COMMISSIONER'S REPORT TO THE JOINT STANDING COMMITTEE OF THE LEGISLATURE ON ENERGY AND NATURAL RESOURCES

ON

IMPLEMENTATION OF A COMPREHENSIVE SURFACE WATER AMBIENT TOXIC MONITORING PROGRAM

Department of Environmental Protection
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EXECUTIVE SUMMARY

- Studies of Maine's eagle population by the Department of Inland Fisheries and Wildlife and the U.S. Fish and Wildlife Service have found reproduction of eagles 15-40% less than other U.S. populations. Preliminary results show some of the highest levels of mercury ever reported, near levels reported in the literature to be associated with reproductive failure, were found in some eagle nestling populations occurring in northern Maine.

- Many emaciated loon carcasses submitted for post-mortem examination are thought to be a result of exposure to mercury and lead as documented by elevated body burden.

- Fish consumption advisories have been established by the Department of Human Services for the Androscoggin River, Kennebec River, and Penobscot River due to contamination with dioxin.

- Levels of mercury in about 25 % of fish sampled by DEP exceeded the US Food and Drug action level.

These findings create great anxiety in the minds of the people of Maine. Of even greater concern is the fact that there may be many other similar environmental problems as yet undiscovered. For this reason in 1992 the Maine legislature enacted L.D. 2237, An Act to Implement a Comprehensive Ambient Toxics Monitoring Program.

L.D. 2237 required the Commissioner to examine how much is known about toxic contamination in Maine's waters and whether the State has an adequate program to monitor the presence of toxic substances in our surface waters. Such a study would (a) list current data collection efforts, (b) describe the source and level of funding of these efforts, (c) summarize the results of these collection efforts, (d) make a finding of whether or not these efforts constitute a scientifically valid toxic monitoring program, and (e) if such a program does not exist , to make recommendations on the appropriate design and necessary components for such a program. In conducting this study the commissioner was required to consult with an advisory group (Surface Water Ambient Toxics Technical Advisory Committee) composed of affected and interested parties in all parts of the study. The committee met seven times and was an integral part of the development of this report.

Commissioner's Findings

- limited current data document that toxic contamination is present in some surface waters in Maine.
- the State does not have a comprehensive ambient surface water toxic monitoring program to assess contamination.
- limited current and past programs have been shown to be capable of providing important information for specific policy decisions.
- the present ambient toxic monitoring is sparse and insufficient to assess threats to human health or ecological health.
- the present monitoring lacks geographic scope and a balanced investigation of all water resource types.
- the present monitoring analyzes for few of the potential contaminants that could be of concern to human health or ecological health.
- the present monitoring lacks the repetition and continuity needed to assess trends.
- ambient toxic monitoring is in decline due to termination of programs, conflicting needs, budget cuts.

It is the Commissioner's recommendation that the Legislature authorize the ambient surface water toxic monitoring program described in this report which:

(1) would be a scientifically valid test for the presence of toxic substances in the State's freshwater and marine environments

(2) would provide for testing of tissue, sediment and water for priority pollutants and other suspected toxics

(3) would include the use of biomonitoring to detect toxic effects in aquatic comunities

(4) would direct the Department of Environmental Protection to conduct the program in cooperation with other state and federal agencies and private entities

(5) would require that the Surface Water Ambient Toxics Technical Advisory Committee be continued to advise the Department on its workplans to assure the objectives of the program are achieved and assure efficient use of resources

(6) would provide a secure source of funding to achieve the objectives of the program.

INTRODUCTION

The State of Maine has known of the potential for toxic contamination problems in its surface waters for many years. Although there is reason to believe that direct discharges of some toxic materials have decreased in recent years, three reasons warrant consideration of a comprehensive assessment of toxic materials in surface waters at this time.

First, control of oxygen-demanding pollutants has allowed fish to return to many waters. There is limited evidence that some of these fish may be contaminated with toxics. We must know more about the human health risks from consuming these fish, and we must be able to assess the impacts of these contaminants on natural systems. Second, our ability to measure contaminants, our understanding of toxic effects, and our understanding of transformations and ultimate fates of these contaminants has increased greatly in the past decade. Knowledge of health effects will continue to improve, but it will always rest on a basic understanding of the amounts of contaminants in the environment. Third, there is clear evidence that certain toxic contaminants do not break down and may accumulate to levels of concern. Contamination comes from historic accumulation of toxic material as well as present sources. There is a potential for continuing risk from toxic contamination even in the face of declining emissions.

Some perspective on the need to understand toxic contamination is available from the limited studies that have been made. Several national studies have found that toxic contamination is much more widespread than previously expected. The National Dioxin Survey (EPA, 1987) revealed dioxin contamination in many national waters (including Maine) where it was not expected to occur and in concentrations that threatened human health. The National Marine Fisheries Service has found significant bioaccumulation of heavy metals in shellfish (including several Maine sites) which may be a threat to the consuming public and which may threaten the health of natural populations. Studies in the Great Lakes have found widespread contamination in the fish stocks of all the lakes, not just those in the area of known toxic discharges. The USEPA has recently released a national survey of chemical residues in fish (EPA, 1992). Of sixty chemicals tested, 22 were detectable in fish tissue at more than half of the 388 sites analyzed. Polychlorinated biphenyls (PCBs), mercury and biphenyl were detected at more than 90% of the sites. Analysis of fish from the Maine sites (13) found 18 of the 60 chemicals in significant amounts (above trace quantities) at one or more of the thirteen sites. Many states and Canadian provinces are now issuing bans and advisories on consumption of fish as a consequence of new information revealing contamination and risk of exposure to humans. Likewise, the effect on ecological health is reflected by an incidence of tumors in fish and wildlife, reproductive disorders, and more acute incidences such as fish kills.

Studies conducted in Maine also indicate that there is significant toxic contamination of Maine's waters. The Department of Environmental Protection compiled data on tissue contamination in Maine from available sources in 1987 (DEP, 1987). The Department had data from seven rivers and four lakes, all of which had detectable levels of various contaminants (heavy metals, PCB, pesticides). Mercury contamination exceeded U.S. Food and Drug Administration (FDA) limits in 25% of the samples. For example, mercury contamination in fish in exceedence of the FDA action level has been documented from Eagle Lake and Allagash Lake, lakes where mercury contamination might not be expected (Haines and Akielaszek, 1981; NAI, 1978). Data from U.S. Fish and Wildlife Service compiled from three rivers over eleven years also found significant quantities of heavy metals, PCB's and pesticides in fish tissues. Data collected as part of the State's Dioxin Monitoring Program has revealed significant contamination and bioaccumulation of dioxins and furans in the tissues of fish from six rivers. Fish consumption advisories have been issued for three of these rivers by the Department of Human Services. In the Department's 1989 report to the legislature on the marine environment (DEP, 1989), the Department documented significant toxic contamination in certain marine waters from heavy metals, polyaromatic hydrocarbons (PAHs), and PCBs which affected the ecosystem and was potentially harmful to human consumers of marine organisms. Sediment studies conducted as part of the Casco Bay project have found elevated levels of heavy metals and PAHs in parts of the bay associated with urban runoff and known discharges.

Studies of Maine's eagle population by the Department of Inland Fisheries and Wildlife and the U.S. Fish and Wildlife Service have found reproduction of eagles 15-40% less than other U.S. populations. Preliminary results show some of the highest levels of mercury ever reported from some eagle nestling populations occurring in northern Maine, near levels associated with reproductive failure (Todd, 1992). Many emaciated loon carcasses submitted for post-mortem examination are thought to be a result of exposure to mercury and lead as documented by elevated body burden (Pokras, 1992).

Because new incidences of toxic contamination continue to appear in the small number of studies undertaken, it is evident that we do not have a clear picture of the extent of the problem, the extent of the damage that may be present, or the direction and nature of trends. The State needs a means to adequately assess toxic contamination in its waters.

In passing L.D. 2237, the Maine Legislature recognized that certain toxic substances were being discharged to Maine waters, that the fate and impact of these substances is not well understood and made the following findings:

A. The State should have a scientifically valid water toxics program to monitor for the presence of toxic substances in the ambient environment of all surface waters of the State. This program should take into consideration but be distinct from testing performed on the effluent from individual discharges;

B. Such a scientifically valid program should allow for the testing of tissues, sediment and the water column for priority pollutants and other suspected toxics and include biomonitoring;

C. The Department of Environmental Protection, other state, local and federal agencies, and private entities have collected and analyzed fish and shellfish tissue, sediment and ambient water samples for toxic substances in Maine lakes, rivers, estuaries and coastal waters. In addition, biomonitoring has been conducted on rivers and streams in the State;

D. Only limited compilation and systematic cataloging of existing data or data collection efforts have been performed in order to evaluate the adequacy of current data collection efforts and to identify gaps in the State's knowledge of the fate and significance of toxic substances in the aquatic and marine environment; and

E. Except for the existing dioxin program, the State currently has no formal program to monitor toxic substances in the ambient aquatic environment.

L.D. 2237 required the Commissioner to examine how much is known about toxic contamination in Maine's waters and whether the State has an adequate program to monitor the presence of toxic substances in our surface waters. Such a study would (a) list current data collection efforts, (b) describe the source and level of funding of these efforts, (c) summarize the results of these collection efforts, (d) make a finding of whether or not these efforts constitute a scientifically valid toxic monitoring program, and (e) if such a program does not exist , to make recommendations on the appropriate design and necessary components for such a program.

This study would be conducted in consultation with an advisory group convened by the Commissioner with representation from the regulated community including industry, small business and municipalities; public interest groups including environmental and public health organizations; the commercial fishing industry; recreational fishing groups; and the general public. A solicitation for names was made by the Commissioner and the following individuals were selected:

Edward Ames, Alden-Ames Laboratories
William Ball, Acheron Engineering, Inc.
Peter Bourque, Department of Inland Fisheries and Wildlife
Dr. Samuel Butcher, Bowdoin College
Derrill Cowing, U.S. Geological Survey
Dr. Robert Frakes, Department of Human Services

Dr. Terry Haines, University of Maine
Vivian Matkivich, Maine Wastewater Control Association
Matthew Scott, Sportsman's Alliance of Maine
Dr. William Sherman, Paper Industry Information Office
William Taylor, Paper Industry Information Office
Peter Washburn, Natural Resources Council of Maine
Hal Winters, Department of Marine Resources

The Department of Environmental Protection was represented by:
Roy Bouchard
David Courtemanch
Barry Mower
John Sowles

The advisory committee met on seven occasions from September to January. Minutes of those meetings and correspondence from members is presented in Appendix D. Findings of the study are presented in the following sections of this report.

Part A Current Data Collection Efforts

The legislation asked that current data collection efforts be listed, but since there are few current efforts, this review was expanded to include other recent efforts in order to provide more insight about what is known of toxic contamination in Maine's surface waters. A summary description for each of these efforts is provided in Appendix A.

Three programs are currently underway within the Department; the Dioxin Monitoring Program and the Biomonitoring Program assess toxics in rivers, and the Musselwatch program assesses coastal waters. The Dioxin Monitoring Program provides for the sampling of fish tissue from sites below no more than 12 sources per year (through 1995) where dioxin or furan contamination is suspected. The Biomonitoring Program consists of about 150 sites (about 65% related to toxic point and nonpoint sources) in the state, of which about 30 to 40 are sampled each year for invertebrates in order to do community analysis. Most of the effort of this program has been devoted to development of biocriteria, which are now complete in draft form. The Musselwatch Program is part of Maine's involvement with Gulfwatch and Maine's own musselwatch effort. Mussel tissue is collected from about 10 sites in the state per year and analyzed for heavy metals, PCB's and pesticides.

The U.S. Geological Survey conducts water chemistry analyses for heavy metals at 8 fixed sites throughout the state sampled four to six times annually. Beginning in 1993, sampling may be suspended while field methods which allow more accurate determination of trace concentrations are developed and tested . Methods used through 1992 may have resulted in contamination of samples analyzed for trace constituents. The National Oceanographic and Atmospheric Administration (NOAA) conducts sampling at 4 fixed sites in the state for sediment and mussel tissue contamination. This sampling is conducted sporadically every few years. The US Food and Drug Administration (FDA) also samples marine fish and shellfish for contaminants sporadically, although these data have thus far proved difficult to obtain.

Dischargers with new federal permits requiring whole effluent toxicity (WET) testing are required to analyze and report the quality of the dilution water (ambient receiving water) used in the tests. This analysis includes measurement of heavy metal concentrations. Monitoring is conducted one to four times per year for one to five years depending on requirements specific to each license. EPA reports that these requirements have been applied to 80 facilities in Maine and may be applied to some additional number of facilities. These requirements may be relaxed or eliminated after 3-5 years depending on the information gained from the testing.

Potentially, there are new initiatives that may contribute to the information base on toxic contamination in Maine's surface waters. The U.S. Environmental Protection

Agency (EPA) is developing an Environmental Monitoring and Assessment Program (EMAP) which would look at water quality at fixed sites throughout the nation. Maine is presently part of the pilot program looking at the lakes component of EMAP. Approximately 46 lakes would be monitored on a four year rotation which would include water and sediment chemistry, and tissue analysis. The pilot program is in its second year. No data have been generated as yet. Continued support by the EPA for EMAP is questionable and as yet there is no stream or coastal component developed for this area of the country. Full implementation is 10 or more years away. The U.S. Geological Survey (USGS) has initiated the National Water Quality Assessment (NAWQUA). This program would eventually conduct monitoring on four rivers in Maine and would include water chemistry, tissue analysis and community analysis. The U.S. Fish and Wildlife Service is considering a Biological Evaluation of Status and Trends program (BEST) which would supplant the National Contaminant Monitoring Program, which ended in 1988. There is no design for this program, and even if developed, it is years away from implementation.

The current effort of ambient toxic monitoring can best be summarized as small, fragmented and in decline. Past and present monitoring do not provide a comprehensive continuous assessment of the status of toxic contamination across the geographic scope of the state for any class of contaminants (metals, pesticides, etc.), any matrix (water sediment or tissue) or any water body type (lake, stream, marine).

The current efforts provide limited long-term trend information. While the eight USGS water quality sites and the four NOAA status and trends sites provide useful information, these programs have a limited scope that does not respond to the full range of concerns about toxic contamination

Part B Current Sources and Level of Funding

The legislation requires that the current sources and level of funding for ambient toxic monitoring be reviewed. Funding information can be found for each specific project in Appendix A.

Presently, the only designated source of State funding for ambient toxic monitoring is found in the Dioxin Monitoring Program which provides $168,000 per year through fees assessed on known dischargers of dioxin. In addition, the Department devotes the time of 1/5 of a staff biologist to support the dioxin program. The Dioxin Monitoring Program is authorized through 1995. The Musselwatch program is conducted using about $14,000 through year-to-year State Planning Office Coastal Zone Management grants. There is no assured funding source for the Musselwatch activities to continue. A grant from NOAA is used to support Gulfwatch ($7200) and is secure only through 1994. The DEP contributes about 1/2 of a state funded staff biologist to conduct the sampling and analysis for the Musselwatch and Gulfwatch efforts. The Biomonitoring Program has been supported by two special grants from USEPA ($15,000 and $30,000) and the services of 1.5 staff biologists, one-half supported on State general fund and one funded through a federal Section 604b grant. The special grants were to develop the biocriteria used in the program (for use in EPA's national guidance) and are not available in the future to support general operation of this program. The toxic analysis part of the Primary Monitoring Network was previously funded with federal Section 106 grant money but is no longer supported due to decline of those monies.

Other existing funding for ambient toxic monitoring is provided by the USGS, which expects some reduction of its 8 water quality sites in the future because the NASQUAN program is 'flat-funded' at about $60,000 per year for monitoring in Maine. NOAA monitors 4 sites in Maine sporadically as part of its status and trends program at a cost of about $32,000 each time it monitors. Future of that program is unknown but presumed secure.

The cost for facilities to comply with federal license requirements to perform analysis for heavy metals in WET test dilution water is highly variable depending on the specific requirements of the license and the cost of the laboratory performing the analysis. As an example, the cost would be approximately $612 using the State Health and Environmental Lab for a suite of six metals analyzed four times per year.

To summarize funding of current ambient toxic monitoring efforts, the Department presently uses $168,000 from fees assessed to dischargers for the dioxin program, approximately $21,200 from federal grant sources and supplies the services of 2.2 staff biologists to support toxic monitoring. As of 1995, when the dioxin program terminates, the Department will have no specific funding to conduct any ambient toxics monitoring. If no new funding is acquired, the Department will probably have to rely largely on efforts of federal agencies to provide ambient toxic contamination information. Historically, such efforts have not constituted an effective or comprehensive assessment of ambient toxic contamination.

Part C Results of Current Collection Efforts

The legislation requires that a summary of the results of current efforts be presented. The following findings are based not only on current efforts but on earlier work and the experience of department staff and members of the advisory committee. This following summary is a compilation of the findings based on the type of data collected to provide some insight about the relative value of each type of analysis. Specific summaries and conclusions from each project which can be found in Appendix A.

The greatest quantity of ambient toxic information is water concentration data for heavy metals and priority pollutants. Sources include the Primary Monitoring Network program, USGS program and other data from discrete sources such as NPDES permit requirements, Superfund sites, etc. Despite the relative abundance of this kind of data, the information value is limited. Because of dilution in the ambient environment, concentrations are very often below detection limits of analytical equipment. However, the concentrations can still be above "action limits", such as EPA published water quality criteria. In addition, the transient nature of discharges leads to a large variance and often renders the quantification of contamination difficult. The high variance of this data diminishes its usefulness in making predictions of a toxic effect. For certain types of toxics that break down rapidly or that do not bioaccumulate (such as ammonia or chlorine), water concentration analysis is the only method for assessment. Water quality criteria exist for many toxic substances. These criteria are correlated with expected human health or ecological health effects.

More meaningful information exists for fish and shellfish tissue data. New methods and equipment now permit accurate analysis of contamination in tissues. Tissue provides a very valuable medium for analysis because many contaminants readily concentrate in living tissue at levels that can be detected. Tissues can accumulate certain types of contaminants, thus, integrating the effect of toxic contamination over time. Bioaccumulation is an important mechanism which determines toxicity, and human and ecological risk assessment is often based on this factor. Tissue analysis is costly which often precludes its use or limits the analysis of sufficient samples. However, the value of the data is very high since it provides information on the presence and fate of certain types of toxic contaminants and can be used directly in human and ecological health risk assessments.

The Dioxin Monitoring Program provides a good example of how tissue analysis can be used to assess toxic contamination and direct management decisions. The program provides for frequent, often annual, monitoring of fish in areas where dioxin contamination is known. Data from the program were used to determine that fish consumption advisories were needed on certain waters to protect human health. Subsequent sampling has found reduced levels of contamination of fish in these waters

as process modifications were made by industry. This has allowed the State to make timely relaxation or elimination of the advisories as toxic reduction has occurred. It would have been very difficult to make confident decisions about the human health threat without such data. Unfortunately, comparable data do not exist for other waters or other contaminants. The limited data that do exist suggest that mercury contamination is substantial and may pose a threat to health, and that PCBs and pesticides are prevalent. Many other substances, particularly many halogenated compounds, have not been measured.

Sediment analysis has been the least used medium. Many toxic substances are known to accumulate in fine grain sediments. Therefore, this may be a useful area of study in lakes, impoundments, wetlands and estuaries. Since many substances, such as heavy metals, readily precipitate in seawater, sediments have important applications in marine toxicity studies. Sediment analysis has been used in a number of the marine studies to assess relative contamination levels. In Boothbay Harbor, for example, sediment contamination transects are helpful in determining the location of sources. In Casco Bay, dated sediment cores are being used to determine contamination trends over time. Although toxic criteria do not exist for sediments, NOAA has recently published a list of contaminant levels associated with biological impacts. In addition, the USEPA expects to propose sediment criteria that relate to human and ecological risk in the near future.

None of the above techniques provide an assessment of the effect of toxic pollutants on organisms or biological communities directly. Biomonitoring, the use of measures of an aquatic community (diversity, indicator species, etc.), is a newly emerging area of analysis to detect toxic effects in aquatic ecosystems. Maine has developed sampling and analytical techniques that produce accurate, reproducible evaluations of community impact related to the state's classification law. Biomonitoring differs from the other types of analysis because it is a measure of the effect of a contaminant but not a measurement of the contaminant itself. Cause of effect can often be determined from the data but confirmation may require other chemical analysis. Evaluation of data collected in recent years in Maine finds that of the 148 sites studied, 56% were known to have some level of toxic contamination associated with the water and that 14% of these sites on one or more occasion had a community response causing nonattainment of its class. In several of these instances, the toxic effect was caused by substances for which there are no criteria or where typical water chemistry analysis would not have detected a problem.

Summary of current program evaluation.

Elements of a comprehensive program	Dioxin Monitoring Program	Bio-monitoring Program	USGS	NPDES	Mussel watch	NOAA	Gulfwatch
Ecological Health		x			x	x	x
Human Health	x				x		x
Point Sources	x	x		x	x		x
Non-Point Sources		x			x		
Continuity							
within sites	x		x	x		x	x
between years	x		x	?		x	
Hydrologic extent							
coastal	x			x	x	x	x
lakes							
rivers and streams	x	x	x	x			
Geographic breadth		x		x			
Analytes							
priority pollutants	dioxin		metals	metals	metals	x	x
other pollutants					x	x	x
Media							
tissue	x				x	x	x
sediment							
water			x	x			
community		x					

Various current and past monitoring activities, although limited in scope and continuity, provide useful and valid information that points to the potential for toxic contamination in Maine surface waters These studies are helpful in defining useful approaches to monitoring. This information points to the need to focus monitoring efforts on tissue, sediment and biological community analysis, as well as to develop other methods to assess human and ecological health risks associated with ambient levels of toxic substances.

Part D Commissioner's Findings

Based on the findings of this study and consultation with the advisory committee appointed to review the issue of ambient toxic monitoring, the Commissioner finds that:

- **limited current data document that toxic contamination is present in some surface waters in Maine.**
- **the State does not have a comprehensive ambient surface water toxic monitoring program to assess contamination.**
- **current and past programs have been shown to be capable of providing important information for specific policy decisions.**
- **the present ambient toxic monitoring is sparse and insufficient to assess threats to human health or ecological health.**
- **the present monitoring lacks geographic scope and a balanced investigation of all water resource types.**
- **the present monitoring analyzes for few of the potential contaminants that could be of concern to human health or ecological health.**
- **the present monitoring lacks the repetition and continuity needed to assess trends.**
- **ambient toxic monitoring is in decline due to termination of programs, conflicting needs, budget cuts.**

It is the Commissioner's recommendation that the Legislature authorize an ambient surface water toxic monitoring program which (1) would be a scientifically valid test for the presence of toxic substances in the State's freshwater and marine environments, (2) would provide for testing of tissue, sediment and water for priority pollutants and other suspected toxics, (3) would include the use of biomonitoring to detect toxic effects in aquatic comunities, (4) would direct the Department of Environmental Protection to conduct the program in cooperation with other state and federal agencies and private entities, (5) would require that the Surface Water Ambient Toxics Technical Advisory Committee be continued to advise the Department on its workplans to assure the objectives of the program are achieved and assure efficient use of resources, and (6) would provide a secure source of funding to achieve the objectives of the program. A proposal for such a program is provided in the following section of this report.

Part E Surface Water Ambient Toxic Monitoring Program

INTRODUCTION

A primary goal of the Federal Clean Water Act and Maine's Surface Water Classification Program is the "prevention of toxic pollutants in toxic amounts". The Maine Surface Water Ambient Toxics Program will formally establish a program that supports the ongoing assessment of threats of toxic contamination in surface waters to human and ecological health. The program will provide a coordinated and comprehensive means to determine progress in water quality management by monitoring toxic pollutants in Maine's surface waters. Data collected will be used for assessment of the distribution and magnitude of chemical contaminants in marine, estuarine, lacustrine, and riverine ecosystems for determining (1) attainment of Maine's water quality standards, (2) levels and distribution of toxic contamination and (3) trends in water quality. Monitoring results will be channeled to appropriate environmental resource managers with an assessment of the relative severity of any problem and a recommendation on the need for follow-up study.

The status of Maine's 31,700 miles of rivers and streams is summarized in The State of Maine 1992 Water Quality Assessment. Of the 865 miles of rivers and streams monitored for toxic pollutants, 237 miles (27%) have toxics elevated to levels of concern. Recent data are limited with most data collected prior to 1983. An exception is Maine's Dioxin Monitoring Program (DMP) established by the Maine legislature in 1988 "to determine the nature of dioxin contamination in the waters and fisheries of the State". The program is an annual one through 1995 with reports due December 1 of each year. Fish and wastewater treatment sludge are analyzed for all 2,3,7,8-substituted and all tetra- through octa- dioxins and furans. As a result of fish tissue analyses, dioxin has been detected at levels that caused the Maine Bureau of Health to issue fish consumption advisory on the Androscoggin River in 1985 with revisions adding the Kennebec River and Penobscot River in 1987. .The Presumpscot River and West Branch of the Sebasticook River were added in 1990. Monitoring in 1991 has showed decreased levels in fish statewide as a result of decreases in discharges from the sources. Consequently, the Bureau of Health revised the advisories in early 1992 removing advisories from the Presumpscot River and West Branch of the Sebasticook River while modifying advisories on the Androscoggin River, Kennebec River, and Penobscot River.

Very few studies have been conducted over Maine's 3,600 miles of coastline to describe toxic contamination. Data prior to 1965 are virtually non-existent and between 1965 and 1985 only 4 studies used protocols producing reliable data. The limited body of information available to us suggests that overall the coast of Maine is still relatively uncontaminated. However, patterns of toxic contamination are evident, especially in and around areas of development. Some areas, such as enclosed embayments and estuaries, appear to be especially susceptible. Furthermore, the limited data show that in areas such as Boothbay Harbor, Portland's Fore River and Back Cove, the Presumpscot estuary, Kittery, and parts of Penobscot Bay, toxic materials are accumulating in the food chain at levels approaching concern for human health.

Although DEP currently has proposed draft rules that would require routine monitoring of point source discharges of toxic pollutants, such monitoring will not substitute for monitoring of the ambient environment for a number of reasons. First, some pollutants are discharged in quantities too small to measure, but may bioaccumulate to levels of concern (i.e. dioxin discharges causing fish consumption advisories). Second,

monitoring of individual discharges cannot assess the cumulative or synergistic impacts of all discharges on the receiving water. Third, non-point sources of toxic pollutants are not monitored at all. Non-point sources of pollutants include a myriad of everyday activities in the State indirectly resulting in discharges of toxic pollutants to waterbodies. Toxic pollutants may also result from activities outside of the state that result in pollutants being transported here by boundary waterways or continental air masses.

The above briefly introduces several compelling reasons that a comprehensive program to monitor toxic contamination in Maine surface waters be established. The limited data collected thus far show that Maine has not been spared contamination by toxic pollutants. Data collection efforts are sporadic and often in response to crises. Without continuity, the State is unable to monitor long term trends in toxic contamination and therefore lacks an important management tool needed to track performance of environmental management decisions. Of the two state programs designed to follow trends, one, the Marine Environmental Monitoring Program, is unfunded and the other, the Dioxin Monitoring Program, is authorized only until 1995.

APPROACH

Because of the several types of surface waters encountered in Maine, a modular approach to the program has been chosen. The three modules include: lakes, rivers and streams, and marine and estuarine waters. For each, a 5-year conceptual plan will be developed and each year a more detailed work plan will be prepared specifying locations, variables, sample design, and level of effort. A careful balance must be reached that recognizes the need for long-term planning for the purpose of supporting a continuing program while maintaining the flexibility necessary to accommodate new information. Even while recognizing the distinct differences between modules, much is common to all. A general program approach follows.

The Program will support extensive and intensive monitoring and a methods development component. These terms are further described.

Extensive monitoring provides a general picture of contaminant distribution over a wide area. Knowing the relative levels and distribution of contaminants over a wide area is important. It enables existing, past and future data to be put into a statewide perspective by scientists and managers in order to prioritize monitoring and research activities.

Intensive monitoring will be used where prior knowledge exists of toxic contamination in an area or when dealing with more complex systems such as estuaries. It may also be used for classification purposes, for establishing long term "indicator" stations for trend monitoring, to confirm or refute prior indications of toxic contamination.

Method Development

A portion of the program's activities will be directed toward development and evaluation of analytical techniques. Two immediate areas of interest will be the development of biological community indices for marine/estuarine waters and the use of biomarkers in all modules. To the extent possible, monitoring techniques will be developed that standardize inter-regional site differences. Examples of present efforts along these lines are the use of a standard substrate in riverine biological community analyses and the use of a standard mussel stock in marine monitoring. New methods will be used when it can be demonstrated that better information can be obtained more efficiently.

Environmental Indicators

Because no single environmental monitoring technique adequately assesses contamination, three (3) types of indicators are initially proposed for evaluation of contaminants in the program. Emphasis may vary within each module.

1.) Contaminant levels in biological tissues and sediments are proposed to be monitored as a first level of screening.

Biological Tissues
Monitoring of biological tissues for contaminants is used primarily to assess the impact to human and wildlife consumers, although a limited amount of information relating tissue levels to direct impact on organisms themselves is beginning to appear in the literature. An advantage of monitoring tissues is that tissues accumulate some contaminants and therefore integrate their effects over time.

Seasonality, species, and the tissue monitored all affect results and must be considered when selecting a test organism. Monitoring levels of contaminants in detoxifying organs such as livers assists in estimating the bioavailability of those contaminants. Looking at edible portions of species helps assess human health risk. Habits of the indicator organism are also useful in deciding which organism to select as a monitoring tool. Factors such as whether the organism is mobile or sedentary, an herbivore or top of the food chain predator, a bottom feeder or plankton feeder, all have a bearing on the suitability of the organism for use in the program. Mobile organisms, for example, integrate environmental conditions over a larger area. On the other hand, mobile organisms may be less useful in defining sources of contamination.

Sediments-
Many pollutants concentrate in sediments, most notably metals in marine sediments. Sediments therefore, are often used as integrators of pollution over long periods of time. Sediment chemistry alone does not signify whether or not a chemical is responsible for a toxic response but rather identifies the potential for toxicity to exist.

2.) Biological Community Analysis -
Organism health and its relationship to toxic contamination exposure is not yet well understood. Furthermore, organism health lacks a wider ecological perspective. Biological community analysis, on the other hand, does provide a broader ecological meaning. Like organism health, the techniques are not a direct measure of toxicity, but rather an indirect measure of the effect of toxicity integrated with other ambient conditions including both natural and human caused. Endorsing the concept, the legislature in 1986 revised the classification standards for Maine waters to include specific aquatic life standards. Draft numerical criteria to assess these standards in rivers have been developed (Davies et al, 1991). No such standards exist for lakes and marine waters.

3.) Organism Health -
Since not all contaminants capable of producing toxic effects accumulate in tissues, since there are no biomonitoring programs for lakes and the marine environment, and since the biomonitoring program for rivers and streams does not assess the impact to all parts of the biological community, it may be important to assess contamination through other monitoring techniques. In more polluted environments, individuals of a species begin to manifest lesions, tumors, and anatomical and physiological anomalies. Such

"biomarkers" have the advantage over tissue concentrations in that they provide evidence of exposure to toxicants independent of bioaccumulation. Furthermore, biomarkers are evidence of a biologically relevant effect of contamination.

Waterbodies

Selection of waterbodies will be affected by a number of considerations. In the Five Year Plan, waters may be listed very generally by river basin, region, or bay rather than by specific site. Only after a thorough investigation of many factors can the actual site be identified for the Annual Work Plan. The following considerations will define the overall program

- Assessment of the distribution and levels of toxic contaminants in biota, sediments and water column requires a sampling design that includes waterbodies representative of the various hydrologic, land-use, discharge, and mineralogical regimes.

- Assessment of toxic contaminant trends over time will require identification of "reference" stations that best represent natural conditions and that can be sustained for a long period of time. Tracking pollution levels over time requires a similar approach, but selecting sites having a signal that can be tracked with confidence.

- Compliance with and attainment of water quality standards will require locating stations which represent worst-case conditions.

Factors considered when choosing waterbodies for inclusion in the program follow:

- Water classification (MRSA 38, Article 4-A Water Classification Program)

- Importance of the waterbody to wildlife and humans

- Likelihood of contamination and its relative risk to human or ecological health

- Pending waste discharge license issuance or other decision

- Availability of "reference" sites

- Anticipated improvement or degradation

- Knowledge of other ongoing programs and their latest findings

Toxic Substances

Eligible toxic substances for inclusion in the program follow:

- Contaminants that have the potential to affect human or ecological health at expected concentrations

- Contaminants that reflect natural sources

- Contaminants that reflect cultural sources

- Contaminants that serve as tracers for human sources of pollution

• Contaminants or measurements that may be more cost effective indicators of other contaminants

Contaminants to be measured will be divided into two groups, (1) general contaminants, which will be measured routinely at most sites, and (2) additional contaminants, which will be included where other pollutants of concern are suspected. Some examples are as follows:

(1) General parameters
Heavy metals such as copper, chromium, cadmium, lead, mercury, nickel and zinc
Organic compounds including polychlorinated biphenyls, chlorinated hydrocarbon pesticides

(2) Additional parameters:
Other metals such as aluminum, arsenic, silver, selenium
Other inorganic substances such as ammonia, chlorine
Other organics such as aromatic hydrocarbons, dioxins and furans, other halogenated hydrocarbons

Intensity of sample collection will be affected by a number of factors to include the following:

•Expected time scale of change for factors affecting contaminant level

•Homogeneity/heterogeneity in sample populations

•Uncertainty in observations due to systematic and analytic error

Schedule

The river basin approach, synchronous with license renewals (5 year) will be used to the extent possible. On the accompanying map, the State has been divided into 9 major hydrologic units. Both extensive and intensive monitoring would be conducted on a 5 year rotation dividing the hydrologic units as equally as possible to distribute the monitoring effort over the 5 years. Presently, the State does not issue licenses or conduct any other activities using a basin approach. Such an approach has attractive economies for management and may be implemented in the future. Spatial differences and comparative studies may be examined through occasional short-term studies. The annual work plan may therefore reflect an integration of these two concepts. There may be sites scattered about the state while others are focused in a particular river basin.

MODULES

The structure of the program recognizes the different characteristics of Maine's aquatic environments. The program is therefore divided into three modules. These three modules vary slightly in their scope and purpose and a more complete approach is provided in each module's Five Year Plan. The following briefly describes the properties unique to each module.

Lakes

Since existing data are limited to a very few waters and pollutants, not much is known about the status of toxics in the majority of Maine lakes and ponds. Given this lack of information and the impacts already documented on human and wildlife consumers in Maine from the existing data, it is clear that there is a critical need for a comprehensive program to gather the necessary information.

In 1992 DEP joined with Labrador, New Brunswick, Nova Scotia, Quebec, New York, and the New England states in the International Toxics Monitoring Program to collect fish during 1992 field season and snow pack samples during the winter of 1992-93 for analysis for mercury, cadmium, arsenic, and lead from three lake systems in each state or province. These and other available data will be compared among all sites to provide insight regarding extent, sources, and factors affecting distribution of these toxics in the Northeast. This program is viewed as a pilot for a continued program to be developed as part of this Surface Water Ambient Toxics Monitoring Program.

The lake systems module will initially rely on tissue analysis to assess toxic contamination in lakes. Methods to conduct community analysis in lakes for toxic response have not been established, although EPA is currently engaged in development of such methods. In addition, Maine does not have a history of toxic problems in lakes that would be expected to alter the biological community. No new direct discharges of pollutants are allowed to lakes and there are very few existing discharges to lakes. Once suitable methods are developed to assess any impacts of toxics in lake systems on ecological health, DEP will develop an appropriate program.

The five year plans will provide more detail regarding design of the lakes module. The five year plan for the period 1993-1997 shows the number of lakes and selection criteria for 1993 and 1994. Plans for 1995-1997 are not detailed since they depend on the results of the first two years. However, the intention is to continue monitoring of lakes at some level. Annual work plans will give specific lakes and parameters to be monitored.

The following table shows how well this proposed program meets the requirements of a comprehensive program for lakes monitoring. Ecological health is only partially assessed. Point sources are not evaluated since there are essentially no discharges allowed to lakes. Continuity between sites and years is desirable although the way in which the program will continue is dependent upon the results of monitoring during the first two years, which is being carried out as part of a cooperative project with EPA.

Elements of a comprehensive program	Fish Tissue.
Ecological Health	X
Human Health	X
Point Sources	
Non-Point Sources	X
Continuity	
within sites	
between years	?
Geographic breadth	X
Hydrologic extent	
coastal	
lakes	X
rivers and streams	
Analytes	
priority pollutants	X
other pollutants	X
Matrix	
tissue	X
sediment	X
water	
community	

Rivers and Streams

One strategy for designing a monitoring program is to focus on known or suspected problem areas first in order that any hazards or unacceptable risks to human health or ecological health can be identified as early as possible. That allows risk managers to take appropriate action to inform the public and develop risk reduction strategies as soon as possible. This may be intensive or special investigation sampling.

Another strategy is to distribute sites about a watershed (for the river basin approach) or throughout the State to identify new issues, pollutants, sources and locations to document the presence or absence of contamination. This is extensive sampling.

Both strategies have merit. The Rivers and Streams Module will be based on an integration of both of these strategies as described below.

The monitoring program for the Rivers and Streams Module will focus initially on fish tissue analysis and biomonitoring. However, as previously stated, water and sediment sampling may be conducted as part of special investigations. The 5 year plan and annual work plans will be developed using an integrated sampling design. Both intensive and extensive sampling will be employed as described below.

In the current Dioxin Monitoring Program, stations are monitored each year for dioxins and furans. Stations are located statewide below known or suspected point sources of dioxin with additional reference sites. This program is currently mandated by legislation to continue until 1995. This program will be continued and expanded to include other appropriate pollutants below these and other known and suspected point sources of toxic pollutants. This is intensive sampling.

In addition, extensive monitoring will be conducted at sites around the state by river basins and according to other site selection information previously discussed.

For some sites, if pollutants are not found in significant amounts in the initial survey, further monitoring of that pollutant may be discontinued. Other 'indicator' sites may be continued to document long term trends. Reference sites will be incorporated into the program for comparison with contaminated sites and as a long-term reference for the program. Five year plans and annual work plans may change the mix of intensive versus extensive sampling as information becomes available from this program each year.

The following table shows how well this proposed program meets the requirements of a comprehensive program for rivers and streams monitoring. Between the two major elements of this module most all of the requirements of a comprehensive monitoring program are met.

Elements of a comprehensive program	Biomonitoring	Fish Tissue
Ecological Health	X	X
Human Health		X
Point Sources	X	X
Non-Point Sources	X	X
Continuity		
within sites	X	X
between years	X	X
Geographic breadth	X	X
Hydrologic extent		
coastal		
lakes		
rivers and streams	X	X
Analytes		
priority pollutants		X
other pollutants		X
Matrix		
tissue		X
sediment		
water		
community	X	

Marine and Estuarine Waters

The Marine and Estuarine Module covers all surface waters classified as marine and estuarine within the State Of Maine to the 3 mile limit. This includes most tidally influenced waters exposed to a salinity regime.

The Marine and Estuarine Module will continue using the blue mussel as a monitoring tool. This technique has been successfully employed in Maine since 1986 for assessing water quality. Recently, the Gulf of Maine Council on the Marine Environment adopted a similar technique which will complement Maine's efforts.

Early on in the program, the module will begin to look at bottom feeding species of fish or shellfish in order to gain insight into pathways of contamination thorough sediment. Additional sediment analyses may be necessary.

The Five Year Work Plan further outlines extensive monitoring, intensive studies, and method development priorities. Trend analysis, describing natural spatial and temporal variation, and developing biological effects assessment techniques are especially targeted.

Implementation of the Marine and Estuarine Toxic Monitoring Module will require cooperation and coordination between the Departments of Environmental Protection and Marine Resources. Many of the tasks proposed above may be done using resources provided by both agencies. Assisting each other collecting samples is one example of efficient use of State resources. On the other hand, each agency has its own areas of expertise and responsibilities. The Department of Environmental Protection is the lead agency responsible for overall program development, administration, coordination and implementation. It will be the responsibility of the DEP to assure data quality and standardization and oversee environmental health monitoring activities. The Department of Marine Resources will provide technical advise in all areas of the program while the Department of Human Services will be lead agency for human health risk assessment.

The following table shows how well this proposed program meets the requirements of a comprehensive program for marine and estuarine monitoring. Between the six major elements of this module most all of the requirements of a comprehensive monitoring program are met. Further details for each element are provided in the Five Year Workplan under separate cover.

Elements of a Comprehensive Monitoring Program	Methods Development	Coastal Status and Trends	Human Health	NPDES Monitoring	Assess Local Pollution	Dredge Study
Ecological Health	x	x		x	x	x
Human Health	x	x	x			
Point Sources		x		x		x
Non-Point Sources		x				
Continuity						
within sites		x	x	x		
between years		x	x	x		
Geographic breadth						
Hydrologic extent	x	x	x	x	x	x
coastal						
lakes						
rivers and streams	x	x	x	x		
Analytes						
priority pollutants	x	x	x	x	x	x
other pollutants	x	x			x	x
Matrix						
tissue	x	x	x	x	x	x
sediment	x			x	x	x
water				x	x	
community	x			x	x	x

ADMINISTRATION

Data Management

The investment in acquisition of ambient toxics data will require an adequate data management system. This system will be needed to track new data and samples, perform routine quality assurance functions, store and manipulate both new and previously acquired data, and provide readily available output for agencies and the public.

Arrangements will be made to maximize the compatibility of the system with other data systems to facilitate acquisition and transfer of data. Data will be tagged to geographical location codes allowing linkage to Geographic Information System applications.

The system will be based on standard database formats which will allow reference to other data via geographical location parameter codes. The database will become part of the DEP Water Bureau system being developed to house other types of ambient water quality data. Modifications will be necessary on an irregular basis, especially in the first two to three years to refine the system elements, including development of automated subroutines for data summary and retrieval.

System Costs

Initial system programming and development: $5000-7000 in year #1.
Specialized system maintenance and programming refinements: $2500-3500 annually for years two and three.
Routine data system operations, including data entry, initial validation/proofing and outputs: $3000 annually.
Total five year cost: $25,000-28,000

Personnel

To accomplish the tasks envisioned in this program DEP will need additional personnel. Existing and needed resources are as follows:

MODULE	EXISTING	NEEDED
Lakes	0.1 Bio III	2 Bio I, 3 Cons. Aide
Marine	0.5 Bio II	1 Bio I, 1 Bio II, 1 Cons. Aide
Rivers	0.2 Bio III 0.5 Bio II 1.0 Bio I	3 Cons. Aide

FUNDING STRATEGIES

Any funding proposal to conduct a comprehensive surface water ambient toxic monitoring program should be structured to provide funding: (1) adequate to conduct monitoring in a comprehensive manner, providing geographic breadth, attention to all waterbody types, selection of appropriate media and recognizing all toxic substances which could pose a significant health or ecological hazard, (2) which will be available over a long period of time at a relatively predictable amount, and (3) that could rely on a diversity of sources which should reflect, as best as possible, the source and relative amount of toxic material released. Where sources are unknown or no longer exist, public funds should be used to assess contamination. Public funds should be used for any research component of the program.

The following were identified as possible sources of funding to support a comprehensive surface water ambient toxic monitoring program:

State sources:

- General fund - new appropriation required, reassign priorities
- Oil Conveyance Fund - new appropriation required
- Hazardous Waste Fund - new appropriation required
- Revised license fees - new appropriation required, reassign priorities
- Special fee for toxic discharge - new legislation required
- Dedicate portion of penalties - new legislation required

Federal sources:

- Dedicate portion of Section 106 grant - revise work program, EPA approval
- Casco Bay Program - limited geographic area, EPA approval
- Coastal Zone Management Program - marine waters only, revise work program
- Special grants - REMAP, NOAA

REPORT

A report to the Energy and Natural Resources Committee shall be produced at the end of each five year plan giving a breakdown of expenditures, findings, and recommendations for future work. The report will also provide a review of current state of research identifying other studies and findings, including new methods, in Maine pertinent to the toxics issue. Results of the Program will also be included in the Department's biennial report to Congress.

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