	260 E	<400	<400	<400
p-Cresol	<80	<80	13 E	<80

E - estimated concentration

4 Future Sampling

Sampling of contaminants of emerging concern in surface waters in conjunction with EPA Region 8 will continue in 2016. In addition, a separately funded project to analyze bed sediments for endocrine-disrupting hormones, initiated with the USGS in 2014,

will continue to be co-sampled in 2016. Co-sampling of surface water and bed sediment samples will provide a more complete understanding of how CECs accumulate and are transported in NCPN aquatic systems. A final report is expected upon completion of the USGS project in 2017.

5 Literature Cited

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Appendix A. All Analytes and their Laboratory Reporting Limits, by Method.

Analyte	CASNumber	2015 report limit	Units	Description	Category code	Category name	Indicator
Hormone							
3-Beta-coprostanol	360-68-9	200	ng/L	27-carbon stanol formed from cholesterol in the gut of most higher animals and birds. This compound has been used as a biomarker of human faecal matter in the environment.	HO	Hormonally active chemical	Hormone
4,4'-bisphenol f	620-92-8	10.0	ng/L	Used to manufacture plastics and epoxy resins, also called 4,4'-Methylenediphenol	HO	Hormonally active chemical	man-made hormone
4-androstene-3,17-dione	63-05-8	0.8	ng/L	Steroid hormone that can serve as a precursor to testosterone as well as estrone and estradiol	HO	Hormonally active chemical	Hormone
11-Ketotestosterone	564-35-2	2.0	ng/L	oxidized form of testosterone found in trace quantities in humans and fish, also used in body building drugs	HO	Hormonally active chemical	Hormone
17-Alpha-estradiol	57-91-0	0.8	ng/L	Synthetic 5a-reductase inhibitor used for the treatment of hair loss	HO	Hormonally active chemical	Hormone
17-Alpha-ethynylestradiol	57-63-6	0.8	ng/L	Synthetic bioactive estrogen used in oral contraceptive pills	HO	Hormonally active chemical	Hormone
17-Beta-estradiol	50-28-2	0.8	ng/L	Steroid and estrogen primarily female sex hormone	HO	Hormonally active chemical	Hormone
Bisphenol a	80-05-7	100	ng/L	Used to manufacture plastics and epoxy resins	HO	Hormonally active chemical	Hormone
Cholesterol	57-88-5	200	ng/L	Principal sterol synthesized by all animals, precursor for biosynthesis of steroid hormones	HO	Hormonally active chemical	Hormone
cis-Androsterone	53-41-8	0.8	ng/L	Endogenous steroid hormone, but also found in pine pollen	HO	Hormonally active chemical	Hormone
Dihydrotestosterone	512-18-6	4.0	ng/L	Sex steroid and androgen hormone	HO	Hormonally active chemical	Hormone
Epitestosterone	481-30-1	2.0	ng/L	Antiandrogen steroid	HO	Hormonally active chemical	Hormone
Equilenin	517-09-0	2.0	ng/L	Estrogenic steroid hormone obtained from the urine of pregnant mares	HO	Hormonally active chemical	Hormone
Equilin	474-86-2	8.0	ng/L	Estrogenic steroid hormone obtained from the urine of pregnant mares	HO	Hormonally active chemical	Hormone
Estriol	50-27-1	2.0	ng/L	Estrogenic hormone also called E3	HO	Hormonally active chemical	Hormone

Appendix A. All Analytes and their Laboratory Reporting Limits, by Method, cont.							
Analyte	CASNumber	2015 report limit	Units	Description	Category code	Category name	Indicator
Hormone, cont.							
Estrone	53-61-7	0.8	ng/L	Estrogenic hormone also called E1	HO	Hormonally active chemical	Hormone
Mestranol	72-33-3	0.8	ng/L	Synthetic steroidal estrogen	HO	Hormonally active chemical	Hormone
Norethindrone	68-22-4	0.8	ng/L	Synthetic steroidal progestin used in oral contraceptive pills	HO	Hormonally active chemical	Hormone
Progesterone	57-83-0	8.0	ng/L	Steroid hormone of the progestogen group	HO	Hormonally active chemical	Hormone
Testosterone	58-22-0	1.6	ng/L	Steroid hormone from androgen group	HO	Hormonally active chemical	Hormone
Trans-diethylstilbestrol	56-53-1	0.8	ng/L	Synthetic non-steroidal estrogen of the stilbestrol group, also known as DES	HO	Hormonally active chemical	Hormone
Nutrient							
Ammonia, filtered	7664-41-7	0.01	mg/L	nutrient	N	Nutrient	Nutrient
Nitrite, dissolved	14797-65-0	0.001	mg/L	nutrient	N	Nutrient	Nutrient
Nitrite plus nitrate, filtered	14797-55-8	0.01	mg/L	nutrient	N	Nutrient	Nutrient
Nitrogen, total filtered	17778-88-0	0.05	mg/L	nutrient	N	Nutrient	Nutrient
Nitrogen, total unfiltered	17778-88-0	0.05	mg/L	nutrient	N	Nutrient	Nutrient
Ortho-phosphate, filtered	14265-44-2	0.004	mg/L	nutrient	N	Nutrient	Nutrient
Phosphorous, total filtered	7723-14-0	0.003	mg/L	nutrient	N	Nutrient	Nutrient
Phosphorous, total unfiltered	7723-14-0	0.004	mg/L	nutrient	N	Nutrient	Nutrient
Pesticide							
2,4,5-T	93-76-5	10.0	ng/L	broad-leaf herbicide, discontinued in U.S.	H	Herbicide	Pesticide
2,4,5-TP	93-72-1	10.0	ng/L	broad-leaf herbicide (Fenoprop), discontinued in U.S.	H	Herbicide	Pesticide
2,4-D	94-75-7	10.0	ng/L	Weed B Gone	H	Herbicide	Pesticide
3-Hydroxycarbofuran	16655-82-6	10.0	ng/L	BP	IN	Insecticide	Pesticide
Acetochlor	34256-82-1	20.0	ng/L	Harness	H	Herbicide	Pesticide
Acetochlor OA	194992-44-4	20.0	ng/L	BP	H	Herbicide	Pesticide
Alachlor	15972-60-8	20.0	ng/L	Lasso	H	Herbicide	Pesticide
Alachlor OA	171262-17-2	50.0	ng/L	BP	H	Herbicide	Pesticide
Aldicarb	116-06-3	10.0	ng/L	Temik	IN	Insecticide	Pesticide

Appendix A. All Analytes and their Laboratory Reporting Limits, by Method, cont.

Analyte	CASNumber	2015 report limit	Units	Description	Category code	Category name	Indicator
<i>Nutrient, cont.</i>							
Aldicarb sulfone	1646-88-4	20.0	ng/L	Standak	IN	Insecticide	Pesticide
Aldicarb sulfoxide	1646-87-3	10.0	ng/L	BP	IN	Insecticide	Pesticide
Atraton	1610-17-9	10.0	ng/L	herbicide	H	Herbicide	Pesticide
Atrazine	1912-24-9	10.0	ng/L	Triazine herbicide for broad-leaf weeds	H	Herbicide	Pesticide
Atrazine de-ethyl	6190-65-4	20.0	ng/L	BP	H	Herbicide	Pesticide
Atrazine de-isopropyl	1007-28-9	20.0	ng/L	BP	H	Herbicide	Pesticide
Azoxystrobin	131860-33-8	20.0	ng/L	fungicide (Amistar, Syngenta)	AF	Fungicide	Pesticide
Bentazon	25057-89-0	10.0	ng/L	Basagran	H	Herbicide	Pesticide
Bromacil	314-40-9	50.0	ng/L	Hyvar	H	Herbicide	Pesticide
Bromoxynil	1689-84-5	10.0	ng/L	herbicide (Torch)	H	Herbicide	Pesticide
Butachlor ESA		10.0	ng/L	Butachlor degradate, pre-emergent herbicide	H	Herbicide	Pesticide
Carbaryl	63-25-2	10.0	ng/L	insecticide	IN	Insecticide	Pesticide
Carbofuran	1563-66-2	10.0	ng/L	Furadan	IN	Insecticide	Pesticide
Chlorimuron ethyl	90982-32-4	20.0	ng/L	Classic	H	Herbicide	Pesticide
Chlorsulfuron	64902-72-3	20.0	ng/L	Glean	H	Herbicide	Pesticide
Clothianidin	210880-92-5	20.0	ng/L	neonicotinoid insecticide	IN	Insecticide	Pesticide
Cyanazine	21725-46-2	10.0	ng/L	Bladex	H	Herbicide	Pesticide
Dacthal monoacid	887-54-7	20.0	ng/L	pre-emergent herbicide	H	Herbicide	Pesticide
Diazinon	333-41-5	20.0	ng/L	organophosphorus insecticide	IN	Insecticide	Pesticide
Dichloroprop	120-36-5	10.0	ng/L	broad-leaf herbicide	H	Herbicide	Pesticide
Dimethachlor	50563-36-5	10.0	ng/L	herbicide	H	Herbicide	Pesticide
Dimethenamid	87674-68-8	10.0	ng/L	herbicide	H	Herbicide	Pesticide
Dimethenamid ESA	205939-58-8	20.0	ng/L	BP	H	Herbicide	Pesticide
Disulfoton sulfone	2497-06-5	20.0	ng/L	BP	IN	Insecticide	Pesticide
Diuron	330-54-1	20.0	ng/L	Karmex	H	Herbicide	Pesticide
Diuron Metabolite	3567-62-2	20.0	ng/L	herbicide metabolite	H	Herbicide	Pesticide
EPTC	759-94-4	20.0	ng/L	herbicide	H	Herbicide	Pesticide
Ethoprop	13194-48-4	10.0	ng/L	Mocap	IN	Insecticide	Pesticide
Fipronil	120068-37-3	20.0	ng/L	insecticide	IN	Insecticide	Pesticide
Fipronil sulfide	120067-83-6	10.0	ng/L	Fipronil metabolite	IN	Insecticide	Pesticide

Appendix A. All Analytes and their Laboratory Reporting Limits, by Method, cont.

Analyte	CASNumber	2015 report limit	Units	Description	Category code	Category name	Indicator
Nutrient, cont.							
Fipronil sulfone	120068-36-2	10.0	ng/L	Fipronil metabolite	IN	Insecticide	Pesticide
Foramsulfuron	173159-57-4	20.0	ng/L	herbicide	H	Herbicide	Pesticide
Hexazinone	51235-04-2	10.0	ng/L	Velpar	H	Herbicide	Pesticide
Imazaquin	81335-37-7	20.0	ng/L	herbicide	H	Herbicide	Pesticide
Imazethapyr	81335-77-5	20.0	ng/L	herbicide	H	Herbicide	Pesticide
Imidacloprid	138261-41-3	20.0	ng/L	Admire	IN	Insecticide	Pesticide
Linuron	330-55-2	20.0	ng/L	Afalon	H	Herbicide	Pesticide
Malathion	121-75-5	10.0	ng/L	Chemathion	IN	Insecticide	Pesticide
MCPP	7085-19-0	20.0	ng/L	Kilprop	H	Herbicide	Pesticide
Metalaxyl	57837-19-1	10.0	ng/L	Ridomil	AF	Fungicide	Pesticide
Methiocarb	2032-65-7	20.0	ng/L	insecticide, molluscicide	IN	Insecticide	Pesticide
Methomyl	16752-77-5	20.0	ng/L	Lannate	IN	Insecticide	Pesticide
Metolachlor	51218-45-2	10.0	ng/L	Dual	H	Herbicide	Pesticide
Metolachlor ESA	947601-85-6	20.0	ng/L	BP	H	Herbicide	Pesticide
Metribuzin	21087-64-9	20.0	ng/L	Sencor	H	Herbicide	Pesticide
Monuron	150-68-5	10.0	ng/L	herbicide	H	Herbicide	Pesticide
Neburon	555-37-3	50.0	ng/L	herbicide	H	Herbicide	Pesticide
Oryzalin	19044-88-3	20.0	ng/L	herbicide	H	Herbicide	Pesticide
Oxamyl	23135-22-0	10.0	ng/L	Vydate	IN	Insecticide	Pesticide
Prometon	1610-18-0	20.0	ng/L	Primatol	H	Herbicide	Pesticide
Propachlor	1918-16-7	10.0	ng/L	herbicide	H	Herbicide	Pesticide
Propachlor ESA	947601-88-9	20.0	ng/L	Propaphlor degradate	H	Herbicide	Pesticide
Propachlor OA	70628-36-3	10.0	ng/L	Propaphlor degradate	H	Herbicide	Pesticide
Propazine	139-40-2	20.0	ng/L	Gesamil	H	Herbicide	Pesticide
Propiconazole	60207-90-1	50.0	ng/L	fungicide	AF	Fungicide	Pesticide
Propoxur	114-26-1	10.0	ng/L	Baygon	IN	Insecticide	Pesticide
Simazine	122-34-9	20.0	ng/L	Princep	H	Herbicide	Pesticide
Sulfometuron methyl	74222-97-2	20.0	ng/L	Oust	H	Herbicide	Pesticide
Tebuconazole	107534-96-3	50.0	ng/L	Elite	AF	Fungicide	Pesticide
Tebuthiuron	34014-18-1	10.0	ng/L	Spike	H	Herbicide	Pesticide

Appendix A. All Analytes and their Laboratory Reporting Limits, by Method, cont.

Analyte	CASNumber	2015 report limit	Units	Description	Category code	Category name	Indicator
Nutrient, cont.							
Terbutylazine	5915-41-3	10.0	ng/L	herbicide	H	Herbicide	Pesticide
Thiamethoxam	153719-23-4	20.0	ng/L	neonicotinoid insecticide	IN	Insecticide	Pesticide
Triclopyr	55335-06-3	20.0	ng/L	Garlon	H	Herbicide	Pesticide
PPCP							
(+/-)11-nor-9-carboxy-delta-THC	104874-50-2	10.0	ng/L	Marijuana (THC) metabolite	PA	Psychoactive	Illicit Drug
10,11-dihydro-10-hydroxycarbamazepine	29331-92-8	10.0	ng/L	Oxcarbazepine degradate, anti-epileptic	PA	Psychoactive	Pharmaceutical
6-Acetylmorphine	2784-73-8	10.0	ng/L	Heroin metabolite	I	Illicit Drug	Illicit Drug
Acebutolol	34381-68-5	10.0	ng/L	Anti-hypertensive (beta blocker)	C	Cardiac	Pharmaceutical
Acetaminophen	103-90-2	10.0	ng/L	Analgesic	PR	Pain Reliever	Pharmaceutical
Albuterol	18559-94-9	10.0	ng/L	Bronchodilator	A	Allergy and Asthma	Pharmaceutical
Amitriptyline	549-18-8	10.0	ng/L	Anti-depressant	PA	Psychoactive	Pharmaceutical
Amitriptyline (+/-)-E-10-hydroxylated	64520-05-04	10.0	ng/L	Anti-depressant metabolite	PA	Psychoactive	Pharmaceutical
Amphetamine	51-63-8	10.0	ng/L	Central nervous system (CNS) stimulant	ST	Stimulant	Illicit Drug
Aripiprazole	129722-12-9	10.0	ng/L	Dopamine agonist, anti-psychotic	PA	Psychoactive	Pharmaceutical
Atenolol	29122-68-7	10.0	ng/L	Anti-hypertensive (beta blocker)	C	Cardiac	Pharmaceutical
Atorvastatin	134523-03-8	10.0	ng/L	Statin, cholesterol reductant (Lipitor)	C	Cardiac	Pharmaceutical
Atrazine	1912-24-9	10.0	ng/L	AAtrex	H	Herbicide	Pesticide
Benzoylcegonine	519-09-5	10.0	ng/L	Cocaine metabolite	I	Illicit Drug	Illicit Drug
Bezafibrate	41859-67-0	10.0	ng/L	Lipid regulator	C	Cardiac	Pharmaceutical
Buprenorphine	53152-21-9	10.0	ng/L	Semi-synthetic opioid, used for addiction treatment	PR	Pain Reliever	Pharmaceutical
Bupropion	34841-39-9	25.0	ng/L	Anti-depressant, smoking cessation aid	PA	Psychoactive	Pharmaceutical
Caffeine	58-08-2	25.0	ng/L	Mild CNS stimulant	ST	Caffeine	Personal Care
Carbamazepine	298-46-4	10.0	ng/L	Anti-convulsant	PA	Psychoactive	Pharmaceutical
Carbamazepine 10,11 epoxide	36507-30-9	10.0	ng/L	Carbamazepine degradate	PA	Psychoactive	Pharmaceutical
Carisoprodol	78-44-4	10.0	ng/L	Muscle relaxant	PR	Pain Reliever	Pharmaceutical
Celecoxib	169590-42-5	10.0	ng/L	NSAID (Celebrex)	NS	NSAID	Pharmaceutical

Appendix A. All Analytes and their Laboratory Reporting Limits, by Method, cont.

Analyte	CASNumber	2015 report limit	Units	Description	Category code	Category name	Indicator
PPCP, cont.							
Chloramphenicol	56-75-7	25.0	ng/L	Bacteriostatic antimicrobial	AB	Antibiotic	Pharmaceutical
Chlorpheniramine	132-22-9	10.0	ng/L	Anti-histamine for treatment of allergies	A	Allergy and Asthma	Pharmaceutical
Clenbuterol	21898-19-1	10.0	ng/L	Bronchodilator	A	Allergy and Asthma	Pharmaceutical
Cocaethylene	529-38-4	10.0	ng/L	Cocaine metabolite	I	Illicit Drug	Illicit Drug
Cocaine	53-21-4	10.0	ng/L	Narcotic	I	Illicit Drug	Illicit Drug
Codeine	76-57-3	10.0	ng/L	Opiate	PR	Pain Reliever	Pharmaceutical
Cotinine	486-56-6	10.0	ng/L	Nicotine degradate, antidepressant	PA	Psychoactive	Pharmaceutical
DEET	134-62-3	10.0	ng/L	Pest repellent	IN	DEET	Personal Care
Dehydroaripiprazole	1008531-60-9	10.0	ng/L	Aripiprazole degradate, dopamine agonist, anti-psychotic	PA	Psychoactive	Pharmaceutical
Desmethylcitalopram	144025-14-9	10.0	ng/L	Citalopram degradate, an anti-depressant	PA	Psychoactive	Pharmaceutical
Desmethylvenlafaxine	93413-62-8	10.0	ng/L	Anti-depressant (Pristique®)	PA	Psychoactive	Pharmaceutical
Dextromethorphan	125-69-9	10.0	ng/L	Cough suppressant	O	Other	Pharmaceutical
Dextrophan	143-98-6	10.0	ng/L	metabolite of dextromethorphan	O	Other	Pharmaceutical
Diclofenac	15307-86-5	10.0	ng/L	Non-steroidal anti-inflammatory drug (NSAID)	NS	NSAID	Pharmaceutical
Diclofenac 4-hydroxy	64118-84-9	10.0	ng/L	metabolite of the NSAID Aceclofenac	NS	NSAID	Pharmaceutical
Diltiazem	33286-22-5	10.0	ng/L	Anti-hypertensive (calcium channel blocker)	C	Cardiac	Pharmaceutical
Diphenhydramine	58-73-1	10.0	ng/L	Anti-histamine for treatment of allergies, mild sedative	A	Allergy and Asthma	Pharmaceutical
Disopyramide	3737-09-5	10.0	ng/L	Antirhythmic medication	C	Cardiac	Pharmaceutical
Donepezil	120014-06-4	10.0	ng/L	Acetylcholinesterase inhibitor	PA	Psychoactive	Pharmaceutical
Duloxetine	116539-59-4	10.0	ng/L	Anti-depressant (Cymbalta®)	PA	Psychoactive	Pharmaceutical
Ecgonine Methyl Ester	38969-40-3	10.0	ng/L	Ecgonine degradate, alkaloid similar to cocaine	I	Illicit Drug	Illicit Drug
EDDP	66729-78-0	10.0	ng/L	Methadone metabolite	PR	Pain Reliever	Pharmaceutical
Erythromycin	114-07-8	10.0	ng/L	Macrolide antibiotic, similar to penicillin	AB	Antibiotic	Pharmaceutical
Erythromycin-anhydro	23893-13-2	25.0	ng/L	Erythromycin degradate	AB	Antibiotic	Pharmaceutical
Escitalopram	128196-01-0	10.0	ng/L	Anti-depressant (Lexapro®)	PA	Psychoactive	Pharmaceutical
Famotidine	76824-35-6	10.0	ng/L	Antacid (Pepcid®)	SA	Stomach Acid	Pharmaceutical
Fenbufen	36330-85-5	25.0	ng/L	NSAID	NS	NSAID	Pharmaceutical
Fentanyl	437-38-7	10.0	ng/L	Opioid analgesic, anesthetic	PR	Pain Reliever	Pharmaceutical

Appendix A. All Analytes and their Laboratory Reporting Limits, by Method, cont.

Analyte	CASNumber	2015 report limit	Units	Description	Category code	Category name	Indicator
PPCP, cont.							
Fluconazole	86386-73-4	10.0	ng/L	antifungal (Diflucan)	AF	Antifungal	Pharmaceutical
Fluoxetine	59333-67-4	25.0	ng/L	Antidepressant (Prozac®)	PA	Psychoactive	Pharmaceutical
Fluticasone propionate	80474-14-2	10.0	ng/L	Corticosteroid for allergies and asthma	A	Allergy and Asthma	Pharmaceutical
Furosemide	54-31-9	10.0	ng/L	Diuretic	C	Cardiac	Pharmaceutical
Gabapentin	60142-96-3	10.0	ng/L	Epileptic treatment and neuropathic pain reliever	PA	Psychoactive	Pharmaceutical
Gemfibrozil	25812-30-0	10.0	ng/L	Lipid regulator	C	Cardiac	Pharmaceutical
Glyburide	10238-21-8	10.0	ng/L	Anti-diabetic	AD	Anti-diabetic	Pharmaceutical
Hydrochlorothiazide	58-93-5	10.0	ng/L	Diuretic	C	Cardiac	Pharmaceutical
Hydrocodone	34195-34-1	10.0	ng/L	Opioid narcotic, analgesic, anesthetic (Vicodin®)	PR	Pain Reliever	Pharmaceutical
Hydromorphone	71-68-1	10.0	ng/L	Opioid analgesic	PR	Pain Reliever	Pharmaceutical
Hydroxybupropion	92264-81-8	10.0	ng/L	Bupropion degradate, anti-depressant	PA	Psychoactive	Pharmaceutical
Ibuprofen	15687-27-1	10.0	ng/L	NSAID	NS	NSAID	Pharmaceutical
Ketoconazole	65277-42-1	10.0	ng/L	antifungal	AF	Antifungal	Pharmaceutical
Ketoprofen	22071-15-4	25.0	ng/L	Non-steroidal anti-inflammatory drug (NSAID)	NS	NSAID	Pharmaceutical
Lamotrigine	84057-84-1	10.0	ng/L	Anti-convulsant	PA	Psychoactive	Pharmaceutical
Levorphanol	77-07-6	10.0	ng/L	Synthetic opoid, morphine-like analgesic	PR	Pain Reliever	Pharmaceutical
Lidocaine	137-58-6	10.0	ng/L	Local anesthetic, antInsecticiderrhythmic	AN	anesthetic	Pharmaceutical
Loratadine	79794-75-5	10.0	ng/L	Histamine antagonist for allergies	A	Allergy and Asthma	Pharmaceutical
Lorazepam	846-49-1	10.0	ng/L	Sedative	S	Sedative	Pharmaceutical
MDA	4764-17-4	10.0	ng/L	Amphetamine metabolite	I	Illicit Drug	Illicit Drug
MDEA	82801-81-8	10.0	ng/L	Amphetamine metabolite	I	Illicit Drug	Illicit Drug
MDMA	42542-10-9	10.0	ng/L	Empathogenic drug, "Ecstasy"	I	Illicit Drug	Illicit Drug
Mefenamic acid	61-68-7	10.0	ng/L	NSAID	NS	NSAID	Pharmaceutical
Meperidine	57-42-1	10.0	ng/L	A.K.A. Pethidine or Demerol - opioid analgesic	PR	Pain Reliever	Pharmaceutical
Meprobamate	57-53-4	10.0	ng/L	Anxiolytic drug, minor tranquilizer	S	Sedative	Pharmaceutical
Metaxalone	1665-48-1	10.0	ng/L	muscle relaxant (Skelaxin)	PR	Pain Reliever	Pharmaceutical
Metformin	657-24-9	10.0	ng/L	Anti-diabetic drug	AD	Anti-diabetic	Pharmaceutical
Methadone	1095-90-5	10.0	ng/L	Synthetic opioid, analgesic	PR	Pain Reliever	Pharmaceutical
Methamphetamine	51-57-0	10.0	ng/L	CNS stimulant, "meth", "speed"	I	Illicit Drug	Illicit Drug
Methylparaben	99-76-3	10.0	ng/L	Antifungal preservative	AF	Antifungal	Personal Care

Appendix A. All Analytes and their Laboratory Reporting Limits, by Method, cont.

Analyte	CASNumber	2015 report limit	Units	Description	Category code	Category name	Indicator
PPCP, cont.							
Methylphenidate	113-45-1	10.0	ng/L	Psychostimulant for ADHD and narcolepsy	PA	Psychoactive	Pharmaceutical
Metoprolol	37350-58-6	10.0	ng/L	Anti-hypertensive	C	Cardiac	Pharmaceutical
Mevastatin	73573-88-3	10.0	ng/L	Statin, cholesterol reductant	C	Cardiac	Pharmaceutical
m-Hydroxybenzoylecgonine	129944-99-6	10.0	ng/L	Cocaine & Benzoylecgonine degradate	I	Illicit Drug	Illicit Drug
Modafinil	68693-11-8	10.0	ng/L	Eugeroic or vigilance-promoting drug	ST	Stimulant	Pharmaceutical
Modafinil acid	112111-45-2	10.0	ng/L	Modafinil degradate, wakefulness stimulant	ST	Stimulant	Pharmaceutical
Monoethylglycinexylidide	7728-40-7	10.0	ng/L	Lidocane degradate, local anesthetic	AN	Anesthetic	Pharmaceutical
Montelukast	158966-92-8	10.0	ng/L	Treatment for allergies and asthma	A	Allergy and Asthma	Pharmaceutical
Morphine	57-27-2	10.0	ng/L	Alkaloid opiate	PR	Pain Reliever	Pharmaceutical
Naproxen	22204-53-1	10.0	ng/L	NSAID	NS	NSAID	Pharmaceutical
n-Butylparaben	94-26-8	10.0	ng/L	Antifungal preservative	AF	Antifungal	Personal Care
Nifedipine	21829-25-4	10.0	ng/L	Anti-hypertensive drug	C	Cardiac	Pharmaceutical
Nifedipine oxidized	67035-22-7	10.0	ng/L	Nifedipine degradate	C	Cardiac	Pharmaceutical
Norfentanyl	1609-66-1	10.0	ng/L	Synthetic opioid (related to Fentanyl), potent analgesic	PR	Pain Reliever	Pharmaceutical
Norfluoxetine	107674-50-0	10.0	ng/L	Metabolite of Fluoxetine (Prozac®)	PA	Psychoactive	Pharmaceutical
Normeperidine	77-17-8	10.0	ng/L	Meperidine degradate, opioid analgesic	PR	Pain Reliever	Pharmaceutical
Norquetiapine	753475-15-9	10.0	ng/L	Quetiapine degradate, anti-psychotic & anti-depressant	PA	Psychoactive	Pharmaceutical
Norsertraline	91797-58-9	10.0	ng/L	metabolite of sertraline, anti-depressant (Zoloft, Lustral)	PA	Psychoactive	Pharmaceutical
Norverapamil	67812-42-4	10.0	ng/L	Verapamil degradate, anti-hypertensive	C	Cardiac	Pharmaceutical
Omeprazole	73590-58-6	10.0	ng/L	Treatment of acid reflux, peptic ulcers, (Prilosec®)	SA	Stomach Acid	Pharmaceutical
Oxazepam	604-75-1	10.0	ng/L	Metabolite of Diazepam, antianxiety, panic attack treatment	PA	Psychoactive	Pharmaceutical
Oxcarbazepine	28721-07-5	10.0	ng/L	anticonvulsant (Trileptal)	PA	Psychoactive	Pharmaceutical
Oxycodone	76-42-6	10.0	ng/L	Narcotic pain reliever "oxycotin"	I	Illicit Drug	Illicit Drug
Oxymorphone	76-41-5	10.0	ng/L	Semi-synthetic opioid analgesic	PR	Pain Reliever	Pharmaceutical
Paroxetine	61869-08-7	10.0	ng/L	Anti-depressant	PA	Psychoactive	Pharmaceutical
Phenmetrazine	134-49-6	10.0	ng/L	Stimulant and appetite supressant	ST	Stimulant	Pharmaceutical
Phenobarbital	50-06-6	10.0	ng/L	Barbituate and anticonvulsant	PA	Psychoactive	Pharmaceutical

Appendix A. All Analytes and their Laboratory Reporting Limits, by Method, cont.

Analyte	CASNumber	2015 report limit	Units	Description	Category code	Category name	Indicator
PPCP, cont.							
Phentermine	122-09-8	10.0	ng/L	Psychostimulant and appetite suppressant	PA	Psychoactive	Pharmaceutical
Phenylpropanolamine	154-41-6	10.0	ng/L	Stimulant, decongestant, and anorectic agent (reduces appetite)	ST	Stimulant	Pharmaceutical
Phenytoin	57-41-0	10.0	ng/L	Anti-epileptic drug	PA	Psychoactive	Pharmaceutical
Pioglitazone	111025-46-8	10.0	ng/L	Anti-diabetic drug	AD	Anti-diabetic	Pharmaceutical
Pravastatin	81131-70-6	25.0	ng/L	Statin, cholesterol reductant (Pravachol)	C	Cardiac	Pharmaceutical
Pregabalin	148553-50-8	10.0	ng/L	Anti-convulsant	PA	Psychoactive	Pharmaceutical
Primidone	125-33-7	10.0	ng/L	Anti-convulsant	PA	Psychoactive	Pharmaceutical
Propranolol	525-66-6	10.0	ng/L	Treatment for hypertension, anxiety and panic	C	Cardiac	Pharmaceutical
Pseudoephedrine	90-82-4	10.0	ng/L	Nasal/sinus decongestant, stimulant	ST	Stimulant	Pharmaceutical
Quetiapine	111974-72-2	10.0	ng/L	Anti-psychotic & anti-depressant	PA	Psychoactive	Pharmaceutical
Ritalinic acid	19395-41-6	10.0	ng/L	Ritalin degradate, psychostimulant for ADHD	ST	Stimulant	Pharmaceutical
Sertraline	79617-96-2	10.0	ng/L	Antidepressant (Zoloft®)	PA	Psychoactive	Pharmaceutical
Sildenafil	171599-83-0	10.0	ng/L	A.K.A. Viagra®	C	Cardiac	Pharmaceutical
Simvastatin	79902-63-9	10.0	ng/L	Statin, cholesterol reductant (Zocor)	C	Cardiac	Pharmaceutical
Sotalol	959-24-0	10.0	ng/L	Antirhythmic medication	C	Cardiac	Pharmaceutical
Sulfamethazine	57-68-1	10.0	ng/L	Sulfonamide anti-bacterial	AB	Antibiotic	Pharmaceutical
Sulfamethoxazole	723-46-6	10.0	ng/L	Sulfonamide anti-bacterial	AB	Antibiotic	Pharmaceutical
Sumatriptan	103628-48-4	10.0	ng/L	Migraine headache treatment	PR	Pain Reliever	Pharmaceutical
Tadalafil	171596-29-5	10.0	ng/L	erectile dysfunction, pulmonary hypertension (Cialis)	C	Cardiac	Pharmaceutical
Temazepam	846-50-4	10.0	ng/L	Psychoactive drug, antianxiety & anti-convulsant	PA	Psychoactive	Pharmaceutical
Thiabendazole	148-79-8	10.0	ng/L	Fungicide and antiparasitic	AF	Antifungal	Pharmaceutical
Tramadol	27203-92-5	10.0	ng/L	Opioid analgesic for arthritis and fibromyalgia	PR	Pain Reliever	Pharmaceutical
Trazodone	19794-93-5	10.0	ng/L	Serotonin antagonist anti-depressant	PA	Psychoactive	Pharmaceutical
Triamterene	396-01-0	10.0	ng/L	Diuretic for treatment of hypertension and edema	C	Cardiac	Pharmaceutical
Triclocarban	101-20-2	10.0	ng/L	Disinfectant	AB	Antibiotic	Pharmaceutical
Triclosan	3380-34-5	10.0	ng/L	Antibacterial and antifungal	AB	Antibiotic	Personal Care
Trimethoprim	738-70-5	10.0	ng/L	Anti-biotic	AB	Antibiotic	Pharmaceutical
Tylosin	1401-69-0	25.0	ng/L	Anti-biotic	AB	Antibiotic	Pharmaceutical

Appendix A. All Analytes and their Laboratory Reporting Limits, by Method, cont.							
Analyte	CASNumber	2015 report limit	Units	Description	Category code	Category name	Indicator
PPCP, cont.							
Valsartan	137862-53-4	10.0	ng/L	Treatment for high blood pressure or congestive heart failure	C	Cardiac	Pharmaceutical
Venlafaxine	93413-44-6	10.0	ng/L	Anti-depressant for anxiety attacks or major depressive disorder	PA	Psychoactive	Pharmaceutical
Verapamil	52-53-9	10.0	ng/L	Anti-hypertensive	C	Cardiac	Pharmaceutical
Warfarin	81-81-2	10.0	ng/L	Anticoagulant	C	Cardiac	Pharmaceutical
Zolpidem	99294-93-6	10.0	ng/L	Short-acting hypnotic for insomnia (Ambien®)	S	Sedative	Pharmaceutical
Zolpidem phenyl-4-carboxylic acid	109461-65-6	10.0	ng/L	Zolpidem degradate	S	Sedative	Pharmaceutical
Wastewater indicator							
1,4-dichlorobenzene	106-46-7	80.0	ng/L	pesticide, disinfectant, deodorant, mothballs, polymer precursor	WI	Chemical intermediate	Wastewater
1-Methylnaphthalene	90-12-0	40.0	ng/L	Combustion by-product, fossil fuels, fumigant, mothballs, chemical intermediate	WI	Combustion by-product	Wastewater
2,2',4,4'-Tetrabromodiphenyl ether	5436-43-1	40.0	ng/L	PBDE 47, brominated flame retardant	WI	Flame retardant	Wastewater
2,6-Dimethylnaphthalene	581-42-0	40.0	ng/L	combustion product, fossil fuels, polymer intermediate	WI	Combustion by-product	Wastewater
2-Methylnaphthalene	91-57-6	40.0	ng/L	Combustion by-product, fossil fuels, fumigant, mothballs, chemical intermediate	WI	Combustion by-product	Wastewater
3,4-Dichlorophenyl isocyanate	102-36-3	320.0	ng/L	chemical intermediate, could be triclocarban degradation product	WI	Chemical intermediate	Wastewater
3-Beta-coprostanol	360-68-9	1600	ng/L	27-carbon stanol formed from cholesterol in the gut of most higher animals and birds. This compound has been used as a biomarker of human faecal matter in the environment.	HO	Hormonally active chemical	Wastewater
3-methyl-1h-indole	83-34-1	40.0	ng/L	skatole, feces, coal tar, flowers, fragrance	WI	Fragrance	Wastewater
4-cumylphenol	599-64-4	40.0	ng/L	precursor plastics/rubber, alkylphenol	WI	Alkylphenol	Wastewater
4-n-octylphenol	1806-26-4	20.0	ng/L	OPE precursor/metabolite, alkylphenol	WI	Alkylphenol	Wastewater
4-nonylphenol monoethoxylate	104-35-8	1600	ng/L	NPE precursor/metabolite, alkylphenol, detergents	WI	Alkylphenol	Wastewater
4-octylphenol diethoxylate	2315-61-9	200	ng/L	detergents, surfactants	WI	Alkylphenol	Wastewater

Appendix A. All Analytes and their Laboratory Reporting Limits, by Method, cont.

Analyte	CASNumber	2015 report limit	Units	Description	Category code	Category name	Indicator
Wastewater indicator, cont.							
4-octylphenol monoethoxylate	2315-67-5	600	ng/L	detergents, surfactants	WI	Alkylphenol	Wastewater
4-tert-octylphenol	140-66-9	400	ng/L	OPE precursor/metabolite, alkylphenol	WI	Alkylphenol	Wastewater
5-methyl-1h-benzotriazole	136-85-6	320	ng/L	deicer, corrosion inhibitor, drug precursor	WI	Corrosion inhibitor	Wastewater
Acetophenone	98-86-2	400	ng/L	precursor resins/pharmaceuticals, fragrance, natural	WI	Fragrance	Wastewater
AHTN	21145-77-7	40.0	ng/L	acetyl-hexamethyl-tetrahydro-naphthalene, fragrance	WI	Fragrance	Wastewater
Anthracene	120-12-7	20.0	ng/L	combustion product, fossil fuels, dye precursor	WI	Combustion by-product	Wastewater
Anthraquinone	84-65-1	40.0	ng/L	precursor dye, bleach pulp paper, fungi, lichen	WI	Natural chemical	Wastewater
Atrazine	1912-24-9	160	ng/L	Aatrex, triazine herbicide used primarily on corn	WI	Herbicide	Pesticide
Benzo(a)pyrene	50-32-8	20.0	ng/L	PAH, coal tar	WI	PAH	Wastewater
Benzophenone	119-61-9	80.0	ng/L	chemical precursor, photoinitiator	WI	Chemical intermediate	Wastewater
beta-Sitosterol	83-46-5	4800	ng/L	natural phytosterol, boldenone precursor	WI	Phytosterol	Wastewater
beta-Stigmastanol	19466-47-8	3400	ng/L	natural phytosterol	WI	Phytosterol	Wastewater
BHA	121-00-6	160	ng/L	food additive, cosmetics, petroleum products, medicines	WI	Food additive	Wastewater
Bisphenol a	80-05-7	40.0	ng/L	Used to manufacture plastics and epoxy resins	HO	Hormonally active chemical	Wastewater
Bromacil	314-40-9	160	ng/L	Hyvar	H	Herbicide	Pesticide
Bromoform	75-25-2	160	ng/L	Tribromomethane, solvent, reagent, disinfection byproduct	WI	Disinfection by-product	Wastewater
Caffeine, USGS method	58-08-2	80.0	ng/L	Mild CNS stimulant	ST	Caffeine	Personal Care
Camphor	76-22-2	80.0	ng/L	natural terpenoid, plasticizer, repellent, antimicrobial	WI	Natural terpenoid	Wastewater
Carbaryl	63-25-2	60.0	ng/L	insecticide	WI	Insecticide	Pesticide
Carbazole	86-74-8	20.0	ng/L	Combustion by-product, human waste, dyes, chemical precursor	WI	Combustion by-product	Wastewater
Chlorpyrifos	2921-88-2	120	ng/L	insecticide (Sevin Dust)	WI	Insecticide	Pesticide
Cholesterol	57-88-5	1600	ng/L	Principal sterol synthesized by all animals, precursor for biosynthesis of steroid hormones	HO	Hormonally active chemical	Hormone

Appendix A. All Analytes and their Laboratory Reporting Limits, by Method, cont.

Analyte	CASNumber	2015 report limit	Units	Description	Category code	Category name	Indicator
Wastewater indicator, cont.							
Cotinine	486-56-6	80.0	ng/L	Nicotine degradate, antidepressant	PA	Psychoactive	Wastewater
DEET	134-62-3	40.0	ng/L	Pest repellant	WI	DEET	Wastewater
DEHP	117-81-7	2000	ng/L	DEHP, common phthalate, plasticizer, sorbs to oils/fats	WI	Phthalate	Wastewater
Diazinon	333-41-5	320	ng/L	organophosphorus insecticide	WI	Insecticide	Pesticide
Dichlorvos	62-73-7	80.0	ng/L	insecticide	WI	insecticide	Wastewater
Diethoxynonylphenols, total	20427-84-3	1600	ng/L	detergents, surfactants	WI	Alkylphenol	Wastewater
Diethyl phthalate	84-66-2	400	ng/L	DEP, plasticizer, cosmetics, fragrances,	WI	Fragrance	Wastewater
d-Limonene	5989-27-5	160	ng/L	natural terpene, cosmetics, food, medicines	WI	Natural terpenoid	Wastewater
Fluoranthene	206-44-0	20.0	ng/L	PAH, coal tar, combustion	WI	Combustion by-product	Wastewater
HHCB	1222-05-5	40.0	ng/L	Hexahydrohexamethylcyclopentabenzopyran, fragrance, Galaxolide	WI	Fragrance	Wastewater
Indole	120-72-9	40.0	ng/L	fragrances, pharmaceutical precursor, bacteria associated with the root zones of coniferous trees	WI	Fragrance	Wastewater
Isoborneol	124-76-5	90.0	ng/L	natural terpenoid	WI	Natural terpenoid	Wastewater
Isophorone	78-59-1	50.0	ng/L	solvent, organic intermediate, natural in cranberries, coal fired power plants	WI	Combustion by-product	Wastewater
isopropylbenzene	98-82-8	40.0	ng/L	Cumene: crude oil, chemical intermediate, cigarette smoke, paving, many other industrial processes	WI	Chemical intermediate	Wastewater
Isoquinoline	119-65-3	800	ng/L	coal tar, dyes, paints, insecticides, antifungals	WI	Chemical intermediate	Wastewater
Menthol	89-78-1	320.0	ng/L	organic compound made synthetically or obtained from corn mint, peppermint or other mint oils.	WI	Organic compound	Wastewater
Metalaxyl	57837-19-1	160	ng/L	Ridomil	AF	Fungicide	Pesticide
Methyl salicylate	119-36-8	80.0	ng/L	natural or synthetic, wintergreen oil, fragrance	WI	Organic ester	Wastewater
Metolachlor, USGS method	51218-45-2	40.0	ng/L	Dual	H	Herbicide	Pesticide
Naphthalene	91-20-3	20.0	ng/L	PAH, mothballs, coal tar	WI	PAH	Wastewater
para-Nonylphenol, total	84852-15-3	1,600	ng/L	NPE precursor/metabolite, alkylphenol, detergents	WI	Alkylphenol	Wastewater
p-Cresol	106-44-5	80.0	ng/L	natural runoff, wood, coal tar, auto exhaust, intermediate chemical production, human waste	WI	Organic compound	Wastewater

Appendix A. All Analytes and their Laboratory Reporting Limits, by Method, cont.

Analyte	CASNumber	2015 report limit	Units	Description	Category code	Category name	Indicator
Wastewater indicator, cont.							
Pentachlorophenol	87-86-5	1600	ng/L	pesticide, disinfectant, fungicide, algaecide, antifoul- ing paint	WI	Pesticide	Wastewater
Phenanthrene	85-01-8	20.0	ng/L	PAH, mineral	WI	PAH	Wastewater
Phenol	108-95-2	160	ng/L	coal tar, petroleum, chemical precursor	WI	Chemical intermediate	Wastewater
Prometon	1610-18-0	160	ng/L	Primatol	WI	Herbicide	Wastewater
Pyrene	129-00-0	20.0	ng/L	PAH, coal tar, fuel combustion, dyes, paints	WI	PAH	Wastewater
Tetrachloroethylene	127-18-4	160	ng/L	solvent, dry cleaning	WI	Solvent	Wastewater
Tri(2-butoxyethyl) phosphate	78-51-3	640.0	ng/L	flame retardant, plasticizer	WI	Flame retardant	Wastewater
Tri(2-chloroethyl) phosphate	115-96-8	160.0	ng/L	flame retardant, plasticizer	WI	Flame retardant	Wastewater
Tributyl phosphate	126-73-8	64.0	ng/L	flame retardant, plasticizer	WI	Flame retardant	Wastewater
Triclosan	3380-34-5	10.0	ng/L	Antibacterial and antifungal	WI	Antibiotic	Wastewater
Triethyl citrate	77-93-0	40.0	ng/L	Ethyl citrate, food additive, pharmaceutical coatings, plasticizer	WI	Plasticizer	Wastewater
Triphenyl phosphate	115-86-6	80.0	ng/L	flame retardant, plasticizer	WI	Flame retardant	Wastewater
Tris(dichloroisopropyl) phosphate	13674-87-8	320	ng/L	flame retardant, plasticizer	WI	Flame retardant	Wastewater

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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National Park Service
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