DIOXIN MONITORING PROGRAM

Including data on Dioxin-like PCBs collected in the Surface Water Ambient Toxics Monitoring Program

2008

REPORT

DEPARTMENT OF ENVIRONMENTAL PROTECTION
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GLOSSARY

CTEh=CTEh, 95th UCL - Coplanar PCB toxic equivalents with non-detects at half the detection level calculated at the 95^{th} percentile upper confidence limit on the mean

DMP- Dioxin Monitoring Program

DTEd- Dioxin toxic equivalents with non-detects at the detection level

DTEh=DTEh, 95th UCL -Dioxin toxic equivalents with non-detects at half the detection level calculated at the 95^{th} percentile upper confidence limit on the mean

DTEo- Dioxin toxic equivalents with non-detects as zero

FTAL- Fish Tissue Action Level

MCDC- Maine Center for Disease Control and Prevention (formerly Maine Bureau of Health)

SWAT- Surface Water Ambient Toxics monitoring program

TAG- SWAT Technical Advisory Group

TCDD- 2,3,7,8-tetrachlorodibenzo-p-dioxin, i.e. the most toxic dioxin

TCDF- 2,3,7,8-tetrachlorodibenzofuran

TEF- Toxicity equivalency factor

EXECUTIVE SUMMARY

Maine's Dioxin Monitoring Program was enacted in 1988 and extended and modified several times. As a result of legislative changes enacted in 2008 the Dioxin Monitoring Program was merged with the Surface Water Ambient Toxics (SWAT) Monitoring Program (38MRSA § 420-B). Dioxin monitoring is undertaken in order to describe the nature of dioxin contamination in the waters and fisheries of the State and to determine the need for fish consumption advisories on affected waters.

Following attainment of the provisions of the 1997 Dioxin Law and elimination of the measurable discharge of dioxins (includes closely related furans) from the bleached kraft pulp and paper mills in 2003-2005, the Dioxin Monitoring Program is now focused on residual levels of dioxins from historic discharges and how they affect Maine's fish consumption advisories. This report contains the findings from the 2008 Dioxin Monitoring Program with respect to three objectives:

1. Human health assessment, Fish Consumption Advisories
2. Trend evaluation
3. 1997 Dioxin Law, Continued Compliance

This report also contains the (dioxin-like) coplanar polychlorinated biphenyl (PCB) data gathered as part of DEP's Surface Water Ambient Toxics (SWAT) monitoring program. Coplanar PCB data are included to show the total exposure to dioxin-like compounds from consumption of certain fish from several Maine rivers. The Maine Center for Disease Control (MCDC) uses both dioxins and coplanar PCB data, which are have similar toxicity characteristics to dioxins, in order to make a complete assessment of the fish consumption advisories. The coplanar PCB data are distinct from the dioxin data and the reporting requirements of the Dioxin Monitoring Program. Sources of the coplanar PCBs are not known, but likely include historic use and discharge in Maine, and long range transport and atmospheric deposition.

1. HUMAN HEALTH ASSESSMENT, FISH CONSUMPTION ADVISORIES

- MCDC has issued Fish Consumption Advisories for the Androscoggin, Kennebec, Penobscot, Sebasticook, and Salmon Falls rivers, due to dioxins or a combination of dioxins and dioxin-like coplanar PCBs. These advisories are more restrictive than the statewide mercury fish consumption advisory.

- An evaluation of the need for fish consumption advisories due to the presence of dioxin-like compounds in fish requires a comparison to a health benchmark. The MCDC uses a health benchmark that is expressed as a toxicity-weighted concentration of dioxin-like compounds in fish tissue, referred to as a "Fish Tissue Action Level" or FTAL. The MCDC has established two FTALs, a FTALc for dioxin-like compounds of 1.5 parts per trillion (ppt) for protection of cancer-related effects and a FTAL of 0.4 parts per trillion for protection of non-cancer related effects. The FTAL of 1.5 ppt for cancer related effects has been used by MCDC since 1990. The FTAL of 0.4 ppt for non-cancer effects is based on the same toxicity data relied upon since 1990, but was adjusted downward in 2008 to account for the substantial background exposure from the presence of these chemicals in most dietary foods. In this report dioxins and coplanar PCB

concentrations in the 2008 samples will be compared to the FTAL of 0.4 ppt since it is the most protective of human health.

- In 2008, concentrations of just dioxins (calculated as DTEh) in fish from most river sampling stations were below the FTAL. However, concentrations exceeded, the FTAL in rainbow trout from the Androscoggin River at Gilead (denoted as AGL in Figure 1 below), in white perch from Androscoggin Lake in Wayne (ALW), in smallmouth bass from the Penobscot River at Woodville (PBW), in largemouth bass from the East Branch of the Sebasticook River at County Road in Newport (SEN), and in smallmouth bass from the main stem of the Sebasticook River at Burnham (SBN) and were at the FTAL in smallmouth bass in the Androscoggin River at Gulf Island Pond (AGI) and in largemouth bass in the Salmon Falls River in South Berwick (SFS) (Figure 1). Concentrations also exceeded the FTAL in white suckers from the Androscoggin River in Gulf Island Pond at Auburn (AGI), from the Penobscot River at Woodville (PBW), Salmon Falls River at South Berwick (SFS), and main stem of the Sebasticook River at Burnham (SBN) and were at the FTAL in suckers from the Presumpscot River at Westbrook (PWB) (Figure 2).

- When the concentrations of dioxin-like coplanar PCBs (calculated as CTEh) were added to the dioxin concentrations, total toxic equivalents increased at all stations and met or exceeded the current FTAL at an additional seven stations (Figures 1 and 2), versus the twelve stations that met or exceeded the FTAL as a result of just the dioxin data. Specific sources of coplanar PCBs are unknown but likely include historic use and discharge in Maine and long-range transport and atmospheric deposition.

Figure 1. Dioxin toxic equivalents (DTEh) and coplanar PCB toxic equivalents (CTEh) in rainbow trout (RBT), smallmouth bass (SMB), white perch (WHP), brown trout (BNT), and largemouth bass (LMB) from Maine rivers, 2008.

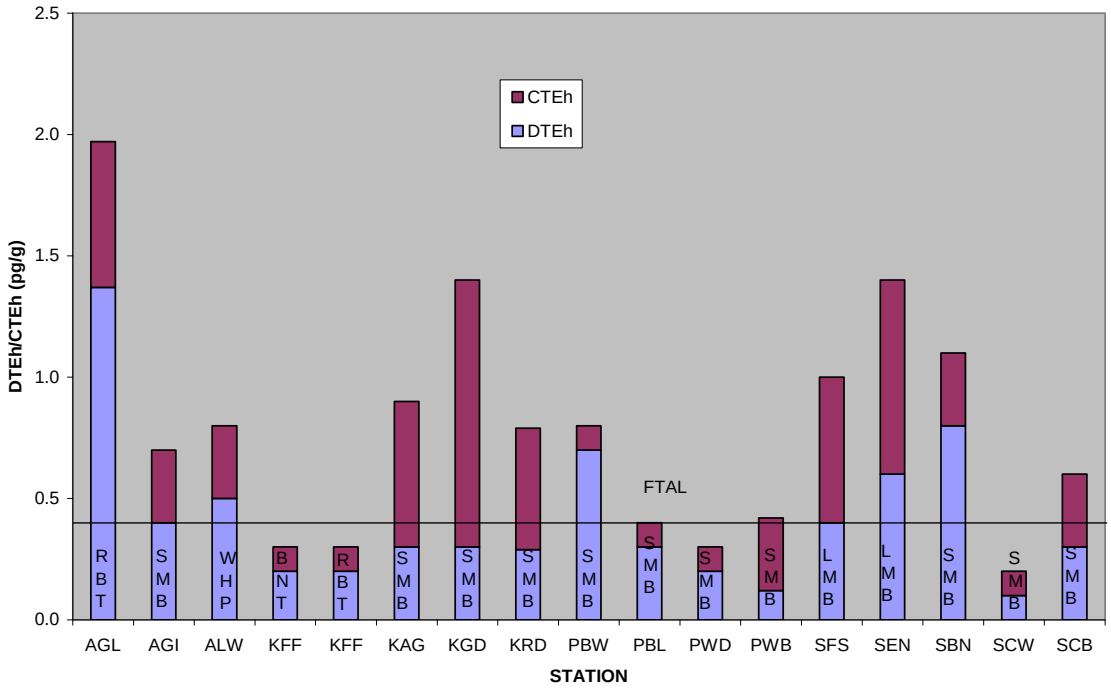
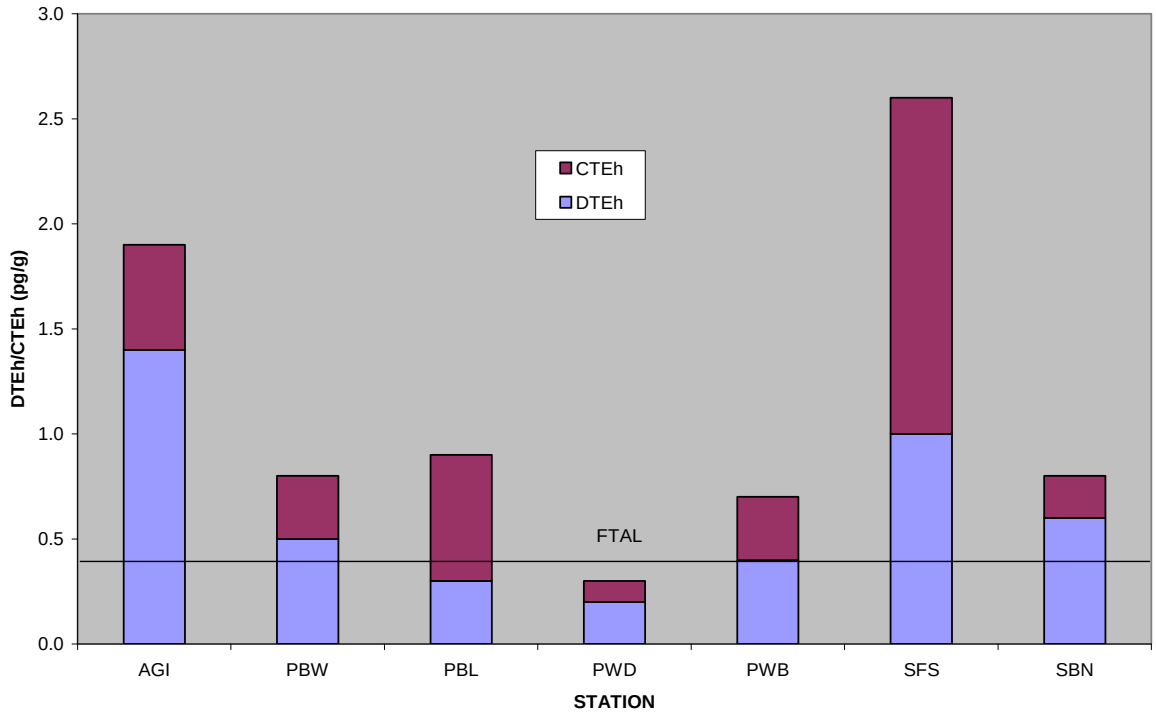


Figure 2. Dioxin toxic equivalents (DTEh) and coplanar PCB toxic equivalents (CTEh) in white suckers from Maine rivers, 2008



2. TRENDS

There is a trend of generally declining concentrations of dioxins in smallmouth bass and white suckers averaged over all stations for each of the Androscoggin, Kennebec and Penobscot rivers since 1997 (Figures 3, 4) no doubt due to reductions in discharges at the mills. Despite the overall declining trend, concentrations sometimes increase from one year to the next, due to variability or unknown cause. Trends at specific locations may not follow the general trend and will be discussed for each in the following sections. Concentrations remain higher in the Androscoggin than in the other two rivers.

Figure 3. Mean dioxin (DTEh, 95th UCL) concentrations in smallmouth bass below bleached kraft pulp and paper mills on the Androscoggin, Kennebec, and Penobscot rivers.

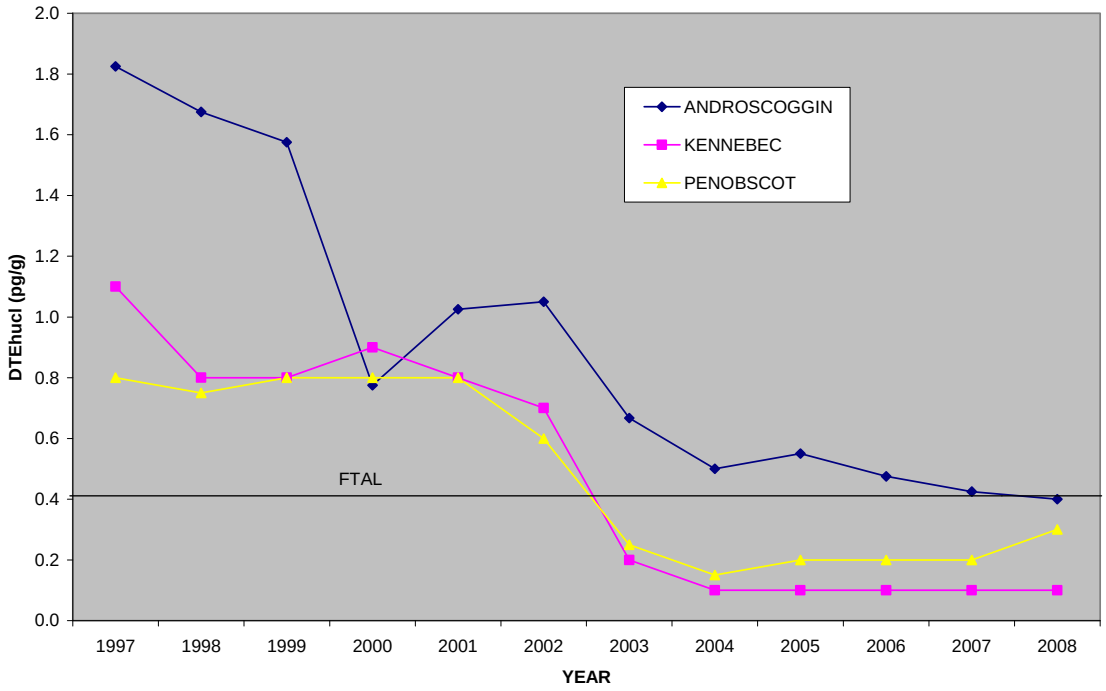
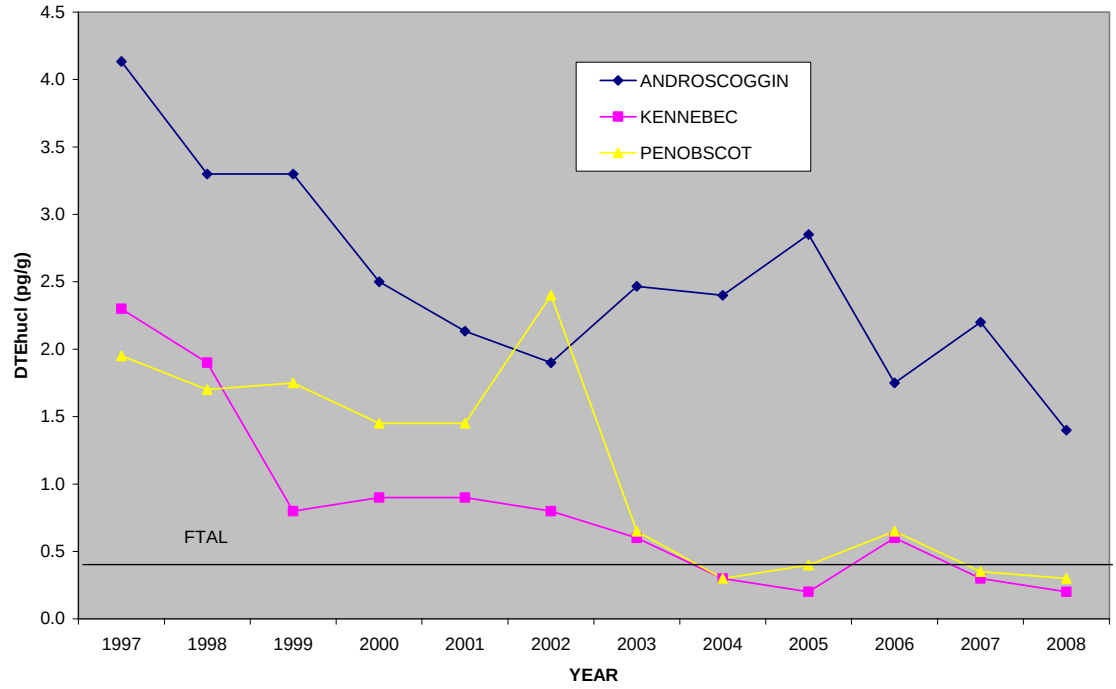


Figure 4. Mean concentrations of dioxins (DTEh, 95th UCL) in white suckers below bleached kraft pulp and paper mills on the Androscoggin, Kennebec, and Penobscot rivers



3. COMPLIANCE WITH THE 1997 DIOXIN LAW'S NO DISCHARGE PROVISION

- The 2003-2005 results indicated that all the mills passed the above and below (A/B) test, where dioxins in fish below the mill were not measurably higher than in fish above the mill, and were no longer discharging measurable amounts of dioxin .

- Continued annual compliance with the no-discharge provision in 38 MRSA section 420 may be demonstrated by one of three methods. 1) Bleach plant effluent concentrations, monitored at quarterly and reported at the actual concentrations rather than the nominal 10 ppq limit, must remain as low as in the years in which a mill demonstrated compliance with the A/B test. 2) Bleach plant effluent concentrations must be tested as above at least once a year. In addition, the mills must provide a certification that the bleach plant and defoamers continue to be operated and used in a manner similar to that in 2003 and 2004. 3) A facility may repeat and must pass the A/B fish test. Continued compliance in 2008 was demonstrated by all mills by methods 1 or 2.

- Continued elevated levels in fish above background at some locations below mills in these rivers are the legacy of the long history of discharges to the rivers.

- Monitoring of fish needs to be continued to allow MCDC periodic review of Fish Consumption Advisories that are due wholly or in part to dioxin. Due to inter-annual variability, the Maine CDC needs at least two consecutive years of monitoring data that show levels of dioxins below the appropriate Fish Tissue Action Level before advisories could potentially be relaxed.

BACKGROUND ON DIOXIN

Due to continuing controversy over the effects of dioxin on human and ecological health, the US Environmental Protection Agency (EPA) announced in 1991 it would begin a thorough scientific reassessment of dioxin. EPA proposed that the process would be open to the public and consequently held several meetings to share information and receive comments. A draft report was issued in 1994 and subsequent review in 1995 by EPA's Science Advisory Board called for revisions of some chapters. Revised drafts published in 2000 indicate that dioxin may exhibit reproductive and developmental effects, immuno-toxic effects, neuro-toxic effects, and cancer. In addition, the report found that concentrations of dioxin in the environment have decreased since the 1970s. Also 'EPA currently estimates that the amount of dioxin in tissues of the general human population approaches, within a factor of 10, the levels at which adverse effects might be expected to occur'. In March 2001 EPA's Scientific Advisory Board published its draft review of EPA's new revisions and is divided on whether or not dioxin is a carcinogen, but does believe EPA has underestimated non-cancer effects. The Scientific Advisory Board also does not agree that there is enough evidence to support EPA's statement about current body burdens and probable adverse health impacts. The reassessment has not yet been completed.

DIOXIN MONITORING PROGRAM

Dioxin was first discovered to be a problem in Maine in 1985, when the results of an analysis of fish collected in 1984 from the Androscoggin River by the Maine Department of Environmental Protection (the Department), used as a reference station for EPA's National Dioxin Study, documented significant concentrations of dioxin. Consequently, the Maine Center for Disease Control and Prevention issued Maine's first fish consumption advisory in 1985. Additional sampling in 1985 and 1986 found similar levels in fish from other rivers below bleached kraft pulp and paper mills, but not from rivers or lakes without such sources. This led to including parts of the Kennebec River and Penobscot River in a revised fish consumption advisory in 1987. As a result there was a bill before the Maine legislature in 1988 to ban the discharge of dioxin. The bill was amended to establish a monitoring program, Maine's Dioxin Monitoring Program (DMP) and enacted into law (38 MRSA section 420-A) to end in 1990. Discovery of continuing significant concentrations in fish from these and other rivers resulted in the DMP being reauthorized in 1990, 1995, 1997, 2002, and most recently in 2008. The Department has issued reports of the results of monitoring annually. Fish consumption advisories have been issued or modified in 1985, 1987, 1990, 1992, 1994, 1997, and 2000.

Maine's Dioxin Monitoring Program has been extended and modified several times since inception. As a result of legislative changes enacted in 2008 the Dioxin Monitoring Program was merged with the Surface Water Ambient Toxics (SWAT) Monitoring Program (38MRSA § 420-B) with the following goal:

1-A. Dioxin monitoring. In order to determine the nature of dioxin contamination in the waters and fisheries of the State, the commissioner shall conduct a monitoring program as described in this subsection. This monitoring must be undertaken to determine the need for fish consumption advisories on affected waters.

Charged with administration of the program, the Department is required to sample fish once a year below no more than 12 bleached pulp mills, municipal wastewater treatment plants, or other known or likely sources of dioxin. Costs for equipment, supplies, and analysis are assessed to the selected facilities annually, and could not exceed $168,000 until 1997 when the limit was raised to $250,000 to incorporate development of the Above/Below (A/B) fish test. In recent years, much less has been spent and the 2008 statutory revision to the program limits fees assessed the bleached kraft pulp and paper mills to $10,000.

The Department is advised by the Surface Water Ambient Toxic (SWAT) Monitoring Program Technical Advisory Group in implementation of the program. An annual report is required to be submitted to the Natural Resources Committee of the Maine Legislature by March 31 with the results from the previous year, including status of continued compliance toward meeting the requirements of the dioxin discharge law

The monitoring program is to be coordinated with other ongoing programs conducted by the Department, US Environmental Protection Agency (EPA), or dischargers of wastewater. The proposed annual monitoring plan must be submitted to the Surface Water Ambient Toxic (SWAT) monitoring program Technical Advisory Group (TAG), created under 38 MRSA section 420-B, for review and advice. The selected facilities must be notified of their inclusion in the proposed program at least 30 days prior to submittal to the TAG. The Department must incorporate the results of all studies into a report due to the Natural Resources Committee by March 31 of the following year. A draft of the report is reviewed by the TAG before completion of the final report. Costs of sample collection and analysis are assessed as a fee to the selected facilities. Payment of the fees is a condition of the waste discharge license granted by the State for continued operation and discharge of wastewater to waters of the State. However, if the selected facility is a publicly owned treatment works (POTW), then the fees may be assessed to the known or likely industrial generator of dioxin, and payment will not be a condition of the waste discharge license of the POTW.

1997 DIOXIN DISCHARGE LAW
CRITERIA FOR CERTIFICATION OF BLEACH PLANT OPERATION

The following certification requirements, included in all kraft pulp mill wastewater discharge licenses, are permit conditions and are designed to maintain compliance with the requirements of the dioxin discharge law.

"In lieu of once per month monitoring of the bleach plant waste stream for 2,3,7,8 TCDD (dioxin) and 2,3,7,8 TCDF (furan) (40 CFR Part 430), by December 31 of each calendar year *(PCS Code 95799)*, the permittee shall sample (1/year) and report the results for said parameters and provide the Department with a certification stating:
a. Elemental chlorine gas or hypochlorite was not used in the bleaching of pulp.
b. The chlorine dioxide (ClO2) generating plant has been operated in a manner which minimizes or eliminates byproduct elemental chlorine generation per the manufacturers/suppliers recommendations.
c. Documented and verifiable purchasing procedures are in place for the procurement of defoamers or other additives without elevated levels of known dioxin precursors."

d. Fundamental design changes that affect the ClO2 plant and/or bleach plant operation have been reported to the Department prior to their implementation and said reports explained the reason(s) for the change and any possible adverse consequences.

FISH CONSUMPTION ADVISORIES

There is a statewide fish consumption advisory due to mercury for all fresh waters. There are additional advisories for a number of rivers due to 1) dioxins and dioxin-like (coplanar) PCBs, 2) total PCBs, and 3) DDTs (Appendix 1).

There are 75 dioxins and 135 related furans, 17 of which are considered toxic, but with different toxicity potencies. The total toxicity of a sample (dioxin toxic equivalents=DTE or toxic equivalents=TEQ) can be calculated as the sum of the product of the concentration and toxicity equivalency factor (TEF, relative to the most toxic dioxin, TCDD) for each of the 17 dioxins and furans.

The Maine Center for Disease Control publishes fish consumption advisories to inform the public about potential risk from consuming fish contaminated with dioxin and dioxin-like compounds. These advisories are based on a comparison of a Fish Tissue Action Level (FTAL) to dioxin toxic equivalent (DTE) concentrations using the 95^{th} percentile upper confidence limit on the mean DTE in fish tissue. Should a tissue concentration exceed an FTAL, a fish consumption rate (e.g., # meals per month), which is unlikely to result in toxic effects, is determined. Two FTALs have been derived for evaluating potential toxic effects from exposure to +dioxins and dioxin-like compounds. Both FTALs were developed using standard USEPA risk assessment methods (EPA 1997). For potential carcinogenic effects associated with long-term exposure, MCDC has developed a FTALc of 1.5 ppt, while for reproductive and developmental effects MCDC has developed a FTAL of 0.4 ppt. The FTAL for reproductive and developmental effects is relevant to women of childbearing age, pregnant women, and lactating women. The FTALs are compared to the concentration of DTE in edible portions of the fish, skinless filet data. Where whole fish data are reported, the DTE concentration is divided by a factor of 3.5 (determined from previous studies with white suckers, to estimate skinless filet concentration). In this report all comparisons with DTE in fish are made with FTAL, since that is the lower of the two and protective against both effects.

WORKPLAN DESIGN

The primary emphasis of the 2008 workplan was to collect fish samples from the appropriate stations and species from each river such that accurate, complete, and current data are available to assess impact to human consumers. The workplan design included sampling at locations recommended by MCDC. The 2008 workplan was initially drafted by DEP according to the objectives listed above and sent to participating facilities for comment on May 12, 2008. After discussion of the draft workplan at a meeting of the SWAT Technical Advisory Group on June 13, 2008, a final workplan was determined by the Commissioner (Table 1). Fish were also collected at other stations as part of the SWAT program at the request of MCDC for assessment of the Fish Consumption Advisories. The 2008 workplan was different than that of recent previous years in that it specified that 10 fish be collected from each station to be combined and analyzed as 2 composites rather than collecting 5 fish to be analyzed individually. All samples were analyzed for all seventeen 2,3,7,8-substituted dioxins and furans as skinless filets.

Table 1 DMP/SWAT 2008 Workplan

RIVER	STATION	FISH predators samples	FISH omnivores samples	DMP PCDD/F samples	DMP facility	SWAT PCDD/F samples	SWAT CPCB samples
ANDROSCOGGIN	GILEAD	2C5 RBT				2	2
	RUMFORD						
	RILEY						
	LIVERMORE FALLS						
	TURNER GIP	2C5 SMB	2C5 WHS	4	RPC, VERSO		4
	LISBON						
	ANDROSCOGGIN L	2C5 WHP		2	RPC, VERSO		2
KENNEBEC	FAIRFIELD	2C5 BNT/RBT		2	SAPPI SOMERSET		2
	WINSLOW						
	AUGUSTA	2C5 SMB		2	KSTD		2
	GARDINER	2C5 SMB				2	2
	RICHMOND	2C5 SMB				2	2
PENOBSCOT	WOODVILLE	2C5 SMB	2C5 WHS	2	KATAHDIN PAPER	2	4
	S LINCOLN	2C5 SMB	2C5 WHS	2	LINCOLN PAPER	2	4
	VEAZIE	2C5 SMB	2C5 WHS	0	RED SHIELD	0	0
PRESUMPSCOT	WINDHAM	2C5 SMB	2C5 WHS			4	4
	WESTBROOK	2C5 SMB	2C5 WHS			4	4
SALMON FALLS	S BERWICK	2C5 SMB	2C5 WHS	4	BERWICK		4
SEBASTICOOK	BURNHAM	2C5 SMB	2C5 WHS			4	4
EAST BRANCH	NEWPORT	2C5 SMB	2C5 WHS			4	4
WEST BRANCH	PALMYRA						
TOTAL				**18**		**26**	**44**

2C5 = 2 composites of 5 fish each

We were able to collect all samples except that we collected only 4 brown trout and 5 rainbow trout of the right size from the Kennebec River at Fairfield, 5 white suckers from the Sebasticook River at Burnham and none from Newport.

The preferred sampling time is late in the summer when fish are likely to be most contaminated after being exposed to higher concentrations of dioxin during low river flows and after significant growth has occurred. At some locations there has been a problem collecting enough fish later in the summer. At those locations sampling began in mid-May to try to insure that a suitable sample was collected. These stations were also visited after the beginning of July if there was time. If fish were captured during the later period, those samples were submitted for analyses. Otherwise, the fish collected during the early period were used. Sampling at other stations began in July. Actual dates of collection are shown in Table 1, Appendix 5.

SAMPLING PROCEDURES

Fish were collected by DEP. Upon capture, fish were immediately killed, weighed and measured, rinsed in river water, wrapped in aluminum foil with the shiny side out, labeled, and placed in a cooler on ice for transport to the DEP lab. Chain-of-custody forms were used to record all field information and document all transfers. In the lab, all fish samples were frozen and later transported whole to the Pace Analytical Services lab in Minneapolis, Minnesota for analysis. All other procedures followed EPA's Sampling Guidance Manual for the National Dioxin Study (July 1984). A laboratory log was kept for an inventory of samples in the lab at any time and final disposition.

Most of the facilities in the program already sample sludge or effluent as part of their Maine Sludge Spreading Permit or Waste Discharge License or Federal NPDES permit. Data from those programs provide adequate information about sources of dioxin. Therefore, no additional sludge samples were collected as part of this program in 2008. Effluent data are also used when available to indicate sources and any trends.

CALCULATIONS

In this report, dioxins are reported in different ways for each goal of the program. Given the uncertainty of true values when results are below the detection level, for the purpose of determining the range of possible concentrations, DTE are shown as a range with non-detects calculated at zero (DTEo) and at the detection limit (DTEd) as a mean for all samples of a given species at each station (Appendix 6). For human health assessment, DTEh, calculated using non-detects at 1/2 the detection limit consistent with the policy of MCDC were compared with the FTAL. The upper 95^{th} percentile confidence limit (UCL) was used for these comparisons, consistent with the policy of the BOH.

A related issue is that of estimated maximum possible concentrations (EMPC). Some compounds, particularly hydroxydiphenyl ethers (DPEs), are coextracted with furans. Laboratory analysis has been modified to minimize these interferences, but some DPEs may remain. In the 2007 Dioxin Monitoring Program report, the Maine Center for Disease Control and Prevention calculated EMPCs as a detected value according to their policy for setting the fish consumption advisories. To be consistent for comparison with MCDC's FTAL, EMPCs were treated the same way in this report.

RESULTS AND DISCUSSION.

Results for each sampling station are discussed with respect to the three objectives of the program, 1) human health assessment, 2) trends, and 3) 1997 Dioxin law, no discharge provision, continued compliance. See Appendix 2 for raw dioxin data for 2008, Table 1, Appendix 5 for fish sample data, and Appendix 6 for all historical dioxin data.

Dioxin concentrations in fish generally continued to decline from previous years, but there is some year-to-year variation among species and stations within the trends. Concentrations remained elevated above natural background levels in fish at some stations, particularly on the Androscoggin and Sebasticook rivers, but approached background levels at some stations on other rivers. Dioxin toxic equivalents (DTEh), most likely from historical discharges from the mills, exceeded or, combined with (dioxin-like)

coplanar PCBs (CTEh) contributed significantly to exceedances of the FTAL at several stations (Figures 1 & 2).

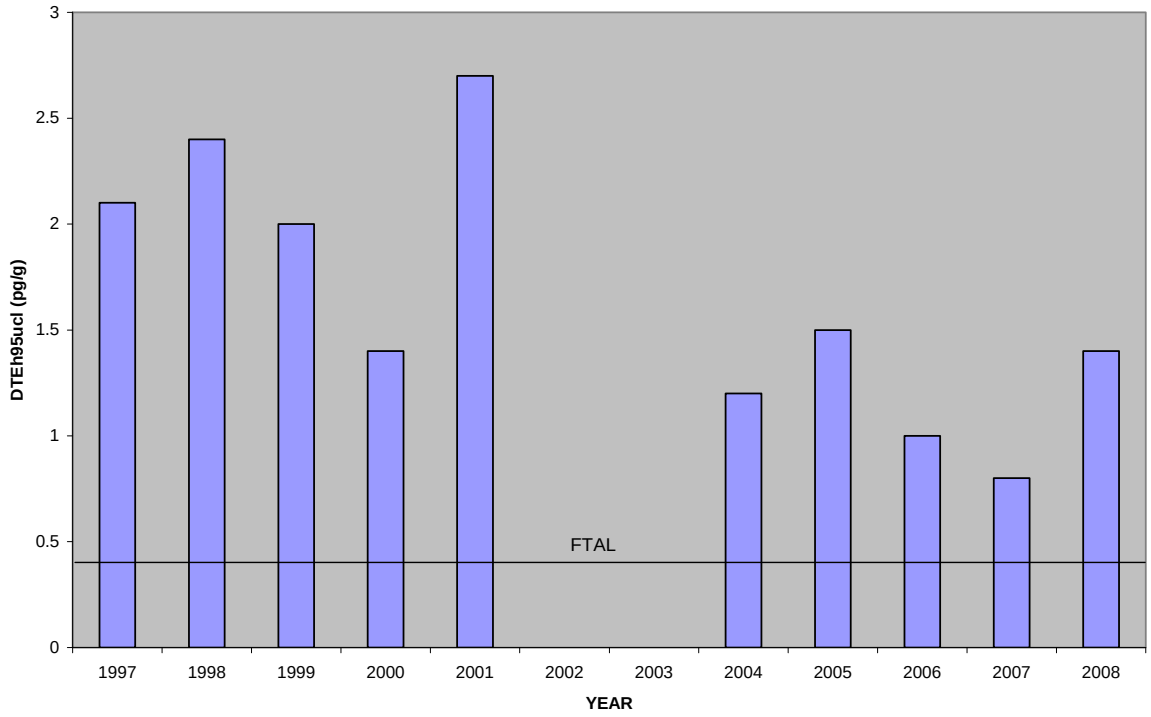
Androscoggin River

Gilead - (AGL) As part of the SWAT monitoring program, a total of ten rainbow trout were collected near Peabody Island in Gilead and combined into two composites of five fish each (Table 1, Appendix 5). This station is downstream of Fraser Paper Co's paper mill in Berlin, New Hampshire, the pulp mill having closed in 2006, but upstream of all Maine mills.

DTEh concentrations greatly exceeded the FTAL (Figure 1, Appendix 2). They were the highest of all fish species on the Androscoggin River and among the highest of all sample stations in the state. The addition of dioxin-like (coplanar) PCBs to DTEh results in even higher levels of total toxic equivalents (TTEh).

Every year measured, DTEh in fish have been significantly higher at this station than in fish from reference stations in Maine (Appendix 6). There was no significant trend for the period 1997-2008 for rainbow trout or any other species captured at this station in the past, although concentrations of DTEh are lower in the past 5 years than previously (Figure 5). The mill in Berlin, New Hampshire has reported the switch to elemental chlorine free (ECF) bleaching (chlorine dioxide) in 1994. The mill closed in 2001 but the paper and pulp mills were purchased by Fraser and reopened in 2002 and 2003 respectively and then the pulp mill closed again in September 2006. The paper mill uses pulp purchased from a variety of sources including post consumer waste.

Figure 5. Dioxin (DTEh, 95th UCL) concentrations in rainbow trout in the Androscoggin River at Gilead (AGL)



Auburn-GIP- (AGI) A total of ten smallmouth bass and ten white suckers were collected in Gulf Island Pond near the deep hole at Seagull Island, approximately 30 miles downstream of Verso Paper and about 50 miles below Rumford Paper Co., and combined into two composites of five fish each for each species (Table 1, Appendix 5).

Concentrations of DTEh in bass were at the FTAL, but DTEh in suckers exceeded the FTAL (Figure 1, Appendix 2). The addition of dioxin-like (coplanar) PCBs to DTEh resulted in an exceedance of the FTAL for bass and further increased the exceedance for suckers.

There is a declining trend in TCDD and DTE in bass during the period 1997-2008 (Figure 6). From limited data there is no significant trend for white suckers for the period 1995-2008, although concentrations since 2001 are lower than those of 1995. Elevated DTEh concentrations suckers are likely the legacy of the long history of discharges accumulating in this deep impoundment. As this station is a popular fishing spot, it warrants some continued monitoring for assessment of the Fish Consumption Advisories.

Fish sampling in 2003 and 2004 documented that the mill was no longer discharging measurable amounts of dioxins. In a letter dated December 12, 2008 the mill demonstrated continued compliance with the 'no discharge' provision of the 1997 Dioxin law by certifying that it has met the performance criteria established by DEP for the bleaching process and defoamer usage (Appendix 7). The bleach plant effluent, analyzed for dioxins in September 2008, documented that concentrations of both TCDD and TCDF have been reported below a 10 ppq detection limit in bleach plant effluent since 2002 and below much lower limits since 2004 (Appendix 4). There are no new sludge data since 1996.

Figure 6. Dioxin (DTEh, 95th UCL) concentrations in smallmouth bass from the Androscoggin River at Gulf Island Pond (AGI)

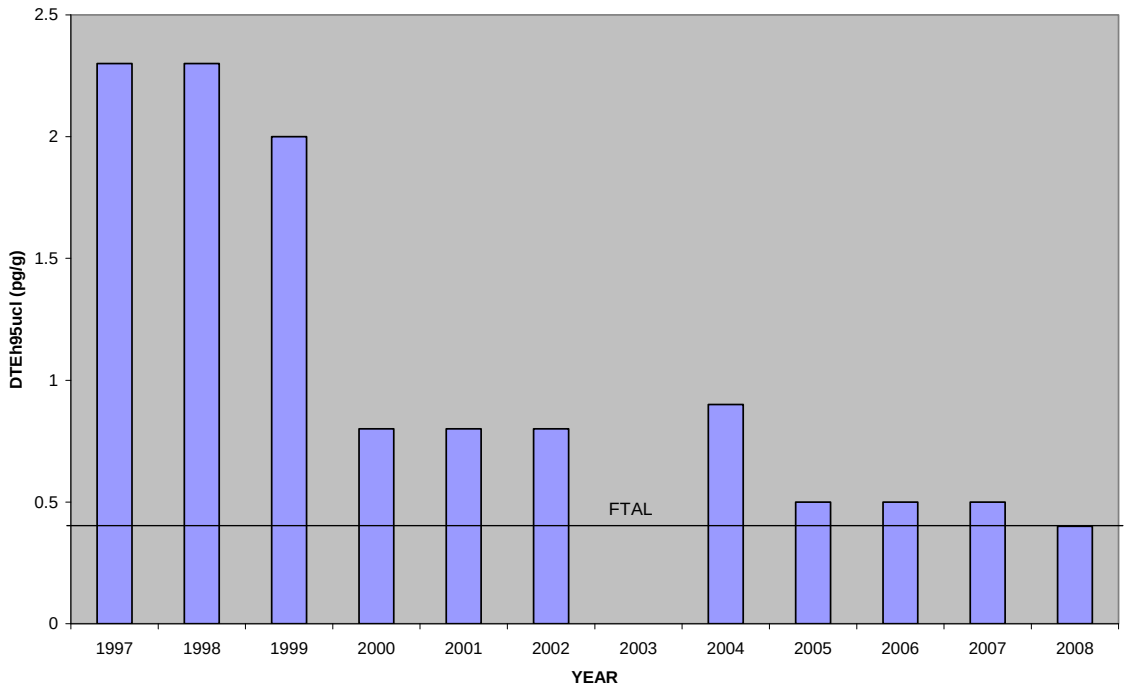
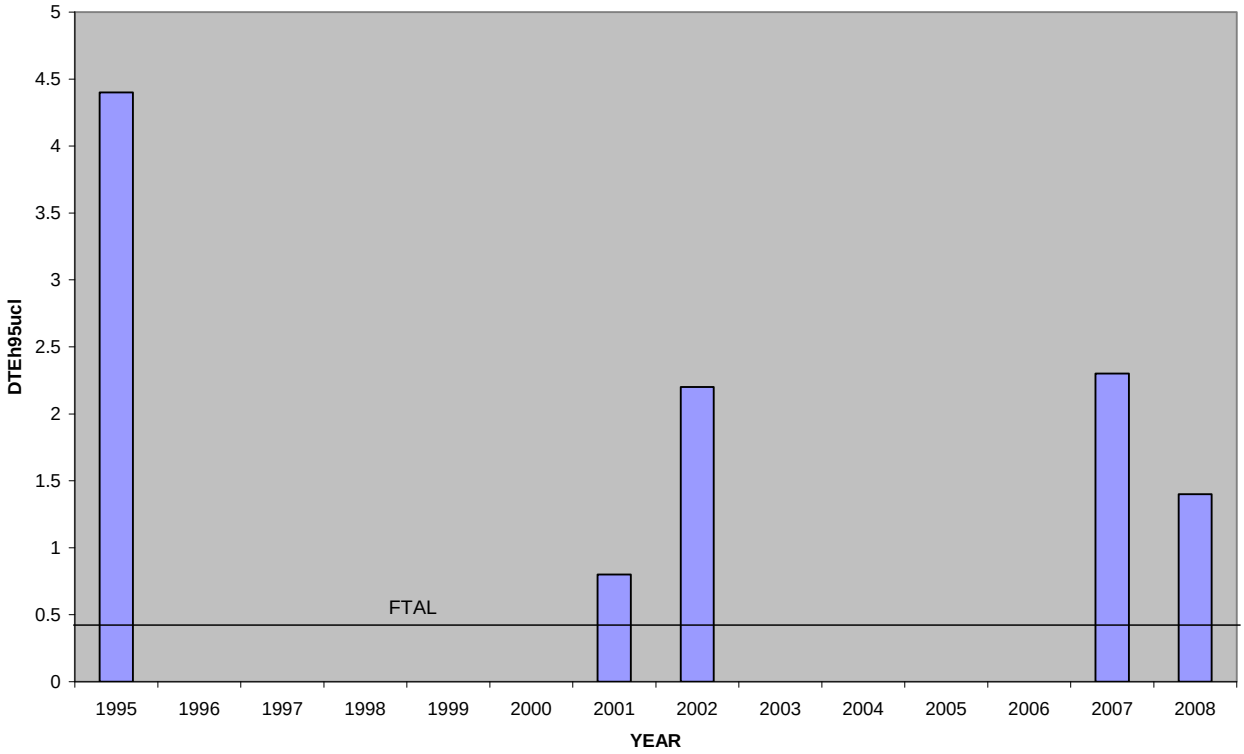


Figure 7. Dioxin (DTEh, 95th UCL) concentrations in white suckers from the Androscoggin River in Gulf Island Pond (AGI)



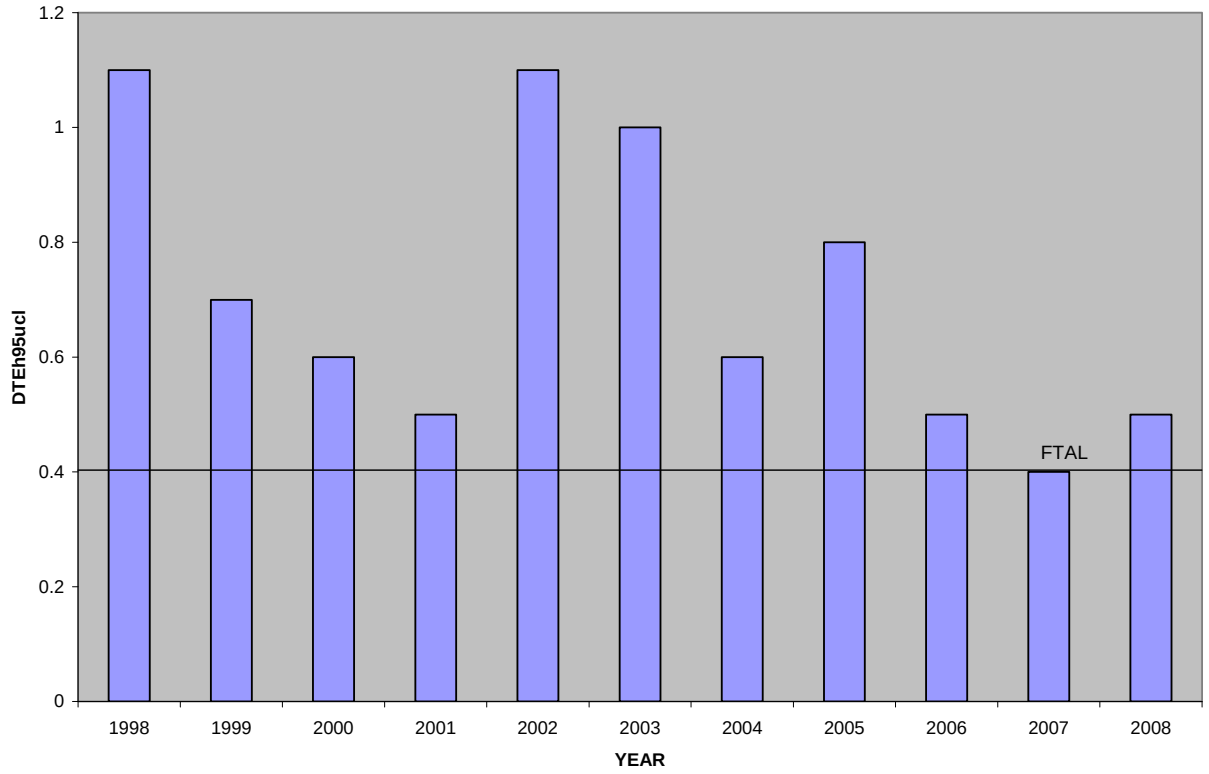
Androscoggin Lake

Wayne- Androscoggin Lake in Wayne (ALW) and Leeds is a 4000-acre, 38-foot-deep meso-trophic lake with a unique reverse delta at the outlet formed by centuries of periodic backflow from the Androscoggin River via the Dead River into the lake. There is a dam on the Dead River that reduces, but does not prevent, the backflow into the lake, which usually occurs once or twice every year. Significant amounts of dioxin were found in fish from the lake beginning in 1996, but have been somewhat lower since.

In 2008, ten white perch were collected from the lake and analyzed as two composites of five fish each (Table 1, Appendix 5). TCDD concentrations were similar to those of historical reference stations unimpacted by point source discharges (Appendix 6) but DTEh concentrations exceeded the FTAL (Figure 1, Appendix 2). The addition of dioxin-like (coplanar) PCBs to DTEh resulted in an increase in total toxic equivalents (TTEh) that further exceeded the FTAL.

There is no trend for the period 1996-2008 although concentrations are lower in the last three years than most previous years (Figure 8). Concentrations in white perch have historically been as high as or higher than those in bass. Continued monitoring is needed for this popular fishing lake.

Figure 8. Dioxin (DTEh, 95th UCL) concentrations in white perch from Androscoggin Lake (ALW)



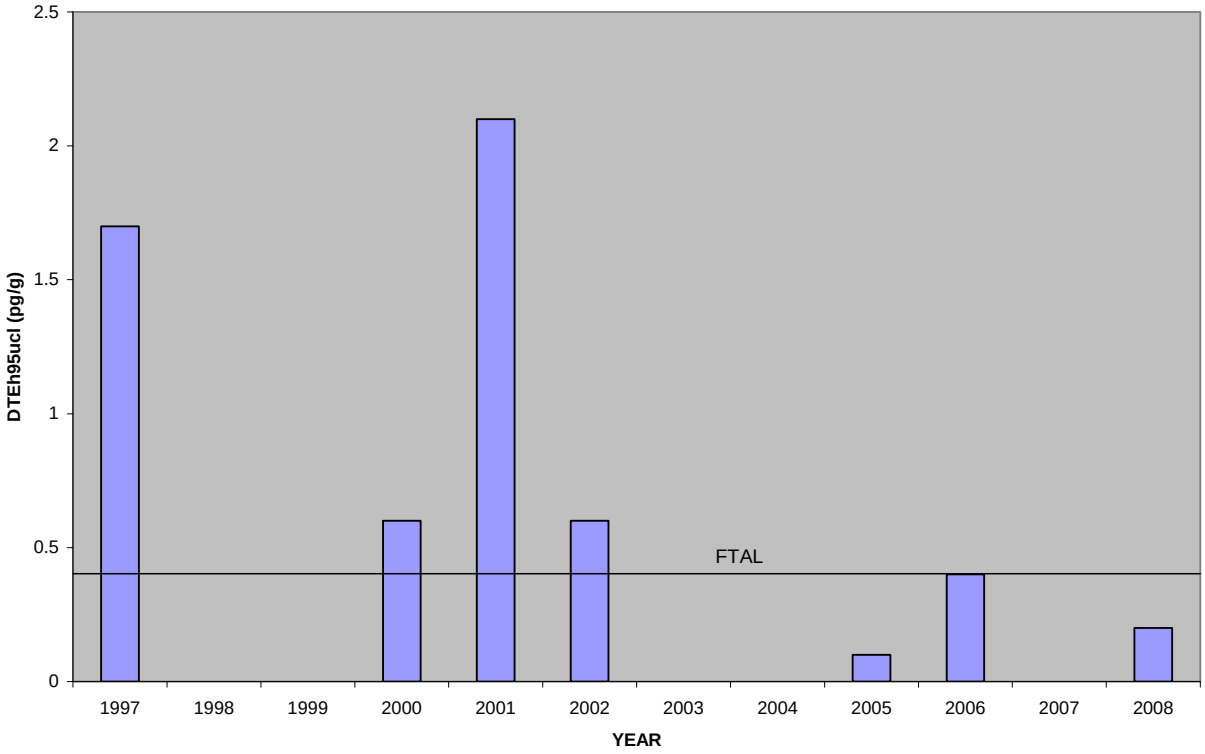
Kennebec River

Fairfield- (KFF) A total of four brown trout and five rainbow trout were collected from the river between the Shawmut Dam and the I-95 bridge, approximately 7-8 miles below SAPPI Somerset's bleached kraft pulp and paper mill in Skowhegan and analyzed as a single composite for each species (Table 1, Appendix 5).

TCDD and DTEh concentrations in both species were similar to those in historical reference stations unimpacted by point sources (Appendix 6) and below the FTAL (Figure 1, Appendix 2). The addition of dioxin-like (coplanar) PCBs to DTEh results in an increase in total toxic equivalents (TTEh) to a level that is still below the FTAL. There is no declining trend with brown trout, but DTEh from 2005 and later appear lower than those from previous years (Figure 9).

Fish sampling in 2003 and 2004 documented that the mill was no longer discharging measurable amounts of dioxins. The mill has demonstrated continued compliance with the 'no discharge' provision of the 1997 Dioxin law. In a letter dated December 17, 2008 the mill certified that it has met the performance criteria established by DEP for the bleaching process and defoamer usage (Appendix 7). Sampling bleach plant effluent was conducted in November 2008 documented that concentrations of both TCDD and TCDF were below detection at a low sample specific detection level (Appendix 4).

Figure 9. Dioxin (DTEh, 95 UCL) concentrations in brown trout from the Kennebec River at Fairfield (KFF)

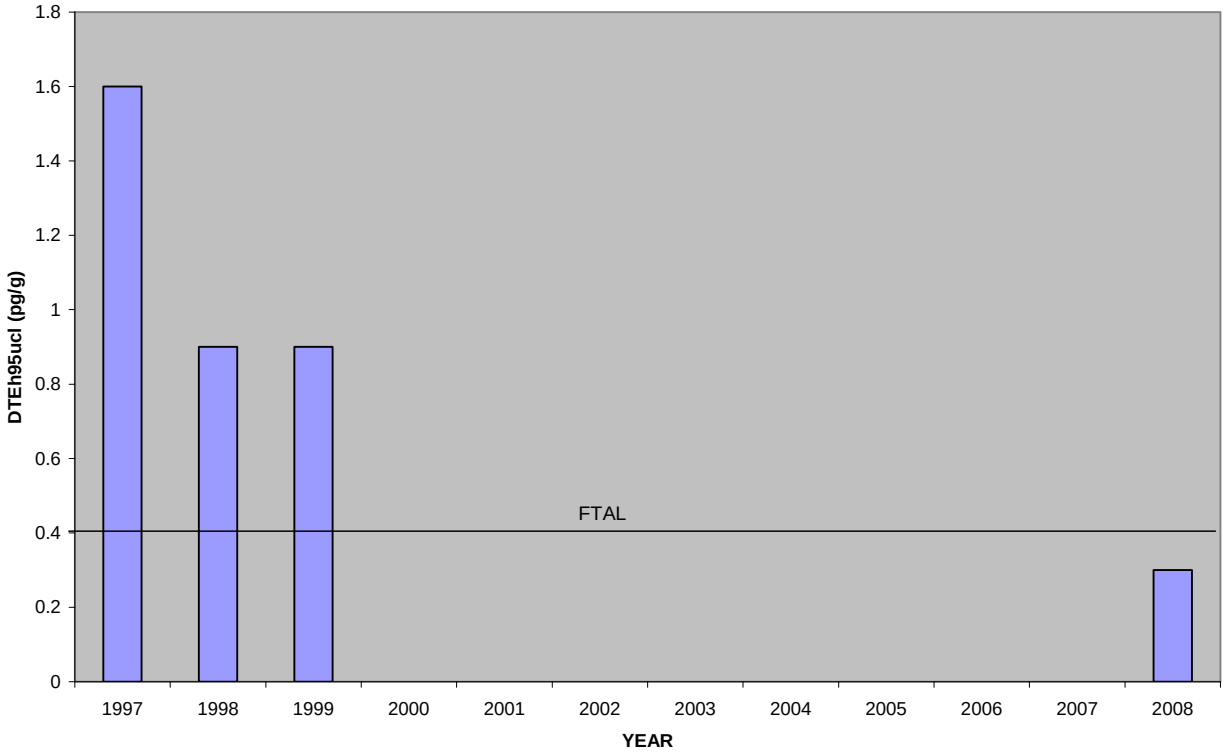


Augusta- (KAG) A total of ten smallmouth bass (Table 1, Appendix 5) were collected in Augusta approximately 20 miles below the discharge from the Kennebec Sanitary Treatment District, which processes effluent from the Huhtamaki paper mill and combined into two composites of five fish each.

Concentrations of TCDD were similar to those at historical reference stations unimpacted by point sources (Appendix 6). DTEh were slightly elevated above those at historical reference stations but below the FTAL (Figure 1, Appendix 2). The addition of dioxin-like (coplanar) PCBs to DTEh results in an increase in total toxic equivalents (TTEh) to a level that greatly exceeded the FTAL. These data corroborate very high levels of PCBs measured previously which resulted in a no consumption fish advisory for the Kennebec from Augusta to tidewater.

There are not enough data for trends analysis, but concentrations in 2008 were significantly lower than when last sampled in 1997-1999 at KAG (Figure 10).

Figure 10. Dioxin (DTEh, 95 UCL) concentrations in smallmouth bass from the Kennebec River in Augusta (KAG)



Gardiner- (KGD) As part of the SWAT monitoring program ten smallmouth bass (Table 1, Appendix 5) were collected from the river at Gardiner, approximately 6 miles below the discharge of the former (Statler, Tree-Free, American Paper) recycled paper mill in Augusta and combined into two composites of five fish each. Concentrations of TCDD were similar to those at historical reference stations unimpacted by point sources (Appendix 6). As as Augusta, DTEh were slightly elevated above those at historical reference stations but below the FTAL (Figure 1, Appendix 2). Concentrations were similar to those from 2006, the only other year with data (Appendix 6). The addition of dioxin-like (coplanar) PCBs to DTEh results in an increase in total toxic equivalents (TTEh) to a level that greatly exceeded the FTAL. Elevated concentrations of total PCBs in fish from the Kennebec River below Augusta has been previously well documented. Consequently, MCDC has issued a Fish Consumption Advisory recommending no consumption of freshwater fish from this river reach (Appendix 1).

Richmond (KRD) As part of the SWAT monitoring program ten smallmouth bass (Table 1, Appendix 5) were collected from the river at Richmond, approximately 10 miles below Gardiner. Concentrations of TCDD were similar to those at historical reference stations unimpacted by point sources (Appendix 6). Similar to upstream stations at Augusta and Gardiner, DTEh were slightly elevated above those at historical reference stations but below the FTAL (Figure 1, Appendix 2). The addition of dioxin-like (coplanar) PCBs to DTEh results in an increase in total toxic equivalents (TTEh) to a level that exceeded the FTAL. Elevated concentrations of total PCBs in fish from the Kennebec River below Augusta has

been previously well documented. Consequently, MCDC has issued a Fish Consumption Advisory recommending no consumption of freshwater fish from this river reach (Appendix 1). Concentrations were much lower than those from this station in 1993 in American eel, often roughly equivalent to those in bass at other stations, (Appendix 6).

Penobscot River

Woodville (Mattaceunk Impoundment)- (PBW) Fish collected at Woodville, downstream of Katahdin Paper's pulp and paper mills in Millinocket and East Millinockett in 1997-2001 had similarly low concentrations of dioxin as the historical reference station at Grindstone on the East Branch, uninfluenced by any mill. Therefore, PBW had served as a reference station for the Penobscot River and the upstream station for Lincoln Paper and Tissue above/below (A/B) test. Finding DTEh in suckers in 2002, 2003, and 2005 elevated above historical levels at this station, it was resampled in 2007 and 2008.

In 2008, as part of the SWAT monitoring program, ten smallmouth bass were collected from this station and combined into two composites of five fish each (Table 1, Appendix 5). As part of the Dioxin Monitoring Program, ten white suckers were also collected from this station and analyzed as two composites of five fish each.

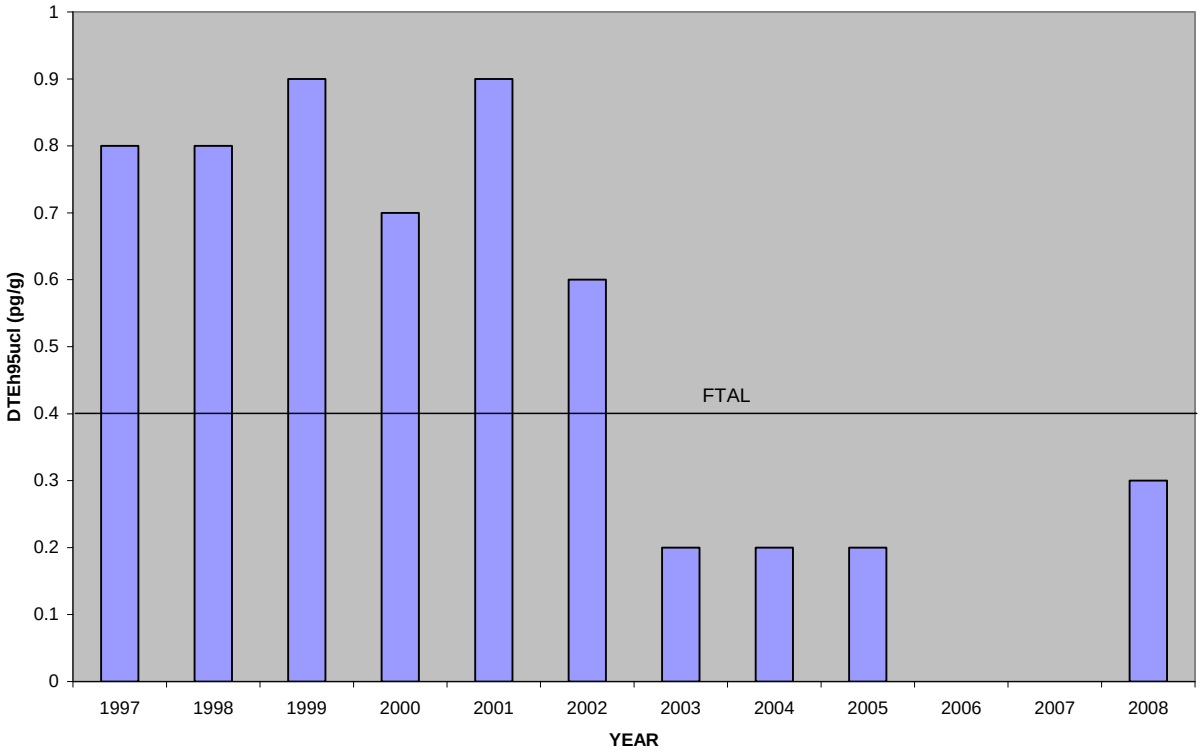
Concentrations of TCDD (Appendix 2) and DTEh (Figure 1) in bass were below the FTAL and TCDD was similar to those from Grindstone and to those at Woodville prior to 2002 (Appendix 6) while DTEh exceeded the FTAL. Concentrations of TCDD in suckers were below the FTAL and similar to those from Grindstone and Woodville prior to 2002, but concentrations of DTEh exceeded the FTAL (Figure 2). The addition of dioxin-like (coplanar) PCBs to DTEh results in small increases in total toxic equivalents (TTEh) for both bass and suckers. Elevated DTEh concentrations in both species in 2008 compared to previous years suggest a potential intermittent source upstream at Millinockett or East Millinockett.

South Lincoln- (PBL) As part of the SWAT monitoring program, ten smallmouth were collected from the river near the boat ramp in South Lincoln, approximately 4 miles downstream of Lincoln Paper and Tissue Company's bleached kraft mill in Lincoln and combined into two composites of five fish each (Table 1, Appendix 5). As part of the Dioxin Monitoring Program, ten white suckers were also collected from this station and analyzed as two composites of five fish each.

Concentrations of TCDD (Appendix 2) and DTEh in both species were slightly elevated but below the FTAL (Figures 1 and 2). The addition of dioxin-like (coplanar) PCBs to DTEh resulted in a small increase in total toxic equivalents (TTEh) to a level that was at the FTAL in bass, but resulted in a substantial increase in DTEh that exceeded the FTAL in suckers.

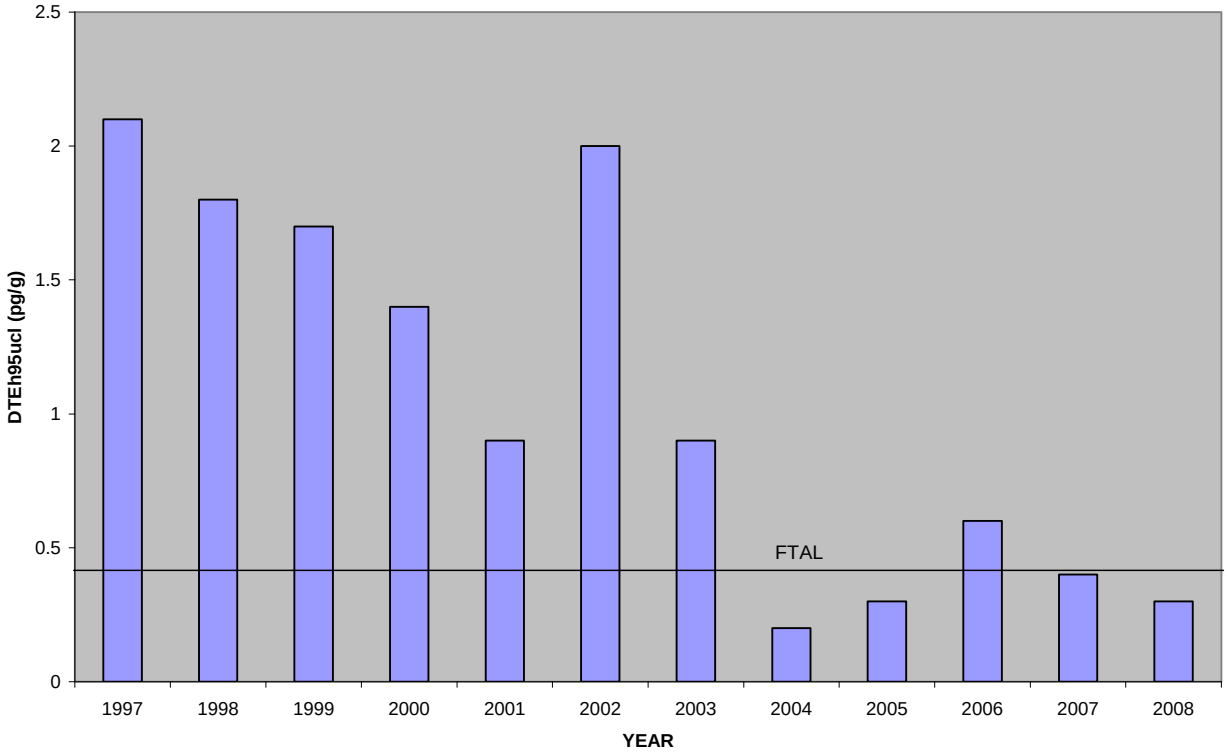
There is no declining trend in DTEh for the period 1997-2008 for bass, although levels are lower since 2002 (Figure 11). There is however, a declining trend for white suckers for the same period (Figure 12).

Figure 11. Dioxin (DTEh, 95 UCL) concentrations in smallmouth bass from the Penobscot River at South Lincoln (PBL)



The mill passed the A/B test in 2003 and 2005, and must demonstrate continuing compliance annually. Reduced discharge of dioxin from the mill has been documented by decreased concentrations of TCDD and TCDF in sludge (Appendix 3) and in effluent (Appendix 4) since a change in the mill's bleaching process from chlorine based bleaching to primarily oxygen based bleaching in 1999. These results are consistent with the declining trend seen in fish, and the finding of no measurable discharge by 2005. The mill has demonstrated continued compliance with the 'no discharge' provision of the 1997 Dioxin law. In a letter dated December 12, 2008 the mill certified that it has met the performance criteria established by DEP for the bleaching process and defoamer usage (Appendix 7). Sampling bleach plant effluent was conducted in June 2008 documented that concentrations of both TCDD and TCDF were below detection at a low sample specific detection level (Appendix 4).

Figure 12. Dioxin (DTEh, 95 UCL) concentrations in white suckers from the Penobscot River at South Lincoln (PBL)



Presumpscot River

Windham -(PWD) As part of the SWAT monitoring program, ten smallmouth and ten white suckers were collected from the Dundee Impoundment in the river in Windham, upstream of the SD Warren paper mill in Westbrook and combined into two composites of five fish each (Table 1, Appendix 5). Concentrations of TCDD (Appendix 6) and DTEh (Figures 1 and 2) were similar to those from other historical reference stations unimpacted by point source discharges. This "reference" station had no point source discharges above it, but in many years had higher concentrations than all other reference stations with no point sources. The addition of dioxin-like (coplanar) PCBs to DTEh resulted in small increases in total toxic equivalents (TTEh) to levels still below the FTAL for both species. There is no trend for the period 1997-2008, but levels were lower than previous levels in both species (Figure 14).

Figure 13. Dioxin (DTEh, 95 UCL) concentrations in smallmouth bass from the Presumpscot River at Windham (PWD)

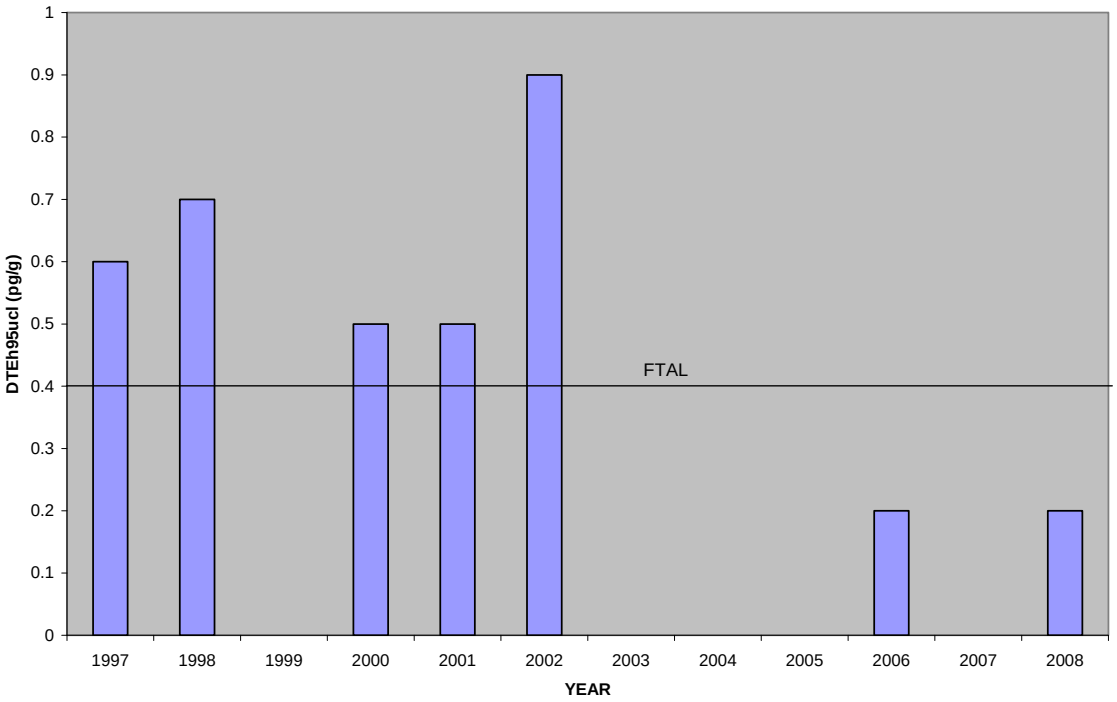
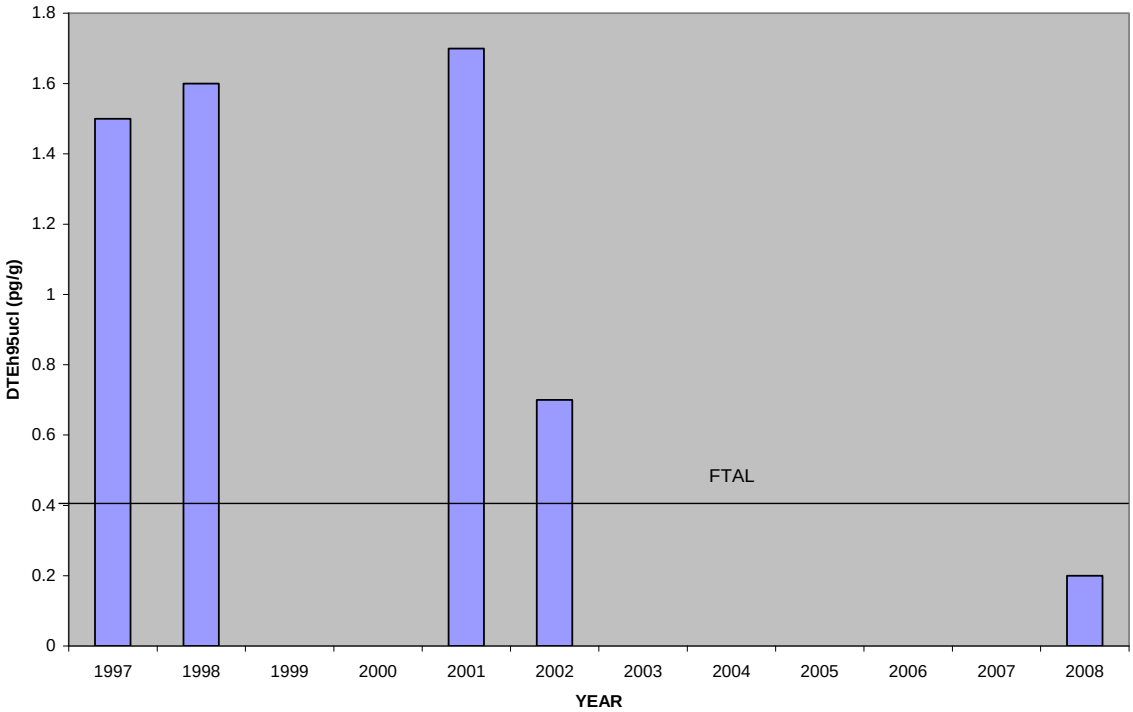


Figure 14. Dioxin (DTEh, 95 UCL) concentrations in white suckers from the Presumpscot River at Windham (PWD)



Westbrook- (PWB) As part of the SWAT monitoring program, ten smallmouth and ten white suckers were collected from the river below the SD Warren paper mill in Westbrook and combined into two composites of five fish each (Table 1, Appendix 5). Concentrations of TCDD (Appendix 6) and DTEh (Figures 1 and 2) were below the FTAL and similar to those from historical reference stations unimpacted by point source discharges for bass while DTEh was at the FTAL in suckers. The combination of dioxin-like (coplanar) PCBs with DTEh resulted in increases in total toxic equivalents (TTEh) to levels that exceeded the FTAL for both species. There is no trend in DTEh for the period 1997-2008 for either species, but levels were lower than previous levels in bass (Figure 15) and in suckers (Figure 16). These levels are higher than those at Windham, upstream of Westbrook.

Figure 15. Dioxin (DTEh, 95 UCL) concentrations in smallmouth bass from the Presumpscot River at Westbrook (PWB)

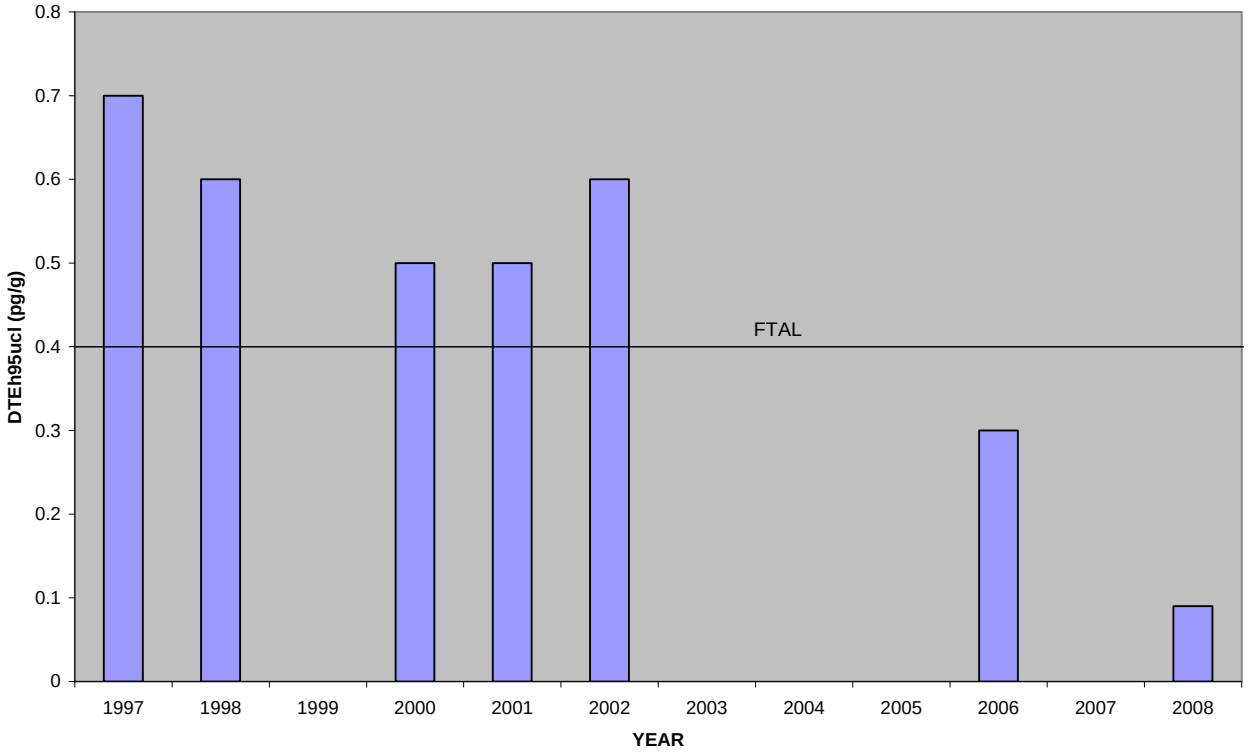
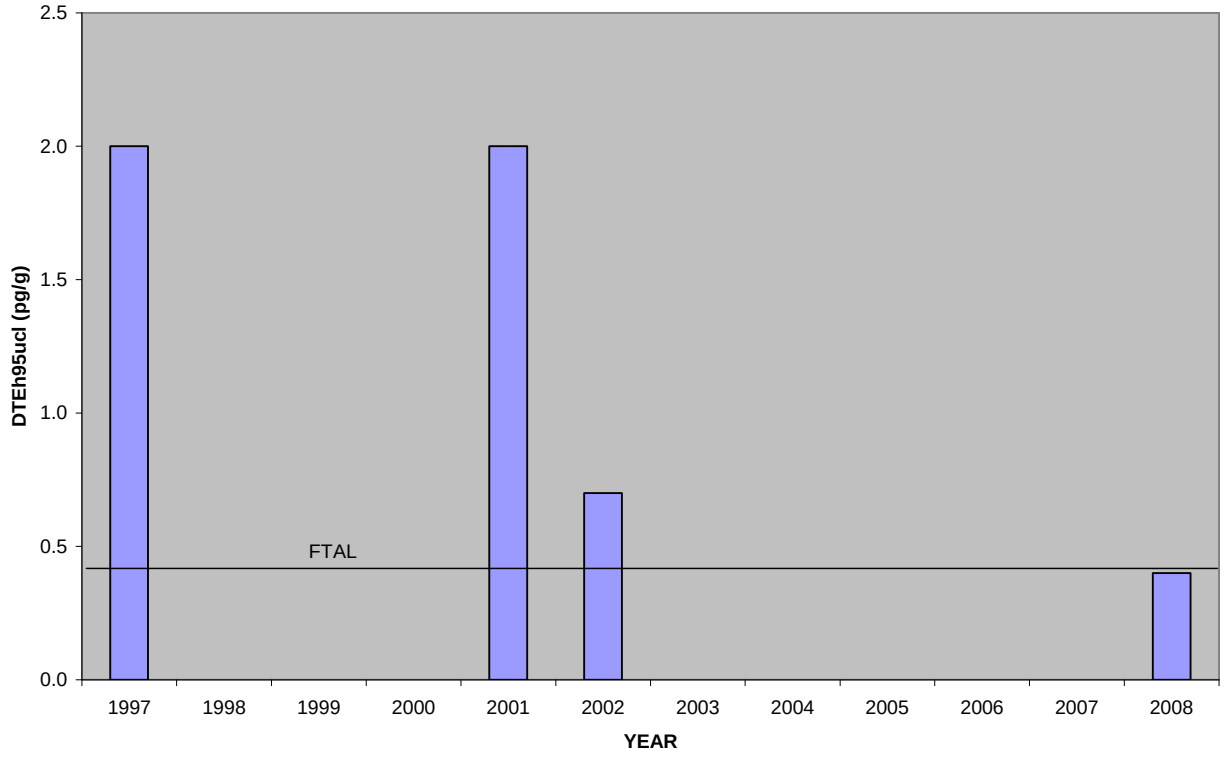


Figure 16. Dioxin (DTEh, 95 UCL) concentrations in white suckers from the Presumpscot River at Westbrook (PWB)



Salmon Falls River

There is currently a fish consumption advisory on the Salmon Falls River below Berwick due to a combination of dioxins and PCBs. Through 2002, fish samples have been collected from the Salmon Falls River about 2 miles below the discharge from the Berwick Sewer District's municipal wastewater treatment plant in Berwick, whose discharge ranged from 65-70% effluent from Prime Tanning Company in the past to ~40% currently. Sampling was scheduled for 2003 and 2004 but fish were not captured. DEP's long standing policy has been that where there is a single discharger of dioxin in a river, fish sampling is the best way to determine the status of any discharge. Where there is more than one source, sampling of sludge may be used to determine discharge status. Prime Tanning Company notified DEP that there was an additional source historically in Somersworth NH. Consequently, after discussion with the New Hampshire Department of Environmental Services, testing of both Berwick and Somersworth, NH wastewater treatment plant sludge was substituted for fish testing on a quarterly basis for two years. The results of the sampling show that concentrations from both are relatively low but similar to those from the Town of Hartland (with the discharge from Irving Tanning) below which are significantly elevated concentrations in fish (Appendix 3).

Consequently, at the request of MCDC, fish were collected below the Berwick discharge for analyses in 2007 and 2008.

South Berwick- A total of ten largemouth bass and ten white suckers (Table 1, Appendix 5) were collected from the Rollinsford Impoundment about 2 miles below the discharge from the Berwick Sewer District's municipal wastewater treatment plant in Berwick, whose discharge is dominated by effluent from Prime Tanning Company, and combined into two composites of five fish each. Concentrations of TCDD were slightly elevated in bass and DTEh were at the FTAL (Figure 1). Concentrations of TCDD were more elevated in suckers but still below the FTAL, while DTEh were elevated to levels exceeding the FTAL (Figure 2). TCDD and DTEh were similar in bass for both 2007 and 2008; there were no data for suckers in 2007 (Appendix 6). The addition of dioxin-like (coplanar) PCBs to DTEh resulted in a substantial increase in total toxic equivalents (TTEh) to levels that exceeded the FTAL for bass and further increased the exceedance for suckers. There was no trend in either TCDD or DTEh although DTEh are lower in bass in the last three years than previously (Figure 17) and lower in suckers in 2008 than in 1997, the last year previously sampled (Figure 18).

Figure 17. Dioxin (DTEh, 95 UCL) concentrations in bass from the Salmon Falls River in South Berwick (SFS)

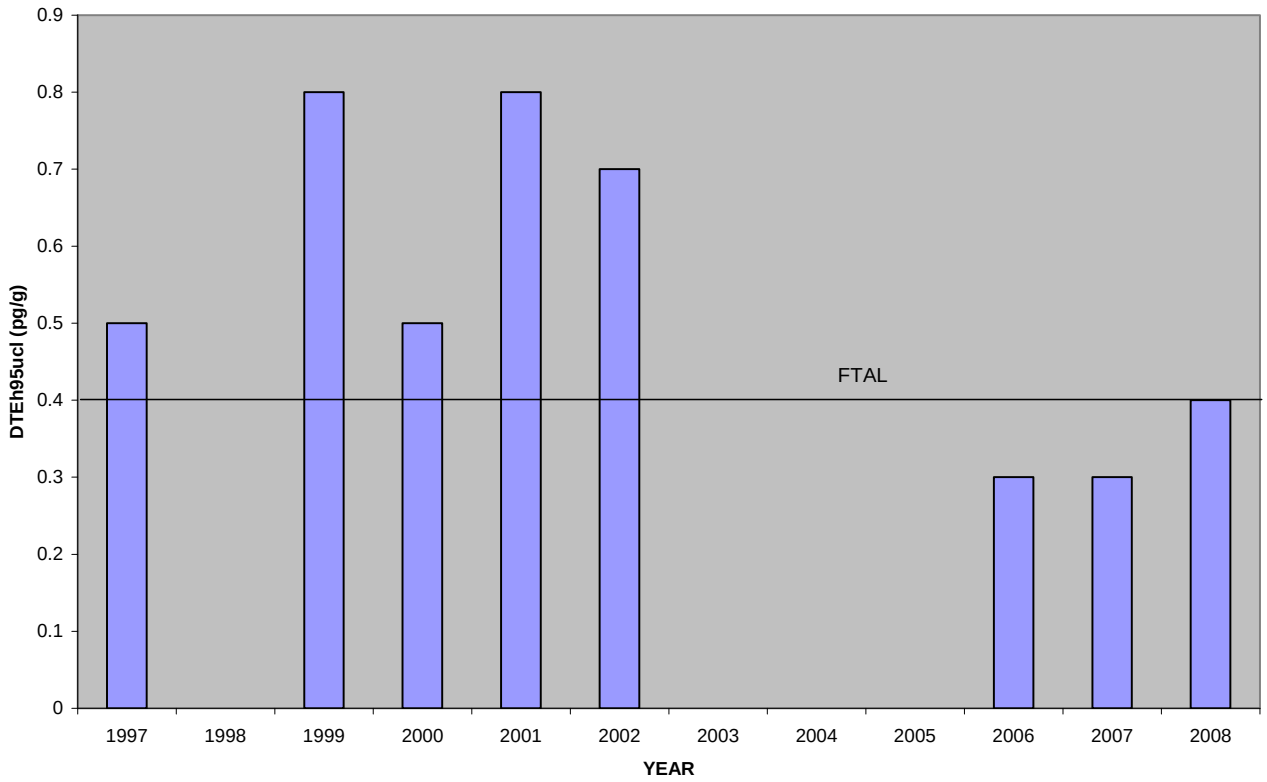
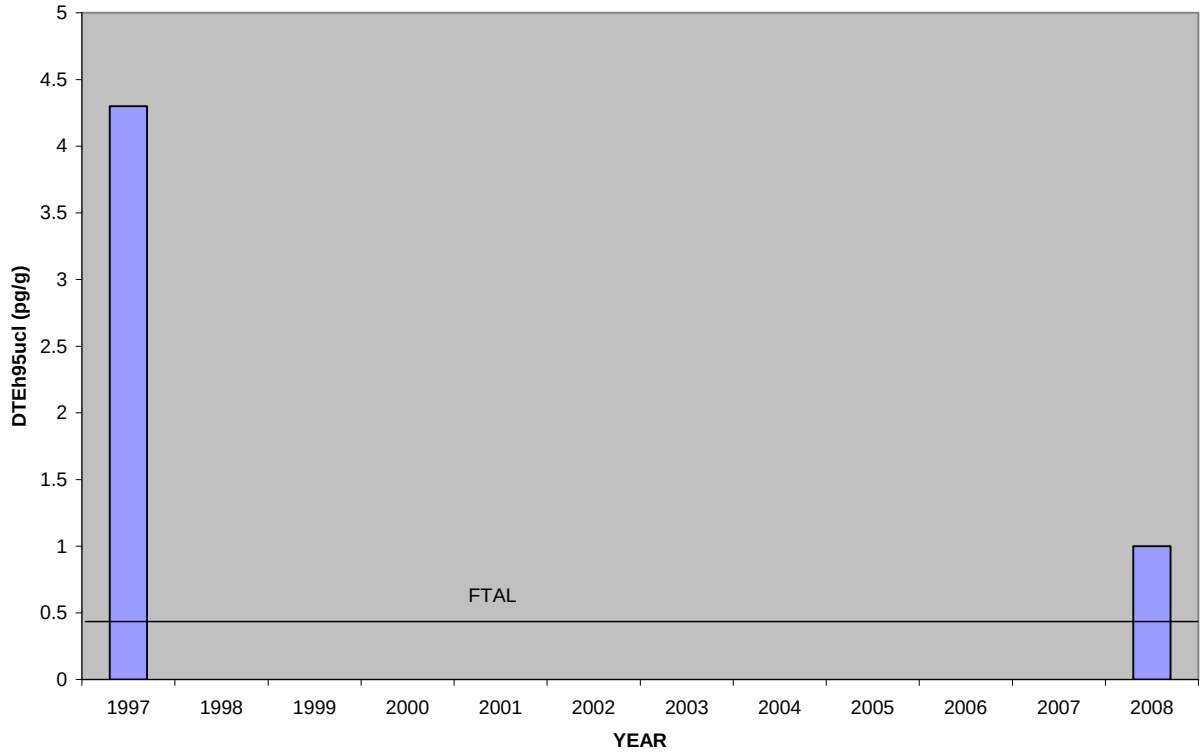


Figure 18. Dioxin (DTEh, 95 UCL) concentrations in white suckers from the Salmon Falls River in South Berwick (SFS)



Sebasticook River

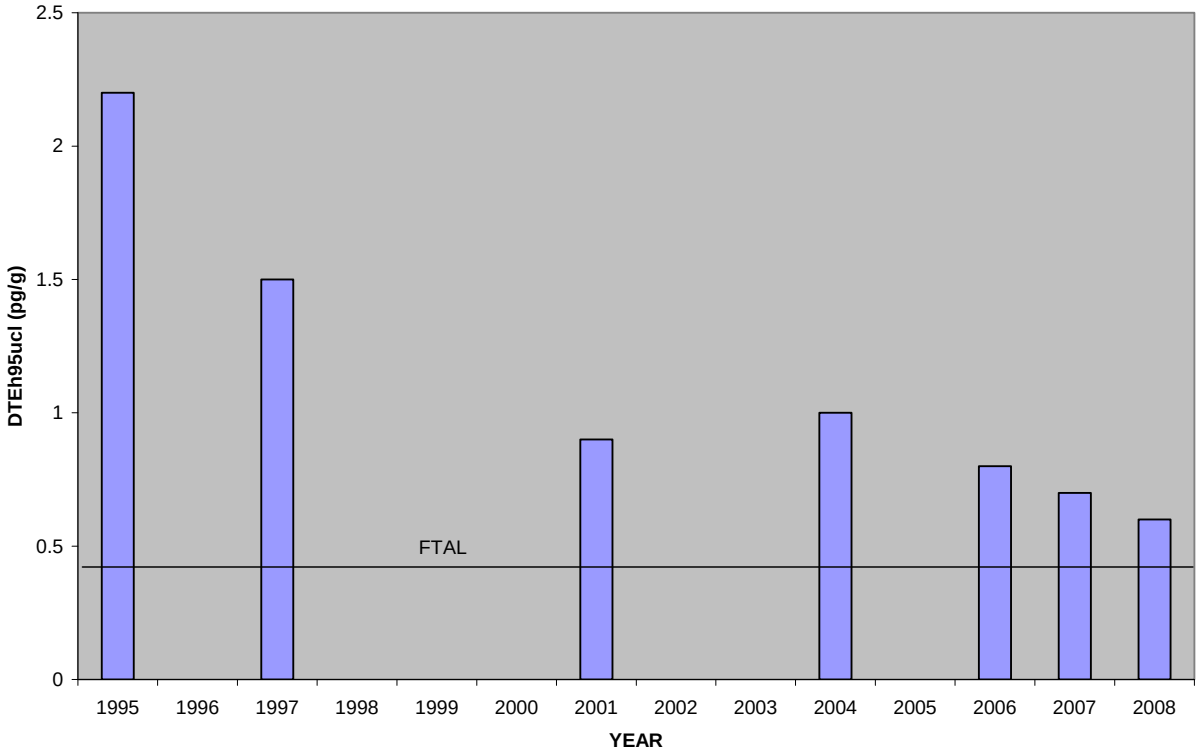
Historical discharges of dioxin have been documented on both the East and West Branches of the Sebasticook River. In 2008, at the request of MCDC as part of DEP's SWAT monitoring program, fish were sampled from the East Branch and main stem.

East Branch at Newport- (SEN) A total of ten largemouth bass (Table 1, Appendix 5) were collected from the river just above the County Road Bridge, a popular fishing spot at the inlet to Sebasticook Lake, and combined into two composites of five fish each. This station is approximately 2 miles below the former Corinna Sewer District discharge, 80% of which was from the Eastland Woolen Mill. This facility treated the waste from the Eastland Woolen Mill in Corinna until 1996, when the mill ceased operation. Since then groundwater and river sediments have been found to be contaminated with a number of pollutants from the mill including dioxin. The site was placed on the National Priorities List of Superfund sites in 1999, and extensive remediation included removal of contaminated soil and the buildings in the 'downtown area' and relocation of a portion of the riverbed. In addition, the Corinna discharge was removed from the river, going to land treatment in 2005.

Concentrations of TCDD in 2008 were similar to those of historical reference stations unimpacted by point source discharges and lower than previous levels (Appendix 6). DTEh, however, were elevated

above the FTAL (Appendix 2, Figure 1). The addition of dioxin-like (coplanar) PCBs to DTEh resulted in a substantial increase in total toxic equivalents (TTEh) above the FTAL. DTEh show a declining trend since 1995, likely documenting the effects of remediation, although levels still exceed the FTAL (Figure 19).

Figure 19. Dioxin (DTEh, 95 UCL) concentrations in bass from the East Branch of the Sebasticook River at County Road, Newport (SEN)



Burnham- (SEB) A total of ten smallmouth bass and five white suckers (Table 1, Appendix 5) were collected from the main stem of the Sebasticook River below the confluence of the East Branch and West Branch (Table 1, Appendix 5) and combined into composites of five fish each at the request of the MCDC as part of Maine's Surface Water Ambient Toxics (SWAT) monitoring program. This reach is downstream of Hartland and Corinna, both former dischargers and perhaps legacy sources of dioxin.

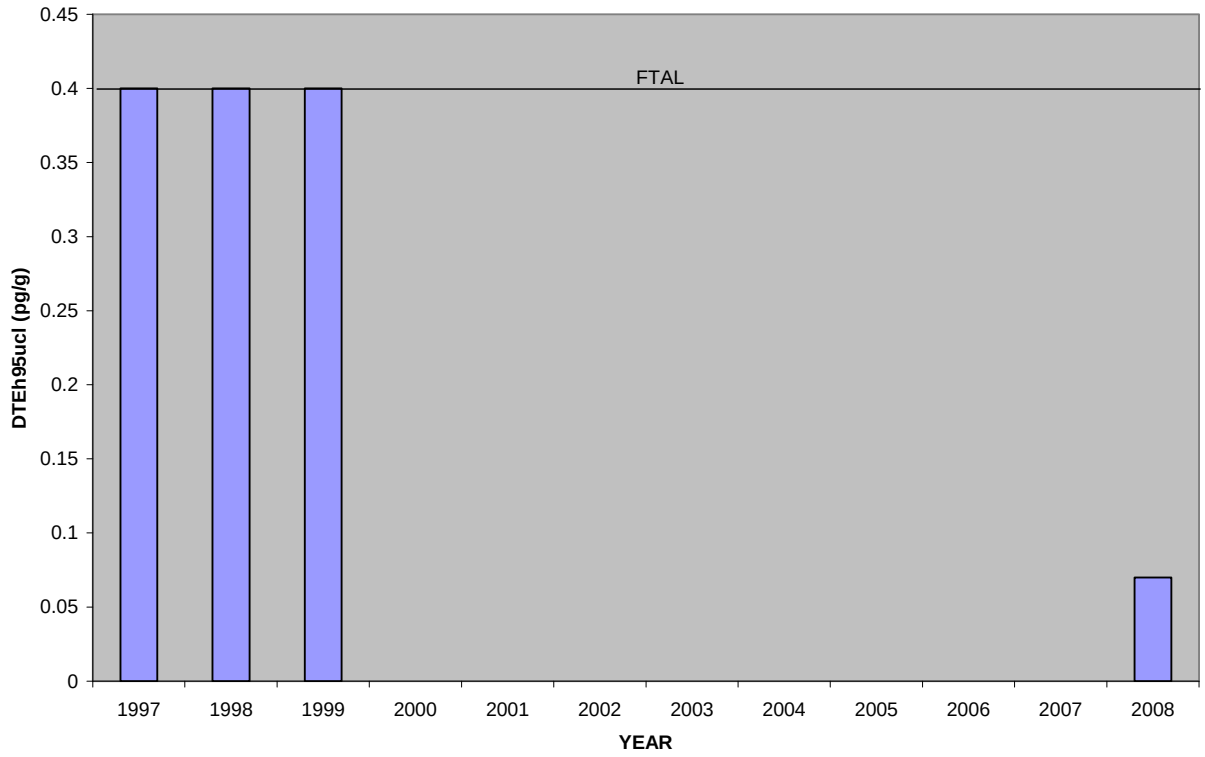
Concentrations of TCDD were slightly elevated above those at historical reference stations unimpacted by point source discharges for both species (Appendix 6). Concentrations of DTEh were also elevated above the FTAL for both species (Figures 1 and 2, Appendix 2). There results are not surprising given the existence of sources upstream on each branch of the river. The addition of dioxin-like (coplanar) PCBs to DTEh results in total toxic equivalents (TTEh) that further exceed the FTAL for both species.

There are not enough data for trends analysis, but concentrations have remained elevated for all years monitored (2004-2006, 2008).

St. Croix River

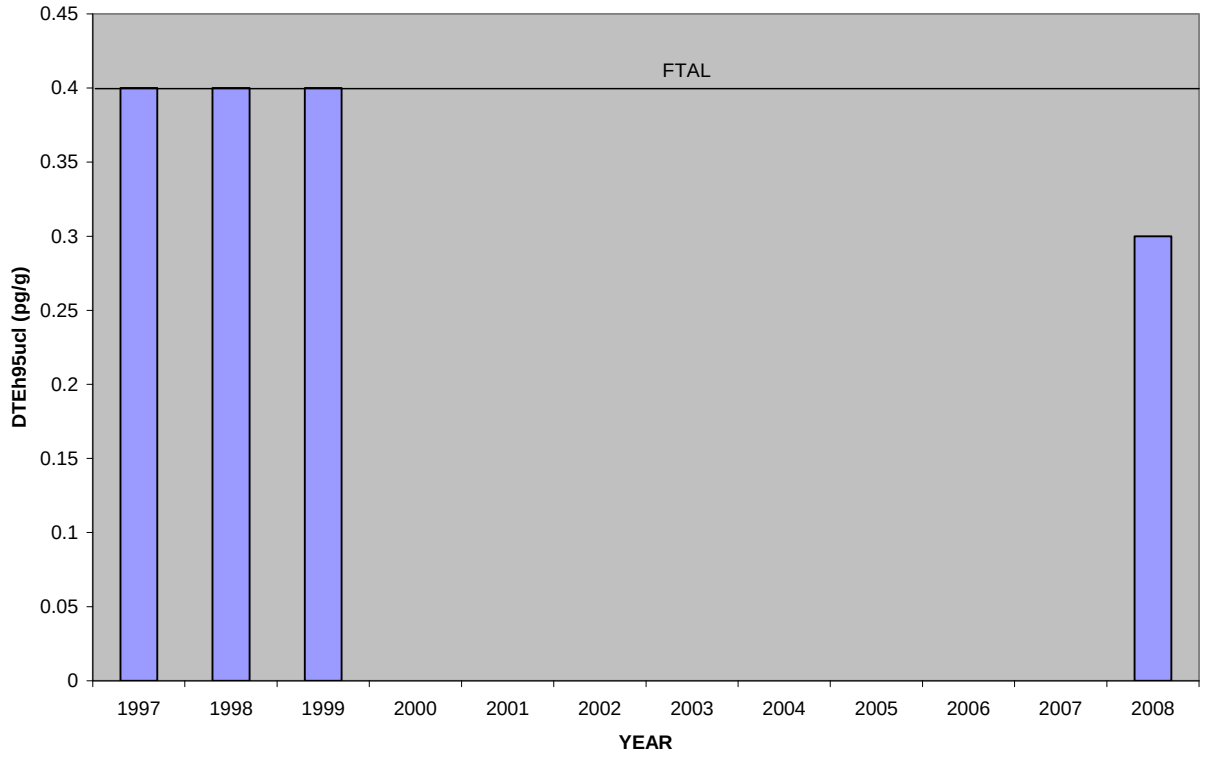
Woodland (SCW) A total of ten smallmouth bass (Table 1, Appendix 5) were collected from the St. Croix River above the Domtar pulp and paper mill (Table 1, Appendix 5) and combined into composites of five fish each at the request of the MCDC as part of Maine's Surface Water Ambient Toxics (SWAT) monitoring program. Concentrations of TCDD (Appendix 6) and DTEh (Figures 1 and 2) were below the FTAL similar to those from historical reference stations unimpacted by point source discharges. The addition of dioxin-like (coplanar) PCBs to DTEh resulted in no measurable increase in total toxic equivalents (TTEh), unlike previous years. There are not enough data for trends analysis, but the 2008 level was lower than previous levels (Figure 20).

Figure 20. Dioxin (DTEh, 95 UCL) concentrations in smallmouth bass from the St. Croix River at Woodland (SCW)



Baring (SCB) A total of ten smallmouth bass (Table 1, Appendix 5) were collected from the St. Croix River below the Domtar pulp and paper mill (Table 1, Appendix 5) and combined into composites of five fish each at the request of the MCDC as part of Maine's Surface Water Ambient Toxics (SWAT) monitoring program. Concentrations of TCDD were similar to concentrations at Woodland (Appendix 6) while DTEh (Figures 1 and 2) were slightly elevated but below the FTAL. The addition of dioxin-like (coplanar) PCBs to DTEh resulted in an increase in total toxic equivalents (TTEh) that exceeded the FTAL. There are not enough data for trends analysis, but the 2008 levels were lower than previous levels (Figure 21).

Figure 21. Dioxin (DTEh, 95 UCL) concentrations in smallmouth bass from the St. Croix River at Baring (SCB)



APPENDIX 1.

FISH CONSUMPTION ADVISORIES

MAINE FISH CONSUMPTION ADVISORIES

MAINE CENTER FOR DISEASE CONTROL AND PREVENTION

WARNING About Eating Freshwater Fish

Warning: Mercury in Maine freshwater fish may harm the babies of pregnant and nursing mothers, and young children.

SAFE EATING GUIDELINES

Pregnant and nursing women, women who may get pregnant, and children under age 8 SHOULD NOT EAT any freshwater fish from Maine's inland waters. Except, for brook trout and landlocked salmon, 1 meal per month is safe.

All other adults and children older than 8 CAN EAT 2 freshwater fish meals per month. For brook trout and landlocked salmon, the limit is 1 meal per week.

It's hard to believe that fish that looks, smells, and tastes fine may not be safe to eat. But the truth is that fish in Maine lakes, ponds, and rivers have mercury in them. Other states have this problem too. Mercury in the air settles into the waters. It then builds up in fish. For this reason, older fish have higher levels of mercury than younger fish. Fish (like pickerel and bass) that eat other fish have the highest mercury levels.

Small amounts of mercury can harm a brain starting to form or grow. That is why unborn and nursing babies, and young children are most at risk. Too much mercury can affect behavior and learning. Mercury can harm older children and adults, but it takes larger amounts. It may cause numbness in hands and feet or changes in vision. The Safe Eating Guidelines identify limits to protect everyone.

See http://www.maine.gov/dhhs/eohp/fish/index.htm

Warning: Some Maine waters are polluted, requiring additional limits to eating fish.

Fish caught in some Maine waters have high levels of PCBs, Dioxins or DDT in them. These chemicals can cause cancer and other health effects. The Bureau of Health recommends additional fish consumption limits on the waters listed below. Remember to check the mercury guidelines. If the water you are fishing is listed below, check the mercury guideline above and follow the most limiting guidelines.

SAFE EATING GUIDELINES

Androscoggin River Gilead to Merrymeeting Bay:----------6-12 fish meals a year.
Dennys River Meddybemps Lake to Dead Stream:----------1-2 fish meals a month.
Green Pond, Chapman Pit, & Greenlaw Brook
(Limestone):----------Do not eat any fish from these waters.
Little Madawaska River & tributaries
(Madwaska Dam to Grimes Mill Road):----------Do not eat any fish from these waters.
Kennebec River Augusta to the Chops:----------Do not eat any fish from these waters.
Shawmut Dam in Fairfield to Augusta:-------5 trout meals a year, 1-2 bass meals a month.
Madison to Fairfield: ----------1-2 fish meals a month.
Meduxnekeag River: ---------- 2 fish meals a month.
North Branch Presque Isle River----------2 fish meals a month.
Penobscot River below Lincoln:----------1-2 fish meals a month
Prestile Stream:----------1 fish meal a month.
Red Brook in Scarborough: ---------- 6 fish meals a year.
Salmon Falls River below Berwick: ----------6-12 fish meals a year.
Sebasticook River (East Branch, West Branch & Main Stem)
(Corinna/Hartland to Winslow):----------2 fish meals a month.

APPENDIX 2.

DIOXIN AND FURAN CONCENTRATIONS IN 2004 FISH AND SHELLFISH SAMPLES

APPENDIX 2A.

SPECIES AND STATION CODES

SPECIES CODES

BNT	brown trout
EEL	eel
LMB	largemouth bass
RBT	rainbow trout
SMB	smallmouth bass
WHP	white perch
WHS	white sucker

STATION CODES

AGL	Androscoggin R at Gilead above NewPage
ARP	Androscoggin R at Rumford Point above NewPage
ARF	Androscoggin R below Rumford below NewPage
ARY	Androscoggin R at Riley above Verso Paper
ALV	Androscoggin R at Livermore Falls below International Paper
AGI	Androscoggin R at Gulf Island Pond, Auburn below International Paper
ALS	Androscoggin R at Lisbon Falls below International Paper
ALW	Androscoggin Lake at Wayne below International Paper
KRM	Kennebec R at Madison above SAPPI Somerset, Skowhegan
KNW	Kennebec R at Norridgewock above SAPPI Somerset, Skowhegan
KHY	Kennebec R at Hinckley, above SAPPI Somerset Skowhegan
KFF	Kennebec R at Shawmut, Fairfield below SAPPI Somerset, Skowhegan
KRS	Kennebec R at Sidney below SAPPI-Somerset & KSTD in Waterville
KAG	Kennebec R at Augusta below former Statler Tissue
KGD	Kennebec R at Gardiner
KRD	Kennebec R at Richmond
PBW	Penobscot R at Woodville above Lincoln Paper & Tissue
PBM	Penobscot R at Winn above Lincoln Pulp and Paper in Lincoln
PBL	Penobscot R at S Lincoln below Lincoln Pulp and Paper in Lincoln
PBC	Penobscot R at Costigan, Milford above Georgia Pacific in Old Town
PBV	Penobscot R at Veazie below Georgia Pacific in Old Town
PBO	Penobscot R at Orrington below Georgia Pacific in Old Town
PWD	Presumpscot R at Windham above SAPPI Westbrook
PWB	Presumpscot R at Westbrook below SAPPI Westbrook
SFS	Salmon Falls R at S. Berwick below Berwick POTW and Prime Tanning
SEN	E Br Sebasticook at Newport below Corinna and former Eastland Woolen mill
SWP	W Br Sebasticook at Palmyra below Hartland POTW and Irving Tanning
SBN	Sebasticook R at Burnham

APPENDIX 3.

TCDD & TCDF IN SLUDGE FROM MAINE WASTEWATER TREATMENT PLANTS

APPENDIX 4.

TCDD & TCDF IN WASTEWATER FROM MAINE PULP AND PAPER MILLS

APPENDIX 5.

LENGTHS AND WEIGHTS FOR 2008 FISH SAMPLES

APPENDIX 6.

SUMMARY OF DIOXINS AND FURANS IN FISH AND SHELLFISH SAMPLES, 1984-2008

APPENDIX 7

CERTIFICATIONS OF BLEACH PLANT OPERATION