COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
ONE WINTER STREET, BOSTON, MA 02108 617-292-5500

August 23, 2010

In the Matter of

Town of Plymouth

Docket No. 2008-114

Plymouth

RECOMMENDED FINAL DECISION

The Southeast Regional Office of the Department of Environmental Protection ("the Department") issued a groundwater discharge permit to the Town of Plymouth ("Plymouth") in 2008. An appeal was filed by the Eel River Watershed Association ("ERWA"), claiming violations of the groundwater and surface water quality standards related to nutrients and the failure to comply with procedural requirements.[1] The permit was based upon the recommendations of the Eel River Nutrient Technical Advisory Committee ("TAC") in a report entitled *Evaluation of Nutrient Inputs and the Health of the Eel River System, Plymouth MA, in Support of a Nutrient Management Plan* (January 2000) ("TAC Report"). The TAC recommended a "zero discharge policy" for phosphorus. The permit required Plymouth to meet special conditions related to phosphorus and to implement a Nutrient Management Plan ("NMP"). ERWA claimed that the Department must require reduction of nitrogen in the discharge and establish effluent limitations based on a Total Maximum Daily Load ("TMDL") analysis to

[1] See 314 CMR 4.00 (Surface Water Quality Standards) and 314 CMR 2.00 (Permit Procedures). 314 CMR 6.00 (Ground Water Quality Standards) was replaced by revisions to 314 CMR 5.00 in March 2009, subsequent to this permit proceeding and appeal. All citations in this Recommended Final Decision are to the regulations in effect when the permit renewal application was filed in 2006 through the permit issuance in 2008.

prevent degradation of the Eel River from nutrients loads attributed to all sources in the watershed, and in the interim, to require changes in the operation of the plant.

I conclude that the Department properly established effluent limitations and monitoring requirements in the permit. The permit and the NMP are sufficient to protect the existing uses of the Eel River, and to protect the existing level of water quality related to the groundwater discharge from the facility. I recommend revisions to the text of the permit which clarify the intent of the Department as to the enforceability of the NMP. My findings as to water quality reflect my acceptance of the scientific evidence on the role of phosphorus limitation in the Western Branch of the Eel River and the case law on the applicability of surface water quality standards in the context of a groundwater discharge permit. See Friends and Fishers of the Edgartown Great Pond v. Department of Environmental Protection, 446 Mass. 830(2006); Richard Healer v. Department of Environmental Protection, 75 Mass. App. Ct. 8 (2009). Finally, I find that the Department did not prepare a fact sheet but that no remedy is required as neither ERWA, nor apparently any other interested party, requested a copy as required under the regulations.

ISSUES IDENTIFIED FOR ADJUDICATION[2]

1. Whether the groundwater discharge permit meets the applicable requirements for the establishment of discharge limitations at 314 CMR 6.07(2)?[3]

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[2] Issues 1, 2, and 3 were limited in scope to nutrients (nitrogen and/or phosphorus) by agreement of the parties. The Department is prohibited from issuing a groundwater discharge permit "when the discharge will cause or contribute to a condition in contravention of standards for classified waters of the Commonwealth, pursuant to 314 CMR 4.00 and 6.00." 314 CMR 5.06(1); see 314 CMR 5.19(1).

[3] 314 CMR 6.07(2) Establishment of Discharge Limits. In regulating discharges of pollutants to ground waters of the Commonwealth, the Department shall limit or prohibit such discharges to insure that the quality standards of receiving waters will be maintained or attained. The Determination by the Department of the applicable level of treatment for an individual discharger will be made in the establishment of discharge limits in the individual ground water discharge permit. In establishing effluent limitations in the

2. Whether the groundwater discharge permit meets the applicable requirements for Monitoring at 314 CMR 6.08?[4]

3. Whether the groundwater discharge permit meets the requirements, to the extent applicable, of the antidegradation provisions at 314 CMR 4.04(1) and/or (2)?[5]

4. Whether the Department complied with the procedural requirements of 314 CMR 2.05, 314 CMR 2.04(2) (second sentence) and/or 314 CMR 2.06(3)(a), and if not, what remedy is required?[6]

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individual permits, the Department must consider natural background conditions, must protect existing adjacent and downgradient uses and must not interfere with the maintenance and attainment of beneficial uses in adjacent and downgradient waters. Toward this end, the Department may provide a reasonable margin of safety to account for any lack of knowledge concerning the relationship between the pollutants being discharged and their impact on the quality of the groundwaters.

[4] 314 CMR 6.08: Monitoring

(1) Collection of Samples. The determination of compliance or non-compliance of sewage, industrial waste or other waste discharges with the requirements of 314 CMR 6.00 shall be made through tests or analytical determinations of ground water or effluent samples collected, transported and stored in such manner as is approved by the Department. The location at which ground water samples are collected shall be determined by the Department. In selecting or approving such locations, the Department shall consider all relevant facts including, but not limited to:

(a) The mobility of pollutants in the unsaturated zone and the pollutant attenuation mechanisms in this zone.

(b) Attenuation mechanisms which may remove potential pollutants in passage through the soil.

(c) The relative thickness of the unsaturated zone.

(d) Attenuation of pollutant concentrations with distance which may occur in the saturated zone, as a result of attenuation processes occurring below the water table.

The location at which effluent samples are collected shall be at a point where the effluent emerges from a treatment works, disposal system, outlet or point source and prior to being discharged to the ground.

(2) Number of Monitoring Wells. The Department shall determine the number of observation and monitoring wells necessary for the determination of compliance with 314 CMR 6.00.

(3) Tests or Analytical Determinations [Not addressed by any Party].

[5] 314 CMR 4.04 Antidegradation Provisions

(1) Protection of Existing Uses. In all cases existing uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.

(2) Protection of High Quality Waters. High Quality waters are waters whose quality exceeds minimum levels necessary to support the national goal uses, low flow waters, and other waters whose character cannot be adequately described or protected by traditional criteria. These waters shall be protected and maintained for their existing level of quality unless limited degradation by a new or increased discharge is authorized by the Department pursuant to 314 CMR 4.04(5). Limited degradation may also be allowed by the Department where it determines that a new or increased discharge is insignificant because it does not have the potential to impair any existing or designated water use and does not have the potential to cause any significant lowering of water quality.

[6] 314 CMR 2.05: Preparation of Fact Sheet or Statement of Basis for Permit

[The Department conceded that it did not prepare a fact sheet.]

PROCEDURAL HISTORY

Project History

This groundwater discharge permit was preceded by problems with wastewater treatment in Plymouth beginning in the 1970s, when the original plant discharging to Plymouth Harbor exceeded its capacity. Frizzell PFDT, Exhibit 1. Attempts to bring the plant into compliance were not successful, and the Commonwealth commenced action against the Town for violation of the state Clean Waters Act in 1987. M.G.L. c. 21, ss. 27-53. In 1992, Plymouth and the Commonwealth entered into a Consent Decree, subsequently amended in 1994, and the Town began facilities planning for its wastewater treatment and Massachusetts Environmental Policy Act ("MEPA") review. Id. Although only portions of the planning documents were submitted for inclusion in the record, it appears that the focus of concern related to water quality was the nutrient nitrogen. ERWA appealed the MEPA Certificate on the project, but was found not to have standing. Enos v. Secretary of Environmental Affairs, 342 Mass. 132 (2000). The facility was planned for a maximum permitted discharge of 3.45 MGD, with 1.75 MGD to the harbor outfall and .75 MGD initially, with potential to increase to 1.25 MGD, to groundwater through infiltration beds at the site. The TAC was established in 1999 by the Department to provide information and recommendations on nutrient issues in the Eel River watershed. The Department issued a groundwater discharge permit in 2000, with a

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314 CMR 2.04(2)(second sentence) The draft permit shall contain such terms and conditions which the Department deems necessary to insure that the permitted activity or facility complies with all applicable requirements of the state or Federal Acts, and regulations adopted thereunder.
314 CMR 2.06(3)(a) [Requirements related to publication of public notice; the Department provided copies of its notice.]

requirement that Plymouth develop and submit for approval a nutrient management plan. The 2000 permit expired and was replaced by the 2008 permit.[7]

Discovery Issues

ERWA filed a Motion to Compel Discovery, seeking entry into Plymouth's wastewater treatment plant to examine ongoing treatment processes and plant conditions. ERWA stated that the limited effluent monitoring under the permit required an evaluation of treatment plant operations to determine whether the permit conditions and monitoring protect the receiving waters with a reasonable margin of safety under 314 CMR 6.07(1) and 314 CMR 6.08.[8] ERWA also sought data on operation and maintenance of the plant and data on septage delivered to the plant, including a list of the septage haulers. Finally, ERWA sought documents on compliance with restrictions on flow contained in the 1994 Modified Consent Judgment.[9] ERWA stated that its discovery requests were relevant to effluent strength and volume, which in turn were relevant to the question of whether permit conditions were protective of receiving waters, and limiting the analysis to the discharge at end-of-the-pipe would preclude an opportunity to assess the potential for protecting the receiving waters prior to discharge. 314 CMR 6.07(2).

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[7] ERWA appealed the permit issued by the Department to Plymouth in 2000. The appeal was transferred from the Department to the Division of Administrative Law Appeals (DALA), but no action occurred after the filing of potentially dispositive motions in 2003. The 2000 permit expired and been replaced by the 2008 permit. The Department and Plymouth filed motions to dismiss the 2000 permit appeal with DALA. On August 12, 2009, after the hearing in this matter, an Administrative Magistrate from DALA issued a Recommended Final Decision that the appeal of the 2000 permit be dismissed as moot, without prejudice to the adjudication of claims asserted in the 2008 permit appeal. Matter of Town of Plymouth, Docket No. 2000-091, Recommended Final Decision (August 12, 2009).

[8] ERWA stated that daily plant operations have an impact on effluent quality, and the twice monthly effluent sampling does not reveal conditions at the plant during the remainder of its operation. ERWA asserted that reports indicate excess flow to infiltration beds and maintenance issues in the equalization tanks and effluent beds.

[9] ERWA also cited M.G.L. c. 66 § 10, the Public Records Law, in reiterating its requests to Plymouth and the Department for documents relied upon in issuance of the 2008 permit, reports on operation and maintenance of the plant, septage receipts and records, the status of sewer banking, and an inspection of the plant. I assume the Department and Plymouth complied with these requests.

In Plymouth's view, information on treatment plant conditions was beyond the scope of the proceedings, which was limited to water quality, and would be akin to an enforcement proceeding rather than a permit appeal. Plymouth stated that allowing entry to the plant raised safety concerns and would be unduly burdensome to plant employees, especially as ERWA had not articulated the manner of making the inspection as required. 310 CMR 1.01(12)(d). Plymouth argued that it had provided operational statistics from 2002 to 2008 which include a column indicating the amount of septage received on a daily basis and further detail on septage receipts and hauler information. Plymouth took the position that documents related to sewer banking stemming from the 1994 Modified Final Judgment were beyond the scope of the proceeding and rest solely within the Department's exercise of its enforcement discretion. Matter of Augustine Luongo, Docket No. 98-053, Final Decision (March 4, 1999). The Department also objected to ERWA's request as an impermissible attempt to seek enforcement.

Under the adjudicatory hearing rules, parties may move to compel discovery where another party has not cooperated in good faith following attempts to conduct discovery that is not overly broad, unduly burdensome, and is reasonably calculated to lead to the discovery of relevant, admissible evidence. 310 CMR 1.01(12) (d). Issues of whether Plymouth has violated its permit or the Modified Consent Judgment are not within the scope of issues identified for adjudication and, further, could not be remedied in this forum. Matter of Augustine Luongo, Docket No. 98-053, Final Decision (March 4, 1999). The focus of this appeal is the contents of the permit, which are apparent within the four corners of the permit itself, and the specified water quality requirements rather

than the operation of the treatment plant.[10] Thus, the discovery dispute was resolved by the exclusion of enforcement matters and adherence to the issues identified for adjudication. See Rulings on Motion in Limine, Motions Related to Discovery, Motion to Remand and Reverse Burdens, and Motion to Stay (April 29, 2009).

Motion in Limine to Clarify Issues; View

The Department moved in limine for an order or instruction clarifying the scope of the issues, the relevant evidence, and limitations on the inclusion of enforcement matters in the appeal. Plymouth also requested clarification on the issues. ERWA responded that it sought to show areas where the plant was not operated in compliance with the permit and other approvals, that the permit is not by itself protective of anything, and that operating conditions at the plant are relevant to whether permit terms are protective of the receiving waters.[11] Although from opposite perspectives, the parties seemed unduly focused on the identification of permit violations.[12] Plymouth had provided monitoring data not only on the effluent but also on the groundwater and surface water quality. I provided the requested clarification, without benefit of briefs, of the regulatory requirements for the protection of surface water from a groundwater discharge. See Rulings on Motion in Limine, Motions Related to Discovery, Motion to

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[10] In addition, the operation of treatment plants is governed by 314 CMR 12.00. The plans of treatment plants are approved under the Department's plan approval authority under M.G.L. c. 21, s. 27 rather than under the permit application. In this appeal, ERWA could argue that the maximum limitations established in the permit do not meet the regulatory requirements or assert that operational practices allowable under the permit may cause exceedances of effluent limitations.

[11] Even if nitrogen or phosphorus levels were underreported end-of-pipe, as ERWA suggested, the monitoring data in the groundwater wells and surface water sampling would still be expected to reflect the effects of the plant's actual discharge.

[12] The focus on violations may be attributable in part to regulatory language in the section on permit conditions stating that a discharge shall not result in a *violation* of the Groundwater or Surface Water Quality Standards. 310 CMR 5.19. However, as similar language appears as a restriction on issuance of a permit, it appears that the question of the affect of a groundwater discharge on surface waters, which is the particular concern here, would be prospective rather than retrospective in nature and be answered by the permit rather than subsequent enforcement. 314 CMR 5.06(1).

Remand and Reverse Burdens, and Motion to Stay (April 29, 2009). I conducted a view of the Eel River and related ponds on July 18, 2009, for the purpose of familiarizing myself with the water body that is the subject of this appeal.

Ruling on Issue 4. Whether the Department complied with the procedural requirements of 314 CMR 2.05, 314 CMR 2.04(2)(second sentence) and/or 314 CMR 2.06(3)(a), and if not, what remedy is required?

In its procedural rules for the issuance of groundwater permits, the Department is required to prepare a fact sheet and to issue a draft permit that contains terms and conditions which the Department deems necessary to insure that the permitted activity or facility complies with the applicable requirements. ERWA asserted that the Department should be required to reissue the permit due to failure to comply with all procedural requirements for public notice and comment. The Department provided copies of its properly published public notice, but conceded that it did not prepare a fact sheet or statement of basis for the permit. I concluded that although the Department had not prepared a fact sheet as required, no remedy is necessary. See Rulings on Motion in Limine, Motions Related to Discovery, Motion to Remand and Reverse Burdens, and Motion to Stay (April 29, 2009).

Specifically, ERWA stated that a fact sheet required under 314 CMR 2.05 was not prepared or sent to it, despite the Department's knowledge of its ongoing and long-standing involvement with water quality issues in the watershed. ERWA further claimed that the Department failed to acknowledge its comments on the prior draft permit, to consider relevant monitoring information that was available prior to permit issuance, or to include terms of the Modified Consent Judgment. ERWA requested remand to the

Department for development of a proper record or shifting the burden to Plymouth and the Department.[13]

Plymouth responded that, even were a fact sheet not prepared, ERWA was not prejudiced nor was the permitting process flawed. In Plymouth's view, neither remand nor a shift of burdens was warranted; the remedy for any technical flaw would be an order to the Department to prepare a statement of basis for the record. Consistent with the Town, the Department argued that ERWA did not request a copy of the fact sheet and therefore was not prejudiced. The Department further stated that the fact sheet, had it been prepared, would not differ substantially from the fact sheet prepared in 1999 for the 2000 permit. The Department stated that it had provided a copy of the permit to ERWA as a courtesy.

I found no defect in the public notice for the permit related to the procedural requirements of 314 CMR 2.06(3)(a). The Department, however, did not comply with the procedural requirements of 314 CMR 2.05 or 314 CMR 2.04(2)(second sentence) because it did not prepare a fact sheet for the 2008 permit. The regulations require the Department to provide a copy of the fact sheet to interested persons, other than the applicant, only upon request. ERWA has not produced a copy of a written request or asserted that an oral request was made, and the Department states that no request was

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[13]The Petitioner placed greater weight on the question of burdens than is warranted. *See* Matter of Horatio's Welding and Sheet Metal Inc., Docket No. 2004-024, Recommended Final Decision (June 13, 2007). The Department has traditionally placed the burden of production on the party disputing the Department's position. See 310 CMR 1.01(13)(c)1; 310 CMR 10.03(2). Absent a failure of a petitioner to meet its initial burden of producing evidence, a case is decided upon which way the evidence preponderates. Permit conditions should reflect the regulatory standard and the predominating facts. The burden of proof is important where the evidence is weighted equally on both sides, in which case the party with the burden of proof fails. Such circumstances are rare, however, and parties are better served by focusing on placing into evidence facts with supporting legal argument to prove that their respective positions should prevail. Id.

received. Thus, even if the fact sheet had been prepared, it would not have been released to ERWA or any other interested person. The Department further stated that it received no comments on the draft permit at all. As to ERWA and the public, therefore, no remedy is required. Despite having not requested a fact sheet or submitting comments on the 2008 draft permit, the ERWA had a full opportunity to challenge the Department's action in this appeal. *See* Matter of Town of Hamilton, Town of Topsfield, Town of Wenham, Docket Nos. 2003-065, 2003-079, 2003-068, Recommended Final Decision (January 19, 2006). The Department prepared and submitted a statement of basis for inclusion in the record and to ensure its availability should the Department receive a request for it.[14]

TECHNICAL BACKGROUND

The TAC Report

The Department convened the TAC to synthesize scientific information, evaluate resource concerns, and report its findings. The purpose of the TAC Report was to provide the basis for recommendations to the Department for preventing significant ecological decline related to effluent from the treatment plant and to changes in land use, primarily from residential development. TAC at I-3.[15] All parties relied upon the TAC Report, and I provide a summary of its contents in light of its central importance to the Department's permit, the Nutrient Management Plan, and the testimony of the Parties.

The issues for adjudication related to the discharge and its effects on the Eel River were limited to the nutrients nitrogen and phosphorus, and the relationship between these

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[14] A statement of basis is prepared when a fact sheet is not prepared. 314 CMR 2.05(5).

[15] I have included page references in my citations to the TAC Report. References to the TAC Report in the filings of the parties were frequent but rarely specified the page, so that often it was not clear to what text in the TAC Report witnesses were referring.

nutrients effects water quality. Plants require specific proportions of nitrogen and phosphorus for growth. TAC at VI-1. A nutrient in excess of its proportion, or further additions of the excess nutrient, generally will not cause plant growth that will adversely affect water quality. In contrast, addition of the limiting nutrient will have the effect of stimulating plant growth. TAC at VI-1. The TAC Report stated that the Eel River system currently has low levels of nutrients, with higher levels in the Western branch, and may alternate between nitrogen and phosphorus limitation, with only a small increase in one nutrient shifting the limitation to the other. TAC at IV-2. In developed watersheds where nitrogen concentrations become very high, pulses of inorganic phosphorus may cause blooms. Id. The TAC concluded that in the Eel River watershed, nitrogen will increase proportionately more than phosphorus and with increased development the system will become "strongly phosphorus limited." Id.

The TAC Report stated that phosphorus limitation may be "better" than nitrogen limitation for the Eel River. TAC at VI-2. With phosphorus limitation, higher levels of nitrate will not affect biota. TAC at VI-2. Phosphorus limitation does not result in the predominance of blue green algae that occurs with nitrogen limitation, and phosphorus management is often more efficient and cost-effective than nitrogen management. TAC at VI-2. The watershed naturally retains phosphorus and is characterized by high infiltration to groundwater, with surface water runoff of less than 10%. TAC at VI-2. The Eel River system is also characterized by short residence times and high throughput of water, so that phytoplankton blooms tend to wash out rather than become established. TAC at VI-2. However, increased phytoplankton levels in upper reaches, such as Russell

Mill Pond which tends to trap nutrients, may lead to blooms in lower reaches and increases in residence times may increase blooms. TAC at VI-3.

The TAC evaluated the projected health of the Eel River system in light of future watershed development, with increased nutrient and flow levels:

> It is clear that with a shift from undeveloped land to residential and recreational development and with the Plymouth WWTP discharge, nutrient levels within the Eel River System will increase. Nitrogen levels will increase faster than phosphorus, as a result of their differential transport through groundwater. The result will be a strong phosphorus limitation for phytoplankton and periphyton within the receiving freshwater ecosystems. The freshwater systems will have sufficient inorganic nitrogen levels that any additional bioavailable phosphorus will have a stimulatory effect on algal production. . . .The most likely result of increased nutrient loading is increased phytoplankton growth and the frequency of blooms. . . .The likelihood of significant ecological shifts depends upon the ability to prevent phosphorus increases in parallel to the nitrogen increases which will occur.

TAC at VII-1 and VII-2.[16] The groundwater discharge from the wastewater treatment plant flows toward the Western Branch of the Eel River. TAC at Figure IV-1 (prepared by CDM).[17] The TAC also concluded that the increased volume from the treatment plant would not negatively impact the Western Branch, because the plume will have the same levels of bio-available phosphorus as the receiving waters and the increased flows will hasten the export of phytoplankton and other organic matter from the freshwater system. TAC at VII-1. Finally, the TAC evaluated the effect of an approximately projected doubling of the nitrogen loads from the Eel River system to Plymouth Harbor, in the

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[16] With the caveat that initial water quality data suffered from problems with detection limits, the TAC Report characterizes the present nutrient status of the Eel River system as exhibiting relatively low levels of inorganic nutrients, total nitrogen, and total phosphorus due to low levels in the groundwater, reflecting the low level of development. TAC at IV-1 and IV-2. Nutrient levels differed within the system, with the Western Branch having higher nutrient levels from its land uses. TAC at IV-2.

[17] The TAC Report includes a map showing monitoring stations and the groundwater times of travel. TAC at Figure IV-1 (prepared by CDM). The times of travel are 1 year, 2 years, and 5 years, with the area above Eel River Pond generally exceeding the 5 year travel time line.

context of the upgraded facility, and concluded that adverse effects were not likely. TAC at VII-4.

The TAC Report estimated present and future nitrogen and phosphorus loadings from the watershed, with the level of enrichment determined by the balance of loadings and attenuation. TAC at V-1. Because nitrogen (as nitrate) is much more mobile in the aquifer than inorganic phosphorus (orthophosphate), nitrogen levels were expected to increase more rapidly and to a greater extent than phosphorus. Id. The TAC's conclusion from the nitrogen and phosphorus loading analysis was that the much greater increases in nitrogen will result in the system becoming strongly phosphorus limited and any increase in phosphorus will directly affect plant production. TAC at V-3. Strict controls on phosphorus would be necessary to reduce declines in water quality from future nitrogen loads.[18] Id..

In management recommendations to address watershed nutrient issues, the TAC advocated a zero discharge policy for phosphorus:

> Since nitrogen levels within the watershed will increase under changing watershed land-use (even if best management practices are used), a zero discharge policy for phosphorus is recommended to be instituted. The objective is to prevent increases in phosphorus loading to the surface freshwater sub-systems to the Eel River. The logical management approach to implement this is through the development of a policy that requires no net increase in phosphorus loading to the freshwater aquatic ecosystems of the Eel River System. The focus on phosphorus stems from the fact that under future conditions, each increase in phosphorus will have a stimulatory effect on algal production. The target concentration for discharges should be phosphorus levels no higher than measured in the receiving waters . . . .

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[18]Without controls, phosphorus loads were projected to increase ten-fold over pre-development conditions and by 42% over late 1990s conditions. TAC at V-3. Rather than a watershed loading model, the TAC calculated a total phosphorus mass flux based on concentrations and flow rate. TAC at V-1 to V-2. A mass of 145.5 kg per year was estimated for pre-development conditions, 1020 kg per year for baseline conditions, and 1450 kg per year for no-control conditions. TAC at V-2.

TAC at VIII-1. For nitrogen, the TAC recommended a "study and see" approach of monitoring, assessing any change, and implementing nitrogen management if necessary. The TAC assumed nitrogen loads and concentrations would increase and stated that "[g]iven the current understanding of the freshwater systems, particularly macrophyte and periphyton communities, it is unknown if the increase in nitrogen will sufficiently stimulate algal production to harmful levels." TAC at VIII-1. Despite its emphasis on phosphorus control, the TAC strongly recommended that nitrogen management be undertaken as feasible. Id.

The TAC developed management recommendations for Plymouth's treatment plant, including ensuring that the effluent plume does not become anoxic, the pH is controlled, and monitoring confirms adsorption, with a plan to implement phosphorus removal if sufficient phosphorus attenuation is not realized. TAC VIII-2 and VIII-3. The TAC recommended evaluation of the ponds and their biota as the primary indicators of the system's overall health, the identification of management options for mitigation in the NMP if nutrient over-enrichment occurs, with a higher threshold for the Western Branch due to its current mesotrophic status. TAC at VIII-4. The TAC also prepared recommendations for water quality monitoring. As to nutrients, it urged strict detection limits and annual reviews to ascertain shifts in conditions relative to baseline. As to monitoring related to the treatment plant, the TAC recommended groundwater monitoring within the plume to determine any potential for breakout of phosphorus from saturation of sorption sites or anoxic groundwater and to confirm location of entry and attenuation of phosphorus prior to reaching surface water. TAC at VIII-4 and VIII-5.

The 2008 Permit

The Department issued a discharge permit which specified an annual average flow limit of 0.75 MGD and effluent limits for total nitrogen (NO2+NO3+TKN) of 10 mg/l, for nitrate nitrogen of 10 mg/l, and for pH of 6.0 – 7.5. The permit contains no discharge limit for phosphorus, but requires effluent monitoring twice monthly for both nitrogen and phosphorus and reporting on water quality in nine monitoring wells for a variety of parameters, including nitrogen and phosphorus. In addition to effluent limits and monitoring requirements, the permit at Supplemental Condition 1 stated:

> The Town agrees to implement the Nutrient Management Plan (as amended) (NMP) and approved by the Department to address nutrient impacts to the Eel River system from the various sources within the Eel River watershed.

Supplemental Condition 5 stated:

> The movement of phosphorus contained in the wastewater treatment plant effluent shall be carefully monitored in the subsurface environment. The Town has prepared a contingency plan which shall be implemented if an increase in phosphorus is detected. This plan is included in the January 2001 Nutrient Management Plan.

The condition identified the five wells immediately adjacent to the infiltration beds (A8, A9, A10, A11, and A16) and four wells downgradient at the property boundary (6S, 6D, 1S, and USGS 475), all subject to predischarge sampling.[19] If any of the four downgradient wells showed an increase of >100% over the background level for either three consecutive monthly samplings or four out of six consecutive monthly sampling periods, Plymouth is required to meet with the Department to establish a compliance schedule for implementing increased phosphorus removal at the treatment plant. If any

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[19] In the section on "Indicators of Change," the NMP identifies an average total phosphorus concentration of 0.017 mg/l in the adjacent wells (called the "inner wells"). For the downgradient wells (called the "outer wells") where the trigger specified in Supplemental Condition 5 of the permit is a 100% increase, the average total phosphorus is identified at 0.084 mg/l. NMP at 7-2. The average total nitrogen concentration is identified as 0.809 mg/l in the adjacent wells and 0.121 mg/l in the downgradient wells. Id.

of the four immediately adjacent wells shows a total phosphorus concentration of 0.2 mg/l or greater for either three consecutive monthly samplings or four out of six consecutive monthly sampling periods, Plymouth is required to meet with the Department "to discuss how to proceed with treatment plant operation and potentially reducing effluent phosphorus concentrations." 2008 Permit, Supplemental Condition 5. Other supplemental conditions require annual submission of infiltration and inflow plans, assessment of groundwater mounding, annual reporting related to mitigation for increased wastewater flows, and various operation and maintenance requirements.[20]

The Nutrient Management Plan

The NMP referenced in the 2008 permit was prepared by Plymouth in 2001 to comply with the 2000 permit and as a mitigation measure under the MEPA. The NMP contains sections on the characteristics of the watershed, the baseline monitoring program, nutrient loads, nutrient controls, nutrient management options, indicators of change, the management plan and an implementation plan. The NMP reflects the conclusions of the TAC, that nitrogen levels were expected to increase, but significant change to the ecological health of the Eel River system from nitrogen was not expected and the triggers for action are contingent. However, any change in phosphorus requires

[20] The 2008 permit referenced the Section 61 Findings appended to the 2000 permit. The Section 61 findings stated that the potential for increased wastewater flows to adversely impact water quality within the Eel River Watershed, particularly in combination with ongoing development of residential lots with septic systems, would be addressed by Plymouth through the preparation of the NMP, monitoring, and implementing water conservation and demand management. Plymouth was to use the NMP "to evaluate and holistically manage the impacts to the watersheds [sic] from all nutrient sources, including the wastewater treatment facility." 2000 Groundwater Discharge Permit, attached Section 61 Findings. The Department's Section 61 Findings summarized the TAC Report as concluding "that phosphorus, not nitrogen, was the key nutrient of concern for the Eel River Watershed." Id. The Department stated that conditions of the permits and approvals for the facility constitute all feasible measures to avoid damage to the environment and minimize and mitigate such damage to the maximum extent practicable for impacts within the Department's authority. Id.

immediate action by Plymouth, because even a small increase in phosphorus could cause changes in the ecological status of the system. NMP at 7-4 to 7-5.

A table provides the average and 95% exceedance levels for total nitrogen and total phosphorus at the six surface water sampling locations. NMP at Table 7-5. If monitoring shows an increase in nitrogen, a chemical change, four ecological indicators must be evaluated to determine whether a biological change has occurred.[21] If both a chemical and an ecological change from nitrogen have occurred, the source of nitrogen must be identified and addressed; if the source is the treatment plant discharge, the options are to change plant operations, upgrade nitrogen removal, or relocate the discharge. NMP at Table 7-4. If the source is development in the watershed, actions in response may include upgrade of septic systems, limiting fertilizer use, and implementation of BMPs to reduce runoff. NMP at Table 7-4.

The average total phosphorus at the six surface water sampling locations ranged from 0.019 to 0.041. NMP at Table 7-5. If total phosphorus concentrations were greater than the 95% exceedance level for two samples in one season, an increase in total phosphorus in the Eel River system would be assumed, triggering immediate action. If the source of phosphorus is the wastewater treatment plant, the prescribed actions are changing plant operations, upgrading the plant to include phosphorus removal, or relocating the discharge. NMP at Table 7-4. If the source of phosphorus is development in the watershed, actions may include reductions in phosphorus loads from cranberry bogs and fish hatcheries, replacing failed septic systems, limiting fertilizer use, and implementation of BMPs to reduce runoff. NMP at Table 7-4.

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[21] Ecological indicators are secchi depth, chlorophyll-a, a macroinvertebrate ratio, and spatial coverage of macrophytes. NMP at 7-5 to 7-6. pH is handled in the same manner as nitrogen for purposes of determining whether action in response to an increase is required.

In sum, if either total phosphorus has increased or an increase in nitrogen has caused a biological change based upon ecological indicators, Plymouth would be required to select an action in response. NMP at 7-6. Plymouth also is required to submit to the Department an annual report, presumably for an independent determination of whether changes have occurred within the Eel River system. Id. In addition to "indicators of change" requirements, the NMP includes an Implementation Plan with a variety of components with timeframes: public education reduction of nutrients (2 yrs), evaluation of buffer strips (2 yrs), implementation of stormwater controls at road crossings (5 yrs), assisting bog and hatchery owners with BMPs (2 yrs), septic system management (2 yrs), a feasibility study on use of reclaimed water at recreational sites (2 yrs), and identification of open space for acquisition (no timetable).

The NMP was amended with Department approval on October 13, 2005 to refine the tasks for implementation, which include public information, setbacks, stormwater controls, point source BMPs, septic system management, wastewater reuse, reporting, and revisions to operational monitoring. The amendment concludes with flow diagrams, the first showing the development of a nutrient management program based on TMDL loads and carrying capacity, leading to a regulatory district with setback and septic system requirements. The second, entitled "Building Trading Program," describes the creation of a regulatory district with subwatersheds and nutrient trading for no net increase in nitrogen and removal of nitrogen loads through septic system controls, stormwater BMPs, setbacks, and water reuse. NMP Amendment, 2005.

PETITIONER'S TESTIMONY AND ARGUMENT

Testimony of Mettie Whipple

The Petitioner filed direct testimony of three witnesses. Mettie Whipple, the President of ERWA, testified that the river near her house had been adversely affected by the discharge from the treatment plant, and submitted a 2006 photograph showing plant growth on the river's surface.[22] Whipple PFDT at para. 1 and 11; Exhibit C. Her testimony also included quotations from the Environmental Impact Reports prepared during the MEPA review of the project, which stated that higher nitrogen concentrations will produce a large impact on the river and increased algal growth may affect the uses of the river. Whipple PFDT at para. 10 and 12. She appended as exhibits the land uses within the watershed and the travel times of the wastewater plumes from the plant. Whipple PFDT at para. 13 and 15; Exhibits A and B. She also compiled sampling results. Whipple PFDT at para. 17 and 18; Exh.D. On cross-examination, Ms. Whipple acknowledged that she was a "resource member" of the TAC.[23] In addition, the photograph taken near her home was downstream of Hayden Pond, a water body identified by the TAC prior to the discharge as having a "very dense" macrophyte cover. See TAC at Table III-3. She could not confirm whether the plant shown in the photograph was fanwort, an invasive species. Whipple Cross. Ms. Whipple's rebuttal testimony included an article from the Boston Globe on a $1 million federal grant to

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[22] A portion of Ms. Whipple's testimony was withdrawn after a Motion to Strike. Ms. Whipple's testimony raised the question of the appropriate scope of testimony from the president of a watershed association, identified as a lay witness who at the same time had acquired considerable knowledge of the Eel River. The parties, however, did not address this question and its resolution was not necessary for purposes of my Recommended Final Decision.

[23] The TAC Report lists 12 "resource members," including Ms. Whipple. It appears from the Minutes of the TAC general meetings, appended to the TAC Report, that Ms. Whipple attended regularly. Wendy Pabich was a full member of the TAC; Ms. Pabich was identified as a graduate student at MIT and a consultant to ERWA.

restore the headwaters of the river, a list of endangered species found in the area, and a photo showing the blocked channel at the mouth of Eel River, to support her view that a TMDL prepared for Plymouth Harbor would not address concerns related to the river. Whipple Rebuttal at para. 2, 4, 5, and 6; Exh. B, C, and D.

Testimony of Peter Shanahan

Peter Shanahan submitted testimony as an expert witness on Issue 3, related to the antidegradation provisions.[24] Dr. Shanahan is a registered professional engineer with a Ph.D. in environmental engineering, a principal at HydroAnalysis, Inc., and a Senior Lecturer in the Department of Civil and Environmental Engineering at MIT. He testified that, while freshwaters are usually phosphorus limited, the Eel River is unusual in being nitrogen limited at times, and therefore, it is necessary to control both nitrogen and phosphorus. Shanahan PFDT at 17. He stated that the Eel River is a "High Quality Water," because it exceeds minimum criteria due to its low levels of phosphorus, nitrogen, and chlorophyll a. Shanahan PFDT at para. 10. See 314 CMR 4.04(2). He described the water quality as "relatively pristine." Shanahan PFDT at para. 13.

Dr. Shanahan cited to the TAC Report frequently for support of his conclusions as to nutrient limitation. He stated that the TAC identified nitrogen as the nutrient that limits algal growth at certain times. He testified that the Eel River system is nitrogen limited, that both nitrogen and phosphorus should be controlled, but that the pollutant of

[24] Dr. Shanahan attached to his testimony only the cover of a document prepared by four MIT graduate students under his supervision for the Eel River Watershed Association entitled, *The Eel River Watershed Study: Nutrient Impact and Mitigation Assessment*, May 2002. He stated specifically at the hearing that he had not intended to submit a copy of the report for the record. Shanahan Cross-Examination. He also attached to his testimony a Memorandum for the Record dated November 15, 2006 by Department staff memorializing the discovery of slimy sculpin, *cottus cognatus*, in an unnamed tributary of the Eel River, a species not known to inhabit waters in Eastern Massachusetts. Dr. Shanahan did not refer to the slimy sculpin in his testimony but did mention that the Eel River is habitat for the bridle shiner, a species of special concern. Shanahan PFDT at para. 11.

greatest concern for the permit is nitrogen. Shanahan PFDT at para. 10, 17 and 24. He calculated that at the full permitted levels of nitrogen under the permit, the increase in nitrogen would be substantial at roughly 40%. Shanahan PFDT at para. 21.

Dr. Shanahan cited an EPA publication, *Ambient Water Quality Criteria Recommendations, Rivers and Streams in Nutrient Ecoregion XIV* (EPA, 2000), prepared as a step towards state development of numerical nutrient standards based upon river water quality data from Maine to Georgia. Comparing the relevant EPA parameters and both Eel River 1998-2000 baseline data and Eel River 2006-2007 data, he concluded that a downward trend in water quality was occurring even when the treatment plant discharged at 20% of its capacity. Shanahan PFDT at para. 24 and 25. He stated that the TAC had forecast an increase in eutrophication as inevitable and that Plymouth's 2006-2007 Data Report shows that average total nitrogen at each sampling site continues to be above baseline as it had been in 2005. Shanahan PFDT at para. 26. Based upon the antidegradation requirement of preventing impairment of existing water quality, Dr. Shanahan concluded that the nutrient impacts from all sources should be quantified to determine a trigger for nutrient reduction at the treatment plant, similar to EPA's Total Maximum Daily Load (TMDL) process or the study conducted for Edgartown Great Pond. Shanahan PFDT at para. 29 to 31; see Friends and Fishers of the Edgartown Great Pond v. Department of Environmental Protection, 446 Mass. 830 (2006).

While describing the NMP as intended to mitigate potential adverse effects of the discharge from the treatment plant, Dr. Shanahan criticized its implementation steps as "vague." Shanahan PFDT at para. 32. He stated that the phosphorus action level is too low, suggesting that the 75% level in EPA's recommended criteria was much more

protective than the 95% level in the NMP. Shanahan PFDT at para. 35. He had a similar criticism of the action levels for chlorophyll a and turbidity. Shanahan PFDT at para. 37 and 38. Of greatest concern to him was the lack of an action level for nitrogen, where the baseline levels were all below the recommended criterion, and he considered this omission a reflection of "the Town's and Department's decision to allow water quality degradation." Shanahan PFDT at para. 39. He summarized the strategy as accepting an increment of degradation from nitrogen loads prior to control of phosphorus, and contrary to the concept of antidegradation. Shanahan PFDT at para. 41. He believed that given the characteristics of the watershed, any degradation could be prevented by controlling nitrogen from the treatment plant and managing future development. Shanahan PFDT at para. 42.

In rebuttal testimony, Dr. Shanahan more pointedly characterized the Department's permitting approach as a lack of will to enforce controls on nonpoint source pollution, so there is no benefit to controlling point source discharges either. Shanahan Rebuttal at para. 2. While he generally agreed with the testimony of Dr. Mattson, he believed that both nitrogen and phosphorus should be removed from the effluent prior to discharge. Shanahan Rebuttal at para. 5. He did not believe that soil adsorption of phosphorus would be an adequate long-term strategy, based upon studies of the plume from the wastewater treatment plant at the Massachusetts Military Reservation ("MMR") where the adsorption capability eventually became overwhelmed. Id. He provided copies of the permits issued for treatment facilities in Acton and Edgartown, which have more stringent limits for phosphorus and nitrogen respectively. He testified

that lapses in monitoring by Plymouth proved that reliance on monitoring is misplaced. Shanahan Rebuttal at para. 4.

On cross-examination, Dr. Shanahan conceded that higher detection limits in the more recent data made comparisons with baseline data problematic, but he stated that he evaluated the data available.[25] He was skeptical that increases in nutrients could be attributed to an unpermitted wetlands clearing rather than the discharge from the plant, but stated that he did not know the cause. Dr. Shanahan conceded that the discharge at the Acton facility is approximately 100 feet from the Assabet River, raising the potential for breakout, as opposed to the much greater distance between the Plymouth plant and the Eel River. He stated that he did not distinguish between the Western and Eastern branches of the Eel River. Dr. Shanahan conceded that the EPA criteria for chlorophyll and total phosphorus were already exceeded in portions of the Eel River system. On redirect, he stated that removing nutrients at the treatment plant was safer than reliance on monitoring wells, when the "horse is out of the barn." He affirmed his view that the Eel River is an unusual system, warranting control of both nitrogen and phosphorus.

Testimony of Stanley D. Elkerton

Stanley D. Elkerton, a professional engineer with considerable experience in wastewater engineering, testified that the treatment plant was not operated in a manner conducive to water quality in compliance with the groundwater and surface water discharge permits. First, he stated that excessive flows were directed to the infiltration beds, as Plymouth was required to discharge 1.75 MGD to the ocean outfall and only any additional amount to the ground. Elkerton PFDT at para. 7. He cited to communications between Plymouth and the Department to support his contention that the full 1.75 MGD

[25] Apparently, CDM assigned values of ½ the detection limit if the sample was below the limit.

should be directed to the ocean. Elkerton PFDT at para. 7 to 9. He analyzed the effluent in 2007 and concluded that of the total 45.4 MG directed to the ground, only 15.1 MG would have been infiltrated if 1.75 MGD went to the ocean. Elkerton PFDT at para. 10. He believed that minimizing flows to the ground is consistent with the TAC recommendation that nitrogen management be under taken as feasible. Elkerton PFDT at para. 11.

Mr. Elkerton also noted that the treatment plant has a history of exceeding the permit limitation of 10 mg/l. Elkerton PFDT at para. 12. He linked the exceedance on one occasion with the receipt of septage at the facility, the lack of exceedances with a hiatus in acceptance of septage, and monthly septage volumes with high concentrations of nitrogen in the effluent. Elkerton PFDT at para. 12 to 16; Exh.7. He stated that the twice monthly samples of total nitrogen should be taken 15 days apart, or four times a month at least five days apart. Elkerton PFDT at para. 18. He urged specific permit revisions on each point, so that operational practices allowable under the permit could not exceed permit limitations. Elkerton PFDT at para. 20. Finally, he stated that a visit to the plant would have potentially improved his testimony. Elkerton PFDT at para. 21. On cross-examination, Mr. Elkerton acknowledged that the nitrogen discharged was about 6 mg/l, much lower than the 10 mg/l allowed under the permit, and conceded that he was not familiar with the Eel River or qualified to offer opinions on water quality.

ERWA Arguments

ERWA focused its arguments primarily on Issue 3, compliance with the antidegradation provisions of the water quality standards. ERWA argued that the permit should have been based upon a determination of the river's capacity to assimilate

nutrients without degradation and an allocated waste load to the treatment plant, citing to the approach in Friends and Fishers of Edgartown Pond, 446 Mass. 830 (2006). ERWA had initially challenged the project in MEPA because the nitrogen loads from the alternative of building the wastewater treatment plant was compared with the impacts of full build-out of the watershed as opposed to a "no build" baseline.[26] ERWA sought to protect the existing level of water quality, which is "currently moderately pristine" according to the TAC and has a population of slimy sculpin and a healthy salmonid fishery that is particularly deserving of protection according to Department aquatic biologists. ERWA argued that the permit should limit nutrients in the plant's effluent based on a TMDL study and Plymouth should be required to operate the plant in a manner that limits nutrients discharged to the ground prior to full TMDL implementation.

ERWA stated that the antidegradation provisions apply to nonpoint sources, and asserted that the Department has not applied this concept to groundwater discharge permits. ERWA compared the contemporaneous permit issued to Pinehills, which was based on a nutrient loading approach and a total limit on nitrogen discharged into the Eel River watershed, and argued that no upper limit on nutrients was established for Plymouth. ERWA called Plymouth's NMP "presently just a compendium of unreferenced tables of imprecise terminology." ERWA claimed that the Department knowingly permitted the degradation of this pristine watershed when it reissued the permit without ensuring compliance and without considering monitoring data, on the theory that nitrogen from other sources would inevitably degrade the receiving waters so that stringency as to the treatment plant was not warranted.

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[26] The appellants were dismissed for lack of standing. Enos v. Secretary, 442 Mass. 132 (2000).

ERWA argued that the testimony of Stanley Elkerton identified practices at the plant, including the receipt of septage and the timing of sampling, which may contribute to water quality degradation. ERWA advocated correcting plant operating deficiencies to further limit nutrient discharges as an interim measure, pending completion of a loading analysis. ERWA further argued that, in addition to reissuance of the permit with more stringent controls, Plymouth should be ordered to adopt Board of Health regulations for septic systems. ERWA argued that in contrast to the NMP, the Edgartown and Acton discharge permits had clear numeric triggers based upon numeric limits for nutrient loads. The NMP does not offer any means to quantify or measure the results of implementation. Further, ERWA asserted that many of the tasks identified in the NMP had not been completed, specifically identifying the failure to prepare annual reports, to adopt a bylaw more stringently regulating septic systems, to address discharges from bogs and hatcheries, and an admitted two year lapse in monitoring by Plymouth.

ERWA claimed that the allocation method used for the Edgartown treatment facility, where an overall nitrogen limit was established for Edgartown Great Pond and a target goal for the groundwater discharge, served as a model that had been upheld in administrative proceedings and in court. In addition, ERWA claimed that the baseline water quality data have been mistakenly revised by Plymouth to address detection limits. ERWA cited as well to specific instances as examples of lax compliance, such as the failure to address a stormwater pipe, the failure to send 1.75 MGD to the ocean outfall, the failure of the Department to review submitted data, and lapses in data submittal.

ERWA argued that distinguishing between the branches of the Eel River system simply ignores a portion of the watershed, particularly where the bridle shiner is found

below the confluence. ERWA stated that the TMDL planned for Plymouth Harbor will focus only on the ecosystem of the Harbor and will be irrelevant to the river. ERWA argued that the language of the permit conditions is unenforceable, pointing to the term "agree" for compliance with the NMP and the requirement for discussion and potential reductions in phosphorus if levels increase. Finally, ERWA criticized the Department and Plymouth witnesses for submitting unsubstantiated testimony and failing to review pertinent data. As a remedy, ERWA sought interim measures while a nutrient load analysis is performed, on a timetable of less than two years. [27]

PLYMOUTH'S TESTIMONY AND ARGUMENT

Testimony of David Worden

David Worden worked for Plymouth as a consultant in limnology and biology beginning in 2001 and was employed by the Department of Conservation and Recreation as the limnologist responsible for water quality monitoring at the Wachusett and Quabbin Reservoirs. Worden PFDT at para. 1-5. He described the biological monitoring program for the lotic (flowing) and lentic (impounded) waters of the Eel River system.[28] Worden

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[27] ERWA moved to include in the record the Motion for a Directed Decision and Exhibits from Docket No. 2000-091, the appeal of the prior permit that was litigated but never decided at DALA, but the motion was filed after the deadline for submittal of its direct case. In addition, a directed decision, which essentially functions within the context of the Department's hearings as a dismissal for failure to sustain a case, would of necessity be based upon the prefiled direct testimony in the matter. ERWA submitted testimony that on its face referenced and addressed data compiled after 2000, the relevant time period for Docket No. 2000-091. The Town and the Department likewise submitted testimony that goes well beyond the scope of the data available in the 2000-2001 timeframe. Therefore, re-submission of the 2001 Motion for Directed Decision cannot provide the basis for a Directed Decision in this matter. While the ERWA's concerns about the permit may have remained unchanged from the earlier permit, making them "capable of repetition," ERWA must counter the testimony filed in the 2008 permit appeal. Id. The request was therefore denied and exhibits were not included in the record.

[28] Lotic waters are sampled for periphyton (e.g., attached algae) and macroinvertebrates (e.g., aquatic insects, shellfish). Lentic waters are sampled for phytoplankton (e.g., suspended algae), with an annual survey of macrophytes (aquatic plants). Worden PFDT at para. 8. Biological monitoring was conducted by CDM from 2001 to 2003, and Plymouth resumed the program in 2006 to the present. Worden PFDT at para. 9 and 10. Additional monitoring of Russell Mill Pond was begun in 2007 to better understand its productivity and potential to export algae. Worden PFDT at para. 15.

PFDT at para. 7. Mr. Worden testified that the data from seven years of monitoring show no significant changes in the biological communities of the Eel River, either as to type or abundance. Worden PFDT at para. 16. He stated that the seasonal variability in phytoplankton populations was common in ponds with similar high rates of nutrient loading and short hydraulic residence times. Worden PFDT at para. 20. Phytoplankton growth in Russell Mill Pond, and particularly a spring bloom, was the source of organisms to lower ponds. Worden PFDT at para. 21. Some ponds showed growth of the invasive species fanwort, *Cabomba caroliniana*, which can accumulate in dense masses. He stated that the photograph provided by Ms. Whipple suggested that any changes she may have observed reflect an increase in invasive species rather than the affects of the discharge from the treatment plant. Worden PFDT at para. 23.

Mr. Worden also disagreed with Dr. Shanahan's description of the Eel River system as a High Quality Water or as relatively pristine. Mr. Worden described a system that is dominated by shallow ponds which are highly eutrophic.[29] Worden PFDT at para. 22 and 26. He also stated that the watershed suffers from cultural eutrophication from agriculture, lawn fertilizers, stormwater, and septic systems, so that the "ecosystem has multiple symptoms of advanced ecological age" from human activity. Worden PFDT at para. 31. He concluded with his opinion that even if additional nutrients were to reach the surface water from the wastewater treatment plant's groundwater discharge, there would be no significant increase in productivity or impacts to the biota. Worden PFDT at para. 33.

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[29] The hypolimnetic anoxia that occurs related to thermal stratification in Russell Mill Pond, with recycling of nutrients released from sediments, also contributed nutrients downstream. Worden PFDT at para. 27 and 28. Russell Mill Pond was effected by phytoplankton, while the other ponds were characterized by profuse macrophyte growth. Worden PFDT at para. 30.

Testimony of Kim Michaelis

Ms. Michaelis has been employed since 2005 by the Town of Plymouth, where her work includes collecting ground and surface water data to implement the monitoring program and various projects to implement the NMP. Michaelis PFDT at para. 3. She has ten years of experience in environmental science positions, including the groundwater remediation program at MMR. Michaelis PFDT at para. 4. In her opinion, the data do not indicate any nitrogen enrichment in the groundwater related to the effluent from the wastewater treatment plant, and no impact on the surface water.[30] Michaelis PFDT at para. 18. She noted that there were events during 2006 and 2007, including a wetlands clearing, which caused a spike amounting to a quadrupling of total nitrogen in the nearby sampling station and increases downstream. Michaelis PFDT at para. 19. She attributed an increase from baseline in total phosphorus in a few samples at the station near Hayden Pond to agricultural activities and stormwater from Route 3 and stated that an increase at the fish hatchery had stabilized at 1 mg/l and the level appeared to be unrelated to the treatment plant. Michaelis PFDT at para. 21-22. She stated her opinion that the surface water monitoring program has not shown a decrease in water quality from the treatment plant discharge. Michaelis PFDT at para. 23.

She explained that "because nitrogen is not the limiting nutrient in the Eel River system, addition of nitrogen to surface water bodies is not expected to cause significant ecological changes." Michaelis PFDT at para. 24, citing to NMP at 7-3. Thus, while nitrogen was monitored in the wells around the treatment plant, response actions were

[30] Relying on reinterpretation of the baseline data by Mr. Price, she testified that groundwater monitoring wells have shown either stable or decreased nitrogen, with the exception of an increase in the well located at the fish hatchery which she believed was attributable to surrounding land uses. Michaelis PFDT at para. 15 to 17.

required only if total nitrogen increased in the surface water and resulted in changes to the biological system. Michaelis PFDT at para. 25. In contrast, any change in total phosphorus, as the limiting factor for aquatic growth, required action. Id.

Ms. Michaelis provided information on the actions taken by Plymouth as required by the NMP to reduce nutrient loads or prevent future increases. For the public education program, Plymouth established a NMP Advisory Committee, created a website, and conducted watershed activities such as a clean-up day. Michaelis PFDT at para. 27. To implement an open space buffer strip along the river, and to promote enhanced nutrient removal, Plymouth purchased more than 300 acres of land and is negotiating for 40 additional acres. Michaelis PFDT at para. 27. Plymouth also has prepared a draft Watershed Management Program General Bylaw for the Plymouth Harbor Watershed, which includes the Eel River watershed and would require mitigation for nutrient loads, but she conceded it had not passed. Michaelis PFDT at para. 28; Exh. G; Cross. Plymouth had implemented stormwater best management practices at road crossings to reduce direct runoff into surface waters, including a constructed wetland treatment system near Warren Wells Brook. Michaelis PFDT at para. 29.

To reduce nutrient loads from agricultural and aquacultural operations, Plymouth was participating in activities under the Eel River Headwaters Restoration Project.[31] Michaelis PFDT at para. 30. For septic system management, Plymouth was conducting

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[31] Plymouth had already acquired 40 acres of former cranberry bog which will be retired from agricultural use. Plymouth acquired more than 80 acres of Eel River headwaters and has $2.5 million in funding to restore 1.25 miles of the river, including 40 acres of wetlands habitat and improvements to fish passage. Id. Ms. Michaelis provided estimates of reductions in nutrient loads as approximately 600 lbs/yr of nitrogen and 500 lbs/yr of phosphorus. Id. Plymouth acquired conservation land along the River, including 14 acres in 2008, 23 in 2007, and the 130 acre Eel River Preserve which abuts the 160-acre Russell Mill Pond Conservation Area. Michaelis PFDT at para. 34. Ms. Michaelis attached a press release from the Executive Office of Energy and Environmental Affairs praising Plymouth's efforts in protecting the watershed of the Eel River. Michaelis PFDT at para. 35 and Exhibit H.

an inventory and had notified all homeowners with property within 100 feet of the river of its zero interest septic upgrade loan program. Michaelis PFDT at para. 31. In 2005, Plymouth completed a feasibility study of reclaimed water use at its schools and was working with a developer to use reclaimed water to reduce nutrient loads. Michaelis PFDT at para. 32. Plymouth has maintained a residential lot size of 3 acres as recommended. Michaelis PFDT at para. 33. Ms. Michaelis also stated that Plymouth in 2007 had conducted a feasibility study of the use of constructed wetlands at the treatment plant, but that the current low flow and low nitrogen input to the infiltration beds was not sufficient to sustain a wetlands treatment system to reduce nutrients. Michaelis PFDT at para. 37.

Ms. Michaelis disagreed with several aspects of Dr. Shanahan's testimony. She stated in response to the description of the Eel River as pristine, that there are currently 1,138 lots with septic systems, and that an estimated 50% within 500 feet of the river are presumed to be failing due to their age; septic systems of any age do not provide the level of nutrient removal as a wastewater treatment plant. Michaelis PFDT at para. 39. The watershed also contained two fish hatcheries, 142 acres of cranberry bogs, and four impoundments, all tending to contribute nutrients which promote plant productivity. Id. In response to Dr. Shanahan's testimony that 70% of samples in 2006 and 2007 were higher than the EPA criteria of 0.71 mg/l, she testified that the high nitrogen levels in 2006 and 2008 were likely attributable to the wetlands clearing and the EPA criteria were not relevant to the Eel River system. As to chlorophyll a levels, she noted that current ranges were within the baseline averages. Michaelis PFDT at para. 41. She stated that the 2008 data showed a decrease in nutrient levels, which she attributed to Plymouth's

involvement in addressing the cause of prior increased levels. Michaelis PFDT at para. 42.

Ms. Michaelis conceded that NMP monitoring lapsed during part of 2004 and 2005, but resumed after Plymouth hired her to perform this work. Michaelis PFDT at para. 45; Cross. She emphasized that monitoring required by the permit was completed. Michaelis Cross and Redirect. With regard to Dr. Shanahan's urging that a TMDL be conducted, Ms. Michaelis stated that the TAC Report already estimated nutrient loads, which had been updated in 2006, and that Plymouth was participating in the Plymouth-Kingston Harbor-Duxbury Bay TMDL, which will include assessment of thresholds for nitrogen and phosphorus in the Eel River watershed. Michaelis PFDT at para. 43. She explained that a CDM loading model, while not a TMDL, could be used to analyze land use and nutrient loads. Michaelis Redirect. She responded to Dr. Shanahan's criticism of the NMP by stating that it outlines specific actions, is not vague, and does contain action levels for nitrogen. Michaelis PFDT at para. 44 and 46. In response to Dr. Shanahan's assertion that control of future development, with modern development practices and nitrogen control at the treatment facility, can control nitrogen sufficiently to prevent any degradation, Ms. Michaelis noted that much of the nutrient loads now come from existing and likely failed septic systems. Michaelis PFDT at para. 48. She conceded that a discharge from a horse farm had not been remedied and work on the dam at Russell Mill Pond had been delayed.[32] Michaelis Cross.

Testimony of Neal Price

Mr. Price is a hydrogeologist at Horsley and Witten, which had provided consulting services to Plymouth related to the Eel River watershed since 2004. Mr. Price

[32] Work on the dam was in progress and observed at the time of the view.

testified that the quality of the receiving groundwaters will be maintained for their use as private water supply, and most downgradient properties are served by the public water supply. Price PFDT at para. 8. Mr. Price examined the baseline monitoring data and concluded that comparison with later data was difficult for several reasons related to the statistical analysis.[33] Price PFDT at para. 9. He testified that Ms. Whipple and Dr. Shanahan erroneously concluded that water quality had deteriorated due to this detection limit issue. Id. Mr. Price obtained reissued data with lower detection limits where available and then reanalyzed the data. Id.

Based on this reanalysis, Mr. Price found that the wells immediately adjacent to the infiltration beds had slight to moderate increases in nitrogen, as might be expected due to proximity to the plant.[34] Price PFDT at para. 10. As to the number and depth of the groundwater wells, Mr. Price testified that their locations were selected based upon modeling of future groundwater flow paths so that the wells would adequately assess groundwater impacts from the effluent. Price PFDT at para. 16. He stated that the wells adjacent to the infiltration beds provide an "early warning" of potential impacts and

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[33] Data were omitted if considered outlying normal ranges and the data was limited to May 1998 to February 2000, but baseline conditions existed until May 2002 when the plant became operational. Thus, the number of data points and the shortened time period were unnecessarily limited and did not provide a fair comparison. Price PFDT at para. 9. More importantly, in his opinion, was that laboratory detection limits, the minimum value at which a compound may be identified from a sample, varied from 1998 to the present. Baseline sampling had lower detection limits, and data values of "Not Detected" (ND) were assigned ½ the detection limit, so that time periods with higher detection limits appear to have higher concentrations. Mr. Price disagreed with Dr. Shanahan's view that the 2006 and 2007 data show negative impacts on the river from the plant, because the issue of detection limits makes the data suspect, those increases had other identifiable causes, and because the effluent could not yet have reached the surface water. Price PFDT at para. 38 and 39. On cross-examination, Mr. Price defended his revisions to correct for detection limits but conceded that his work had been peer reviewed only within his firm.

[34] Downgradient wells showed variable slight to moderate increases or decreases, and this inconsistency was the basis of his conclusion that sources other than the plant were involved. Price PFDT at para. 11. He attributed a large decrease in total nitrogen at a far downgradient well to the travel time from the plant and concluded that the discharge from the plant had not reached more distant wells. Price PFDT at para. 13. He stated that overall, total nitrogen concentrations had increased over time, with the immediately downgradient wells from the plant showing the greatest increase as expected and two downgradient wells showing the smallest increases. Price PFDT at para. 15 and Exh. E1. Mr. Price conceded on cross-examination that the drawdown to repair the dam at Russell Mill Pond could affect groundwater flows.

represent the worst conditions because no dilution or attenuation had occurred. Price PFDT at para. 17. The downgradient wells were more than two years travel time away and indicated prevailing groundwater quality while still upgradient from the Eel River, so that any unexpected increases could be addressed if necessary. Downgradient wells may show nutrients from other land uses, in addition to the treatment plant effluent. Price PFDT at para. 17.

As depicted in a fan shape generally eastward with some northeasterly and southeasterly flow, travel times of groundwater from the treatment plant to the river ranged from two years to more than 5 years. Id. The depth to groundwater was 45 to 50 feet, allowing for increased travel times in addition to lateral transport times and additional pollutant reduction to the effluent plume. Price PFDT at para. 19. The fan shape was based upon CDM modeling at a wastewater discharge of 0.75 MGD, but because the actual discharge averaged only 0.22 MGD, the actual flow path would be more narrow and the travel times slower. Price PFDT at para. 18 and Exh. C.

As to effects on surface water, Mr. Price testified that the lack of significant increases in the downgradient groundwater monitoring wells demonstrated that the treatment plant discharge could not have increased concentrations of nutrients in the river or ponds.[35] The closest surface water sampling location to the infiltration beds, at the outlet of Russell Mill Pond, showed no change in nitrogen and a decrease in total phosphorus from baseline. Price PFDT at para. 26. Increases in nutrients were identified on the Eastern Branch and at Warren Wells Brook, sampling locations outside the

[35] He agreed with the view of the Department's witness, Steve. Hallem, based upon recent USGS modeling, that the travel time from the beds to the river is 10 to 11 years and from the beds to the water table is 3 to 7.5 years, so that the total travel time is 13 to 18.5 years. Thus, he concluded that the discharge would not have reached the river in the 7 years of the plant's operation. Price PFDT at para. 22.

effluent flowpath at 0.75 MGD. Price PFDT at para. 24 and 25. Mr. Price stated that after increases in 2006 and 2007 attributable to causes unrelated to the plant, nutrient concentrations diminished in 2008. Price PFDT at para. 28 and 29; Exh. E2 and E3. Mr. Price's opinion was that the discharge from the plant would not impair uses or cause any significant lowering of water quality, and any changes that have been observed were attributable to other factors. Price PFDT at para. 30.

Mr. Price responded to ERWA's testimony by stating that Dr. Shanahan misrepresented the findings of the TAC as to nutrient limitation. In Mr. Price's view, the TAC Report clearly concluded that the Eel River system, particularly the Western Branch that could be affected by the plant, is phosphorus limited. The Eastern Branch has lower levels of nutrients overall and may be more susceptible to nitrogen, and Mr. Price testified that Dr. Shanahan has relied on TAC statements referring to this hydrologically distinct portion of the watershed and the potential for increased productivity related to factors other than the treatment plant discharge. Price PFDT at para. 31, 36 and 40. Thus, the TAC recommended phosphorus control to protect water quality and the Department's permit focused on phosphorus, while the NMP addresses both nitrogen and phosphorus. Price PFDT at para. 32 and 33. Mr. Price believed Dr. Shanahan's statement that most of the discharged nitrogen will reach the river was incorrect, as both the TAC and the Massachusetts Estuaries Program uses an attenuation rate of 50%, and even if the figure is lower, the attenuation would still be significant. Price PFDT at para. 34. He stated that in comparison to the EPA criteria introduced by Dr. Shanahan, the Department appropriately used the best available data, as developed by the TAC. Price PFDT at para. 37.

Testimony of Gary P. Frizzell

Mr. Frizzell is the Wastewater Manager Pretreatment Coordinator for the Town of Plymouth, where he has spent more than 30 years involved in wastewater treatment. Frizzell PFDT at para. 1 through 4. His testimony included a description of the advanced treatment technology used at the plant, called sequencing batch reactors. Frizzell PFDT at para. 7. His testimony primarily responded to the testimony of Stanley Elkerton on the issues of maximizing flows to the ocean, nitrogen excursions, septage receipt, and effluent monitoring.

He stated that the facility was designed to maximize the discharge to the ocean outfall but not necessarily to require the entire first 1.75 MGD to be directed to the outfall, noting that 1.75 MGD is the ceiling for flows to the outfall under the Town's NPDES permit and the facility was designed to ensure that flows to the ocean outfall do not exceed that amount.[36] Frizzell PFDT at para. 9 and 10. He prepared a chart showing annual average flows to the ocean and to the basins; for the fully operational years 2003 to 2008, the flow to the ocean was greater then 1.5 MGD except for 2003 when it was 1.33 MGD and the flow to the basins ranged from 0.124 to 0.198 MGD. Frizzell PFDT at Exhibit 6. Thus, Mr. Frizzell concluded that in his opinion, the plant had instituted feasible operational changes to maximize the discharge to the ocean outfall and routing more flow would be inconsistent with the design of the facility. Frizzell PFDT at para.17. As to nitrogen excursions, Mr. Frizzell conceded that exceedances occurred

[36] He explained that in response to a Notice of Noncompliance from the Department in 2003, a pumping regimen was altered to increase flows to the outfall and a more sophisticated flow meter was installed to ensure accuracy. Frizzell PFDT at para. 11. He stated the Department approved the effluent management plan, which was premised on diurnal flows typically exceeding 1.75 MGD which the system was not designed to hold and thus, the excess diurnal flows were discharged to the infiltration beds. Frizzell PFDT at para. 12 through 14.

during the initial operation of the facility from May 2002 to May 2003 and from November 2006 to February 2007 after the additional of chlorine to address a settling problem. Frizzell PFDT at para. 18 and Exh. 7; Cross. He states that these excursions were isolated and reported as required to the Department. Frizzell PFDT at para. 20 and 21.

Mr. Frizzell stated that there is no correlation between the receipt of septage at the facility and higher total nitrogen concentration in the effluent as alleged by Mr. Elkerton. The exhibit showing total nitrogen in the effluent and septage receipt at the facility does not show a correlation, and in fact the average monthly nitrogen was lower in 2004 and 2005 when the facility received septage than in 2008 when it did not. Frizzell PFDT at para. 28 and Exhibits 7 and 10. Finally, as to monitoring, Mr. Frizzell testified that plant operators conduct routine tests that are not required by the permit but provide a timely assessment of plant performance. Thus, while Mr. Frizzell stated he would not necessarily oppose additional testing under the permit, he does not believe it would necessarily meet the goal stated by Mr. Elkerton of increased understanding of plant performance. Frizzell PFDT at para. 29.

Plymouth's Arguments

Plymouth argued that the TAC did not predict any degradation of water quality from the plant, the monitoring shows no significant changes, and the NMP has proven a successful tool to promote protection of the watershed. Plymouth stated that the receiving groundwater will be protected for its private water supply use, and that monitoring shows that total nitrogen in the effluent is below the permit limit of 10 mg/l, often well below that limit. ERWA identified periods of excursions, but Plymouth

argued that allegations that future exceedances may occur do not justify more stringent permit limitations, citing Matter of Otis Wastewater Treatment Facility, Docket No. 98-120, Final Decision (June 15, 1999). Plymouth stated that wells adjacent to the infiltration beds show an expected increase in nitrogen, and results in the downgradient wells show that the permit properly established discharge limitations under 314 CMR 6.07(2). Similarly, Plymouth asserted it has shown that the monitoring complies with the regulatory standards at 314 CMR 6.08 through the locations of the inner and outer sets of wells and the frequency of sampling.

As to the antidegradation provisions, Plymouth noted that they are intended primarily to apply to discharges to surface waters, that this discharge is not new, and that even if the Western Branch is a High Quality Water, the nutrient of concern is phosphorus, not nitrogen as urged by ERWA. Plymouth argued that the permit's focus on phosphorus is therefore appropriate, and monitoring does not show any degradation of water quality from the treatment plant. In response to ERWA's view that the permit condition on phosphorus was insufficient, Plymouth argued that phosphorus was attenuated in the subsurface environment so that additional controls were not necessary, or according to the Colman report, could be counterproductive. Hearing Exhibit 13, p. 26. The monitoring regimen for phosphorus was sufficient to identify and address any impacts that could occur from phosphorus, so no effluent limitation or additional conditions were warranted.[37] Plymouth noted that the permit contain provisions to

[37] Plymouth further argued that Dr. Shanahan's comparison of the 2006-2007 data to the baseline in support of his opinion that water quality had deteriorated was invalid due to various analytical shortcomings and the failure to consider that other factors might be responsible for any increase in nutrients. Plymouth asserted that its witnesses showed that the monitoring results are not evidence of degradation from the treatment plant discharge, and that the discharge, in fact, has not reached the river. While conceding a gap in NMP monitoring, Plymouth asserted that the program is now fully implemented by Ms. Michaelis.

reduce both nitrogen and phosphorus through the NMP.[38] Plymouth argued that a TMDL is not necessary because, as explained by Ms. Michaelis during the hearing, Plymouth studied nutrient loads in 2006 and a TMDL is already underway for Plymouth Harbor. As to ERWA's claim that the first 1.75 MGD must be allocated to the outfall, Plymouth argued that the permit requires that discharges to be the outfall be maximized. The Town further stated that its current discharge of 1.663 MGD is close to 1.75 MGD, the NPDES permit limit, and any further permit condition would be costly without any demonstrated environmental benefit.

DEPARTMENT TESTIMONY AND ARGUMENT

Testimony of Mark Mattson

The Department's expert witness on water quality was Mark Mattson, the principal author of the 2004 *Final Generic Environmental Impact Report on Eutrophication and Aquatic Plant Management* and numerous lake TMDLs during an 11 year career at the Department. He has a PhD in Ecology, and also was a senior research scientist at the University of Massachusetts Water Resources Research Center. Mattson PFDT at para. 1 and Exh. A. Dr. Mattson testified that Russell Mill Pond had been listed as impaired on the 303(d) list since 1998, and upon further evaluation in 2003 was still considered impaired due to noxious aquatic plants based on a measured secchi disk transparency of 1.0 m. Mattson PFDT at 5 to 7. Sampling of periphyton (attached algae) both upstream and downstream of Russell Mill Pond in 2006 indicated generally low

[38] Plymouth identified its purchase of conservation land and implementation of stormwater BMPs as examples of actions under the NMP. Plymouth asserted that Dr. Shanahan's view of the NMP as vague and routine was simply uninformed. The NMP contained specific triggers for action, and the NMP was an enforceable requirement of the permit, even if the drafting may suggest otherwise.

densities and confirmed that those segments were not impaired by noxious aquatic plants. Mattson PFDT at 8.

Dr. Mattson described an evolving, and more complex, understanding of nitrogen and phosphorus limitation. He noted that the TAC reported nitrogen to phosphorus ratios in two ways, in the dissolved inorganic forms of DIN:PO4 uM (called the Redfield ratio in the TAC Report) and as a ratio of total nitrogen to total phosphorus (TN:TP). As to the dissolved inorganic forms, the TAC had viewed ratios of less than 16 in the spring and summer as indicating nitrogen limitation. He noted, however, that the total ratios of TN:TP at sampling sites 1 to 6 had a median ratio of 24.75, and 34 of the 36 ratios at the sites exceeded 16, indicating phosphorus limitation. Mattson PFDT at 9. Dr. Mattson testified that most researchers, including himself, use the total ratios or N:P in seston rather than the dissolved inorganic form (DIN:PO4) to determine nutrient limitation. Mattson PFDT at 10, citing Wetzel (2001) and Dodds (2003). One reason to rely on TN:TP ratio is that low concentrations of PO4 are difficult to measure, as inaccuracy may result from the low detection levels. Mattson PFDT at 10.

Dr. Mattson cited to scientific literature supporting the view that a more comprehensive view of nutrient limitation is warranted, replacing reliance on whether the ratio of nitrogen to phosphorus is greater or less than 16. Mattson PFDT at 11, citing Elser et. al. and Horne and Goldman. He testified that the algal community, comprised of multiple species, is likely to be co-limited by both nitrogen and phosphorus if ratios are close to 16. Mattson PFDT at 11. He stated, however, that even where there is co-limitation or slight nitrogen limitation from previous phosphorus influx, it was better to focus on control of phosphorus. Dr. Mattson stated his view that control of phosphorus is

easier and more cost-effective, does not favor cyanobacteria which blooms under nitrogen limitation, and phosphorus does not have a gaseous phase. Nitrogen limitation favors cyanobacteria, which can biologically fix and uses nitrogen from the atmosphere. Mattson PFDT at 12. On cross-examination, Dr. Mattson stated that he had not reviewed the 2008 permit or the sampling results, but he reiterated his agreement with the permit approach and provided an explanation of why only the limiting nutrient must be controlled.[39]

Testimony of Alan Slater

Alan Slater is the Section Chief of the Department's Groundwater Permitting Program, has an M.S. in Environmental Engineering and has been a registered Professional Engineer since 1983. He testified that typically a groundwater permit for a municipal wastewater treatment plant will focus only on its discharge, but the Plymouth permit was unique in that NMP contained a comprehensive management plan to control nutrients from all sources and had been included as an enforceable condition of the permit. Slater PFDT at para. 30. He stated that although the permit allowed the discharge of an annual average of 0.75 MGD to the ground and total nitrogen of 10 mg/l, since 2002 the actual flow has averaged only 0.15 MGD and nitrogen has generally been between 3 and 5 mg/l. Slater PFDT at para. 31.

Mr. Slater countered Ms. Whipple's testimony by asserting that the discharge from the plant has not yet reached the Eel River, and that the macrophyte growth she

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[39] Dr. Mattson concluded his testimony with this quote from a state guide to lake management:

> One of the most effective ways to control algal populations is by limiting the nutrient supply to the lake, and thus limiting growth of algae. Phosphorus is the best nutrient to control, and the nutrient control options will deal primarily with phosphorus control. Even in cases where lakes are limited by nitrogen, phosphorus control is still the preferred method to control algae.

Mattson PFDT at 13, quoting Wagner K., *The Practical Guide to Lake Management in Massachusetts*, 2004.

observed in 2006 had been seen in the ponds before the plant was constructed. Slater PFDT at para. 32 and 33. He reviewed the data compiled by Ms. Whipple and noted a wide variation in values prior to the plant's discharge, indicating the presence of other sources of nutrients within the watershed as identified in the TAC Report. Slater PFDT at para. 41. He countered Mr. Elkerton on the volume of discharge routed to the infiltration beds by stating that the original permit required that the facility "maximize" flows to the ocean.[40] While agreeing with Dr. Shanahan that a long-term discharge of sewage can overcome the adsorption capability or change the geochemistry to allow phosphorus mobility in the soil, Mr. Slater testified that the monitoring provisions for pH and phosphorus were designed to determine if levels increase, indicating such mobility.[41] Slater PFDT at para. 38.

Mr. Slater testified that the EPA Nutrient Criteria Recommendations cover an extensive geographical area and specifically state that criteria development should reflect local conditions, as was accomplished by the TAC. Slater PFDT at para. 39. He emphasized the TAC conclusion that phosphorus control was the key to preserving the health of the river system. Slater PFDT at para. 40. Finally, he stated his professional opinion that the permit complied with all regulatory criteria for establishing limitations for a groundwater discharge to Class I groundwaters and complied with the

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[40] He further noted that the excursions related to the 10 mg/l of nitrogen were addressed by the Department in a Notice of Noncompliance followed by a Return to Compliance Plan. Slater PFDT at para. 35. Isolated exceedances were possible in sequencing batch reactors because it is a biological treatment, but it is nonetheless a standard and successful method for nitrogen removal. Slater PFDT at para. 36. As to the issue of septage at the facility, Mr. Slater stated that the facility was designed to accept septage and a review of the data showed that the nitrogen concentration in the effluent was not related to the volumes of septage delivered to the facility. Slater PFDT at para. 37.

[41] On cross-examination, Mr. Slater conceded he was not familiar with the data underlying the TAC conclusions regarding phosphorus and acknowledged that the Stearns and Wheeler Third Party Review stated that "flexibility for additional phosphorus removal should be considered." Stearns and Wheeler Report at ES-5. Nonetheless, Mr. Slater reiterated his view that the phosphorus controls were protective and he had no reason to believe the phosphorus would not be adsorbed so that it would not impair the water quality of the Eel River. *See* Stearns and Wheeler Report at 3-3.

antidegradation provisions for surface waters by ensuring that no degradation will occur in the river, due to the monitoring for phosphorus, the action triggers, and the NMP. Slater PFDT at para. 42 and 44.

Testimony of Steve Hallem

Steve Hallem is a hydrogeologist with a master's degree in hydrogeology, and he provides technical support for policy development and permitting at the Department.[42] He estimated that it would take between 6.5 and 7.5 years for the discharge to reach the water table, at a depth of 45 feet, or from 3 to 4 years using a second methodology. Mr. Hallem testified that at 0.15 MGD, the discharge would take 9.9 to 11 years to reach the closest reach of the Eel River from the saturated water table. At 0.75 MGD, the discharge would take between 4.4 years and 47.3 years (average of 37 years) depending on the depth of the aquifer the water reaches. He concluded that the discharge from the plant had not reached the surface water in the Eel River. Id.

Department's Arguments

The Department argued that after intensive planning by the Town, review in MEPA, and study by the TAC, the permit was protective of the water quality of the Eel River. Even if a "High Quality Water," the Eel River showed some signs of nutrient enrichment prior to any discharge from the plant but was not an impaired water body for which a TMDL would be required.[43] The Western and Eastern Branches of the river

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[42] He stated that he was familiar with the USGS Plymouth-Carver studies of the hydrogeology of the area of the Eel River. Hallem PFDT at para. 1 and 6. His testimony included maps showing the location of the plant, the river and ponds, and the monitoring locations. Aerial photographs show the increase in residential development of the area north of Russell Mill Pond between 1996 and 2008. Hallem PFDT at para. 7. On cross-examination, Mr. Hallem conceded that he had not read the TAC Report in its entirety or visited the Eel River watershed. He stated that the USGS Report he referenced was final but not yet published and that his conclusions had not been peer reviewed.

[43] As to the antidegradation provisions, the Department argued that, even if the entire Eel River system were to be considered a High Quality Water, the permit does not allow any degradation and there has been

differ as described by the TAC, but nitrogen is expected to increase throughout the watershed. Because the TAC believed that the system either was already, or was in the process of becoming, phosphorus limited, the permit properly focused on phosphorus.[44] The permit was conditioned to detect any phosphorus early and require action before surface waters are affected. The Department took the unusual step of including the NMP as a permit condition to ensure the reduction of nutrients from all sources throughout the watershed. The Department asserted that the investigation involved, the permit requirements, and the NMP exceed a TMDL analysis and provide an ample margin of safety. The Department asserted that ERWA has been unable to show any link between the discharge from the plant and any increase in nutrients in the surface water, either by conducting any monitoring of its own or showing that the discharge could actually have reached the source waters of the Eel River. Thus, the Department argued that any claims are speculative at best.

As to monitoring, the Department argued that twice monthly sampling is more than customarily required and only if reuse were added would four times a month be required. Any lapses in monitoring should not be grounds for assuming that the permit is defective, and Plymouth has more recently resumed its responsibilities under the NMP.

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no evidence that any degradation has actually occurred as a result of the discharge. The Department argued that the concept of High Quality Waters may not apply at all in the context of groundwater discharges as a nonpoint source discharge to a surface water, but instead only the protection of existing uses is required. However, whatever regulatory distinctions may apply, the Department argued that ERWA had not shown any degradation from the plant, and any evidence of nutrient enrichment could be explained by other sources or simply the explosive growth of an invasive plant species.

[44] The Department argued that ERWA was not satisfied with the focus on phosphorus because it has been concerned instead about nitrogen, and looks to the permit for the Pinehills development as a better model. The Pinehills permit allowed nitrogen loading over a large acreage, but nitrogen moves through the ground unattenuated as opposed to the considerable removal at a treatment plant (from 30 mg/l to 5-6 mg/l) within a more discrete area.

The Department claimed that there was no evidence that either further maximizing the discharge to the outfall or greater monitoring related to septage would be more protective.

DISCUSSION

Although the testimony was wide-ranging, the issues for adjudication focused specifically on whether the groundwater discharge permit for the Plymouth wastewater treatment plant meets the applicable requirements of the groundwater and surface water quality standards at 314 CMR 6.00 and 4.00, specifically the establishment of discharge limitations at 314 CMR 6.07(2), monitoring at 314 CMR 6.08, and the antidegradation provisions at 314 CMR 4.04(1) and (2). The testimony of the parties primarily focused on whether the permit is protective of the surface water quality of the Eel River system. Thus, I addressed Issue 3 in considerable detail, including the fundamental questions raised about nutrient limitation, the respective roles of nitrogen and phosphorus, and how they are measured. Issues 1 and 2 relate to the protection of groundwater from the discharge of nitrogen and phosphorus in the effluent from the treatment plant, and allow a relatively straightforward resolution.[45]

Issue 1: Whether the groundwater discharge permit meets the requirements for the establishments of discharge limits at 314 CMR 6.07(2).

When regulating a discharge to the ground, the Department is required to impose a level of treatment in the permit to insure that the water quality standards of receiving waters will be maintained or attained. The Department must consider natural background conditions, must protect existing adjacent and downgradient uses, must not interfere with the maintenance and attainment of beneficial uses in adjacent and downgradient waters,

[45] Issue 4, related to the Department's failure to comply with procedural requirements for the preparation of a fact sheet and whether a remedy is warranted, was decided prior to the hearing and is addressed in the section on procedural history.

and may provide a reasonable margin of safety to account for any lack of knowledge concerning the relationship between the pollutants being discharged and their impact on the quality of the groundwaters. 314 CMR 6.07(2). The issue was limited in scope to the discharge limits for nitrogen and phosphorus.

Friends and Fishers established that the references to "receiving waters" and "adjacent and downgradient waters" in 314 CMR 6.07(2) apply to groundwater, not surface waters. Friends and Fishers, 446 Mass. at 840, n. 14. Thus, the receiving waters for purposes of 314 CMR 6.07(2) are groundwaters downgradient from the treatment plant. The effluent limitations for Class A, drinking water, apply to this groundwater discharge. The standard for nitrogen is 10 mg/l. 314 CMR 6.06. There is no standard for phosphorus. ERWA challenged the effluent limits for nitrogen and phosphorus, but did not provide any evidence to show that an effluent limit lower than the groundwater quality standard of 10 mg/l was warranted to protect groundwater quality. ERWA did not show any risk from the discharge of phosphorus to the quality of the groundwater. See Richard Healer v. Department of Environmental Protection, 75 Mass. App. Ct. 8 (2009). Thus, I find that the Department has properly established effluent limits in the permit to protect groundwater quality.

2. Whether the groundwater discharge permit meets the applicable requirements for monitoring at 314 CMR 6.08?

314 CMR 6.08 applies to monitoring of effluent at the point of discharge to groundwater from the plant, groundwater sampling, and groundwater well monitoring. 314 CMR 6.08(1) and (2). Effluent samples must be collected prior to being discharged to the ground. 314 CMR 6.08(1). Groundwater sampling locations must take into

account pollutant mobility and attenuation. ERWA did not challenge the location of the effluent sampling locations, the locations of the adjacent and downgradient groundwater monitoring wells, or claim that the number of groundwater monitoring locations was insufficient.

ERWA challenged the receipt of septage at the facility and attempted to prove that the septage was handled in a manner that additional nitrogen would not be recorded in the effluent monitoring reports. The evidence provided by Plymouth was sufficient to refute this claim, as there was no consistent correlation between septage receipt and increased levels of total nitrogen in the effluent. ERWA noted that twice monthly samples had been taken within seven days, and urged that twice monthly samples be taken 15 days apart, or four times a month at least five days apart. The Department and Plymouth argued that additional sampling requirements were not necessary.

General Condition 10 of the permit states that "[s]amples and measurements taken for the purpose of monitoring shall be representative of the monitored activity." This general condition appears sufficient to address selective sampling to improve results. Thus, if it were true, as Mr. Elkerton suggests might be the case, that treatment plant operators were choosing days for sampling based on the expected quality of the effluent, the Department would have the authority to pursue an enforcement action against Plymouth for violation of the permit. Thus, I find that the monitoring required by the permit as conditioned by General Condition 10 meets the requirements of 314 CMR 6.08.

Issue 3. Whether the groundwater discharge permit meets the requirements, to the extent applicable, of the antidegradation provisions at 314 CMR 4.04(1) and/or (2)? [46]

The antidegradation provisions require that existing uses and the level of water quality necessary to protect the existing uses be protected and that High Quality waters be protected and maintained for their existing level of quality.[47] ERWA identified nitrogen as the nutrient of primary concern in the Eel River watershed. ERWA argued that the permit is not sufficiently protective to prevent the discharge from the wastewater treatment plant from degrading the water quality in the Eel River and points to conditions that demonstrate that degradation has already occurred. ERWA advocated for a TMDL-type study to provide the basis for nutrient allocations, and in the meantime urged improvements in the operation of the plant. After considering all the evidence and argument, I conclude that the requirements of the permit properly reflect the TAC's recommendations related to the control of phosphorus, comply with the antidegradation provisions, and are sufficient to protect the surface water quality of the Eel River from degradation by the treatment plant's discharge to groundwater. [48]

Applicability of the Antidegradation Provisions

Although the antidegradation provisions appear in the Surface Water Quality Standards, they apply to groundwater discharges because the regulations prohibit the

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[46] The antidegradation provisions are one component of the Surface Water Quality Standards, which establish goals for water bodies and provide the basis for water quality- based effluent limitations in surface water discharge permits.

[47] High Quality Waters are waters whose quality exceeds minimum levels necessary to support the national goal uses, low flow waters, and other waters whose character cannot be adequately described or protected by traditional criteria. 314 CMR 4.04(2).

[48] In many instances, ERWA viewed the permit from the perspective of whether it could be more protective of water quality. Friends and Fishers held that the Department need not endorse the most conservative assumptions, but may instead accept the most likely assumptions as to the protectiveness of a permit.

issuance of a groundwater discharge permit that would cause or contribute to a contravention of both groundwater and surface water standards. 314 CMR 5.06(1); 314 CMR 5.19(1). Friends and Fishers cautioned against arguments that "merge" the ground and surface water permitting programs and standards, but concluded that the antidegradation provisions apply "to some extent." Friends and Fishers, supra. Friends and Fishers did not address the question of High Quality waters.

Under 314 CMR 4.04(1), existing and designated uses of all waters must be protected. [49] The standard for a High Quality water at 314 CMR 4.04(2) is to protect the existing level of water quality, essentially maintaining its quality at its higher level. Limited degradation may be allowed either through an authorization procedure or where the new or increased discharge is "insignificant," i.e., it does not have the potential to impair any existing use *and* does not have the potential to cause any significant lowering of water quality. 314 CMR 4.04(2).[50] While the provision on "new and increased discharges" applies to point source discharges as opposed to the nonpoint source discharge at issue here, it does not necessarily follow that the concept of the protection of High Quality waters does not apply at all in the context of a groundwater discharge

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[49]The concept of protecting existing uses and high quality waters is derived from EPA's antidegradation policy, which states are required to implement in their surface water quality standards. 40 CFR §131.12(a)(2); 33 U.S.C. §1313(d)(4)(b). Existing uses are designated uses and any other uses actually attained in the water body after November 25, 1975. 314 CMR 4.02 Existing Use. This provision provides protection of existing (since 1975) instream beneficial uses, including the health and diversity of aquatic species, and the level of water quality necessary to protect those uses. The provision allows any lowering of water quality only if the uses are fully protected. See U.S. EPA, Water Quality Standards Handbook, Second Edition, August 1994, Chapter 4 – Antidegradation and Appendix G – Questions and Answers on Antidegradation dated August 1985.

[50]In the Ruling on the Motion in Limine, I viewed this discharge as "new," even though the 2008 permit was a renewal, because the earlier permit was appealed and never reached final agency action. I further note that there is an authorization procedure for limited but significant lowering of water quality under defined circumstances for surface water discharges, but this authorization procedure applies to point source discharges. 314 CMR 4.04(5). Finally, I note that because the protection of uses dates to 1975, the antidegradation provisions would appear to address the concern of ERWA that the point of reference for water quality would be a future full build-out condition rather than prior to the discharge from the plant.

permit. See Matter of Town of Hopkinton, Docket No. 2007-148 and 165, Recommended Final Decision (October 7., 2009), adopted by Final Decision (October 9, 2009) ("new or increased discharge" prohibition in Outstanding Resource Water provision does not apply to nonpoint sources, but ORW protected for values identified in ORW designation).

By operation of the regulations, Eel River is presumed a High Quality water to the extent its level of water quality exceeds the minimum levels necessary to support Class B goal uses. 314 CMR 4.06(4). The evidence shows that the Eel River system varies in water quality. Witnesses testified as to whether the Eel River is "pristine." The term "pristine," however, is not synonymous with a High Quality water, which is a technical term derived from federal law. Russell Mill Pond is identified as impaired by aquatic nuisance vegetation on the 303(d) list, and thus is not a High Quality water as to nutrients.[51] The TAC did not address the Eel River's status under the antidegradation provisions, but it sought to prevent significant ecological changes from increases in nutrients within the watershed, with the goal of maintaining the level of quality as it existed at the time of the baseline monitoring from 1998 to 2000.[52]

Although the Department and Plymouth were reluctant to accept a regulatory classification of High Quality for the Eel River or indeed any application of the

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[51]High Quality waters are determined on a parameter by parameter basis, so that a water body may be high quality as to one parameter but not others.

[52]The TAC viewed a change in trophic state as a significant lowering of water quality, in the context of a shift of the Eastern Branch to mesotrophic, so a shift for the Western Branch from mesotrophic to eutrophic would be a significant lowering of water quality. The parties did not address the question of precisely what level of water quality above the protection of existing uses was or should be required and how it should be measured to prevent the hallmarks of impairment, algal blooms and excessive macrophytic growth. Indeed, it is not apparent whether, in the context of nutrient enrichment, there is a difference between the protection of existing uses and the protection of the existing level of water quality, as the presence (or absence) of algal blooms and excessive macrophyte growth would either fail to meet (or meet) both levels of protection.

antidegradation provisions to the nonpoint source discharge from the plant, neither argued that the conditions on phosphorus and nitrogen in the permit would allow a significant lowering of water quality.[53] The provisions in the permit and NMP requiring action in response to increases in phosphorus levels provide support for a conclusion that the Department intended to maintain the level of surface water quality prior to the groundwater discharge from the treatment plant. Thus, it appears reasonable to conclude that the Department should not allow a significant lowering of a High Quality water when issuing a groundwater discharge permit. The Department and Plymouth argue that no impairment of uses or significant lowering of existing water quality has or will result from the discharge from the treatment plant. Thus, despite some ambiguity around the regulatory standard, the goal for the protection of the Eel River from impacts from the discharge are not genuinely disputed.

EPA Ambient Water Quality Criteria Recommendations

The narrative criterion for nutrients is similar to the antidegradation standard: surface waters shall be free of nutrients that would cause or contribute to an impairment of existing or designated uses. 314 CMR 4.05(5)(c). The Department has not established

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[53] In 2001, the Department argued, in response to a motion by the Petitioner in the earlier appeal of Plymouth's 2000 permit to add this issue, that the antidegradation provisions at 314 CMR 4.04 were inapplicable to an appeal of a groundwater discharge permit because it is part of the surface water quality standards. The Administrative Magistrate concluded that the surface water quality standards, including the antidegradation provisions, did apply, citing 314 CMR 5.19(1) and 314 CMR 5.06(1). Ruling on Motion of the ERWA and Mettie Whipple to Add Issue, Docket No. 2000-091 (August 3, 2001). In the Final Decision for the Edgartown case and under the regulations applicable here, the Commissioner specifically referenced the antidegradation provisions of the water quality standards as applicable. Matter of Edgartown Wastewater Commission, Docket No.s. 99-046, 047, and 048 (April 22, 2002), Final Decision (August 22, 2002). In March 2009, the Department's regulations had been revised to state "All permits shall also contain limits which are adequate to protect surface waters for their existing and designated uses and to assure the attainment and maintenance of the Massachusetts Surface Water Quality Standards. The Department shall consider natural background conditions and any Total Maximum Daily Loads established by the Department, shall protect existing uses of hydrologically connected downgradient ground waters and surface waters, and shall not interfere with the maintenance and attainment of beneficial uses in hydrologically connected downgradient waters." 314 CMR 5.10(3) (March 2009).

numeric criteria for nutrients. Under Section 304(a)(1) of the Clean Water Act, EPA recommends water quality criteria that states may consider for purposes of adopting state standards for pollutant levels necessary to protect state water bodies under Section 303(c)(2). EPA recommended numeric standards for Rivers and Streams in Nutrient Ecoregion XIV, the Eastern Coastal Plain, in 2000. Dr. Shanahan used the recommended criteria for total phosphorus, total nitrogen, chlorophyll a and turbidity for purposes of evaluating the water quality in the Eel River. Shanahan PFDT at 24-25 and Cross-exam.[54]

The Department and Plymouth argue that the EPA Recommended Criteria have not been adopted in Massachusetts and their use in this context is inappropriate. The EPA document contains a section entitled "Best Use of this Information," which clarifies that EPA does not expect states to adopt its proposed numeric criteria but instead anticipates that in most cases it will be necessary for states to develop more refined criteria based on local information and expertise. EPA Recommendations at 4-6. Indeed, it is clear from Dr. Shanahan's testimony that the EPA criteria do not offer a good match; he states that of the baseline data, 50% exceeded the EPA criterion for phosphorus, even though he described the Eel River as "relatively pristine" and no party asserted that any use was impaired. Shanahan PFDT at para. 25. The TAC was a source of local information and expertise for the Eel River, and I find that the TAC Report provides the most relevant and accurate benchmarks and recommendations. Any numeric criteria for nutrients that the Department may establish in the future in 314 CMR 4.00 will be applicable as effluent limitations for future permit renewals.

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[54] He used the EPA criteria for purposes of comparison to the monitoring results from 2006-2007 and for assessing the action levels and 95% exceedance levels in the NMP.

Nitrogen or Phosphorus Limitation

The gravamen of this dispute is the relative importance of nitrogen and phosphorus as the nutrient of primary concern in the Eel River watershed. The TAC identified phosphorus as the critical nutrient to control, as nitrogen was projected to increase even with controls because of anticipated development and the lack of attenuation. ERWA argued that degradation of water quality will occur from nitrogen before the system becomes phosphorus limited, and that the approach underlying the permit assumes future degradation from increased nutrients in the watershed is inevitable. It appears from the record that nitrogen was the nutrient of concern during the early stages of project planning in the 1990s.[55] The initial focus on nitrogen may have reflected concerns about nitrogen levels in the marine waters of Plymouth Harbor or from the permit for Pinehills. The TAC in the late 1990s identified phosphorus as the nutrient of concern, and the permits issued in both 2000 and 2008 reflected this focus on phosphorus.

This shift in focus from nitrogen to phosphorus may also be attributable to shifts in the scientific approach to nutrients that occurred after the planning related to this discharge began. First, the replacement of the "Redfield ratio," based upon dissolved forms, by a ratio of total nitrogen to total phosphorus may yield a different result as to

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[55] Apparently, the planning of the facility as of 1993 was based upon data that identified nitrogen as the limiting nutrient. *See* Town of Plymouth, Wastewater Treatment Facilities Plan/Environmental Impact review, Phase II, Vol. 3 – Draft Report, EOEA #8228, prepared by Camp Dresser & McKee ("CDM")(October 1993), Hearing Exhibit 3. This report states that higher nitrogen concentrations, from a 2.45 MGD flow and 1 mg/l nitrate, "will produce a large impact on the river." Id. at 6-43. It appears that this conclusion may have been based upon nitrate and inorganic phosphorus rather than total nitrogen and total phosphorus. Id. at Table 6-19. Plymouth commissioned a third party review of its plan that stated that the modeling analysis assumed the Eel River system was nitrogen limited. *See* Third –Party Review of Wastewater Facilities Plan Prepared for Plymouth, Stearns & Wheeler (October 1996) at 3-4, Hearing Exhibit 20. The review concurred with an earlier assessment that minimal impacts at .6 MGD would be expected, and suggested further monitoring and a "build and measure approach." Id. at 3-9 and 3-7.

which nutrient is limiting.[56] Second, a more refined view has emerged of the importance of nutrient limitation when both are low or co-limiting. Third, Massachusetts state environmental agencies adhere to the view that controlling phosphorus to control algae is preferable as to both cost-effectiveness and disfavoring harmful cyanobacteria.[57] I conclude that each of these views, stated by the Department's witness and not disputed by the Petitioner's witness, reflect the best current science, and when applied to the Eel River and the Plymouth discharge, supports the Department's permit conditions for both nitrogen and phosphorus.

All parties agree that nutrients such as nitrogen and phosphorus are required for plant growth generally at a constant ratio of 16:1 (molar; 7.2:1 by weight), with phytoplankton growth limited by a deficiency in either nutrient. If one is less available relative to the other, it can restrict plant growth and is called the limiting nutrient. Because the limiting nutrient controls the rate of growth, a management approach to avoid excessive growth will likely focus on the limiting nutrient.[58] In other words, phosphorus limited means that there is proportionately less phosphorus than nitrogen (or excess nitrogen) and nitrogen limited means that there is proportionately less nitrogen than phosphorus (or excess phosphorus). Generally, phosphorus is the limiting nutrient in freshwater and nitrogen is limiting in marine waters.

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[56] Redfield is the scientist who observed that the ratio of carbon to nitrogen to phosphorus in marine phytoplankton was relatively constant at 40:7:1 by weight.

[57] According to the Centers for Disease Control, cyanobacteria can cause harmful algal blooms that may produce toxins powerful enough to affect the brains and liver of animals and humans. Also called blue-green algae, cyanobacteria is more closely related to bacteria. Exposure to high concentrations may cause a variety of health effects; studies continue on the effects of long-term exposure to low levels of cyanobacteria toxins. *About Cyanobacteria*, Centers for Disease Control, May 2004.

[58] The concept of limitation may be somewhat counterintuitive, as the limiting nutrient is the deficient nutrient. Thus, it would seem logical to develop a control strategy which would address the nutrient in excess, but instead the approach is most likely to attempt to further restrict the nutrient that is already in short supply. In addition, both nutrients may be very low or both may be very high. Other factors such as water temperature, light, and residence time are important to the rate of algal growth and may be specific to the water body and season.

Although the parties relied on the TAC Report as the source of the baseline assessment of nitrogen and phosphorus in the Eel River system, they differ in their assessment of nitrogen and phosphorus as limiting nutrients in the Eel River watershed. ERWA identified nitrogen as limiting and the nutrient of most concern, and advocated for strict controls on both phosphorus and nitrogen and the development of a TMDL-type allocation for nitrogen. Plymouth argued that the Eel River is phosphorus limited, justifying the focus on control of phosphorus in the permit and NMP, but also citing to the NMP as controlling nitrogen as well. The Department's expert witness identified phosphorus as limiting in the Eel River system, but stated that even if the algal community is limited by both nitrogen and phosphorus or slightly nitrogen limited, the nutrient of concern from a management perspective should be phosphorus. ERWA's expert witness did not disagree with the Department's expert witness as to the importance of phosphorus, but asserted a transition from a current nitrogen limitation to a projected phosphorus limitation during which there will be an "incremental degradation" of water quality. Shanahan Rebuttal at para. 7.

The TAC Report data for the surface water monitoring stations is presented in Figure IV-7, Nitrogen to Phosphorus Ratios. TAC at Figure IV-7. The figure shows two ratios, the "Redfield Ratio" based upon the dissolved inorganic forms (N:P (DIN:PO4 uM)) and "TN:TP" or Total Nitrogen to Total Phosphorus (TDN+PON:TP uM). Using the "Redfield Ratio," 24 of 36 ratios were below the value of 16. Using the TN:TP ratio, 34 of 36 exceeded the value of 16. Id.; see Mattson at para. 9. The text states that the inorganic nitrogen and phosphorus were evaluated to determine which nutrient would stimulate production, noting that ratios less than 16 indicate nitrogen limitation but values

were between 8 and 24 are not definitive. The TAC concluded that the system may alternate between nitrogen and phosphorus limitation, with an indication of nitrogen limitation during the spring and summer. TAC Report at IV-2. While the TAC clearly concluded that the system would become strongly phosphorus limited, the text discusses the "Redfield Ratio" rather than the TP:TN ratio. This focus of the text on the "Redfield Ratio" in the TAC Report, together with some ambiguity over the branches referred to, may be one source of ERWA's firmly held belief that the Eel River is nitrogen limited and that nitrogen is the nutrient of greatest concern.

The Department's expert witness testified that TN:TP ratios should be used instead of dissolved DIN:PO4 ratios, i.e., the "Redfield Ratio." Dr. Mattson noted that low concentrations of PO4 are difficult to measure, a problem acknowledged by the TAC. He cited to a study by W.K. Dodds, entitled *Misuse of inorganic N and soluble reactive P concentrations to indicate nutrient status of surface waters,* J. N. Am. Benthol. Soc. 200322(2):171-181. ERWA's expert, Dr. Shanahan, did not dispute this view. In fact, he generally agreed with Dr. Mattson's testimony, stating that Mattson had made "a compelling case for the control of phosphorus in nutrient enriched freshwater ecosystems." Shanahan Rebuttal at 7. Dr. Shanahan believed Dr. Mattson's testimony supports the view that there is the potential for incremental degradation from the discharge and that removal of phosphorus from the effluent prior to its discharge from the wastewater treatment plant should be required.

The testimony supports a finding that for purposes of determining nutrient limitation, the total nitrogen to total phosphorus (TN:TP) ratio should be used instead of the inorganic DIN:PO4 ratio. I base my conclusion on the opinion of Dr. Mattson, which

he supported by reference to the research by Dodds and which was not refuted by Dr. Shanahan.[59] I find that the data from the TAC Report based on TN:TP ratios, with 34 of 36 exceeding the value of 16, suggests that the Eel River system, and particularly the Western Branch, is more likely phosphorus limited than nitrogen limited.[60] The TAC Report is the only source of these ratios in the record. Thus, to the extent that Dr. Shanahan's concern about incremental degradation during the transition between nitrogen limitation and phosphorus limitation, a conclusion that the Western Branch is already phosphorus limited means that there would be no transition during which degradation could occur.

While this conclusion might resolve the question of nutrient limitation in the Eel River, the Department's witness introduced another refinement to reflect relevant research. Dr. Mattson stated that reliance on the ratio has been replaced by a more comprehensive view that where the algal community is a mix of species and the TN:TP ratio is close to 16, the algae is co-limited by both nitrogen and phosphorus. Mattson PFDT at para. 11, citing Elser, J.J., Marzolf, E.R. and Goldman, C.R., *Phosphorus and Nitrogen Limitation of Phytoplankton Growth in the Freshwaters of North America: A Review and Critique of Experimental Enrichments*, Can. J. Fish. Aquat. Sci. 47:1468-1477 (1990); Horne, A.J. and Goldman, C.R., *Limnology*, 2nd Ed., McGraw-Hill, Inc.

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[59] Dodds concluded that the dissolved forms, DIN:SRP (soluble reactive phosphorus), "probably does not reliably provide an ecologically sound and general measure of nutrient limitation. The best values to use for indication of trophic state and nutrient limitation are TN and TP." Dodds, W.K., *Misuse of inorganic N and soluble reactive P concentrations to indicate nutrient status of surface waters,* J. N. Am. Benthol. Soc. 200322(2):171-181, at 180.

[60] The Department did not state whether it had adopted a policy on this question, but I note that the Nutrient TMDL Development for the Lower Charles River Basin, Massachusetts used TN:TP ratios to conclude that although nitrogen might limit algal growth for portions of the year, the TMDL focused on phosphorus as the limiting nutrient. See Final - Nutrient TMDL Development for the Lower Charles River Basin, Massachusetts. This TMDL uses the ratio of 7.2:1, by weight, which is the same as a 16:1 molar ratio. Note that a TMDL is prepared for impaired waters.

(1994). However, Dr Mattson further stated that in circumstances of co-limitation or even slight nitrogen limitation, it is preferable to control phosphorus because it is more cost-effective, does not favor toxic cyanobacteria, and does not have a gaseous phase. Nitrogen limitation tends to favor cyanobacteria which can use atmospheric nitrogen. Mattson PFDT at para. 12.

Dr. Shanahan believed, based on the TAC Report, that control of nitrogen is necessary to avoid incremental degradation during the transition to phosphorus limitation. He testified that Dr. Mattson finds a lesser degree of nitrogen limitation than did the TAC, but to the extent there is any nitrogen limitation, there is the potential for incremental degradation. Shanahan Rebuttal at 7. Dr. Shanahan supported his position that incremental degradation warrants additional controls on nitrogen by referring to the TAC Report. Id. I have reviewed the TAC Report with considerable care, in light of the research related to the TN:TP ratio and co-limitation cited by Dr. Mattson, and conclude that it does not support Dr. Shanahan's position.

The TAC stated that concentrations of both nitrogen and phosphorus were low, and with alternating limitation a small increase in either could shift the limitation. TAC at IV-2. The TAC then determined that the greater proportional increases in nitrogen, largely due to watershed characteristics, will result in a strong phosphorus limitation. In the Eel River watershed, surface waters are fed primarily by groundwater and while development may contribute nitrogen and phosphorus, phosphorus tends to be retained in the aquifer while nitrogen reaches the river. The TAC stated that "[i]nitially there may (sic) a modest increase in phytoplankton production, but soon the increase in nitrogen input will render phosphorus limiting." TAC at V-3. The TAC stated that "it is

unknown if the increase in nitrogen will sufficiently stimulate algal production to harmful levels." TAC at VIII-1. Thus, the TAC believed that nutrient increases could cause some increased production but did not conclude there would necessarily be an impairment of water quality, i.e., algal blooms or excessive macrophyte growth. Dr. Shanahan's testimony that the TAC acknowledged some possibility of increased production does not predict a significant lowering of water quality.

Secondly, the TAC distinguished between the branches of the Eel River in its assessment of the potential for increased productivity. The TAC stated its certainty that there would be an initial increase in system production in the Eastern Branch. By implication, the TAC was not certain whether or not there would be any increase in production in the Western Branch. But most importantly, the TAC did not recommend, even for the Eastern Branch, that nitrogen management should be undertaken immediately, but instead advised the monitoring of the watershed, assessment of any ecological changes, and the implementation of nitrogen management "if necessary." TAC Report at VIII-1. Thus, the TAC did not expect an incremental degradation, as stated by Dr. Shanahan. It would be more accurate to conclude that the TAC recognized the possibility of an increase in production in the Western Branch, but even recognizing the certainty of an increase in production in the Eastern Branch, the TAC recommended nitrogen management only where necessary after a finding of ecological change.

This approach is indeed precisely the approach in the TAC's recommendations, the Department's permit and the NMP. Thus, based on the TAC Report, I find that the Western Branch of the Eel River is likely co-limited or phosphorus limited, and will become strongly phosphorus limited as nitrogen loads rise in the watershed due to

increased development. Consistent with the findings of the TAC Report, the permit properly implements the "Zero Phosphorus" management strategy for the groundwater discharge from the wastewater treatment plant. The focus on phosphorus in the discharge is consistent with the theory of nutrient limitation, that excessive growth may be avoided by controlling the supply of the more scarce nutrient.

Whether a TMDL-Type Study is Necessary?

A TMDL analysis determines the amount of a pollutant that could be added to a water body and still provide its beneficial uses. This total loading capacity, plus a margin of safety, is then allocated between point sources and nonpoint sources. ERWA advocated that a TMDL-type study be performed to allocate the nutrient loads between the various sources of nutrients in the watershed. ERWA cited to the "Wilcox Report," a study that provided the allocation for the Edgartown wastewater treatment plant and other sources of nitrogen within the watershed of Edgartown Great Pond that was upheld in Friends and Fishers.[61]

I conclude that a TMDL-type study is not appropriate at this time for several reasons. First, the preparation of a TMDL is required for impaired waters, so that a

[61] Friends and Fishers involved a permit based on an allocation of loadings between the treatment plant and other contributors of the pollutants of concern within the watershed, although the Department may adopt the most likely rather than the most conservative projections for loadings. Friends and Fishers, 446 Mass. at 841. The Edgartown case also involved a wastewater treatment plant with a groundwater discharge raising concerns about nutrient loads to downgradient surface waters, and the applicability of the water quality standards. Edgartown had constructed a tertiary facility, the permit was based on a study of loads in the watershed (the "Wilcox" report), and the receiving water was a brackish coastal pond. The Commissioner in the Edgartown case had applied the antidegradation provisions identified for adjudication, specifically the protection of the existing uses and level of water quality to protect those uses, and for "high quality waters," the protection of their existing level of quality. Id. at 843. *See* Matter of Edgartown Wastewater Commission, Docket No.s. 99-046, 047, and 048 (April 22, 2002), Final Decision (August 22, 2002). Because the Edgartown permit resulted in an increased volume of discharge but not to an increased load of nitrogen to the pond, however, the Commissioner properly concluded that additional conditions to meet the antidegradation provisions were not required. Friends and Fishers, 446 Mass. at 843.

TMDL, with the exception of Russell Mill Pond, would not typically be required.[62] Second, the TAC Report already has complied substantial information on nutrient loads in the watershed. In the Edgartown Great Pond case, the permit was based upon nitrogen loads allocated to various sources of nitrogen in the watershed. A TMDL for the watershed would focus on phosphorus as the limiting nutrient. Because the TAC recommended zero discharge of phosphorus to the Eel River, a load allocation to the wastewater treatment facility to the surface water is essentially zero, or no change in ambient conditions from the groundwater discharge. Thus, as to this permit, a TMDL could not result in a smaller allocation of phosphorus to the treatment plant.

Finally, the Town of Plymouth is participating in the development of a TMDL for three marine water bodies, including Plymouth Harbor. The TMDL, for nitrogen as the limiting nutrient in marine waters, will include the watershed of the Eel River. ERWA was dismissive of this effort as having no relevance to the freshwater flows of the Eel River, and the focus is indeed Plymouth Harbor. Nonetheless, the inputs of nutrients from the contributing watersheds may well inform the reissuance of this permit after completion of the study. To the extent a more comprehensive study of the Eel River watershed than the TAC Report is warranted, it would be appropriate after the assessment of nitrogen loads to Plymouth Harbor. If the TMDL for the Harbor leads to greater nitrogen management within the Eel River watershed, it would seem desirable to reevaluate both the permit and the NMP in that context. The technical report for the TMDL is expected to be complete in 2012.

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[62] Ironically, the presence of Russell Mill Pond, a water body close to a potential effluent plume from the wastewater treatment plant, on the 303(d) list for nutrient and thus a candidate for a TMDL drew no particular attention from any party as a means of generating data or imposing requirements for nutrients.

Evidence on Water Quality Subsequent to the Discharge

ERWA alleged that the discharge from the treatment plant had reached the Eel River and degraded water quality by causing macrophyte growth. Ms. Whipple introduced a photograph of macrophyte growth near her home. Dr. Shanahan compared Plymouth's monitoring results with EPA's Recommended Criteria and asserted that water quality had deteriorated. I find, based on the testimony of Mr. Hallem and Mr. Price, that the groundwater discharge from the wastewater treatment plant has most likely not reached the surface waters of the Eel River. The CDM modeling was based upon a discharge of 0.75, but the flow path will be slower and more narrow than depicted because the actual discharge is much smaller. Mr. Hallem testified that at the actual 0.15 MGD discharge, effluent from the treatment plant would take 9.9 to 11 years to travel from the water table to the closest reach of the Eel River, after several years to reach the water table. Although ERWA challenged this testimony, it did not offer a more specific timetable than the CDM model.[63]

Mr. Price addressed the problem, identified much earlier by the TAC, of detection limits in the surface water quality monitoring data. Price PFDT at para. 9. Although the data that formed the basis of his testimony differed from what was used by ERWA and had been published by Plymouth in its reports, I find that the use of data with lower detection limits will make the water quality analysis more accurate. I recommend that Plymouth submit this data to the Department for review and a determination of whether or how to revise and reanalyzed the monitoring data. The monitoring data is critical to

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[63] I find that the photograph submitted by Ms. Whipple is not sufficient to prove that the nutrients from the groundwater discharge caused the depicted plant growth. Ms. Whipple did not know the species of the plant shown in the photograph, and other witnesses believed that it was fanwort, an invasive species. There was no testimony related to nutrients and the occurrence of invasive plant species.

assessing the health of the Eel River system over time, and it is therefore critically important that the data be as accurate as possible. I also recommend that any reanalysis based upon reissued data be accompanied by an explanation to ensure transparency and confidence in the monitoring program.

The Permit Conditions Related to Phosphorus and Nitrogen

ERWA argued that the terms of the permit are insufficiently protective of water quality, imprecise, and unenforceable, pointing specifically to limits for phosphorus in groundwater monitoring wells and the NMP. Supplemental Condition 5 of the permit requires action if the total phosphorus levels are greater than 0.2 in the groundwater below the infiltration beds. This provision is drawn from the TAC recommendation for the treatment plant, that the discharge be monitored to ensure phosphorus is adsorbed and a plan for phosphorus removal be in place if sufficient attenuation is not realized. The NMP requires additional action if phosphorus levels increase in surface water. Action is required if monitoring shows that total concentrations are greater than 95% exceedance level for two samples in one sampling season. If the source of the exceedance is the WWTP, the available actions are to change plant operations, upgrade the plant to include phosphorus removal, or relocate the discharge to another site.

ERWA makes two arguments for stricter controls on phosphorus. First, ERWA argues that the 95% exceedance levels are too high, and 75% would be more in line with the EPA Recommended Criteria. I was not persuaded by this argument because I have not accepted the EPA Criteria as applicable to the Eel River system. The second argument relates to the attenuation of phosphorus in the groundwater. ERWA cites to studies at the MMR that showed that phosphorus from a 30 year old treatment plant

reached a pond. All parties were familiar with the MMR studies. For the Plymouth discharge, the Department, as recommended by the TAC, has placed stringent limits on pH to promote phosphorus attenuation. I am not persuaded that phosphorus removal prior to discharge is warranted, where steps have been taken to prevent the plume from becoming anoxic, which would reduce the capacity of the soil to attenuate phosphorus. I also find that the facts of the Acton wastewater treatment plant, where removal was required, are distinguishable because the Acton discharge was extremely close to the Assabet River, almost at breakout, in comparison the much greater distance between the Plymouth discharge and the Eel River.

There was considerable testimony on the flow discharged to the infiltration beds under the groundwater discharge permit. Mr. Elkerton offered permit conditions that would require Plymouth to further direct flows from the infiltration beds. The original permit required that Plymouth "maximize" the flow to the ocean outfall under Plymouth's NPDES surface water discharge permit which is limited to 1.75 MGD. The 2008 permit contains an effluent limit for flow of 0.75 MGD as an annual average, and 3.45 MGD as a maximum day flow which is the difference between the 5.2 MGD maximum day design flow and the 1.75 MGD discharged through the ocean outfall. There is an obvious tension between maximizing the discharge to ocean outfall without violating the NPDES limit. I conclude that because Plymouth must not exceed the limits of its NPDES permit and a more precise calibration of the direction of flows is not appropriate here, further specification related to the term "maximizing" is not warranted. In addition, as noted by Mr. Slater, actual flows to the infiltration beds since the inception of the discharge in 2002 have averaged only 0.15 MGD, far below the 0.75 allowed under

the 2008 permit.[64] Although the Parties recognized that the requirement to "maximize" flows appeared in the 2000 permit, they did not address its absence in the 2008 permit. The testimony of the Department and Plymouth demonstrates an intent to continue to "maximize" flows to the ocean outfall, thus minimizing flows to the infiltration beds that would contribute nutrients to the Eel River system. I therefore recommend that the requirement of the 2000 permit that flows be maximized to the ocean outfall be specifically stated in the 2008 permit.

The evidence on the operation of the treatment plant shows that there was a violation in January 2003. The Department responded with enforcement and Plymouth took the necessary steps to address the violation. While this proves that a violation of the permit occurred, it does not prove any deficiency in the permit itself. ERWA argues that strict controls should be placed upon the receipt of septage at the facility. As noted by Plymouth, the facility was designed to accept septage, and I have not found nitrogen exceedances attributable to septage as alleged by ERWA. Thus, I do not recommend additional conditioning related to the receipt of septage.

ERWA argued that the permit does not require Plymouth to take action when the immediately adjacent wells show a total phosphorus concentration above 0.2 mg/l from the prescribed sampling, but only "to meet with the Department to discuss how to proceed with treatment plant operation and potentially reducing the effluent phosphorus concentration." 2008 Permit, Supplemental Condition 5. It certainly appears from the testimony of Plymouth and the Department that this condition was intended to reflect the TAC recommendations, which expected that action actually would be taken. Therefore, I

[64] Friends and Fishers drew a distinction between the permitted levels and actual levels. 446 Mass. at 841, n. 15.

recommend that the text of the last paragraph of Supplemental Condition 5 be revised to clarify that Plymouth shall propose and implement a plan, after approval by the Department, that will reduce phosphorus concentrations below 0.2 mg/l in the wells by operational changes, phosphorus removal, or relocation of the discharge.

Finally, ERWA objected to several aspects of the NMP. Foremost, ERWA disputed the text of Supplemental Condition 1, which states that "[t]he Town agrees to implement the Nutrient Management Plan . . ." The Department stated that it viewed this condition as a mandatory requirement, despite the use of the term "agrees." I recommend that the ambiguity created by the phrasing of Supplemental Condition 1 be resolved by a revision of this Condition to clarify that the "Town shall implement" the NMP.

The TAC, while focusing on phosphorus, strongly recommended that "nitrogen management be undertaken as feasible." TAC Report at VIII-1. The TAC did not explain why, given the concept of nutrient limitation and its focus on phosphorus, nitrogen management should be undertaken. The Department's position was somewhat ambiguous on this question, as Dr. Mattson clearly viewed phosphorus as the limiting nutrient and implicitly the only nutrient to control.[65] Plymouth pointed to the NMP as the means that it would achieve nitrogen reductions urged by ERWA, but did not explain how nitrogen management would promote water quality.

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[65]While the Generic Environmental Impact report on Lake and Pond Management Commonwealth can not be challenged in this forum, I note that recent research appears to endorse it. In a study published in the Proceedings of the National Academy of Sciences in 2008 on a 37 year investigation into experimental nitrogen and phosphorus inputs to a lake concluded that phosphorus management was necessary to control address eutrophication, and decreasing nitrogen may increase eutrophication. Schindler et al., *Eutrophication of lakes cannot be controlled by reducing nitrogen input: Results of a 37-year whole-ecosystem experiment,* PNAS 2008 10511254-11258; Commentary, Carpenter, S., *Phosphorus control is critical to mitigating eutrophication*, PNAS 2008 105:11039-11040.

Although the permit correctly focuses on phosphorus, contributions of nitrogen are potentially important for two reasons. First, the Eel River flows into Plymouth Harbor, which as a marine water would likely be nitrogen limited. The TAC did not anticipate ecological changes to the Harbor from the wastewater treatment plant groundwater discharge. Although the increase in nitrogen loads was expected to increase, a projected doubling, the change in nitrogen is mitigated by the decrease in loads from the upgraded plant. TAC at p. VII-4. Any adverse effects were anticipated near the breakwater where the Eel River discharges into the Harbor. However, the technical study underway to support TMDL development should provide additional information that may revise this assessment.

Second, although not stated by Dr. Mattson, or by Dr. Shanahan as a basis for his view that both nutrients should be controlled, there is some indication in the recent research that particularly where co-limitation occurs, when both nutrients are added together the response of enhanced algal growth is much more pronounced than if either is added singly. *See* Elser, J.J., Marzolf, E.R. and Goldman, C.R., *Phosphorus and Nitrogen Limitation of Phytoplankton Growth in the Freshwaters of North America: A Review and Critique of Experimental Enrichments*, Can. J. Fish. Aquat. Sci. 47:1468-1477 (1990); Horne, A.J. and Goldman, C.R., *Limnology*, 2nd Ed., McGraw-Hill, Inc. (1994), cited in Mattson PFD at para. 11. Thus, assuming that phosphorus is effectively controlled from the treatment plant but some other source caused phosphorus levels to rise, the negative impact of any increase in phosphorus could be mitigated by lower levels of nitrogen. Thus, any reductions in nitrogen achieved by activities conducted under the NMP would be beneficial aside from any contributions from the plant.

At this time, the permit, with the NMP, is sufficient to ensure that the Eel River will not be degraded by the discharge from the wastewater treatment plant. Managing the contributions of nutrients from all other sources within the watershed, a commitment emerging from MEPA review, is a much more ambitious undertaking. The permit at General Condition 10 requires Plymouth to reapply for a permit at least 180 days prior to the expiration of the 2008 permit in July 2013. The technical data in support of the TMDL for Plymouth Harbor is anticipated in 2012. Plymouth stated that it had a model for predicting nutrient reductions from various activities. Michaelis Cross. I recommend that the Department include a condition in this permit that requires Plymouth, prior to submittal of its renewal application, to review the technical data related to nitrogen compiled for the TMDL from the Eel River watershed to Plymouth Harbor as soon as it becomes available, confirm the TN:TP ratios as to the limitation of the freshwater system, and then revise the NMP to reflect actions as necessary to prevent increases in phosphorus and any reductions in nitrogen that may be necessary. The NMP can then be available for public comment along with the draft permit in 2013.

CONCLUSION

The TAC established a "zero phosphorus" policy for the watershed, based upon its conclusion that the watershed would become strongly phosphorus limited. The TAC recommendations are reflected in the groundwater discharge permit issued by the Department to the Town of Plymouth. I conclude that the 2008 permit meets the requirements for the establishment of effluent limitations, for monitoring, and of the antidegradation provisions. I conclude that the Department did not comply with

procedural requirements for the preparation of a fact sheet, but because no person requested a copy of the fact sheet, no remedy is warranted.

I recommend that the groundwater discharge permit issued to Plymouth be sustained, with revisions to clarify the intent of the Department that the NMP shall be implemented by Plymouth and any exceedance of the 0.2 limit for phosphorus in the adjacent downgradient wells trigger action to reduce phosphorus in the effluent. I also recommend that Plymouth's reanalysis of monitoring results to address detection limits be submitted to the Department for review and approval. Finally, I recommend that the issue of nitrogen and phosphorus in the Eel River watershed be reviewed as new information becomes available in 2012 and the NMP be revised prior to submittal of a renewal application in January 2013.

Pamela D. Harvey

Pamela D. Harvey
Presiding Officer

NOTICE- RECOMMENDED FINAL DECISION

This decision is a Recommended Final Decision of the Presiding Officer. It has been transmitted to the Commissioner for her Final Decision in this matter. This decision is therefore not a Final Decision subject to reconsideration under 310 CMR 1.01(14)(e), and may not be appealed to Superior Court pursuant to M.G.L. c. 30A. The Commissioner's Final Decision is subject to rights of reconsideration and court appeal and will contain a notice to that effect.

Because this matter has now been transmitted to the Commissioner, no party shall file a motion to renew or reargue this Recommended Final Decision or any part of it, and no party shall communicate with the Commissioner's office regarding this decision unless the Commissioner, in her sole discretion, directs otherwise.

SERVICE LIST

In The Matter Of:	Town of Plymouth
Docket No. 2008-114	File No.1-677 Plymouth
Representative	Party
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