Memorandum

MIAMI-DADE COUNTY

Date: January 10, 2008

Agenda Item No.8(D)(1)(B)

To: Honorable Chairman Bruno A. Barreiro and Members, Board of County Commissioners

From: George M. Burgess, County Manager

Subject: Resolution Authorizing Execution of Joint Funding Agreement No. 08E0FL208014 Between Miami-Dade County and the United States Geological Survey

Recommendation

It is recommended that the Board approve the attached resolution authorizing the execution of Joint Funding Agreement No. 08E0FL208014 between Miami-Dade County (County) and the United States Geological Survey (USGS) for analytical services developed and provided by the USGS but are not available through county laboratories or contracted laboratories.

Scope

Due to the sampling of wastewater generated throughout the County, these services are Countywide.

Fiscal Impact/Funding Source

The total estimated project cost of $240,000 will be equally split between the Miami-Dade County Water and Sewer Department and the Department of Environmental Resources Management (DERM).

Track Record/Monitor

The Director of DERM will monitor this contract.

Background

The Florida Department of Environmental Protection is strongly urging the County to recharge treated wastewater to the Biscayne Aquifer. Given the aquifer's exceptional vulnerability, wastewater reuse options must be assessed carefully for both existing public health-based water quality standards and for wastewater residuals having no water quality standards, including pharmaceutical drugs, hormones and antibiotics. In 2004, the USGS detected various trace residuals in treated effluent from the South District Wastewater Facility, including effluent further treated by advanced techniques during a pilot study.

For over three decades, most of the county's treated wastewater effluent has not been discharged into the Biscayne Aquifer because of the potential risk to public and private drinking water wells. The impact of state mandates to recharge the aquifer with treated wastewater must be carefully assessed by analyzing samples from the county wastewater facilities for the same suite of pollutants at the most sensitive levels. This includes sample analyses from the north and central regional wastewater facilities and from the City of Homestead facility that currently discharges effluent into the Biscayne Aquifer as allowed under the Florida Department of Environmental Protection discharge permit issued to the City of Homestead.

The services provided under USGS Agreement No. 08E0FL208014 include analyses for wastewater residuals from samples collected from the wastewater treatment facilities, groundwater wells and canal stations and analyzed for 220 constituents at parts per trillion levels. Neither DERM's laboratory nor private contract environmental labs can provide the full scope of specialized analytical services to be used for this project. The USGS is recognized as the lead research agency in developing and applying most of these analytical techniques and in assessing the presence of wastewater residuals in the nation's water supplies. The methods and results of this study will be published in a USGS Open-File Report or Journal article.

Assistant County Manager

MEMORANDUM

(Revised)

TO: Honorable Chairman Bruno A. Barreiro and Members, Board of County Commissioners

DATE: January 10, 2008

FROM: R. A. Cuevas, Jr. County Attorney

SUBJECT: Agenda Item No.8(D)(1)(B)

Please note any items checked.

_____ "4-Day Rule" ("3-Day Rule" for committees) applicable if raised

_____ 6 weeks required between first reading and public hearing

_____ 4 weeks notification to municipal officials required prior to public hearing

_____ Decreases revenues or increases expenditures without balancing budget

_____ Budget required

_____ Statement of fiscal impact required

_____ Bid waiver requiring County Manager's written recommendation

_____ Ordinance creating a new board requires detailed County Manager's report for public hearing

_____ Housekeeping item (no policy decision required)

_____ No committee review

Approved _____ Mayor
Veto _____
Override _____

Agenda Item No. 8(D)(1)(B)
01-10-08

RESOLUTION NO. _____

RESOLUTION AUTHORIZING EXECUTION OF JOINT FUNDING AGREEMENT NO. 08E0FL208014 BETWEEN MIAMI-DADE COUNTY AND THE UNITED STATES GEOLOGICAL SURVEY; AND AUTHORIZING THE MAYOR OR HIS DESIGNEE TO EXECUTE SAID AGREEMENT AND ANY AMENDMENTS THERETO

WHEREAS, this Board desires to accomplish the purposes outlined in the accompanying memorandum, a copy of which is incorporated herein by reference,

NOW, THEREFORE, BE IT RESOLVED BY THE BOARD OF COUNTY COMMISSIONERS OF MIAMI-DADE COUNTY, FLORIDA, that this Board approves Joint Funding Agreement No. 08E0FL208014 between Miami-Dade County and the U.S. Geological Survey for Water Resources Investigations, in substantially the form attached hereto and made part hereof; and authorizes the Mayor or his designee to execute said Agreement and any amendments thereto.

The foregoing resolution was offered by Commissioner _____ who moved its adoption. The motion was seconded by Commissioner _____ and upon being put to a vote, the vote was as follows:

Bruno A. Barreiro, Chairman
Barbara J. Jordan, Vice-Chairwoman

Jose "Pepe" Diaz	Audrey M. Edmonson
Carlos A. Gimenez	Sally A. Heyman
Joe A. Martinez	Dennis C. Moss
Dorrin D. Rolle	Natacha Seijas
Katy Sorenson	Rebeca Sosa
Sen. Javier D. Souto	

The Chairperson thereupon declared the resolution duly passed and adopted this 10th day of January, 2008. This resolution shall become effective ten (10) days after the date of its adoption unless vetoed by the Mayor, and if vetoed, shall become effective only upon an override by this Board.

MIAMI-DADE COUNTY, FLORIDA
BY ITS BOARD OF
COUNTY COMMISSIONERS

HARVEY RUVIN, CLERK

By:_____
Deputy Clerk

Approved by County Attorney as
to form and legal sufficiency.

PST

Peter S. Tell

ORIGINAL

Form 9-1366
(Oct. 2005)

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement

Customer #:	FL016
Agreement #:	08E0FL208014
Project #:	8-2080-CVB00
TIN #:	59-6000573
Fixed Cost Agreement	☑ Yes ☐ No

FOR
WATER RESOURCES INVESTIGATION

THIS AGREEMENT is entered into as of the 1st day of October, 2007, by the U.S. GEOLOGICAL SURVEY, UNITED STATES DEPARTMENT OF THE INTERIOR, party of the first part, and the MIAMI-DADE COUNTY, party of the second part.

1. The parties hereto agree that subject to availability of appropriations and in accordance with their respective authorities there shall be maintained in cooperation AN INVESTIGATION OF ORGANIC WASTEWATER COMPOUNDS, ANTIBIOTICS, HORMONES, AND PHARMACEUTICALS IN WASTEWATER, CANALS, AND GROUNDWATER IN MIAMI-DADE COUNTY, herein called the program. The USGS legal authority is 43 USC 36C; 43 USC 50; and 43 USC 50b.
2. The following amounts shall be contributed to cover all of the cost of the necessary field and analytical work directly related to this program. 2(b) includes In-Kind Services in the amount of $0.00.

(a) $0.00 by the party of the first part during the period January 01, 2008 **to** June 30, 2009

(b) $240,000.00 by the party of the second part during the period January 01, 2008 **to** June 30, 2009

(c) Additional or reduced amounts by each party during the above period or succeeding periods as may be determined by mutual agreement and set forth in a written amendment between the parties.

(d) The performance period may be changed by mutual agreement and set forth in a written amendment between the parties.

3. The costs of this program may be paid by either party in conformity with the laws and regulations respectively governing each party.
4. The field and analytical work pertaining to this program shall be under the direction of or subject to periodic review by an authorized representative of the party of the first part.
5. The areas to be included in the program shall be determined by mutual agreement between the parties hereto or their authorized representatives. The methods employed in the field and office shall be those adopted by the party of the first part to insure the required standards of accuracy subject to modification by mutual agreement.
6. During the course of this program, all field and analytical work of either party pertaining to this program shall be open to the inspection of the other party, and if the work is not being carried on in a mutually satisfactory manner, either party may terminate this agreement upon 60 days written notice to the other party.
7. The original records resulting from this program will be deposited in the office of origin of those records. Upon request, copies of the original records will be provided to the office of the other party.

5

Form 9-1366 continued

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement

Customer #:	FL016
Agreement #:	08E0FL208014
Project #:	8-2080-CVB00
TIN #:	59-6000573

8. The maps, records, or reports resulting from this program shall be made available to the public as promptly as possible. The maps, records, or reports normally will be published by the party of the first part. However, the party of the second part reserves the right to publish the results of this program and, if already published by the party of the first part shall, upon request, be furnished by the party of the first part, at costs, impressions suitable for purposes of reproduction similar to that for which the original copy was prepared. The maps, records, or reports published by either party shall contain a statement of the cooperative relations between the parties.

9. USGS will issue billings utilizing Department of the Interior Bill for Collection (form DI-1040). Billing documents are to be rendered **QUARTERLY**. Payments of bills are due within 60 days after the billing date. If not paid by the due date, interest will be charged at the current Treasury rate for each 30 day period, or portion thereof, that the payment is delayed beyond the due date. (31 USC 3717; Comptroller General File B-212222, August 23, 1983).

U.S. Geological Survey
United States
Department of the Interior

USGS Point of Contact

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Signatures

By_____ Date_____
Name: Dr. Barry Rosen
Title: DOI/USGS/FISC Director

By_____ Date_____
Name:
Title:

MIAMI-DADE COUNTY

Customer Point of Contact

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Email: bakerj@miamidade.gov

Signatures

By_____ Date_____
Name:
Title:

By_____ Date_____
Name:
Title:

ORGANIC WASTEWATER COMPOUNDS, ANTIBIOTICS, HORMONES, AND PHARMACEUTICALS IN WASTEWATER, CANALS, AND GROUNDWATER IN MIAMI-DADE COUNTY

USGS, FLORIDA INTEGRATED SCIENCE CENTER, FORT LAUDERDALE, FL
SEPTEMBER 14, 2007

ORGANIC WASTEWATER COMPOUNDS, ANTIBIOTICS, HORMONES, AND PHARMACEUTICALS IN WASTEWATER, CANALS, AND GROUNDWATER IN MIAMI-DADE COUNTY

Introduction and Background

Artificial recharge using treated wastewater, or reclaimed water, is becoming a widely utilized management technique to recharge aquifers in Florida and other parts of the U.S. (York et al. 2002; U.S. Environmental Protection Agency 2004; St. Johns River Water Management District 2006). Miami-Dade County, Florida operates three regional wastewater treatment facilities (North, Central and South Districts) that primarily dispose of treated effluent to ocean outfalls or by deep well injection into the saline, confined Boulder Zone of the Lower Floridan aquifer. To date, the reuse of highly treated wastewater has been limited in Miami-Dade County. Miami-Dade County, however, is seeking to increase the amount of wastewater reused from its regional wastewater treatment plants, and is actively pursuing reuse plans for aquifer recharge, irrigation, and wetland rehydration.

Prescription and non-prescription pharmaceuticals, human and veterinary antibiotics, personal care products, and reproductive hormones, are present in treated wastewater effluent, and have been detected in surface and ground waters near known sources of these constituents in the U.S. and other parts of the world. For simplicity, these compounds will be referred to as pharmaceuticals and other wastewater organics throughout the remainder of this document. Several studies have confirmed the presence of these compounds in wastewater effluent. Sando et. al. (2005) measured approximately 50-60 pharmaceuticals and other wastewater organics in treated wastewater effluent in South Dakota, and Lietz and Meyer (2006) reported that approximately 30-35 pharmaceuticals and other wastewater organics were present in treated effluent from Miami-Dade County, Florida. These compounds also have been detected in surface waters that receive wastewater discharges, and some of these constituents may be sufficiently mobile to be transported to the ground water. Kolpin et al. (2002) detected approximately 80 pharmaceuticals and other wastewater organics in water from streams in the U.S. near known contaminant sources. Cordy et. al. (2004) determined in a laboratory study that some pharmaceuticals and other wastewater organics, including carbamazapine, sulfamethoxazole, benzophenone, 5-methyl-1H-benzotriazole, N-N-diethyltoluamide (DEET), tributylphosphate, and tri(2-chloroethyl) phosphate, may potentially reach the ground water. Studies by Heberer et. al. (2004) and Barnes et. al. (2004) also indicated that selected constituents, such as carbamazapine, DEET, and tri(2-chloroethyl) phosphate, may be transported within the ground water system. Heberer et. al. (2004) detected carbamazapine and several other pharmaceuticals in public supply wells which were transported from a nearby stream by bank filtration. Barnes et. al. (2004) detected approximately 20 pharmaceuticals and other wastewater organics, including DEET, at wells downgradient from a municipal landfill, which suggested some of these constituents may be transported in the ground water system.

Pharmaceuticals and other wastewater organics present in the environment may have adverse effects on human and ecological health. The effects on human and ecological

health have not yet been fully evaluated (Kinney et. al., 2006), and no guidelines have been established regarding acceptable concentrations of these constituents in the environment. Adverse effects, however, are suspected because some pharmaceuticals are designed to modulate endocrine and immune systems, and these compounds may potentially act as endocrine disruptors in the environment (Ankley et al., 1998; Daughton and Ternes, 1999). Stream studies have documented that native bacterial populations display resistance to antibiotics (Daughton and Ternes, 1999), which may make illnesses more difficult to treat. The effects of some of the compounds are expected to be subtle and may not be observed until a substantial impact has occurred (Daughton and Ternes, 1999).

Problem Statement

Pharmaceuticals and other wastewater organics present in wastewater discharged to the land surface in Miami-Dade County may be transported to the highly transmissive Biscayne aquifer, and ultimately to potable water wells or sensitive coastal and surface water ecosystems. The types of pharmaceuticals and other organic wastewater compounds present in treated wastewater from facilities in Miami-Dade County may vary from previously reported results (Lietz and Meyer, 2006) due to the amount and type of urban and industrial wastes processed. Conn et. al. (2006) measured wastewater organics in onsite wastewater treatment systems and reported the number of compounds detected and the associated concentrations were greater for nonresidential sources compared to residential sources of contaminants.

Purpose and Scope

The purpose of this project is to further assess the occurrence of pharmaceuticals and other organic wastewater compounds, including NDMA, in treated effluent produced in Miami-Dade County, and determine whether these constituents are present in the ground water and a canal in the immediate vicinity of a site which artificially recharges the ground water. Detections of these constituents, if any, in the ground water and canal likely indicate contaminants associated with wastewater discharges are being transported through the hydrologic system. The scope of this study includes assessing all newly-collected data plus the information published by Lietz and Meyer (2006).

Approach

Water samples will be collected from three wastewater treatment facilities in the County and from wells and a canal in the immediate vicinity of a site which artificially recharges the ground water. Three wastewater facilities (North District, Central District, and the City of Homestead) will be sampled to define which pharmaceuticals and other wastewater organics are present, and determine the removal efficiencies from the various

facilities. The types and concentrations of pharmaceuticals and other wastewater organics likely differ among the wastewater treatment facilities proposed for sampling as part of this study. The North and Central District facilities receive domestic and varying amounts of industrial waste, whereas the Homestead facility primarily receives residential waste. A comparison of the effluent characteristics from these three facilities, combined with analytical results previously reported by Lietz and Meyer (2006) will provide for the determination of a broad array of pharmaceuticals and other organic wastewater compounds in treated wastewater, ground water, and canal water from the County. Ground water and canal sites near the Homestead facility will be sampled to determine whether pharmaceuticals and other wastewater organics which originated from discharges to soakage trenches at the Homestead facility have been transported to these environments.

Water samples will be collected and analyzed to determine concentrations of a broad suite of pharmaceuticals and other wastewater organics, N-Nitrosodimethylamine (NDMA), and pesticides. Monitoring of NDMA and pesticides also will be included because NDMA which may be formed in the wastewater treatment process and pesticides applied to upgradient urban and agricultural lands also may be transported the ground- and surface-water resources. NDMA is a potential human carcinogen, which may be formed when wastewater is disinfected. Grab influent and effluent water samples will be collected from the wastewater facilities during the daily high-flow period, which usually corresponds to 7:30 AM. These data will provide information on the presence and distribution of these constituents and their removal during the wastewater treatment process. This approach may not permit quantification of the removal of all constituents present in the wastewater, and some compounds likely will be detected in wastewater effluent samples that were not detected in influent. Lietz and Meyer (2006) determined more pharmaceuticals and other wastewater organics were present in treated wastewater samples compared to the influent, and Kroening (2004) determined more constituents were present in conventionally treated drinking water samples compared to the river water source. Both studies attributed the higher number of detections in the treated waters to the removal of matrix interference or solubility changes due to matrix conditions. Three groundwater monitoring wells will be sampled. Two wells will be located downgradient of the soakage trenches at the Homestead facility to assess the impact of tertiary treated effluent disposal to the ground water. This facility has discharged treated effluent for decades, initially to onsite percolation ponds and more recently, to on-site soakage trenches. The third monitoring well will be located upgradient of the Homestead facility to characterize background conditions. Water samples from two sites on the Mowry Canal will be sampled to determine whether any pharmaceuticals, other wastewater organics, NDMA, and pesticides that may be present in the ground water system and are transported to this surface water body. One of the stream sites will be located near the Homestead facility and the other site will be located near the discharge point to Biscayne Bay. Some of the pharmaceuticals and other wastewater organics transported to the canal may preferentially accumulate in the stream-bottom sediments (Kinney et. al., 2006). Stream-bottom sediment samples from the two canal sites also will be analyzed to determine concentrations of pharmaceuticals, antibiotics, and other wastewater organics. Any constituents present in the Mowry canal water or bottom

sediments may be rapidly transported to Biscayne Bay after rainfall events. Sampling will be conducted twice to document any seasonal occurrence of constituents. Some of the pharmaceuticals may be present at greater concentrations during the winter dry season due to an increased use of pharmaceuticals during the corresponding cold and flu season. All sampling activities will be coordinated with samples collected by the County to assess the concentration of inorganic and organic compounds, metals, nutrients, and microbiological constituents using conventional field and laboratory techniques.

A suite of approximately 220 constituents, including pharmaceuticals, pesticides, and other wastewater organics (tables 1 through 5) will be analyzed in the water samples. Water samples analyzed according to Zaugg et al. (in press) also will include a library screen of non-target analytes to maximize detection of all compounds of interest. Groundwater samples collected during the second sampling event may be analyzed using instrumentation capable of lower detection limits for the constituents cited in table 1 and screened for non-target analytes if earlier analytical data obtained from the first sample set indicates the water matrix is suitable for analysis on this instrument. Analyses for organic wastewater compounds and prescription and non-prescription drugs will be performed at the USGS National Water-Quality Laboratory (NWQL) in Denver, Colorado. Organic wastewater compounds will be analyzed in unfiltered samples using gas chromatography/mass spectrometry according to Zaugg et al. (in press). The analytical schedule for unfiltered wastewater organics samples contains most of the analytes previously measured by Lietz and Meyer (2006), and offer lower reporting limits when compared to the filtered method. Analysis of unfiltered samples also will permit detection of any wastewater organics that may by sorbed onto suspended sediment particles. Prescription and non-prescription drugs will be analyzed in filtered samples using high performance liquid chromatography/mass spectrometry according to Cahill et al. (2004). Human and veterinary antibiotics and hormones will be analyzed in filtered samples at the USGS Organic Geochemistry Laboratory in Lawrence, Kansas. Antibiotics will be determined using high performance liquid chromatography/mass spectrometry according to Kolpin et al. (2002). The USGS NWQL recently completed validation and implementation of a new method for the analysis of 19 hormones and sterols using GS/MS/MS that potentially are now available [October 2007]. Samples will be analyzed for this suite of hormones using the GS/MS/MS in lieu of the ELISA-based method if the new method is available.

A suite of approximately 80-100 pharmaceuticals, antibiotics, and other wastewater organics will be analyzed in stream bottom sediments. Pharmaceuticals and organic wastewater constituents to be analyzed are listed in tables 6 and 7. Pharmaceuticals will be analyzed by LC/MS as described by Kinney et. al. (2006), and wastewater organics will be analyzed by GC/MS as described by Burkhardt et. al. (2006).

The USGS NWQL is NELAC accredited by the Florida State Department of Health for the suite of compounds listed in table 5. There is no accreditation for the other compounds for two reasons. The remaining compounds are not on the accrediting agency's list of compounds, and there are no performance test samples available for this suite of analytes.

Water samples will be collected according to USGS protocol (Wilde et al., 2006) to prevent contamination and minimize degradation of organic compounds. All sampling equipment will be constructed of inert materials; such as teflon, glass, or stainless steel; to minimize sample contamination. Samples requiring filtration will be filtered through a 0.7-micron nominal pore size filter that was precombusted at 450 degrees Celsius to remove all organic residues. As part of the equipment decontamination procedure, all sampling equipment will be rinsed with pesticide-grade methanol to remove any organic compounds sorbed onto the equipment. Samples collected for analysis of compounds such as antibiotics, personal care products, and pharmaceuticals, are susceptible to contamination because these compounds are ubiquitous in daily use. To minimize sample contamination, field personnel will avoid or minimize contact with products containing caffeine, DEET, fragrances, over-the-counter medications, sunscreen, and tobacco. Some of the analyzed compounds degrade in the presence of chlorinated water, such as wastewater effluent. To prevent degradation and maximize constituent recoveries, water samples collected for analysis of pharmaceuticals, organic wastewater constituents, and antibiotics will be preserved with pH 7 buffer and ascorbic acid.

Quality Assurance

Quality-assurance samples will be collected to quantify that: (1) the grab influent and effluent samples were representative of concentrations in the waste stream throughout the day, (2) bias and precision of the data, and (3) constituent recoveries in the sampled matrix. To verify that grab influent and effluent samples were representative of the waste stream throughout the day, composite influent and effluent samples will be collected at the three facilities. Composite samples will be prepared by collecting six grab influent and effluent samples at four-hour intervals during the day. The six grab samples will be composite sample (individual samples are physically combined and mixed into a single sample in a Teflon churn splitter) prior to filtration. Field blank, replicate, and matrix spike samples will be prepared to document the bias and precision of the data and constituent recoveries. Field blank samples will be prepared to quantify the amount of contamination bias during each wet and dry season sampling event using water certified by the USGS to be free of the analytes in tables 1-5. A replicate effluent and groundwater sample will be collected during each sampling event to quantify the precision in the data, and an effluent and groundwater sample will be spiked for the constituents listed in tables 1 and 2 during each sampling event. Spike solutions are not readily available to USGS field personnel for the remaining analytes.

Relevance and Benefits

Water-quality impacts of artificial recharge are an issue within the State of Florida as well as other parts of the Nation. This study will collect data which will assist the Miami-Dade County in determining which pesticides, semi-volatile organic compounds,

pharmaceuticals, and other wastewater organics are present in effluent in wastewater treatment facilities operated within the County and evaluate the effect of wastewater disposal on ground-water quality. The proposed work is consistent with the Mission of the USGS Cooperative Water Program, which is to provide reliable, impartial, and timely information needed to understand the Nation's water resources, and also addresses several high-priority issues for the USGS Federal-State Cooperative Program. These high priority issues include providing information which will:1) assist the State and County protect the quality of the ground-water resources, 2) describe contaminants potentially affecting the coastal zones of Florida, and 3) describe the occurrence of potentially harmful contaminants in the ground water.

Products

The methods and results of this study will be published in a USGS Open-File Report or Journal article.

Personnel and Funding

The project would be conducted by a part-time GS-15 Research Hydrologist with experience in water-quality investigations. A part-time GS-14 Research chemist will assist interpreting any hormone data analyzed by the GS/MS/MS method. A GS-11 Hydrologic technician and GS-9 Hydrologist will assist in data-collection activities. Project costs will total $240,000 and will be contributed by Miami-Dade County.

Project Timeline

The study will be conducted over a 1 ½ year period, beginning on. January 1, 2007 and ending on June 30, 2007. Scheduling of tasks is shown below:

Task	Jan-March	April-June	July-Sept	October-December	January - March	April-May
Site Reconnaissance						
Dry season EPOCS sampling						
Wet season EPOCS sampling						
Review water-quality data						
Write and publish final data report						

References

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Table 1. Organic wastewater compounds analyzed in water samples, method reporting levels, and possible sources or uses of compounds.

[Values shown in micrograms per liter]

Compound	Method reporting level	Possible sources or uses of compound
Acetophenone	0.2	Fragrance in detergent, tobacco
Acetyl-hexamethyl-tetrahydro-naphthalene (AHTN)	0.2	Musk fragrance
3-*tert*-Butyl-4-hydroxyanisole (BHA)	0.2	Antioxidant, general preservative
Anthracene	0.2	Wood preservative, component of tar, diesel, crude oil
Anthraquinone	0.2	Used in manufacture of dye/textiles, seed treatment, bird repellant
Atrazine	0.2	Herbicide
Benzo[*a*]pyrene	0.2	Regulated polycyclic aromatic hydrocarbon, used in cancer research
Benzophenone	0.2	Fixative for perfumes and soaps
Hexahydrohexamethyl cyclopentabenzopyran (HHCB)	0.2	Musk fragrance
5-Methyl-1H-benzotriazole	1.6	Antioxidant in antifreeze and deicers
1,4-Dichlorobenzene	0.2	Moth repellant, fumigate, deodorant
Bisphenol A	0.4	Used in manufacture of polycarbonate resins, antioxidant
Bromacil	0.2	General use pesticide
Bromoform	0.2	Wastewater ozination by-product, military explosives
Caffeine	0.2	Beverages, diuretic
Camphor	0.2	Flavor, odorant, ointments
Carbaryl	0.2	Insecticide, crop and garden uses
Carbazole	0.2	Insecticide, manufacture of dyes, explosives, lubricants
Chlorpyrifos	0.2	Insecticide, domestic pest and termite control
Cholesterol	0.8	Fecal indicator, plant sterol
Triethyl citrate (ethyl citrate)	0.2	Cosmetics, pharmaceuticals
Cotinine	0.8	Primary nicotine metabolite
3 Beta-coprostanol	0.8	Carnivore fecal indicator
para-Cresol	0.2	Wood preservative
Diazinon	0.2	Insecticide, nonagricultural uses, ants, flies
Dichlorvos	0.2	Insecticide, pet collars, flies
2,2',4,4'-Tetrabromodiphenyl ether	0.2	
Fluoranthene	0.2	Component of coal tar and asphalt
Indole	0.2	Pesticide inert ingredient, fragrance in coffee
3-Methyl-1H-indole (skatol)	0.2	Fragrance, stench in feces, coal tar
Isoborneol	0.2	Fragrance in perfumes, disinfectants
3,4-Dichlorophenyl isocyanate	2	
Isophorone	0.2	Solvent for lacquer, plastic, oil, silicon, resin
Isopropylbenzene (cumene)	0.2	Manufacture of phenol/acetone, fuels, and paint thinner
Isoquinoline	0.2	Flavors and fragrances
d-Limonene	0.2	Fungicide, antmicrobial, antiviral, fragrance in aerosols

Compound	Method reporting level	Possible sources or uses of compound
Menthol	0.2	Cigarettes, cough drops, liniment, mouthwash
Metalaxyl	0.2	Herbicide, fungicide, mildew, blight, pathogens, golf/turf
Methyl salicylate	0.2	Liniment, food, beverage, ultraviolet-absorbing lotion
Metolachlor	0.2	Herbicide, indicator of agricultural drainage
Naphthalene	0.2	Fumigant, moth repellent
2,6-Dimethylnaphthalene	0.2	Present in diesel fuel, kerosene
1-Methylnaphthalene	0.2	Gasoline, diesel fuel, crude oil
2-Methylnaphthalene	0.2	Gasoline, diesel fuel, crude oil
4-Cumylphenol	0.2	Nonionic detergent metabolite
para-Nonylphenol (total)	1.6	Nonionic detergent metabolite
monoethoxy-Nonylphenol	2.0	Nonionic detergent metabolite
4-Nonylphenol diethoxylates	3.2	Nonionic detergent metabolite
4-*n*-Octylphenol	0.2	Nonionic detergent metabolite
4-*tert*-Octylphenol	0.2	Nonionic detergent metabolite
4-Octylphenol diethoxylates	0.32	Nonionic detergent metabolite
4-octylphenol monoethoxylates	1.0	Nonionic detergent metabolite
Pentachlorophenol	0.8	Herbicide, fungicide, wood preservative, termite control
Phenanthrene	0.2	Explosives, tar, diesel fuel, crude oil
Phenol	0.2	Disinfectant
Tributyl phosphate	0.2	Plasticizer, resin, wax, finish, roofing paper
bis(2-ethylhexyl) phthalate	2	
Diethyl phthalate	0.2	
Triphenyl phosphate	0.2	Plasticizer, resin, wax, finish, roofing paper
Tris(2-butoxyethyl) phosphate	0.2	Flame retardant
Tris(2-chloroethyl) phosphate	0.2	Plasticizer, flame retardant
Tris(dichloroisopropyl) phosphate	0.2	Flame retardant
Prometon	0.2	Herbicide, applied prior to blacktop
Pyrene	0.2	Component of coal tar and asphalt
beta-Sitosterol	0.8	Plant sterol
beta-Stigmastanol	0.8	Plant sterol
N,N-diethyl-*meta*-toluamide (DEET)	0.2	Mosquito repellent
Tetrachloroethylene	0.4	Solvent, degreaser, veterinary anthelminthic
Triclosan	0.2	Disinfectant, antimicrobial

Table 2. Pesticides analyzed in water samples and method reporting limits.

[Values shown in micrograms per liter]

Compound	Method reporting level
1_Napthol	0.088
2-Chloro-2,6-diethylacetanalide	0.007
2-Ethyl-6-methylaniline	0.010
3,4-Dichloroaniline	0.005
4-Chloro-2-methylphenol	0.005
Acetochlor	0.006
Alachlor	0.005
2,6-Diethylaniline	0.006
Atrazine	0.007
Azinphos-methyl	0.050
Azinphos-methyl-oxon	0.042
Benfluralin	0.010
Carbaryl	0.041
Chlorpyrifos	0.005
Chlorpyrifos, oxygen analog	0.056
cis-Permethrin	0.006
Cyfluthrin	0.053
Cypermethrin	0.046
Dacthal	0.003
2-Chloro-4-isopropylamino-6-amino-s-triazine (CIAT)	0.014
Diazinon	0.005
Diazinon, oxygen analog	0.006
Dichlorvos	0.013
Dicrotophos	0.084
Dieldrin	0.009
Dimethoate	0.006
Ethion	0.016
Ethion monoxon	0.021
Fenamiphos	0.029
Fenamiphos sulfone	0.053
Fenamiphos sulfoxide	0.040
Desulfinylfipronil amide	0.029

Compound	Method reporting level
Fipronil sulfide	0.013
Fipronil sulfone	0.024
Desulfinylfipronil	0.012
Fipronil	0.016
Fonofos	0.005
Hexazinone	0.026
Iprodione	0.026
Isofenphos	0.011
Malaoxon	0.039
Malathion	0.027
Metalaxyl	0.007
Methidathion	0.009
Parathion-methyl	0.015
Metolachlor	0.006
Metribuzin	0.028
Myclobutanil	0.033
Paraoxon-methyl	0.019
Pendimethalin	0.022
Phorate	0.055
Phorate oxygen analog	0.027
Phosmet	0.008
Phosmet oxon	0.051
Prometon	0.010
Prometryn	0.006
Propyzamide	0.004
Simazine	0.005
Tebuthiuron	0.016
Terbufos	0.017
Terbufos oxygen analog sulfone	0.045
Terbuthylazine	0.008
Tribufos	0.035
Trifluralin	0.009

Table 3. Human and veterinary antibiotics analyzed in water samples and method reporting limits.

[Values shown in micrograms per liter]

Compound	Method reporting level
Carbamazapine	0.005
Ibuprofen	0.050
Azithromycin	0.005
Erythromycin	0.008
Erythromycin-H_2O	0.008
Roxithromycin	0.005
Tylosin	0.005
Virginiamycin	0.005
Ciprofloxacin	0.005
Lomefloxacin	0.005
Norfloxacin	0.005
Ofloxacin	0.005
Sarafloxacin	0.005
Enrofloxacin	0.005
Sulfachloropyridazine	0.005
Sulfadiazine	0.050
Sulfadimethoxine	0.005
Sulfamethazine	0.005
Sulfamethoxazole	0.005
Sulfathiazole	0.020
Chlorotetracycline	0.010
Epi-chlorotetracycline	0.010
Iso-chlorotetracycline	0.010
Epi-iso-chlorotetracycline	0.010
Doxycycline	0.010
Oxytetracycline	0.010
Epi-oxytetracycline	0.010
Tetracycline	0.010
Epi-tetracycline	0.010
Lincomycin	0.005
Trimethoprim	0.005
Chloramphenicol	0.010
Ormetoprim	0.005

Table 4. Prescription and non-prescription pharmaceuticals analyzed in water samples and method reporting limits.

[Values shown in micrograms per liter]

Compound	Method reporting level
1,7-dimethylxanthine	0.144
Codeine	0.015
Caffeine	0.016
Thiabendazole	0.011
Albuterol (Salbutamol)	0.023
Acetaminophen	0.036
Cotinine	0.014
Dehydronifedipine	0.015
Carbamazapine	0.011
Trimethoprim	0.013
Warfarin	0.012
Diphenhydramine	0.015
Sulfamethoxazole	0.064
Diltiazem	0.016
Ibuprofen	0.042
Ranitidine	0.013
Cimetidine	0.012
Fluoxetine	0.014
Gemfibrozil	0.013
Erythromycin	0.009
Azithromycin	0.004
Miconazole	0.018
Metformin	N/D

Table 5. Semivolatile organic compounds analyzed in water samples and method reporting limits.

Compound	Method reporting level
Dibenz[a,h]anthracene	0.70
Chyrsene	0.33
bis(2-chloroisopropyl) ether	0.38
2,4-dimethylphenol	0.37
4,6-dinitro-2-methylphenol	0.77
4-bromophenylphenylether	0.36
4-chlorophenyl phenyl ether	0.34
Fluorene	0.33
Acenaphthene	0.28
Acenaphthylene	0.30
Anthracene	0.39
Benz[a]anthracene	0.26
1,2,4-trichlorobenzene	0.41
Hexachlorobenzene	0.30
1,3-dichlorobenzene	0.57
Nitrobenzene	0.21
1,2-dichlorobenzene	0.49
1,4-dichlorobenzene	0.53
Benzidine	1000
3,3'-dichlorobenzidine	0.65
Benzo[a]pyrene	0.33
Benzo[b]fluoranthene	0.40
Benzo[ghi]perylene	0.64
Benzo[k]fluoranthene	0.45
bis(2-chloroethyl) ether	0.30
Hexachlorobutadiene	0.46
Hexachlorocyclopentadiene	0.52
N-nitrosodi-n-propylamine	0.82
N-nitrosodimethylamine (NDMA)	0.33

Compound	Method reporting level
N-nitrosodiphenylamine	0.81
Hexachloroethane	0.66
Fluoranthene	0.30
1,2-diphenylhydrazine	0.30
Indeno[1,2,3-cd]pyrene	0.56
Isophorone	0.60
4-chloro-3-methylphenol	0.55
bis(2-chloroethoxy)methane	0.35
Naphthalene	0.32
2-chloronaphthalene	0.38
Phenanthrene	0.32
Phenol	0.44
2,4,5-trichlorophenol	0.31
2,4-dichlorophenol	0.39
2,4-dinitrophenol	0.80
2-chlorophenol	0.42
2-nitrophenol	0.30
4-nitrophenol	0.51
Pentachlorophenol	0.87
bis(2-ethylhexyl) phthalate	1.05
Butylbenzyl phthalate	1.26
Di-n-butyl phthalate	0.87
Diethyl phthalate	0.61
Dimethyl phthalate	0.59
Di-n-octyl phthalate	1.86
Pyrene	0.35
2,4-dinitrotoluene	0.43
2,6-dinitrotoluene	0.43

Table 6. Organic wastewater compounds analyzed in sediment samples and method reporting levels.

[Values shown in micrograms per kilogram]

Compound	Method reporting level
Acetophenone	150
Acetyl-hexamethyl-tetrahydro-naphthalene (AHTN)	50
3-*tert*-Butyl-4-hydroxyanisole (BHA)	150
Anthracene	50
Anthraquinone	50
Atrazine	100
Benzo[*a*]pyrene	50
Benzophenone	50
Hexahydrohexamethyl cyclopentabenzopyran (HHCB)	50
Bisphenol A	50
Bromacil	500
Camphor	50
Carbazole	50
Chlorpyrifos	50
Cholesterol	250
Triethyl citrate (ethyl citrate)	0.2
Cotinine	0.8
3 Beta-coprostanol	500
para-Cresol	250
Diazinon	50
2,2',4,4'-Tetrabromodiphenyl ether	50
1,4-dichlorobenzene	50
Fluoranthene	50
Indole	100
3-Methyl-1H-indole (skatol)	50
Isoborneol	50
Isophorone	50
Isopropylbenzene (cumene)	100
Isoquinoline	100
d-Limonene	50

Compound	Method reporting level
Menthol	50
Metolachlor	50
Naphthalene	50
2,6-Dimethylnaphthalene	50
1-Methylnaphthalene	50
2-Methylnaphthalene	50
4-Cumylphenol	50
para-Nonylphenol (total)	500
4-Nonylphenol diethoxylates	1000
4-Nonylphenol	750
4-*n*-Octylphenol	50
4-*tert*-Octylphenol	50
4-Octylphenol diethoxylates	50
4-octylphenol monoethoxylates	250
Phenanthrene	50
Phenol	50
Tributyl phosphate	50
bis(2-ethylhexyl) phthalate	250
Diethyl phthalate	100
Triphenyl phosphate	50
Tris(2-butoxyethyl) phosphate	150
Tris(2-chloroethyl) phosphate	100
Tris(dichloroisopropyl) phosphate	100
Prometon	50
Pyrene	50
beta-Sitosterol	500
beta-Stigmastanol	500
N,N-diethyl-*meta*-toluamide (DEET)	100
Triclosan	50

Table 7. Prescription and non-prescription pharmaceutical compounds analyzed in sediment samples and method reporting levels.

[Values shown in micrograms per kilogram]

Compound	Method reporting level
Cotinine	1.30
Salbutamol	1.09
Cimetidine	0.88
Acetaminophen	0.76
1,7-dimethylxanthine	2.03
Trimethoprim	1.47
Diltiazem	1.48
Fluoxetine	2.17
Warfarin	1.26
Gemifibrozil	5.46
Caffeine	1.33
Sulfamethoxazole	1.58
Dehydronifedipine	1.69
Codeine	1.32
Thiabendazole	1.04
Diphenhydramine	1.35
Erythromycin	1.66
Carbamazapine	1.65
Miconazole	0.97

Table 8. Hormone compounds

Compound	Method reporting level
Analyte	
11-Ketotestosterone	0.8
17-alpha-Estradiol	0.8
17-alpha-Ethynylestradiol-2,4,16,16-d4	
17-beta-Estradiol	0.8
17-beta-Estradiol-d4	
17-alpha-Ethynylestradiol	0.8
Norethindrone-2,2,4,6,6,10-d6	
Norethindrone	0.8
4-Androsten-3,17-dione	2
4-Androstene-3,17-dione-2,2,4,6,6,16,16-d7	
cis-Androsterone	0.8
Cholesterol	4000
Cholesterol-d7	
3-beta-Coprostanol	4000
trans-Diethyl-1,1,1',1'-d4-stilbesterol-3,3',5,5'-d4	
Epitestosterone	4
Equilenin	2
Equilin	4
Estriol	0.8
Estriol-2,4,17-d3	
Estrone	0.8
Estrone-2,4,16,16-d4	
Mestranol	0.8
Mestranol-2,4,16,16-d4	
Progesterone	4
Progesterone-2,2,4,6,6,17a,21,21,21-d9	
Sample volume	
Stan lone	0.8
Stanolone-1,2,4,5a-d4	
trans-Diethylstilbestrol	0.8
Testosterone	0.8
Testosterone-2,2,4,6,6-d5	