Meduxnekeag River TMDL

Final

September 2000

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Meduxnekeag River TMDL
DEPLW2000-22
Sept, 2000

ADDENDUM

June 19, 2000

Please note the following:

We have been informed by USGS that the Meduxnekeag River flow data for the 1999 season may not be accurate due to problems at the gage site.

ADDENDUM

September 12, 2000

Conflicting information has been provided to MDEP regarding effluent phosphorous monitoring by the Houlton Water Co. (HWC). DEP was previously led to believe that total Phosphorous (TP) was measured, but recent comments from the HWC indicate that ortho-Phosphorous (ortho-P) was measured. References to effluent TP measured by HWC in this report have been changed to ortho-P, although references in the previously published 1997 data report (appendix C) were not changed.

All modeling performed by MDEP (as well as recommendations based on this modeling) used TP effluent data collected only by MDEP.

Please refer to the formal TMDL submittal letter to EPA for responses to HWC comments (including TP vs. ortho-P) on the May 2000 draft of this TMDL.

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Executive Summary

A 13.3 mile long segment of the Meduxnekeag River from above the confluence of the South Branch to the Maine/Canada border was studied by Maine DEP staff to evaluate current water quality and to assess the impact of existing and proposed licensed discharges upon water quality. The water quality model QUAL2E, version 3.22, was used in the evaluation. An empirical total phosphorous (TP) allocation model was developed for the point sources. Several summers of instream monitoring were made under varying conditions of TP treatment by the Houlton treatment plant.

Currently a six mile segment of the Meduxnekeag River is included on the state's 305b list of water quality non-attainment waters. This segment extends from the Houlton wastewater treatment plant outfall to the covered bridge. This segment is also included on the state's 303d list, requiring a TMDL (total maximum daily load) study. This report constitutes an updated TMDL submittal to EPA as required under the Clean Water Act.

The survey data as well as model runs indicate that the Meduxnekeag River is not attaining standards for dissolved oxygen (DO) concentration below the Houlton outfall. Occasional, marginal non-attainment of DO standards was also measured above the Houlton outfall. The major factor in this non-attainment is the diurnal DO effect from the respiration of attached plant growth as a result of phosphorous enrichment.

DO deficit component analyses as well as treatment plant performance data indicate that point source BOD is a minor factor in the instream DO concentrations below the Houlton outfall. Data clearly show that the TP enrichment below the Houlton outfall comes mainly from the Houlton discharge.

The recommended TMDL for total phosphorous includes:

(1) Houlton summer TP limit of 0.25 mg/l during June 1 through September 15 and a limit of 1.25 lbs./day TP from July 1 through September 15 with continued instream DO monitoring
(2) Continue NPS work previously initiated
(3) Maintain current A.E. Staley permit limits and conditions, although this discharge is located above the listed river segment

Introduction

This report constitutes an updated TMDL submittal to EPA for the Meduxnekeag River. Included are references to previous reports (included as appendices). An updated summary of data, analyses, conclusions and recommendations is presented.

A timeline of significant events follows:

1990	Meduxnekeag study initiated
Aug 6-8, 1990	Intensive survey
July 27-29, 1993	Intensive survey
April 1994	Issued draft TMDL report
July 18-20, 1995	Intensive survey
Nov 17, 1995	Maine Staley permit issued
Mar 1996	EPA Staley draft permit
May 1996	Revised draft TMDL report
Aug 12, 1996	Houlton comments on TMDL
Nov 12, 1996	Response to Houlton comments (to Barden)
Jan 7, 1997	Maliseet comments on draft TMDL
Spring 1997	1997 work plan
April 10, 1997	EPA comments on revised draft TMDL
May 7, 1997	Houlton comments on 1997 study plan
June 23, 1997	Further Houlton comments
Dec 1997	Supplemental data report
Jan 7 & 17, 2000	Comments by Acheron on draft permit
Jan 20, 2000	Meeting between DEP and Houlton reps
Mar 1, 2000	Comments by Acheron on draft permit & TMDL
Mar 31, 2000	Houlton permit issued
June 20, 2000	Draft TMDL out for public comment

The Meduxnekeag River is located in northeastern Maine and is a tributary of the Saint John River. A six mile segment of this river is currently listed on the state's 305(b) and 303(d) lists for non attainment of water quality standards due to nutrients (phosphorous), with a TMDL submittal required by 2003. This study encompassed a 13.3 mile river reach from approximately one mile above the confluence of the South Branch Meduxnekeag River at Carys Mills to the Canadian border. The Meduxnekeag River is classified B by the state of Maine, which requires:

A. Class B waters shall be of such quality that they are suitable for the designated uses of drinking water supply after treatment; fishing; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation, except as prohibited under Title 12, section 403; and navigation; and as habitat for fish and other aquatic life. The habitat shall be characterized as unimpaired.

B. The dissolved oxygen content of Class B waters shall be not less than 7 parts per million or 75% of saturation, whichever is higher, except that for the period from October 1st to May 14th, in order to ensure spawning and egg incubation of indigenous fish species, the 7-day mean dissolved oxygen concentration shall not be less than 9.5 parts per million and the 1-day minimum dissolved oxygen concentration shall not be less than 8.0 parts per million in identified fish spawning areas. Between May 15th and September 30th, the number of Escherichia coli bacteria of human origin in these waters may not exceed a geometric mean of 64 per 100 milliliters or an instantaneous level of 427 per 100 milliliters.

C. Discharges to Class B waters shall not cause adverse impact to aquatic life in that the receiving waters shall be of sufficient quality to support all aquatic species indigenous to the receiving water without detrimental changes in the resident biological community.

Two reports have been previously issued: Meduxnekeag River TMDL, May 1996, describing the intensive survey sampling and subsequent water quality modeling and Meduxnekeag River 1997 Data Report, December 1997, presenting additional data and recommended phosphorous controls.

The licensed discharges within the study reach include A.E. Staley Manufacturing Co. (model rivermile 13.2) and the city of Houlton (model rivermile 7.5). This study was initiated by a request from Staley to permit a year round discharge to the Meduxnekeag River. As a result of the initial studies/conclusions, strict permit limits were placed upon the A.E. Staley discharge and a six mile segment of the river below the Houlton discharge was listed as non-attainment of water quality standards (DO) due to nutrient (phosphorous) enrichment.

A.E. Staley is not permitted to discharge when river flow at the outfall is less than 30 cfs (note that the river flow monitoring site is located below the outfall and also below the confluence of the South Branch, so that any flow measurement made at the gage must be corrected for application to the Staley outfall). As such Staley is not a factor in the low flow TP loading. At times when river flow is above 30 cfs at Staley, Staley’s permitted TP loading would have an insignificant impact on diurnal DO (see figures 34, 35 of the 1996 report, appendix B).

Problem Statement

The Meduxnekeag River does not meet its classification (B) for dissolved oxygen (DO) below the Houlton wastewater treatment plant. Marginal non-attainment of DO standards has been measured occasionally above the Houlton outfall. This non-attainment is due to the respiration of attached plant growth and is the result of nutrient (phosphorous) enrichment. Excessive attached algae growth occurs most summers below the Houlton outfall. No direct quantitative standards exist for this algae growth. By observation this growth may reach nuisance levels and may also impact designated uses and aesthetics.

Data Collection

Data has been collected on an almost yearly basis since 1990. Data from 1990 through 1995 is presented in the report Meduxnekeag River TMDL, May 1996. Data from 1996 through 1997 is presented in the report Meduxnekeag River 1997 Data Report, December 1997. These reports are included as appendices. Additional data from 1998 and 1999 are presented in appendix A of this report. (Data from 2000 not compiled as of this report date.)

Evaluation

Previous Analyses

Water quality modeling was performed and reported upon in the 1996 report (appendix B). It was concluded that non-attainment of DO standards was due to high phosphorous loading to the river resulting in excessive growth of attached plants, specifically filamentous algae. A phosphorous loading allocation was presented in this report and expanded upon in the 1997 report (appendix C). The QUAL2E modeling was based on three intensive datasets (most DEP modeling efforts utilize two datasets). The empirical phosphorous allocation model was based upon data from 1993 and 1995 and was subsequently verified by additional data collected during 1997. (Note that subsequent data, 1998-2000, are not included in the model development. These subsequent efforts were not as comprehensive as the 1990/1993/1995 surveys due to money and personnel constraints and do not include all the data required by the model)

Phosphorous Limiting Assumption

The empirical total phosphorous (TP) allocation model presented in the previous reports included an assumption that all the data represented a phosphorous limiting condition upon plant growth rate. The data were evaluated to confirm this assumption.

As represented in most algae models the algal growth rate is a function of temperature, light and nutrient limiting factors:

$$G = G_{opt(20)}\ G_T\ G_L\ G_N$$

G = growth rate at given site conditions
$G_{opt(20)}$ = maximum growth rate under optimum conditions, 20^{o}C
G_T = temperature limitation factor
G_L = light limitation factor
G_N = nutrient limitation factor

For a site with given hydraulic and environmental conditions:

$$G = G_{TL}\ G_N$$

G_{TL} = maximum growth rate adjusted for given temperature and light conditions
Nutrient limitation is a function of available nitrogen and phosphorous. The

nutrient limiting factor is represented as:

$$G_N = \text{minimum}\left(\frac{DIP}{DIP+K_P}, \frac{DIN}{DIN+K_N} \right)$$

DIP = dissolved inorganic phosphorous
DIN = dissolved inorganic nitrogen
K_P = half saturation constant for phosphorous
K_N = half saturation constant for nitrogen

As represented by the above equation, nutrient limitation is due to either limited available DIN or DIP. In general if the ratio of DIN:DIP<10, nitrogen is limiting; if the ratio is >20, phosphorous is limiting; and if the ratio is in between either may be limiting. Also it is possible that both nitrogen and phosphorous may be in excess such that nutrients are not limiting. For the purpose of this evaluation if it is assumed that K_P=1 ug/l and K_N=15 ug/l (these values are within accepted ranges for these factors), a DIN:DIP ratio of >15 represents phosphorous limiting conditions.

For each survey (1993, 1995) instream concentrations of dissolved phosphorous (PO4) and dissolved nitrogen (NH3+NOx) were tabulated for the MDX1 sample site (located above the licensed discharges) and the DIN:DIP ratio calculated. All data indicate that this background site represents strong P limitation (DIN/DIP ratios 95 to 123). For the sites below Houlton the instream concentrations cannot be used due to the rapid uptake of nutrients that was measured. In this case the PO4 and NH3+NOx loading (both background and effluent) was calculated using the data and the DIN:DIP ratio determined. The assessment from 1993 and 1995 data show phosphorous was marginally limiting below the Houlton outfall during 1993 (DIN:DIP=16) and not limiting during 1995 (DIN:DIP=8).

The data also showed that growth was not limited by N during either 1993 or 1995 (the instream DIN concentration was high enough that the growth limitation due to nitrogen, $\frac{DIN}{DIN+K_N}$, was approximately equal to 1).

In other words, plant growth was at its maximum rate for the site conditions (theoretical maximum rate limited by environmental factors of temperature and light) and not limited by nutrients below Houlton during 1995. As a result, the last point (representing the greatest diurnal swing) on the TP allocation graphs (figures 30, 31 in the 1996 report) is beyond the point of phosphorous limitation upon growth rate. The diurnal range represented by the last point from 1995 should be associated with a lower phosphorous concentration (roughly 0.07 mg/l as TP, based on DIN:DIP=15, DIN=0.783 mg/l and DIP=0.75TP) and the line should be plotted as a steeper upward trend. By inspection of figure 30, moving the last point to a TP concentration of 0.07 mg/l (same diurnal range) would improve the regression.

In conclusion, the empirical TP allocation chart may be somewhat unconservative in its predictions in the mid to high end of the TP scale (diurnal range should be greater than predicted for a given TP concentration) and that beyond a TP concentration of about 0.07 mg/l the plot should level off. Note that 1995 represents the greatest phosphorous loading measured from the Houlton plant, almost double the concentration of 1993 (see data) as well as the largest diurnal DO swings. In this case instream TP concentration would have to be reduced to the point at which P becomes limiting before any DO/algae growth improvements could be realized.

<u>1998 Data</u>
During 1998, river flow data (at USGS gage site, collected by Staley) and instream DO data (by the Houlton Band Of Maliseet Indians in cooperation with DEP Presque Isle office) were collected. These data are included in appendix A. River flows remained relatively high throughout the summer and no TP treatment was performed at the Houlton plant. Staley did not discharge to the river from June 8 to October 23. Marginal non attainment of DO standards was measured on three occasions below Houlton (6.9, 6.5, 6.9 mg/l). A reading of 6.9 mg/l was measured one day above the Staley outfall. The river flow and morning DO at the three stations below the Houlton outfall are shown on the following chart:

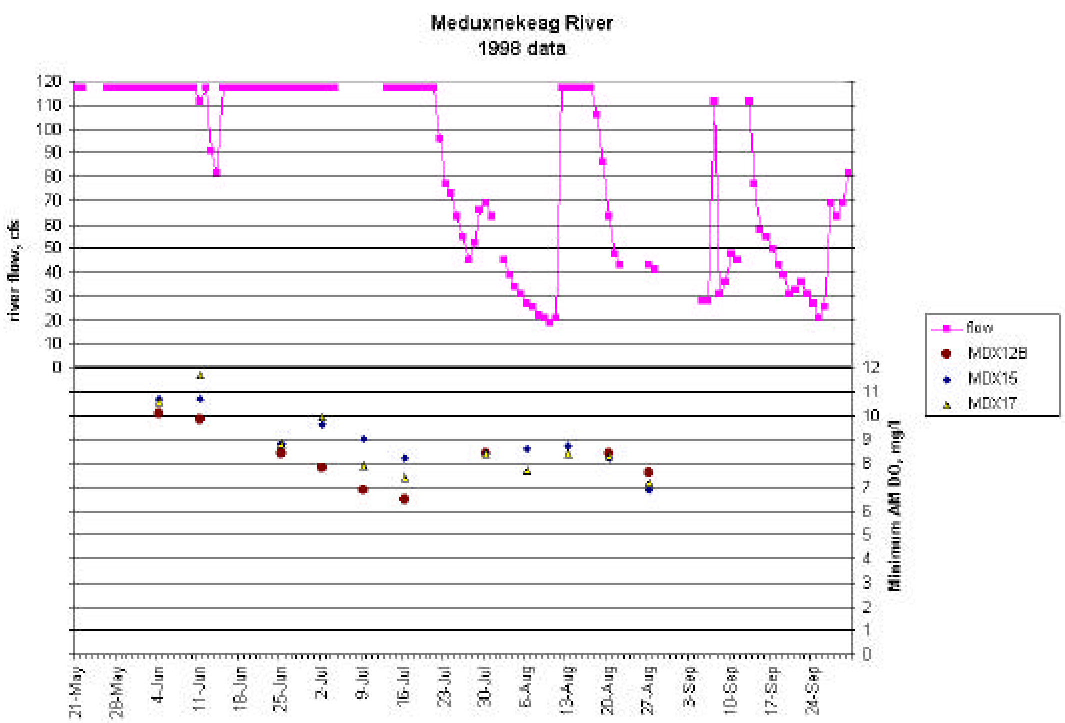


Figure 1

<u>1999 Data</u>
During 1999, river flow data (at USGS gage site, collected by Staley), effluent

ortho-P and discharge flow data (from Houlton treatment plant) and instream DO data (by the Maliseets in cooperation with DEP Presque Isle office) were collected. These data are included in appendix A. USGS comments that the flow data may be inaccurate due to obstructions in the river (if obstructions resulted in increased river stage, the flow would be over estimated). Staley did not discharge to the river from June 7 to November 4. The following chart depicts river flow, effluent ortho-P loading and morning DO at the three sites below Houlton during the summer of 1999. In general TP treatment was not consistent until late July. Non attainment was measured at the bridge sites below Houlton throughout the summer. Two non attainment measurements were made at the site immediately above the Houlton outfall (6.8 mg/l on 6/24/99, 6.9 mg/l on 7/22/99). The chart shows an upward trend in minimum DO with a decrease in effluent P load from mid July through mid August. Also, minimum DO does not approach the standard of 7 mg/l until effluent ortho-P load was reduced to and stabilized at approximately 1 lbs./day.

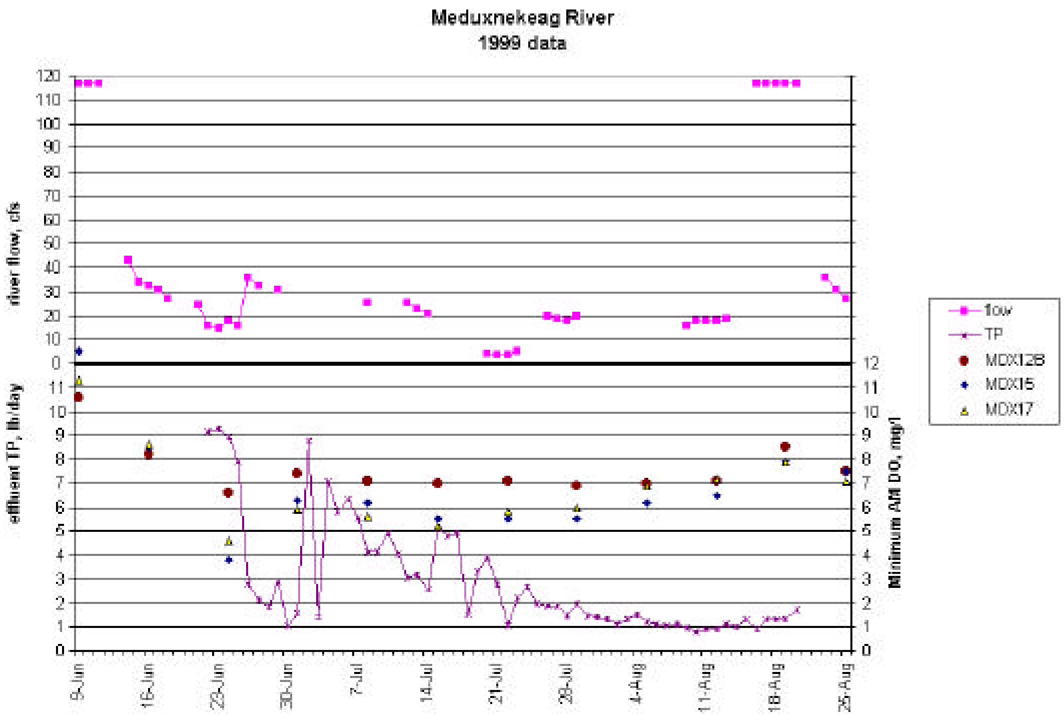


Figure 2

<u>Nonpoint vs. point loading</u>

Phosphorous data and diurnal DO data were used to evaluate the impact of nutrient loading and aquatic plant growth relative to non point loading vs. point source loading.

(1) Above Houlton

Data indicate elevated diurnal variation along with occasional morning DO readings marginally below standards above the Houlton outfall (see appendix E, page E6, response to comments). The diurnal variation above the Houlton outfall is greater than what would be expected for "natural" or unimpacted sites indicating some degree of increased plant growth.

Dry weather instream TP concentrations above the Houlton outfall are not abnormally high (average 11 ug/l, 1990-1997 data) and are comparable to natural or unimpacted sites. Instream TP above Houlton and from the tributaries is mostly in the organic or non-dissolved form (low fraction of dissolved PO4 which is the form most readily used by plants). These data do not differentiate between natural background and NPS sources.

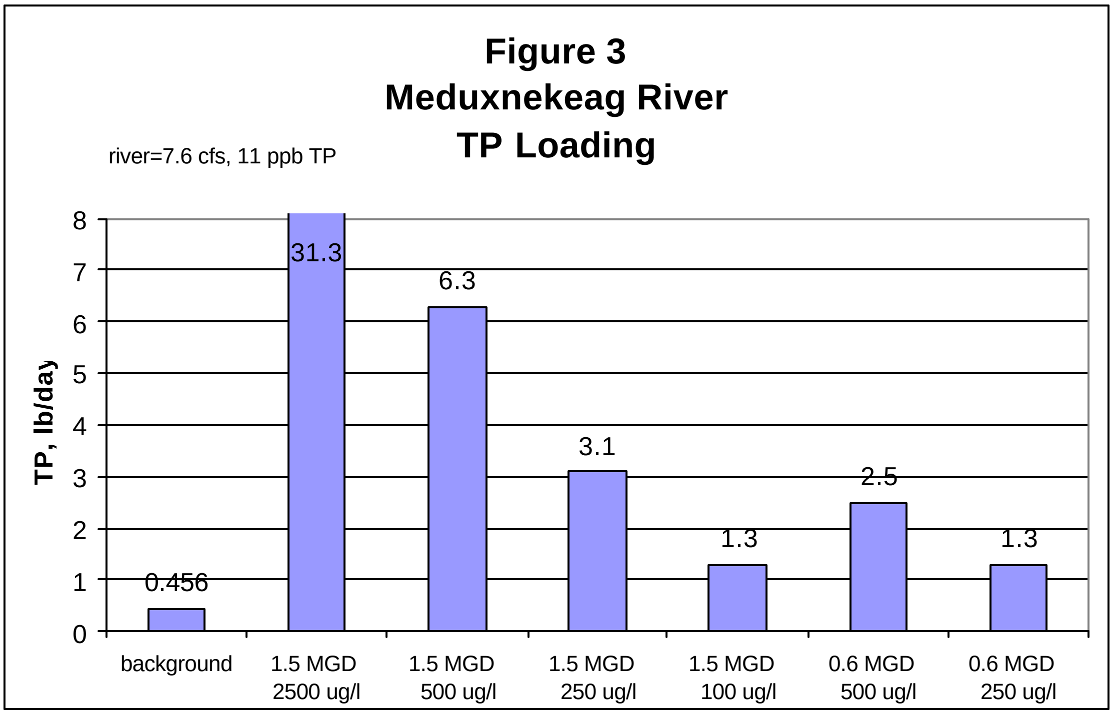
If it is presumed that the source of nutrients contributing to this elevated diurnal DO range through plant growth is due to non point sources (NPS) during runoff events (the only other point source is Staley which has stringent limits on discharge and often does not discharge to the river during the summer months), the mechanism of any nutrient loading from non point sources must be through rapid uptake of nutrients during the short term runoff events and/or through benthic storage from runoff events and subsequent slow release to the water column or utilization by rooted plants during dry periods. Instream TP concentration above Houlton is relatively constant from station to station during non runoff periods possibly indicating a balance between nutrient uptake from the water column by plants and benthic nutrient release.

On the other hand, a finding of Wisconsin's Department of Natural Resources study, "Impacts of Phosphorous on Streams"; Mace, Sorge and Lowry; April 1984 was that it is unlikely that the primary producers utilize P in runoff. Streambed scouring, turbidity and short contact time limit the availability. This would tend to indicate minimal impact of NPS upon plant growth within this segment.

(2) below Houlton
The data as well as observation clearly show that plant growth is significantly increased below the Houlton outfall as compared to above due to the discharge of phosphorous from the Houlton treatment plant. This plant growth results in very large diurnal DO swings below Houlton and subsequent non attainment of DO standards during the morning. The Houlton effluent TP is mostly dissolved, as PO4. Instream TP below Houlton outfall is initially elevated but rapidly decreases to near background levels at the covered bridge site 6 miles downstream. Settling is not a factor because most of the P is in dissolved form. Also, dilution does not account for the measured concentration reduction. This indicates a rapid utilization of P by plants, above and beyond that available from any benthic supply.

Data analyses and modeling indicate that absent the impact of the Houlton discharge (i.e. if diurnal variation below Houlton equaled that of the background sites above the outfall) DO standards would be met below Houlton and presumably plant growth would be reduced.

(3) relative P loading
TP loading from the treatment plant represents 98.5% of the TP input to the river below the outfall under no treatment conditions assuming a river flow of 7.6 cfs (model 7Q10), background of 11 ug/l TP, full licensed plant flow (1.5 MGD) and average effluent TP concentration of 2500 ug/l (concentrations as high as 3400 ug/l have been measured). The relative loadings for this and other scenarios are presented in the following chart.



(4) effect of point source (Houlton) TP treatment

1996
P treatment was implemented at Houlton from late June to early August. Staley did not discharge to the river from May 31 to October 23. No non-attainment was measured and the minimum DO measured was 7.8 mg/l. In general 1996 was a cool, wet summer. The average effluent ortho-P loading during July 1996 was 3.5 lbs./day, based on an average ortho-P concentration of 0.223 mg/l and an average effluent flow of 1.9 MGD. This includes a five day period of no treatment and high effluent flow (7/9 to 7/13) when average effluent ortho-P concentration was 0.626 mg/l.

1997
During 1997 DO standards were attained at an average Houlton effluent ortho-P loading of 1.31 lbs/day (mid June-mid August). Staley did not discharge to the

river from July 8 to October 21 (June TP averaged 0.5 lbs/day). Minimum river flow occurred on August 7 and 10 at 7.1 cfs (at USGS gage) which was somewhat higher than 7Q10 (5.5 cfs). Minimum instream DO was 7.0 mg/l below Houlton (site MDX15 – Lowery Bridge) on August 6. (see report <u>Meduxnekeag River 1997 Data Report</u>, December 1997) Also during this period, Houlton was discharging much less than permit BOD loads.

1998

No P treatment. Staley did not discharge to the river from June 7 to October 23. Marginal non attainment was measured on three occasions below the Houlton outfall. On only one occasion was non attainment measured at a bridge site below Houlton (6.9 mg/l at MDX15). River flows were generally high throughout the summer. (see 1998 data section above, page 5)

1999

DO standards were not attained at the bridge sites below Houlton (MDX15 and MDX17) with P treatment at Houlton, but treatment was started late and not stabilized until late in the summer. Staley did not discharge to the river from June 7 to November 4. Minimum DO increased with reduced effluent P loading. (see 1999 data section above, page 6).

(5) high river flow periods

DO data collected during periods of elevated river flows (dry weather base flows supplemented by increased runoff) generally indicated attainment of DO standards. Observations are that high river flows tend to scour any attached algae from the river bottom. It is apparent that the critical condition with regard to instream DO is the low flow, high temperature condition and that during higher flow effects such as scouring, increased dilution, increased aeration, etc. result in attainment of DO standards. By observation runoff events are associated with increased sediment loading and presumably increased nutrient loading. The impact of short term increased TP loading upon dry weather instream plant growth and DO is addressed in (1) above.

<u>Loading Capacity & Houlton TP Limit</u>

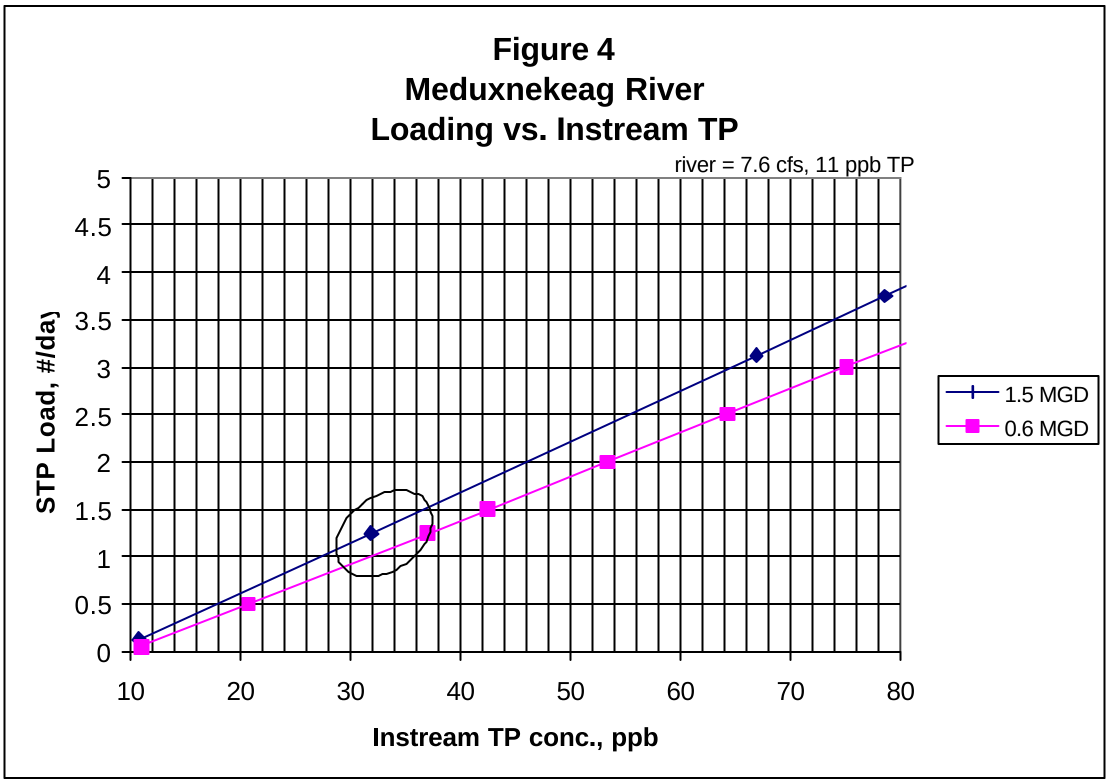
Data as well as low flow modeling indicate that existing background/NPS (non point source) loading represents maximum instream TP capacity in regard to DO. The average background TP is 11 ug/l. Background monitoring indicates general attainment of DO standards with a few measurements of marginal non-attainment (refer to responses to comments appendix E, page E6) under existing loading conditions. Modeling shows that if downstream diurnal variation is limited to that measured above Houlton, DO standards would be attained except for the possible effect of low effluent DO.

Although the data indicate a need for reduction of non-point TP loads (elevated diurnal range; occasional, marginal DO non-attainment; sediment load), the effect of NPS reductions upon the river below Houlton discharge would be masked by the effect of the point source TP load. Before any benefit can be realized from non-point nutrient load reductions, the point source load must be reduced.

TP limits are in place for the Staley discharge and have been proposed for the Houlton discharge (1.25 lbs./day TP) in the previous reports. The Staley permit includes a TP limit of 1.14 lbs./day. Additionally, no discharge from Staley is to be allowed when river flows above the confluence of the South Branch Meduxnekeag are less than 30 cfs or when DO as measured at the two bridge sites below Houlton are less than 7.0 mg/l. The proposed Houlton TP limit is supported by the following:

(1) Water quality modeling which includes a QUAL2E 7Q10 model and an empirical phosphorous loading model.

(2) Actual data collected during a period of low river flow and effluent P treatment.



(3) Study of the Little Androscoggin River below Paris (<u>Little Androscoggin River Waste Load Allocation</u>, May 1987, Mitnik and <u>Little Androscoggin River Additional Modeling Analysis and Treatment Options</u>, March 1988, Mitnik)

concluded that a reduced loading resulting in an instream TP concentration of 30-35 ug/l was required for attainment of river water quality standards (in this case class C). This report recommended TP limits of 0.57 #/day and 0.33 #/day for South Paris and Norway. Figure 4 shows the resulting theoretical (no immediate plant uptake) instream TP concentration verses Houlton effluent TP load. The proposed Houlton TP mass limit of 1.25 lbs./day would result in an instream TP concentration of 32 ug/l with an effluent flow of 1.5 MGD.

(4) A study of streams below DIFW fish hatchery discharges also confirms the instream TP threshold concentration of about 35 ppb.

The non-attainment of DO is a function of plant activity and is therefore a seasonal impact. TP limits on point sources are required during the growing season only. The beginning date of this period must be early enough to prevent initial establishment of algae growth and account for possible early warm, dry weather (such as occurred during June 1999). Although data has shown that treatment during periods of high flow may not be required, high flow periods or years cannot be predicted. The actual start-up of treatment must allow for lag time required to reach adequate treatment efficiency. Treatment must be continuous throughout the growing season.

The recent Maine waste discharge permit issued to Houlton (March 30, 2000) includes reference to the incorporation and implementation of the results of an approved TMDL into the permit. Specifically, “Within 30 days of finalizing the TMDL that recommends limits for total phosphorous, this license will be reopened pursuant to Special Condition H to incorporate new mass and concentration limits for total phosphorous.”

Figure 5
Total Phosphorous TMDL (Critical 7Q10 conditions)

	Flow (model)	TP, lbs/day
Staley	0	0
Background	7.6 cfs	0.45
Houlton	1.5 MGD	1.25
Drainage 6 mi. below Houlton	1.1 cfs	0.07
total	11.02 cfs	1.77

(1) background site is immediately above Houlton outfall and does not differentiate between natural background and NPS sources
(2) TP limits apply to summer season
(3) the totals translate to an instream TP concentration of 30 ug/l 6 miles below the outfall or 32 ug/l immediately below the outfall not accounting for plant uptake

Additional Requirements
(1) Includes continuation of NPS work (no allocation for future NPS is included in the TMDL)
(2) Continued instream monitoring in accordance with an approved sampling plan

<u>Margin of Safety Issues</u>
Regulations require a TMDL to include a margin of safety (MOS). No explicit MOS is included in this study. The QUAL2E modeling, by incorporating 7Q10 river flow (which occurs infrequently) in combination with maximum license BOD loads (Houlton routinely discharges 10% or less of permitted BOD5) and high temperature conditions, includes a degree of implicit MOS. 7Q10 flow is exceeded over 99% of the time (USGS gage statistics). Therefore the above combination of events probably represents a condition that would occur significantly less than 1% of the time annually, if at all during a given year.

In general the empirical model and the analyses based on actual data include a number of unconservative assumptions in regard to the resulting TP limitations on the Houlton point source loading (see various references to the empirical model and 1997 data collection conditions; page 5, appendix D, appendix E). While these assumptions reduce the MOS established in the QUAL2E modeling this approach is defended as follows:

(1) The empirical model incorporated the maximum allowable diurnal range determined from the QUAL2E model.

(2) The proposed limits represent a significant decrease in TP loading to the river.

(3) Modeling results were verified by subsequent field data

(4) The TP modeling did not consider non-point source (NPS) reductions. NPS work has been done in the watershed and further work is planned – thus there are reasonable assurances of continued NPS reductions. Since 1995, DEP has provided three 319 grants to the Southern Aroostook SWCD for the Meduxnekeag River Project:

Meduxnekeag 319 Grant Phase I (ME95-08) was completed as of fall 1999. This project addressed a variety of NPS sources (mostly soil erosion) from around the watershed.

Meduxnekeag 319 Grant Phase II (ME97-08) is now in its second year. The goal of this project is to address NPS sources in two targeted areas, Pearce Brook and the South Branch of the Meduxnekeag River. Both livestock inputs and soil erosion are being addressed.

Meduxnekeag 319 Restoration Phase I (ME99R-32) started in the summer of 1999. This is a very focused project on 5 tributary streams to the Meduxnekeag River. The confluence of these streams is roughly in the Lowery Bridge to Covered Bridge vicinity. These streams all have had high bacteria numbers.

The project is focusing on livestock inputs. There has and will be data collected on these small streams for a before and after study.

The Maliseet Indians have a number of 'base line' sites throughout the watershed on both the mainstem and tributary streams.

Moose Brook, a tributary to the Meduxnekeag, was the target of both periphyton and the rapid bioassement sampling protocols.

(5) Instream monitoring would be continued (as a license condition) to assess the level of treatment. More strict TP limits would be imposed if indicated by the monitoring.

Monitoring
A monitoring plan will be developed at the time that recommended TP limits are implemented in the Houlton permit. Monitoring should include effluent TP, river flow, instream diurnal DO/temperature. The plan should include QA/QC procedures. Monitoring frequency should be similar to that of recent years. It is anticipated that DEP (Presque Isle office), the Maliseets and Houlton treatment plant personnel will participate in the monitoring. The summer 2000 sampling plan is included as appendix G.

Recommendations

It is recommended that TP limits be imposed on the Houlton wastewater treatment plant effluent as specified in the Meduxnekeag River 1997 Data Report, December 1997. Specifically, a monthly average TP concentration limit of 0.25 mg/l for the period June 1 through September 15 and a monthly average mass limit of 1.25 lbs./day for July 1 through September 15. Monitoring (in accordance with an approved monitoring plan) should be continued for up to 5 years to assess the effectiveness of the proposed limit in attaining DO standards below the outfall.

NPS studies be performed as planned and controls be implemented as required.

Limits on Staley discharge be maintained.