Testimony of Paul Rush, P.E.
Deputy Commissioner for Water Supply
New York City Department of Environmental Protection
(DEP)
before the Council of the City New York
Committee on Environmental Protection
concerning Pharmaceuticals in Drinking Water

City Hall, April 3, 2008

Good morning, Chairman Gennaro and Members of the Committee. I am Paul Rush, Deputy Commissioner for Water Supply at DEP. On behalf of Commissioner Emily Lloyd, thank you for the opportunity to speak to the Committee and the public on the concerns that have been raised about the presence of trace pharmaceuticals in water supply systems nationwide. DEP has worked closely on this issue with our colleagues at the Department of Health and Mental Hygiene. I am very pleased to be joined this morning by one of those colleagues - Jessica Leighton, Deputy Commissioner for Environmental Health. I am also joined by Steve Schindler, Director of Water Quality for DEP.

While it is certainly disconcerting to the public to learn that even minute amounts of foreign substances have been found in drinking water across the United States, the compounds in question are present in amounts so small they are barely detectable using the most advanced scientific methods available. At such low levels, the United States Environmental Protection Agency (EPA) has affirmed there are no known health impacts associated with the presence of trace amounts of pharmaceuticals in the water supply. Because pharmaceuticals do not represent an active threat to public drinking

water supplies, they are not regulated by EPA as a class of contaminants under the Safe Drinking Water Act. As I will explain more in the course of my testimony, because New York City tap water is very closely monitored, we know that it remains safe and among the best in the world. So I want to discourage New Yorkers from unnecessarily pursuing expensive and environmentally less desirable bottled alternatives to the public drinking water supply. Just as a point of fact, bottled water is not subject to the same high level of regulatory scrutiny as public water supplies.

To give you a sense of scale, based on the parts-per-trillion levels of pharmaceutical compounds detected in some water supply systems nationally, a person would have to drink one million glasses of water to get the dose of even one over-the-counter ibuprofen tablet or the caffeine in one cup of coffee. Even at eight glasses of water per day, this would take the average person over 300 years to consume.

Because of technological advances in monitoring, scientists are now able to detect extremely small quantities of compounds in water that historically may have been present although they were never able to be detected. As water suppliers learn how to detect ever smaller quantities of substances, we will continue to work with scientists, regulators, other water suppliers and public health officials on what conclusions, if any, may be drawn from the monitoring data. EPA maintains an active program called the Contaminant Candidate List (CCL) to identify contaminants in public drinking water that warrant more detailed study. The CCL does not include any personal care products or pharmaceuticals. To continue to protect the health of New Yorkers, DEP has been tracking research on this emerging issue for several

years now – as has much of the water utility industry – and we will continue to closely monitor all new research.

The rest of my testimony is a lengthier response to five key questions that have arisen with respect to these compounds:

- What kinds of compounds are covered by "pharmaceuticals"?
- How do they get into the water?
- When did water suppliers start testing for them?
- How can we keep them out of the water?
- What are the impacts of having them in the water?

What do water suppliers mean by "pharmaceuticals?"

To water suppliers the term "pharmaceuticals" is often shorthand for a broad class of organic compounds, including both pharmaceuticals and personal care products, which are being studied by researchers, regulators and water suppliers. The industry jargon for these two types of compounds is "Pharmaceuticals and Personal Care Products," also known by the acronym "PPCPs." That acronym generally refers to any product used by individuals for personal health or cosmetic reasons. In this statement the term "pharmaceuticals" will be used in preference to that acronym.

Pharmaceuticals comprise a diverse collection of thousands of chemical substances, including prescription and over-the-counter therapeutic drugs, veterinary drugs, fragrances and cosmetics. Although caffeine is not, strictly speaking, exclusively either a pharmaceutical or a personal care product, because of its prevalence in our diet it is often lumped together with the other organic compounds that are clearly PPCPs by definition.

How do pharmaceuticals and personal care products get into the water supply?

Pharmaceuticals have probably been present in water and the environment for as long as we have been using them. The simple reason is that the pharmaceuticals are not entirely absorbed by our bodies and are therefore excreted and passed into wastewater and then into the surface waters, into which wastewater eventually flows. In addition, disposal of unused pharmaceuticals into toilets or sinks also contributes to their presence in the water environment.

We are fortunate in New York City that our source waters are well protected and that in our upstate watersheds, most byproducts of human waste are removed at wastewater treatment plants. These wastewater treatment plants use an advanced level of treatment -- called tertiary treatment -- to protect the watershed, a level of treatment that is funded by New York City. Quite apart from the treatment provided at watershed treatment plants, New York City's watershed also has an enormous capacity to purify water naturally. Moreover, many physical impurities are removed in the course of settling out as water moves into and out of the various reservoirs. Bacteria and other disease-causing organisms simply die off because they cannot survive in the natural environment during the days, weeks and months it takes for water to travel from upstate reservoirs through our aqueducts and tunnels.

Some pharmaceuticals are easily broken down and processed by the human body; others naturally degrade in the environment. But some compounds are not easily broken down and processed, so they can remain in the treated

effluent discharged by a wastewater treatment plant in the watershed. Because only recently did the technology advance enough to allow detection of these substances at the very minute levels at which they occur in the environment, there is not yet a convincing body of data demonstrating the extent to which pharmaceuticals are removed during various types of treatment processes found at either wastewater or drinking water treatment plants.

Does New York City test its water supply for pharmaceuticals?

New York City tests its finished tap water -- which is the term we use for water that is ready to be distributed for consumption -- for approximately 240 chemical constituents, well above regulatory requirements. The City performs more than 1,200 tests daily; 35,000 monthly; and 420,000 on an annual basis from up to 1,000 sampling locations throughout the City. Test results are reported to our regulators and are summarized in our annual report on the quality of New York City's drinking water.

However, like other water suppliers nationwide, DEP does not routinely test its water supply for pharmaceuticals. In fact there is no regulator-approved test or regimen for detecting pharmaceuticals in drinking water supplies. We are technically able, though, to detect the presence of caffeine in the distribution system. Based on that detection we know it is present in an extremely small amount, at the parts-per-trillion level. What we know about the presence of pharmaceuticals in our own water supply comes from papers published by researchers using data obtained from our system or systems like ours elsewhere in the State and nation.

For example, in June 2006 researchers working for the Center for Environmental Health at the New York State Department of Health (NYSDOH) published a paper based on 2003 and 2004 sampling data from twelve sites in the New York City watershed. In that paper, the authors noted that they found traces of caffeine in six of 240 samples of water taken from New York City reservoirs. Seven of 240 samples were positive for ibuprofen. However, the paper's authors noted that these ibuprofen and caffeine results could have been caused by sampling errors or contamination. The authors concluded that reservoir samples did not have consistently detectable concentrations of pharmaceuticals.

On the other hand, samples of treated effluent from four sewage treatment plants in the watershed did consistently show very low-level traces of pharmaceuticals in the water discharged from the plants. In both cases, the samples were taken from locations upstate, at some distance from our consumers.

At this point, there is a large body of literature on pharmaceuticals in the environment, although only approximately 40 papers deal with the presence of pharmaceuticals in treated drinking water. One paper of direct relevance to New York City was just mentioned. Other papers of particular interest to New York City have been prepared by researchers working for the United States Geological Survey. There are also many national and international studies on pharmaceuticals in the aquatic environment, biosolids, and other media. The EPA hosts a website devoted to the pharmaceutical issue, which provides very useful information. In general, this literature points to the conclusion that low levels of pharmaceuticals are consistently detectable in

the effluent from wastewater treatment plants and in most surface water bodies.

How can we keep pharmaceuticals out of the water?

The scientific community is in the process of generating better information about the detection of water-borne pharmaceuticals, which is essential to studying the fate of these chemicals as they travel through a water system. One report (Phillips et al., February 2005) based on New York State data suggests that conventional wastewater treatment plant processes are effective in removing significant amounts of these compounds. The paper concludes that more research is required to more conclusively establish the fate of pharmaceuticals as they are subjected to different types of treatment. At this point it is far too early for DEP to make any predictions about the long-term need for any particular treatment technology as a response to the presence of pharmaceuticals.

DEP will be participating with our City and State Health colleagues as part of a New York State roundtable to evaluate pharmaceutical disposal issues in relation to source water and environmental protection. In addition, we are committed to working with our State colleagues and watershed partners to design an upstate outreach campaign, encouraging watershed residents to properly dispose of pharmaceuticals so that, whenever possible, they are not introduced into the watershed.

What are the impacts of having pharmaceuticals in the water at this level?

Under the Safe Drinking Water Act, EPA is charged with establishing regulations assuring the safety of the nation's drinking water. To date,

pharmaceuticals have not been identified as contaminants of concern because EPA does not believe that pharmaceuticals present a human health risk.

With respect to non-human impacts, I can report that studies have found that, in some areas, the pharmaceuticals found in wastewater treatment plant effluent may affect the health of fish and other aquatic organisms that live in receiving waters. Here, too, the risks posed to aquatic organisms are unknown, largely because the concentrations are so low. While the major concerns have been resistance to antibiotics and disruption of aquatic endocrine systems (the system of glands that produces hormones that regulate an organism's metabolic activity) by natural and synthetic steroids, many other pharmaceuticals have unknown consequences. More research is needed to draw any conclusions about the ecological impacts of pharmaceuticals and any role they may have in potential human health effects.

In closing, please be assured that New York City has consistently been ahead of the curve in watershed protection efforts. The City continues to closely monitor and track all research into this issue and will adopt and comply with any future federal or State mandates. Our water quality measures have always been consistent with state-of-the-science research, and, as more is known about this particular issue, we will continue to modify our policies and infrastructure accordingly.

Thank you for the opportunity to testify. I will be glad to answer any questions.

NYC City Council Hearing on Pharmaceuticals in Drinking Water – April 3, 2008

The Croton Watershed Clean Water Coalition, Inc. is an association of 54 organizations within the five Boroughs of the City and Westchester and Putnam Counties of NY State. We are a grassroots organization working to ensure the high quality of NY water remains undiminished for the future. Our focus is primarily on the Croton Watershed, East of the Hudson River because we realize this watershed is the default system for the City. It supplies 10% of the water however in times of draught, 30% - i.e., more water when we need it most. The repairs needed on the Delaware Aqueduct and the siltation of the Catskill Watershed from storm events brings the Croton Watershed to the forefront as the one reliable source water system. The unique, resilient, qualities of the Croton Watershed are because 70% of wetlands in the entire 2000 square mile system are located there even though it is only 380 square miles in size. The Croton wetlands have the ability to control floods and naturally filter water because of its rich alluvial soils and diversity of plants and wildlife.

We applaud the good media coverage on water issues concerning bottled water so think this pharmaceutical scare is probably a response from the bottled water industry. However I am puzzled as to how widespread this press coverage is on pharmaceuticals since these constitute only one part per billion or one part per trillion found – there is possibly more risk from placing our hand on a stair rail. We wonder where has been the coverage on phosphorus and nitrogen found in concentrations that are dangerous to our health and well being. Why has there been favorable coverage on the $2.8 billion (and rising) Chemical Treatment Plant when spending $200 million on source water protection by purchasing land in the Croton Watershed would be the permanent solution. The critical water infrastructure problems get little media attention while a costly treatment plant, more infrastructure whose useful life will be 20 years and would need expensive maintenance. The purchase of land in the Croton Watershed would need minor maintenance and $2.8 billion, the cost of the treatment plant, would pay the taxes on the land for 200 years or more. In addition we could get the benefit of clean air, clean water and good health – not the destruction of a neighborhood, fine particulate air pollution and bad tasting water because of the treatment chemicals. In addition, the precedent set by building in Van Cortlandt Park has caused the loss of parks and open space all over the city. I encourage continued coverage of NY water; it is an ugly story of the failure of three levels of government to protect the great water quality of NY water.

It is not too late to switch to the water treatment technology of choice in the 21st century, membranes, instead of the Dissolved Air Flotation Plant (DAF) being built by the City. A membrane filtration plant can remove pharmaceuticals as well as being one thousand times more effective at removing pathogens such as cryptosporidium. In addition, it uses one-third

less electrical power. The city would save a great deal of money and the small size of a membrane filtration plant could be placed anywhere, not a public park. The Memorandum of Agreement (MOA) deadlines, the legal settlement between DEP, DOH and EPA, would be met regardless of the switch to membranes. The technology is modular so can be built and/or upgraded quickly and more economically than DAF.

Most important however, is protection at the source and this means purchasing land in the watershed. The Croton Watershed's wetlands are valuable resources in the watershed since they purify the water by absorbing pollutants, controlling floodwaters, and recharging the groundwater aquifers that, in turn, are connected to the streams and reservoirs. Wetlands act as sponges that are capable of absorbing large volumes of stormwater and then releasing it slowly to the environment. Wetlands purify our drinking water by trapping harmful pollutants such as pesticides, heavy metals (lead and mercury), sediments and chemicals including pharmaceuticals. Their hydric soils bind pollutants and promote the degradation of bacteria. Wetlands also serve as incomparable habitats for a large variety of wildlife ranging from fish and amphibians to reptiles, birds and four-footed creatures. This natural filtration of our water is unparalelled, the web of life that keeps the planet healthy and continues to keep the Croton Watershed viable. Think global, act local for long-term clean and safe water.

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**TESTIMONY OF**
**THE CLEAN DRINKING WATER COALITION (CDWC)**
**BEFORE THE ENVIRONMENTAL PROTECTION COMMITTEE**
**OF THE NEW YORK CITY COUNCIL ON**
**PHARMACEUTICALS IN OUR DRINKING WATER**
**NEW YORK, NEW YORK**
**APRIL 3, 2008**

Good afternoon, my name is Cathleen Breen. I am the Watershed Protection Coordinator for the New York Public Interest Research Group (NYPIRG). Thank you for this opportunity to comment on the increasingly problematic issue of pharmaceuticals in our drinking water. I speak on behalf of the Clean Drinking Water Coalition (CDWC), which is comprised of NYPIRG, Riverkeeper and the Catskill Center for Conservation and Development.

As signatories to the 1997 Watershed Memorandum of Agreement (MOA), the CDWC has long been active in monitoring the New York City Watershed to ensure that the drinking water consumed by millions of New Yorkers remains of the highest quality. While we are fortunate to possess what is arguably the greatest metropolitan water supply system in the world, keeping it safe requires constant vigilance and anticipation of growing water quality threats.

A recent finding by the Associated Press (AP) that prescription drugs and other medicines were found in the drinking water supplies for millions of Americans is troubling. However, pharmaceuticals in our waterways is not a new phenomenon. Scientists have known about this problem for some time; but with advanced technologies we are now able to detect them at low levels. Many believe that it is safe to assume that as long as pharmaceuticals have been in use, they and their metabolites have contributed to the overall environmental contamination load. This issue began to gain recognition in Europe in the early 1990s, when German scientists found a cholesterol-lowering drug in groundwater. Soon after, other European researchers discovered chemotherapy drugs, antibiotics and hormones in drinking water sources.

Pharmaceuticals and personal care products (PPCPs) include over-the-counter (OTC) medications such as ibuprofen and acetaminophen; prescription medications such as antibiotics and those used for cardiac disorders and hypertension; female sex hormones used in birth control pills and hormone replacement therapy; cosmetics and other personal care products such as perfumes; as well as veterinary medications and growth hormones used with livestock. Some PPCPs are endocrine disrupting compounds, which have the potential to interfere with hormonal production.

In response to the AP article, some water utilities are quick to point out that such low levels of pharmaceuticals, much lower than what s considered a medical dose, pose no real threat to humans. But, the reality is that no one really knows what the true

impacts to humans are, and while some scientists believe the exposure levels are so low they're ineffective, others are concerned about cumulative, long-term, chronic and synergistic effects in humans. And, with the release of antibiotics into our waters, disease-causing bacteria may become immune to treatments, and as a result, drug-resistant diseases may develop.

One point on which scientists generally agree is that aquatic ecosystems are noticeably at risk from exposure to pharmaceuticals, and thus, the focus of most of the scientific study has been in aquatic ecosystems. With fish and amphibians expressing behavioral and sexual mutations, they are in effect the new "canaries in the coal mine."

Typically, prescription and OTC medication residues get into the water supply by being passed out of the body and flushed into sewer lines and septic tanks; externally-applied drugs and personal care products are washed down the drain when we shower or bathe; and unused or expired medications are unwisely disposed of by being flushed down the toilet. Since wastewater treatment plants (WWTPs) and septic systems are not designed to remove pharmaceuticals and personal care products, the compounds end up in surface waters and groundwater.

In response to the recent AP reports, the Department of Environmental Protection (DEP) issued a statement that, "New York City's drinking water continues to meet all federal and state regulations regarding drinking water quality in the watershed and the distribution system." And, they are correct. All of the pharmaceuticals reported in drinking water supplies are unregulated in tap water. Although the drugs found by the AP research were at low concentrations, measured in parts per billion or parts per trillion, any level is legal and currently the U.S. Environmental Protection Agency (EPA) does not require water utilities to test for these substances.

During the MOA negotiations, the environmental parties recognized that pharmaceuticals could contaminate our waters and successfully pressed the New York State Department of Health (NYSDOH) to agree to conduct a study to determine if pharmaceuticals were present in New York City source waters. WWTP effluents and reservoir samples were collected at twelve locations within the New York City Watershed and analyzed for eleven compounds.[1] Results of the tests conducted by NYSDOH and the United States Geological Survey (USGS) showed that trace concentrations of heart medicine, infection fighters, estrogen, anti-convulsant medications, a mood stabilizer and a tranquilizer were indeed detected in varying degrees.

As a nation, we cannot ignore this problem or give it short shrift any longer. There are steps that, we believe, can be taken that will begin to address this issue.

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1 The analysis focused on the following compounds: amoxicillin, cephalexin, sulfamethoxazole and trimethoprim (antibiotics); estrone, 17α-ethinylestradiol, and 17β-estradiol (natural and synthetic estrogens); valproic acid (anti-epileptic drug); atenolol (high blood pressure and heart medication); and ibuprofen (pain-relief medication.) Caffeine was also included in the survey, as it can be an indicator of human waste in natural waters.

1) **Establish a national strategy to address how these contaminants make their way into the environment.** EPA must assume a leadership role and take action. Congress directed EPA to screen pesticides for hormonal activity in humans through the enactment of the Food Quality Protection Act (FQPA) of 1996, and the Safe Drinking Water Act (SDWA) Amendments of 1996 (Section 136) authorized EPA to screen for drinking water contaminants as well. While EPA did develop an Endocrine Disruptor Screening and Testing Advisory Committee in 1996, there has been very little progress. After 11 years and in response to a lawsuit filed by environmentalists, 73 out of 87,000 chemicals were finally placed on a draft list of chemicals EPA intends to screen for.

2) **Include pharmaceuticals, personal care products and endocrine disruptors in the Contaminant Candidate Listing (CCL).** Section 1412(b)(1) of the SDWA requires EPA to publish a list of unregulated contaminants that are known or anticipated to occur in public water systems and may require control through national primary drinking water regulation. The CCL merely advises people that the contaminant may be regulated in the future. Of the 287 pharmaceuticals analyzed for inclusion in the CCL, only one – nitroglycerin – was added. Strangely, nitroglycerine was listed not because of its contaminant status, but because it can be used to make explosives. EPA has not only failed to screen for these PPCP contaminants, but also failed to even add them to the CCL.

3) **Hold the pharmaceutical industry accountable by calling for them to reformulate medications to allow for more efficient human intake thereby making them more environmentally friendly.** As has been widely reported in the media, even the pharmaceutical industry is taking note. In remarks at an industry conference, Mary Buzby, Director of Environmental Technology for drug maker Merck & Co. Inc. said, "There's no doubt about it, pharmaceuticals are being detected in the environment and there is genuine concern that these compounds, in the small concentrations that they're at, could be causing impacts to human health or to aquatic organisms."

4) **Upgrade Wastewater Treatment Plants to technologies that will remove pharmaceuticals during treatment.** The tools and technologies exist to remove pharmaceuticals from our water supplies – including reverse-osmosis, membrane filtration, activated carbon absorption and exposure to ozone or ultraviolet light – and such technologies should be employed. This year, the USGS will conduct a pilot study to see which of these treatment technologies will best reduce pharmaceuticals in the New York City Watershed.

5) **Establish pharmaceutical "take-back" programs, which are collection programs aimed at reducing the quantity of unused pharmaceuticals entering the environment.** These initiatives provide the legal framework and the logistic resources required to allow the general public to turn in pharmaceuticals to be disposed of safely. Several states, cities, and counties throughout the United

States – including Alachua County, Florida, Clark County, Washington, Kendall County, Illinois, La Crosse, Wisconsin, Olmsted Falls, Ohio and Southern California – have successfully initiated long-term pharmaceutical collection programs, while others have organized single-day or annual collection events.

6) **Provide states with more funding.** There should be increased funding for research into the potential aquatic and human health impacts from exposure to trace concentrations of these contaminants. Our concern is not so much what we know, but what we don't know. The studies conducted by NYSDOH and USGS in New York were funded through SDWA monies and that funding has been used up. Although Congress reauthorized additional funding in FY04, appropriations have not been forthcoming.

Clean, healthy drinking water is vital, but with our population aging and pharmaceutical use on the rise, the problem can only be expected to get worse. The CDWC will continue to monitor this important issue, educate the public about the problem and call for the above-named actions. We applaud the New York City Council for having this hearing today and look forward to working with you on implementing these five actions. I thank you for the opportunity to testify today and would be happy to answer any questions.

# Emerging Contaminants in Wastewaters and Receiving Streams

Testimony by the USGS to the Committee on Environmental Protection of the Council of the City of New York

April 3, 2008

The U.S Geological Survey (USGS) is an agency of the Department of the Interior whose mission is to serve the Nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life. As the Nation's largest water, earth, biological science and civilian mapping agency, the USGS collects, monitors and analyzes data, and provides scientific understanding about natural resource conditions, issues, and problems. The diversity of our scientific expertise enables us to carry out large-scale, multi-disciplinary investigations and provide impartial scientific information to resource managers, planners, and other customers. The USGS has no regulatory or enforcement responsibilities.

The Water Resources Discipline (WRD) is one of four science disciplines of the USGS. The WRD mission is to provide reliable, impartial, timely information that is needed to understand the Nation's water resources. WRD actively promotes the use of this information by decision makers to –

- Minimize loss of life and property as a result of water-related natural hazards, such as floods, droughts, and land movement.
- Effectively manage ground-water and surface-water resources for domestic, agricultural, commercial, industrial, recreational, and ecological uses.
- Protect and enhance water resources for human health, aquatic health, and environmental quality.
- Contribute to wise physical and economic development of the Nation's resources for the benefit of present and future generations.

Much of the USGS effort in monitoring for trace organic compounds including pharmaceuticals has focused on assessing the effectiveness of wastewater treatment plant processes on the removal of these compounds from WWTP effluent in the New York City watershed. These findings are summarized in Attachment 4, which is the abstract for a technical paper that was forwarded to the committee. These data have shown that upgrades to WWTP have resulted in increased ability of the facilities to remove some, but not all, of the trace organic compounds and pharmaceuticals.

Sampling of these compounds has expanded in the last few years to include keypoints and source waters within the New York City Reservoir system. Because these data have not received scientific review through the USGS scientific review process, we have not released the results to the general public.

The pharmaceuticals listed in Attachment 3 were added in the last few years in response to recent indications of their presence in WWTP effluents. We are currently preparing a scientific report that summarizes the occurrence of the drugs included in this method, and anticipate submitting this report for technical review within the next couple of weeks. This report, as all publications from the USGS, will pass a thorough peer review process including scientists from the NYSDEC and New York City Department of Environmental Protection (NYCDEP), as well as qualified scientists from across the nation. Once the report has been accepted for publication, we would be happy to share these findings with the committee, and be available for additional questions.

We would like to emphasize that as a non-regulatory agency, the USGS policy is to release data it collects to all parties simultaneously, and once released, these data are available to the public. We look forward to providing data and technical assistance to the City of New York on trace organics including pharmaceuticals in the New York City watershed and water supply system.

**Attachment 1** : List of Compounds included in USGS Method 1.

| Compound | CAS Number | Potential Source/Use |
|---|---|---|
| 1,4-Dichlorobenzene | 106-46-7 | Deodorizer |
| 1-Methylnaphthalene | 90-12-0 | Fuels |
| 2,6-Dimethylnaphthalene | 581-42-0 | Fuels |
| 2-Methylnaphthalene | 91-57-6 | Fuels |
| 3-beta-Coprostanol | 360-68-9 | Fecal Sterol |
| 3-Methyl-1(H)-indole (Skatole) | 83-34-1 | Fragrance |
| 3-tert-Butyl-4-hydroxy anisole (BHA) | 25013-16-5 | Antioxidant |
| 4-Cumylphenol | 599-64-4 | Detergent degradate |
| 4-Methyl phenol | 106-44-5 | Wood preservative |
| 4-n-Octylphenol | 1806-26-4 | Detergent degradate |
| 4-Nonylphenol | 84852-15-3 | Detergent degradate |
| 4-Nonylphenoldeithoxylate (NPEO2 - total) | 26027-38-2 | Detergent degradate |
| 4-Octylphenol deitheoxylate (OPEO2) | 26636-32-8 | Detergent degradate |
| 4-Octylphenol monoethoxylate (OPEO2) | 26636-32-8 | Detergent degradate |
| 4-Tert-Octylphenol | 140-66-9 | Detergent degradate |
| 5-Methyl-1H-benzotriazole | 136-85-6 | Anticorrosive |
| Acetophenone | 98-86-2 | Fragrance |
| Acetyl hexamethyl tetrahydronaphthalene (AHTN) | 21145-77-7 | Fragrance |
| Anthracene | 120-12-7 | PAH |
| Anthraquinone | 84-65-1 | Manufacturing |
| Benzo[a]pyrene | 50-32-8 | PAH |
| Benzophenone | 119-61-9 | Fixative |
| beta-Sitosterol | 83-46-5 | Plant sterol |
| beta-Stigmastanol | 19466-47-8 | Plant sterol |
| Bisphenol A | 80-05-7 | Plasticizer |
| Bromacil | 314-40-9 | Herbicide |
| Bromoform | 75-25-2 | Trihalomethane |
| Caffeine | 58-08-2 | Stimulant |
| Camphor | 76-22-2 | Flavorant |
| Carbaryl | 63-25-2 | Insecticide |
| Carbazole | 86-74-8 | Insecticide |
| Chlorpyrifos | 2921-88-2 | Insecticide |
| Cholesterol | 57-88-5 | Plant/Animal Sterol |
| Cotinine | 486-56-6 | Nicotine degradate |
| Diazinon | 333-41-5 | Insecticide |
| Dichlorvos | 62-73-7 | Insecticide |
| d-Limonene | 5989-27-5 | Fungicide |
| Fluoranthene | 206-44-0 | PAH |
| Hexadydrohexamethylcyclopentabenzopyran (HHCB) | 1222-05-5 | Fragrance |
| Indole | 120-72-9 | Pesticide inert |
| Isoborneol | 124-76-5 | Fragrance |
| Isophorone | 78-59-1 | Solvent |
| Isopropylbenzene | 98-82-8 | Fuels |
| Isoquinoline | 119-65-3 | Flavorant |
| Menthol | 89-78-1 | Fragrance |
| Metalaxyl | 57837-19-1 | Fungicide |

**Attachment 2**: List of Compounds included in USGS Method 2.

| Compound | CAS Number | Potential Source/Use |
|---|---|---|
| 1,7-dimethylxantine | 611-59-6 | A caffeine metabolite |
| Acetaminophen | 103-90-2 | Analgesic |
| Salbutamol | 18559-94-9 | antiasthmatic |
| Caffeine | 58-08-2 | A stimulant |
| Carbamazampine | 298-46-4 | Anticonvulsant |
| Codeine | 76-57-3 | Analgesic |
| Cotinine | 486-56-6 | A nicotine metabolite |
| Dehydronifedipine | 67035-22-7 | A nifedipine metabolite -- Nifedipine is an antihypertensive |
| Diltiazem | 42399-41-7 | Antihypertensive |
| Diphenydramine | 147-24-0 | Antihistamine |
| Fluoxetine | 54910-89-3 | Antidepressent (Prozac) |
| Ranitidine | 66357-35-5 | Antiacid |
| Sulfamethoxazole | 723-46-6 | Antibiotic |
| Thiabendazole | 148-79-8 | Fungicide |
| Trimethoprim | 738-70-5 | Antibiotic |
| Warfarin | 81-81-2 | Anticoagulant |

Attachment 4: Abstract of Publication on removals of trace organic compounds.

Water Environment Federation WEFTEC 78th Annual Technical Exhibition and Conference, Conference Proceedings, Washington DC, November 2005, p. 5095-5124

# A MULTI-DISCIPLINARY APPROACH TO THE REMOVAL OF EMERGING CONTAMINANTS IN MUNICIPAL WASTEWATER TREATMENT PLANTS IN NEW YORK STATE, 2003-2004

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## ABSTRACT

Across the United States, there is a rapidly growing awareness of the occurrence and the toxicological impacts of natural and synthetic trace compounds, known as emerging Contaminants(ECs) in the environment. Wastewater treatment plants (WWTPs) have been identified as a key collection point for ECs in the water cycle and potentially an ideal location at which to treat to remove them, thereby mitigating their release into the environment. Little is known about the nature, variability, transport and fate of ECs in typical wastewaters and treatment facilities in the United States. Furthermore few studies have been performed to monitor or understand the capability of conventional or innovative wastewater treatment processes to remove or reduce the concentrations of a wide variety of ECs at wastewater facilities. This study was designed to provide baseline information on this topic.

Wastewaters appear to contain a wide range of ECs. Over 55 of the 63 target contaminants were detected in the five different wastewaters examined during the course of this study, 44 of them frequently. The median cumulative concentrations of EC in the wastewaters ranged from between 120 µg/L to just over 500 µg/L. The raw wastewater characteristics were not as variable as anticipated.

Conventional wastewater treatment processes were effective in removing significant amounts of the ECs. Results indicated that the type of technology operated and the mode of operation both had an impact on the removal capability of the plants.

Over half of the frequently detected ECs were reduced by 95 percent or more in samples collected at Plants which operated an activated sludge process. Less than 10 percent of the ECs were reduced by 95 percent or more at Plant D, which uses a trickling filter treatment process

Furthermore, focused pilot studies indicated that increased removals of ECs were closely associated with increased SRTs in the activated sludge process. The most significant impact of SRT appeared to occur as the sludge age increased above 5 days. While removals continued to improve as the SRT increased above 10 days the benefits were less marked.