Mercury in Wastewater:

Discharges to the Waters of the State

1999

A Report by the Department of Environmental Protection

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Joint Standing Committee on Natural Resources
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I. INTRODUCTION

Mercury is a naturally occurring metal that is commonly found in the environment in small amounts. It is released and dispersed throughout the globe by natural processes and human activities. Several forms of mercury can cause serious health problems in humans and wildlife. Methylmercury, an organic form of the metal, is of particular concern because it is readily taken up by living organisms. There it can persist for long periods of time and become more concentrated as it moves up the food chain.

Fish monitoring programs in Maine and other states have identified many water bodies where concentrations of methylmercury in fish are above levels that are considered safe for human consumption. Mercury-based advisories have been established in 40 states. Advisories in Maine, apply to all fresh surface waters of the state. These advisories warn pregnant women, women who plan to become pregnant, and young children to avoid consuming any warm water fish species and to limit consumption of cold water species. The general public is warned to restrict consumption of warm water fish, but faces no restriction on consumption of cold water fish. The fish consumption advisories are aimed at minimizing potential human health risks from mercury, but do not remove the threat mercury poses to wildlife.

During the 118th legislative session when the mercury issue was being discussed, 38 MRSA §420(1) was revisited. This legislation, which was enacted in 1971, prohibited the discharge of mercury or any compounds containing mercury, whether organic or inorganic, in any concentration which increases the natural concentration of mercury in the receiving waters. Because of proposed new testing methods, which now enable mercury to be detected at much lower levels in treatment plant wastewater effluent than previously, there was concern that there may in fact be many facilities that are discharging mercury in excess of that allowed by Section 420(1). This led the Legislature to enact Public Laws 1997, Chapter 722, which requires the Department of Environmental Protection (DEP) to report back to the Natural Resources Committee on the following aspects of mercury:

- Evaluate the current discharges of mercury into waters of the state;
- Evaluate current and potential methods for testing mercury discharges;
- Report of facilities that are in non-compliance with water quality standards for mercury or with 38 MRSA §420;
- Results of effluent testing using more refined testing protocols;
- Evaluation of the sources of mercury in the discharge of facilities that have detectable quantities of mercury;
- Review of incidental sources of mercury;
- Report on natural concentrations of mercury in receiving waters; and
- The status of the Environmental Protection Agency's approval of effluent testing protocols.

In response to this new legislation, the DEP developed monitoring plans to gather information concerning levels of natural concentrations of mercury in receiving waters and levels of mercury in wastewater treatment plant effluents for public and private facilities. All of the effluent samples were collected and analyzed using "clean" techniques, EPA Method 1669 and EPA Method 1631, respectively. These techniques are designed to eliminate contamination from the sampling and analysis process. The DEP partnered with the Maine Wastewater Control Association (MWWCA) to develop the effluent sampling plan.

In October the DEP developed a "clean techniques" training session and trained nine department staff members to be able to properly sample wastewater effluent and influent. During the months of October through December, these DEP staff members collected influent and effluent samples from 85 municipal and industrial wastewater treatment facilities.

In December 1998, the DEP formed a mercury work group to begin to obtain feedback concerning this mercury sampling project and the subsequent findings. This work group was comprised of members of the Maine DEP, Maine Wastewater Control Association, Maine Pulp & Paper Association, Maine Dental Association, Environmental Business Council of Maine, Penobscot Indian Nation, Natural Resources Council of Maine, and a few representatives of two pulp and paper mills. The group met to discuss the results of the effluent, influent, and ambient sampling and to begin to strategize about possible future actions and activities to address the mercury found in the waters of the State and the municipal and industrial effluents and influents. This group also was involved in the review of this report.

Section II of this report is a discussion of the analytical test method, EPA Method 1631, utilized to analyze all of the effluent, influent, and ambient samples collected for this project and how it differs from the method that is currently approved.

Section III is a discussion of how the ambient sampling program was conducted. Ambient samples were collected from 60 sites across the State in order to take into account any regional, drainage basin, or geographical differences that might occur. This information was collected to ascertain the "natural" levels of mercury in the waters of the State.

Section IV is a discussion of how the effluent sampling program was conducted. Effluent samples were collected from 75 municipal and 10 industrial wastewater treatment facilities. In addition, 29 samples were collected from 16 locations throughout the City of Bangor's wastewater collection system. This effort was undertaken to assist the DEP in identifying possible sources of mercury.

Section V is a summary of the results of effluent monitoring for municipal and industrial effluents.

Section VI is a discussion of various sources of mercury into municipal and industrial wastewater treatment facilities.

Section VII is a discussion of the compliance status of the municipalities and industries with both the water quality standards for mercury and the Maine Revised Statutes 38 MRSA §420.

II. TESTING METHODS

The precision and accuracy of mercury testing is controlled by two major factors: the collection and handling procedures used by the sampling team to obtain a sample and the analytical method used by the laboratory testing that sample. The Environmental Protection Agency (EPA) approves methods for the analysis for effluents discharged from wastewater treatment facilities. EPA is also active in development of new sample collection and test methods.

Historically, samples for mercury testing have been collected using conventional, approved methods in the wastewater treatment industry, and have not employed any special precautions. In discussing testing for trace levels of metals, the EPA notes, "The most serious problem faced by laboratories conducting metals analyses at these very low levels is the potential for sample contamination during collection and handling. Mercury is particularly difficult to collect due to its ubiquity in the environment." 63 Fed. Reg. 28869 (1998)

Laboratory analyses for mercury in treated effluents have historically been conducted using the so-called cold vapor method, or EPA Method 245.1, that can detect mercury concentrations down to a level of 200 parts per trillion (ppt). Where mercury is not found at that concentration, the laboratory will typically report the results as "<200 ppt". Although mercury may be present at some concentration below 200 ppt, the laboratory report provides no indication of what that level may be as the test method is simply not able to detect it reliably. Since concentrations of mercury in ambient waters are typically below 5 ppt, EPA Method 245.1 is inappropriate for assessing the impact of a treated effluent on the waterway to which it is discharged. As with sampling, EPA Method 245.1 is subject to contamination from extraneous mercury in the laboratory.

Since 1994, DEP has required significant municipal and industrial wastewater treatment facilities to test their discharges for a range of toxic pollutants, including mercury under its effluent toxics testing program. Samples were normally collected using conventional techniques and testing was done using EPA Method 245.1. Of the mercury results received by the DEP through 1997, approximately three-quarters reported results as simply <200 ppt. The remaining one-quarter reported detectable concentrations ranging from 200 ppt to 2,400 ppt (excluding the HoltraChem facility). However, because EPA Method 245.1 and normal sample collection procedures are subject to contamination, the reliability of these data is highly questionable.

In order to improve the quality of testing for heavy metals, EPA has been developing a new series of sampling and testing methods. As part of this effort, contract laboratories working under the direction of EPA have developed EPA Method 1631: mercury in water by oxidation, purge and trap and cold vapor atomic fluorescence. This method is approximately 1000 times more sensitive than currently approved methods for the determination of mercury and allows detection of mercury at concentrations below water quality criteria and what is typically found in Maine's natural waters. EPA's method detection limit is 0.2 ppt, although some laboratories are able to achieve lower levels. Along with EPA Method 1631, EPA has developed improved sampling procedures, EPA Method 1669, to avoid contamination during collection and handling of samples. These methods are often referred to a "clean" methods since rigorous precautions are take to prevent contamination of the samples and laboratory equipment. Proposed EPA Methods 1631 and 1669 are "performance based," meaning that they may be adapted or modified to meet the needs of the individual applications, provided that performance criteria and quality control standards are met.

For some time, EPA Methods 1631 and 1669 have been used for research and testing of ambient waters. However, EPA Method 1631 (which incorporates EPA Method 1669 sampling techniques) has not been used for testing of treated effluents since it is not listed by EPA as an approved method. Under the Clean Water Act, testing methods used in regulatory programs, such as monitoring of treated effluents, must be approved by EPA. The list of approved tests and related requirements is published at 40 CFR part 136. On May 26, 1998, EPA published in the Federal Register a proposed rule that would formally adopt EPA Method 1631 for use on treated effluents. The method is not being proposed for use with untreated wastewaters as mercury concentrations at those sources may exceed the 100 ppt maximum for which EPA Method 1631 is designed. However, using smaller samples may extend the range of the method. DEP investigations have included untreated wastewaters and, although results from those samples should be regarded as approximate, they do establish a range for mercury concentrations in untreated wastewaters in Maine. Subsequent to EPA's proposal for adoption of EPA Method 1631, the DEP requested from EPA special permission to use the method in Maine. On November 10, 1998, EPA responded to the DEP request stating, "we do hereby grant approval for the use of Method 1631, as printed in the Federal Register 63, p.28868 ff. (May 26 1998), for the analysis of mercury in NPDES municipal and industrial effluents originating in Maine until such time as the method receives our Agency's nationwide approval."

The EPA's approval of EPA Method 1631 allows for its use in Maine for effluent analyses. For other purposes, including collection of data for this report, Method 1631 has been used by Maine wastewater treatment facilities during 1998. Most facilities started using the method in response to a July 1998 request from the DEP. Earlier, others began using EPA Method 1631 out of interest in mercury-related issues and often conducted more testing than required by DEP's rules. Some facilities began using EPA Method 1631 when the testing under the old method showed an exceedence, in order to ascertain whether these results were valid effluent concentrations or were the result of contamination during sampling or analysis. From this work, some comparisons between sampling and testing methods are available.

- In June 1998, the Town of Falmouth used its normal sampling method to collect a sample that was then split into two portions that were sent to different laboratories for testing using EPA Methods 245.1 and 1631. The results were 220 ppt and 62.9 ppt, respectively, demonstrating the differences that can be obtained from the same sample and different test methods. The Superintendent of Falmouth's treatment facility commented on the results that, "The Town feels that the results of all prior testing using EPA Method 245.1 should be invalidated." However, this test did not use "clean techniques". Another sample of Falmouth's effluent collected by the DEP in November 1998 using EPA Methods 1669 and 1631 yielded a result of 15.3 ppt.

- In July 1998, the Kennebec Sanitary Treatment District in Waterville collected an effluent sampling using conventional sampling techniques and had it analyzed using EPA Method 245.1. The laboratory result was reported as <200 ppt. Two days later, the District collected another sample for testing using EPA Method 1631, with a result of 6 ppt. Subsequent testing by the DEP in November 1998 using EPA Methods 1669 and 1631 produced a result of 9 ppt.

- In May 1998, Champion International in Bucksport collected two samples on the same day for mercury testing. One sample was tested using EPA Method 245.1 and the other sample was tested using EPA Method 1631, and the results were <200 ppt and 1.1 ppt, respectively.

III. NATURAL CONCENTRATIONS OF MERCURY IN MAINE'S RIVERS AND STREAMS 1998

A. Introduction

Section 6 of PL 1997 Chapter 722, requires the DEP to report 'the levels of natural concentrations of mercury in receiving waters to the joint standing committee of the Legislature having jurisdiction over natural resources matters by February 1, 1999.

DEP, the Maine office of the U.S. Geological Survey (USGS), and other entities have been collecting ambient mercury data from rivers and streams for decades. Until the early 1990's, however, the EPA Method 245.1, which has a detection limit of 200 parts per trillion (ppt=ng/l), was the method used for all analyses. At that time, with advances in analytical capability, USGS, the national leader in water sampling and analysis, and EPA determined that most of the historical data were not accurate due to contamination during sampling and analysis, and that ambient levels in rivers and streams were much lower than 200 ppt.

Consequently, USGS suspended their sampling program pending development of more suitable sampling and analytical methods. As discussed above, EPA has recently developed a new method for sampling of trace metals, EPA Method 1669 (EPA, 1995) and draft method for analysis of trace metals, EPA Method 1631, (EPA, 1994). These new methods are performance-based and use rigorous quality assurance and quality control procedures. The published method detection limit for mercury is 0.2 ppt where there are no interferences and the minimum level is 0.5 ppt. An method detection limit as low as 0.05 ng/L can be achieved for samples with low levels using larger sample sizes, lower BrCl levels (0.2%), and extra caution in sample handling.

Research conducted by Dr. Steve Norton, Dr. Steve Kahl, and Dr. Terry Haines of the University of Maine in the 1990s using new improved methods documented that ambient concentrations of mercury in 2 small streams, unaffected by point source discharges, in Hancock County were generally less than 10 ppt. Mercury concentrations of less than 5 ppt were measured in water samples gathered by Dr. Haines from 3 lakes in Maine. Although these data indicate relatively low natural concentrations in Maine waters, they are limited in number and to small geographic ranges. In order to fulfill the legislative mandate, an additional study was needed.

B. Study Design

Marine waters were not sampled at this time for technical reasons. Issues of applicability of EPA Method 1631 in salt water, resuspension of particulates, lack of clear above and below stations due to tidal movement, and locating reference stations raise sufficient uncertainty to warrant deferring until the river and stream background has been established. If marine water data are needed and if appropriate laboratory methodologies for ambient sampling in saline waters are resolved, work may proceed at a later date to establish natural concentrations of mercury in marine waters.

There were several study design criteria and they are as follows:

1. Since the purpose of this study was to evaluate the levels of natural concentrations of mercury in receiving waters, the focus was freshwater rivers and streams since, in general, no point source discharges are allowed to Maine lakes and ponds.

2. Given the fact that Maine, like the rest of the world, receives atmospheric deposition of anthropogenic mercury, it is not possible to determine truly 'natural' levels of mercury in its receiving waters. Nevertheless, to measure mercury levels in the most natural possible setting, the DEP chose sampling stations upstream of any known or suspected sources of mercury. Those included licensed discharges of wastewater, major urban and agricultural areas, and certain impoundments in rivers, where relatively large fluctuations in water levels for hydropower generation has been shown to result in increased levels of mercury.

3. In order to determine whether concentrations of mercury in water varied geographically, sampling stations were selected from each major river and stream in the state. Each of the 70 maps in the Maine Atlas and Gazetteer published by the DeLorme Mapping company was studied before selecting 60 sampling stations geographically distributed across the state (Figure 1).

4. Each station was scheduled to be sampled once during low flow and again during higher flows to determine whether there might be differences related to stream flow.

C. Methods

1. Sample Collection

All samples were collected in 500 ml FEP bottles that were cleaned in accordance with the procedures outlined in EPA Method 1631. The samples were collected following the protocols in EPA Method 1669. Teams of two people collected samples, one designated as 'dirty hands' the other as 'clean hands'. Samples were collected by wading into the main channel of the stream and sampling was done upstream of the sampler. Sample bottles were double bagged, delivered to the lab and preserved at the end of the sampling trip.

State of Maine

20 0 20 40 Miles

N

< 1.45 Ng/L
1.45 - 4.48 Ng/L
> 4.48 Ng/L

1998
Ambient Waters Project

Sites Tested for Mercury
Low Flow Sample Locations

2. Analytical Method

The method developed for the analysis of total mercury in water follows Federal Register / Vol. 63, No. 100 / Tuesday, May 26, 1998 / Proposed Rules: Guidelines Establishing Test Procedures for the Analysis of Mercury in Water, EPA Method 1631:

In the sample pretreatment step, 2% bromine monochloride is added to the sample to oxidize all forms of mercury to Hg (II). The samples are then placed in a 50 °C oven for at least 12 hours. After oxidation, 100mL of the sample is sequentially pre-reduced with 200uL of hydroxylamine hydrochloride to destroy free halogens then reduced with 500uL of stannous chloride to convert Hg (II) to volatile Hg (0). The Hg (0) is purged from the solution with nitrogen onto a gold-coated quartz sand trap. The trapped mercury is thermally desorbed from the trap into a flowing argon gas stream into the quartz cell of a cold-vapor atomic fluorescence spectrometer. Sample peaks generated are collected, and areas determined, via two computer programs.

Deviations from the stated method:

1. The working calibration standard is at a concentration of 5 ng/mL, not 10.0 ng/mL.
2. The sample purge time used is 15 minutes, not 20 minutes.
3. A single-trap amalgamation system is used.
4. Thermal desorption of the gold traps following sample collection is for 2.5 minutes, not 3.0 minutes.
5. Final results are corrected for reagent blanks and the dilution introduced by bromine monochloride preservation.
6. Gold traps are placed in-line for all gas lines.

D. *Quality Control Summary*

The following QC tests are performed on a routine and/or analytical run basis:

1. Initial calibration and verification of the standard curve throughout each analytical run.
2. Initial precision and recovery (IPR).
3. Analysis of blanks.
4. Matrix spike/matrix spike duplicate analysis at a frequency of 10%.
5. Ongoing precision and recovery (OPR).
6. Quality control sample analyzed once per analytical run.
7. Sample duplicate analysis at a frequency of 10%.
8. Method detection limit.

Although there were deviations from the published protocol, since this method is performance based, only the results matter. Examination of the quality control results documents the integrity of the analyses that were conducted. (Appendix B)

E. *Results*

The DEP contracted the study to the Water Research Institute at the University of Maine. Sampling began in September and the low flow round was completed in early October. After significant rains in mid-October, the high flow round began. Sampling continued until freeze-up in mid-December when the effort was terminated. Of the 60 sites, 44 were sampled during the high flow round, although only 13 were sampled during significantly higher flows. When the remaining 31 sites were sampled in the second round, flows were intermediate of low and high flows.

For all 104 samples combined the median mercury concentration was 1.45 ppt, the 95th percentile concentration was 4.48 ppt, and the 99th percentile concentration was 6.00 ppt (Appendix C). When the data were segregated between high and low flow samples, mercury concentrations were statistically significantly, ($p=0.05$), higher during high flows than during low flows. This was true regardless of whether or not all 60 low flow stations or only those 13 low flow stations that also had high flow mercury data were used in the comparison.

In order to determine if mercury concentrations differed geographically within Maine, the data were divided into three categories by value (<50th percentile, 50-75th percentile, and >75th percentile). They were then mapped by category using DEP's Geographic Information System (GIS) to observe how the categories were distributed around the state. For the low flow period, most of the data from Northern Maine fell above the median value, but the number of samples there was relatively low (Figure 1). There were also several stations elsewhere with values exceeding the median. For medium and high flow periods, Northern Maine did not have a preponderance of values exceeding the median. Consequently, there was no clear geographic pattern to mercury concentrations around the state.

F. *Conclusions*

Truly 'natural' concentrations of mercury in Maine's receiving waters do not exist anymore due to atmospheric deposition of anthropogenic mercury originating from Maine, New England, North American and the Northern Hemisphere. From our sampling we found concentrations in rivers and streams, unaffected by known or likely sources of mercury, to be generally less than 5 ppt. From these limited data, concentrations appear to be higher during higher stream flows than during lower stream flows. Since the samples, 1 to 2 at each site, were collected during late summer and fall, no effect of season, other than flow, was examined. It was also unclear if there are any geographical differences. Additional samples would need to be collected to better describe the effects of flow, season, and geographic distribution in order to establish a value for background concentrations for compliance purposes.

IV. DEP EFFLUENT SAMPLING PROGRAM

A comprehensive effluent monitoring program involving 75 municipal and 10 industrial wastewater treatment plants was undertaken in the fall of 1998 as part of the reporting requirements of 38 MRSA §722 (Figure 2 & Appendix D). These facilities were selected because they are currently monitoring effluent in Maine's Surface Waters Toxics Control Program. A screening sampling plan was developed to generate data representative of point sources at a reasonable cost and within the time frame provided. Sampling procedures were developed in consultation with a private laboratory and the Maine Waste Water Control Association. The sampling procedure was based on EPA Method 1669. Teams of DEP staff were assigned facilities on a regional basis. All of the sampling teams completed training on the sampling procedures. All samples were collected in 250-ml glass bottles. The sampling procedure required two people at each site, one "clean hands" and one "dirty hands." Samples were collected using a clamp to secure the bottle to a pole and positioning the bottle upstream of the sampling device. Sample bottles were double bagged and shipped to the laboratory. Field quality control and quality assurance measures were adopted which included field duplicates, field blanks and trip blanks. Over 150 samples were collected from October 1998 to December 1998. These included some influent samples, some repeat samples and 32 samples collected throughout the City of Bangor. A contract laboratory in Seattle, Washington used EPA Method 1631 to analyze the samples. Standard laboratory quality control and quality assurance tests were performed. Concentration of pollutants in water is measured in units of mass of chemicals (milligram, microgram or nanogram) per volume (liters).

1 milligram (mg) = 1/1,000 gram = one part per million
1 microgram (μg) = 1/1,000,000 gram = one part per billion
1 nanogram (ng) = 1/1,000,000,000 gram = one part per trillion

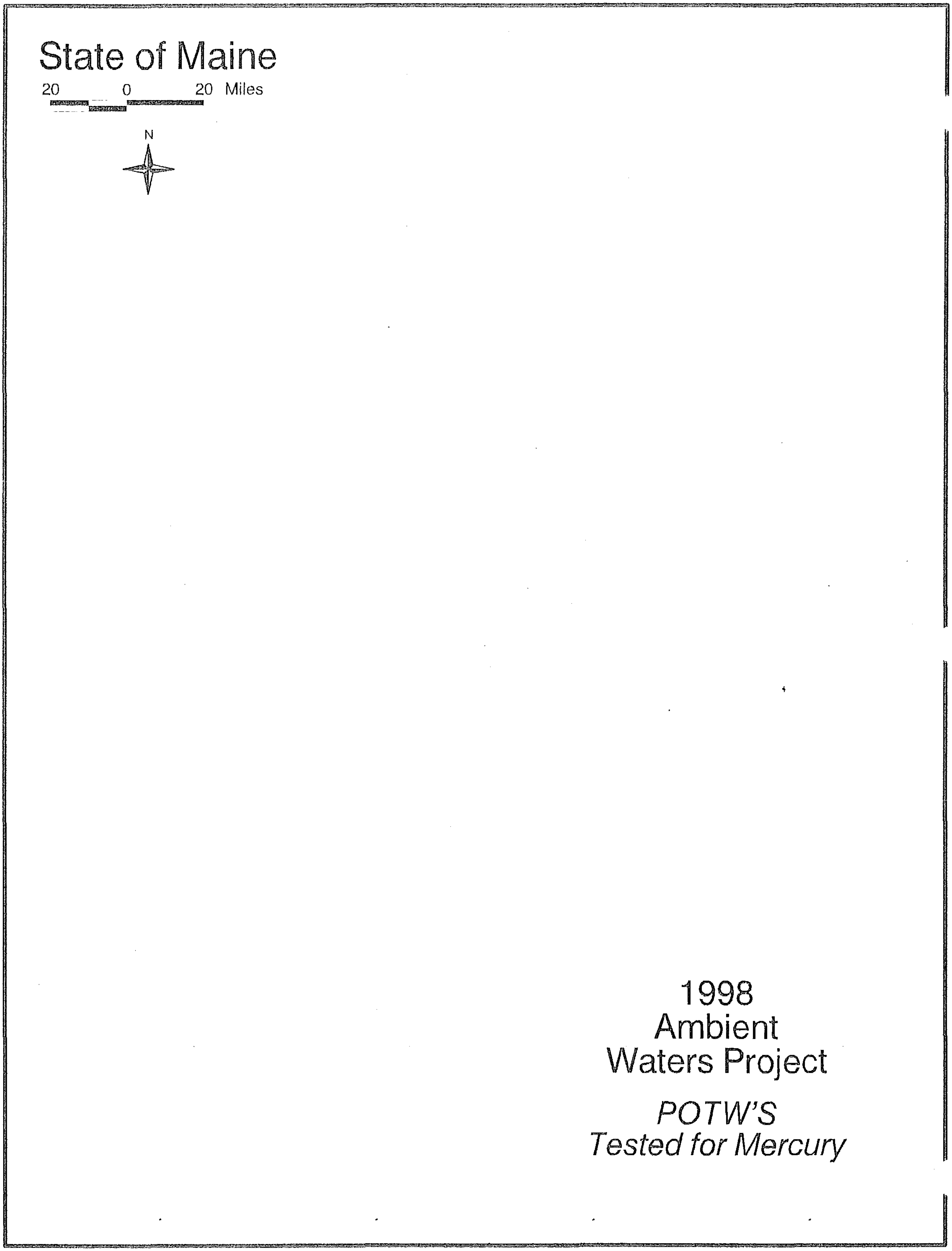
The results of the field QA/QC are summarized in Appendix E. Field blanks are generated to demonstrate that sample contamination has not occurred during field sampling and sample processing. The trip blank is used to evaluate the security and handling of the sample bottles. Field duplicates are collected to assess the precision of the field sampling and analytical processes. The field and trip blanks should be equal to or less than the Minimum Level (ML) (O.5 ppt), or one-fifth the level in the associated sample, whichever is less.

Table 2

Field QA/QC (Field Blanks)				
Number of Samples	Mercury Concentration in (ppt)			
	Average	Median	Maximum	Minimum
18	0.117	0.105	0.33	0.03

Table 3

Field QA/QC (Trip Blanks)				
Number of Samples	Mercury Concentration in (ppt)			
	Average	Median	Maximum	Minimum
4	0.18	0.14	0.40	0.03


State of Maine
20 0 20 Miles
N
1998
Ambient
Waters Project
POTW'S
Tested for Mercury

The field quality assurance and quality control tests indicate that, in general, potential interference is not a factor for effluent data reported above 2 ppt.

All of the field duplicate relative percent differences (RPD) for effluent samples were within the 20% acceptable range (see Appendix E).

V. MERCURY IN MUNICIPAL AND INDUSTRIAL EFFLUENTS

1. Municipal Wastewater Treatment Facilities

The results of the DEP sampling program are located in Appendix F, and indicate the following:

a) the average mercury concentration of raw municipal wastewater (prior to treatment) is 297 ppt,

b) the average mercury concentration for secondary treated municipal wastewater effluent is 11.3 ppt,

c) this represents an average removal efficiency of 96%,

c) the median mercury concentration for secondary treated municipal wastewater effluent is 6.21 ppt,

d) the total flow from municipal wastewater treatment facilities is about 52 billion gallons per year,

e) the total discharge of mercury from municipal wastewater treatment plants is about 2.6[1] pounds per year.

Table 4

POTW Sample Data				
Number of Samples	Mercury Concentration in (ppt)			
	Average	Median	Maximum	Minimum
121	11.30	6.21	99.23	0.74

The mercury in municipal wastewater treatment plant effluent can come from the incidental release from treatment chemicals and the "re-release" of mercury which includes mercury discharged to the sewer system from industries, hospitals, dental facilities, households, and others. The sources of re-released mercury are discussed later in section VI.

[1] Based on 75 communities in Maine.

2. Industrial Wastewater

The total discharge of mercury from the industrial direct dischargers is approximately 9.2[2] pounds per year. The industrial facilities discharge about 88 billion gallons of total wastewater per year.

Table 5

Industry Sample Data				
Number of Samples	Mercury Concentration in (ppt)			
	Average	Median	Maximum	Minimum
25	23.75	11.30	246.80	0.10

HoltraChem Manufacturing, a chlor-alkali plant in Orrington, discharges about 2.9 pounds per year of mercury at 20,000 ppt from their process water to the Penobscot River. These discharge figures for HoltraChem are not included in table 5 above.

VI. SOURCES OF MERCURY

A. Introduction

Mercury is a naturally-occurring metallic element that is used extensively in many products and processes due to its properties that enable it to conduct electricity, function as a catalyst, measure pressure and temperature, act as a pesticide and fungicide, and alloy with other metals. Many of the products we use everyday are made with mercury or contain a mercury component, including thermometers, thermostats, dental fillings, latex paint and fluorescent lights. The annual use of mercury in the United States exceeds 500 metric tons (Great Lakes National Program Office 1994). Mercury is also released as an unintentional by-product of several processes and products. Mercury is released to the atmosphere when raw materials are heated and is redeposited as precipitation.

Most scientists believe that atmospheric deposition is the largest pathway by which mercury enters surface waters. Mercury is emitted into the air through combustion, incineration, or manufacturing processes and is eventually deposited into rivers and lakes. Mercury also comes from natural sources including the marine and aquatic environments, as well as volcanic and geothermal activity. Anthropogenic (man-made) sources may contribute a significant amount of mercury released to surface waters. On January 28, 1998 the DEP submitted a report to the Joint Standing Committee on Natural Resources

[2] Total pounds from 7 pulp and paper mills with actual data, 4 other pulp and paper mills using extrapolated data, 3 metal finishing facilities, 1 textile mill and 1 industrial development.

investigating Mercury in Maine. Specifically, section IIIA of this report is a discussion of mercury associated with air emissions. Specifically, figure III-4 shows Maine's mercury emissions in 1992 to be 2786 pounds, realizing that only a portion of these emissions are redeposited here in the state.

Mercury enters Maine's surface waters by atmospheric deposition, rock weathering, soil erosion, point sources and non-point sources. It tends to accumulate in lake and river sediments. It accumulates in sewer pipes which lead to long-term releases to wastewater treatment plants. The contributions of mercury to surface waters by natural sources, atmospheric deposition and non-point sources are very difficult to quantify. The sources of mercury, which are discussed in this section, are: 1) natural, 2) point sources and 3) incidental sources. *Natural sources* are those that are unrelated to human activities, for example, emissions from oceans and wildfires. *Point sources* are anthropogenic sources that are readily associated with a fixed geographic location, such as municipal wastewater treatment plants and industrial manufacturing facilities (although these discharges also may contain natural and incidental sources of mercury). *Incidental sources* are typically small and numerous, usually cannot be readily located and are released in conjunction with something else, e.g., consumer products.

B. Natural Sources of Mercury

Mercury is a natural element that makes up our solar system. It is present in the sun, moon rocks and meteorites. Mercury deposits, on earth, are found in Cinnabar (HgS). Granite contains about 200,000 parts per trillion mercury (Press and Siever, 1978). Volcanic sources emit mercury to the atmosphere. It has been estimated that, at times, volcanic activity alone may constitute 40 to 50 percent of the natural mercury in the atmosphere. It is extremely difficult to determine the amount of naturally occurring mercury that enters surface waters.

C. Marine Deposit of Mercury

In 1944, the Vessel Empire Knight sank off the coast of York, Maine, one and a half miles form Boon Ledge in 260 feet of water. Included in the cargo was 16,800 pounds of mercury. Survey work around the hull found somewhat elevated levels of mercury in the immediate vicinity of the vessel. The United States Coast Guard (USCG) conducted an emergency removal action which confirmed the presence of the mercury.

Due to the depth of the wreck and condition of the cargo, the Coast Guard was able to retrieve only approximately 1,200 pounds of mercury. At $42 million, the cost of further removal was deemed prohibitive. Rather, the USGS recommendation was that, assuming the wreck remains undisturbed, the low risk created by "no action" strategy would be the appropriate response. In 1995, the USGS instituted a permanent 1,000 yard radius safety zone around the wreck which prohibits dredging, diving, anchoring and fishing.

D. *Production and Uses*

This section provides an overview of the uses of mercury in consumer products and raw materials.[3]

1. *Electrical Apparatus*

Mercury is used in fluorescent tube lights, rectifiers, and batteries. Mercury is also used in silent light switches. Button batteries are used in toys, greeting cards, watches and games. The use of mercury in button batteries is expected to decline.

2. *Production of Chlorine and Caustic Soda*

Mercury is used as a cathode in an electrolytic process by which chlorine and caustic soda are produced from a solution of sodium chloride.

3. *Paint*

Because of its toxic qualities, the use of mercury-containing pigments have been used in paints, coating and plastics, but cadmium has replaced the general use of mercury in pigments.

4. *Measuring Devices*

Mercury is used in thermometers, manometers, thermostats, barometers and vacuum gauges. Breakage of these devices and potential disposal down the drain results in mercury discharges to the wastewater treatment plant.

5. *Dental Preparations*

Mercury is combined either with silver or gold to form amalgams used in dental fillings. The use, removal and improper disposal of amalgam can be a significant source of mercury to a wastewater treatment plant.

6. *Catalysts*

Mercury is used as a catalyst to speed up chemical reactions. Mercury is used in the production of PVC.

7. *Agriculture*

Mercury was used as a coating on seeds to protect them from attack by fungi during storage.

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[3] A companion Report submitted by the Land and Water Resources Council on January 1, 1999 entitled: "Labeling and Collection of Mercury-Added Products" gives a more in-depth discussion of some consumer products containing mercury.

8. General Laboratory Use

Mercury is used as a catalyst in certain chemical reactions and as a preservative for biological specimens.

9. Pharmaceuticals

Mercury is used for its germ-killing properties and as a diuretic. The use of mercury in pharmaceuticals is decreasing. Mercury compounds are used as preservatives, nasal spray, topical anti-microbial products, and vaccines for both humans and animals.

E. Mercury as an Unwanted Contaminant

Mercury can be found as a contaminant of chemicals manufactured by the mercury-cell process. These include sodium hydroxide, potassium hydroxide, chlorine and muriatic acid. These chemicals are also used to make household bleach, cosmetics and pharmaceuticals. Mercury is also found in sulfuric acid and lime. Mercury as an unwanted contaminant is a source of mercury for both municipal wastewater treatment plants and pulp and paper mills.

F. Contributions of Mercury to a Municipal Wastewater Treatment Plant

These represent the sources of mercury that is re-released by municipal wastewater treatment plants.

1. Medical Facilities

Hospitals and other healthcare facilities use a variety of products that contain mercury, such as thermometers, blood pressure cuffs, fluorescent bulbs, batteries, laboratory chemicals and many cleaning products. Electrical equipment such as fiber optics and switches may contain mercury. Zenker's solution and mercurochrome also contain mercury.

2. Dentists

Western Lake Superior Sanitary District (WLSSD) reports an average mercury contribution to wastewater from 0.1 - 0.3 grams/dentist/day. If this reported average mercury contribution to wastewater is accurate, and assuming no reclamation units are being used, an estimated 40 pounds of mercury is discharged from dentists in Maine. Most of that mercury concentrates in the wastewater sludge because particulate materials are incorporated in the solids.

3. Sewer Cleaning Practices

Mercury collects in the sewer lines and flushing the lines can send a lot of mercury to the treatment plants. Removing the sediment can reduce the mercury loading.

4. Septic Haulers

The mercury concentration of septage can be very high. WLSSD reports an average concentration of 62,000 ppt.

5. Residential Wastewater

The Maine DEP found an average mercury concentration of 80 ppt when sampling sewer lines from residential neighborhoods.

6. Industrial Laundries

Cleaning chemicals and the dirt, oil and grease from industrial laundries may contain mercury. Dyes and preservatives in imported clothing may also contain mercury. WLSSD found 700 ppt in the effluent of one facility.

7. Laboratories

Laboratories use equipment and reagents that contain mercury.

8. Veterinary Clinics

Veterinary clinics use reagents and measuring devices that contain mercury. Thermometers can easily be broken when working with animals such as cats and dogs.

9. Printing Industry

Small quantities of mercury can be discharged from inks and coatings.

10. Pottery and Arts

Pigments in art materials may contain mercury.

11. Automobile Service

Dirt and oil contain mercury that may be discharged by automobile service centers.

12. Painting and Paint Stripping

Mercury has not been used in latex paint since 1990. At the South East Pollution Control Plant in San Francisco, CA during a household hazardous waste collection day, old latex paint had an average mercury concentration of 125,000,000 ppt.

13. Landfill Leachate

Municipal solid waste landfill leachate contains from 700 ppt to 2,000 ppt according to MPCA *Strategies for Reducing Mercury in Minnesota*.

G. *Bangor Mercury Sampling Project*

To help provide some understanding of the sources of mercury within a community, the DEP collected samples from various points throughout the City of Bangor sewer system. The results of that sampling program indicate the following:

1) the plant influent averaged 269 ppt of mercury,
2) the plant effluent averaged 9.9 ppt of mercury,
3) this represents an average removal rate of 96% from the wastewater,
4) the tap water was 0.86 ppt which indicates the influent mercury is coming from various sources within the system,
5) the highest concentration of mercury, 508 ppt, was collected from the Kenduskeag Pump Station which conveys wastewater from about 2/3 of the city,
6) the lowest concentration of mercury, 4 ppt, was collected from a new residential development.

Table 7

Bangor Sample Sources	Average Mercury Concentration (ppt)
Drinking Water	0.86
Plant Influent	269
Plant Effluent	9.9
New Residential	19.4
Commercial	118
Heavy Development/Commercial	300

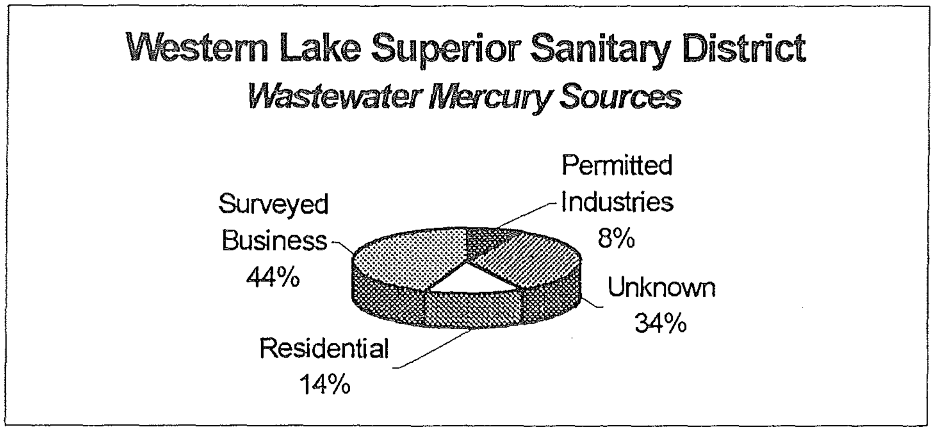
These data suggest that older sections of the city have higher concentrations of mercury. Mercury may have accumulated in the sediments and sewers. There is some detectable mercury from all parts of the system. The more highly developed parts of the city have more mercury. Although some individual sources can be identified, it would be very difficult to find all of them.

H. *Incidental Sources*

An incidental source is an unintentional use of mercury or a product contaminated with mercury. Thus, mercury releases occur as a result of decisions to intentionally use mercury in consumer products or manufacturing processes, and as a result of incidental releases. The majority, if not all of the mercury released by pulp and paper mills is incidental. Municipal wastewater treatment facilities have both known sources and incidental sources. Incidental sources include: 1) consumer products used in households, 2) atmospheric deposition and 3) treatment chemicals contaminated with mercury.

At one bleached Kraft pulp and paper mill in Minnesota a significant source of mercury originated from the pulp bleaching process. Most of that mercury was identified as coming from the sulfuric acid, a feedstock chemical used to adjust the pH prior to the first bleaching stage. Sulfuric acid is frequently produced from the sulfur dioxide that is captured to reduce air emissions from smelting process. Mercury gets into these processes with the mined materials.

The Western Lake Superior Sanitary District reports the following breakdown of the sources of mercury within their system.



Mercury enters municipal wastewater treatment systems from many sources, including dentists, a hospital, a high school and businesses that use chemicals that contain mercury. Most households have the potential to discharge small quantities of mercury. All these small sources of mercury can have a cumulative effect on total loadings of mercury to the treatment plant. Deriving detailed estimations of individual sources of mercury into municipal wastewater treatment systems is a complex undertaking that is beyond the scope of this report.

VII. WASTEWATER DISCHARGE COMPLIANCE

A. Compliance with Section 420

Section 420 prohibits the discharge of mercury or any compound containing mercury in any concentration that increases the natural concentration of mercury in receiving waters. To determine whether treatment plants were meeting this standard, the Department obtained effluent samples from 85 municipal and industrial wastewater treatment plants in the fall of 1998. The universe of facilities required to test effluent for toxics, including mercury is approximately 100. There are 23 facilities that have an estuarine or ocean outfall which can not be evaluated for compliance with "natural concentrations" because the "natural concentration" of the ocean has not been determined. Samples were collected using EPA Method 1669 protocols and analyzed using EPA Method 1631 which are the "clean techniques" (See section I). Based upon the results of this sampling effort, as well as testing conducted by municipal and industrial facilities, 32 facilities exceeded the "natural" concentration of mercury in receiving waters using the 95th percentile, (4.48 parts per trillion – ppt). At the 99th percentile, (6.00 parts per trillion – ppt), 29 facilities were in exceedence.

B. Compliance with mercury ambient water quality criteria

EPA routinely publishes recommended ambient water quality criteria (AWQC) for 157 pollutants pursuant to the Clean Water Act (CWA) §304(a) for states to use as guidance when promulgating water quality standards under Section 303(c) of the CWA. Water quality criteria are based solely on data and scientific judgments on the relationship between pollutant concentration and environmental and human health effects. The criteria do not reflect consideration for economic impacts or technological feasibility of meeting the chemical concentration in ambient water. Except for mercury, Maine statutorily adopted these criteria by reference (38 MRSA §420(2)(A)). EPA recently revised it's Section 304(a) criteria that resulted in a number of criteria changes, including mercury. The chronic fresh water aquatic life criteria for merucury increased from 12 ppt to 770ppt (the corresponding salt water chronic value increased from 25ppt to 940ppt). However, the human health criteria of 50ppt is unchanged. (See Table 8) For purposes of this analysis, the department measured compliance of facilities discharging to freshwaters against the previously published chronic fresh water aquatic life criteria of 12ppt, since this is would provide the most stringent standard for screening compliance. Effluent discharges from facilities not in compliance with the 12ppt standard could then be evaluated against the more current human health criteria of 50ppt for a futher overview of compliance trends.

Table 8

National Recommended Water Quality Criteria for Mercury

Freshwater Acute	Freshwater Chronic	Saltwater Acute	Saltwater Chronic	Human Health Water+Organism	Human Health Organism Only
1,400 ppt	**770 ppt** 12 ppt	**1800 ppt**	**940 ppt** 25 ppt	**50 ppt**	**51 ppt**

(Note: Bolded values indicate current water quality criteria)

When calculating whether a given facility's effluent is in compliance with an AWQC, the department uses a dilution-adjusted formula following procedures adopted in the Chapter 530.5 toxics rule. (38 MRSA § 451 prohibits the discharge of any pollutant that, after reasonable opportunity for dilution, diffusion or mixing with the receiving water, would lower the quality such water body.) Accordingly, after calculating the applicable dilution factor for each facility, no exceedences of the 12 ppt criteria were detected; thus making evaluation against the 50 ppt human health criteria a moot issue.

It must be noted that data variability is a common occurrence when measuring levels of a pollutant at such low concentrations (i.e. ppt), and can be further compounded at municipal treatment plants that receive waste waters from a wide mix of residential and commercial users. This variability can complicate the determination of a particular facility's compliance status. For example, at one waste water treatment facility, samples collected and analyzed by clean techniques on four separate sampling events (11/04/98; 11/02/98;10/30/98; 10/27/98) revealed mercury values of 3.64 ppt, 4.59 ppt, 6.29 ppt, and

3.20 ppt respectively. Likewise, results from a DEP staff /treatment plant staff split sampling event at one facility on October 23, 1998, detected mercury concentrations of 5.06 ppt and 2.85 ppt. Accordingly, depending on which sampling event is considered, the facility's mercury result may/may not be greater than our current estimate of natural concentration.

Appendix A

List of Contributors

List of Contributors

A host of people have contributed to the mercury sampling project,and the preparation of this report. Thanks are due to all of the following individuals, without whose contributions this initiative would not have been able to move forward:

Effluent Mercury Sampling Project

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Thanks to mercury group members who provided comments on the report

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Appendix B

Natural Concentration QA/QC Results

Initial Precision and Recovery (IPR): True Value: 5.0 ng/L 94.7 Average %R
Analyzed: 11/2/98:

Method Detection Limit (MDL): 0.16 ng/L
Analyzed 9/22/98:

QC Sample (QCS) Results

Date Analyzed	% Recovery
8/26/98	94.00
8/28/98	92.40
9/8/98	86.80
9/11/98	90.40
9/15/98	93.20
9/17/98	99.60
9/22/98	84.80
9/28/98	84.00
10/6/98	110.80
10/8/98	98.40
10/13/98	102.80
10/14/98	102.40
10/19/98	96.00
10/20/98	106.80
10/27/98	102.00
10/29/98	104.40
11/2/98	103.20
11/4/98	96.80
11/19/98	101.20
12/28/98	91.20

In-House Teflon Bottle Blanks:

Date Analyzed	Result ng/L
8/26/98	<0.5
8/28/98	0.67
9/1/98	0.63
9/8/98	<0.5
9/28/98	<0.5
10/6/98	<0.5
10/6/98	<0.5
10/6/98	<0.5
10/8/98	<0.5
10/8/98	1.43
10/13/98	<0.5
10/13/98	<0.5
10/14/98	<0.5
10/14/98	<0.5
10/19/98	<0.5
10/19/98	<0.5
10/20/98	<0.5
10/20/98	<0.5
10/20/98	<0.5
10/20/98	<0.5
10/20/98	<0.5
10/27/98	<0.5
11/2/98	<0.5
11/2/98	<0.5
11/2/98	<0.5
12/28/98	<0.5
12/28/98	<0.5

MATRIX SPIKE / MATRIX SPIKE DUPLICATES:

Acceptance: 75-125 %R; RPD < 24%

Analysis Date	Sample ID	Matrix Spike %R	Spike Dupl. %R	RPD
08/26/98	PLE-1 8/19/98	59.70	74.80	22.50
9/1/98	MAC-1 8/27/98	86.60	74.40	15.10
9/11/98	KBC-2 8/26/98	82.50	85.10	3.13
9/22/98	NMAR-01 8/31/98	91.20	91.30	0.17
9/28/98	SBK-1 9/4/98	78.40	79.70	1.57
10/6/98	ROY-01 9/4/98	72.60	74.60	2.72
10/13/98	SBC-1 9/24/98	100.80	97.60	3.21
10/14/98	LAND-1 10/4/98	96.00	93.40	2.67
10/19/98	LIT-01 9/7/98	87.80	90.20	2.79
10/19/98	TMP 9/9/98	85.60	84.30	1.59
10/20/98	SBS-1 9/10/98	93.10	95.60	2.68
10/20/98	UNI-1 10/1/98	92.30	91.30	1.59
10/22/98	DED 10/16/98	96.50	99.60	9.64
10/22/98	SAB 10/19/98	87.80	87.60	0.18
11/2/98	SPNB-1 10/28/98	91.00	91.00	0.00
11/2/98	ROY-1 10/30/98	86.50	86.90	0.51
12/28/98	WMTW 12/8/98	80.60	93.20	14.50

Reagent Blank Values:

Problem Indication: 0.25 ng/L

Date Analyzed	ng/L
10/6/98	0.20
10/8/98	<0.2
10/13/98	0.23
10/14/98	0.21
10/20/98	0.24
10/27/98	<0.2
10/29/98	0.44
11/2/98	0.48
12/28/98	<0.2

ANALYTICAL SAMPLE DUPLICATES:

Acceptance: RPD < 20%

Date Analyzed	Sample ID	Replicate #1	Replicate #2	% RPD
08/28/98	SCRB-1	0.52	1.09	71.30
9/1/98	EMAC-1	1.03	1.01	1.96
9/28/98	KDK-1	0.42	0.46	10.70
10/6/98	KBK-1	1.22	1.23	0.82
10/8/98	ELL-1	1.3	1.31	0.77
10/13/98	NPNB-1	4.02	3.82	5.10
10/14/98	WLD-1	4.58	4.48	2.21
10/19/98	GRW-1	1.76	1.53	14.00
10/19/98	ELL-1	1.53	1.55	1.30
10/20/98	KBG-1	2.5	2.49	0.40
10/20/98	PLE-1	1.82	1.76	3.35
10/22/98	SDY	2.21	2.16	2.29
10/22/98	WNEZ-1	1.77	1.77	0.00
11/2/98	NPNB-1	2.89	2.5	14.50
11/2/98	NON	2.1	2.04	2.90
12/28/98	WMTW-1 12/8/98	1.28	1.19	7.29

Bubbler Blanks Averaged Per Analytical Run

Acceptance: Mean <25 pg

Date Analyzed	Average, pg/L
8/26/98	3.73
9/1/98	5.08
9/8/98	5.14
9/11/98	6.61
9/22/98	3.98
9/28/98	1.05
10/6/98	3.47
10/8/98	1.71
10/13/98	1.33
10/14/98	2.54
10/19/98	1.7
10/20/98	1.88
10/22/98	2.6
11/2/98	1.15
12/28/98	2.09

Sampling Duplicates:

Acceptance: RPD <20%

Date Analyzed	Sample ID	Replicate #1	Replicate #	%RPD
8/26/98	UNI-01 8/19/98	1.4	1.56	10.81
9/1/98	MAC-1 8/27/98	1.69	1.34	23.1
10/6/98	ROY-1 9/7/98	0.74	0.8	7.79
10/8/98	WEB-1 9/9/98	0.82	1.44	54.87
10/13/98	WPLE-1 9/24/98	2.04	1.88	8.16
10/14/98	RDC-1 10/3/98	2.07	2.16	4.26
10/14/98	ALD-1 10/3/98	5.7	5.48	3.94
10/22/98	SCRB 10/16/98	4.14	4.21	1.68
10/22/98	KBK-1 10/20/98	2.83	2.83	0
11/2/98	MAC-1 10/29/98	1.51	1.55	2.61
11/2/98	LIT 10/30/98	1.4	1.47	4.88

Appendix C

Natural Concentration Test Results

Code	Site ID	Gaz. Ma	Site Description	Date	flow	ng/L
CRO-01	Crooked	10	Hunts Corner Rd. off Rt. 118, 4-5 miles NW of East Waterf	09/09/98	L	0.093
PLE-01	Pleasant	26	~2 mi. below Pleasant River Lake, near Otter Pond	10/01/98	M	0.12
PSM-01	Sebago Lake	5	State Par(as remote as possible)	10/20/98	M	0.22
SAL-01	Salmon Falls River	3	below Great East Lake on N.H. border	10/30/98	M	0.35
STC-01	St. Croix	46	below Scott Brook concluence and Tyler Rips	09/25/98	L	0.4
KSK-01	Kenduskeag Stream	32	off Rt. 94 south of Earnest Corner	09/03/98	L	0.42
KBC-02	Kennebec	20	off Rt. 210A ~5mi north of North Anson	08/26/98	L	0.49
WES-01	Wesserunsett Stream	21	Huff Rd. ~1mi. east of Cornville	08/26/98	L	0.49
MOU-02	Mousam River	3	Rt.11/109 at Emery Mills, N.W. of Springvale		M	0.56
SAL-01	Salmon Falls River	2	below Great East Lake on N.H. border	09/29/98	L	0.57
ePDK-01	East Branch Passadum	34	~2 or 4 mi. above The Oxbow	09/25/98	L	0.6
SAC-01	Saco	4	upstream of North Conway NH	09/29/98	L	0.67
PQA-01	Piscataqua	5	Mountain Rd.in West Falmouth Corner	09/07/98	L	0.68
I AND-01	Little Androscoggin	11	below Bryant Pond	10/11/98	h	0.74
MOU-01	Mousam River	2	Rt.11/109 at Emery Mills, N.W. of Springvale	09/29/98	L	0.74
ROY-01	Royal	5	Rt. 231 New Gloucester	09/07/98	L	0.74
SDY-01	Sandy	19	above Rt. 4 just south of Saddleback Mtn. trailhead	09/19/98	L	0.74
I AND-01	Little Androscoggin	10	below Bryant Pond	09/09/98	L	0.75
wSHP-01	West Branch Sheepsco	14	off Rt. 3 in Palermo	10/19/98	M	0.78
WEB-01	Webb	19	Rt. 142, 1-2 mi. below Webb Lake	09/09/98	L	0.82
STC-1	St. Croix	47	below Scott Brook concluence and Tyler Rips	10/29/98	M	0.87
wNEZ-01	West Branch Nezinscot	11	Rt. 219 in West Sumner	09/09/98	L	0.87
SAB-01	Sabattus	13	below Sabattus Pond Sabattus	10/19/98	M	0.89
MOO-1	Moose	39	~2 mi. above Holeb	09/03/98	L	0.94
SAB-01	Sabattus	12	below Sabattus Pond Sabattus	08/31/98	L	0.99
SOU-01	Souadabscook Stream	22	Newburg Rd. above Hermon Pond	08/31/98	L	0.99
LIT-1	North Branch Little Rive	5	off Rt. 25 S.E. of Standish	09/07/98	L	1
eMAC-01	East Machias	36	Rt. 9 below Crawford Lake, above Harmon Brook	08/27/98	L	1.03
nMDX-01	North Branch Meduxne	60	East of Harvey	12/16/98	M	1.04
TMP-01	Temple Brook	19	above Rt. 156 at Wilton Intervale	09/09/98	L	1.06
SBC-01	Sebec	32	off Brownville Sebec Rd., ~5 mi. above Milo	09/24/98	L	1.09
sCRB-01	South Branch Carrabas	29	Bigelow above Rt. 27/16	08/26/98	L	1.09
SKZ-01	Sunkhaze Stream	33	above Dudley Brook confluence	09/25/98	L	1.1
SBK-1	Sebasticook	31	Dexter Rd. , 3-4 mi. SW of North Dexter	09/03/98	L	1.12
STG-01	St. George	14	Rt. 173 in South Montville, below Trues Pond	08/31/98	L	1.15
KBK-01	Kennebunk	3	Rt. 1 at Bartlett Mills, just north of Kennebunk	09/07/98	L	1.2
MSQ-01	Big Musquash Stream	35	on main road 8-9 miles NE of Grand Lake Stream	08/27/98	L	1.21
wSHP-01	West Branch Sheepsco	13	off Rt. 3 in Palermo	08/31/98	L	1.22
WEB-01	Webb	20	Rt. 142, 1-2 mi. below Webb Lake	10/16/98	H	1.23
NON-01	Nonesuch	3	Beech Ridge Rd. north of Beech Ridge Farm	09/07/98	L	1.24
ELL-01	Ellis	18	above Rt. 120 in Andover	09/09/98	L	1.28
ePNB	East Branch Penobscot	52	below Bowlin Brook at Spencer Rips	12/07/98	M	1.28
WLD-01	Wild	10	Rt. 113 above Gilead	09/09/98	L	1.31
SBS-01	Seboeis	51	~4 mi. above concluence with Penobscot	09/10/98	L	1.32
MOO-1	Moose	40	~2 mi. above Holeb	10/28/98	M	1.34
ROY-01	Royal	6	Rt. 231 New Gloucester	10/30/98	M	1.34
GRW-01	Great Works River	2	Rt. 4 above North Berwick	09/07/98	L	1.37
ePNB-01	East Branch Penobscot	51	below Bowlin Brook at Spencer Rips	09/10/98	L	1.4
LIT-1	North Branch Little Rive	6	off Rt. 25 S.E. of Standish	10/30/98	M	1.4
UNI-01	Union	24	Tannery Rd. north of Amherst	08/18/98	L	1.4
PQA-01	Piscataqua	6	Mountain Rd.in West Falmouth Corner	10/3098	M	1.45
WMTW-	West Branch Mattawam	53	1-2 mi. east of Batesville	12/07/98	M	1.45
SBS-01	Seboeis	52	~4 mi. above concluence with Penobscot	12/07/98	M	1.46
UNI-01	Union	25	Tannery Rd. north of Amherst	10/01/98	M	1.48
MAC-1	Machias	36	2 mi. below Third Machias Lake	10/29/98	M	1.51
NAR-01	Narraguagus	34	Barrel Brook confluence, ~2 mi. south of Studmill Rd.	08/27/98	L	1.51
wPQS-01	West Branch Piscataqu	41	Shirley Rd. below West Shirley Bog	09/24/98	L	1.52
ALD-01	Alder Brook	65	below Alder brook Lake	12/16/98	M	1.55
STH-01	South River	4	Pratt Rd, Porter	09/29/98	L	1.55
nMAR-01	North Branch Marsh Str	22	Jackson Rd. in Jackson	08/31/98	L	1.57
KBG-01	Kennebago	28	~1 mi. below Little Kennebago Lake	09/19/98	L	1.63
sPNB-01	South Branch Penobsc	49	just above Canada Falls lake	10/28/98	M	1.64

Code	Site ID	Gaz. Ma	Site Description	Date	flow	ng/L	
PLE-01	Pleasant	25	~2 mi. below Pleasant River Lake, near Otter Pond	08/18/98	L	1.65	
MAC-1	Machias	35	1 mi. below Third Machias Lake	08/27/98	L	1.69	
KBC-02	Kennebec	21	off Rt. 210A ~5mi north of North Anson	10/15/98	H	1.71	
BOG-01	Belgrade Str	12	Wings Mills, 8-10 mi NW of Augusta	08/31/98	L	1.74	
DED-1	Spencer Stream	29	above Dead River confluence	08/26/98	L	1.75	
wNEZ-01	West Branch Nezinscot	12	Rt. 219 in West Sumner	10/19/98	M	1.77	
ePDK-01	East Branch Passadum	35	~2 or 4 mi. above The Oxbow	10/29/98	M	1.81	
AND-01	Androscoggin	10	above Berlin NH	09/29/98	L	1.9	
PRA-01	Pratt Lake Stream	63	Inflow to Big Machias Lake	10/02/98	L	1.91	
FIS-01	Fish	63	Fish Lake Rd. above Fish River Lake	10/02/98	L	1.92	
TMP-01	Temple Brook	20	above Rt. 156 at Wilton Intervale	10/16/98	H	2.03	
wPLE-01	West Branch Pleasant	41	~1 or 3 mi. below Baker Mountain Brook	09/24/98	L	2.04	
RDC-01	Riviere Des Chutes	65	River Des Chutes road	10/03/98	L	2.07	
NON-01	Nonesuch	4	Beech Ridge Rd. north of Beech Ridge Farm	10/30/98	M	2.1	
SOU-01	Souadabscook Stream	23	Newburg Rd. above Hermon Pond	10/15/98	H	2.11	
SDY-01	Sandy	20	above Rt. 4 just south of Saddleback Mtn. trailhead	10/16/98	H	2.21	
BOG-01	Belgrade Str	13	Wings Mills, 8-10 mi NW of Augusta	10/19/98	M	2.22	
GRW-01	Great Works River	3	Rt. 4 above North Berwick	10/20/98	M	2.27	
sPNB-01	South Branch Penobsc	48	just above Canada Falls lake	09/24/98	L	2.31	
ALG-01	Allagash Stream	55	at confluence with St. John River	10/02/98	L	2.37	
ARO-01	Aroostook	57	at Oxbow check point	10/02/98	L	2.52	
KSK-01	Kenduskeag Stream	33	off Rt. 94 south of Earnest Corner	10/15/98	H	2.52	
nMAR-01	North Branch Marsh Str	23	Jackson Rd. in Jackson	10/11/98	H	2.63	
KBG-01	Kennebago	29	~1 mi. below Little Kennebago Lake	10/16/98	H	2.64	
WES-01	Wesserunsett Stream	22	Huff Rd. ~1mi. east of Cornville	10/15/98	H	2.71	
KBK-01	Kennebunk	4	Rt. 1 at Bartlett Mills, just north of Kennebunk	10/20/98	M	2.83	
nPNB-01	North Branch Penobsco	49	North Branch Access Rd. just above Big Bog	10/28/98	M	2.89	
nMDX-01	North Branch Meduxne	59	East of Harvey	10/03/98	L	2.9	
STG-01	St. George	15	Rt. 173 in South Montville, below Trues Pond	10/11/98	L	2.98	
NAR-01	Narraguagus	35	Barrel Brook confluence, ~2 mi. south of Studmill Rd.	10/29/98	M	3.1	
SBK-1	Sebasticook	32	Dexter Rd. , 3-4 mi. SW of North Dexter	10/15/98	H	3.53	
STJ-01	St. John	66	In Dickey	10/02/98	L	3.75	
1MDW-0	Little Madawaska	65	1/2 mi. NW of Blackstone	12/16/98	M	3.83	
nPNB-01	North Branch Penobsco	48	North Branch Access Rd. just above Big Bog	09/24/98	L	4.02	
sCRB-01	South Branch Carrabas	30	Bigelow above Rt. 27/17	10/16/98	H	4.14	
MSQ-1	Big Musquash Stream	36	on main road 8-9 miles NE of Grand Lake Stream	10/29/98	M	4.54	
WLD-01	Wild	11	Rt. 113 above Gilead	10/11/98	M	4.58	
ALD-01	Alder Brook	64	below Alder brook Lake	10/03/98	L	5.7	
CRO-01	Crooked	11	Hunts Corner Rd. off Rt. 118, 4-5 miles NW of East Waterf	10/11/98	H	5.72	
wMTW-0	West Branch Mattawam	52	1-2 mi. east of Batesville	10/02/98	L	6.01	
l MDW-0	Little Madawaska	64	1/2 mi. NW of Blackstone	10/03/98	L	7.01	
RDC-01	Riviere Des Chutes	66	River Des Chutes road	12/16/98	M	<0.5	
				ALL	L	L	H
			N	104	60	13	13
			Mean	1.78	1.63	0.87	2.61
			SD	1.29	1.32	0.44	1.29
			Range	0.09-7.01	0.09-7.01	.09-1.6	0.74-5.72
			25th%	0.99			
			Median	1.45	1.26	0.82	2.52
			75th%	2.14			
			95th %	4.48	4.10	1.59	4.77
			99th %	6.00	6.42	1.62	5.53
			X+1.96 SD	4.3	1.73	4.21	5.14
			X+2SD	4.36	1.75	4.27	5.19

Appendix D

List of Effluent Sampling Sites

Actual Mercury Sampling Program - October - December, 1998

Sampling Schedule - NMRO --- 10 POTW's and *2 Industries* Sampled

Ashland
Fort Kent
Madawaska - *I*
Caribou
Presque Isle
Loring Development Corp.
Washburn
Limestone
Fort Fairfield
Mars Hill
Fraser Paper
Houlton

Sampling Schedule - EMRO --- 14 POTW's and *1 Industry* sampled

Dover-Foxcroft
Guilford
Milo
Millinocket - *I*
Bowater - Millinocket
Lincoln
Old Town
Bangor - *I*
(Note: Several influent and effluent samples were taken at the Bangor POTW)
Orono - *I*
Brewer
Ellsworth
Southwest Harbor
Bar Harbor
Machias
Calais - *I*

Sampling Schedule - CMRO --- 30 POTW's and *4 Industries* sampled

Waterville (KSTD) - *I*
Oakland
SAPPI - Hinkley
Skowhegan
Anson-Madison
Augusta
Belfast
Camden
Rockland - *I*
Thomaston
Warren
Waldoboro
Gardiner
Wiscassett
Boothbay Harbor -*I*
Bath
Brunswick
Lisbon
Sabattus
LAWPCA
Paris
Norway
Robinson Manufacturing
Mechanic Falls
Farmington
Wilton
North Jay
International Paper - Jay
Rumford/Mexico - *I*
Hartland
Corinna
Newport
Unity
OSRAM Sylvania

I - indicates an Influent sample was taken.

Sampling Schedule - SMRO --- 21 POTW's and ***3 Industries*** sampled

Freeport
Yarmouth
Falmouth
Westbrook
SAPPI - Westbrook
Portland
South Portland - *I*
Scarborough
Cape Elizabeth
Old Orchard Beach
Saco
Biddeford
Kennebunk
Kennebunkport
Sanford
Wells
Ogunquit
York
Kittery - *I*
South Berwick
Berwick
North Berwick
Pratt & Whitney
Control Devices

I - Indicates and influent sample was taken.

Appendix E

Effluent QA/QC Results

Mercury Sampling Project

Summary of Quality Control Information

January 19, 1999

Date Sent	Samples Sent	Field Blank	Trip Blank	Lab Duplicate	Field Duplicate	Certified Fish Tissue	Matrix Spike Recovery
10/22/98	JCMRO-01 16						
10/24/98	DEMRO-02 22	0.17 ppt 0.11 ppt		6.86 ppt 7.09 ppt 3.3% RPD	11.15 ppt 12.55 ppt 11.8%RPD (a)	4498 ppt 96.9% 4378 ppt 94.4%	MS 17.25 ppt (101.7%) MSD 17.15 ppt (100.7%)
10/27/98	JCMRO-17 32	0.28 ppt 0.10 ppt 0.12 ppt		97.83 ppt 100.6 ppt 2.8% RPD 4.12 ppt 4.18 ppt 1.5% RPD	7.76 ppt 9.26 ppt 17.6%RPD (a)	4498 ppt 96.9% 4378 ppt 94.4%	MS 202.7 ppt (102.4%) MSD 198.5 ppt (98.3%) MS 18.04 ppt (89.3%) MSD 18.14 ppt (90.0%)
10/29/98	JCMRO-33 56	0.22 ppt 0.33 ppt 0.04 ppt	0.40 ppt (c) 0.24 ppt (d)	8.89 ppt 8.84 ppt 0.6% RPD	8.87 ppt 9.00 ppt 1.5%RPD (a)	4498 ppt 96.9% 4378 ppt 94.4%	MS 29.96 p (96.8%) MSD 29.96 ppt (96.8%)
10/30/98	DNMRO-01 17	0.04 ppt	0.03 ppt	77.04 ppt 85.13 ppt 10.0%RPD		4528 ppt 97.6%	MS 279.9 ppt (99.4%) MSD 285.0 ppt (102.0%)
11/04/98	JSMRO-01 17 JCMRO-57 60	0.21 ppt 0.03 ppt 0.06 ppt	0.03 ppt (e)	1185.8 ppt 1191.6 ppt 1% RPD		4492 ppt 96.8%	MS 3412 ppt (105.5%) MSD 3383 ppt (104.1%)
11/06/98	P-BANGOR-01 14	0.04 ppt		38.90 ppt 40.69 ppt 4.5% RPD 72.09 ppt 72.17 ppt 0.1% RPD	44.84 ppt 49.28 ppt 9.4%RPD (a)	4693 ppt 101.1%	MS 299.7 ppt (108.1%) MSD 298.0 ppt (107.3%)
11/12/98	JSMRO-18 32	0.05 ppt 0.11 ppt		8.78 ppt 8.88 ppt 1.2% RPD	9.19 ppt 8.83 ppt 4.0%RPD (a)	4359 ppt 93.9%	MS 28.23 ppt (96.1%) MSD 28.81 ppt (99.1%)

Mercury Sampling Project

Summary of Quality Control Information

Date Sent	Samples Sent	Field Blank	Trip Blank	Lab Duplicate	Field Duplicate	Certified Fish Tissue	Matrix Spike Recovery
11/20/98	P-BANGOR-15 31	0.05 ppt		281.0 ppt 273.7 ppt 2.6% RPD	277.4 ppt 197.4 ppt 33.7%RPD (b)	4359 ppt 93.9%	MS 661.9 ppt (90.5%) MSD 691.7 ppt (97.6%)
12/18/98	DCMRO-01 05 JSMRO-33 - 37 JCMRO-101	0.03 ppt 0.12 ppt		22.68 ppt 22.94 ppt 1.1% RPD		55.34 ppt (90.7%)	MS 887.6 ppt (96.1%) MSD 691.1 ppt (103.7%)

Cell Notes:

(a) Field Duplicates performed on wastewater effluent samples
(b) Field Duplicates performed on wastewater influent samples
(c) Trip Blank associated with samples J-CMRO-33 to J-CMRO-41
(d) Trip Blank associated with samples J-CMRO-42 to J-CMRO-49
(e) Trip Blank associated with samples J-SMRO-08 to J-SMRO-17

Appendix F

Effluent Test Results

NPDES Number	Facility Name	Mercury Concentration in p.p.t.	Sampling Date	Source	Sample Taken by
E0100285	KITTERY WPCF	1,191.60	11/03/98	*Influent*	DEP
ME[illegible]00064	BOOTHBAY HARBOR SEWER DISTRICT	1,018.20	10/27/98	*Influent*	DEP
ME[illegible]0781	BANGOR WWTP	476.00	07/28/98	*Influent*	POTW
E0100595	ROCKLAND WWTF	387.00	08/19/98	Effluent	POTW
ME0100633	SOUTH PORTLAND WPCF	338.40	11/10/98	*Influent*	DEP
ME0100129	CALAIS WWTP	302.90	10/23/98	*Influent*	DEP
E0100803	MILLINOCKET WWTF	302.90	10/22/98	*Influent*	DEP
ME0100781	BANGOR WWTP	277.40	11/20/98	*Influent*	DEP
ME0100781	BANGOR WWTP	257.20	11/06/98	*Influent*	DEP
E0002381	OSRAM - Sylvania	246.80	12/16/98	Effluent	DEP
ME0100552	RUMFORD-MEXICO SDTP	230.00	10/29/98	*Influent*	DEP
ME0100781	BANGOR WWTP	202.90	12/14/98	*Influent*	POTW
ME0100781	BANGOR WWTP	197.40	11/20/98	*Influent*	DEP
ME0100498	ORONO WPCF	127.30	10/22/98	*Influent*	DEP
ME0100951	PARIS UTILITY DISTRICT	126.00	09/01/98	*Influent*	POTW
ME0101290	HOULTON WATER COMPANY	118.10	10/30/98	*Influent*	DEP
ME0100595	ROCKLAND WWTF	100.40	10/22/98	*Influent*	DEP
ME0100714	WALDOBORO SEWER DISTRICT	99.23	10/23/98	Effluent	DEP
ME0100072	BREWER W W T P	86.72	10/23/98	*Influent*	POTW
ME0100561	PRESQUE ISLE W W T F	81.09	10/27/98	*Influent*	DEP
ME0100854	KENNEBEC SANITARY TREAT. DIST.	79.98	10/28/98	*Influent*	DEP
ME0100102	BRUNSWICK SEWER DISTRICT	66.74	10/27/98	Effluent	DEP
ME0100307	LISBON PCF	66.58	10/27/98	Effluent	DEP
ME0100498	ORONO WPCF	59.96	07/29/98	*Influent*	POTW
M[illegible]00935	KENNEBUNK SEWER DISTRICT	56.43	10/30/98	Effluent	DEP
ME0021521	SAPPI - HINCKLEY	55.07	11/06/98	Effluent	POTW
ME0021521	SAPPI - HINCKLEY	53.17	10/28/98	Effluent	DEP
ME0100102	BRUNSWICK SEWER DISTRICT	37.75	12/16/98	Effluent	DEP
ME0100102	BRUNSWICK SEWER DISTRICT	33.30	08/03/98	Effluent	POTW
ME0100889	ELLSWORTH PCF	32.42	10/23/98	Effluent	DEP
ME0100439	MILO WATER DISTRICT	31.82	10/22/98	Effluent	DEP
ME0101532	BELFAST WWTF	30.83	10/22/98	Effluent	DEP
ME0101915	WILTON WWTF	30.10	04/19/98	Effluent	POTW
ME0100102	BRUNSWICK SEWER DISTRICT	28.90	11/16/98	Effluent	POTW
ME0101036	FREEPORT SEWERAGE DISTRICT	27.99	11/09/98	Effluent	DEP
ME0101249	FARMINGTON WPCF	27.93	10/29/98	Effluent	DEP
ME0101915	WILTON WWTF	26.20	08/20/98	Effluent	POTW
ME0102059	SCARBOROUGH SANITARY DISTRICT	26.17	11/09/98	Effluent	DEP
ME0100145	CARIBOU UTILITIES DISTRICT	25.30	07/27/98	Effluent	POTW
ME0021521	SAPPI - HINCKLEY	22.81	12/17/98	Effluent	DEP
ME0100986	OGUNQUIT SEWER DISTRICT	22.24	11/03/98	Effluent	DEP
ME0021521	SAPPI - HINCKLEY	22.00	04/28/98	Effluent	POTW
ME0100714	WALDOBORO SEWER DISTRICT	19.88	12/16/98	Effluent	DEP
ME0100234	FORT KENT UTILITY DISTRICT	16.82	10/27/98	Effluent	DEP
ME0100641	SOUTHWEST HARBOR WWTF	15.90	10/23/98	Effluent	DEP
ME0001937	I. P. ANDROSCOGGIN	15.80	10/29/98	Effluent	DEP

NPDES Number	Facility Name	Mercury Concentration in p.p.t.	Sampling Date	Source	Sample Taken by
ME0100218	FALMOUTH - R.B. GOODENOW, PCF	15.32	11/09/98	Effluent	DEP
ME0100498	ORONO WPCF	15.15	10/22/98	Effluent	DEP
ME0101915	WILTON WWTF	15.05	10/29/98	Effluent	DEP
ME0102032	GUILFORD SANGERVILLE S.D.	14.90	05/26/98	Effluent	POTW
ME0102253	WARREN SANITARY DISTRICT	14.85	10/23/98	Effluent	DEP
ME0100471	OLD TOWN PCF	13.62	10/22/98	Effluent	DEP
ME0101702	GARDINER W W T F	13.60	08/19/98	Effluent	POTW
ME0001937	I. P. ANDROSCOGGIN	12.75	12/23/98	Effluent	POTW
ME0100781	BANGOR WWTP	12.66	09/30/98	Effluent	POTW
ME0101796	LINCOLN SANITARY DISTRICT	12.55	10/22/98	Effluent	DEP
ME0001937	I. P. ANDROSCOGGIN	12.49	12/21/98	Effluent	POTW
ME0100781	BANGOR WWTP	12.38	11/20/98	Effluent	DEP
ME0100552	RUMFORD-MEXICO SDTP	12.30	10/29/98	Effluent	DEP
ME0002526	ROBINSON MANUFACTURING	11.94	10/26/98	Effluent	DEP
ME0100951	PARIS UTILITY DISTRICT	11.65	10/26/98	Effluent	DEP
ME0002526	ROBINSON MANUFACTURING	11.30	09/08/98	Effluent	POTW
ME0101796	LINCOLN SANITARY DISTRICT	11.15	10/22/98	Effluent	DEP
ME0100781	BANGOR WWTP	11.10	07/28/98	Effluent	POTW
ME0100145	CARIBOU UTILITIES DISTRICT	10.79	10/27/98	Effluent	DEP
ME0100064	BOOTHBAY HARBOR SEWER DISTRICT	10.75	10/27/98	Effluent	DEP
ME0100137	CAMDEN WPAF	10.75	10/22/98	Effluent	DEP
ME0100951	PARIS UTILITY DISTRICT	10.30	09/01/98	Effluent	POTW
ME0100048	BIDDEFORD WWTF	10.17	10/30/98	Effluent	DEP
ME0100935	KENNEBUNK SEWER DISTRICT	9.87	12/16/98	Effluent	DEP
ME0100226	FORT FAIRFIELD U.D. WTP	9.84	10/30/98	Effluent	DEP
ME0100803	MILLINOCKET WWTF	9.66	10/22/98	Effluent	DEP
ME0100323	MACHIAS WWTF	9.26	10/23/98	Effluent	DEP
ME0102075	PWD - PORTLAND	9.19	11/10/98	Effluent	DEP
ME0101915	WILTON WWTF	9.15	07/20/98	Effluent	POTW
ME0100854	KENNEBEC SANITARY TREAT. DIST.	9.00	10/28/98	Effluent	DEP
ME0100854	KENNEBEC SANITARY TREAT. DIST.	8.87	10/28/98	Effluent	DEP
ME0102075	PWD - PORTLAND	8.83	11/10/98	Effluent	DEP
ME0100552	RUMFORD-MEXICO SDTP	8.50	11/10/98	Effluent	POTW
ME0101702	GARDINER W W T F	8.34	10/27/98	Effluent	DEP
ME0100846	PWD - WESTBROOK WWTP	8.21	11/09/98	Effluent	DEP
ME0100846	PWD - WESTBROOK WWTP	8.04	12/10/98	Effluent	POTW
ME0100790	WELLS SANITARY DISTRICT	7.88	11/03/98	Effluent	DEP
ME0101184	KENNEBUNKPORT WWTP	7.88	10/30/98	Effluent	DEP
ME0100323	MACHIAS WWTF	7.76	10/23/98	Effluent	DEP
ME0101702	GARDINER W W T F	7.70	11/10/98	Effluent	POTW
ME0100781	BANGOR WWTP	7.35	11/06/98	Effluent	DEP
ME0101214-1	BAR HARBOR - MAIN FACILITY	6.98	10/23/98	Effluent	DEP
ME0002526	ROBINSON MANUFACTURING	6.80	06/23/98	Effluent	POTW
ME0000159	FRASER PAPER CO	6.29	10/30/98	Effluent	POTW
ME0100781	BANGOR WWTP	6.21	12/14/98	Effluent	POTW
ME0101079	MARS HILL UTILITY DISTRICT	6.21	10/30/98	Effluent	DEP

NPDES Number	Facility Name	Mercury Concentration in p.p.t.	Sampling Date	Source	Sample Taken by
ME0101443	HARTLAND PCF	6.20	05/05/98	Effluent	POTW
ME0101443	HARTLAND PCF	6.11	11/02/98	Effluent	DEP
ME0100854	KENNEBEC SANITARY TREAT. DIST.	6.00	07/26/98	Effluent	POTW
ME0100846	PWD - WESTBROOK WWTP	5.99	10/20/98	Effluent	POTW
ME0100765	YARMOUTH WWTP	5.98	11/09/98	Effluent	DEP
ME0100447	NEWPORT SANITARY DISTRICT	5.82	11/02/98	Effluent	DEP
ME0100285	KITTERY WPCF	5.65	11/03/98	Effluent	DEP
ME0100129	CALAIS WWTP	5.56	10/23/98	Effluent	DEP
ME0100013	AUGUSTA SANITARY DISTRICT	5.46	10/27/98	Effluent	DEP
ME0100641	SOUTHWEST HARBOR WWTF	5.43	06/09/98	Effluent	POTW
ME0101681	MADAWASKA PCF	5.24	10/27/98	Effluent	DEP
ME0100633	SOUTH PORTLAND WPCF	5.20	08/10/98	Effluent	POTW
ME0100595	ROCKLAND WWTF	5.16	10/22/98	Effluent	DEP
ME0101028	WASHBURN WWTF	5.13	10/30/98	Effluent	DEP
ME0100072	BREWER W W T P	5.06	10/23/98	Effluent	DEP
ME0100021	BATH WPCF	4.93	10/27/98	Effluent	DEP
ME0100668	THOMASTON WWTF	4.79	10/23/98	Effluent	DEP
ME0100765	YARMOUTH WWTP	4.63	11/09/98	Effluent	DEP
ME0000159	FRASER PAPER CO	4.59	11/02/98	Effluent	POTW
ME0100307	LISBON PCF	4.56	12/16/98	Effluent	DEP
ME0100498	ORONO WPCF	4.50	07/29/98	Effluent	POTW
ME0100633	SOUTH PORTLAND WPCF	4.50	11/10/98	Effluent	DEP
ME0102121	PWD - CAPE ELIZABETH WWTF	4.39	11/09/98	Effluent	DEP
ME0100498	ORONO WPCF	4.32	07/27/98	Effluent	POTW
ME0100498	ORONO WPCF	4.20	07/27/98	Effluent	POTW
ME0100498	ORONO WPCF	4.19	07/27/98	Effluent	POTW
ME0100455	NORWAY WWTF	4.15	10/26/98	Effluent	DEP
ME0100561	PRESQUE ISLE W W T F	4.11	10/27/98	Effluent	DEP
ME0101389	ANSON-MADISON SANITARY DIST	4.05	10/28/98	Effluent	DEP
ME0100498	ORONO WPCF	4.01	07/29/98	Effluent	POTW
ME0101443	HARTLAND PCF	4.00	08/11/98	Effluent	POTW
ME0100498	ORONO WPCF	3.84	07/27/98	Effluent	POTW
ME0101117	SACO W W T P	3.68	10/30/98	Effluent	DEP
ME0000159	FRASER PAPER CO	3.64	11/04/98	Effluent	POTW
ME0101061	NORTH JAY WWTF	3.26	10/29/98	Effluent	DEP
ME0000159	FRASER PAPER CO	3.20	10/27/98	Effluent	DEP
ME0101842	SABATTUS SANITARY DISTRICT	3.20	08/25/98	Effluent	POTW
ME0101524	OLD ORCHARD BEACH WWTF	3.15	10/30/98	Effluent	DEP
ME0102032	GUILFORD SANGERVILLE S.D.	3.10	10/22/98	Effluent	DEP
ME0100820	SOUTH BERWICK SEWER DISTRICT	3.09	11/03/98	Effluent	DEP
ME0100625	SKOWHEGAN WPCF	3.03	10/28/98	Effluent	DEP
ME0100072	BREWER W W T P	2.85	10/23/98	Effluent	POTW
ME0101087	ASHLAND WATER & SEWER DIST.	2.83	10/27/98	Effluent	DEP
ME0100447	NEWPORT SANITARY DISTRICT	2.80	09/29/98	Effluent	POTW
ME0101095	LIMESTONE WATER & SEWER DIST.	2.76	10/27/98	Effluent	DEP
ME0102067	CANTON WPCF	2.58	11/10/98	Effluent	POTW

NPDES Number	Facility Name	Mercury Concentration in p.p.t.	Sampling Date	Source	Sample Taken by
ME0100757	WISCASSET WWTF	2.50	10/27/98	Effluent	DEP
ME0100153	CORINNA SEWER DISTRICT	2.49	11/02/98	Effluent	DEP
ME0101478	LEWISTON-AUBURN WPCA	2.49	10/26/98	Effluent	DEP
ME0001724	LORING DEVELOPMENT CORP.	2.34	10/27/98	Effluent	DEP
ME0101290	HOULTON WATER COMPANY	2.34	10/30/98	Effluent	DEP
ME0101842	SABATTUS SANITARY DISTRICT	2.29	10/26/98	Effluent	DEP
ME0100617	SANFORD SANITARY DISTRICT	2.23	10/14/98	Effluent	POTW
ME0101885	NORTH BERWICK SANITARY DIST	2.08	11/03/98	Effluent	DEP
ME0102121	PWD - CAPE ELIZABETH WWTF	2.02	12/10/98	Effluent	POTW
ME0101397	BERWICK SEWER DISTRICT	1.86	11/03/98	Effluent	DEP
ME0000167	BOWATER - GNP - MILLINOCKET	1.73	10/22/98	Effluent	DEP
ME0101095	LIMESTONE WATER & SEWER DIST.	1.70	08/13/98	Effluent	POTW
ME0101222	YORK SEWER DISTRICT	1.67	11/03/98	Effluent	DEP
ME0100391	MECHANIC FALLS SANITARY DIST.	1.55	10/26/98	Effluent	DEP
ME0002321	SAPPI - WESTBROOK	1.44	11/09/98	Effluent	DEP
ME0100501	DOVER-FOXCROFT WWTF	1.41	10/22/98	Effluent	DEP
ME0002399	Control Devices Inc.	1.33	12/16/98	Effluent	DEP
ME0100463	OAKLAND WWTF	1.32	10/28/98	Effluent	DEP
ME0101290	HOULTON WATER COMPANY	1.30	09/22/98	Effluent	POTW
ME0100072	BREWER W W T P	0.97	09/29/98	Effluent	POTW
ME0100617	SANFORD SANITARY DISTRICT	0.74	10/30/98	Effluent	DEP
ME0022861	PRATT & WHITNEY	0.50	05/10/98	Effluent	POTW
ME0022861	PRATT & WHITNEY	0.10	11/03/98	Effluent	DEP

NPDES Number	Facility Name	Mercury Concentration in p.p.t.	Sampling Date	Source	Sample Taken by
E0101389	ANSON-MADISON SANITARY DIST	4.05	10/28/98	Effluent	DEP
.E0101087	ASHLAND WATER & SEWER DIST.	2.83	10/27/98	Effluent	DEP
ME[illegible]0013	AUGUSTA SANITARY DISTRICT	5.46	10/27/98	Effluent	DEP
E0100781	BANGOR WWTP	6.21	12/14/98	Effluent	POTW
.E0100781	BANGOR WWTP	11.10	07/28/98	Effluent	POTW
ME0100781	BANGOR WWTP	12.66	09/30/98	Effluent	POTW
IE0100781	BANGOR WWTP	202.90	12/14/98	*Influent*	POTW
.IE0100781	BANGOR WWTP	476.00	07/28/98	*Influent*	POTW
ME0100781	BANGOR WWTP	7.35	11/06/98	Effluent	DEP
IE0100781	BANGOR WWTP	257.20	11/06/98	*Influent*	DEP
.IE0100781	BANGOR WWTP	277.40	11/20/98	*Influent*	DEP
ME0100781	BANGOR WWTP	197.40	11/20/98	*Influent*	DEP
ΛE0100781	BANGOR WWTP	12.38	11/20/98	Effluent	DEP
ΛE0101214-1	BAR HARBOR - MAIN FACILITY	6.98	10/23/98	Effluent	DEP
ME0100021	BATH WPCF	4.93	10/27/98	Effluent	DEP
ΛE0101532	BELFAST WWTF	30.83	10/22/98	Effluent	DEP
ΛE0101397	BERWICK SEWER DISTRICT	1.86	11/03/98	Effluent	DEP
ME0100048	BIDDEFORD WWTF	10.17	10/30/98	Effluent	DEP
ΛE0100064	BOOTHBAY HARBOR SEWER DISTRICT	10.75	10/27/98	Effluent	DEP
ΛE0100064	BOOTHBAY HARBOR SEWER DISTRICT	1,018.20	10/27/98	*Influent*	DEP
ME0000167	BOWATER - GNP - MILLINOCKET	1.73	10/22/98	Effluent	DEP
ME0100072	BREWER W W T P	0.97	09/29/98	Effluent	POTW
ME0100072	BREWER W W T P	2.85	10/23/98	Effluent	POTW
ME0100072	BREWER W W T P	86.72	10/23/98	*Influent*	POTW
M[illegible]100072	BREWER W W T P	5.06	10/23/98	Effluent	DEP
M[illegible]100102	BRUNSWICK SEWER DISTRICT	28.90	11/16/98	Effluent	POTW
ME0100102	BRUNSWICK SEWER DISTRICT	33.30	08/03/98	Effluent	POTW
ME0100102	BRUNSWICK SEWER DISTRICT	66.74	10/27/98	Effluent	DEP
ME0100102	BRUNSWICK SEWER DISTRICT	37.75	12/16/98	Effluent	DEP
ME0100129	CALAIS WWTP	5.56	10/23/98	Effluent	DEP
ME0100129	CALAIS WWTP	302.90	10/23/98	*Influent*	DEP
ME0100137	CAMDEN WPAF	10.75	10/22/98	Effluent	DEP
ME0102067	CANTON WPCF	2.58	11/10/98	Effluent	POTW
ME0100145	CARIBOU UTILITIES DISTRICT	25.30	07/27/98	Effluent	POTW
ME0100145	CARIBOU UTILITIES DISTRICT	10.79	10/27/98	Effluent	DEP
ME0100153	CORINNA SEWER DISTRICT	2.49	11/02/98	Effluent	DEP
ME0002399	Control Devices Inc.	1.33	12/16/98	Effluent	DEP
ME0100501	DOVER-FOXCROFT WWTF	1.41	10/22/98	Effluent	DEP
ME0100889	ELLSWORTH PCF	32.42	10/23/98	Effluent	DEP
ME0100218	FALMOUTH - R.B. GOODENOW, PCF	15.32	11/09/98	Effluent	DEP
ME0101249	FARMINGTON WPCF	27.93	10/29/98	Effluent	DEP
ME0100226	FORT FAIRFIELD U.D. WTP	9.84	10/30/98	Effluent	DEP
ME0100234	FORT KENT UTILITY DISTRICT	16.82	10/27/98	Effluent	DEP
ME0000159	FRASER PAPER CO	3.64	11/04/98	Effluent	POTW
ME0000159	FRASER PAPER CO	4.59	11/02/98	Effluent	POTW
ME0000159	FRASER PAPER CO	6.29	10/30/98	Effluent	POTW

NPDES Number	Facility Name	Mercury Concentration in p.p.t.	Sampling Date	Source	Sample Taken by
IE0000159	FRASER PAPER CO	3.20	10/27/98	Effluent	DEP
..IE0101036	FREEPORT SEWERAGE DISTRICT	27.99	11/09/98	Effluent	DEP
ME0101702	GARDINER W W T F	7.70	11/10/98	Effluent	POTW
IE0101702	GARDINER W W T F	13.60	08/19/98	Effluent	POTW
..IE0101702	GARDINER W W T F	8.34	10/27/98	Effluent	DEP
ME0102032	GUILFORD SANGERVILLE S.D.	14.90	05/26/98	Effluent	POTW
IE0102032	GUILFORD SANGERVILLE S.D.	3.10	10/22/98	Effluent	DEP
..IE0101443	HARTLAND PCF	4.00	08/11/98	Effluent	POTW
ME0101443	HARTLAND PCF	6.20	05/05/98	Effluent	POTW
/IE0101443	HARTLAND PCF	6.11	11/02/98	Effluent	DEP
..IE0101290	HOULTON WATER COMPANY	1.30	09/22/98	Effluent	POTW
ME0101290	HOULTON WATER COMPANY	2.34	10/30/98	Effluent	DEP
/IE0101290	HOULTON WATER COMPANY	118.10	10/30/98	***Influent***	DEP
./IE0001937	I. P. ANDROSCOGGIN	12.49	12/21/98	Effluent	POTW
ME0001937	I. P. ANDROSCOGGIN	12.75	12/23/98	Effluent	POTW
/IE0001937	I. P. ANDROSCOGGIN	15.80	10/29/98	Effluent	DEP
./IE0100854	KENNEBEC SANITARY TREAT. DIST.	6.00	07/26/98	Effluent	POTW
ME0100854	KENNEBEC SANITARY TREAT. DIST.	9.00	10/28/98	Effluent	DEP
/IE0100854	KENNEBEC SANITARY TREAT. DIST.	8.87	10/28/98	Effluent	DEP
.ME0100854	KENNEBEC SANITARY TREAT. DIST.	79.98	10/28/98	***Influent***	DEP
ME0100935	KENNEBUNK SEWER DISTRICT	56.43	10/30/98	Effluent	DEP
ME0100935	KENNEBUNK SEWER DISTRICT	9.87	12/16/98	Effluent	DEP
ME0101184	KENNEBUNKPORT WWTP	7.88	10/30/98	Effluent	DEP
ME0100285	KITTERY WPCF	5.65	11/03/98	Effluent	DEP
ME0100285	KITTERY WPCF	1,191.60	11/03/98	***Influent***	DEP
ME0101478	LEWISTON-AUBURN WPCA	2.49	10/26/98	Effluent	DEP
ME0101095	LIMESTONE WATER & SEWER DIST.	1.70	08/13/98	Effluent	POTW
ME0101095	LIMESTONE WATER & SEWER DIST.	2.76	10/27/98	Effluent	DEP
ME0101796	LINCOLN SANITARY DISTRICT	12.55	10/22/98	Effluent	DEP
ME0101796	LINCOLN SANITARY DISTRICT	11.15	10/22/98	Effluent	DEP
ME0100307	LISBON PCF	66.58	10/27/98	Effluent	DEP
ME0100307	LISBON PCF	4.56	12/16/98	Effluent	DEP
ME0001724	LORING DEVELOPMENT CORP.	2.34	10/27/98	Effluent	DEP
ME0100323	MACHIAS WWTF	9.26	10/23/98	Effluent	DEP
ME0100323	MACHIAS WWTF	7.76	10/23/98	Effluent	DEP
ME0101681	MADAWASKA PCF	5.24	10/27/98	Effluent	DEP
ME0101079	MARS HILL UTILITY DISTRICT	6.21	10/30/98	Effluent	DEP
ME0100391	MECHANIC FALLS SANITARY DIST.	1.55	10/26/98	Effluent	DEP
ME0100803	MILLINOCKET WWTF	9.66	10/22/98	Effluent	DEP
ME0100803	MILLINOCKET WWTF	302.90	10/22/98	***Influent***	DEP
ME0100439	MILO WATER DISTRICT	31.82	10/22/98	Effluent	DEP
ME0100447	NEWPORT SANITARY DISTRICT	2.80	09/29/98	Effluent	POTW
ME0100447	NEWPORT SANITARY DISTRICT	5.82	11/02/98	Effluent	DEP
ME0101885	NORTH BERWICK SANITARY DIST	2.08	11/03/98	Effluent	DEP
ME0101061	NORTH JAY WWTF	3.26	10/29/98	Effluent	DEP
ME0100455	NORWAY WWTF	4.15	10/26/98	Effluent	DEP

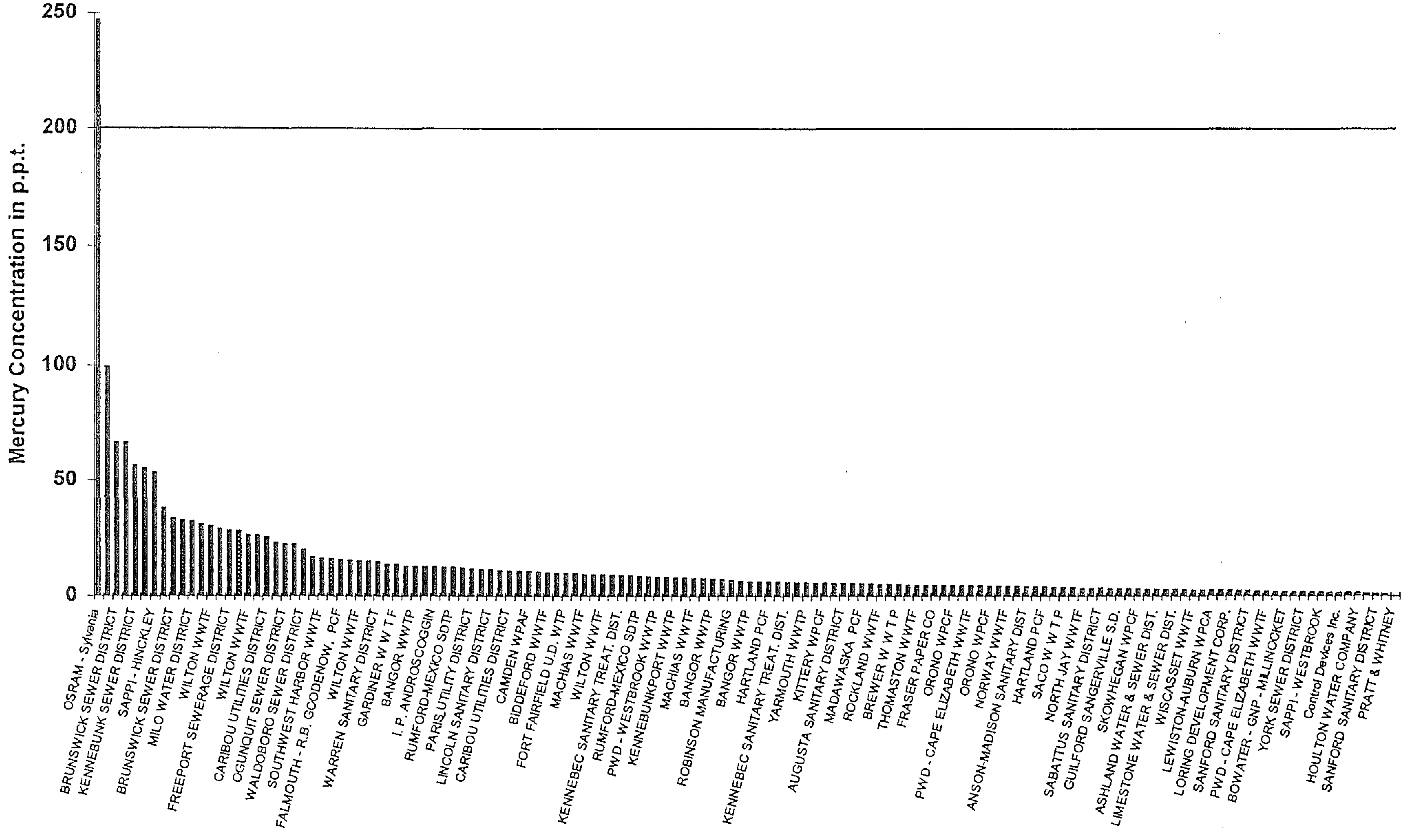
NPDES Number	Facility Name	Mercury Concentration in p.p.t.	Sampling Date	Source	Sample Taken by
ME0100463	OAKLAND WWTF	1.32	10/28/98	Effluent	DEP
ME0100986	OGUNQUIT SEWER DISTRICT	22.24	11/03/98	Effluent	DEP
M 01524	OLD ORCHARD BEACH WWTF	3.15	10/30/98	Effluent	DEP
ME0100471	OLD TOWN PCF	13.62	10/22/98	Effluent	DEP
ME0100498	ORONO WPCF	3.84	07/27/98	Effluent	POTW
ME0100498	ORONO WPCF	4.01	07/29/98	Effluent	POTW
ME0100498	ORONO WPCF	4.19	07/27/98	Effluent	POTW
ME0100498	ORONO WPCF	4.20	07/27/98	Effluent	POTW
ME0100498	ORONO WPCF	4.32	07/27/98	Effluent	POTW
ME0100498	ORONO WPCF	4.50	07/29/98	Effluent	POTW
ME0100498	ORONO WPCF	59.96	07/29/98	***Influent***	POTW
ME0100498	ORONO WPCF	15.15	10/22/98	Effluent	DEP
ME0100498	ORONO WPCF	127.30	10/22/98	***Influent***	DEP
ME0002381	OSRAM - Sylvania	246.80	12/16/98	Effluent	DEP
ME0100951	PARIS UTILITY DISTRICT	10.30	09/01/98	Effluent	POTW
ME0100951	PARIS UTILITY DISTRICT	126.00	09/01/98	***Influent***	POTW
ME0100951	PARIS UTILITY DISTRICT	11.65	10/26/98	Effluent	DEP
ME0022861	PRATT & WHITNEY	0.50	05/10/98	Effluent	POTW
ME0022861	PRATT & WHITNEY	0.10	11/03/98	Effluent	DEP
ME0100561	PRESQUE ISLE W W T F	4.11	10/27/98	Effluent	DEP
ME0100561	PRESQUE ISLE W W T F	81.09	10/27/98	***Influent***	DEP
ME0102121	PWD - CAPE ELIZABETH WWTF	2.02	12/10/98	Effluent	POTW
ME0102121	PWD - CAPE ELIZABETH WWTF	4.39	11/09/98	Effluent	DEP
ME0102075	PWD - PORTLAND	8.83	11/10/98	Effluent	DEP
M 02075	PWD - PORTLAND	9.19	11/10/98	Effluent	DEP
ME0100846	PWD - WESTBROOK WWTP	5.99	10/20/98	Effluent	POTW
ME0100846	PWD - WESTBROOK WWTP	8.04	12/10/98	Effluent	POTW
ME0100846	PWD - WESTBROOK WWTP	8.21	11/09/98	Effluent	DEP
ME0002526	ROBINSON MANUFACTURING	6.80	06/23/98	Effluent	POTW
ME0002526	ROBINSON MANUFACTURING	11.30	09/08/98	Effluent	POTW
ME0002526	ROBINSON MANUFACTURING	11.94	10/26/98	Effluent	DEP
ME0100595	ROCKLAND WWTF	387.00	08/19/98	Effluent	POTW
ME0100595	ROCKLAND WWTF	5.16	10/22/98	Effluent	DEP
ME0100595	ROCKLAND WWTF	100.40	10/22/98	***Influent***	DEP
ME0100552	RUMFORD-MEXICO SDTP	8.50	11/10/98	Effluent	POTW
ME0100552	RUMFORD-MEXICO SDTP	12.30	10/29/98	Effluent	DEP
ME0100552	RUMFORD-MEXICO SDTP	230.00	10/29/98	***Influent***	DEP
ME0101842	SABATTUS SANITARY DISTRICT	3.20	08/25/98	Effluent	POTW
ME0101842	SABATTUS SANITARY DISTRICT	2.29	10/26/98	Effluent	DEP
ME0101117	SACO W W T P	3.68	10/30/98	Effluent	DEP
ME0100617	SANFORD SANITARY DISTRICT	2.23	10/14/98	Effluent	POTW
ME0100617	SANFORD SANITARY DISTRICT	0.74	10/30/98	Effluent	DEP
ME0021521	SAPPI - HINCKLEY	22.00	04/28/98	Effluent	POTW
ME0021521	SAPPI - HINCKLEY	55.07	11/06/98	Effluent	POTW
ME0021521	SAPPI - HINCKLEY	22.81	12/17/98	Effluent	DEP
ME0021521	SAPPI - HINCKLEY	53.17	10/28/98	Effluent	DEP

NPDES Number	Facility Name	Mercury Concentration in p.p.t.	Sampling Date	Source	Sample Taken by
ME0002321	SAPPI - WESTBROOK	1.44	11/09/98	Effluent	DEP
ME0102059	SCARBOROUGH SANITARY DISTRICT	26.17	11/09/98	Effluent	DEP
ME0100625	SKOWHEGAN WPCF	3.03	10/28/98	Effluent	DEP
ME0100820	SOUTH BERWICK SEWER DISTRICT	3.09	11/03/98	Effluent	DEP
ME0100633	SOUTH PORTLAND WPCF	5.20	08/10/98	Effluent	POTW
ME0100633	SOUTH PORTLAND WPCF	4.50	11/10/98	Effluent	DEP
ME0100633	SOUTH PORTLAND WPCF	338.40	11/10/98	***Influent***	DEP
ME0100641	SOUTHWEST HARBOR WWTF	5.43	06/09/98	Effluent	POTW
ME0100641	SOUTHWEST HARBOR WWTF	15.90	10/23/98	Effluent	DEP
ME0100668	THOMASTON WWTF	4.79	10/23/98	Effluent	DEP
ME0100714	WALDOBORO SEWER DISTRICT	19.88	12/16/98	Effluent	DEP
ME0100714	WALDOBORO SEWER DISTRICT	99.23	10/23/98	Effluent	DEP
ME0102253	WARREN SANITARY DISTRICT	14.85	10/23/98	Effluent	DEP
ME0101028	WASHBURN WWTF	5.13	10/30/98	Effluent	DEP
ME0100790	WELLS SANITARY DISTRICT	7.88	11/03/98	Effluent	DEP
ME0101915	WILTON WWTF	9.15	07/20/98	Effluent	POTW
ME0101915	WILTON WWTF	26.20	08/20/98	Effluent	POTW
ME0101915	WILTON WWTF	30.10	04/19/98	Effluent	POTW
ME0101915	WILTON WWTF	15.05	10/29/98	Effluent	DEP
ME0100757	WISCASSET WWTF	2.50	10/27/98	Effluent	DEP
ME0100765	YARMOUTH WWTP	4.63	11/09/98	Effluent	DEP
ME0100765	YARMOUTH WWTP	5.98	11/09/98	Effluent	DEP
ME0101222	YORK SEWER DISTRICT	1.67	11/03/98	Effluent	DEP

Appendix G

Effluent Test Results Chart

Mercury Effluent Sampling Results



Glossary

Glossary

Anthropogenic ------- Developed or caused by activities of human beings
Clean Techniques---- Refers to EPA Methods 1669 & 1631 which are designed to greatly reduce accidental contamination of water samples by the field sampler and or the laboratory
DEP -------------------- Maine Department of Environmental Protection
Effluent---------------- Treated discharge from a wastewater treatment facility
EPA -------------------- United States Environmental Protection Agency
Incidental-------------- Unknown or unintentional presence of a substance
Influent---------------- Raw wastewater as it arrives at the wastewater treatment facility for treatment through the collection system
Method Detection---- Limit Minimum value that can be detected by analysis
Minimum Level------ Minimum analysis value that can be reported
Natural---------------- Maine DEP believes that in 1971 the Maine Legislature used this term to mean an area that was without human influence. Maine DEP realizes that it is not possible to find an area that is absent of human influence. For the purposes of this report, Maine DEP uses this term to mean an area or condition of the environment that is absent of known sources of local origin.
PPT -------------------- Part Per Trillion
QA / QC-------------- Quality Assurance / Quality Control, work that is done to ensure that water sample analyses are accurate and precise