Pharmaceuticals and Chemicals of Concern in Rivers: Occurrence and Biological Effects

An extensive study of Minnesota's rivers and streams reveals that several commonly used pharmaceuticals and other commercial chemicals are present in most of the state's flowing waters. These contaminants were found to have measurable effects on fish exposed to them in river water.

Minnesota Pollution Control Agency

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Authors

Mark Ferrey, Minnesota Pollution Control Agency
Dalma Martinovic, University of St. Thomas
Will Backe, Minnesota Department of Health
April Andrews, Minnesota Pollution Control Agency

Contributors/acknowledgements

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Minnesota Pollution Control Agency

520 Lafayette Road North | Saint Paul, MN 55155-4194 |

651-296-6300 | 800-657-3864 | Or use your preferred relay service. | Info.pca@state.mn.us

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Executive summary

For several years, the Minnesota Pollution Control Agency (MPCA) has sampled lakes and rivers for chemicals of emerging concern that may adversely affect aquatic ecosystems and human health. Past work has demonstrated that pharmaceuticals and personal care products (PPCPs), and similar contaminants that are endocrine active compounds are frequently present in Minnesota's surface water. These contaminants are typically detected at only part per trillion (ppt) concentrations in water. However, an increasing number of studies have shown that several of these chemicals can be harmful to fish and wildlife at very low levels, both to individual organisms and to populations.

The purpose of this study was twofold. First, it was designed to expand our understanding of the extent to which these chemicals of concern are present in rivers and streams throughout Minnesota. Second, it investigated, on a genetic level, how the chemicals that were detected in those water samples are likely affecting fish and wildlife. Thus, unlike previous studies, this investigation combined monitoring of these emerging contaminants in water with a powerful effects analysis showing how those chemicals are affecting aquatic organisms.

For this study, water from 50 river and stream locations across Minnesota was analyzed in 2014 for 146 PPCPs, and other contaminants. Among the pharmaceuticals detected, iopamidol, an X-ray contrast agent, was the most frequently detected, found at 78% of the locations sampled. The antidepressants sertraline, amitriptyline, and fluoxetine were detected in water from 48%, 44%, and 10% of the locations, respectively, and the antibiotics sulfamethoxazole and erythromycin were detected in water at 24% and 14% of the locations, respectively. Metformin, a medication used to treat type II diabetes; triamterene, a diuretic; and carbamazepine, an anticonvulsive medicine, were detected at 18%, 16%, and 14% of the locations, respectively. The insect repellent DEET, the plastic component bisphenol A, the corrosion inhibitor benzotriazole, and benzotriazole breakdown products were also widespread.

The biological effect of the contaminants detected in water samples was evaluated in two ways. First, predictions of biological effect were possible by comparing our contaminant detection data with compiled toxicological data in the U.S. Environmental Protection Agency's (EPA) *ToxCast* database. Second, laboratory effect studies were performed on water that was collected from 10 of the 50 sampling locations. These lab tests included one that measured the degree to which contaminants in the water sample behaved like the hormone estrogen. Another measured what particular genes in fish are activated, or expressed, by the contaminants that were present in the water. Coupled with the rapidly expanding understanding of the specific functions of genes, this observed activation – or inactivation – of genes in response to the presence of a chemical in an organism's environment leads to predictions of how a contaminant might adversely affect reproduction, behavior, or other metabolic functions.

The effect studies indicated that 5 of the 10 water samples exhibited low estrogenic activity. Fish gene expression data from fathead minnows that were exposed to water from the 10 locations indicate that contaminants often found in Minnesota streams may have impacts on genes associated with reproduction, development, growth, and tumor formation. In general, there was agreement between the predictions made by the *ToxCast* database and the laboratory effects studies.

Overall, this study reveals that PPCPs, and other chemicals of emerging concern can be found in most of the state's river and stream water. The predictions made by EPA's ToxCast database, together with the laboratory analysis of genetic expression when fish were exposed to water samples containing these contaminants, suggest that the pharmaceuticals and other chemicals of concern in river and stream surface water have impacts on genes that are associated with reproduction, development, growth, and tumor formation.

Introduction

For several years, the Minnesota Pollution Control Agency (MPCA) has sampled lakes and rivers for chemicals of emerging concern that may adversely affect aquatic ecosystems and human health. In 2008, a study of 11 Minnesota lakes [1, 2] revealed the presence of pharmaceuticals and endocrine active chemicals (EACs) in lakes ranging from urban to remote. Studies of male fish collected from these same locations revealed endocrine system abnormalities, indicated by their production of vitellogenin, a protein normally produced only by female fish in egg development.

Subsequent studies have confirmed the presence of many pharmaceuticals and other chemicals in surface water across the state on a surprisingly wide scale. A 2009 study of 25 wastewater treatment plants (WWTPs) across Minnesota [3] confirmed that treated effluent from these plants was a source of PPCPs, and other EACs, largely due to the inevitable excretion of pharmaceuticals into sewer systems. However, the study also indicated that many of these chemicals were present upstream of WWTPs. A 2010 study of Minnesota rivers [4] and a 2011 study of four quite remote Minnesota lakes [5] revealed the presence of similar contaminants. These results led to a larger study of ambient lakes in 2012 [6] , in which water samples from 50 randomly selected lakes were analyzed for 125 chemicals. Forty-seven of the 50 lakes were found to contain at least 1 chemical, and 38 of the 125 chemicals that were analyzed – including antidepressants, alkylphenols, hormones, illicit drugs, and antibiotics – were detected at least once.

These contaminants are typically detected at only ppt concentrations in water. However, effect studies have shown that several are toxic or harmful to fish and wildlife at very low levels, both to individual organisms and to populations. The introduction of diclofenac, a non-steroidal analgesic, for the treatment of livestock in rural India eradicated over 97% of the *Gyps* vulture population over a decade [7] due to the acute renal toxicity of diclofenac to this species of bird. Benzotriazole, a corrosion inhibitor, and its breakdown products are often detected in surface water and are toxic to aquatic organisms in low or sub-part per million concentrations [8, 9]. Iopamidol, a frequently detected pharmaceutical in surface water, is not itself toxic, but forms very cytotoxic and genotoxic iodinated disinfection by-products when water containing iopamidol is chlorinated [10], an important consideration as wastewater effluent is chlorinated at many WWTPs. Other aquatic contaminants, while not toxic, have hormone-like, or endocrine active, properties and trigger physiologic changes at extremely low concentrations [11]. The synthetic contraceptive hormone ethinylestradiol caused the complete collapse of fish populations when added to lake water at 5 ppt [12]; similarly, spawning in freshwater mussels is triggered by 30 ppt of the antidepressant fluvoxamine [13]; and reproductive success is altered in fathead minnows when exposed to ppt concentrations of nonylphenol [14]. Moreover, there is growing concern that antibiotics routinely detected in the environment may be promoting antibiotic resistance in bacteria that are continually exposed to these pharmaceuticals at low concentration[15].

Similar in scope and intent to the 2012 study of lakes, 50 river locations were randomly selected in 2014 for analysis of 146 pharmaceuticals, commercial or industrial chemicals, and personal care products. Several are known or suspected EACs. The results of this study show a similar profile of contaminants to that of lakes, with iopamidol, DEET, antidepressants, antibiotics, and corrosion inhibitors frequently detected. Estimates of the magnitude of contamination by these chemicals across the state are presented. Effect studies show that water from some locations is weakly estrogenic, and that specific changes in the regulation of genes in fish exposed to water taken from these locations may lead to altered reproduction, growth, or development.

Study methods and approach

Fifty Minnesota river locations were randomly selected for the study, which was designed in cooperation with EPA (Figure 1; see Appendix A for details on the locations sampled). The survey provides environmental data on the nation's rivers and streams every five years to assess their overall quality. Because the river locations that were included in the study were selected at random, the data collected in the study provides a statistically valid representation of PPCPs, EACs, and other chemicals present in Minnesota rivers and streams.

Sampling and analysis

Samples were collected in September and October 2014, during a reconnaissance of the locations that were selected for the flowing waters study of 2015. Grab samples were collected in amber glass or HDPE bottles, depending on the chemical analysis performed on the water samples. Field staff did not apply fragrances, insect repellant (DEET), or sunscreen prior to sampling. Sample bottles were transported to the site in re-sealable plastic bags. During sampling, powder-free latex gloves were used by samplers. Samples were collected by immersing the sample bottles in the stream flow, facing upstream. Bottles were re-sealed in the plastic bags, chilled, and shipped overnight to AXYS Analytical Laboratory, Vancouver, BC or to the Minnesota Department of Health, Public Health Laboratory for chemical analysis. Water samples were extracted at the laboratory within seven days of sample collection. A total of 146 chemicals were analyzed, including 124 pharmaceuticals, the personal care products DEET and triclosan, and four alkylphenol and alkylphenol ethoxylates by AXYS Analytical Laboratory. The suite of illicit drugs, benzotriazole, its degradation products, and benzothiazole were analyzed by the Minnesota Department of Health Laboratory. Table 1 lists all chemicals analyzed for this study. For a description of chemicals, see Appendix C. For a detailed description of sampling procedures and analytical methods, see Appendices B and E.

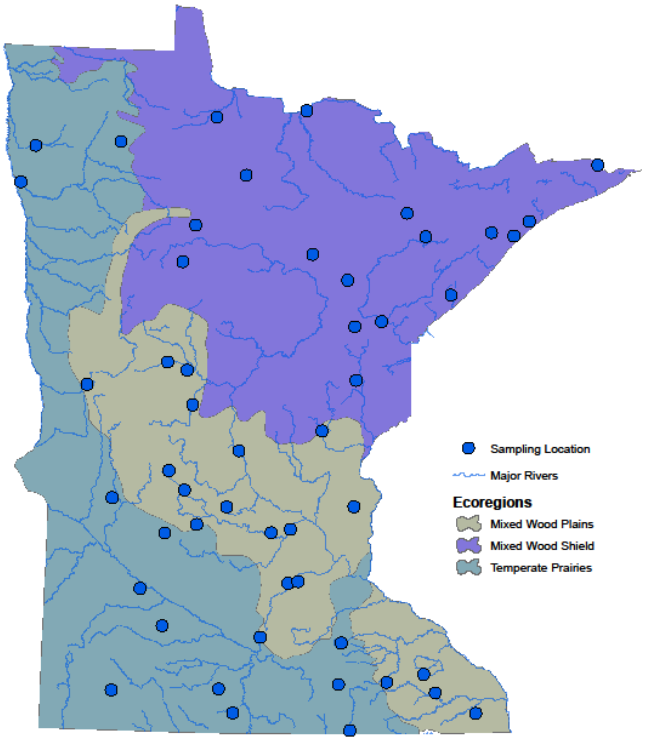

Figure 1. Locations where samples were taken for this study.

Table 1. Chemicals analyzed for this study.

Pharmaceuticals				**Personal Care**
1,7-Dimethylxanthine	Cotinine*	Lincomycin*	Pseudoephedrine*	Triclocarban
10-hydroxy-amitriptyline*	Cyclophosphamide	Lomefloxacin	Ranitidine	Triclosan*
2-Hydroxy-ibuprofen*	Daunorubicin	Medroxyprogesterone Acetate	Rosuvastatin	DEET*
Acetaminophen	Dehydronifedipine	Melphalan	Roxithromycin	
Albuterol	Desmethyldiltiazem*	Meprobamate*	Sarafloxacin	**Alkylphenols**
Alprazolam	Diatrizoic acid*	Metformin*	Sertraline*	4-Nonylphenol
Amitriptyline*	Diazepam*	Methylprednisolone	Simvastatin	4-Nonylphenol monoethoxylate
Amlodipine	Digoxigenin	Metoprolol*	Sulfachloropyridazine*	4-Nonylphenol diethoxylate
Amphetamine*	Digoxin	Metronidazole	Sulfadiazine*	4-Octylphenol
Amsacrine	Diltiazem*	Miconazole	Sulfadimethoxine*	
Atenolol*	Diphenhydramine*	Morphine	Sulfamerazine*	**Illicit drugs**
Atorvastatin	Doxorubicin	Moxifloxacin	Sulfamethazine*	MDMA
Azathioprine	Drospirenone	Naproxen*	Sulfamethizole	Benzoylecgonine*
Azithromycin	Enalapril	Norfloxacin	Sulfamethoxazole*	Cocaine
Benztropine	Enrofloxacin	Norfluoxetine	Sulfanilamide	Methamphetamine*
Betamethasone*	Ephedrine*	Norgestimate	Sulfathiazole	
Busulfan	Erythromycin*	Norverapamil	Tamoxifen	**Other**
Caffeine*	Etoposide	Ofloxacin*	Teniposide	Bisphenol A*
Carbadox*	Flumequine	Ormetoprim	Theophylline*	2-aminobenzothiazole*
Carbamazepine*	Fluocinonide	Oxacillin	Thiabendazole*	2-hydroxybenzothiazole*
Cefotaxime	Fluoxetine*	Oxazepam	Trenbolone	2-methylthiobenzothiazole
Cimetidine*	Fluticasone propionate	Oxolinic Acid*	Trenbolone acetate*	4-hydroxybenzotriazole
Ciprofloxacin*	Furosemide	Oxycodone*	Triamterene*	4-methylbenzotriazole*
Citalopram*	Gemfibrozil*	Paroxetine	Trimethoprim*	5,6-dimethylbenzotriazole*
Clarithromycin*	Glipizide	Penicillin G	Tylosin	5-chlorobenzotriazole
Clinafloxacin	Glyburide	Penicillin V	Valsartan*	5-methylbenzotriazole*
Clonidine	Hydrochlorothiazide	Prednisolone	Venlafaxine*	Benzothiazole*
Clotrimazole	Hydrocodone	Prednisone	Verapamil	Benzotriazole*
Cloxacillan	Hydrocortisone	Promethazine	Virginiamycin M1	
Codeine	Ibuprofen	Propoxyphene	Warfarin	
Colchicine	Iopamidol*	Propranolol	Zidovudine	

*****Detected in this study

Condition estimates

The MPCA conducts a state wide randomized survey of rivers and streams every five years, to measure the health of Minnesota's flowing waters. Fifty sites were sampled as part of this survey. The randomized site list is generated by the EPA, using a Generalized Random-Tessellation Stratified design [15]. This design allows for probabilistic surveys to maintain a sampling balance between small first order streams and large four-plus order streams, while maintaining spatial balance throughout the state. Four stream order classes (1, 2, 3, and 4+) along with Minnesota's three Omernick level II ecoregions [16, 17] (Mixed Wood Shield, Mixed Wood Plains, and Temperate Prairies) were used in the survey. The relative abundance of sampled streams in each class allows for "weighting" the surveyed streams to represent the overall population of stream miles within Minnesota.

A sample size of 50 allowed for condition estimates at the state level with 90% confidence in the estimates, as determined by EPA using a binomial distribution (Tony Olson, EPA Corvallis, personal communication). The weights of the individual stream locations allow extrapolation of the data to generate a statistically valid estimate of the condition of streams statewide [18].

Effects studies

Predictive toxicology evaluation

The EPA's Toxicity Forecaster (ToxCast) (https://www.epa.gov/chemical-research/toxicity-forecaster-toxcasttm-data) provides toxicity screening data for approximately 2,000 chemicals from a broad range of industrial and consumer products. ToxCast data were generated using high-throughput chemical screening methods - 700 bioassays covering a broad range of biological targets and responses. ToxCast data can be used to predict biological effects based on the chemical composition of the environmental sample, and/or to conduct initial ranking and prioritization of chemicals.

For this study, ToxCast data (the iCSS Dashboard v1; actor.epa.gov) were used to predict toxicity information for the chemicals found in Minnesota water samples. The following toxicity information was extracted from the iCSS Dashboard: 1) the identity of all ToxCast assays and associated biological targets (i.e., genes) for chemicals detected in Minnesota streams, and 2) the concentration of each chemical that exerted a half maximal response (AC50) in these assays. From these data, exposure:biological activity ratios (similar to hazard quotients; see [19]) were calculated to predict the biological targets likely to be impacted by the chemicals found in Minnesota streams.

Empirical evaluation

Cell-based assessment of endocrine activity of water samples

Estrogenic and androgenic activity were measured using cell-based *in vitro* assays on surface water collected from 10 of the 50 river locations (Table 2). These assays [20, 21] quantify hormonal activity of the environmental samples based on their ability to bind to the hormone (estrogen or androgen) cell receptor and to induce or attenuate subsequent biological responses.

Table 2. Samples that were collected for the cell-based estrogenic assays and fish exposure studies.

Habitat	Site Name	Site ID	# of Chemicals Detected
Temperate Prairies	Boiling Spring Creek	15EM046	12
Temperate Prairies	Tributary to Zumbro River, North Fork Rice	15EM070	7
Mixed Wood Shield	Pike River	15EM037	0
Mixed Wood Shield	W Branch Baptism River	15EM017	1
Temperate Prairies	Red Lake River	15EM032	2
Mixed Wood Plains	Bevens Creek	15EM014	10
Temperate Prairies	Perch Creek	15EM067	4
Mixed Wood Plains	Knife River	15EM027	4
Mixed Wood Plains	Tributary to Leaf River	15EM015	1
Mixed Wood Plains	South Fork Whitewater River	15EM038	13

Fish-based evaluation of effects on gene expression

Sexually mature fathead minnows (n=7-8 per treatment) were exposed for 48 hours to either clean water controls (filtered, ultraviolet light treated Lake Superior water) or to the surface water collected from the 10 sites identified in Table 2. Flow rates, photoperiod, feeding, water temperature and dissolved oxygen levels were kept the same for all fish exposures. Microarray-based analysis of liver gene expression was conducted using a custom 60K feature fathead minnow DNA microarray following previously published protocols [22].

Results and discussion

Analytical

Fifty-eight of the 146 chemicals analyzed in Table 1 were detected in water at least once. The x-ray contrast agent iopamidol was the most frequently detected, found at 78% of the locations sampled (Figure 2). Several antidepressants, including sertraline, amitriptyline, venlafaxine, and fluoxetine, were detected at 48%, 44%, 16%, and 10% of the locations, respectively. Other pharmaceuticals that were found included the diabetes medicine metformin, detected at 18% of the sampling locations, the diuretic triamterene, at 16%, and the ADHD medicine carbamazepine, found at 14% of the locations. Several antibiotics were detected, including sulfamethoxazole, erythromycin, lincomycin, and trimethoprim at 24%, 14%, 8%, and 6% of the sampling points, respectively.

As in prior investigations of lake and river water, the insect repellant DEET was a commonly detected contaminant, found in 36% of samples. The nicotine metabolite, cotinine, was present at 38% of the locations, and bisphenol A was present in water at 16% of the locations. The anti-corrosive chemical benzotriazole and benzotriazole breakdown products were all detected frequently. Complete analytical results are included in Appendix D.

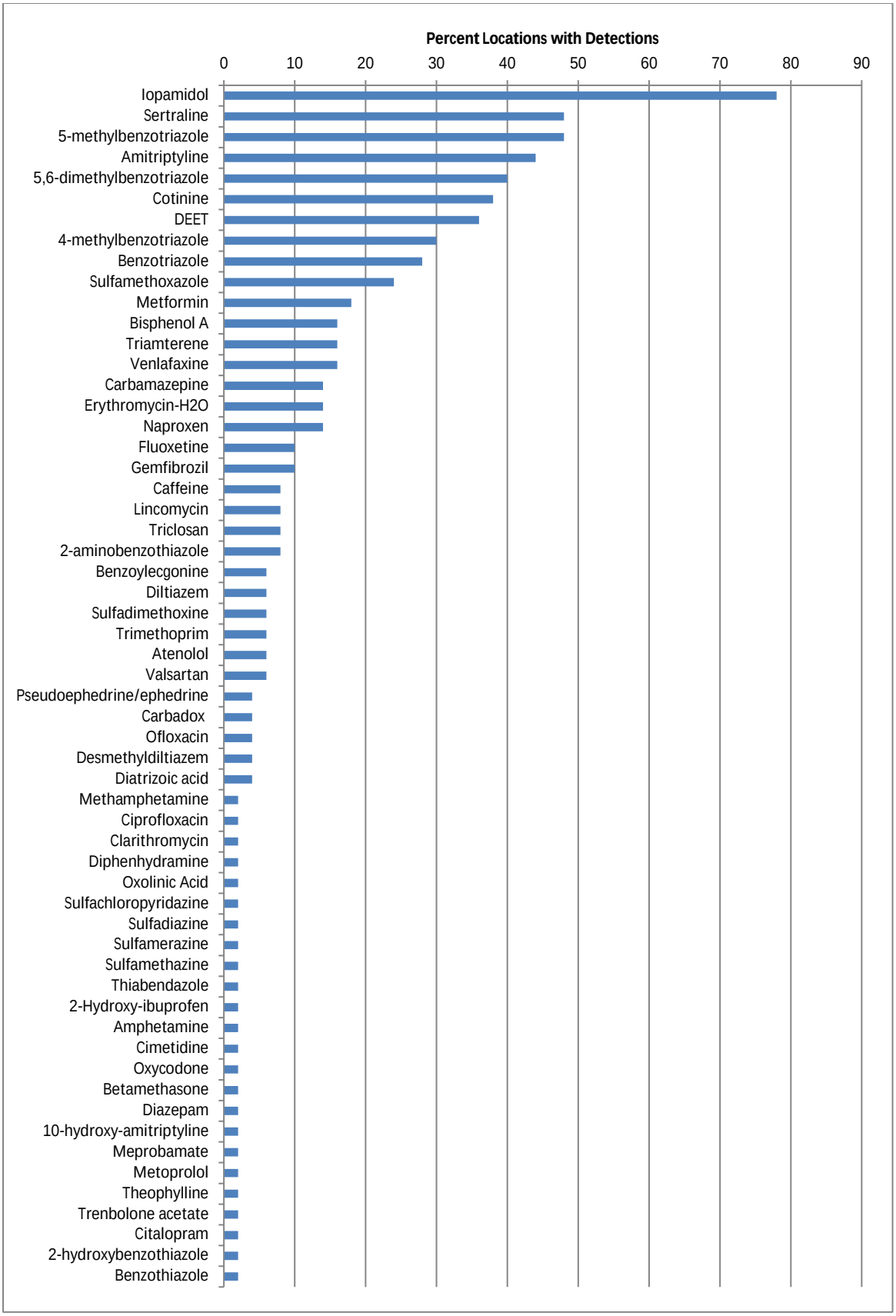

Figure 2. Detection frequency of chemicals analyzed for this study.

Table 3 shows the highest concentrations for the contaminants that were detected in this study. Although most of the analytes were detected in the low ppt range, a few were found at much higher levels. Among those with the highest concentrations, iopamidol was reported at 1,650 ppt at one location, and DEET was detected in one sample at 781 ppt. Benzotriazole was detected at 1,600 ppt, while its degradation product, 4-methylbenzotriazole, was present at 1,500 ppt. This is consistent with the results of the 2010 Minnesota rivers study [4], when these anticorrosive chemicals were detected at concentrations over 1,000 ppt.

Statewide, there was an average of 5.8 contaminants per location, and at least one chemical was found in 49 of the 50 sites sampled (Table 4). The highest number of contaminants was found in the Cedar River, in southern Minnesota, while the one site with no detections, Pike River, is located in the sparsely populated northern area of Minnesota. Figure 3 shows how the detections were distributed across the state. Similar to the results of the 2012 National Lake Assessment study [23], surface water in the more highly developed Mixed Wood Plains and Temperate Prairie ecoregions of the state contained the highest frequency of detected chemicals, while the fewest detections were reported for waters of the less developed and sparsely populated Mixed Wood Shield region in northern Minnesota.

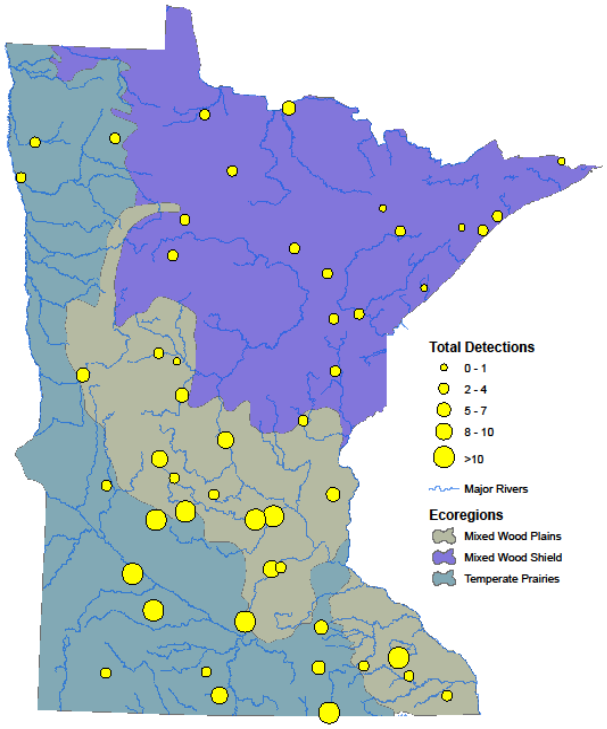

Figure 3. Number of chemicals detected at each sampling location.

River condition estimates

The random selection of the 50 locations for this survey allowed a statistical evaluation of the proportion of Minnesota's rivers likely to contain a given contaminant. Table 5 shows the estimates of the river miles affected by the twelve most frequently detected chemicals in this study on a statewide basis. These evaluations indicate that iopamidol is likely present in 82% of the state's river miles, representing the highest proportion of river water with a particular chemical measured in this study.

The often-detected antidepressant amitriptyline is likely present in 50.7% of the state's river miles. Similarly, nearly 20% of Minnesota's river and stream miles contain the antibiotic sulfamethoxazole, while metformin, the medicine used to treat diabetes, is likely to be found in 13% of the state's waterways. Table 5 also shows that a large proportion of the state's rivers likely contain benzotriazole (a corrosion inhibitor) and its degradation products.

Generally, the Temperate Prairie Region had the highest number of detections of these chemicals, likely reflecting the greater proportion of developed land use in this ecoregion. Interestingly, whereas other chemicals detected in this study appear to occur much less frequently in the relatively undeveloped Mixed Wood Shield region of the state, iopamidol did not follow this trend, and was detected as

frequently in the Mixed Wood Shield region than in the other two ecoregions. This is consistent with the very frequent detection of iopamidol in a 2013 study of 11 Minnesota lakes [24] and other studies of this pharmaceutical in the aquatic environment [25].

The results of this analysis indicate that several of the chemicals that were analyzed are widespread in our rivers. This is a similar result to the 2012 study of 50 randomly selected lakes, in which we reported that many of these same contaminants were often present in ambient lake water that lacked identifiable sources. Together, these studies of lakes and rivers reveal that most of the state's surface water is contaminated to some degree by PPCPs, and chemicals of commercial or industrial application.

Table 3. Maximum concentration of chemicals detected. (ND, not detected)

	Max detect (ppt)
Alkylphenols	
4-Nonylphenol	ND
4-Nonylphenol monoethoxylate	ND
4-Nonylphenol diethoxylate	ND
4-Octylphenol	ND
Illicit drugs	
3-methylenedioxy-N-methylamphetamine (MDMA)	ND
Amphetamine	1.59
Benzoylecgonine	1.24
Cocaine	ND
Methamphetamine	16
Morphine	ND
Pseudoephedrine/ephedrine	11
Other	
Bisphenol A	15.1
2-aminobenzothiazole	1.5
2-hydroxybenzothiazole	34
2-methylthiobenzothiazole	ND
4-hydroxybenzotriazole	ND
4-methylbenzotriazole	1500
5,6-dimethylbenzotriazole	12
5-chlorobenzotriazole	2.6
5-methylbenzotriazole	460
Benzothiazole	40
Benzotriazole	1600
Personal Care Products	
Triclosan	6.82
DEET	781
Triclocarban	ND

	Max detect (ppt)
Pharmaceuticals	
1,7-Dimethylxanthine	ND
10-hydroxy-amitriptyline	0.435
2-Hydroxy-ibuprofen	83.7
Acetaminophen	ND
Albuterol	ND
Alprazolam	ND
Amitriptyline	5.14
Amlodipine	ND
Amsacrine	ND
Atenolol	2.47
Atorvastatin	ND
Azathioprine	ND
Azithromycin	ND
Benztropine	ND
Betamethasone	2.64
Busulfan	ND
Caffeine	35.6
Carbadox	12.1
Carbamazepine	10.9
Cefotaxime	ND
Cimetidine	1.02
Ciprofloxacin	5.86
Citalopram	1.77
Clarithromycin	4.3
Clinafloxacin	ND
Clonidine	ND
Clotrimazole	ND
Cloxacillan	ND
Codeine	ND
Colchicine	ND
Cotinine	12.1

	Max detect (ppt)
Pharmaceuticals (cont.)	
Cyclophosphamide	ND
Daunorubicin	ND
Dehydronifedipine	ND
Desmethyldiltiazem	0.957
Diatrizoic acid	49.9
Diazepam	0.322
Digoxigenin	ND
Digoxin	ND
Diltiazem	3.56
Diphenhydramine	1.83
Doxorubicin	ND
Drospirenone	ND
Enalapril	ND
Enrofloxacin	ND
Erythromycin	2.98
Etoposide	ND
Flumequine	ND
Fluocinonide	ND
Fluoxetine	2.79
Fluticasone propionate	ND
Furosemide	ND
Gemfibrozil	18.6
Glipizide	ND
Glyburide	ND
Hydrochlorothiazide	ND
Hydrocodone	ND
Hydrocortisone	ND
Ibuprofen	ND
Iopamidol	1650
Lincomycin	6.23
Lomefloxacin	ND
Medroxyprogesterone Acetate	ND
Melphalan	ND
Meprobamate	5.49
Metformin	667
Methylprednisolone	ND
Metoprolol	16.3
Metronidazole	ND
Miconazole	ND
Moxifloxacin	ND
Naproxen	16
Norfloxacin	ND
Norfluoxetine	ND
Norgestimate	ND
Norverapamil	ND

	Max detect (ppt)
Ofloxacin	9.58
Ormetoprim	ND
Oxacillin	ND
Oxazepam	ND
Oxolinic Acid	2.5
Oxycodone	1.51
Paroxetine	ND
Penicillin G	ND
Penicillin V	ND
Prednisolone	ND
Prednisone	ND
Promethazine	ND
Propoxyphene	ND
Propranolol	ND
Ranitidine	ND
Rosuvastatin	ND
Roxithromycin	ND
Sarafloxacin	ND
Sertraline	1.73
Simvastatin	ND
Sulfachloropyridazine	5.29
Sulfadiazine	1.57
Sulfadimethoxine	21.8
Sulfamerazine	0.815
Sulfamethazine	11.9
Sulfamethizole	ND
Sulfamethoxazole	51
Sulfanilamide	ND
Sulfathiazole	ND
Tamoxifen	ND
Teniposide	ND
Theophylline	71.7
Thiabendazole	1.59
Trenbolone	ND
Trenbolone acetate	1.32
Triamterene	3.76
Trimethoprim	51.4
Tylosin	ND
Valsartan	33.8
Venlafaxine	11
Verapamil	ND
Virginiamycin M1	ND
Warfarin	ND
Zidovudine	ND

Table 4. Number of contaminants detected by sampling location. Color highlights correspond to each of the three ecoregions of the state shown in Figures 1 and 3.

Location	Name	Ecoregion	No. of Detections
15EM056	Cedar River	Temperate Prairies	38
15EM058	Crow River	Mixed Wood Plains	20
15EM003	Minnesota River	Mixed Wood Plains	18
15EM038	South Fork Whitewater River	Mixed Wood Plains	13
15EM051	Mill Creek	Mixed Wood Plains	13
15EM035	County Ditch 47	Mixed Wood Plains	12
15EM046	Boiling Spring Creek	Temperate Prairies	12
15EM071	County Ditch 68	Temperate Prairies	12
15EM030	Hawk Creek	Temperate Prairies	11
15EM014	Bevens Creek	Mixed Wood Plains	10
15EM040	South Creek	Temperate Prairies	9
15EM052	Mississippi River	Mixed Wood Plains	8
15EM063	Judicial Ditch # 1	Mixed Wood Plains	8
15EM079	Long Prairie River	Mixed Wood Plains	7
15EM077	Rainy River	Mixed Wood Shield	7
15EM070	North Fork Zumbro River Tributary	Temperate Prairies	7
15EM043	Sunrise River	Mixed Wood Plains	6
15EM084	Otter Tail River	Mixed Wood Plains	5
15EM022	Straight River Tributary	Temperate Prairies	5
15EM027	Knife River	Mixed Wood Plains	4
15EM072	North Fork Crow River	Mixed Wood Plains	4
15EM049	Prairie River	Mixed Wood Shield	4
15EM050	Turtle River	Mixed Wood Shield	4
15EM081	Caribou River	Mixed Wood Shield	4
15EM023	Judicial Ditch # 12	Temperate Prairies	4
15EM067	Perch Creek	Temperate Prairies	4
15EM080	Snake River	Temperate Prairies	4
15EM004	Leaf River	Mixed Wood Plains	3
15EM036	Clearwater River	Mixed Wood Plains	3
15EM054	Trout Run	Mixed Wood Plains	3
15EM009	Partridge River	Mixed Wood Shield	3
15EM025	Stoney Brook	Mixed Wood Shield	3
15EM069	Floodwood River	Mixed Wood Shield	3
15EM034	Agricultural Drainage Ditch (A)	Temperate Prairies	3
15EM047	County Ditch 23	Temperate Prairies	3
15EM010	South Fork Zumbro Tributary	Mixed Wood Plains	2
15EM024	Beaver Creek West	Mixed Wood Plains	2
15EM078	Sand Creek Tributary	Mixed Wood Plains	2
15EM002	Schoolcraft River	Mixed Wood Shield	2
15EM033	Temperance River	Mixed Wood Shield	2

Location	Name	Ecoregion	No. of Detections
15EM039	Prairie River	Mixed Wood Shield	2
15EM045	Moose Creek Drainage Ditch	Mixed Wood Shield	2
15EM055	Birch Creek	Mixed Wood Shield	2
15EM061	Unnamed Creek (A)	Mixed Wood Shield	2
15EM032	Red Lake River	Temperate Prairies	2
15EM015	Leaf River Tributary	Mixed Wood Plains	1
15EM017	West Branch Baptism River	Mixed Wood Shield	1
15EM053	West Branch Knife River Tributary	Mixed Wood Shield	1
15EM065	Royal River	Mixed Wood Shield	1
15EM037	Pike River	Mixed Wood Shield	0

Table 5. Condition estimates of Minnesota rivers for the most frequently detected contaminants.

Contaminant	Estimate of river miles affected (%)	Standard Error
Iopamidol	81.8	5.1
Sertraline	40.9	7.7
Amitriptyline	50.7	7.7
Cotinine	35.8	7.4
DEET	39.8	7.6
Sulfamethoxazole	19.7	6.2
Metformin	13.1	4.1
Bisphenol A	7.6	2.7
4-Methyl Benzotriazole	26.4	6.5
5,6-Dimethyl Benzotriazole	36.5	5.9
5-Methyl Benzotriazole	40.4	8.0
Benzotriazole	22.9	6.3

Biological effects

Predictive toxicology evaluation

A total of 24 chemicals were detected in water collected from the 10 sites that were selected for fish-based toxicity evaluations. Extensive *in vitro* toxicity data for nine of those chemicals was available through ToxCast. Our predictive toxicity evaluation for each site was thus based on the toxicity data available for those nine contaminants (bisphenol A, triclosan, caffeine, carbamazepine, cotinine, amitriptyline, DEET, diazepam, and meprobamate).

Based on this data, the concentrations of individual contaminants detected in 6 of 10 water samples (sites 15EM037, 15EM017, 15EM032, 15EM067, 15EM015, 15EM027) were present below those concentrations that are reported to exert biological effects in ToxCast assays. At the remaining four sites, the concentrations of chemicals measured in surface waters initiated a variety of toxicological responses in ToxCast assays. It is important to note that none of the sites exerted effects above half-maximal response (AC50) for any of the given assays, and the majority of the responses were several orders of magnitude below AC50, indicating very low levels of toxicity for the short-term exposure that ToxCast measures. Table 6 shows the top 16 toxicity targets – genes that were activated and are

associated with a known toxicity response. Only those targets for which biological activity/AC50 ratio was > 0.0001 are shown. The contaminants that were most likely to initiate biological responses at concentrations measured at the four locations are identified below with the predicted biological targets.

Site 15EM038 - The largest number of genetic targets (16) likely to be affected by contaminants detected in water was predicted for the South Fork of Whitewater River site (Table 6). Contaminant interaction with the following genes was predicted: PPARg, ERa, SOX, CAR, PPARα, ERE, Pax6, MMP3, and CAM3C. The chemicals most likely to initiate biological effects were identified as bisphenol A, caffeine, and DEET. All three chemicals were present at sufficient concentrations in water from this location to initiate biological responses in ToxCast assays.

Site 15EM014 – Seven genes - FXR, GABAR, AdoRA, PXRE, ESR1, ESR1 responsive element, and PXR - were identified that could be affected by the chemicals detected at this location. Carbamazepine was identified as the main contaminant of concern at this site (based on the chemical concentration detected in the water sample from this location and ability of that concentration to have impact on biological targets). None of the targets had biological activity/AC50 ratio higher than 0.0001; thus they are listed as negative interactions in Table 6.

Site 15EM046 –Five genes - PPARg, SOX, PAX6, GATA, CASM3C – were identified by ToxCast that could be affected by the chemicals found at this location. DEET, triclosan, and caffeine were identified as the contaminants detected at this site likely to initiate these biological responses.

Site 15EM070 – ToxCast analyses predicted the strongest impacts on four biological targets - ESR1, CAR, PPARα, and ESR1 responsive element - and identified bisphenol A as the contaminant most likely to initiate these biological impacts.

Predictive toxicology

Very few of the thousands of commercial or industrial chemicals have been evaluated for adverse health effects, and scientists are looking for better ways to test chemicals that don't require animal testing. New highly efficient methods of evaluating chemicals for toxicity rely on recent advances in biotechnology and computer science to rapidly screen chemicals for harmful biological effects. In the ToxCast program, over 2,000 commercial and industrial chemicals have already been evaluated in over 700 "high throughput" assays that measure in a detailed way how cells and biochemical pathways respond to a chemical. The results of each assay are reported as a percentage of the maximum response possible for that biochemical test. Thus, a half-maximal response, or AC50, indicates that the chemical triggered a reaction in that assay that is one-half of the maximum. The combined results of these assays allow predictions of how toxic a chemical is likely to be to an animal.

The predictive toxicology evaluation conducted for the chemicals detected at the locations in this study is limited and possibly biased because of the low availability of toxicity data for individual chemicals. Thus, systematically generated toxicity data for many of the contaminants detected in the water samples is not currently available through ToxCast. However, toxicity data for chemicals of emerging concern are anticipated to grow exponentially over the next five years due to the coordinated national effort to populate the toxicity databases using high throughput toxicity testing approaches. Toxicity data for tens of thousands of contaminants will become available over the next decade. This will significantly enhance our ability to identify contaminants of concern and estimate their toxicity in Minnesota's ambient waters. Thus, chemical monitoring data collected now and in the past can be evaluated in the future as the toxicity data become available.

Table 6. Biological targets predicted by ToxCast as affected by the contaminants detected in water at ten of the study locations.

Predicted Biological Target	15EM046	15EM070	15EM037	15EM017	15EM032	15EM014	15EM067	15EM027	15EM015	15EM038	Assay ID
Estrogen receptor 1 (ESR1)	N	N	N	N	N	N	N	N	N	Y	ACEA_T47D_80hr_Positive
Responsive to exogenous estrogen receptor 1 (ESR1)	N	Y	N	N	N	N	N	N	N	Y	ATG_ERa_TRANS_up
Responsive to endogenous estrogen receptor 1 (ESR1)	N	Y	N	N	N	N	N	N	N	Y	ATG_ERE_CIS_up
Responsive to endogenous GATA binding protein (GATA)	Y	N	N	N	N	N	N	N	N	Y	ATG_GATA_CIS_up
Responsive to endogenous paired box 6 (PAX6)	Y	N	N	N	N	N	N	N	N	Y	ATG_Pax6_CIS_up
Responsive to endogenous sex determining region Y box 1 (SOX1)	Y	N	N	N	N	N	N	N	N	Y	ATG_Sox_CIS_up
Coagulation factor III protein (F3)	Y	N	N	N	N	N	N	N	N	Y	BSK_CASM3C_TissueFactor_up
Matrix metallopeptidase 3 (MMP3)	N	N	N	N	N	N	N	N	N	Y	NVS_ENZ_hMMP3
Estrogen receptor 1 (ESR1)	N	N	N	N	N	N	N	N	N	Y	NVS_NR_bER
Antagonist of nuclear receptor subfamily 1, group 1, member 3 (NR1I3)	N	Y	N	N	N	N	N	N	N	Y	NVS_NR_hCAR_Antagonist
Estrogen receptor 1 (ESR1)	N	N	N	N	N	N	N	N	N	Y	NVS_NR_hER
Peroxisome proliferator-activated receptor alpha (PPARa)	N	Y	N	N	N	N	N	N	N	Y	NVS_NR_hPPARa
Peroxisome proliferator-activated receptor gamma (PPARg)	Y	N	N	N	N	N	N	N	N	Y	NVS_NR_hPPARg
Estrogen receptor 2 (ESR2)	N	N	N	N	N	N	N	N	N	Y	OT_ER_ERbERb_0480
Estrogen receptor 2 (ESR2)	N	N	N	N	N	N	N	N	N	Y	OT_ER_ERbERb_1440
Estrogen receptor 1 (ESR1)	N	N	N	N	N	N	N	N	N	Y	Tox21_ERa_LUC_BG1_Agonist

Empirical evaluation

Cell-based assessment of endocrine activity of water samples

Estrogenic activity

Five of the 10 water samples tested positive for estrogenic activity, but the activity was very low and below the concentration at which 10% of maximum estrogenic response can be initiated. Given the low response, estrogenic activity cannot be accurately quantified for these samples. The activity of the 5 samples is below 0.25 ng ethinylestradiol equivalents/L. However, the activation of estrogen receptor (ER) related pathways was also observed with the fish-based genetic transcription array (discussed below) and predicted by ToxCast (Tables 6, 7). Given the importance of ER function for reproduction and development, future monitoring for estrogenic effects and associated adverse outcomes is needed.

Androgenic activity

Only one sample tested positive for androgenic activity (15EM067). Activity was very low and could not be quantified (likely below 0.1 micrograms per liter, or parts per billion (ppb) (ng/L testosterone equivalents).

Some chemicals, while not toxic, are known to mimic hormones such as the female hormone estrogen. Because these chemicals behave like molecular "triggers" that can set in motion important physiological responses, exposure to very small concentrations of these chemicals can affect the growth, functioning, or reproduction of an organism.

Biologists have developed molecular tests to determine how *estrogenic* chemicals are by measuring their affinity for estrogen receptors in the cell and their ability to turn on genes similar to the naturally produced hormone. These estrogenicity assays are now routinely used to identify chemicals that have hormone-like properties.

Fish-based evaluation of effects on gene expression: transcriptomic analysis

While the predictive toxicology analysis conducted through ToxCast provided insight to which genes are likely affected through exposure to the chemicals found in the water samples, it was not a direct measure of these effects induced by our samples. To compare what was predicted by ToxCast to laboratory analysis of effects on specific genes, fish were exposed to a subset of the 50 water samples. The fish were then analyzed to determine which genes, out of many thousands, were expressed after exposure.

In these experiments, short-term exposure (48h) of fish to the 10 surface water samples resulted in changes in gene expression correlated to the activation of 28 toxicity pathways (Table 7). While the pathways itemized in Table 7 are very detailed, generally speaking the potential adverse outcomes of these toxicity pathways can include changes in how the organism metabolizes food or other cellular molecules, changes in hormone production that may lead to altered reproduction, changes in anatomy, or the promotion of cancers. The potential adverse outcomes of the activation of these toxicity pathways that were observed in greater than 50% of the evaluated stream locations are discussed below:

Transcriptomic analysis is a powerful tool that allows researchers to understand what specific genes are being turned on - or turned off - in an organism when it is exposed to a drug or environmental contaminant.

When genes that are encoded in DNA are switched on, or expressed, they are transcribed into RNA "messenger" molecules, which are, in turn, used by the cell to produce proteins needed by the organism. By isolating the messenger RNA from cells and comparing it to several thousand known RNA sequences, biologists are able to see exactly which genes are being expressed in an organism. Because the function of many genes are now known, it is possible to predict what effect contaminants might be having on an organism by knowing what genes are being expressed in response to chemical exposures.

1. **PPARα/RXRα activation**: PPARα is a xenobiotic receptor. Many contaminants are known to bind to and activate it (e.g., pharmaceuticals such as fibrates, phthalates). Interference of normal PPARα function by contaminants could lead to the alteration of lipid and glucose metabolism and cellular differentiation. Activation of PPARα [26] can also lead to activation of peroxysomal enzymes. When sustained, peroxisomal enzyme activation can lead to abnormal cell proliferation, which has been associated with hepatic cancer [27].
2. **LXR/RXR activation**: LXR is a liver receptor that forms a heterodimer with RXR. LXRs act as sterol sensors and protect cells from cholesterol overload [28]. The induction of this toxicity pathway is indicative of disruption of lipid metabolism - LXR activation can lead to liver steatosis (fatty liver). Steatosis can be reversible or can progress to permanent liver damage.
3. **TR/RXR activation**: Thyroid receptor (TR) is a thyroid hormone receptor that is important in the regulation of metabolism, heart rate, and development of organisms. Interaction of contaminants with this pathway is of concern as it could adversely impact many important biological functions that the TR mediates including carbohydrate metabolism, lipid metabolism, steroid metabolism, body temperature maintenance, and central nervous system function.
4. **Liver proliferation**: Liver proliferation leads to increased liver cell production. Unchecked liver cell proliferation can lead to liver cancer.
5. **Aryl hydrocarbon receptor (AhR) signaling**: Activation of the AhR has been shown to cause a range of adverse effects in vertebrates, especially during early life stages. The adverse outcomes associated with this toxicity pathway include: cardiovascular dysfunction, pericardial and yolk sac edemas, subcutaneous hemorrhages, craniofacial deformities, reduced growth, and increased mortality. In fish, activation of AhR has been shown to lead to cardiac toxicity and yolk sac edemas [29]. Gene expression changes induced by AhR activation occur within hours [30], but only sustained AhR activation has been shown to lead to tumor formation. This receptor is typically involved in, though not limited to, regulation of biological responses to aromatic hydrocarbons (PAHs) and dioxins.
6. **Liver necrosis/cell death:** Necrosis is a form of cell injury leading to premature cell death by autolysis. Necrosis results in the release of intracellular content that causes inflammation and harm to other nearby cells.

7. **NF-κB signaling**: This is a protein complex that controls transcription of DNA. NF-κB is found in almost all animal cell types and is involved in responses to stimuli such as chemicals (e.g., metals), stress, free radicals, UV irradiation and bacterial or viral agents. Altered regulation of NF-κB has been linked to viral infections, cancer, inflammatory and autoimmune disease and improper immune system development [31].
8. **RAR activation**: Retinoic acid receptor (RAR) is a nuclear receptor that can act as a DNA transcription factor. The beta form of RAR binds retinoic acid (the biologically active form of vitamin A), which mediates cellular signaling in embryonic morphogenesis, cell growth and differentiation; this protein limits growth of many cell types by regulating gene expression.

Fish gene expression data indicate that the contaminants detected in this study may have impacts on reproduction, development, growth, and may cause tumor formation. While evaluation of gene expression profiles is an excellent tool for the identification of monitoring targets and identification of possible biological effects, the alteration of gene expression alone should not be interpreted as an adverse outcome. Changes in gene expression do not necessarily progress to adverse outcome at higher levels of biological organization (i.e., cell, tissue, organism), and in some cases may represent adaptive, compensatory responses to chemical exposure. Estrogenic effects are of special concern as multiple methodologies indicated disruption or estrogen receptor binding and signaling. Follow-up, whole organism studies that evaluate these endpoints are needed to confidently establish whether these adverse outcomes are occurring in Minnesota streams.

Table 8 summarizes the estrogen receptor related effects from the predictive toxicology analysis (the ToxCast database), the cell-based estrogenic tests on water samples, and the fish-based exposure evaluations of each water sample. Five of the samples show complete agreement between the predictive analysis, estrogenic activity, and fish exposure evaluations, indicated in bold type. The agreement between predictive toxicology and laboratory analysis in this study indicates that predictive toxicology will be a useful tool in evaluating the results of other studies of chemical contaminants in water. The predictive analysis for the other five samples indicated no potential estrogenic effects based on the nine chemicals in the water samples for which there were toxicology data available in ToxCast, while the cell-based estrogenic analysis and fish-based exposures of the actual water samples indicated positive estrogenic effects. However, as mentioned above, not all of the chemicals detected in the water samples collected for this study have been evaluated in the ToxCast program. These gaps in the existing ToxCast database may be leading to false negative results in the predictions. In addition, other contaminants may be present in the surface water at these locations for which we have no occurrence data, and unknown chemicals may be eliciting positive results in the cell-based estrogenicity and fish-based assays.

Table 7. The toxicity pathways that are correlated with the changes in gene expression observed in the fish exposure experiments.

Incidence	Toxicity Pathway	15EM046	15EM070	15EM037	15EM017	15EM032	15EM014	15EM067	15EM027	15EM015	15EM038
90	PPARα/RXRα Activation	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
80	LXR/RXR Activation	Y	N	Y	N	Y	Y	Y	Y	Y	Y
70	TR/RXR Activation	Y	Y	Y	N	Y	N	N	Y	Y	Y
60	Liver Proliferation	N	Y	Y	N	Y	Y	N	Y	N	Y
50	Aryl Hydrocarbon Receptor Signaling	N	Y	N	N	N	Y	Y	Y	N	Y
50	Liver Necrosis/Cell Death	Y	Y	N	N	Y	Y	N	Y	N	N
50	NF-κB Signaling	N	Y	Y	N	Y	Y	N	Y	N	N
50	RAR Activation	N	Y	Y	N	N	Y	N	Y	N	Y
40	Hypoxia-Inducible Factor Signaling	N	N	Y	N	Y	Y	N	Y	N	N
40	Gene Regulation by Peroxisome Proliferators via PPARα	N	Y	N	N	N	N	Y	Y	N	Y
40	p53 Signaling	N	Y	N	N	N	N	N	Y	Y	Y
30	Cholesterol Biosynthesis	N	N	N	N	Y	N	N	Y	N	Y
30	TGF-β Signaling	N	Y	Y	N	N	N	Y	N	N	N
20	Cell Cycle: G1/S Checkpoint Regulation	N	N	Y	N	N	Y	N	N	N	N
20	FXR/RXR Activation	N	N	Y	N	N	N	N	N	N	Y
20	Hormone Receptor Regulated Cholesterol Metabolism	Y	N	N	N	N	N	N	Y	N	N
20	NRF2-mediated Oxidative Stress Response	N	Y	N	N	N	N	N	Y	N	N
20	Oxidative Stress	N	N	N	N	N	Y	N	N	N	Y
10	Anti-Apoptosis	N	N	N	N	N	N	N	N	N	Y
10	Biogenesis of Mitochondria	N	N	N	N	N	N	N	N	N	Y
10	Cardiac Hypertrophy	N	Y	N	N	N	N	N	N	N	N
10	Decreases Permeability Transition of Mitochondria/Their Membranes	N	N	N	N	N	Y	N	N	N	N
10	Hepatic Cholestasis	N	N	N	N	N	Y	N	N	N	N
10	Hepatic Fibrosis	N	N	N	Y	N	N	N	N	N	N
10	Hepatic Stellate Cell Activation	N	N	N	N	N	N	Y	N	N	N
10	Increases Renal Proliferation	N	N	N	N	N	Y	N	N	N	N
10	Primary Glomerulonephritis Biomarker Panel (Human)	N	N	Y	N	N	N	N	N	N	N
10	PXR/RXR Activation	N	N	N	N	N	N	N	N	N	Y

Table 8. Estrogen receptor related effects for each of the ten water samples evaluated in this study. Low levels of estrogenic activity were detected in surface water samples (in vitro cell assays, below 0.25 ng EE2 equivalents/L). Enrichment of pathways associated with estrogen receptor signaling was observed in fish from several sites (* = vitellogenin upregulation).

Site ID	ToxCast Prediction	Estrogenic Assay	Fish Gene Expression
15EM017	N	Y	Y
15EM014	N	N	N
15EM032	N	N	N
15EM37	N	N	N
15EM015	N	N	Y*
15EM038	Y	Y	Y
15EM046	N	Y	Y
15EM070	Y	Y	Y
15EM027	N	Y	Y
15EM067	N	N	Y

Conclusions

This study expands our understanding of the extent to which our surface water is contaminated by pharmaceuticals and commercial chemicals, some of which are endocrine active. Although several studies in the past have focused on the contribution of sources of these chemicals to surface water, such as WWTPs [3] or septic drain fields [32], this investigation reveals that many medicines and consumer products are detectable in most of the state's rivers and streams. This is consistent with the study results of Minnesota lakes [6], in which these chemicals were discovered in most of the lakes sampled, including lakes lacking obvious contamination sources.

The effects analysis performed in this study provides additional and much needed insight to how these chemicals are affecting fish and likely other organisms in aquatic ecosystems. The rapidly expanding molecular-based approaches to evaluating the toxicity and endocrine activity of chemicals, such as the ToxCast database and gene-targeting assays that were done as part of this study, are providing unprecedented clarity to the possible impacts these chemicals might be having on organisms on a genetic level. In the future, this approach will allow us to evaluate more confidently which chemicals are harmful and what biological or metabolic pathways are likely to be affected. While it is too early to determine if adverse effects are actually occurring in fish populations based on these molecular-based effects studies, these chemicals are clearly eliciting changes in gene regulation that have the potential to cause adverse physiologic or reproductive effects.

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Appendix A

Study sample locations

Location	Name	County	Latitude	Longitude	Date Sampled	Ecoregion	Strahlen Order
15EM002	Schoolcraft River	Hubbard	47.29738	-94.9806	10/7/2014	Mixed Wood Shield	3
15EM003	Minnesota River	Nicollet	44.27752	-94.0092	9/26/2014	Mixed Wood Plains	8
15EM004	Leaf River	Wadena	46.48455	-95.1271	9/25/2014	Mixed Wood Plains	4
15EM009	Partridge River	St. Louis	47.51271	-92.0948	10/1/2014	Mixed Wood Shield	3
15EM010	South Fork Zumbro Tributary	Olmsted	43.91258	-92.5889	9/30/2014	Mixed Wood Plains	3
15EM014	Bevens Creek	Carver	44.7149	-93.6996	10/9/2014	Mixed Wood Plains	4
15EM015	Leaf River Tributary	Wadena	46.4242	-94.8978	10/7/2014	Mixed Wood Plains	2
15EM017	West Branch Baptism River	Lake	47.53634	-91.3166	9/30/2014	Mixed Wood Shield	2
15EM022	Straight River Tributary	Steele	43.89789	-93.1253	10/1/2014	Temperate Prairies	3
15EM023	Judicial Ditch # 12	Nobles	43.82328	-95.6596	9/26/2014	Temperate Prairies	2
15EM024	Beaver Creek West	Houston	43.65652	-91.6008	10/1/2014	Mixed Wood Plains	3
15EM025	Stoney Brook	St. Louis	46.83041	-92.6286	10/1/2014	Mixed Wood Shield	3
15EM027	Knife River	Kanabec	45.94708	-93.3219	10/7/2014	Mixed Wood Plains	3
15EM030	Hawk Creek	Kandiyohi	45.10315	-95.1106	9/24/2014	Temperate Prairies	3
15EM032	Red Lake River	Polk	47.8905	-96.9449	10/2/2014	Temperate Prairies	6
15EM033	Temperance River	Cook	47.62087	-90.8621	9/30/2014	Mixed Wood Shield	4
15EM034	Agricultural Drainage Ditch (A)	Marshall	48.25207	-95.7631	9/24/2014	Temperate Prairies	0
15EM035	County Ditch 47	Meeker	45.18081	-94.7495	9/23/2014	Mixed Wood Plains	2
15EM036	Clearwater River	Stearns	45.32677	-94.4098	10/8/2014	Mixed Wood Plains	2
15EM037	Pike River	St. Louis	47.70299	-92.3168	10/1/2014	Mixed Wood Shield	4
15EM038	South Fork Whitewater River	Olmsted	43.97806	-92.1737	10/2/2014	Mixed Wood Plains	3
15EM039	Prairie River	St. Louis	46.78983	-92.9436	10/1/2014	Mixed Wood Shield	2
15EM040	South Creek	Martin	43.65976	-94.3043	9/30/2014	Temperate Prairies	2
15EM043	Sunrise River	Chisago	45.33395	-92.9538	10/7/2014	Mixed Wood Plains	2
15EM045	Moose Creek Drainage Ditch	Lake of the Woods	48.46858	-94.6135	10/8/2014	Mixed Wood Shield	0

Location	Name	County	Latitude	Longitude	Date Sampled	Ecoregion	Strahlen Order
15EM046	Boiling Spring Creek	Yellow Medicine	44.65151	-95.3711	9/24/2014	Temperate Prairies	2
15EM047	County Ditch 23	Swift	45.37621	-95.7226	9/24/2014	Temperate Prairies	2
15EM049	Prairie River	Itasca	47.37328	-93.4418	9/30/2014	Mixed Wood Shield	4
15EM050	Turtle River	Beltrami	47.59727	-94.8374	9/25/2014	Mixed Wood Shield	2
15EM051	Mill Creek	Wright	45.12073	-93.8986	9/23/2014	Mixed Wood Plains	3
15EM052	Mississippi River	Morrison	45.7781	-94.2791	10/8/2014	Mixed Wood Plains	6
15EM053	West Branch Knife River Tributary	St. Louis	47.03888	-91.8066	9/30/2014	Mixed Wood Shield	2
15EM054	Trout Run	Fillmore	43.82604	-92.0494	10/1/2014	Mixed Wood Plains	3
15EM055	Birch Creek	Pine	46.35562	-92.928	10/7/2014	Mixed Wood Shield	2
15EM056	Cedar River	Mower	43.5273	-93.0016	9/30/2014	Temperate Prairies	5
15EM058	Crow River	Hennepin	45.1504	-93.6789	9/23/2014	Mixed Wood Plains	6
15EM061	Unnamed Creek (A)	Koochiching	48.00653	-94.243	10/8/2014	Mixed Wood Shield	2
15EM063	Judicial Ditch # 1	Stearns	45.60882	-95.0815	10/3/2014	Mixed Wood Plains	3
15EM065	Royal River	Cook	48.05771	-90.0196	10/7/2014	Mixed Wood Shield	3
15EM067	Perch Creek	Watonwan	43.85355	-94.463	10/8/2014	Temperate Prairies	3
15EM069	Floodwood River	St. Louis	47.16575	-93.0243	9/30/2014	Mixed Wood Shield	2
15EM070	North Fork Zumbro River Tributary	Rice	44.23377	-93.0971	10/2/2014	Temperate Prairies	2
15EM071	County Ditch 68	Redwood	44.35268	-95.1109	10/8/2014	Temperate Prairies	1
15EM072	North Fork Crow River	Stearns	45.45487	-94.8949	10/8/2014	Mixed Wood Plains	2
15EM077	Rainy River	Koochiching	48.53364	-93.5236	10/7/2014	Mixed Wood Shield	6
15EM078	Sand Creek Tributary	Scott	44.72945	-93.5901	10/9/2014	Mixed Wood Plains	2
15EM079	Long Prairie River	Todd	46.14369	-94.8252	10/7/2014	Mixed Wood Plains	4
15EM080	Snake River	Marshall	48.19101	-96.7847	10/8/2014	Temperate Prairies	4
15EM081	Caribou River	Lake	47.50535	-91.0505	10/9/2014	Mixed Wood Shield	2
15EM084	Otter Tail River	Otter Tail	46.28292	-96.0606	10/9/2014	Mixed Wood Plains	4

Appendix B

Water sample collection

Samples were collected in one-liter amber glass or HDPE bottles, depending on the specific analysis for which the sample was intended. Sample bottles for pharmaceutical, triclosan, bisphenol A, and alkylphenol analyses were provided by AXYS Analytical Services in Sidney, BC, Canada. 250 ml amber glass bottles for illicit drugs, benzotriazole, and benzothiazole analyses were provided by the Minnesota Department of Health (MDH) Public Health Laboratory.

Field staff did not apply fragrances, insect repellant (DEET), or sunscreen prior to sampling and wore disposable powder-free, nitrile gloves while sampling. Sample bottles were transported to the site in re-sealable plastic bags and coolers.

Samples were collected at arm's length from upstream relative to the field staff. Sample bottles were removed from the plastic re-sealable bags and uncapped for sample collection only with gloved hands. Samples were not collected during rainfall. Sample collection was not flow-weighted.

For all sample collection events, sample bottles were rinsed with the surface water three times by filling and emptying the bottle completely. Bottles were immersed below the surface so as not to allow exposed skin above the gloved hand to come into contact with the surface water. The final sample was collected without headspace in the bottle. Once filled, bottles were re-capped, re-sealed in the plastic bags, and chilled in the accompanying coolers on ice.

Field blanks were collected by transporting duplicate sample bottles to a location where samples were collected. Field blank water, also supplied by the laboratory in identical glass or HDPE bottles, was transported to the site. Field blank water bottles were transported in identical re-sealable plastic bags and in coolers to replicate the procedure used for actual samples. Using gloved hands and facing upwind, the field blank water was poured from the lab-supplied bottles into empty sample bottles without rinsing. The field blank samples were then re-capped, re-sealed in plastic bags, and treated identically to the surface water samples.

After returning from the field, samples were refrigerated at 4 degrees Celsius. All samples were kept in the original re-sealable plastic bags and were shipped overnight to AXYS Analytical Services or to the MDH Public Health Laboratory for analysis. The maximum holding time for samples, from the date of collection to their extraction in the laboratory, was seven days.

Appendix C

Chemicals analyzed in this study and their uses

Alkylphenols	
4-Nonylphenol diethoxylate	Nonionic detergent
4-Nonylphenol monoethoxylate	Nonionic detergent
4-Nonylphenol	An alkylphenol; a breakdown product of nonylphenol ethoxylate detergents
Octylphenol	An alkylphenol; a breakdown product of octylphenol ethoxylate detergents
Personal Care Products	
DEET	Pesticide; insect repellant
Triclosan	Antibacterial disinfectant
Triclocarban	Antibacterial disinfectant
Illicit/Recreational Drugs	
Cocaine	Central nervous system stimulant
Benzoylecgonine	Metabolite of cocaine
MDMA	Psychoactive drug
Methamphetamine	Central nervous system stimulant; recreational drug
Hormones	
Trenbolone	Steroid hormone used to increase muscle mass in livestock
Trenbolone acetate	Steroid hormone used to increase muscle mass in livestock
Pharmaceuticals/Medications	
1,7-Dimethylxanthine	Metabolite of caffeine
10-Hydroxy-amitriptyline	Metabolite of amitriptyline
2-Hydroxy-ibuprofen	Metabolite of ibuprofen
Acetaminophen	A common analgesic
Albuterol	Asthma medication; smooth muscle relaxant
Alprazolam	A sedative and muscle relaxant
Amitriptyline	An antidepressant
Amlodipine	Blood pressure medication
Amphetamine	Central nervous system stimulant
Amsacrine	Antineoplastic; anti-cancer drug
Atenolol	Beta blocker used to treat cardiovascular disease and hypertension
Atorvastatin	Lipid regulator

Azothioprine	Immunosuppressive used in organ transplantation and autoimmune disease
Azithromycin	Antibiotic
Benztropine	Anticholinergic used to treat Parkinson's disease
Betamethasone	Anti-inflammatory steroid
Busulfan	Antineoplastic used in cancer treatment
Caffeine	Central nervous system stimulant; psychoactive drug
Carbadox	Antibiotic used in rearing swine
Carbamazepine	Anticonvulsive used to treat epilepsy and attention deficit hyperactivity disorder (ADHD)
Cefotaxime	An antibiotic
Cimetidine	Inhibitor of stomach acid production
Ciprofloxacin	An antibiotic
Citalopram	Antidepressant (Selective serotonin reuptake inhibitor)
Clarithromycin	An antibiotic
Clinafloxacin	An antibiotic
Clonidine	Adrenergic agonist used to treat high blood pressure, attention deficit hyperactivity disorder (ADHD), and anxiety.
Clotrimazole	Antifungal medication
Cloxacillin	An antibiotic
Codeine	Narcotic analgesic
Colchicine	Medication used to treat gout
Cotinine	Metabolite of nicotine
Cyclophosphamide	Antineoplastic used in cancer treatment
Daunorubicin	Chemotherapy drug
Dehydronifedipine	Metabolite of nifedipine, a blood pressure medication
Desmethyldiltiazem	A metabolite of diltiazem
Diatrizoic acid	x-ray contrast agent
Diazepam	Anti-anxiety medication; sedative
Digoxigenin	A plant-derived steroid used as a probe in molecular biology
Digoxin	Heart medication
Diltiazem	Heart medication
Diphenhydramine	Antihistamine
Doxorubicin	Cancer chemotherapeutic drug
Drospirenone	Steroidal progestin used in hormone replacement therapy and contraceptives
Enalapril	ACE inhibitor used to treat hypertension and chronic heart failure
Enrofloxacin	A veterinary antibiotic

Ephedrine	Vasoconstrictor and bronchodilator; precursor to methamphetamine
Erythromycin-H2O	An antibiotic
Etoposide	Chemotherapeutic drug
Flumequine	An antibiotic
Fluocinonide	Anti-inflammatory steroid
Fluoxetine	Antidepressant (Selective serotonin reuptake inhibitor)
Fluticasone propionate	Steroid medication for asthma
Furosemide	Diuretic used to treat high blood pressure and edema
Gemfibrozil	Lipid regulator
Glipizide	anti-diabetic drug
Glyburide	Anti-diabetic drug
Hydrochlorothiazide	Diuretic used to treat high blood pressure and edema
Hydrocodone	Narcotic analgesic
Hydrocortisone	Cortisol; a steroid hormone
Ibuprofen	Nonsteroidal anti-inflammatory analgesic
Iopamidol	X-ray contrast agent
Lincomycin	An antibiotic
Lomefloxacin	An antibiotic
Meprobamate	Anti-anxiety medication; sedative
Methylprednisolone	Anti-inflammatory steroid
Medroxyprogesterone Acetate	Synthetic progesterone used in hormone treatment and as a contraceptive
Melphalan	Cancer chemotherapeutic drug
Meprobamate	Anti-anxiety medication
Metformin	Type 2 diabetes medication
Methylprednisilone	Synthetic anti-inflammatory corticosteroid
Metoprolol	Blood pressure medication
Metronidazole	An antibiotic and antiprotozoal
Miconazole	Topical antifungal medication
Morphine	Opiate-derived pain medication
Moxifloxacin	An antibiotic
Naproxen	An analgesic
Norfloxacin	A seldom used antibiotic
Norfluoxetine	An antidepressant
Norgestimate	A hormone used in oral contraceptives
Norverapamil	Blood pressure medication

Ofloxacin	An antibiotic
Ormetoprim	An antibiotic used with sulfonamides
Oxacillin	An antibiotic
Oxazepam	Anti-anxiety medication
Oxolinic Acid	An antibiotic
Oxycodone	Narcotic analgesic
Paroxetine	An antidepressant
Penicillin G	An antibiotic
Penicillin V	An antibiotic
Prednisolone	An anti-inflammatory corticosteroid and active metabolite of prednisone
Prednisone	An anti-inflammatory corticosteroid
Promethazine	An antihistamine
Propoxyphene	An analgesic
Propranolol	Sedative and blood pressure medication
Pseudoephedrine	Stimulant; nasal and sinus decongestant
Ranitidine	Inhibitor of stomach acid production
Rosuvastatin	Lipid regulator
Roxithromycin	An antibiotic
Sarafloxacin	An antibiotic
Sertraline	An antidepressant
Simvastatin	Lipid regulator
Sulfachloropyridazine	One of several sulfonamide antibiotics
Sulfadiazine	One of several sulfonamide antibiotics
Sulfadimethoxine	One of several sulfonamide antibiotics
Sulfamerazine	One of several sulfonamide antibiotics
Sulfamethazine	One of several sulfonamide antibiotics
Sulfamethizole	One of several sulfonamide antibiotics
Sulfamethoxazole	One of several sulfonamide antibiotics
Sulfanilamide	One of several sulfonamide antibiotics
Sulfathiazole	One of several sulfonamide antibiotics
Tamoxifen	Drug used in the treatment of breast cancer
Teniposide	Chemotherapeutic
Theophylline	Asthma medication
Thiabendazole	A fungicide
Triamterene	Diuretic used to treat hypertension and edema
Trimethoprim	An antibiotic used together with sulfonamides

Tylosin	An antibiotic
Valsartan	Blood pressure medication
Venlafaxine	Antidepressant (Selective serotonin reuptake inhibitor)
Verapamil	Medication for high blood pressure and migraines
Virginiamycin	An antibiotic
Warfarin	Blood thinner
Zidovudine	Anti-retroviral medication

Other	
Bisphenol A	Material to make polycarbonate plastic and other uses
2-aminobenzothiazole	Degradation product of benzothiazole
2-hydroxybenzothiazole	Degradation product of benzothiazole
2-methylthiobenzothiazole	Degradation product of benzothiazole
4-hydroxybenzotriazole	Degradation product of benzotriazole
4-methylbenzotriazole	Degradation product of benzotriazole
5,6-dimethylbenzotriazole	Degradation product of benzotriazole
5-chlorobenzotriazole	Degradation product of benzotriazole
5-methylbenzotriazole	Degradation product of benzotriazole
Benzothiazole	Feedstock used in the manufacture of dyes and other chemicals
Benzotriazole	Corrosion inhibitor

Appendix D

Analytical data tables

Table 1: Alkylphenols and alkylphenol ethoxylates

Table 2: Triclosan and bisphenol A

Tables 3-7: Pharmaceuticals

Table 8: Benzotriazoles and benzothiazoles

Table 9: Illicit and other drugs

Data flags for analytical data in tables 1-7

B	Analyte found in sample and the associated blank
D	Dilution data
E	Exceeds calibrated linear range, see dilution data
H	Data provided for information only
K	Peak detected but did not meet quantification criteria, result reported represent the estimated maximum possible concentration
MAX	Concentration is a maximum estimated value
N	Analyte recovery is not within method control limits in the OPR
NQ	Data not quantifiable
TIC	Compound identity and concentration are estimated
U	Identifies a compound that was not detected
V	Surrogate recovery is not within method control limits
X	Results reported separately

Sample ID suffices

i	Instrumental re-analysis performed on the sample extract
N	A dilution of the sample extract followed by instrumental re-analysis
R	Repeat analysis using a fresh aliquot of sample

Table 1. Alkylphenols and alkylphenol ethoxylates

River Location	4-Nonylphenols	4-Nonylphenol monoethoxylates	4-Nonylphenol diethoxylates	Octylphenol
15EM002	B 29.7	U 11.7	U 19.1	U 3.96
15EM003	U 4.3	U 5.44	U 7.79	U 2.05
15EM004	U 2.7	U 7.55	U 7.43	U 0.792
15EM009	B 32	U 12.6	U 12.3	U 5.48
15EM010	U 5.15	U 13.7	U 11.3	U 2.94
15EM014	B 29.2	U 11	U 28.3	U 2.24
15EM015	B 28	U 14.8	U 16	U 3.51
15EM017	B 22.3	U 9.55	U 8.07	U 1.27
15EM022	U 6.53	U 12.8	U 8.07	U 3.94
15EM023	U 3.63	U 7.51	U 7.15	U 1.29
15EM024	B 17.1	U 8.03	U 8.3	U 3.19
15EM025	U 24.6	U 29	U 17	U 5.97
15EM027	U 5.75	U 10.8	U 9.85	U 2.4
15EM030	U 3.34	U 5.2	U 4.82	U 2.31
15EM032	B 37.7	U 17.1	U 19	U 4.91
15EM033	B 38.5	U 18.3	U 18.7	U 4.34
15EM034	U 3.6	U 5.08	U 10.2	U 2.73
15EM035	U 4.52	U 7.89	U 7.67	U 2.41
15EM036	B 41.5	U 8.85	U 5.97	U 3.32
15EM037	B 22.9	U 16.6	U 22.1	U 4.73
15EM038	U 4.41	U 6.9	U 7.01	U 1.6
15EM039	B 33.5	U 20.1	U 13.3	U 3.35
15EM040	U 19.6	U 25.8	U 11.5	U 4.65
15EM043	U 6.32	U 6.99	U 13	U 2.56
15EM045	B 25.2	U 16.8	U 11.8	U 2.78
15EM046	U 3.31	U 6.08	U 12.4	U 1.5
15EM047	U 3.54	U 11.5	U 10.7	U 1.98
15EM049	B 31.5	U 21.1	U 13.5	U 3.35
15EM050	U 3.29	U 4.21	U 9.68	U 1.01
15EM051	U 5.46	U 9.92	U 5.98	U 1.94
15EM052	U 7.12	U 10.4	U 16.1	U 2.81
15EM053	B 17.1	U 23	U 29.2	U 6.04
15EM054	U 9.14	U 15.5	U 16.9	U 2.11
15EM055	U 9.36	U 8.41	U 13.6	U 3.5
15EM056	U 5.74	U 9.59	U 16.4	U 2.53
15EM058	U 4.43	U 10.3	U 10.9	U 1.64
15EM061	U 12.1	U 18.9	U 60.6	U 5.98
15EM063	U 6.45	U 12.4	U 17.8	U 3.04

River Location	4-Nonylphenols	4-Nonylphenol monoethoxylates	4-Nonylphenol diethoxylates	Octylphenol
15EM065	U 7.55	U 11.8	U 5.12	R 5.19
15EM067	U 4.91	U 7.79	U 20.9	U 1.28
15EM069	B 22.5	U 19.4	U 25.8	U 3.83
15EM070	U 8.03	U 8.31	U 15	U 3.65
15EM071	U 9.2	U 5.35	U 9.63	U 2.39
15EM072	U 4.79	U 5.5	U 6.37	U 1.62
15EM077	B 43.9	U 7.04	U 5.26	U 4.24
15EM078	U 7.3	U 7.84	U 16.6	U 2.65
15EM079	U 8.83	U 11.3	U 15.7	U 4.16
15EM080	B 24.9	U 14.1	U 12.8	U 2.72
15EM081	B 13.1	U 6.52	U 8.12	U 3.83
15EM084	U 7.09	U 11.1	U 16.3	U 2.59
Field Blank	U 8.38	U 16.6	U 32.3	U 5.93
Field Blank	U 6.69	U 12.3	U 13.3	U 1.72
Field Blank	B 74	U 9.9	U 10.7	U 1.33

Table 2. Triclosan and Bisphenol A

River Location	Triclosan	Bisphenol A
15EM002	U 4.86	U 2.1
15EM003	U 5.3	U 2.11
15EM004	U 4.89	U 1.95
15EM009	U 5.17	U 2
15EM010	U 5.29	U 1.98
15EM014	U 5.12	U 2.14
15EM015	U 5.27	U 1.98
15EM017	U 4.97	U 2.03
15EM022	U 5	U 2.07
15EM023	U 4.97	U 2.03
15EM024	U 4.97	10.6
15EM025	U 5.12	U 1.97
15EM027	U 5.01	U 2.06
15EM030	5.52	U 2.13
15EM032	U 5.16	U 2.03
15EM033	U 4.92	U 2.06
15EM034	U 4.92	U 2.01
15EM035	6.82	U 2.11
15EM036	U 5.45	U 1.93
15EM037	U 5.07	U 2.02
15EM038	U 5.07	15.1
15EM039	U 5.06	U 2.01
15EM040	U 5.29	12.1
15EM043	U 4.92	U 2.21
15EM045	U 5.14	U 2.01
15EM046	5.97	U 1.99
15EM047	U 4.8	U 2.06
15EM049	U 5.07	U 1.99
15EM050	U 4.94	U 1.94
15EM051	U 5.02	U 2.03
15EM052	U 4.88	U 2.1
15EM053	U 5.03	U 1.99
15EM054	U 5.14	8.68
15EM055	U 5.11	U 2.02
15EM056	4.97	U 2.08
15EM058	U 5.16	U 2.06
15EM061	U 5.17	U 2.03
15EM063	U 5.43	7.42
15EM065	U 5.5	U 2.14
15EM067	U 4.87	U 2.18
15EM069	U 5.19	12.5
15EM070	U 5	2.77
15EM071	U 5	U 2.11
15EM072	U 5.25	U 2.03
15EM077	U 4.72	U 2.2
15EM078	U 4.98	U 2.08
15EM079	U 5.25	U 2.05
15EM080	U 5.34	U 1.94
15EM081	U 4.82	U 2.1
15EM084	U 5.02	U 2
Field Blank	U 6.52	U 2.09
Field Blank	U 5.9	10.7
Field Blank	U 5.78	U 2.4

Table 3. List 1 pharmaceuticals

River Location	Acetaminophen	Azithromycin	Caffeine	Carbadox	Carbamazepine	Cefotaxime	Ciprofloxacin	Clarithromycin
15EM002	U 15.8	U 1.58	U 15.8	U 1.58	U 1.58	U 6.31	U 12.4	U 1.58
15EM003	U 15.2	U 1.52	U 15.2	U 3.66	7.42	U 30.2	U 18.8	U 1.52
15EM004	U 15.4	U 1.54	U 15.4	U 1.54	U 1.54	U 26.5	U 27.8	U 1.54
15EM009	U 15.6	U 1.56	U 15.6	U 2.48	U 1.56	U 36.2	U 37.5	U 1.56
15EM010	U 14.8	U 1.48	U 14.8	U 1.48	U 1.48	U 13.9	U 5.9	U 1.48
15EM014	U 15.5	U 1.55	U 15.5	U 6.71	10.2	U 37.3	U 32.1	U 1.55
15EM015	U 15.8	U 1.58	U 15.8	U 1.58	U 1.58	U 6.33	U 11.9	U 1.58
15EM017	U 15.4	U 1.54	U 15.4	U 3.13	U 1.54	U 41.2	U 33.9	U 1.54
15EM022	U 14.5	U 1.45	U 14.5	U 1.45	U 1.45	U 20.7	U 20.5	U 1.45
15EM023	U 14.3	U 1.43	U 14.3	U 4.77	U 1.43	U 38.7	U 16.8	U 1.43
15EM024	U 14.3	U 1.43	U 14.3	U 1.43	U 1.43	U 8.39	U 5.72	U 1.43
15EM025	U 15.3	U 1.82	U 15.3	U 11.3	U 1.53	U 86.2	U 58.6	U 1.53
15EM027	U 15.3	U 1.53	U 15.3	U 11	U 1.53	U 52.7	U 32	U 1.53
15EM030	U 15.4	U 1.54	U 15.4	7.3	U 1.54	U 40.7	U 55.7	U 1.54
15EM032	U 15.2	U 1.52	U 15.2	U 1.52	U 1.52	U 56.1	U 24.2	U 1.52
15EM033	U 15.5	U 1.55	U 15.5	U 1.55	U 1.55	U 50.4	U 18.6	U 1.55
15EM034	U 15.9	U 1.59	U 15.9	U 7.52	U 1.59	U 75.2	U 32.3	U 1.59
15EM035	U 14.9	U 1.49	15.1	U 2.34	U 1.49	U 24	U 11.6	U 1.49
15EM036	U 15.9	U 1.59	U 15.9	U 1.59	U 1.59	U 6.35	U 20.5	U 1.59
15EM037	U 15.7	U 1.57	U 15.7	U 1.57	U 1.57	U 24.6	U 38.9	U 1.57
15EM038	U 15	U 1.5	19.9	U 1.74	U 1.5	U 11.6	U 10.7	U 1.5
15EM039	U 15.4	U 1.61	U 15.4	U 1.54	U 1.54	U 44.5	U 23.6	U 1.54
15EM040	U 14.8	U 1.55	U 14.8	12.1	U 1.48	U 50.1	U 45.6	U 1.48
15EM043	U 15.6	U 1.56	U 15.6	U 8.1	U 1.56	U 39.3	U 33	U 1.56
15EM045	U 15.8	U 2.15	U 15.8	U 1.58	U 1.58	U 6.33	NQ	U D 4.75
15EM046	U 15.7	U 1.57	32.4	U 14	U 1.57	U 64.8	U 28.1	U 1.57
15EM047	U 14.5	U 1.45	U 14.5	U 1.45	U 1.45	U 19.3	U 11.9	U 1.45
15EM049	U 15.4	U 1.54	U 15.4	U 1.54	U 1.54	U 64.6	U 32	U 1.54
15EM050	U 14.6	U 1.46	U 14.6	U 6.53	U 1.46	U 37.3	U 21.3	U 1.46
15EM051	U 15.6	U 1.56	U 15.6	U 4.07	3.51	U 10.8	U 18.5	U 1.56
15EM052	U 15.9	U 1.59	U 15.9	U 1.59	U 1.59	U 6.35	U 25.5	U 1.59
15EM053	U 15.7	U 1.57	U 15.7	U 1.57	U 1.57	U 19.5	U 21.4	U 1.57
15EM054	U 14.8	U 1.48	U 14.8	U 1.48	U 1.48	U 11.4	U 5.91	U 1.48
15EM055	U 14.9	U 1.49	U 14.9	U 9.27	U 1.49	U 50.4	U 70.7	U 1.49
15EM056	U 15.1	U 1.51	35.6	U 1.51	9.94	U 11.3	U 12.6	4.3
15EM058	U 14.6	U 1.46	U 14.6	U 10.2	9.18	U 58	U 25.1	U 1.46
15EM061	U 15.8	U 1.58	U 15.8	U 1.58	U 1.58	U 6.33	U 32.7	U 1.58
15EM063	U 14.4	U 1.44	U 14.4	U 1.44	U 1.44	U 21.5	U 12.8	U 1.44
15EM065	U 15.6	U 1.56	U 15.6	U 5.87	U 1.56	U 32.7	U 22	U 1.56
15EM067	U 15.7	U 1.57	U 15.7	U 6	U 1.57	U 55.7	U 57.5	U 1.57

River Location	Acetaminophen	Azithromycin	Caffeine	Carbadox	Carbamazepine	Cefotaxime	Ciprofloxacin	Clarithromycin
15EM069	U 15.4	U 1.54	U 15.4	U 1.54	U 1.54	U 34.9	U 22	U 1.54
15EM070	U 14.5	U 1.45	U 14.5	U 1.45	U 1.45	U 15.6	5.85	U 1.45
15EM071	U 15.3	U 1.53	U 15.3	U 3.37	10.9	U 38.3	U 17	U 1.53
15EM072	U 15.4	U 1.54	U 15.4	U 3.31	U 1.54	U 38.2	U 16.4	U 1.54
15EM077	U 15.7	U 1.57	U 15.7	U 1.57	U 1.57	U 6.28	U 35.3	U 1.57
15EM078	U 15.5	U 1.55	U 15.5	U 2.92	U 1.55	U 40.6	U 16.8	U 1.55
15EM079	U 15.9	U 1.59	U 15.9	U 4.49	3.07	U 6.35	U 30.3	U 1.59
15EM080	U 16	U 2.12	U 16	U 9.59	U 1.6	U 6.41	U 40.3	U 1.6
15EM081	U 15.3	U 1.53	U 15.3	U 3.46	U 1.53	U 47.7	U 17.9	U 1.53
15EM084	U 15.3	U 1.53	U 15.3	U 2.29	U 1.53	U 34.6	U 17.6	U 1.53
Field Blank	U 15.8	U 1.58	U 15.8	U 1.58	U 1.58	U 26	U 6.32	U 1.58
Field Blank	U 14.5	U 1.45	U 14.5	U 1.45	U 1.45	U 5.79	U 5.79	U 1.45
Field Blank	U 15.7	U 1.57	U 15.7	U 1.57	U 1.57	U 6.28	U 6.28	U 1.57

River Location	Clinafloxacin	Cloxacillin	Dehydronifedipine	Diphenhydramine	Diltiazem	Digoxin	Digoxigenin	Enrofloxacin
15EM002	U 46.6	U H 3.16	U 0.631	U 0.631	U 0.316	U 6.31	U 223	U 3.16
15EM003	U 86.3	U H 10.1	U 0.608	U 0.608	0.716	U 6.08	U 102	U 3.04
15EM004	U 96.7	U H 10.3	U 0.615	U 0.615	U 0.308	U 6.15	U 148	U 3.08
15EM009	U 66.7	U H 3.11	U 0.623	U 0.623	U 0.311	U 6.23	U 260	U 3.82
15EM010	U 14.9	U H 2.95	U 0.59	U 0.59	U 0.406	U 5.9	U 103	U 2.95
15EM014	U 45.9	U H 3.1	U 0.62	U 0.62	U 0.31	U 6.2	U 115	U 3.1
15EM015	U 50.9	U H 3.16	U 0.633	U 0.633	U 0.316	U 6.33	U 110	U 4.1
15EM017	U 136	U H 3.08	U 0.674	U 0.617	U 0.527	U 6.17	U 298	U 6.57
15EM022	U 29.8	U H 2.9	U 0.644	U 0.58	U 0.468	U 5.8	U 135	U 2.9
15EM023	U 25.5	U H 9.57	U 0.574	U 0.574	U 0.287	U 5.74	U 113	U 2.87
15EM024	U 10.7	U H 2.86	U 0.572	U 0.572	U 0.286	U 5.72	U 38.4	U 2.86
15EM025	U 114	U H 3.06	U 0.611	U 0.611	U 0.553	U 6.11	U 351	U 4.3
15EM027	U 110	U H 3.05	U 0.61	U 0.61	U 0.305	U 6.1	U 255	U 4.49
15EM030	U 84.8	U H 10.3	U 0.617	U 0.617	U 0.379	U 6.17	U 161	U 3.58
15EM032	U 119	U H 3.04	U 0.607	U 0.607	U 0.304	U 6.07	U 148	U 3.36
15EM033	U 67.3	U H 3.11	U 0.622	U 0.622	U 0.361	U 6.22	U 152	U 3.11
15EM034	U 74.4	U H 10.7	U 0.635	U 0.635	U 0.506	U 6.35	U 271	U 3.45
15EM035	U 45.5	U H 9.95	U 0.597	U 0.597	U 0.298	U 5.97	U 107	U 2.98
15EM036	U 75.1	U H 3.17	U 0.635	U 0.635	U 0.449	U 6.35	U 224	U 4.07
15EM037	U 111	U H 3.14	U 0.628	U 0.628	U 0.314	U 6.28	U 215	U 3.14
15EM038	U 32.2	U H 3	U 0.6	U 0.6	U 0.302	U 6	U 109	U 3
15EM039	U 119	U H 3.08	U 0.762	U 0.615	U 0.482	U 6.15	U 286	U 3.08
15EM040	U 67.9	U H 3.21	U 0.816	U 0.592	U 0.562	U 5.92	U 251	U 3.37
15EM043	U 73.4	U H 3.12	U 0.767	U 0.625	U 0.379	U 6.25	U 196	U 3.12
15EM045	NQ	U H 4.56	U 0.633	U 0.633	U 1.13	U 6.33	U 687	NQ
15EM046	U 70.6	U H 10.5	U 0.63	U 0.63	U 0.361	U 6.3	U 240	U 3.79
15EM047	U 56.6	U H 9.67	U 0.58	U 0.58	U 0.29	U 5.8	U 66.7	U 2.9
15EM049	U 84	H 3.25	U 0.614	U 0.614	U 0.482	U 6.14	U 289	U 3.07

River Location	Clinafloxacin	Cloxacillin	Dehydronifedipine	Diphenhydramine	Diltiazem	Digoxin	Digoxigenin	Enrofloxacin
15EM050	U 28.1	U H 9.75	U 0.585	U 0.585	U 0.358	U 5.85	U 159	U 2.93
15EM051	U 74.2	U H 10.4	U 0.623	U 0.623	U 0.312	U 6.23	U 120	U 3.12
15EM052	U 94.7	U H 3.18	U 0.635	U 0.635	U 0.318	U 6.35	U 247	U 3.58
15EM053	U 34.5	U H 3.13	U 0.627	U 0.627	U 0.316	U 6.27	U 129	U 3.13
15EM054	U 14.2	U H 2.96	U 0.591	U 0.591	U 0.296	U 5.91	U 88	U 2.96
15EM055	U 136	U H 3.13	U 0.811	U 0.594	U 0.359	U 5.94	U 310	U 3.12
15EM056	U 25	U H 3.02	U 0.604	1.83	3.56	U 6.04	U 86.8	U 3.02
15EM058	U 56.8	U H 9.76	U 0.586	U 0.586	0.621	U 5.86	U 154	U 2.93
15EM061	U 63.5	U H 3.16	U 0.633	U 0.633	U 0.316	U 6.33	U 147	U 3.64
15EM063	U 31.9	U H 2.88	U 0.58	U 0.577	U 0.343	U 5.77	U 124	U 2.88
15EM065	U 86.1	U H 3.11	U 0.622	U 0.622	U 0.311	U 6.22	U 185	U 3.11
15EM067	U 56.2	U H 3.14	U 0.755	U 0.628	U 0.52	U 6.46	U 326	U 3.14
15EM069	U 35.4	U H 3.08	U 0.617	U 0.617	U 0.308	U 6.17	U 197	U 3.08
15EM070	U 21	U H 2.89	U 0.639	U 0.579	U 0.289	U 5.79	U 100	U 2.89
15EM071	U 59.8	U H 3.06	U 0.612	U 0.612	U 0.306	U 6.12	U 78.9	U 3.06
15EM072	U 42.9	U H 3.09	U 0.618	U 0.618	U 0.309	U 6.18	U 68.4	U 3.44
15EM077	U 212	U H 3.14	U 0.628	U 0.628	U 0.314	U 6.28	U 225	U 5.69
15EM078	U 39.5	U H 3.11	U 0.622	U 0.622	U 0.311	U 6.22	U 55.5	U 3.11
15EM079	U 71.1	U H 3.18	U 0.635	U 0.635	U 0.4	U 6.35	U 291	U 4.66
15EM080	U 138	U H 3.21	U 0.641	U 0.641	U 0.629	U 6.41	U 392	U 4.46
15EM081	U 44	U H 3.06	U 0.613	U 0.613	U 0.306	U 6.13	U 101	U 3.06
15EM084	U 46.2	U H 3.07	U 0.614	U 0.614	U 0.307	U 6.14	U 81.5	U 3.07
Field Blank	U 6.32	U H 3.16	U 0.632	U 0.632	U 0.316	U 6.32	U 11.1	U 3.16
Field Blank	U 5.79	U H 2.9	U 0.579	U 0.579	U 0.29	U 5.79	U 19.2	U 2.9
Field Blank	U 12.4	U H 3.14	U 0.628	U 0.628	U 0.314	U 6.28	U 10.6	U 3.14

River Location	Erythromycin-H2O	Flumequine	Fluoxetine	Lincomycin	Lomefloxacin	Miconazole	Norfloxacin	Norgestimate
15EM002	U 2.42	U 2.05	U 1.58	U 3.16	U 15.5	U 1.58	U 61.1	U 8.25
15EM003	U 2.33	U 2.05	U 1.52	U 3.04	U 8.64	U 1.52	U 43	U 7.72
15EM004	U 2.36	U 1.54	U 1.54	U 3.08	U 6.04	U 1.54	U 121	U 5.51
15EM009	U 2.39	U 3.65	U 1.56	U 3.11	U 19.7	U 1.56	U 122	U 7.56
15EM010	2.46	U 1.48	U 1.48	U 2.95	U 4.57	U 1.48	U 27.7	U 5.16
15EM014	U 2.38	U 2.87	U 1.55	U 3.1	U 6.14	U 1.55	U 103	U 9.01
15EM015	U 2.43	U 2.34	U 1.58	U 3.16	U 11.2	U 1.58	U 58	U 8.83
15EM017	U 2.36	U 2.36	U 1.54	U 3.08	U 30.2	U 1.54	U 207	U 10.5
15EM022	U 2.22	U 1.88	U 1.45	U 2.9	U 8.77	U 1.45	U 37.1	U 7.96
15EM023	U 2.2	U 2.01	U 1.43	2.99	U 5.62	U 1.43	U 51.4	U 5.79
15EM024	U 2.19	U 1.43	U 1.43	U 2.86	U 4.94	U 1.43	U 14.3	U 4.41
15EM025	U 2.34	U 7.94	U 1.53	U 3.06	U 13.3	U 1.55	U 128	U 11.9
15EM027	U 2.34	U 2.62	U 1.53	U 3.05	U 14.5	U 1.53	U 140	U 13.1
15EM030	U 2.37	U 3.32	2.79	U 3.09	U 15.7	U 1.54	U 87.8	U 9.48
15EM032	U 2.33	U 3.44	U 1.52	U 3.04	U 16.1	U 1.52	U 163	U 9.99

River Location	Erythromycin-H2O	Flumequine	Fluoxetine	Lincomycin	Lomefloxacin	Miconazole	Norfloxacin	Norgestimate
15EM033	U 2.38	U 1.55	U 1.55	U 3.11	U 10.3	U 1.55	U 104	U 7.49
15EM034	U 2.43	U 3.08	U 1.59	U 3.17	U 10.5	U 1.59	U 174	U 10.5
15EM035	U 2.29	U 1.56	U 1.49	U 2.98	U 4.82	U 1.49	U 48.2	U 4.43
15EM036	U 2.43	U 1.69	U 1.59	U 3.17	U 8.73	U 1.59	U 107	U 11
15EM037	U 2.41	U 10.7	U 1.57	U 3.14	U 9.77	U 1.57	U 154	U 8.34
15EM038	2.4	U 1.74	U 1.5	U 3	U 7.43	U 1.5	U 29.8	U 6.62
15EM039	U 2.36	U 3.75	U 1.54	U 3.08	U 14	U 1.54	U 67.8	U 9.45
15EM040	2.53	U 4.17	1.98	U 4.05	U 16.5	U 2	U 210	U 14
15EM043	U 2.4	U 4.36	U 1.56	U 3.12	U 10.3	U 1.95	U 221	U 16.3
15EM045	U 2.43	U 3.58	U 1.58	U 3.17	NQ	U 2.02	NQ	U 19.6
15EM046	U 2.41	U 4.77	U 1.57	U 3.15	U 8.6	U 1.57	U 67.9	U 6.88
15EM047	U 2.22	U 1.45	U 1.45	U 2.9	U 6.78	U 1.45	U 27.3	U 4.16
15EM049	U 2.35	U 2.85	U 1.54	U 3.07	U 18.4	U 1.54	U 88.5	U 12
15EM050	U 2.24	U 2.13	U 1.46	U 2.93	U 11.9	U 1.46	U 68.6	U 5.71
15EM051	U 2.39	U 2.14	2.28	U 3.12	U 8.22	U 1.56	U 49	U 6.06
15EM052	U 2.43	U 3.57	U 1.59	U 3.18	U 14.6	U 1.59	U 111	U 7.3
15EM053	U 2.4	U 1.57	U 1.57	U 3.13	U 6.22	U 1.57	U 70	U 6.24
15EM054	U 2.27	U 1.48	U 1.48	U 2.96	U 4.17	U 1.48	U 20.3	U 6.92
15EM055	U 2.28	U 2.62	U 1.49	U 2.97	U 14.1	U 1.83	U 192	U 14.2
15EM056	2.98	U 1.92	2.41	6.23	U 7.68	U 1.51	U 61.6	U 5.5
15EM058	U 2.25	U 2.55	1.99	U 2.93	U 8.33	U 1.46	U 92.4	U 7.02
15EM061	U 2.43	U 3.03	U 1.58	U 3.16	U 6.39	U 1.58	U 72.7	U 5.05
15EM063	U 2.21	U 1.44	U 1.44	U 2.88	U 11.2	U 1.44	U 62.1	U 7.28
15EM065	U 2.39	U 2.14	U 1.56	U 3.11	U 7.7	U 1.56	U 70.7	U 6.19
15EM067	U 2.41	U 2.95	U 1.57	3.39	U 5.77	U 1.8	U 95.5	U 16
15EM069	U 2.36	U 2.87	U 1.54	U 3.08	U 7.69	U 1.54	U 56.7	U 8.51
15EM070	2.34	U 1.45	U 1.45	U 2.89	U 4.29	U 1.45	U 26.5	U 5.98
15EM071	2.46	U 3.16	U 1.53	5.67	U 9.67	U 1.53	U 47.6	U 10.9
15EM072	U 2.37	U 2.13	U 1.54	U 3.09	U 6.5	U 1.54	U 62.8	U 8.76
15EM077	U 2.41	U 2.04	U 1.57	U 3.14	U 26.7	U 1.57	U 217	U 9.53
15EM078	U 2.38	U 2.12	U 1.55	U 3.11	U 8.45	U 1.55	U 37	U 7.39
15EM079	U 2.44	U 3.83	U 1.59	U 3.18	U 17.9	U 1.59	U 94.5	U 10.1
15EM080	U 2.46	U 4.02	U 1.6	U 3.21	U 25.1	U 2.39	U 90.2	U 22.4
15EM081	U 2.35	U 2.68	U 1.53	U 3.06	U 6.28	U 1.53	U 29.7	U 7.15
15EM084	U 2.35	U 2.05	U 1.53	U 3.07	U 9.72	U 1.53	U 36.8	U 9.69
Field Blank	U 2.42	U 1.58	U 1.58	U 3.16	U 3.16	U 1.58	U 15.8	U 4.4
Field Blank	2.74	U 1.45	U 1.45	U 2.9	U 3.2	U 1.45	U 14.5	U 6.7
Field Blank	U 2.41	U 1.57	U 1.57	U 3.14	U 4.15	U 1.57	U 19.1	U 6.36

River Location	Ofloxacin	Ormetoprim	Oxacillin	Oxolinic Acid	Penicillin G	Penicillin V	Roxithromycin	Sarafloxacin
15EM002	U 2.94	U 0.631	U H 3.16	U 0.631	U H 3.16	U 3.16	U 0.416	U 16.4
15EM003	U 1.8	U 0.608	U H 3.04	U 2.52	U H 3.04	U 3.04	U 0.304	U 15.2
15EM004	1.77	U 0.615	U H 3.08	U 3.81	U H 3.08	U 3.08	U 0.308	U 15.4
15EM009	U 3.03	U 0.623	U H 3.11	U 2.46	U H 3.11	U 3.11	U 0.311	U 17.6
15EM010	U 1.48	U 0.59	U H 2.95	U 2.57	U H 2.95	U 2.95	U 0.295	U 14.8
15EM014	U 2.22	U 0.62	U H 3.1	U 3.99	B H 4.01	U 3.1	U 0.31	U 15.5
15EM015	U 2.85	U 0.633	U H 3.16	U 0.633	U H 3.16	U 3.16	U 0.316	U 23.3
15EM017	U 6.32	U 0.617	U H 3.18	U 3.25	U H 3.29	U 3.08	U 0.308	U 20.6
15EM022	U 1.45	U 0.58	U H 2.9	U 2.85	U H 2.9	U 2.9	U 0.29	U 14.5
15EM023	U 1.75	U 0.574	U H 2.87	U 3.53	U H 2.87	U 2.87	U 0.287	U 14.3
15EM024	U 1.43	U 0.572	U H 2.86	U 2.4	U H 2.86	U 2.86	U 0.286	U 14.3
15EM025	U 4.13	U 0.611	U H 3.08	U 2.95	U H 3.06	U 3.06	U 0.306	U 51.9
15EM027	U 6.26	U 0.61	U H 3.05	U 3.72	B H 7.62	U 3.05	U 0.305	U 19.3
15EM030	U 2.19	U 0.617	U H 3.09	U 5.04	U H 3.09	U 3.09	U 0.309	U 18.4
15EM032	U 3.98	U 0.607	U H 3.04	U 2.1	U H 3.04	U 3.04	U 0.304	U 16.2
15EM033	U 3.96	U 0.622	U H 3.11	U 3.94	U H 3.11	U 3.11	U 0.311	U 17.4
15EM034	U 2.91	U 0.635	U H 3.57	U 3.05	U H 3.17	U 3.17	U 0.317	U 22.6
15EM035	U 1.49	U 0.597	U H 2.98	U 2.36	U H 2.98	U 2.98	U 0.298	U 14.9
15EM036	U 4.06	U 0.635	U H 3.17	U 0.635	U H 3.17	U 3.17	U 0.317	U 19.3
15EM037	U 1.57	U 0.628	U H 3.19	U 2.25	U H 3.14	U 3.14	U 0.314	U 20
15EM038	U 1.5	U 0.6	U H 3	U 2.85	U H 3	U 3	U 0.3	U 15
15EM039	U 1.54	U 0.615	U H 3.08	U 2.44	U H 3.08	U 3.08	U 0.308	U 26
15EM040	U 3.23	U 0.592	U H 2.96	U 3.42	U H 2.96	U 2.96	U 0.384	U 20.2
15EM043	U 6.15	U 0.625	U H 3.12	U 6.65	B H 5.33	U 3.12	U 0.312	U 15.6
15EM045	NQ	U 0.633	U H 3.17	U 0.633	U H 3.17	U 3.17	U D 0.95	NQ
15EM046	U 2.54	U 0.63	U H 3.47	U 2.42	U H 3.15	U 3.15	U 0.315	U 15.7
15EM047	U 2.06	U 0.58	U H 2.9	U 2.56	U H 2.9	U 2.9	U 0.29	U 14.5
15EM049	U 1.54	U 0.614	U H 3.07	U 2.39	U H 3.07	U 3.07	U 0.307	U 18.1
15EM050	U 1.94	U 0.585	U H 2.93	U 2.69	U H 2.93	U 2.93	U 0.293	U 14.6
15EM051	U 2	U 0.623	U H 3.12	U 2.79	U H 3.12	U 3.12	U 0.312	U 15.6
15EM052	U 4.44	U 0.635	U H 3.18	U 1.85	U H 3.18	U 3.18	U 0.358	U 24.3
15EM053	U 1.57	U 0.627	U H 3.13	U 2.32	U H 3.13	U 3.13	U 0.313	U 15.7
15EM054	U 1.48	U 0.591	U H 2.96	U 2.45	U H 2.96	U 2.96	U 0.296	U 14.8
15EM055	U 4.52	U 0.594	U H 2.97	U 3.96	B H 4.44	U 2.97	U 0.297	U 25.9
15EM056	9.58	U 0.604	U H 3.02	U 2.63	U H 3.02	U 3.02	U 0.302	U 15.1
15EM058	U 2.76	U 0.586	U H 2.93	U 2.74	U H 2.93	U 2.93	U 0.293	U 16.9
15EM061	U 2.58	U 0.633	U H 3.16	U 0.844	U H 3.16	U 3.16	U 0.316	U 19
15EM063	U 1.44	U 0.577	U H 2.88	2.5	U H 2.88	U 2.88	U 0.288	U 14.4
15EM065	U 2.38	U 0.622	U H 3.11	U 4.2	B H 3.98	U 3.11	U 0.311	U 15.6
15EM067	U 3.32	U 0.628	U H 4.26	U 4.51	B H 6.43	U 3.14	U 0.314	U 15.7
15EM069	U 1.54	U 0.617	U H 3.29	U 2.68	U H 3.08	U 3.08	U 0.308	U 15.4
15EM070	U 1.45	U 0.579	U H 2.89	U 2.68	U H 2.89	U 2.89	U 0.289	U 14.5
15EM071	U 2.86	U 0.612	U H 3.06	U 3.23	B H 6.19	U 3.06	U 0.306	U 15.3
15EM072	U 2.4	U 0.618	U H 3.09	U 2.96	B H 4.92	U 3.09	U 0.309	U 15.4

River Location	Ofloxacin	Ormetoprim	Oxacillin	Oxolinic Acid	Penicillin G	Penicillin V	Roxithromycin	Sarafloxacin
15EM077	U 10.9	U 0.628	U H 3.14	U 0.746	U H 3.14	U 3.14	U 0.314	U 43.1
15EM078	U 1.86	U 0.622	U H 3.11	U 3.35	B H 4.14	U 3.11	U 0.311	U 15.5
15EM079	U 7.05	U 0.635	U H 3.18	U 2.88	U H 3.18	U 3.18	U 0.318	U 29
15EM080	U 4.8	U 0.641	U H 3.21	U 4.93	U H 11	U 3.73	U 0.697	U 45.3
15EM081	U 2.27	U 0.613	U H 3.06	U 2.99	B H 4.33	U 3.06	U 0.306	U 15.3
15EM084	U 2.59	U 0.614	U H 3.07	U 4.59	B H 5.17	U 3.07	U 0.307	U 15.3
Field Blank	U 1.58	U 0.632	U H 3.16	U 2.72	B H 3.69	U 3.16	U 0.316	U 15.8
Field Blank	U 1.45	U 0.579	U H 2.9	U 2.36	U H 2.9	U 2.9	U 0.29	U 14.5
Field Blank	U 1.57	U 0.628	U H 3.14	U 0.628	U H 3.14	U 3.14	U 0.314	U 15.7

River Location	Sulfachloropyridazine	Sulfadiazine	Sulfadimethoxine	Sulfamerazine	Sulfamethazine	Sulfamethizole	Sulfamethoxazole	Sulfanilamide
15EM002	U 3.88	U 1.58	U 0.316	U 0.631	U 0.631	U 1.09	U 1.16	U 15.8
15EM003	U 1.52	U 1.52	8.3	U 1.73	U 0.608	U 1.15	15.1	U 15.2
15EM004	U 1.54	U 1.54	U 0.772	U 1.18	U 3.56	U 0.696	U 2.47	U 15.4
15EM009	U 1.56	U 1.56	U 0.311	U 2.17	U 10.7	U 3.12	U 3.41	U 15.6
15EM010	U 1.48	U 1.48	U 0.295	U 0.59	U 0.59	U 0.59	U 0.672	U 21.8
15EM014	U 1.55	U 1.55	U 0.31	U 0.723	U 2.7	U 0.62	7.61	U 15.5
15EM015	U 2.61	U 1.58	U 0.316	U 0.633	U 0.633	U 1.52	U 1.95	U 15.8
15EM017	U 1.54	U 2.61	U 0.308	U 7.81	U 21.2	U 9.83	U 7.35	U 15.4
15EM022	U 1.45	U 1.45	U 0.611	U 0.863	U 5.82	U 1.13	U 2.06	U 22.6
15EM023	U 1.43	U 1.43	U 0.287	U 1.04	U 2.19	U 1.19	U 1.19	U 14.3
15EM024	U 1.43	U 1.43	U 0.286	U 0.572	U 0.572	U 0.572	U 0.572	U 14.3
15EM025	U 1.53	U 1.53	U 0.306	U 5.76	U 18.6	U 6.88	U 5	U 15.3
15EM027	U 1.53	U 1.53	U 0.305	U 0.861	U 7.79	U 0.61	U 0.61	U 15.3
15EM030	U 1.54	U 1.54	U 0.812	U 1.07	U 3.77	U 2.74	U 2.87	U 15.4
15EM032	U 1.52	U 1.52	U 0.304	U 3.23	U 8.9	U 1.58	U 3.24	U 15.2
15EM033	U 1.55	U 1.55	U 0.311	U 1.65	U 10.5	U 2.98	U 3.29	U 15.5
15EM034	U 8.6	U 1.59	U 1.59	U 1.24	U 6.34	U 3.21	U 4.28	U 24.2
15EM035	U 1.49	U 1.49	21.8	U 0.597	U 0.597	U 0.597	U 1.11	U 14.9
15EM036	U 2.08	U 1.59	U 0.317	U 0.635	U 5.21	U 1.28	U 3.12	U 15.9
15EM037	U 1.57	U 1.57	U 0.314	U 1.54	U 9.24	U 3.52	U 3.82	U 15.7
15EM038	U 1.5	U 1.5	U 0.39	U 0.6	U 0.6	U 0.6	2.82	U 22
15EM039	U 1.54	U 1.54	U 0.308	U 4.22	U 7.52	U 3.18	U 4.08	U 15.4
15EM040	U 1.48	U 1.48	U 2.73	U 2.18	U 7.79	U 5.76	U 4	U 48
15EM043	U 1.56	U 1.56	U 0.312	U 0.685	U 4.8	U 0.625	U 0.625	U 15.6
15EM045	U D 28.8	U D 4.75	U 0.317	U D 1.9	U D 1.9	U 19.4	U 9.09	U D 47.5
15EM046	U 1.57	U 1.57	U 0.84	U 2.27	U 0.63	U 1.76	U 2.47	U 15.7
15EM047	U 1.45	U 1.45	U 0.29	U 0.58	U 0.58	U 0.58	U 0.757	U 14.5
15EM049	5.29	U 1.54	U 0.307	U 2.97	U 15.7	U 4.28	U 4.09	U 15.4
15EM050	U 1.46	U 1.46	U 0.303	U 1.43	U 3.09	U 0.795	U 1.85	U 14.6
15EM051	U 1.56	U 1.56	U 0.628	U 1.32	U 4.54	U 1.09	U 3.59	U 15.6
15EM052	U 8.42	U 1.59	U 0.318	U 0.635	U 0.635	U 2.34	5.16	U 15.9
15EM053	U 1.57	U 1.57	U 0.313	U 0.799	U 2.14	U 1.83	U 2.17	U 15.7

River Location	Sulfachloropyridazine	Sulfadiazine	Sulfadimethoxine	Sulfamerazine	Sulfamethazine	Sulfamethizole	Sulfamethoxazole	Sulfanilamide
15EM054	U 1.48	U 1.48	U 0.296	U 0.591	U 0.591	U 0.591	1.25	U 14.8
15EM055	U 1.49	U 1.49	U 0.297	U 3.99	U 20.1	U 0.594	U 0.594	U 14.9
15EM056	U 1.51	1.57	U 0.349	U 0.735	U 0.604	U 0.604	30.2	U 22.9
15EM058	U 1.46	U 1.46	U 0.293	U 1.59	U 0.586	U 1.32	14.6	U 14.6
15EM061	U 2.17	U 1.58	U 0.316	U 0.633	U 0.633	U 0.725	U 1.17	U 15.8
15EM063	U 1.44	U 1.44	U 0.288	U 1.32	11.9	U 1.43	26.6	U 21.1
15EM065	U 1.56	U 1.56	U 0.311	U 0.883	U 1.52	U 0.622	U 0.622	U 15.6
15EM067	U 1.57	U 1.57	U 0.314	0.815	U 2.78	U 0.628	U 0.628	U 15.7
15EM069	U 1.54	U 1.54	U 0.308	U 1.62	U 7.74	U 1.75	U 2.51	U 15.4
15EM070	U 1.45	U 1.45	U 0.452	U 0.878	U 0.579	U 1.32	U 1.65	U 23.9
15EM071	U 1.53	U 1.53	U 0.306	U 0.9	U 1.69	U 1.33	51	U 15.3
15EM072	U 1.54	U 1.54	U 0.309	U 0.618	U 1.93	U 0.618	5.24	U 15.4
15EM077	U 6.47	U 1.57	U 0.314	U 0.628	U 0.628	U 2.22	U 3.49	U 15.7
15EM078	U 1.55	U 1.55	0.809	U 0.622	U 0.969	U 0.622	U 0.622	U 15.5
15EM079	U 6.12	U 1.59	U 0.318	U 0.635	U 0.635	U 1.16	6.02	U 15.9
15EM080	U 16	U 1.6	U 0.321	U 0.641	U 0.641	U 6.82	U 3.39	U 16
15EM081	U 1.53	U 1.53	U 0.306	U 0.725	U 2.62	U 1.16	2.38	U 15.3
15EM084	U 1.53	U 1.53	U 0.307	U 0.63	U 1.67	U 0.614	U 0.614	U 15.3
Field Blank	U 1.58	U 1.58	U 0.316	U 0.632	U 0.632	U 0.632	U 0.632	U 15.8
Field Blank	U 1.45	U 1.45	U 0.29	U 0.579	U 0.579	U 0.579	U 0.579	U 14.5
Field Blank	U 1.57	U 1.57	U 0.314	U 0.628	U 0.628	U 0.628	U 0.628	U 15.7

River Location	Sulfathiazole	Thiabendazole	Trimethoprim	Tylosin	Virginiamycin M1	1,7-Dimethylxanthine
15EM002	U 1.58	U 1.58	U 1.58	U 6.31	U 3.16	U 63.1
15EM003	U 1.52	U 1.52	U 2.25	U 6.08	U 3.04	U 60.8
15EM004	U 1.54	U 1.54	U 1.58	U 6.15	U 3.08	U 61.5
15EM009	U 1.56	U 1.56	U 1.73	U 6.23	U 3.12	U 62.3
15EM010	U 1.48	U 1.48	U 1.48	U 5.9	U 2.95	U 59
15EM014	U 1.55	U 1.55	U 1.55	U 6.2	U 3.42	U 62
15EM015	U 1.58	U 1.58	U 2.34	U 6.33	U 3.16	U 63.3
15EM017	U 6.69	U 1.54	U 1.81	U 6.17	U 4.57	U 61.7
15EM022	U 1.45	U 1.45	U 1.45	U 5.8	U 2.9	U 58
15EM023	U 1.43	U 1.43	U 2.66	U 5.74	U 2.91	U 57.4
15EM024	U 1.43	U 1.43	U 1.43	U 5.72	U 2.86	U 57.2
15EM025	U 3.42	U 1.53	U 1.64	U 6.11	U 5.19	U 61.1
15EM027	U 1.53	U 1.53	U 2.33	U 6.1	U 5.4	U 61
15EM030	U 1.8	U 1.54	U 2.13	U 6.17	U 3.34	U 61.7
15EM032	U 1.52	U 1.52	U 1.9	U 6.07	U 3.04	U 60.7
15EM033	U 1.55	U 1.55	U 1.55	U 6.22	U 3.11	U 62.2
15EM034	U 2.33	U 1.59	U 1.87	U 6.35	U 4.09	U 63.5
15EM035	U 1.49	U 1.49	U 1.49	U 5.97	U 2.98	U 59.7
15EM036	U 1.59	U 1.59	U 2.04	U 6.35	U 3.17	U 63.5
15EM037	U 1.57	U 1.57	U 1.71	U 6.28	U 3.26	U 62.8

River Location	Sulfathiazole	Thiabendazole	Trimethoprim	Tylosin	Virginiamycin M1	1,7-Dimethylxanthine
15EM038	U 1.5	U 1.5	4.18	U 6	U 3	U 60
15EM039	U 1.54	U 1.54	U 2.41	U 6.15	U 3.08	U 61.5
15EM040	U 3.96	U 1.48	U 5.17	U 5.92	U 6.39	U 59.2
15EM043	U 1.56	U 1.56	U 2.98	U 6.25	U 5.34	U 62.5
15EM045	U 8.5	1.59	U 2.42	U D 19	U 8.02	U 63.3
15EM046	U 1.84	U 1.57	U 2.05	U 6.3	U 3.78	U 63
15EM047	U 1.45	U 1.45	U 1.45	U 5.8	U 2.9	U 58
15EM049	U 1.54	U 1.54	U 1.95	U 6.14	U 3.37	U 61.4
15EM050	U 1.46	U 1.46	U 1.46	U 5.85	U 3.18	U 58.5
15EM051	U 1.56	U 1.56	U 1.8	U 6.23	U 3.12	U 62.3
15EM052	U 1.59	U 1.59	U 1.68	U 6.35	U 3.18	U 63.5
15EM053	U 1.57	U 1.57	U 1.57	U 6.27	U 3.13	U 62.7
15EM054	U 1.48	U 1.48	U 1.48	U 5.91	U 2.96	U 59.1
15EM055	U 1.49	U 1.49	U 2.14	U 11.3	U 10.7	U 59.4
15EM056	U 1.51	U 1.51	7.67	U 6.04	U 3.02	U 60.4
15EM058	U 1.51	U 1.46	U 1.63	U 5.86	U 3.19	U 58.6
15EM061	U 1.58	U 1.58	U 1.8	U 6.33	U 3.16	U 63.3
15EM063	U 1.44	U 1.44	51.4	U 5.77	U 2.88	U 57.7
15EM065	U 1.56	U 1.56	U 1.56	U 6.22	U 3.67	U 62.2
15EM067	U 1.57	U 1.57	U 1.57	U 6.28	U 4.91	U 62.8
15EM069	U 1.54	U 1.54	U 1.54	U 6.17	U 3.08	U 61.7
15EM070	U 1.45	U 1.45	U 1.45	U 5.79	U 2.89	U 57.9
15EM071	U 1.53	U 1.53	U 1.53	U 6.12	U 4.47	U 61.2
15EM072	U 1.54	U 1.54	U 1.54	U 6.18	U 3.63	U 61.8
15EM077	U 1.57	U 1.57	U 1.57	U 6.28	U 3.14	U 62.8
15EM078	U 1.55	U 1.55	U 1.55	U 6.22	U 3.11	U 62.2
15EM079	U 1.59	U 1.59	U 2.33	U 6.35	U 3.18	U 63.5
15EM080	U 2.66	U 1.6	U 3.56	U 6.41	U 4.36	U 64.1
15EM081	U 1.53	U 1.53	U 1.53	U 6.13	U 3.95	U 61.3
15EM084	U 1.53	U 1.53	U 1.53	U 6.14	U 3.42	U 61.4
Field Blank	U 1.58	U 1.58	U 1.58	U 6.32	U 3.16	U 63.2
Field Blank	U 1.45	U 1.45	U 1.45	U 5.79	U 2.9	U 57.9
Field Blank	U 1.57	U 1.57	U 1.57	U 6.28	U 3.14	U 62.8

Table 4. List 3 pharmaceuticals

River Location	Bisphenol A	Furosemide	Gemfibrozil	Glipizide	Glyburide	Hydrochlorothiazide
15EM002	U 526	U 42.1	U 1.58	U 6.31	U 3.16	U 15.6
15EM003	U 507	U 40.5	3.98	U 6.08	U 3.04	U 15
15EM004	U 513	U 41	U 1.54	U 6.15	U 3.08	U 15.2
15EM009	U 519	U 41.5	U 1.56	U 6.23	U 3.11	U 15.4
15EM010	U 492	U 39.3	U 1.48	U 5.9	U 2.95	U 14.6
15EM014	U 517	U 41.4	U 1.55	U 6.2	U 3.1	U 15.3
15EM015	U 527	U 43.7	U 1.58	U 6.33	U 3.16	U 15.6
15EM017	U 514	U 41.1	U 1.54	U 6.17	U 3.08	U 21.5
15EM022	U 483	U 38.6	U 1.45	U 5.8	U 2.9	U 14.3
15EM023	U 478	U 38.3	U 1.43	U 5.74	U 2.87	U 14.2
15EM024	U 477	U 38.2	U 1.43	U 5.72	U 2.86	U 14.1
15EM025	U 509	U 40.7	U 1.53	U 6.11	U 3.06	U 15.1
15EM027	U 508	U 40.7	U 1.53	U 6.1	U 3.05	U 15
15EM030	U 514	U 41.1	U 1.54	U 6.17	U 3.09	U 15.2
15EM032	U 506	U 40.5	U 1.52	U 6.07	U 3.04	U 15
15EM033	U 518	U 41.5	U 1.55	U 6.22	U 3.11	U 15.3
15EM034	U 529	U 42.3	U 1.59	U 6.35	U 3.17	U 15.7
15EM035	U 497	U 39.8	U 1.49	U 5.97	U 2.98	U 14.7
15EM036	U 529	U 42.3	U 1.59	U 6.35	U 3.17	U 15.7
15EM037	U 523	U 41.9	U 1.57	U 6.28	U 3.14	U 15.5
15EM038	U 500	U 40	U 1.5	U 6	U 3	U 14.8
15EM039	U 513	U 41	U 1.54	U 6.15	U 3.08	U 15.2
15EM040	U 494	U 39.5	U 1.48	U 5.92	U 2.96	U 14.6
15EM043	U 521	U 41.7	U 1.56	U 6.25	U 3.12	U 15.4
15EM045	U 528	U 42.2	U 1.58	U 6.33	U 3.17	U 15.6
15EM046	U 525	U 42	U 1.57	U 6.3	U 3.15	U 15.5
15EM047	U 484	U 38.7	U 1.45	U 5.8	U 2.9	U 14.3
15EM049	U 512	U 40.9	U 1.54	U 6.14	U 3.07	U 15.1
15EM050	U 488	U 39	U 1.46	U 5.85	U 2.93	U 14.4
15EM051	U 519	U 41.5	1.58	U 6.23	U 3.12	U 15.4
15EM052	U 529	U 42.3	U 1.59	U 6.35	U 3.18	U 15.7
15EM053	U 522	U 41.8	U 1.57	U 6.27	U 3.13	U 15.5
15EM054	U 493	U 39.4	U 1.48	U 5.91	U 2.96	U 14.6
15EM055	U 495	U 53.4	U 1.49	U 5.94	U 2.97	U 14.7
15EM056	U 503	U 40.3	12.8	U 6.04	U 3.02	U 14.9
15EM058	U 488	U 40	1.95	U 5.86	U 2.93	U 14.4
15EM061	U 527	U 42.2	U 1.58	U 6.33	U 3.16	U 15.6
15EM063	U 481	U 38.5	U 1.44	U 5.77	U 2.88	U 14.2
15EM065	U 519	U 41.5	U 1.56	U 6.22	U 3.11	U 15.4
15EM067	U 524	U 41.9	U 1.57	U 6.28	U 3.14	U 15.5
15EM069	U 514	U 41.1	U 1.54	U 6.17	U 3.08	U 15.2
15EM070	U 482	U 38.6	U 1.45	U 5.79	U 2.89	U 14.3
15EM071	U 510	U 40.8	18.6	U 6.12	U 3.06	U 15.1

River Location	Bisphenol A	Furosemide	Gemfibrozil	Glipizide	Glyburide	Hydrochlorothiazide
15EM072	U 515	U 69.2	U 1.54	U 6.18	U 3.09	U 15.2
15EM077	U 523	U 41.9	U 1.57	U 6.28	U 3.14	U 15.5
15EM078	U 518	U 41.4	U 1.55	U 6.22	U 3.11	U 15.3
15EM079	U 530	U 42.4	U 1.59	U 6.35	U 3.18	U 15.7
15EM080	U 534	U 42.7	U 1.6	U 6.41	U 3.21	U 15.8
15EM081	U 511	U 40.8	U 1.53	U 6.13	U 3.06	U 15.1
15EM084	U 512	U 40.9	U 1.53	U 6.14	U 3.07	U 15.1
Field Blank	U 527	U 42.2	U 1.58	U 6.32	U 3.16	U 15.6
Field Blank	U 483	U 38.6	U 1.45	U 5.79	U 2.9	U 14.3
Field Blank	U 524	U 41.9	U 1.57	U 6.28	U 3.14	U 15.5

River Location	2-Hydroxy-ibuprofen	Ibuprofen	Naproxen	Triclocarban	Triclosan	Warfarin
15EM002	U 84.1	U 22.1	U 4.25	U 3.16	U 63.1	U 1.58
15EM003	U 81.1	U 15.2	4.29	U 3.04	U 60.8	U 1.52
15EM004	U 82	U 15.4	U 3.08	U 3.08	U 61.5	U 1.54
15EM009	U 83	U 15.6	U 3.11	U 3.11	U 62.3	U 1.56
15EM010	U 78.7	U 15.1	U 2.95	U 2.95	U 59	U 1.48
15EM014	U 82.7	U 15.5	U 7.59	U 3.1	U 62	U 1.55
15EM015	U 84.4	U 15.8	U 4.13	U 3.16	U 63.3	U 1.58
15EM017	U 82.2	U 23.6	U 3.52	U 3.08	U 61.7	U 1.54
15EM022	U 79.8	U 14.5	U 2.9	U 2.9	U 58	U 1.45
15EM023	U 76.5	U 14.3	U 2.87	U 2.87	U 57.4	U 1.43
15EM024	U 76.3	U 14.3	U 2.86	U 2.86	U 57.2	U 1.43
15EM025	U 101	U 15.3	U 3.06	U 3.06	U 61.1	U 1.53
15EM027	U 81.3	U 15.3	U 7.39	U 3.05	U 61	U 1.53
15EM030	U 82.3	U 15.4	U 3.11	U 3.09	U 61.7	U 1.54
15EM032	U 81	U 15.2	U 3.04	U 3.04	U 60.7	U 1.52
15EM033	U 82.9	U 15.5	U 3.11	U 3.11	U 62.2	U 1.55
15EM034	U 84.7	U 15.9	U 3.17	U 3.17	U 63.5	U 1.59
15EM035	U 79.6	U 14.9	9.94	U 2.98	U 59.7	U 1.49
15EM036	U 84.7	U 15.9	U 3.53	U 3.17	U 63.5	U 1.59
15EM037	U 83.7	U 21.6	U 3.44	U 3.14	U 62.8	U 1.57
15EM038	U 80	U 16.3	U 3	U 3	U 60	U 1.5
15EM039	U 82.1	U 17.4	U 4.91	U 3.08	U 61.5	U 1.54
15EM040	U 85.9	U 14.8	U 2.96	U 2.96	U 59.2	U 1.48
15EM043	U 83.3	U 27.9	U 7.29	U 3.12	U 62.5	U 1.56
15EM045	U 84.5	U 32.2	U 9.21	U 3.17	U 63.3	U 1.58
15EM046	U 83.9	U 15.7	8.13	U 3.15	U 63	U 1.57
15EM047	U 77.4	U 14.5	U 2.9	U 2.9	U 58	U 1.45
15EM049	U 82.2	U 19.2	U 3.07	U 3.07	U 61.4	U 1.54
15EM050	U 78	U 14.6	U 2.93	U 2.93	U 58.5	U 1.46
15EM051	U 83.1	U 15.6	U 3.12	U 3.12	U 62.3	U 1.56
15EM052	U 84.7	U 30.3	U 4.47	U 3.18	U 63.5	U 1.59

River Location	2-Hydroxy-ibuprofen	Ibuprofen	Naproxen	Triclocarban	Triclosan	Warfarin
15EM053	U 83.6	U 15.7	U 3.13	U 3.13	U 62.7	U 1.57
15EM054	U 78.8	U 14.8	U 2.96	U 2.96	U 59.1	U 1.48
15EM055	U 79.2	U 20.3	U 14.9	U 2.97	U 59.4	U 1.49
15EM056	83.7	U 15.1	13.2	U 3.02	U 60.4	U 1.51
15EM058	U 78.1	U 14.6	4.38	U 2.93	U 58.6	U 1.46
15EM061	U 84.4	U 15.8	U 3.64	U 3.16	U 63.3	U 1.58
15EM063	U 76.9	U 14.4	U 2.88	U 2.88	U 57.7	U 1.44
15EM065	U 83	U 22.2	U 6.83	U 3.11	U 62.2	U 1.56
15EM067	U 83.8	U 15.7	U 8.65	U 3.14	U 62.8	U 1.57
15EM069	U 82.2	U 15.4	U 3.08	U 3.08	U 61.7	U 1.54
15EM070	U 77.2	U 14.5	7.54	U 2.89	U 57.9	U 1.45
15EM071	U 81.6	U 24.9	16	U 3.06	U 61.2	U 1.53
15EM072	U 82.4	U 15.4	U 6.29	U 3.09	U 61.8	U 1.54
15EM077	U 83.7	U 15.7	U 6.13	U 3.14	U 62.8	U 1.57
15EM078	U 82.9	U 16.3	U 6.64	U 3.11	U 62.2	U 1.55
15EM079	U 84.7	U 16.7	U 3.18	U 3.18	U 63.5	U 1.59
15EM080	U 85.5	U 18.1	U 8.39	U 3.21	U 64.1	U 1.6
15EM081	U 81.7	U 18	U 8.52	U 3.06	U 61.3	U 1.53
15EM084	U 81.8	U 20.8	U 6.8	U 3.07	U 61.4	U 1.53
Field Blank	U 84.3	U 15.8	U 3.28	U 3.16	U 63.2	U 1.58
Field Blank	U 77.2	U 14.5	U 2.9	U 2.9	U 57.9	U 1.45
Field Blank	U 83.8	U 15.7	U 4.59	U 3.14	U 62.8	U 1.57

Table 5. List 4 pharmaceuticals

River Location	Albuterol	Amphetamine	Atenolol	Atorvastatin	Cimetidine	Clonidine	Codeine
15EM002	U 0.995	U 1.49	U 0.597	U 1.49	U 0.597	U 1.49	U 2.99
15EM003	U 0.294	U 1.47	0.886	U 1.47	U 0.587	U 1.47	U 2.94
15EM004	U 0.308	U 1.54	U 0.616	U 1.54	U 0.616	U 1.54	U 3.08
15EM009	B 0.992	U 1.45	B 1.68	U 1.45	U 0.579	U 1.45	U 2.9
15EM010	U 0.295	U 1.48	U 0.59	U 1.48	U 0.59	U 1.48	U 2.95
15EM014	B 1.34	U 1.57	B 3.02	U 1.57	U 0.626	U 1.57	U 3.13
15EM015	U 1	U 1.5	U 0.6	U 1.5	U D 3	U 1.5	U 3
15EM017	B 0.784	U 1.49	B 3.01	U 1.49	U 0.598	U 1.49	U 2.99
15EM022	U 0.296	U 1.48	U 0.651	U 1.48	U 0.592	U 1.48	U 2.96
15EM023	U 0.292	U 1.46	U 0.584	U 1.46	U 0.584	U 1.46	U 2.92
15EM024	U 0.289	U 1.45	U 0.578	U 4.82	U 1.18	U 1.45	U 2.89
15EM025	B 0.772	U 1.45	B 2.13	U 1.45	U 0.579	U 1.45	U 2.9
15EM027	B 0.355	U 1.49	U 1.3	U 1.49	U 0.597	U 1.49	U 2.99
15EM030	U 0.3	U 1.5	U 0.601	U 1.5	U 0.601	U 1.5	U 3
15EM032	B 0.791	U 1.46	B 1.98	U 1.46	U 0.584	U 1.46	U 3.45
15EM033	B 0.444	U 1.36	B 1.4	U 1.36	U 0.545	U 1.36	U 2.73
15EM034	U 0.302	U 1.51	U 0.603	U 1.51	U 0.731	U 1.51	U 3.02
15EM035	U 0.294	U 1.47	2.47	U 1.47	U 0.587	U 1.47	U 2.94
15EM036	U 0.993	U 1.49	U 0.596	U 1.49	U D 2.98	U 1.49	U 2.98
15EM037	U 0.286	U 1.43	U 1.3	U 1.43	U 0.573	U 1.43	U 2.86
15EM038	U 0.293	U 1.46	U 0.585	U 1.46	U 0.585	U 1.46	U 2.93
15EM039	B 0.415	U 1.41	B 0.927	U 1.41	U 0.564	U 1.41	U 3.74
15EM040	U 0.295	U 1.47	U 0.693	U 1.47	U 1.25	U 1.47	U 2.95
15EM043	B 0.502	U 1.46	B 0.923	U 1.46	U 0.585	U 1.46	U 2.93
15EM045	U 1	U 1.5	U 0.6	U 1.5	U 0.6	U 1.5	U 3
15EM046	U 0.302	U 1.51	U 0.604	U 1.51	U 0.604	U 1.51	U 3.02
15EM047	U 0.298	U 1.49	U 0.596	U 1.49	U 0.596	U 1.49	U 2.98
15EM049	U 0.293	U 1.47	B 0.794	U 1.47	U 0.586	U 1.47	U 3.24
15EM050	U 0.315	U 1.57	U 0.629	U 1.57	U 0.629	U 1.57	U 3.15
15EM051	U 0.308	U 1.54	U 0.616	U 1.54	U 0.616	U 1.54	U 3.08
15EM052	U 1	U 1.51	U 0.603	U 1.51	U 0.603	U 1.51	U 3.01
15EM053	U 0.302	U 1.51	B 0.636	U 1.51	U 0.604	U 1.51	U 3.63
15EM054	U 0.297	U 1.49	U 0.594	U 1.49	U 0.594	U 1.49	U 2.97
15EM055	U 0.296	U 1.48	U 1	U 1.48	U 0.592	U 1.48	U 2.96
15EM056	B 0.948	U 1.54	B 11	U 1.54	U 0.615	U 1.54	U 3.07
15EM058	U 0.294	U 1.47	0.787	U 1.47	1.02	U 1.47	U 2.94
15EM061	U 1.01	U 1.51	U 0.606	U 1.51	U 0.606	U 1.51	U 3.03
15EM063	U 0.29	U 1.45	B 0.98	U 1.45	U 0.581	U 1.45	U 2.9
15EM065	B 0.598	U 1.39	B 0.907	U 1.39	U 0.556	U 1.39	U 2.78
15EM067	B 0.66	U 1.48	B 1.49	U 1.48	U 0.591	U 1.48	U 2.96
15EM069	U 0.296	U 1.48	B 0.995	U 1.48	U 0.593	U 1.48	U 2.96
15EM070	U 0.293	U 1.47	U 0.786	U 1.47	U 0.587	U 1.47	U 2.93
15EM071	B 0.554	U 1.52	U 1.02	U 1.52	U 0.607	U 1.52	U 5.15

River Location	Albuterol	Amphetamine	Atenolol	Atorvastatin	Cimetidine	Clonidine	Codeine
15EM072	B 0.911	U 1.55	B 2.04	U 1.55	U 0.619	U 1.55	U 3.09
15EM077	U 1.02	U 1.53	B 0.619	U 1.53	U 0.611	U 1.53	U 3.06
15EM078	U 0.29	U 1.45	U 0.581	U 1.45	U 0.581	U 1.45	U 2.9
15EM079	U 1	U 1.5	U 0.6	U 1.5	U 0.6	U 1.5	U 3
15EM080	U 1	U 1.5	U 0.601	U 1.5	U 0.944	U 1.5	U 3
15EM081	B 0.579	U 1.42	B 1.2	U 1.42	U 0.566	U 1.42	U 2.83
15EM084	B 0.453	U 1.51	U 1.19	U 1.51	U 0.604	U 1.51	U 3.02
Field Blank	B 1.3	U 1.55	B 1.74	U 1.55	U 0.619	U 1.55	U 3.09
Field Blank	U 0.29	U 1.45	U 0.581	U 4.84	U 1.6	U 1.45	U 2.9
Field Blank	U 1.03	1.59	U 0.618	U 1.55	U 0.618	U 1.55	U 3.09

River Location	Cotinine	Enalapril	Hydrocodone	Metformin	Oxycodone	Ranitidine	Triamterene
15EM002	U 1.49	U 0.709	U 1.49	U 4.62	U 0.597	U 0.597	U 0.299
15EM003	3.58	U 0.582	U 1.47	131	U 1.74	U 0.587	1.77
15EM004	U 1.54	U 0.308	U 1.54	4.29	U 1.8	U 0.616	U 0.308
15EM009	U 1.45	U 0.29	U 1.45	B 10	U 4.29	U 0.579	U 0.29
15EM010	U 1.48	U 0.295	U 1.48	U 5.9	U 1.23	U 0.59	U 0.295
15EM014	2.27	U 0.313	U 1.57	B 34.2	U 2.02	U 0.626	0.472
15EM015	U 1.5	U 0.487	U 1.5	B 6.37	U D 3	U 0.6	U 0.3
15EM017	U 1.49	U 0.299	U 1.49	B 5.03	U 1.26	U 0.598	U 0.299
15EM022	U 1.48	U 0.451	U 1.48	U 9.91	U 1.33	U 0.592	U 0.296
15EM023	U 1.46	U 0.738	U 1.46	U 2.92	U 2.39	U 0.584	U 0.292
15EM024	U 1.45	U 0.289	U 1.45	B 16.6	U 0.578	U 0.578	U 0.289
15EM025	U 1.45	U 0.432	U 1.45	B 6.44	U 1.57	U 0.579	U 0.29
15EM027	U 1.49	U 0.299	U 1.49	U 2.99	U 0.597	U 0.597	U 0.299
15EM030	6.72	U 0.378	U 1.5	14.5	U 0.87	U 0.601	U 0.412
15EM032	2.43	U 0.307	U 1.46	B 22.4	U 1.66	U 0.584	U 0.292
15EM033	U 1.36	U 0.508	U 1.36	U 3.13	U 1.35	U 0.545	U 0.273
15EM034	U 1.51	U 0.582	U 1.51	U 3.02	U 2.29	U 0.603	U 0.369
15EM035	U 1.47	U 0.294	U 1.47	U 2.94	U 1.58	U 0.587	U 0.294
15EM036	2.64	U 0.424	U 1.49	B 59.3	U D 2.98	U 0.596	U 0.298
15EM037	U 1.43	U 0.492	U 1.43	U 4.13	U 1.53	U 0.573	U 0.286
15EM038	4.99	U 0.293	U 1.46	83.7	U 2.47	U 0.585	U 0.293
15EM039	U 1.41	U 0.885	U 1.41	B 10.1	U 1.97	U 0.564	U 0.282
15EM040	2.7	U 0.642	U 1.47	U 4.48	U 7.35	U 0.59	U 0.37
15EM043	6.36	U 0.293	U 1.46	B 6.64	U 3.4	U 0.585	U 0.293
15EM045	U 1.5	U 0.482	U 1.5	U 3	U D 3	U 0.6	U 0.432
15EM046	6.7	U 0.302	U 1.51	9.01	U 1.94	U 0.604	0.611
15EM047	U 1.49	U 0.298	U 1.49	5.24	U 0.81	U 0.596	U 0.298
15EM049	U 1.47	U 0.442	U 1.47	B 11.6	U 3.66	U 0.586	U 0.293
15EM050	2.17	U 0.4	U 1.57	U 3.15	U 2.09	U 0.629	U 0.315
15EM051	3.45	U 0.308	U 1.54	13	U 0.965	U 0.616	0.558
15EM052	2.49	U 1.84	U 1.51	B 28.8	U D 3.09	U 0.603	0.54

River Location	Cotinine	Enalapril	Hydrocodone	Metformin	Oxycodone	Ranitidine	Triamterene
15EM053	U 1.51	U 0.312	U 1.51	U 3.83	U 1.21	U 0.604	U 0.302
15EM054	U 1.49	U 0.297	U 1.49	U 6.1	U 0.983	U 0.594	U 0.297
15EM055	U 1.48	U 0.296	U 1.48	U 2.96	U 0.81	U 0.592	U 0.296
15EM056	12.1	U 0.41	U 1.54	667	U 2.41	U 0.615	3.76
15EM058	4.03	U 0.294	U 1.47	36.8	U 1.28	U 0.588	2.8
15EM061	U 1.51	U 1.91	U 1.51	B 12.6	U D 3.03	U 0.606	U 0.303
15EM063	U 1.45	U 0.522	U 1.45	B 17.1	U 2.38	U 0.581	U 0.29
15EM065	U 1.39	U 0.278	U 1.39	B 12.2	U 2.74	U 0.556	U 0.278
15EM067	U 1.48	U 0.305	U 1.48	B 46.5	U 1.26	U 0.591	U 0.296
15EM069	U 1.48	U 0.744	U 1.48	B 6.99	U 2.49	U 0.593	U 0.296
15EM070	U 1.47	U 0.293	U 1.47	U 6.28	U 1.85	U 0.587	U 0.293
15EM071	5.9	U 0.779	U 1.52	B 118	U 1.91	U 0.607	U 0.304
15EM072	U 1.55	U 0.451	U 1.55	B 11.8	U 0.619	U 0.619	U 0.309
15EM077	1.73	U 0.306	U 1.53	B 21.3	1.51	U 0.611	0.366
15EM078	U 1.45	U 0.29	U 1.45	B 3.5	U 0.826	U 0.581	U 0.29
15EM079	3.74	U 1.2	U 1.5	B 57.1	U 2.36	U 0.6	U 0.346
15EM080	1.86	U 0.669	U 1.5	B 11.5	U 2.31	U 0.601	U 0.31
15EM081	U 1.42	U 0.311	U 1.42	B 3.81	U 0.631	U 0.566	U 0.283
15EM084	1.72	U 0.523	U 1.51	B 4.24	U 2	U 0.604	U 0.302
Field Blank	U 1.55	U 0.309	U 1.55	B 7.57	U 0.619	U 0.619	U 0.309
Field Blank	U 1.45	U 0.29	U 1.45	B 3.15	U 0.581	U 0.581	U 0.29
Field Blank	U 1.55	U 0.309	U 1.55	B 5.2	U 0.618	U 0.618	U 0.309

Table 6. List 5 pharmaceuticals

River Location	Alprazolam	Amitriptyline	Amlodipine	Benzoylecgonine	Benztropine	Betamethasone	Cocaine	DEET
15EM002	U 0.316	0.898	U 1.58	U 0.451	U 0.526	U 1.58	U 0.246	B 10.7
15EM003	U 0.304	0.754	U 1.52	U 0.409	U 0.507	U 1.52	U 0.167	B 7.91
15EM004	U 0.308	U 0.587	U 1.54	U 0.385	U 0.513	U 1.54	U 0.197	B 12
15EM009	U 0.311	1.31	U 1.56	U 0.473	U 0.519	U 1.56	U 0.25	781
15EM010	U 0.295	U 0.295	U 1.48	U 0.295	U 0.492	U 1.48	U 0.148	B 1.65
15EM014	U 0.31	1.67	U 1.55	U 0.366	U 0.517	U 1.55	U 0.178	B 17.2
15EM015	U 0.316	U 0.371	U 1.58	U 0.316	U 0.527	U 1.58	U 0.158	B 2.55
15EM017	U 0.326	U 0.715	U 1.63	U 0.426	U 0.514	U 1.54	U 0.26	B 4.73
15EM022	U 0.29	0.714	U 1.45	U 0.335	U 0.483	U 1.45	U 0.229	B 4.59
15EM023	U 0.287	U 0.443	U 1.43	0.414	U 0.478	U 1.43	U 0.196	B 3.22
15EM024	U 0.286	U 0.324	U 1.43	U 0.286	U 0.477	U 1.43	U 0.143	B 1.81
15EM025	U 0.306	1.05	U 1.53	U 0.473	U 0.509	U 1.53	U 0.338	11.3
15EM027	U 0.305	1.07	U 1.53	U 0.611	U 0.508	U 1.53	U 0.21	B 16.3
15EM030	U 0.309	2.49	U 1.54	U 0.469	U 0.514	U 1.54	U 0.236	53.7
15EM032	U 0.304	1.95	U 1.52	U 0.541	U 0.506	U 1.52	U 0.206	B 10.5
15EM033	U 0.311	U 0.55	U 1.55	U 0.384	U 0.518	U 1.55	U 0.225	B 6.15
15EM034	U 0.317	0.868	U 1.59	U 0.534	U 0.529	U 1.59	U 0.29	B 3.64
15EM035	U 0.298	U 0.353	U 1.49	U 0.298	U 0.497	U 1.49	U 0.149	21.4
15EM036	U 0.317	U 0.346	U 1.59	U 0.374	U 0.529	U 1.59	U 0.214	B 14
15EM037	U 0.314	U 0.665	U 1.57	U 0.573	U 0.523	U 1.57	U 0.252	B 5.39
15EM038	U 0.3	U 0.468	U 1.5	U 0.357	U 0.5	U 1.5	U 0.15	50.9
15EM039	U 0.308	U 0.705	U 1.54	U 0.512	U 0.513	U 1.54	U 0.336	158
15EM040	U 0.296	5.14	U 1.51	U 0.789	U 0.494	U 1.48	U 0.264	B 7.25
15EM043	U 0.312	U 1.77	U 1.67	U 0.612	U 0.521	U 1.56	U 0.354	58.7
15EM045	U D 0.95	U D 1.74	U D 4.75	U D 0.95	U D 1.58	U D 4.75	U D 0.487	D 24.9
15EM046	U 0.315	0.92	U 1.57	U 0.439	U 0.525	U 1.57	U 0.226	14.2
15EM047	U 0.29	U 0.445	U 1.45	U 0.29	U 0.484	U 1.45	U 0.145	B 2.44
15EM049	U 0.307	1.13	U 1.54	U 0.388	U 0.512	U 1.54	U 0.289	37
15EM050	U 0.293	U 0.469	U 1.49	U 0.538	U 0.488	2.64	U 0.186	24.1
15EM051	U 0.312	0.952	U 1.56	U 0.316	U 0.519	U 1.56	U 0.177	18
15EM052	U 0.318	1.16	U 1.59	U 0.482	U 0.529	U 1.59	U 0.214	86.1
15EM053	U 0.313	U 0.486	U 1.57	U 0.495	U 0.522	U 1.57	U 0.171	B 5.22
15EM054	U 0.296	U 0.519	U 1.48	U 0.296	U 0.493	U 1.48	U 0.148	B 1.77
15EM055	U 0.297	U 0.759	U 1.51	U 0.569	U 0.495	U 1.49	U 0.395	B 3.01
15EM056	U 0.302	0.635	U 1.78	1.24	U 0.503	U 1.51	U 0.151	44.2
15EM058	U 0.293	0.463	U 1.46	0.442	U 0.488	U 1.46	U 0.238	18.3
15EM061	U 0.316	U 0.388	U 1.58	U 0.423	U 0.527	U 1.58	U 0.176	268
15EM063	U 0.288	U 0.441	U 1.44	U 0.375	U 0.481	U 1.44	U 0.206	B 2.84
15EM065	U 0.311	U 0.948	U 1.56	U 0.564	U 0.519	U 1.56	U 0.228	B 10.6
15EM067	U 0.314	U 0.613	U 1.57	U 0.6	U 0.524	R 22.9	U 0.258	B 2.75
15EM069	U 0.308	0.476	U 1.6	U 0.452	U 0.514	U 4.92	U 0.216	38.9
15EM070	U 0.289	U 0.409	U 1.45	U 0.291	U 0.482	U 1.45	U 0.164	B 2.51
15EM071	U 0.306	U 0.626	U 1.53	U 0.36	U 0.51	U 1.53	U 0.18	53.8
15EM072	U 0.309	U 0.467	U 1.54	U 0.332	U 0.515	U 1.54	U 0.179	B 3.63

River Location	Alprazolam	Amitriptyline	Amlodipine	Benzoylecgonine	Benztropine	Betamethasone	Cocaine	DEET
15EM077	U 0.314	0.916	U 1.57	U 0.355	U 0.523	U 1.57	U 0.229	B 7.1
15EM078	U 0.311	U 0.565	U 1.55	U 0.377	U 0.518	U 1.55	U 0.155	B 1.98
15EM079	U 0.318	1.09	U 1.59	U 0.323	U 0.53	U 1.59	U 0.193	22.2
15EM080	U 0.321	2.62	U 1.72	U 0.567	U 0.534	U 1.6	U 0.357	B 5.85
15EM081	U 0.306	U 1.17	U 1.53	U 0.306	U 0.511	U 1.53	U 0.209	B 2.36
15EM084	U 0.307	1.05	U 1.53	U 0.435	U 0.512	U 1.53	U 0.29	B 11.1
Field Blank	U 0.316	U 0.316	U 1.58	U 0.316	U 0.527	U 1.58	U 0.158	B 1.95
Field Blank	U 0.29	U 0.29	U 1.45	U 0.29	U 0.483	U 1.45	U 0.145	B 2.03
Field Blank	U 0.314	U 0.314	U 1.57	U 0.314	U 0.524	U 1.57	U 0.157	B 2.11

River Location	Desmethyldiltiazem	Diazepam	Fluocinonide	Fluticasone propionate	Hydrocortisone	10-hydroxy-amitriptyline	Meprobamate	Methylprednisolone
15EM002	U 0.158	U 0.33	U 6.31	U 3.28	U 63.1	U 0.158	U 4.21	U 13.7
15EM003	0.157	U 0.304	U 6.08	U 2.21	U 60.8	U 0.152	U 4.05	U 9.48
15EM004	U 0.154	U 0.308	U 6.15	U 2.84	U 61.5	U 0.154	U 4.1	U 5.39
15EM009	U 0.156	U 0.438	U 6.23	U 3.97	U 62.3	U 0.156	U 4.15	U 23.3
15EM010	U 0.148	U 0.295	U 5.9	U 2.17	U 59	U 0.148	U 3.93	U 3.93
15EM014	U 0.155	U 0.447	U 6.2	U 2.07	U 62	U 0.155	5.49	U 15.7
15EM015	U 0.158	U 0.316	U 6.33	U 3.08	U 63.3	U 0.158	U 4.22	U 6.69
15EM017	U 0.154	U 0.578	U 6.17	U 3.82	U 61.7	U 0.154	U 4.11	U 23.2
15EM022	U 0.145	U 0.29	U 5.8	U 2.66	U 58	U 0.145	U 3.86	U 10.7
15EM023	U 0.143	U 0.287	U 5.74	U 2.39	U 57.4	U 0.143	U 3.83	U 10
15EM024	U 0.143	U 0.286	U 5.72	U 1.91	U 57.2	U 0.143	U 3.82	U 10.5
15EM025	U 0.153	U 0.473	U 6.11	U 3.5	U 61.1	U 0.153	U 4.07	U 21.8
15EM027	U 0.153	U 0.305	U 7.12	U 4.38	U 62.9	U 0.153	U 4.07	U 11.6
15EM030	U 0.154	U 0.345	U 6.17	U 2.69	U 61.7	U 0.154	U 4.11	U 11.2
15EM032	U 0.152	U 0.308	U 6.07	U 2.8	U 60.7	U 0.152	U 4.05	U 19.6
15EM033	U 0.155	U 0.311	U 6.22	U 3.25	U 62.2	U 0.155	U 4.15	U 14
15EM034	U 0.159	U 0.559	U 6.35	U 2.78	U 63.5	U 0.159	U 4.23	U 9.78
15EM035	U 0.149	U 0.314	U 5.97	U 2.19	U 59.7	U 0.149	U 3.98	U 9.35
15EM036	U 0.159	U 0.317	U 6.35	U 2.57	U 63.5	U 0.159	U 4.23	U 7.63
15EM037	U 0.157	U 0.329	U 6.28	U 2.63	U 62.8	U 0.157	U 4.19	U 13.6
15EM038	U 0.15	U 0.3	U 6	U 3.29	U 60	U 0.15	U 4	U 8.94
15EM039	U 0.154	U 0.345	U 6.15	U 3.99	U 61.5	U 0.154	U 4.1	U 23.8
15EM040	U 0.148	U 0.374	U 5.92	U 5.13	U 59.2	U 0.148	U 3.95	U 12.7
15EM043	U 0.156	U 0.312	U 6.25	U 4.42	U 66.9	U 0.156	U 4.17	U 21.4
15EM045	U D 0.475	U D 1.19	U D 19	U D 8.26	U D 190	U D 0.475	U D 12.7	U D 38.1
15EM046	U 0.157	0.322	U 6.3	U 3.23	U 63	U 0.157	U 4.2	U 10.6
15EM047	U 0.145	U 0.29	U 5.8	U 2.07	U 58	U 0.145	U 3.87	U 7.11
15EM049	U 0.154	U 0.442	U 6.14	U 3.24	U 61.4	U 0.154	U 4.09	U 26.1
15EM050	U 0.146	U 0.293	U 5.85	U 2.4	U 58.5	U 0.146	U 3.9	U 13.7
15EM051	U 0.156	U 0.312	U 6.23	U 2.08	U 62.3	U 0.156	U 4.15	U 10.6
15EM052	U 0.159	U 0.318	U 6.35	U 3.34	U 63.5	U 0.159	U 4.23	U 18.4

River Location	Desmethyldiltiazem	Diazepam	Fluocinonide	Fluticasone propionate	Hydrocortisone	10-hydroxy-amitriptyline	Meprobamate	Methylprednisolone
15EM053	U 0.157	U 0.313	U 6.27	U 3.71	U 62.7	U 0.157	U 4.18	U 12.9
15EM054	U 0.148	U 0.296	U 5.91	U 2.62	U 59.1	U 0.148	U 3.94	U 5.84
15EM055	U 0.149	U 0.297	U 9.26	U 6.71	U 129	U 0.203	U 3.96	U 40.7
15EM056	0.957	U 0.302	U 6.04	U 3.81	U 60.4	0.435	U 4.03	U 4.52
15EM058	U 0.146	U 0.328	U 5.86	U 2.25	U 58.6	U 0.146	U 3.9	U 8.69
15EM061	U 0.158	U 0.316	U 6.33	U 3.03	U 63.3	U 0.158	U 4.22	U 10.4
15EM063	U 0.144	U 0.288	U 5.77	U 2.01	U 57.7	U 0.144	U 3.85	U 8.25
15EM065	U 0.156	U 0.349	U 6.22	U 2.11	U 62.2	U 0.156	U 4.15	U 9.87
15EM067	U 0.157	U 0.482	U 6.28	U 2.83	U 62.8	U 0.157	U 4.19	U 19.2
15EM069	U 0.154	U 0.308	U 6.17	U 2.76	U 61.7	U 0.154	U 4.11	U 15
15EM070	U 0.145	U 0.289	U 5.79	U 2.54	U 57.9	U 0.145	U 3.86	U 6.68
15EM071	U 0.153	U 0.306	U 6.12	U 3.38	U 64.8	U 0.153	U 4.08	U 16.4
15EM072	U 0.154	U 0.315	U 6.18	U 2.06	U 61.8	U 0.154	U 4.12	U 10.7
15EM077	U 0.157	U 0.355	U 6.28	U 3.81	U 62.8	U 0.157	U 4.19	U 16.7
15EM078	U 0.155	U 0.311	U 6.22	U 4.86	U 62.2	U 0.155	U 4.14	U 6.09
15EM079	U 0.159	U 0.318	U 6.35	U 2.94	U 63.5	U 0.159	U 4.24	U 17
15EM080	U 0.16	U 0.424	U 6.41	U 4.98	U 64.1	U 0.16	U 4.27	U 4.27
15EM081	U 0.153	U 0.306	U 6.13	U 3.05	U 61.3	U 0.153	U 4.08	U 17.2
15EM084	U 0.153	U 0.307	U 6.14	U 2.59	U 61.4	U 0.153	U 4.09	U 9.45
Field Blank	U 0.158	U 0.316	U 6.32	U 2.11	U 63.2	U 0.158	U 4.22	U 4.22
Field Blank	U 0.145	U 0.29	U 5.79	U 2.69	U 57.9	U 0.145	U 3.86	U 3.86
Field Blank	U 0.157	U 0.314	U 6.28	U 2.09	U 62.8	U 0.157	U 4.19	U 4.19

River Location	Metoprolol	Norfluoxetine	Norverapamil	Paroxetine	Prednisolone	Prednisone	Promethazine	Propoxyphene
15EM002	U 8.89	U 1.58	U 0.158	U 4.21	U 26	U 74.4	U 1.4	U 0.316
15EM003	U 5.52	U 1.52	U 0.152	U 4.05	U 20.7	U 28	U 1.35	U 0.304
15EM004	U 7.38	U 1.54	U 0.154	U 4.1	U 22.7	U 43.7	U 1.36	U 0.308
15EM009	U 11.5	U 1.56	U 0.156	U 4.15	U 21.5	U 64.4	U 1.38	U 0.311
15EM010	U 3.61	U 1.48	U 0.148	U 3.93	U 9.73	U 26.3	U 1.31	U 0.295
15EM014	U 10.4	U 1.55	U 0.155	U 4.14	U 10.4	U 20.7	U 1.38	U 0.31
15EM015	U 4.99	U 1.58	U 0.158	U 4.22	U 14.6	U 41.3	U 1.4	U 0.316
15EM017	U 7.54	U 1.54	U 0.162	U 4.11	U 32.4	U 50.2	U 1.37	U 0.308
15EM022	U 5.55	U 1.45	U 0.145	U 3.86	U 17.8	U 41.2	U 1.28	U 0.29
15EM023	U 4.5	U 1.43	U 0.143	U 3.83	U 18.3	U 36.6	U 1.27	U 0.287
15EM024	U 1.99	U 1.43	U 0.143	U 3.82	U 6.22	U 19.1	U 1.27	U 0.286
15EM025	U 8.58	U 1.53	U 0.153	U 4.07	U 41.4	U 73.2	U 1.35	U 0.306
15EM027	U 13.3	U 1.53	U 0.153	U 4.07	U 41.5	U 20.3	U 1.35	U 0.305
15EM030	U 9.14	U 1.54	U 0.154	U 4.11	U 23.5	U 49.5	U 1.37	U 0.309
15EM032	U 11.2	U 1.52	U 0.152	U 4.05	U 39.4	U 63.4	U 1.35	U 0.304
15EM033	U 8.91	U 1.55	U 0.155	U 4.15	U 20.1	U 43.7	U 1.38	U 0.311
15EM034	U 11	U 1.59	U 0.159	U 4.23	U 37.9	U 62.2	U 1.41	U 0.317
15EM035	U 5.6	U 1.49	U 0.149	U 3.98	U 14.2	U 21.5	U 1.32	U 0.298

River Location	Metoprolol	Norfluoxetine	Norverapamil	Paroxetine	Prednisolone	Prednisone	Promethazine	Propoxyphene
15EM036	U 6.14	U 1.59	U 0.159	U 4.23	U 16	U 40.1	U 1.41	U 0.317
15EM037	U 8.36	U 1.57	U 0.157	U 4.19	U 26.3	U 93.5	U 1.39	U 0.314
15EM038	U 4.14	U 1.5	U 0.15	U 4	U 11.4	U 20	U 1.33	U 0.3
15EM039	U 9.27	U 1.54	U 0.154	U 4.1	U 39.2	U 67.1	U 1.36	U 0.308
15EM040	U 16.3	U 1.48	U 0.148	U 3.95	U 44.1	U 44.8	U 1.31	U 0.296
15EM043	U 13.4	U 4.44	U 0.156	U 4.17	U 39.3	U 20.8	U 1.39	U 0.312
15EM045	U D 21.7	U D 4.75	U D 0.475	U D 12.7	U D 79.3	U D 133	U D 4.21	U D 0.95
15EM046	U 8.2	U 1.57	U 0.157	U 4.2	U 16.9	U 40.3	U 1.4	U 0.315
15EM047	U 4.63	U 1.45	U 0.145	U 3.87	U 12.2	U 20.3	U 1.29	U 0.29
15EM049	U 9.5	U 1.54	U 0.154	U 4.09	U 34	U 58.8	U 1.36	U 0.307
15EM050	U 6.69	U 1.46	U 0.146	U 3.9	U 34.4	U 36.2	U 1.3	U 0.293
15EM051	U 9.73	U 1.56	U 0.156	U 4.15	U 16.5	U 42.7	U 1.38	U 0.312
15EM052	U 10	U 1.59	U 0.159	U 4.23	U 29.3	U 39.7	U 1.41	U 0.318
15EM053	U 4.62	U 1.57	U 0.157	U 4.18	U 17.9	U 35.9	U 1.39	U 0.313
15EM054	U 1.92	U 1.48	U 0.148	U 3.94	U 7.92	U 19.7	U 1.31	U 0.296
15EM055	U 12.9	U 1.49	U 0.149	U 3.96	U 70.2	U 19.8	U 1.32	U 0.297
15EM056	16.3	U 1.51	U 0.151	U 4.03	U 14.1	U 25	U 1.34	U 0.302
15EM058	U 5.12	U 1.46	U 0.146	U 3.9	U 24.1	U 47.3	U 1.3	U 0.293
15EM061	U 5.42	U 1.58	U 0.158	U 4.22	U 17.6	U 34.2	U 1.4	U 0.316
15EM063	U 6.44	U 1.44	U 0.144	U 3.85	U 12.9	U 28.2	U 1.28	U 0.288
15EM065	U 12.2	U 1.56	U 0.156	U 4.15	U 9.41	U 54.9	U 1.38	U 0.311
15EM067	U 15.4	U 1.6	U 0.193	U 4.19	U 18.3	U 20.9	U 1.39	R 0.694
15EM069	U 8.39	U 1.54	U 0.154	U 4.11	U 27.7	U 48.9	U 1.37	U 0.308
15EM070	U 4.47	U 1.45	U 0.145	U 3.86	U 10.2	U 25.1	U 1.28	U 0.289
15EM071	U 8.29	U 1.53	U 0.157	U 4.08	U 17.3	U 42.5	U 1.36	U 0.306
15EM072	U 7.61	U 1.54	U 0.154	U 4.12	U 18.6	U 41.4	U 1.37	U 0.309
15EM077	U 10	U 1.57	U 0.157	U 4.19	U 23.3	U 72.1	U 1.39	U 0.314
15EM078	U 5.25	U 1.55	U 0.155	U 4.14	U 6.22	U 20.7	U 1.38	U 0.311
15EM079	U 7.13	U 1.59	U 0.159	U 4.24	U 24.5	U 47.3	U 1.41	U 0.318
15EM080	U 12.7	U 1.6	U 0.16	U 4.27	U 40.3	U 99.5	U 1.42	U 0.321
15EM081	U 6.82	U 1.6	U 0.153	U 4.08	U 6.13	U 100	U 1.36	U 0.306
15EM084	U 7.11	U 1.53	U 0.153	U 4.09	U 13.3	U 20.5	U 1.36	U 0.307
Field Blank	U 1.88	U 1.58	U 0.158	U 4.22	U 6.32	U 21.1	U 1.4	U 0.316
Field Blank	U 1.51	U 1.45	U 0.145	U 3.86	U 5.79	U 19.3	U 1.28	U 0.29
Field Blank	U 1.57	U 1.57	U 0.157	U 4.19	U 6.28	U 20.9	U 1.39	U 0.314

River Location	Propranolol	Sertraline	Simvastatin	Theophylline	Trenbolone	Trenbolone acetate	Valsartan	Verapamil
15EM002	U 2.1	U 0.421	U 21	U 63.1	U 4.21	U 0.408	U 4.21	U 0.158
15EM003	U 2.03	U 0.405	U 20.3	U 60.8	U 4.05	U 0.304	U 4.05	U 0.152
15EM004	U 2.05	0.525	U 20.5	U 65.5	U 4.1	U 0.308	U 4.1	U 0.162
15EM009	U 2.08	U 0.415	U 20.8	U 72.8	U 4.15	U 0.569	U 4.15	U 0.156
15EM010	U 1.97	U 0.393	U 19.7	U 59	U 3.93	U 0.295	U 3.93	U 0.148
15EM014	U 2.07	0.524	U 20.7	U 62	U 4.14	U 0.31	U 4.14	U 0.155
15EM015	U 2.11	U 0.422	U 21.1	U 63.3	U 4.22	U 0.316	U 4.22	U 0.158
15EM017	U 2.06	U 0.411	U 20.6	U 69.3	U 7.76	U 1.15	U 4.24	U 0.195
15EM022	U 1.93	0.503	U 19.3	U 58	U 3.86	U 0.29	U 3.86	U 0.145
15EM023	U 1.91	0.605	U 19.1	U 59.6	U 3.83	U 0.287	U 3.83	U 0.143
15EM024	U 1.91	U 0.382	U 19.1	U 57.2	U 3.82	U 0.286	U 3.82	U 0.143
15EM025	U 2.04	U 0.407	U 20.4	U 72.6	U 4.07	U 0.521	U 4.07	U 0.195
15EM027	U 2.03	1.04	U 20.3	U 78.8	U 4.07	U 0.624	U 4.07	U 0.181
15EM030	U 2.06	0.415	U 20.6	U 67.6	U 4.11	U 0.309	U 4.11	U 0.154
15EM032	U 2.02	U 0.405	U 20.2	U 60.7	U 4.05	U 0.304	U 4.05	U 0.152
15EM033	U 2.07	U 0.415	U 20.7	U 62.2	U 4.15	U 0.347	U 4.15	U 0.204
15EM034	U 2.12	0.811	U 21.2	U 77.8	U 4.23	U 0.449	U 4.23	U 0.172
15EM035	U 1.99	0.48	U 19.9	U 59.7	U 3.98	U 0.298	U 3.98	U 0.149
15EM036	U 2.12	0.662	U 21.2	U 63.5	U 4.23	U 0.317	U 4.23	U 0.159
15EM037	U 2.09	U 0.419	U 20.9	U 72.9	U 4.19	U 0.46	U 4.19	U 0.166
15EM038	U 2	U 0.4	U 20	U 60	U 4	U 0.325	U 4	U 0.15
15EM039	U 2.05	U 0.41	U 20.5	U 70.4	U 4.1	U 0.543	U 4.1	U 0.192
15EM040	U 1.97	0.597	U 19.7	U 80.1	U 3.95	U 0.355	U 3.95	U 0.193
15EM043	U 2.08	0.954	U 20.8	U 78.8	U 4.17	U 0.556	U 4.17	U 0.156
15EM045	U D 6.33	U D 1.27	U D 63.3	U D 213	U D 12.7	U D 1.27	U D 12.7	U D 0.639
15EM046	U 2.1	0.609	U 21	U 63	U 4.2	U 0.324	U 4.2	U 0.17
15EM047	U 1.93	0.486	U 19.3	U 58	U 3.87	U 0.29	U 3.87	U 0.145
15EM049	U 2.05	U 0.409	U 20.5	U 71	U 5.06	U 0.456	U 4.09	U 0.198
15EM050	U 1.95	0.469	U 19.5	U 62	U 3.9	U 0.293	U 3.9	U 0.146
15EM051	U 2.08	0.695	U 20.8	U 62.3	U 4.15	U 0.353	U 4.15	U 0.156
15EM052	U 2.12	U 0.423	U 21.2	U 67.4	U 4.23	U 0.464	5.91	U 0.159
15EM053	U 2.09	U 0.418	U 20.9	U 62.7	U 4.18	U 0.377	U 4.18	U 0.157
15EM054	U 1.97	U 0.394	U 19.7	U 59.1	U 3.94	U 0.296	U 3.94	U 0.148
15EM055	U 1.98	1.73	U 19.8	U 167	U 3.96	U 1.09	U 3.96	U 0.322
15EM056	U 2.01	0.527	U 20.1	71.7	U 4.03	U 0.302	33.8	U 0.151
15EM058	U 1.95	0.95	U 19.5	U 58.6	U 3.9	U 0.293	U 3.9	U 0.146
15EM061	U 2.11	U 0.422	U 21.1	U 63.3	U 4.22	U 0.338	U 4.22	U 0.158
15EM063	U 1.92	0.493	U 19.2	U 57.7	U 3.85	U 0.288	U 3.85	U 0.144
15EM065	U 2.07	U 0.415	U 20.7	U 62.2	U 4.15	U 0.374	U 4.15	U 0.156
15EM067	U 2.09	U 0.419	U 20.9	U 68.4	U 5.96	U 0.389	U 4.19	U 0.157
15EM069	U 2.06	U 0.411	U 20.6	U 61.7	U 4.11	U 0.462	U 4.11	U 0.162
15EM070	U 1.93	0.432	U 19.3	U 57.9	U 3.86	U 0.289	U 3.86	U 0.145
15EM071	U 2.04	U 0.484	U 20.4	U 100	U 4.08	U 0.416	U 4.08	U 0.153

River Location	Propranolol	Sertraline	Simvastatin	Theophylline	Trenbolone	Trenbolone acetate	Valsartan	Verapamil
15EM072	U 2.06	0.554	U 20.6	U 66.9	U 4.12	U 0.309	U 4.12	U 0.154
15EM077	U 2.09	0.496	U 20.9	U 62.8	U 4.19	U 0.454	8.4	U 0.163
15EM078	U 2.07	U 0.443	U 20.7	U 62.2	U 4.14	U 0.37	U 4.14	U 0.155
15EM079	U 2.12	U 0.424	U 21.2	U 63.5	U 4.24	U 0.358	U 4.24	U 0.159
15EM080	U 2.14	U 0.427	U 21.4	U 76.8	U 4.27	U 0.54	U 4.27	U 0.201
15EM081	U 2.04	0.889	U 20.4	U 61.3	U 4.08	1.32	U 4.08	U 0.153
15EM084	U 2.05	0.526	U 20.5	U 63.8	U 4.09	U 0.465	U 4.09	U 0.153
Field Blank	U 2.11	U 0.422	U 21.1	U 63.2	U 4.22	U 0.316	U 4.22	U 0.158
Field Blank	U 1.93	U 0.386	U 19.3	U 57.9	U 3.86	U 0.29	U 3.86	U 0.145
Field Blank	U 2.09	U 0.419	U 20.9	U 62.8	U 4.19	U 0.314	U 4.19	U 0.157

Table 7. List 6 pharmaceuticals

River Location	Diatrizoic acid	Iopamidol	Citalopram	Tamoxifen	Cyclophosphamide	Venlafaxine	Amsacrine	Azathioprine
15EM002	U 25.1	791	U 0.418	U 0.418	U 0.836	U 0.836	U 0.696	U 2.09
15EM003	49.9	B 744	U 0.405	U 0.405	U 0.811	2.67	U 0.549	U 3.48
15EM004	U 24.6	B 1190	U 0.41	U 0.41	U 0.82	U 1.64	U 0.873	U 4.03
15EM009	U 24.9	1630	U 0.415	U 0.415	U 0.962	U 1.66	U 0.668	U 2.08
15EM010	U 23.6	316	U 0.393	U 0.393	U 0.787	U 1.57	U 0.157	U 1.97
15EM014	U 24.8	700	U 0.414	U 0.414	U 0.827	U 0.827	U 0.457	U 2.07
15EM015	U 38.2	407	U 0.958	U 0.422	U 0.844	U 0.844	U 0.475	U 2.11
15EM017	U 24.7	1620	U 0.411	U 0.411	U 0.822	U 1.64	U 0.565	U 2.06
15EM022	U 23.2	409	U 0.386	U 0.386	U 0.773	1.59	U 0.399	U 2.7
15EM023	U 23	B 695	U 0.383	U 0.383	U 0.967	U 1.53	U 0.153	U 1.91
15EM024	U 22.9	148	U 0.382	U 0.382	U 0.763	U 1.53	U 0.153	U 1.91
15EM025	U 24.4	1350	U 1.71	U 0.407	U 0.87	U 1.63	U 0.479	U 2.04
15EM027	U 24.4	1080	U 0.407	U 0.407	U 0.813	U 0.813	U 0.447	U 2.25
15EM030	U 24.7	B 713	U 3.29	U 0.411	U 0.823	U 1.65	U 0.348	U 5.66
15EM032	U 24.3	B 881	U 0.871	U 0.405	U 0.86	U 1.62	U 0.683	U 2.09
15EM033	U 24.9	1350	U 2.22	U 0.415	U 0.829	1.71	U 1.47	U 2.07
15EM034	U 25.4	1360	U 0.423	U 0.423	U 0.847	U 1.69	U 1.14	U 5.64
15EM035	U 34.6	B 225	U 0.398	U 0.398	U 0.796	2.03	U 0.64	U 3.07
15EM036	U 30.2	826	U 0.423	U 0.423	U 0.847	U 0.847	U 0.485	U 2.12
15EM037	U 25.1	R B 1020	U 1.1	U 0.419	U 0.837	U 1.67	U 1.93	U 2.09
15EM038	U 24	214	U 0.759	U 0.4	U 0.8	U 1.6	U 0.16	U 2
15EM039	U 24.6	1560	U 2.29	U 0.41	U 0.821	U 1.64	U 0.673	U 2.05
15EM040	U 23.7	787	U 0.394	U 0.394	U 0.931	U 1.58	U 0.991	U 2.38
15EM043	U 25	924	U 0.417	U 0.417	U 0.833	U 0.833	U 1.29	U 2.08
15EM045	U 31.4	1630	U 2.42	U 0.422	U 0.845	U 0.845	U 1.37	U 2.11
15EM046	U 25.2	1230	U 3.06	U 0.42	U 0.839	U 1.68	U 0.495	U 17.3
15EM047	U 23.2	B 480	U 1.63	U 0.387	U 0.774	U 1.55	U 0.361	U 3.15
15EM049	U 24.6	1350	U 2.04	U 0.409	U 1.1	U 1.64	U 1.01	U 3.2
15EM050	U 23.4	B 470	U 0.39	U 0.39	U 0.78	U 1.56	U 0.156	U 1.95
15EM051	26.4	B 757	U 2.92	U 0.415	U 0.831	1.93	U 0.568	U 4.9
15EM052	U 25.4	908	U 0.423	U 0.423	U 0.847	U 0.847	U 0.873	U 2.12
15EM053	U 28.1	1390	U 0.418	U 0.418	U 1.07	U 1.67	U 0.455	U 2.09
15EM054	U 23.7	132	U 0.394	U 0.394	U 0.788	U 1.58	U 0.158	U 1.97
15EM055	U 23.8	1650	U 0.396	U 0.396	U 0.792	U 0.792	U 0.913	U 1.98
15EM056	U 24.2	282	1.77	U 0.403	U 0.805	11	U 0.161	U 2.01
15EM058	U 23.4	B 794	U 0.39	U 0.39	U 0.919	3.18	U 0.757	U 1.95
15EM061	U 80.1	224	U 0.67	U 0.422	U 0.844	U 0.844	U 0.752	U 2.11
15EM063	U 23.1	611	U 0.385	U 0.385	U 0.769	U 1.54	U 0.154	U 2.48
15EM065	U 24.9	524	U 0.415	U 0.415	U 0.83	U 0.83	U 0.757	U 2.07
15EM067	U 31.5	1160	U 2.23	U 0.419	U 0.838	U 0.838	U 0.478	U 2.09
15EM069	U 24.7	B 1200	U 1.83	U 0.411	U 0.822	U 1.64	U 0.661	U 2.06
15EM070	U 23.2	285	U 0.386	U 0.386	U 0.772	U 1.54	U 0.154	U 1.93
15EM071	U 28.9	372	U 0.408	U 0.408	U 0.816	U 0.816	U 0.92	U 2.04

River Location	Diatrizoic acid	Iopamidol	Citalopram	Tamoxifen	Cyclophosphamide	Venlafaxine	Amsacrine	Azathioprine
15EM072	U 24.7	774	U 0.412	U 0.412	U 0.824	U 0.824	U 0.714	U 2.06
15EM077	U 25.1	700	U 0.419	U 0.419	U 0.837	U 0.837	U 0.507	U 2.09
15EM078	U 24.8	365	U 0.413	U 0.413	U 0.825	U 0.825	U 0.339	U 2.06
15EM079	U 25.4	604	U 0.424	U 0.424	U 0.847	U 0.847	U 0.42	U 2.12
15EM080	U 26.5	1080	U 2.3	U 0.427	U 0.855	U 0.855	U 0.766	U 2.14
15EM081	U 24.5	1090	U 0.408	U 0.408	U 0.817	U 0.817	U 0.789	U 2.04
15EM084	U 24.6	392	U 0.409	U 0.409	U 0.818	1.09	U 0.509	U 2.05
Field Blank	U 25.3	140	U 0.422	U 0.422	U 0.843	U 0.843	U 0.169	U 2.11
Field Blank	U 23.2	U 198	U 0.386	U 0.386	U 0.772	U 1.54	U 0.154	U 1.93
Field Blank	U 25.1	U 97.1	U 0.419	U 0.419	U 0.838	U 0.838	U 0.168	U 2.09

River Location	Busulfan	Clotrimazole	Colchicine	Daunorubicin	Doxorubicin	Drospirenone	Etoposide	Medroxyprogesterone Acetate
15EM002	U 5.19	U 0.418	U 5.25	U 8.36	U 25.1	U 8.36	U 2.09	U 4.18
15EM003	U 4.05	U 0.405	U 3.96	U 8.11	U 24.3	U 8.11	U 2.03	U 4.05
15EM004	U 4.1	U 0.41	U 2.76	U 8.2	U 24.6	U 8.2	U 2.05	U 4.1
15EM009	U 4.15	U 0.415	U 0.83	U 10.1	U 24.9	U 8.3	U 2.08	U 4.15
15EM010	U 3.93	U 0.393	U 2.11	U 9.27	U 23.6	U 7.87	U 1.97	U 3.93
15EM014	U 4.14	U 0.414	U 2.67	U 9.4	U 24.8	U 8.27	U 2.07	U 4.14
15EM015	U 4.59	U 0.422	U 4.16	U 9.37	U 25.3	U 8.44	U 2.11	U 4.22
15EM017	U 4.11	U 0.411	U 4.82	U 18.7	U 24.7	U 8.22	U 2.06	U 4.11
15EM022	U 3.86	U 0.386	U 4.95	U 8.07	U 23.2	U 7.73	U 1.93	U 3.86
15EM023	U 3.83	U 0.383	U 4.76	U 8.96	U 23	U 7.66	U 1.91	U 3.83
15EM024	U 3.82	U 0.382	U 4.39	U 7.63	U 22.9	U 7.63	U 1.91	U 3.82
15EM025	U 5.77	U 0.407	U 7.07	U 11.1	U 24.4	U 8.15	U 2.04	U 4.07
15EM027	U 4.77	U 0.407	U 4.2	U 13.8	U 24.4	U 8.13	U 2.03	U 4.07
15EM030	U 4.11	U 0.411	U 3.49	U 8.23	U 24.7	U 8.23	U 4.07	U 4.11
15EM032	U 4.05	U 0.405	U 4.83	U 9.36	U 24.3	U 8.1	U 2.02	U 4.05
15EM033	U 4.15	U 0.415	U 2.14	U 12.1	U 24.9	U 8.29	U 2.07	U 4.15
15EM034	U 4.23	U 0.423	U 11.5	U 8.47	U 25.4	U 12.2	U 3.74	U 4.23
15EM035	U 3.98	U 0.398	U 6.42	U 7.96	U 23.9	U 7.96	U 1.99	U 3.98
15EM036	U 4.23	U 0.423	U 3.57	U 11.3	U 25.4	U 8.47	U 2.12	U 4.23
15EM037	U 4.19	U 0.419	U 4.89	U 14.9	U 25.1	U 8.37	U 2.09	U 4.19
15EM038	U 4	U 0.4	U 3.46	U 8	U 24	U 8	U 2	U 4
15EM039	U 4.1	U 0.41	U 5.46	U 17.8	U 24.6	U 8.21	U 2.05	U 4.1
15EM040	U 3.94	U 0.394	U 5.85	U 8.15	U 23.7	U 7.89	U 1.97	U 3.94
15EM043	U 6.68	U 0.417	U 3.74	U 9.93	U 25	U 8.33	U 2.08	U 4.17
15EM045	U 7.12	U 0.422	U 9.91	U 25.9	U 25.3	U 8.45	U 4.88	U 4.22
15EM046	U 4.2	U 0.42	U 5.98	U 14.8	U 25.2	U 8.39	U 3.26	U 4.2
15EM047	U 3.87	U 0.387	U 0.774	U 7.74	U 23.2	U 7.74	U 1.93	U 3.87
15EM049	U 4.09	U 0.409	U 6.98	U 8.19	U 24.6	U 8.19	U 2.05	U 4.09
15EM050	U 3.9	U 0.39	U 4.79	U 7.8	U 23.4	U 7.8	U 1.95	U 3.9
15EM051	U 4.15	U 0.415	U 1.78	U 8.31	U 24.9	U 8.31	U 2.08	U 4.15

River Location	Busulfan	Clotrimazole	Colchicine	Daunorubicin	Doxorubicin	Drospirenone	Etoposide	Medroxyprogesterone Acetate
15EM052	U 4.48	U 0.423	U 4.74	U 11.7	U 25.4	U 8.47	U 2.12	U 4.23
15EM053	U 4.18	U 0.418	U 5.8	U 8.36	U 25.1	U 8.36	U 2.09	U 4.18
15EM054	U 3.94	U 0.394	U 3.06	U 7.88	U 23.7	U 7.88	U 1.97	U 3.94
15EM055	U 8.99	U 0.396	U 4.77	U 9.57	U 23.8	U 7.92	U 1.98	U 3.96
15EM056	U 4.03	U 0.403	U 3.79	U 8.05	U 24.2	U 8.05	U 2.01	U 4.03
15EM058	U 3.9	U 0.39	U 2.39	U 7.81	U 23.4	U 7.81	U 1.95	U 3.9
15EM061	U 4.27	U 0.422	U 3.95	U 8.44	U 25.3	U 8.44	U 2.11	U 4.22
15EM063	U 3.85	U 0.385	U 1.71	U 7.69	U 23.1	U 7.69	U 1.92	U 3.85
15EM065	U 4.44	U 0.415	U 1.66	U 11.1	U 24.9	U 8.3	U 2.22	U 4.15
15EM067	U 6.67	U 0.419	U 2.67	U 9.77	U 25.1	U 8.38	U 2.09	U 4.19
15EM069	U 4.11	U 0.411	U 3.38	U 9.23	U 24.7	U 8.22	U 2.06	U 4.11
15EM070	U 3.86	U 0.386	U 3.46	U 7.72	U 23.2	U 7.72	U 1.93	U 3.86
15EM071	U 4.08	U 0.408	U 6.65	U 8.31	U 24.5	U 8.16	U 2.11	U 4.08
15EM072	U 6.76	U 0.412	U 3	U 8.78	U 24.7	U 8.24	U 2.06	U 4.12
15EM077	U 5.85	U 0.419	U 2.22	U 15.8	U 25.1	U 8.37	U 2.56	U 4.19
15EM078	U 4.13	U 0.413	U 3.58	U 9.41	U 24.8	U 8.25	U 2.06	U 4.13
15EM079	U 4.24	U 0.424	U 6.35	U 11.4	U 25.4	U 8.47	U 2.12	U 4.24
15EM080	U 8.23	U 0.427	U 3.74	U 10.3	U 25.6	U 8.55	U 2.26	U 4.27
15EM081	U 4.08	U 0.408	U 4.25	U 9.26	U 24.5	U 8.17	U 2.04	U 4.08
15EM084	U 4.41	U 0.409	U 3.82	U 12.1	U 24.6	U 8.18	U 2.05	U 4.09
Field Blank	U 4.22	U 0.422	U 1.69	U 9.42	U 27.6	U 8.43	U 2.11	U 4.22
Field Blank	U 3.86	U 0.386	U 1.1	U 7.72	U 23.2	U 7.72	U 1.93	U 3.86
Field Blank	U 4.19	U 0.419	U 1.68	U 8.38	U 25.1	U 8.38	U 2.09	U 4.19

River Location	Metronidazole	Moxifloxacin	Oxazepam	Rosuvastatin	Teniposide	Zidovudine	Melphalan
15EM002	U 5.2	U 9.24	U 4.18	U 4.18	U 4.18	U 42.2	U 25.1
15EM003	U 4.05	U 8.12	U 4.05	U 4.05	U 4.05	U 24.3	U 97.3
15EM004	U 4.1	U 11.6	U 6.96	U 5.49	U 4.1	U 24.6	U 151
15EM009	U 4.15	U 24.2	U 4.15	U 4.15	U 4.15	U 24.9	U 192
15EM010	U 3.93	U 6.6	U 3.93	U 3.93	U 3.93	U 23.6	U 47.2
15EM014	U 4.14	U 18.6	U 4.14	U 4.14	U 4.14	U 27.3	U 24.8
15EM015	U 4.22	U 7.13	U 4.22	U 4.22	U 4.22	U 25.5	U 65.8
15EM017	U 4.11	U 18.7	U 4.11	U 4.11	U 7.5	U 24.7	U 95.7
15EM022	U 3.86	U 5.06	U 3.86	U 3.86	U 3.86	U 23.2	U 62.3
15EM023	U 3.83	U 9.13	U 3.83	U 3.83	U 3.83	U 23	U 45.9
15EM024	U 3.82	U 3.93	U 3.82	U 3.82	U 3.82	U 22.9	U 45.8
15EM025	U 4.07	U 19.5	U 4.07	U 4.07	U 7.96	U 24.4	U 48.9
15EM027	U 4.07	U 15.4	U 4.07	U 5.87	U 4.07	U 51	U 24.4
15EM030	U 4.11	U 6.45	U 10.8	U 6.09	U 4.11	U 24.7	U 121
15EM032	U 4.05	U 10.9	U 4.05	U 4.05	U 4.05	U 24.3	U 106
15EM033	U 5.37	U 10.9	U 4.15	U 4.15	U 4.15	U 24.9	U 87.7
15EM034	U 4.23	U 16.5	U 8.17	U 5.24	U 4.23	U 25.4	U 137

River Location	Metronidazole	Moxifloxacin	Oxazepam	Rosuvastatin	Teniposide	Zidovudine	Melphalan
15EM035	U 3.98	U 6.72	U 4.25	U 3.98	U 3.98	U 23.9	U 175
15EM036	U 4.94	U 22.3	U 4.23	U 4.23	U 4.23	U 25.4	U 83.4
15EM037	U 4.19	U 5.75	U 4.19	U 4.19	U 5.95	U 25.1	U 50.2
15EM038	U 4	U 7.25	U 4	U 4	U 4	U 24	U 48
15EM039	U 4.1	U 10.2	U 4.1	U 4.1	U 4.97	U 24.6	U 135
15EM040	U 3.94	U 18.7	U 3.94	U 3.94	U 5.1	U 23.7	U 47.3
15EM043	U 4.17	U 28.1	U 4.17	U 4.17	U 4.17	U 60.2	U 25
15EM045	U 4.22	NQ	U 4.22	U 7.92	U 5.85	U 81.7	U 113
15EM046	U 4.2	U 15.4	U 5.4	U 4.79	U 5.62	U 25.2	U 161
15EM047	U 3.87	U 7.61	U 4.44	U 3.87	U 3.87	U 23.2	U 92.8
15EM049	U 4.09	U 44.2	U 4.09	U 4.09	U 5.18	U 24.6	U 49.1
15EM050	U 6.53	U 9.47	U 3.9	U 3.9	U 3.9	U 23.4	U 46.8
15EM051	U 4.15	U 25.4	U 4.85	U 4.15	U 4.15	U 24.9	U 138
15EM052	U 4.47	U 10.5	U 4.23	U 4.23	U 4.23	U 31.4	U 25.4
15EM053	U 4.18	U 12.7	U 4.18	U 4.18	U 4.18	U 25.1	U 50.1
15EM054	U 3.94	U 6.54	U 3.94	U 3.94	U 3.94	U 23.7	U 47.3
15EM055	U 4.94	U 24.2	U 3.96	U 3.96	U 7.53	U 62.9	U 92.2
15EM056	U 4.03	U 4.92	U 4.03	U 4.03	U 4.03	U 24.2	U 48.3
15EM058	U 3.9	U 7.02	U 3.9	U 3.9	U 3.9	U 23.4	U 46.9
15EM061	U 4.22	U 13.6	U 4.22	U 4.22	U 4.22	U 28.6	U 43.3
15EM063	U 3.85	U 10.1	U 3.85	U 3.85	U 3.85	U 23.1	U 46.2
15EM065	U 5.9	U 10.7	U 4.15	U 4.79	U 4.73	U 35.4	U 24.9
15EM067	U 4.92	U 19.3	U 4.19	U 4.19	U 4.19	U 65.5	U 25.1
15EM069	U 7.43	U 12.7	U 4.11	U 4.11	U 4.11	U 24.7	U 68.4
15EM070	U 3.86	U 8.95	U 3.86	U 3.86	U 3.86	U 23.2	U 46.3
15EM071	U 5.56	U 9.32	U 4.08	U 4.08	U 4.08	U 33.1	U 24.5
15EM072	U 5.44	U 10.5	U 4.12	U 4.12	U 4.12	U 37.8	U 24.7
15EM077	U 4.19	U 10.4	U 4.19	U 4.19	U 4.6	U 34.8	U 25.1
15EM078	U 4.13	U 7.51	U 4.13	U 4.13	U 4.13	U 24.8	U 24.8
15EM079	U 4.24	U 15.8	U 4.24	U 4.24	U 4.24	U 41.9	U 25.4
15EM080	U 5.48	U 24	U 4.27	U 4.27	U 4.27	U 66.7	U 25.6
15EM081	U 5.59	U 8.15	U 4.08	U 4.08	U 4.08	U 24.6	U 24.5
15EM084	U 7.5	U 7.42	U 4.09	U 4.09	U 4.09	U 43.1	U 24.6
Field Blank	U 4.22	U 3.37	U 4.22	U 4.22	U 4.22	U 33.9	U 25.3
Field Blank	U 3.86	U 3.09	U 3.86	U 3.86	U 3.86	U 23.2	U 46.3
Field Blank	U 5.39	U 3.35	U 4.19	U 4.19	U 5.79	U 25.1	U 25.1

Table 8. Benzotriazoles and benzothiazoles

River Location	2-amino-benzothiazole	2-hydroxy-benzothiazole	2-methyl-thiobenzothiazole	4-hydroxy-benzotriazole	4-methyl-benzotriazole
15EM002	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM003	U 0.45	U 22	U 3.2	U 8.0	36
15EM004	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM009	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM010	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM014	U 0.45	U 22	U 3.2	U 8.0	14
15EM015	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM017	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM022	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM023	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM024	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM025	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM027	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM030	0.86	U 22	U 3.2	U 8.0	8.1
15EM032	U 0.45	U 22	U 3.2	U 8.0	2.6
15EM033	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM034	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM035	U 0.45	U 22	U 3.2	U 8.0	1500
15EM036	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM037	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM038	1.5	34	U 3.2	U 8.0	9.5
15EM039	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM040	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM043	0.76	U 22	U 3.2	U 8.0	7.7
15EM045	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM046	U 0.45	U 22	U 3.2	U 8.0	1.9
15EM047	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM049	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM050	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM051	U 0.45	U 22	U 3.2	U 8.0	23
15EM052	U 0.45	U 22	U 3.2	U 8.0	130
15EM053	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM054	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM055	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM056	U 0.45	U 22	U 3.2	U 8.0	57
15EM058	U 0.45	U 22	U 3.2	U 8.0	69
15EM061	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM063	U 0.45	U 22	U 3.2	U 8.0	1.2
15EM065	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM067	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM069	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM070	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM071	0.53	U 22	U 3.2	U 8.0	17

River Location	2-amino-benzothiazole	2-hydroxy-benzothiazole	2-methyl-thiobenzothiazole	4-hydroxy-benzotriazole	4-methyl-benzotriazole
15EM072	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM077	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM078	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM079	U 0.45	U 22	U 3.2	U 8.0	8.6
15EM080	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM081	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM084	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM015/Blank	U 0.45	U 22	U 3.2	U 8.0	0.69 (Z01a)
15EM038 FB	U 0.45	U 22	U 3.2	U 8.0	U 0.69
15EM052/ Blank	U 0.45	U 22	U 3.2	U 8.0	U 0.69

River Location	5,6-dimethyl-benzotriazole	5-chloro-benzotriazole	5-methyl-benzotriazole	Benzothiazole	Benzotriazole
15EM002	U 0.60	U 0.45	0.77	U 32	U 3.0
15EM003	1.2	U 0.45	12	U 32	58
15EM004	U 0.60		U 0.71	U 32	U 3.0
15EM009	U 0.60	U 0.45	U 0.71	U 32	U 3.0
15EM010	U 0.60	U 0.45	1.1	U 32	U 3.0
15EM014	0.83	U 0.45	3.6	U 32	8.3
15EM015	U 0.60	U 0.45	U 0.71	U 32	U 3.0
15EM017	U 0.60	U 0.45	U 0.71	U 32	U 3.0
15EM022	2.9	U 0.45	U 0.71	U 32	U 3.0
15EM023	2	U 0.45	1.2	U 32	U 3.0
15EM024	U 0.60	U 0.45	1.2	U 32	U 3.0
15EM025	U 0.60	U 0.45	U 0.71	U 32	U 3.0
15EM027	0.65	U 0.45	U 0.71	U 32	U 3.0
15EM030	1.2	U 0.45	7.2	U 32	4.4
15EM032	U 0.60	U 0.45	1.9	U 32	U 3.0
15EM033	U 0.60	U 0.45	U 0.71	U 32	9.6
15EM034	U 0.60	U 0.45	0.8	U 32	U 3.0
15EM035	9.4	U 0.45	460	U 32	1600
15EM036	U 0.60	U 0.45	U 0.71	U 32	U 3.0
15EM037	U 0.60	U 0.45	1	U 32	U 3.0
15EM038	0.98	U 0.45	9.3	40	8.5
15EM039	U 0.60	U 0.45	U 0.71	U 32	U 3.0
15EM040	3.2	U 0.45	U 0.71	U 32	U 3.0
15EM043	U 0.60	U 0.45	6.6	U 32	3.2
15EM045	U 0.60	U 0.45	U 0.71	U 32	U 3.0
15EM046	1.7	U 0.45	2.3	U 32	U 3.0
15EM047	1.7	U 0.45	0.73	U 32	U 3.0
15EM049	U 0.60	U 0.45	U 0.71	U 32	U 3.0
15EM050	U 0.60	U 0.45	U 0.71	U 32	U 3.0
15EM051	1.3	U 0.45	6.5	U 32	10

River Location	5,6-dimethyl-benzotriazole	5-chloro-benzotriazole	5-methyl-benzotriazole	Benzothiazole	Benzotriazole
15EM052	U 0.60	U 0.45	2.6	U 32	3.9
15EM053	U 0.60	U 0.45	U 0.71	U 32	U 3.0
15EM054	U 0.60	U 0.45	1.1	U 32	13
15EM055	U 0.60	U 0.45	U 0.71	U 32	U 3.0
15EM056	12	U 0.45	19	U 32	68
15EM058	1.8	U 0.45	20	U 32	160
15EM061	U 0.60	U 0.45	U 0.71	U 32	U 3.0
15EM063	2.4	U 0.45	1.7	U 32	U 3.0
15EM065	U 0.60	U 0.45	U 0.71	U 32	U 3.0
15EM067	2.2	U 0.45	U 0.71	U 32	U 3.0
15EM069	U 0.60	U 0.45	U 0.71	U 32	U 3.0
15EM070	1.8	U 0.45	U 0.71	U 32	U 3.0
15EM071	1.5	U 0.45	12	U 32	3.5
15EM072	1.5	U 0.45	U 0.71	U 32	U 3.0
15EM077	U 0.60	U 0.45	0.83	U 32	U 3.0
15EM078	U 0.60	U 0.45	U 0.71	U 32	U 3.0
15EM079	U 0.60	U 0.45	1	U 32	12
15EM080	5.9	U 0.45	U 0.71	U 32	U 3.0
15EM081	U 0.60	U 0.45	U 0.71	U 32	U 3.0
15EM084	U 0.60	U 0.45	U 0.71	U 32	U 3.0
15EM015/Blank	U 0.60	U 0.45	1.8 (Z01a)	55 (Z01a)	3.3 (Z01a)
15EM038 FB	U 0.60	U 0.45	0.9	U 32	U 3.0
15EM052/ Blank	U 0.60	U 0.45	1.1 (Z01)	54 (Z01a)	U 3.0

Table 9. Illicit and other drugs

River Location	MDMA	Amphetamine	Benzoylecgonine	Cocaine	Codeine	Methamphetamine	Morphine	Pseudoephedrine/ephedrine
15EM002	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM003	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	0.97
15EM004	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM009	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM010	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM014	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM015	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM017	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM022	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM023	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM024	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM025	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM027	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM030	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM032	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM033	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM034	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM035	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM036	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM037	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM038	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM039	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM040	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM043	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM045	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM046	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM047	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM049	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM050	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM051	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM052	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM053	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM054	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM055	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM056	U 0.50	U 1.1	1.5	U 0.47	U 7.9	16	U 9.1	11
15EM058	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM061	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM063	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM065	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM067	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM069	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM070	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM071	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78

River Location	MDMA	Amphetamine	Benzoylecgonine	Cocaine	Codeine	Methamphetamine	Morphine	Pseudoephedrine/ephedrine
15EM072	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM077	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM078	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM079	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM080	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM081	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78
15EM084	U 0.50	U 1.1	U 0.50	U 0.47	U 7.9	U 0.75	U 9.1	U 0.78

Appendix E

Laboratory analytical methods

Five separate analyses were performed to target the 146 compounds (see Table 1) analyzed in this study as described below.

Pharmaceuticals and personal care products

The pharmaceuticals and personal care products (PPCPs) selected for analysis were based on U. S. Environmental Protection Agency (EPA) Method 1694 with additional compounds incorporated into List 3 and an additional run for List 5 compounds. This expanded EPA 1694 analyte list represents those PPCP compounds identified by the EPA and other AXYS clients (AXYS Analytical Services, Sidney, BC, Canada) as priorities for assessment based on annual consumption, expected toxicity, and persistence. For analysis of List 1, 2, 3, and 5 compounds (Table C1), a 1.0 L sample was filtered (1.6 µm), adjusted to pH 2 by addition of HCl, spiked with a suite of isotopically labeled internal standards and extracted by solid phase extraction using an Oasis HLB cartridge. The extract was analyzed by LC/MS/MS operated in the ESI positive mode for List 1, 2, 5 and 6 compounds and analyzed in the ESI negative mode for List 3 compounds. Separate analysis runs and conditions were used for each of the lists of target analytes.

Hormones

A 1.0 L sample was filtered (1.6 µm), adjusted to pH 2 by addition of HCl, spiked with a suite of isotopically labeled internal standards, and extracted by solid phase extraction using an Oasis HLB cartridge. The extract was analyzed by LC/MS/MS operated in the ESI positive mode for the ESI+ hormones and by LC/MS/MS operated in the ESI negative mode for the ESI- hormones (Table 1).

Alkylphenols

An unfiltered 1.0 L sample was spiked with isotopically labeled internal standards, adjusted to pH 11 -12 by the addition of potassium carbonate solution, and acetylated with acetic anhydride. The extract was then acidified to pH 6 with HCl and extracted with hexane. Extracts were cleaned up by silica column chromatography and analyzed by GC/MS operated in the multiple ion detection (MID) mode.

Bisphenol A

A 0.5 L sample was filtered (1.6 µm), adjusted to pH 2 by addition of HCl, and spiked with deuterated bisphenol A internal standard and extracted by solid phase extraction using an Oasis HLB cartridge. The extract was analyzed by LC/MS/MS operated in the ESI negative mode.

Triclosan

A 0.5 L sample was filtered (1.6 µm), adjusted to pH 2 by addition of HCl, spiked with [^{13}C]-labeled triclosan, and extracted by solid phase extraction using an Oasis HLB cartridge. The extract was analyzed by LC/MS/MS operated in the ESI negative mode.

Illicit drugs

Samples were acidified to a final concentration of 0.1% v:v formic acid. A 1 mL aliquot of the sample was transferred to a micro-centrifuge tube to which isotopically labeled internal standards were added. The samples were then centrifuged to remove suspended solids and 500 µL of the supernatant was directly analyzed by large-volume injection HPLC-MS/MS. The MS/MS was operated using multiple reaction monitoring (MRM) in positive polarity and was interfaced with an ESI source.

Benzotriazoles/benzothiazoles

A 1.5 mL aliquot of each sample was transferred to an individual micro-centrifuge tube to which isotopically-labeled internal standards were added. The sample was then centrifuged to remove suspended solids and 900 µL of the supernatant was directly analyzed by large-volume injection HPLC-MS/MS. The MS/MS was operated under both positive and negative polarity and was equipped with an ESI source. Data were acquired by scheduled multiple reaction monitoring (MRM).

Quality control and assurance

All analytes were quantified either by isotope dilution internal standard quantification or, when an isotopically labeled analog of the analyte was unavailable, by internal standard methods using a related labeled compound. This produces accurate results that are recovery-corrected for losses during the analysis procedure and compensated for LC/MS/MS suppression or enhancement due to sample matrix. For each batch of samples analyzed, a lab blank was included to demonstrate that detected analytes were not due to lab background or other external contamination. Results for lab blanks were compliant with AXYS' statistically determined blank control limits (mean plus three standard deviations of about 30 blanks) and any detects were used to censor field sample results. Each analysis batch also included a "known" or quality control sample to demonstrate the accuracy of the method for each analyte. Recoveries of all added labeled standards were monitored to ensure that analyses were in control and meeting regular method specifications.

Table E1.

PPCP List 1	PPCP List 3	PPCP List 5
Acetaminophen	Bisphenol A	Paroxetine
Azithromycin	Furosemide	Prednisolone
Caffeine	Gemfibrozil	Prednisone
Carbadox	Glipizide	Promethazine
Carbamazepine	Glyburide	Propoxyphene
Cefotaxime	Hydrochlorothiazide	Propranolol
Ciprofloxacin	2-Hydroxy-ibuprofen	Sertraline
Clarithromycin	Ibuprofen	Simvastatin
Clinafloxacin	Naproxen	Theophylline
Cloxacillin	Triclocarban	Trenbolone
Dehydronifedipine	Triclosan	Trenbolone acetate
Diphenhydramine	Warfarin	Valsartan
Diltiazem		Verapamil
Digoxin	**PPCP List 4**	
Digoxigenin	Albuterol	**PPCP List 6**
Enrofloxacin	Amphetamine	Diatrizoic acid
Erythromycin-H2O	Atenolol	Iopamidol
Flumequine	Atorvastatin	Citalopram
Fluoxetine	Cimetidine	Tamoxifen
Lincomycin	Clonidine	Cyclophosphamide
Lomefloxacin	Codeine	Venlafaxine
Miconazole	Cotinine	Amsacrine
Norfloxacin	Enalapril	Azathioprine
Norgestimate	Hydrocodone	Busulfan
Ofloxacin	Metformin	Clotrimazole
Ormetoprim	Oxycodone	Colchicine
Oxacillin	Ranitidine	Daunorubicin
Oxolinic Acid	Triamterene	Doxorubicin
Penicillin G		Drospirenone
Penicillin V	**PPCP List 5**	Etoposide
Roxithromycin	Alprazolam	Medroxyprogesterone Acetate
Sarafloxacin	Amitriptyline	Metronidazole
Sulfachloropyridazine	Amlodipine	Moxifloxacin
Sulfadiazine	Benzoylecgonine	Oxazepam
Sulfadimethoxine	Benztropine	Rosuvastatin
Sulfamerazine	Betamethasone	Teniposide
Sulfamethazine	Cocaine	Zidovudine
Sulfamethizole	DEET	Melphalan
Sulfamethoxazole	Desmethyldiltiazem	
Sulfanilamide	Diazepam	**Alkylphenols**
Sulfathiazole	Fluocinonide	4-Nonylphenol monoethoxylates
Thiabendazole	Fluticasone propionate	4-Nonylphenol diethoxylates
Trimethoprim	Hydrocortisone	4-Nonylphenols
Tylosin	10-hydroxy-amitriptyline	Octylphenol
Virginiamycin	Meprobamate	
1,7-Dimethylxanthine	Methylprednisolone	**Bisphenol A**
	Metoprolol	
	Norfluoxetine	**Triclosan**
	Norverapamil	

Illicit Drugs	Benzotriazoles/thiazoles
MDMA	2-aminobenzothiazole
Benzoylecgonine	2-hydroxybenzothiazole
Cocaine	2-methylthiobenzothiazole
Methamphetamine	4-hydroxybenzotriazole
	4-methylbenzotriazole
	5,6-dimethylbenzotriazole
	5-chlorobenzotriazole
	5-methylbenzotriazole
	Benzothiazole
	Benzotriazole