In the facility planning conducted for the current upgrade, UBWPAD considered the possibility of more stringent effluent limits for nutrients than required by the expired permit. We understand that UBWPAD has designed treatment consistent with achieving total nitrogen levels of 8 to 10 mg/l and consistent with treatment that would be necessary to achieve a total phosphorus level of 0.2 mg/l. While UBWPAD may achieve even better performance, the current design will not be able to achieve the 0.1 mg/l limit for total phosphorus or the 5 mg/l limit for total nitrogen.

The scientific basis for the nutrient limits in the new permit is documented in the Fact Sheet and in this response to comments. The permit limits are not based on the 1997 Dissolved Oxygen Waste Load Allocation or on Rhode Island legislation requiring reduction in nitrogen loading at point sources in that State [R.I. Gen. Laws § 46-12-2]. *See also* Response #F43 below.

In addition, we disagree with the suggestions in the comment that numeric water quality criteria and a TMDL are necessary in order for EPA to establish water quality-based effluent limits. *See also* Responses #A3 and #E3.

Finally, we disagree with UBWPAD's characterization of the comments made by EPA's Science Advisory Board ("SAB") regarding the dissolved oxygen model developed in conjunction with the Blackstone River Initiative. To promote interstate assessment and cleanup of the Blackstone River, EPA established the Blackstone River Initiative (BRI) in 1991. The BRI included an intensive environmental sampling and assessment program to describe interstate water quality, biology and toxicity in the river system under both dry and wet weather conditions, and to develop a wasteload allocation model and a toxics model to predict impacts of contaminant loadings to the system. It is one of several sources of data documenting the severe eutrophication in the Blackstone River and the significance of the nitrogen loadings to Narragansett Bay from the Blackstone River. The University of Rhode Island, MassDEP, and RIDEM all participated. The Region requested that the SAB review the results of the BRI. In no way did the SAB recommend that the use of the dissolved oxygen model be restricted in establishing effluent limits in NPDES permits. To the contrary, the SAB noted that the model was specifically suited for modeling BOD/DO in rivers and streams. The SAB did recommend some additional calibration to "fine tune" the model so that it could be used with more confidence under flow conditions other than dry weather. In addition, EPA and the other participants developed a response to the SAB's report, which fully addressed all points (including those related to the dissolved oxygen model) and was posted on the SAB website. [Letter dated February 4, 1999 from John P. DeVillars, Regional Administrator to Drs. Joan M. Daisey and Dr. Mark A. Harwell.] In any event, UBWPAD's comment is irrelevant to establishment of nutrient limits in this permit; as detailed above, EPA did not use the 1997 Dissolved Oxygen model as the basis for the phosphorus or nitrogen limits in the current permit.

Comment #F6: There is no defensible evidence that the proposed TN limits will improve the water quality in the Blackstone River or Narragansett Bay. DEP, the Narragansett Bay Commission and other Rhode Island dischargers all have challenged

the science of the new nitrogen limit. In its comments on analysis conducted by Rhode Island Department of Environmental Management, DEP said that the limits were based on incomplete science at best and that it was more appropriate for the District to complete its ongoing upgrades and analyze what needs to be done next. In addition, DEP is undertaking studies with USGS of sediment transport in the Blackstone River to assess nitrogen attenuation and DEP is also studying the cost of TN compliance to better understand the financial impact of plant upgrades.

While we know some of potential negative impacts, we don't know what the benefits will be from the new limits. The District believes that our ratepayers, many of them members of Environmental Justice populations – should know if another $200 million to improve sewers and build the plant, plus an additional $3.7 million to operate it annually will provide a commensurate or discernable benefit.

Response #F6: The need for nitrogen limits is based on an extensive amount of water quality/use impairment data and scientific knowledge regarding the environmental impacts of excessive nitrogen loadings on the receiving waters. For many years, it has been recognized that Rhode Island and Massachusetts municipal wastewater treatment facilities are a significant source of nutrients to the Seekonk River, Providence River and Upper Narragansett Bay. Excessive nitrogen loadings are significantly impairing water quality criteria and uses in Narragansett Bay. Impairments include low dissolved oxygen, which is so severe that it causes occasional fish kills, and dramatic loss of eel grass (which provides important spawning, nursery, foraging and refuge habitat for many fish and invertebrate species, including commercially important species). The *Governor's Narragansett Bay and Watershed Planning Commission, Nutrient and Bacteria Pollution Panel, Initial Report* (March 3, 2004) summarizes and references many of the studies and reports that have evaluated these impacts and loadings to the Bay.

The Blackstone River discharges directly into the upper part of the Seekonk River, which is the most severely impaired section of Narragansett Bay. On a per unit area basis, current total nitrogen loads to the Seekonk River are 24 times higher than the nitrogen load to Narragansett Bay as a whole**.** The predominant sources of the nitrogen loading are municipal wastewater treatment facilities in Rhode Island and Massachusetts. As reflected in the Blackstone River Initiative and RIDEM's 2004 study (*Evaluation of Nitrogen Targets and WWTF Load Reductions for the Providence and Seekonk Rivers*, RIDEM, December 2004), the UBWPAD is the dominant source of nitrogen loading to the Blackstone River. The UBWPAD facility represents approximately 70% of the municipal wastewater flow to the Blackstone River.

The nitrogen limit in this permit is based upon an application of the requirements of the federal Clean Water Act and has been imposed to meet Rhode Island's water quality standards. The Act and EPA's regulations require EPA to condition any permit to ensure compliance with applicable water quality standards of the state where the discharge originates *and* any downstream affected state. Rhode Island, like most states, has not yet developed statewide numeric total nitrogen criteria or numeric response variable criteria, nor has Rhode Island developed site-specific numeric criteria for total nitrogen or response variable for Narragansett Bay. Until such numeric criteria values are available,

EPA must base effluent limits on its interpretation of the narrative criteria in the currently approved water quality standards. *See* Rhode Island Water Quality Regulations, Rule 8(D)(1)(d) and Table 2, Rule 8(D)(3)(10). Water quality-based effluent limits imposed through NPDES permits must ensure that all components of water quality standards are achieved. *See* CWA 301(b)(1)(C); 40 C.F.R. §§ 122.4(d), 122.44(d)(1).

When imposing an effluent limit on a particular point source in order to implement a narrative water quality criterion, EPA is not required to have a TMDL, a dynamic water quality model, or comparable analysis that comprehensively allocates loads to all point and nonpoint pollutant sources that are contributing to an impairment. Instead, when calculating a numeric permit limit to achieve a narrative criterion, EPA's regulations direct the Agency (in relevant part) to use one or more of the following methodologies:

> (A) Establish effluent limits using a calculated numeric water quality criterion for the pollutant which the permitting authority demonstrates will attain and maintain applicable narrative water quality criteria and will fully protect the designated use. Such a criterion may be derived using a proposed State criterion, or an explicit State policy or regulation interpreting its narrative water quality criterion, supplemented with other relevant information which may include: EPA's Water Quality Standards Handbook, October 1983, risk assessment data, exposure data, information about the pollutant from the Food and Drug Administration, and current EPA criteria documents; or
> (B) Establish effluent limits on a case-by-case basis, using EPA's water quality criteria, published under section 304(a) of the CWA, supplemented where necessary by other relevant information[.]

40 C.F.R. §§ 122.44(d)(1)(vi)(A), (B). EPA is clearly authorized, even in technically and scientifically complex cases, to base its permitting decision on a wide range of relevant material, including EPA technical guidance, state laws and policies applicable to the narrative water quality criterion, and site-specific studies. Nothing in the foregoing regulation, or its preamble, suggests that EPA is required to await the completion of approved TMDLs or dynamic water quality models as predicates to imposing a water quality-based effluent limit.[7]

In the absence of a dynamic model or TMDL, EPA relied on the best information reasonably available to it to establish the permit limit for nitrogen. The agency considered more than 15 years of water quality data, studies and reports evaluating nitrogen levels and response variables in Narragansett Bay. These materials included

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[7] In keeping with the regulation, EPA does not believe that any one source of information should necessarily be given definitive weight, nor does it believe that the absence of a particular information source should necessarily preclude EPA from establishing an effluent limit. The approach of utilizing available guidance and materials generated by the EPA and States, as supplemented by other information reasonably available at the time of permit reissuance, makes sense in light of federal regulations requiring EPA to include requirements that will achieve state water quality standards when reissuing a permit and prohibiting issuance of a permit when the imposition of conditions cannot ensure compliance with the applicable state water quality requirements of all affected States. *See* 40 C.F.R. §§ 122.4(d), 122.44(d)(1).

EPA's *Nutrient Criteria Technical Guidance Manual: Estuarine and Coastal Marine Waters* (EPA, October 2001) and a variety of site-specific reports commissioned by Rhode Island to address nitrogen loading and control the effects of cultural eutrophication in the receiving waters. *See, e.g., Evaluation of Nitrogen Targets and WWTF Load Reductions for the Providence and Seekonk Rivers* (December 2004); *Plan for Managing Nutrient Loadings to Rhode Island Waters* (RI-DEM, February 1, 2005); *Nutrient and Bacteria Pollution Panel – Initial Report* (Governor's Narragansett Bay and Watershed Planning Commission, March 3, 2004); and *Massachusetts Estuaries Project – Site-Specific Nitrogen Thresholds for Southeastern Massachusetts Embayments: Critical Indicators*, July 21, 2003 as revised).

In addition, EPA relied on the results of a physical water quality model operated by the Marine Ecosystems Research Laboratory (MERL) at the University of Rhode Island that was designed to predict the relationship between nitrogen loading and several trophic response variables in the Narragansett Bay system.[8] In establishing the nitrogen limit in this permit and evaluating the MERL model, EPA also considered actual measurements of nitrogen loadings from point source discharges, including a 1995-96 study by RIDEM Water Resources. The basic relationship demonstrated by the MERL tank experiments between the primary causal and response variables relative to eutrophication corresponds to what is actually occurring in the Providence/Seekonk River system. Both the MERL tank experiments and the data from the Providence/Seekonk River system indicate a clear correlation between nitrogen loadings, dissolved oxygen impairment and chlorophyll *a* levels. *See* Response #F18A for additional detail on EPA's use of the MERL experiments and water quality data in establishing the nitrogen limits in the permit.

The CWA requires EPA to establish water quality-based effluent limits that ensure that standards are met. The limits in this permit are based on the available science, which in this case is quite extensive. EPA cannot avoid its responsibility to establish water quality-based limits simply because further studies are underway, especially since there is no reasonable likelihood that a less stringent limit will meet standards. In making its decision to move forward with nitrogen limits at this time, EPA also considered the need to expeditiously address the severe existing nitrogen-driven cultural eutrophication in the receiving waters. In the time that RIDEM has been attempting to develop a dynamic model, the Seekonk/Providence River system and waters downstream have continued to

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[8] EPA's guidance document Nutrient Criteria Technical Guidance Manual, Estuarine and Coastal Marine Waters cites the MERL experiments as compelling evidence that nitrogen criteria are necessary to control enrichment of estuaries. Specifically, the guidance states: "Three case studies provide some of the strongest evidence available that water quality managers should focus on N for criteria development and environmental control (see NRC 2000 for details). One study involves work in large mesocosms by the University of Rhode Island (Marine Ecosystem Research Laboratory–MERL) on the shore of Narragansett Bay. Experiments showed that P addition was not stimulatory, but N or N+P caused large increases in the rate of net primary production and phytoplankton standing crops. (Oviatt et al. 1995)." RIDEM has also embraced the model as a basis to impose permit limits on Rhode Island facilities to control the effects of cultural eutrophication.

suffer from the effects of severe cultural eutrophication. These adverse affects have included fish kills (see www.dem.ri.gov/bart/fishkill.htm).

Moreover, the tendency for nitrogen to not only exacerbate existing water quality impairments but to persist in the environment in a way that contributes to future water quality problems counsels in favor of imposing a nitrogen limit on UBWPAD's discharge based on information currently available to EPA. EPA also notes that the permit was last issued to the facility in 2001, has expired, and has been administratively continued for several years.

The ongoing upgrades at the UBWPAD are designed to achieve total nitrogen levels of approximately 8.0 - 10.0 mg/l. While actual performance might result in lower levels, the upgrade will not achieve 5.0 mg/l and, therefore, will not ensure water quality standards will be met. While we welcome further analyses of sediment transport in the Blackstone River, the current evidence indicates that attenuation of nitrogen in the Blackstone River is small and further reductions in phosphorus-driven eutrophication levels in the Blackstone are likely to result in even lower nitrogen attenuation rates in the future. *See also* Response #F17 below.

The loading reduction targeted in the RIDEM December 2004 report represents a significant reduction and reflects an appropriate and reasonable determination of water quality-based limits necessary to achieve water quality standards. The reductions required at the UBWPAD facility through this permit in conjunction with reductions at other facilities will have substantial environmental benefits, including significant reductions in algal growth and associated dissolved oxygen impairments. The reductions and anticipated improvements are necessary to address the ongoing severe impairments to the marine fish community and to restore the recreational use of Narragansett Bay.

In establishing the nitrogen limit in the permit, EPA took into account uncertainties in extrapolating the physical model to a complex, natural setting such as Upper Narragansett Bay. *See* Response #F18A for additional detail on this issue. The uncertainties in extrapolating the physical model may ultimately mean that additional nitrogen reductions are needed, but there is no realistic likelihood that water quality standards could be met with a less stringent nitrogen limit than 5.0 mg/l. With the limitations established as a concentration limit of 5.0 mg/l, at current flows, the Seekonk River would receive nitrogen loads of approximately 6.5 times higher than the Bay-wide load. In the event future permit issuances result in an even lower nitrogen limit, the technologies to reduce beyond 5 mg/l can be added to the facilities installed to meet the requirements in this permit. We encourage UBWPAD to evaluate compatibility of add-on technologies in selecting the treatment necessary to achieve the 5 mg/l limit.

With regard to the proceedings related to RIDEM's issuance of permits to facilities in Rhode Island, RIDEM prepared a response to significant comments as part of the referenced permitting proceedings. In addition, the appeals in NBC Fields Point, NBC Bucklin Point and East Providence have all been resolved with final permits including the proposed nitrogen limits – 5.0 mg/l for the NBC facilities and 8.0 mg/l for the East

Providence facility. RIDEM recently resolved the appeal of the Woonsocket permit with an agreement that the facility will meet a nitrogen limit of 3.0 mg/l. *See* Consent Agreement, In re: AAD No. 05-004/WRA dated June 27, 2008.

As to UBWPAD's cost estimates (which range in oral and written comments from $100 to $200 million), EPA has not seen the basis for these estimates and cannot evaluate their validity. Further, implicit in UBWPAD's comment is the notion that, in establishing water quality-based effluent limits, EPA must conduct a cost-benefit analysis and evaluate the costs of treatment against quantified benefits to the receiving water. As noted above, EPA cannot set water quality-based effluent limits based on the cost of treatment. *See* Response #A9. Relief is available where a permittee can demonstrate that costs warrant a variance or modification of the state's water quality standards. In addition, it is EPA's intent to establish a reasonable schedule for UBWPAD to come into compliance with the new nutrient limits. *See* Response #E2.

Comment #F7: The timing of the permit revisions is premature and illogical. Given that the District is scheduled to complete its current upgrade project in two years, it makes sense to operate the new plant for two full seasons beyond the completion date to assess its capabilities. At that time we will know what levels of P and TN the new plant can achieve. Other facilities along the river and around Narragansett Bay are also being upgraded and it makes sense to see how the river fares with all of these upgrades before imposing further mandates. Moreover, by December [2007], the results from a new model of the river developed by University of Massachusetts School of Engineering and the District's environmental consultants, CDM, will be known. The model, together with the results obtained by operating the improved plant, will provide the needed science to guide rational decision making – and complete required TMDLs. It would make sense to continue under the terms of the current permit until we have all had a chance to assess these results.

The District believes that a more common sense approach to establishing discharge limits for the Blackstone River is to complete the new river model; finish the current wastewater treatment improvements; optimize and fine-tune the new facilities; and monitor the results for two years. In 2012 we could review and revise river management decisions as needed based on science, experience and a true cost-benefit analysis. If we find that more stringent effluent limits than the new plant can achieve are needed to make a proven difference in water quality, the District can then undertake reasonable upgrades. We think this common sense cost-effective approach can be accomplished more cooperatively and with equal expedience to the alternative approach of drawn out court battles.

Response #F7: The CWA and EPA's regulations require that permits be issued for fixed periods of time not to exceed five years. 33 U.S.C. §§1342(a)(3) and (b)(1)(B); 40 CFR §122.46(a). EPA revisits all aspects of NPDES permits when the term expires, consistent with the CWA's goal of restoring and maintaining the chemical, physical, and biological integrity of the Nation's waters. The clear intent of the statute is to ensure that permit

requirements are updated on a regular basis rather than left in effect, unexamined and unchanged for long periods of time.

The facilities planning for the current upgrade makes clear that these upgrades will not achieve the new permit limits of 5 mg/l for total nitrogen and 0.1 mg/l for total phosphorus and, therefore, cannot ensure attainment of water quality standards. The UBWPAD is the dominant source of nitrogen to the receiving waters. The UBWPAD is approximately 70 percent of the municipal wastewater flow to the Blackstone River based on its permitted design flow of 56 MGD and a total permitted municipal wastewater flow to the Blackstone River of 80.4 MGD. The loadings data utilized in RIDEM's 2004 study indicate that UBWPAD represented approximately 64% of the nitrogen load discharged to the Blackstone River from municipal wastewater treatment facilities for the period of time considered in the study. After accounting for attenuation, UBWPAD is also the dominant source of nitrogen loadings from the Blackstone River into the Seekonk River. *See* Response #F17. In addition, the Blackstone River discharges into the headwaters of the Seekonk River, where the greatest impairments in the Narragansett Bay Basin have been measured.

As reflected in the Blackstone River Initiative and other reports cited in the Fact Sheet, UBWPAD is also the dominant source of phosphorus loadings to the Blackstone River and the Blackstone River demonstrates substantial phosphorus-driven eutrophication. *See* Response #F9 and #F10 below.

Water quality standards will not be met if UBWPAD does not further reduce discharges of nitrogen and phosphorus beyond treatment planned as part of the current upgrade. *See* UBWPAD Regional Wastewater Treatment Facilities Plan (May 2001). Under these circumstances, the CWA and EPA's regulations mandate that EPA establish water quality-based effluent limitations to control discharges of nutrients. It is not appropriate to adopt a "wait and see" approach following the current upgrades, because there is no reasonable likelihood that water quality standards relative to eutrophication will be achieved with less stringent limits.

UBWPAD's concerns regarding the timing of permit issuance as it relates to the ongoing upgrades are more appropriately addressed through compliance scheduling, rather than through delay of permit issuance. For example, it may be appropriate to allow some period of time to operate the new plant before making a final decision on all aspects of additional treatment facilities to enable UBWPAD and its consultants to determine the most cost-effective technologies for achieving the new limits. (With regard to the specifics of establishing the compliance schedules, *see also* Response #E2 and Response #F21 below).

With reference to UBWPAD's modeling efforts, if the model being developed for the UBWPAD, together with any other relevant evidence, makes it clear that alternative limits will result in attainment of water quality standards, EPA will modify the permit accordingly. In order to be used for development of water quality based effluent phosphorus limits, UBWPAD's model needs to be calibrated and verified to 7Q10 flow

conditions. In addition, use of any model to establish phosphorus limits must also ensure that both Massachusetts' and Rhode Island's relevant water quality standards are met. If the intent is to also simulate the role of non-point sources of phosphorus, the model must be able to not only simulate non-point source phosphorus loadings but also must be able to simulate the fate of the phosphorus in the river system as it is taken up by a variety of aquatic plants and then released as the plants die and undergo the decay process. *See also* Response #F1 and Response #F43 below. As detailed above, phosphorus models and TMDLs can be very difficult to develop. *See* Response #E3.

Relative to nitrogen limits, we note that the model will not simulate Narragansett Bay water quality and thus will not be able to evaluate the full range of nitrogen sources, the responses to the nitrogen sources, or reductions necessary to achieve water quality standards. The model may, however, provide further information on attenuation rates of nitrogen in the Blackstone River. While much is currently known relative to attenuation rates (*see* Response #F17 below), EPA will evaluate any significant new information relative to attenuation to determine if a permit modification is appropriate.

Comment #F8: The facilities currently being built by the District have predictable costs that are based on reliable treatment processes. If new facilities are to be built to achieve the latest proposed limits, the treatment processes will not be as sustainable, using large quantities of chemicals (including an energy source such as methanol) and about 20 percent more electricity. Chemical addition will increase sludge production, and since the inert chemicals in the sludge are more difficult to burn, the District will have to use more fuel for incineration, increasing air emissions, and landfill volume needed to dispose of more ash. We wonder if these negative environmental consequences were fully evaluated in assessing the draft permit limits.

Response #F8: We are supportive of UBWPAD's efforts to plan and design the most environmentally sustainable treatment processes necessary to meet the effluent limits. These considerations, however, come into play in selection of the appropriate treatment technologies – not in setting water quality-based effluent limits. As noted above, cost and technological considerations are not factors in establishment of water quality-based limits. *See* Response #A9.

The improved treatment will result in additional sludge being generated and the most cost-effective and environmentally sustainable method of managing sludge should be carefully considered as part of facilities planning. There are treatment processes that can be pursued that minimize the need for chemical addition and/or minimize the chemicals in the discharge and the sludge. In light of heightened scrutiny on energy costs and advances in engineering designs, we would expect the current and future upgrades to be much more energy efficient than current or previous designs.

We also believe it is important to examine energy efficiency holistically, across a utility's management and operations. *See also* Response #52. Examination of current incineration processes presents one opportunity for improving efficiency and sustainability. Another opportunity for gains in energy efficiency at UBWPAD is

through control of flow volumes to the treatment facility. A large percentage of the total annual flow volume reaching the UBWPAD is the result of storm water and groundwater entering separate sewer pipes and, to a lesser extent, combined sewer flows. UBWPAD estimates that 15 million gallons per day of the total current average flow to the facility of 37 million gallons per day is inflow/infiltration. *See* NPDES Permit Application. The estimated CSO flow to the treatment plant is currently about 3 million gallons per day. *See* CSO Phase II CSO Long-Term Control Plan Report (February 2004). Pumping and treating all of this flow is a very energy-intensive process. A more aggressive infiltration/inflow control program should be an important component of an overall plan to reduce energy consumption. In addition, further sewer separation within Worcester's combined sewer service area may be appropriate to reconsider in light of the energy and chemical use concerns related with pumping and treating peak flows that cannot be treated at the Quinsigamond CSO Facility**.**

EPA is very supportive of efforts to reduce power use and associated costs at wastewater treatment facilities. Energy is the largest expense for many facilities and one of the top three expenses at almost all of them. By working to reduce the amount of energy these facilities use without compromising the quality of treatment, we can help to save public money and protect the environment at the same time. We applaud UBWPAD for participating in a MassDEP pilot to reduce energy use at wastewater treatment facilities. EPA staff assisted in the initial energy benchmarking of the facility through the use of EPA's new ENERGYSTAR® benchmarking tool. We look forward to continuing to support MassDEP and UBWPAD in efforts to save energy and to realize the associated financial and environmental benefits.

Comments raised in Attachment A (Technical Issues/Comments) prepared by CDM on behalf of UBWPAD are addressed below.

Comment #F9: The information cited in the Fact Sheet to create the impression that the proposed permit limits are justified is erroneously applied. The Fact Sheet states:

> The impacts associated with the excessive loading of phosphorus are documented in the following reports: *Blackstone River Initiative Report*, May 2001 (EPA New England); *Blackstone River Basin 1998 Water Quality Assessment Report* (Mass DEP); *Blackstone River Watershed 2003 DWM Water Quality Monitoring Data*, May 2005 (Mass DEP); *Phase I: Water Quality Evaluation and Modeling of the Massachusetts Blackstone River, Draft - March 2004* (US Army Corps of Engineers (http://www.nae.usace.army.mil/projects/ma/blackstone/wqe.htm); and Blackstone River Watershed 2003 Biological Assessment, April 4, 2006 (Mass DEP), as well as in the Massachusetts and Rhode Island 303(d) Lists of Impaired Waters as discussed above.

But, as the EPA well knows, the District is in the process of constructing facilities to comply with the phosphorus limit contained in the 2001 permit, according to a schedule agreed to by the EPA. Thus the "excessive phosphorus levels" alluded to by the EPA that led to the conditions cited in the Fact Sheet are not the conditions that will exist after

the completion of the ongoing construction, but rather reflect the same loadings that compelled the implementation of the 0.75 mg/1 phosphorus limitation. In that respect, it was misleading to suggest that the referenced information compelled the draft limits. Moreover, the cited reports contain no quantitative data on the occurrence of macrophytes and or periphyton. Development of quantitative data with respect to these two metrics is a necessary precursor to the development of programs to reduce their existence to acceptable levels.

Response #F9: EPA is aware of the ongoing upgrade and discusses it in the Fact Sheet. As explained in the Fact Sheet, the limit of 0.75 mg/l in the expired permit was established to address dissolved oxygen criteria only. *See* Response #F5 for a description of the establishment of the limit in the expired permit. The reference to excessive phosphorus loadings is made relative to phosphorus loadings that would be necessary to control cultural eutrophication. As documented in the Fact Sheet for this permit issuance, federal recommended criteria and guidance documents clearly indicate that a limit of 0.75 mg/l would result in instream concentration far in excess of levels that would be necessary to control cultural eutrophication.

The most recent data set collected under low flow conditions by MassDEP (August 28, 2003) indicates that UBWPAD was discharging total phosphorus at a level very close to the current permit limit of 0.75 mg/l (August monthly average discharge was 0.8 mg/l). At the first station downstream of the UBWPAD discharge, instream aquatic vegetation was described as being "extremely abundant, covering virtually the entire river bottom and dominated by rooted submergent macrophytes (coontail, Ceratophyllum sp.; waterweed, elodea sp.; pondweed, Potamogeton crispus). Slight turbidity in the water column was noted during sampling. A luxuriant algal community was also observed, with green filamentous algae attached to submergent vegetation and a brown flock covering much of the rocky substrates."

This qualitative/quantitative data on macrophytes and periphyton is a clear indicator of cultural eutrophication and reinforces the conclusions based on discharge concentrations of phosphorus and appropriate instream phosphorus concentration targets. The *Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition* (EPA 1999) states that > 40% cover by macroalgae is an indication of nutrient or organic enrichment.

See also Response #F48 for additional detail regarding EPA's establishment of the phosphorus limit in this permit.

Comment #F10: The permit references The 1986 Quality Criteria for Water as the source document for its recommend instream concentration. The 1986 document is clear that there is no national criteria for control of Phosphorus. (*See* Attachment Al to this document.) It begins by saying "Although a total phosphorus criterion to control nuisance aquatic growths is not presented, it is believed that the following rationale to support such a criterion, which currently is evolving, should be considered." (Gold Book, page 240 of 477). It goes on to describe various recommendations and

observations of Mackenthun and Hitchinson concerning tolerable levels of phosphorus in receiving waters. It also suggests that:

> The majority of the Nation's eutrophication problems are associated with lakes or reservoirs and currently there are more data to support the establishment of a limiting phosphorus level in those waters than in streams or rivers that do not directly impact such water. There are natural conditions, also, that would dictate the consideration of either a more or less stringent phosphorus level. Eutrophication problems may occur in waters where the phosphorus concentration is less than that indicated above and, obviously, such waters would need more stringent nutrient limits. *Likewise there are those waters within the Nation where phosphorus is not now a limiting nutrient and where the need for phosphorus limit is substantially diminished.* Such conditions are described in the last paragraph of this rationale. (Gold Book, page 241 of 477)

The last paragraph contains a number of caveats that need to somehow be taken into account in the development of the criterion. The factors include the following

1. Naturally occurring phenomena may limit the development of plant nuisances.

2. Technological or cost effective limitations may help control introduced pollutants.

3. Waters may be highly laden with natural silts or colors which reduce the penetration of sunlight needed for plant photosynthesis.

4. Some waters morphometric features of steep banks, great depth, and substantial flows contribute to a history of no plant problems.

5. Waters may be managed primarily for waterfowl or other wildlife.

6. In some waters a nutrient other than phosphorus is limiting to plant growth: the level and nature of such limiting nutrient would not be expected to increase to an extent that would influence eutrophication.

7. In some waters phosphorus control cannot be sufficiently effective under present technology to make phosphorus the limiting nutrient. (Gold Book, page 243 of 477)

Thus, although there was no criterion established in the 1986 document, and the rationale was only evolving and proposed for consideration, the EPA elected to ignore the caveats about its use. This was improper because, as discussed below the EPA had the tools to make substantive assessments that could incorporate these caveats, and which would not have relied on the irrelevant field data to support its conclusions.

Response #F10: In the course of determining the trophic status of the receiving water and deriving a protective phosphorus effluent limit that would meet the narrative phosphorus criterion, the Region looked to a variety of sources, including the Gold Book, Ecoregional Nutrient Criteria (*Ambient Water Quality Criteria Recommendations: Information Supporting the Development of State and Tribal Nutrient Criteria, December 2000*) and Nutrient Criteria Guidance (*Nutrient Criteria Technical Guidance Manual: Rivers and Streams, July 2000)*. These constitute information published under CWA §304(a) and were used as *guidance* to interpret the State's narrative criterion for nutrients and not as substitutes for state water quality criteria. The Region's use of the Gold Book and other relevant materials published under Section 304(a) to develop a numeric phosphorus limit sufficiently stringent to achieve the narrative nutrient criterion is consistent with applicable NPDES regulations. When deriving a numeric limit to implement a narrative water quality criterion, EPA is authorized (40 CFR §122.44(d)(1)(vi)(B)) to: "Establish effluent limits on a case-by-case basis, using EPA's water quality criteria, published under Section 304(a) of the CWA, supplemented where necessary by other relevant information."

EPA recognizes that the Gold Book does not contain a phosphorus criterion *per se*, but instead presents a "rationale to support such a criterion." Gold Book at 240. The guidance document goes on to recommend in-stream phosphorus concentrations of 0.05 mg/l in any stream entering a lake or reservoir, 0.1 mg/l for any stream not discharging directly to lakes or impoundments, and 0.025 mg/l within the lake or reservoir.

The commenter references a statement in the Gold Book that indicates that, at the time of the Gold Book's publication, there was more data to support the establishment of a limiting phosphorus level in lakes than in streams or rivers. Much more recent data and criteria guidance published under Section 304(a) of the CWA reinforces the Gold Book recommendations related to streams and rivers.

The more recent Nutrient Criteria Guidance document, as well as the Ecoregional Nutrient Criteria, indicate that instream phosphorus concentrations need to be less then 100 ug/l (0.1 mg/l) in order to control cultural eutrophication. The Nutrient Criteria Guidance document cites a range from 10-90 ug/l to control periphyton and from 35-70 ug/l to control plankton (*see* Table 4 on page 101). The Ecoregional Nutrient Criteria document outlines so-called "reference" conditions in waters within specific ecoregions across the country, which are minimally impacted by human activities, and thus are representative of waters without cultural eutrophication. The UBWPAD is in Ecoregion XIV, *Eastern Coastal Plain*. Recommended criteria for this ecoregion is a total phosphorus criterion of 24 ug/l.

The commenter also recites verbatim seven site-specific considerations that the Gold Book indicates can reduce the threat of phosphorus as a contributor to eutrophication in lakes. The commenter does not indicate which, if any, of the site-specific considerations is determinative in this case and how it would specifically alter the permit limits for phosphorus. For instance, the commenter does not cite and EPA is not aware of any evidence that "naturally occurring phenomena;" "steep banks, great depth and substantial

flows;" "natural silts or colors;" or a "nutrient other than phosphorus" are inhibiting plant growth in this case. To the contrary, certain characteristics of the Blackstone River exacerbate the impacts associated with phosphorus. For instance, the River is characterized by numerous shallow impoundments and low velocity. Further, management of waters "primarily for waterfowl or other wildlife" would conflict with the designated use of contact recreation. In addition, consideration of "technological or cost effective limitations" in establishment of the water-quality based phosphorus limit is inappropriate. *See* Response #A9.

The well documented cultural eutrophication in the Blackstone River does not support that site-specific factors are mitigating the effects of excessive phosphorus loadings. Rather, there is substantial evidence of extensive impairments related to phosphorus loadings, and phosphorus is widely recognized as the limiting nutrient in most freshwater systems. *See Nutrient Criteria Technical Guidance Manual – Rivers and Streams,* July 2000 (EPA-822-B-00-002). Further, there is no indication that available control technologies, which have improved greatly since the Gold Book was published, are insufficient to make phosphorus the limiting nutrient. Any such demonstration could be made as part of a Use Attainability Analysis (*see* Response #F1).

Comment #F11: The 1986 Quality Criteria for Water suggests a level of 0.1 mg/l as "a desired goal for the prevention of plant nuisances in streams or other flowing waters" and references a 1973 publication of Kenneth Mackenthun, a copy of which is included as Attachment A2 to this document. However, that document does not present information concerning the development of the 0.1 mg/1 "desired goal," but rather makes reference to a 1968 paper published in the Journal of the American Waterworks Association by the same author. A copy of the 1968 paper is included as Attachment A3 to this document. The 1968 document indicates that " ... A considered judgment suggests that to prevent biological nuisances, total phosphorus should not exceed 100 ug/1 P at any point within the flowing stream, nor should 50 ug/1 be exceeded where waters enter a lake, reservoir or other standing water body ..." (Mackenthun, 1968 p 1053). A careful reading of this document suggests that it is referencing streams which are tributary to water supply reservoirs and lakes and standing waters that serve as sources of water supply. This would explain why it was published in what would otherwise be thought to be about water supply, and not water pollution. Moreover, the 1968 document presents no information concerning the development of the recommendation – and so it presents no guidance on how it should be applied – seasonally, monthly, or over the growing season?

Response #F11: EPA disagrees with the suggestion that the Gold Book recommendation regarding in stream phosphorus concentrations is limited to sources of water supply and cannot be used as guidance in this matter. The Gold Book includes no such limitation or characterization of its recommendation. Similarly, the 1973 paper by Kenneth Mackenthun referenced by the Gold Book includes no such restrictions. The commenter does not explain how a "careful reading" of a 1968 publication by the same author supports the suggested restrictions on the recommendations. To the contrary, the 1968 article twice states "total phosphorus concentrations should not exceed 100 ug/l at any point within a flowing stream" with no reference that this recommendation is limited to

tributaries to drinking water supplies. Indeed, if Mr. Mackenthun intended such a restriction, he presumably would have explicitly included it in his 1968 or 1973 publications.

Regarding application of the recommendations, the Gold Book values are clearly referenced as values not to be exceeded at any time, not simply annual averages. The Ecoregional values represent average values during the critical growing season. *See also* Response #F10 and Response #F49 below relative to the use of Gold Book values.

Comment #F12: In recent times the EPA and Commonwealth have collaborated on the development of Total Maximum Daily Load Studies to establish nutrient management goals. These studies have been or are being conducted on the Assabet, The Nashua River and the Lower Charles River. The TMDL studies on the Assabet and Lower Charles are available on DEP's website (*see* http:/www.mass.gov/dep/water/resources/tmdls.htm). Studies on the Nashua are reported to be underway and supportive of phosphorus effluent limits proposed for the City of Leominster, but are not yet available for public review. The studies of the Lower Charles and the Assabet clearly attempted to take into account the myriad of factors presented as caveats in the EPA's 1986 guidance, as well as others. In the case of the waste water plants discharging to the Assabet River, limits were developed based not on the diluted concentration of phosphorus in the receiving waters, but rather on the reduction in aggregate biomass (measured as chlorophyll a) achieved in response to reductions in waste water loads and sediment phosphorus sources. For the Charles River, required reductions in phosphorus loadings from various sources were developed based on seasonal average chlorophyll a levels, rather than in- stream, dilution driven phosphorus levels. This criterion was declared to be adequate to "satisfy all Class B narrative (nutrients, aesthetics and clarity) and numeric (dissolved oxygen in the photic zone of the upper water column and pH) criteria as specified in the MAWQ" (Draft Nutrient TMDL Development for the Lower Charles River Basin, Massachusetts, page vii). Such investigations attempt to address the many factors that impact the growth of nuisance algae; comparable studies should have been undertaken on the Blackstone, rather than resorting to overly simplistic concentration and dilution based analyses.

Response #F12: Of the three examples of TMDL development cited in the comment, the Assabet River is the most similar to the Blackstone River, i.e., effluent dominated with many shallow impoundments. The Assabet River TMDL concluded that total phosphorus limits of 0.1 mg/l for each of four POTWs is necessary to control eutrophication and additionally, 90% of the sediment sources of phosphorus in the river system need to be remediated.

The Nashua River TMDL, was more than five years overdue with much work remaining for it to be approvable by EPA. *See also* Response #E3. In the absence of an approved TMDL, EPA issued a final permit to the City of Leominster, and is preparing a draft permit for the City of Fitchburg with phosphorus effluent limitations developed using an approach similar to this permit – i.e., the Region looked to a variety of sources, including the Gold Book, Ecoregional Nutrient Criteria and Nutrient Criteria Guidance to develop a

numeric phosphorus limit sufficiently stringent to achieve the state's narrative nutrient criterion.

The Lower Charles is very different than the Blackstone River. The Lower Charles acts more like a large lake, and the phosphorus contributions to the Lower Charles are predominately from non-point sources. The average total phosphorus concentration in the Lower Charles River necessary to meet the seasonal chlorophyll a target was determined to be 28 ug/l, much lower than the instream target of 100 ug/l used for the Blackstone River.

In light of the existing nutrient impairments documented in the Blackstone River, the fact that MassDEP has only recently announced plans to initiate a phosphorus TMDL (which, according to MassDEP's proposed schedule, would not be completed until July 2013 – *see* Comment #E3), and the difficulty of conducting nutrient TMDLs, it is not appropriate for EPA to delay issuance of the phosphorus limit in the permit. Neither the CWA nor EPA regulations require that a TMDL be completed before a water quality-based effluent limit may be included in a permit. Rather, water quality-based effluent limitations in NPDES permits must be "consistent with the assumptions and requirements of any *available* [emphasis added] wasteload allocation." 40 CFR 122.44(d)(1)(vii)(B).

Comment #F13: In order to support the development of the 0.75 mg/1 permit limit contained in the existing permit the EPA developed a waste load allocation using the QUAL2E model that was developed as part of the Blackstone River Initiative (BRI). Although the EPA argues that the model was not used to assess cultural eutrophication, it was used to assess the fate of chlorophyll a under various phosphorus control strategies. Seasonal average chlorophyll a was directly used in the Charles as a measure of cultural eutrophication, and in the Blackstone model it serves as an indicator of general plant growth. The Blackstone model runs indicated that at extreme low flow conditions (as compared to seasonal average values) with the phosphorus limitations contained in the existing permit (0.75 mg/1) and with 25% reduction in sediment phosphorus flux, that chlorophyll a levels would be reduced substantially from 67 ug/1 to 22 ug/l. The increased seasonal average flow would undoubtedly have lowered the chlorophyll a limits further, both as a result of dilution and significantly reduced residence time that would serve to mitigate algal growth.

We had never thought that the previous implementation of the QUAL2E model was particularly well done. But it represented the EPA's estimate of the best science it had at the time. It seems surprising then that it was not used in the development of this permit, particularly since the Fact Sheet accompanying this permit makes reference to the response to comments from the previous permit. Those responses indicated that "We believe that the model in its current form is scientifically sound and that further refinements will have little effect on the model predictions... the model indicates that under the permit conditions chlorophyll a values and diurnal dissolved oxygen variations will still be at levels of concern relative to eutrophication impacts." (RTC, 1999 permit page 5). If the model were sufficient to indicate problems then, why was it not used in this permit development to determine an appropriate level of control? Moreover, it

should be noted that the in-stream values that the EPA seeks to apply in this permit were known as far back as 1968 – the date of their original publication and certainly 1986 when they were incorporated into the Gold Book. If these are immutable criteria that need to be met under all conditions, as the EPA now claims, why then were they not used in the BRI analyses? The answer of course, is that to adopt them and apply them in the manner now proposed is too simplistic, and does not reflect real world conditions.

Response #F13: The comment incorrectly characterizes EPA's position on the model and the basis for the previous permit limits. While the model assesses cultural eutrophication, as represented by the response variable chlorophyll a, the waste load allocation did not establish limits necessary to control eutrophication consistent with the narrative criteria in the standards. Phosphorus reductions were evaluated only to the point where the model indicated that minimum dissolved oxygen criteria would be met. As documented in the Fact Sheet for the new permit, the resulting phosphorus limit of 0.75 mg/l is insufficient for addressing cultural eutrophication.

The model was not used to develop effluent limitations addressing cultural eutrophication in the new permit because efforts to update the model in light of new data were unsuccessful. Data collected as part of the Corps of Engineers study [*Phase I: Water Quality Evaluation and Modeling of the Massachusetts Blackstone River, Draft - March 2004* (US Army Corps of Engineers [http://www.nae.usace.army.mil/projects/ma/blackstone/wqe.htm)] indicate that there have been some significant changes in the system relative to productivity since the Blackstone River Initiative study that was the basis for the dissolved oxygen waste load allocation. The Corps of Engineers study indicated high levels of productivity and resulting losses of phosphorus in the upstream reaches immediately below the UBWPAD discharge. Macrophytes were documented as dominating these upstream reaches but were not evident in downstream reaches. The plants that dominated these reaches all have in common that they grow in dense, thick, and long masses and are all indicators of eutrophic freshwater. Since the model is not able to simulate rooted aquatic plants, efforts to update the model based on the new Corps of Engineers data were unsuccessful relative to simulating instream phosphorus levels.

EPA agrees that the in-stream phosphorus recommendations in the Gold Book have been available since at least the time of the Gold Book's publication in 1986. That initial efforts to calibrate the QUAL2E model were not successful or that MassDEP has not yet initiated a phosphorus TMDL does not result in the conclusion that EPA should not address the impacts of cultural eutrophication. The record includes evidence that significant impairments of the receiving waters due to phosphorus-driven eutrophication have already occurred, as discussed elsewhere in Responses #F5 and #F9. Based on these impacts and the fact that UBWPAD is by far the dominant source of bioavailable phosphorus loading to the Blackstone River under critical low flow conditions, it is not appropriate to delay establishment of limitations to address cultural eutrophication. Absent an approved TMDL, EPA must base effluent limits for phosphorus on the narrative criteria in the currently approved water quality standards.

Comment #F14: As is required by EPA, the Commonwealth of Massachusetts is developing its own criteria for nutrients that will be used for determining compliance with its nutrient criteria. The Commonwealth periodically reports on the progress of these efforts as part of the State and EPA Performance Partnership Agreement (PPA). According to the most recent PPA, this activity is ongoing. Given that recent nutrient TMDL's in the Commonwealth have relied on response criterion (e.g. biomass reduction, water clarity or chlorophyll a levels) rather than specific numeric criterion, it would seem that the EPA should have at least attempted to use these metrics, rather than arbitrarily selecting a numeric criterion.

Response #F14: While MassDEP has begun the process of developing numeric criteria for controlling nutrients, the Commonwealth has not yet submitted any proposed revisions to its water quality standards that incorporate numeric criteria for controlling cultural euthrophication and has not proposed a specific time frame for making such a submittal. If MassDEP chooses to propose site specific criteria based on reponse variables, it must also include a procedure for translating these criteria to phosphorus limits. Further, any proposed revision to standards must then be approved by EPA after an evaluation of whether the proposed criteria are sufficient for protecting and achieving designated uses.

In the process of setting the effluent limitation for phosphorus, we did consider response variables. As detailed in the Fact Sheet, we considered the relationship of phosphorus and cultural eutrophication, as measured by response variables such as chlorophyll a, periphyton and macrophytes. (Data on response variables is contained in the studies documented in the Fact Sheet.) In interpretation of MassDEP's narrative criterion, we consulted nationally recommended criteria and other technical documents to establish effluent limitations designed to address the response variables and to ensure attainment of water quality standards. *See* 40 CFR 122.44(d)(1)(vi)(B). *See also* Response #F9 and #F13 relative to response variable considerations in setting permit limits.

Comment #F15: The Fact Sheet is in error at page 7 when it suggests that the limits on phosphorus are necessary to meet technology based standards of the Massachusetts Surface Water Quality Standards. As presented on page 10, the EPA rejects the use of its interpretation of the Commonwealth's technology based requirement for highest and best practicable treatment, suggesting that such a level of treatment is insufficient because "the receiving water does not provide sufficient dilution to ensure that a limit of 0.2 mg/1 would adequately control eutrophication to meet water quality criteria". Thus, the limits presented in this Fact Sheet are not technology based standards under Massachusetts FS page 10, contrary to the claim of page 7 of the Fact Sheet.

Note that the District does not believe that the Commonwealth's requirement for highest and best practicable treatment compels the use of a 0.2 mg/1 phosphorus limit. The actual language from the Commonwealth's water quality standards defines it as "...The best practicable waste treatment technology for publicly owned treatment works that is the most appropriate means available on a regional basis for controlling the direct discharge of toxic and non-conventional pollutants to navigable waters....". 314 CMR 4.02 and

further, that "....Any existing point source discharge containing nutrients in concentrations that would cause or contribute to cultural eutrophication, including the excessive growth of aquatic plants or algae, in any surface water shall be provided with the most appropriate treatment as determined by the Department, including, where necessary, highest and best practical treatment (HBPT) for POTWs and BAT for non POTWs, to remove such nutrients to ensure protection of existing and designated uses..." 314 CMR 4.05(5)(c).

It is thus clear that if higher levels of phosphorus discharge would serve to mitigate cultural eutrophication, that those levels are acceptable under Massachusetts' Water Quality Standards.

Response #F15: As outlined in the Fact Sheet, the phosphorus limit is based on water quality criteria and is not based on technology requirements. Specifically, the limit is based on the narrative criteria for controlling cultural eutrophication. The reference on page 7 of the Fact Sheet to the "highest and best practicable treatment" for nutrients was included to provide a more complete discussion of references to eutrophication in Massachusetts Surface Water Quality Standards. We note for the record UBWPAD's interpretation of the "highest and best practicable treatment" requirement in the Commonwealth's standards.

Comment #F16: The District suggests that the most appropriate way forward is for it to complete construction of the upgraded facilities, that the District should monitor operation of these facilities for a period of not less than two full growing seasons that the District, in conjunction with others, should complete and refine its ongoing modeling efforts, which would form the basis of a TMDL by the Commonwealth. Thereafter, the permit should be modified to incorporate the appropriate level of treatment. The current consent agreement could be modified to affect these efforts. The District believes that this approach is substantially in agreement with the proposal submitted by the Commonwealth of Massachusetts at the permit hearing of May 9, 2007.

More importantly, this approach is entirely consistent with the intention of the 1999 permit. As the EPA indicated in their response to comments on that permit

> "...It is important to note that [the] permit limits reflect a phased approach and are based on a WLA designed to increase minimum predicted dissolved oxygen levels to 5.0 mg/l. The model indicates that under the permit conditions chlorophyll-a values and diurnal dissolved oxygen variations will still be at levels of concern relative to eutrophication impacts. ***If these problems persist,*** then more stringent phosphorus limits.... will need to be implemented... " RTC, 1999 permit, page 5, emphasis supplied.

It thus seems clear that the EPA expected the District to complete the upgrade of the facilities and to assess the efficacy of the improvements before moving forward with new limits.

Response #F16: *See* Response #A3, #E3, #F9 and #F12 relative to delaying establishment of more stringent nutrient effluent limitations; Responses #A2, #E2 and #F7 relative to schedules; Response #F9 relative to persistence of eutrophic impacts even with discharge levels approaching the 0.75 limit in the expired permit; and Response #F7 relative to inappropriateness of delay in setting limits pending UBWPAD's modeling efforts. With regard to the above-quoted language in the response to comments for the expired permit (and EPA's caution to UBWPAD regarding the possibility of more stringent phosphorus limits), please see Response #F5.

Comment #F17: EPA and RIDEM have used an 87% delivery factor as an estimator of the amount of nitrogen discharged at UBWPAD that is delivered to the Seekonk River (EPA Fact Sheet). However, in its response to comments, RIDEM has said the following:

> The fate and transport from the MA/RI state line to the mouth of the River expected when WWTF's meet their current permit limits, was evaluated by applying the methods described above to the results of the 1997 WLA model. It was determined that 79% of the MA loading at the state line and 86% of the Woonsocket WWTF load will be delivered to the mouth of the Blackstone River when the required WLA is met. By combining the delivery from each MA WWTF to the state line with that from the state line to the mouth of the river, refined delivery factors were computed for each MA WWTF. It was determined that between 71 and 77% of the individual MA WWTFs nitrogen loading will be delivered to the mouth of the River (72% for UBWPAD) and 86% of the Woonsocket WWTF. In the DEM evaluation, the Woonsocket and UBWPAD WWTFs were both assigned a river delivery factor equal to 87%.

Thus, while RIDEM may have used 87% as a River delivery factor, their actual analysis indicates that for the Upper Blackstone, the value is actually 72%, assuming compliance with the 2001 permit limits for phosphorus. If only 72% of the discharge makes it to the Seekonk River, then this suggests that an effluent limit of 6.94 mg/1 is more appropriate if one accepts RIDEM's analysis -- or that the limit on plants discharging directly into the Seekonk and Providence Rivers ought to have an equivalent limit of 3.6 mg/l.

Compounding this error is that fact that RIDEM's analysis to produce the 87% value used in their analysis is conceptually flawed. According to their supporting materials, the 87% factor reflects the fact that the amount of nitrogen discharged out the Blackstone River in 1995/1996 (1,552 kg/day) was 87% of the amount discharged from the Upper Blackstone and Woonsocket treatment plants (1,782 kg/day). But this analysis ignores the baseload associated with the watershed, which RIDEM has separately estimated at 370 kg/day, and the nitrogen discharge of other plants in the Blackstone River Watershed in Massachusetts and Rhode Island. RIDEM makes no separate estimate of the load from these 8 plants. A reasonable estimate suggests that the loadings from these plants could approach an additional 400 kg/d, which would make the delivery factor for the combined Woonsocket and District discharge drop to 61% (1,552/(1782+370+400). If, as indicated by RIDEM that the UBWPAD river delivery factor was actually at 72% as compared to the combined 86%, then the UBWPAD river delivery factor would be 51% (61*(72/86)).

If the river delivery factor is only 51%, then the appropriate limits for the UBWPAD discharge to ensure an equivalent 5 mg/1 discharge at the mouth of the Blackstone is 9.8 mg/l.

Response #F17: The nitrogen attenuation processes in the Blackstone River will vary due to many factors, including water quality, season, weather conditions, and flow regime. The estimates prepared by RIDEM were intended to estimate attenuation during dry weather summer periods, when receiving water quality impacts due to eutrophication have been shown to be most severe. During these conditions, non point source discharges would be expected to be minimized due to the minimal storm water runoff, and in-stream nitrogen removal processes such as algal growth and biological denitrification would be maximized due to the warmer temperature and increased sunlight.

The estimated total nitrogen delivery factor of 87% used by RIDEM in its recommendation of loading reductions for facilities in Rhode Island and Massachusetts [*Evaluation of Nitrogen Targets and WWTF Load Reductions for the Providence and Seekonk Rivers*, RIDEM, December 2004] was based on an analysis of 1995/1996 data and assumed that the majority of nitrogen delivered to the system was from the two major point sources – UBWPAD and Woonsocket. Importantly, the 87% estimate was based on the conditions existing at the time of data collection, and did not attempt to predict the effect of future reductions of phosphorus loadings on nitrogen attenuation rates.

A subsequent analysis used data from 2001 and 2002 (*see* RIDEM Response to Comments document cited in the Fact Sheet) and employed a model that did account for other point sources, as well as non-point sources. The second analysis also took into account the impact of NPDES-required reductions in phosphorus loadings from the wastewater treatment plants (using the 0.75 mg/l total phosphorus limit in the expired permit for UBWPAD), assumed a total nitrogen discharge of 10 mg/l from UBWPAD, and assumed that the treatment plants were discharging at design flow. The analysis indicated that under these conditions, the UBWPAD total nitrogen delivery factor to the state line will increase from 69% to 92%, and 79% of the loading at the state line will be delivered to the mouth of the Blackstone River. This results in an overall river total nitrogen delivery factor of approximately 73%.[9]

Significantly, the second analysis showed that as phosphorus discharges to the river are reduced, the delivery of nitrogen increased. The reason for the reduced attenuation for nitrogen is that phosphorus-driven algal growth is the primary cause of nitrogen uptake. Given that the two largest sources of phosphorus to the River (UBWPAD and

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[9] The commenter suggests further adjustments based on its estimates of non-point and point source loadings, resulting in a proposed delivery factor of 51%. However, the second analysis conducted by RIDEM quantified these loadings and accounted for them in the revised estimate of attenuation. The commenter does not identify any specific concerns with the loadings in the revised analysis that warrants use of the commenter's estimated loadings.

Woonsocket) are both proposed to have limits of 0.1 mg/l total phosphorus (which are more stringent than the 0.75 mg/l limit on which RIDEM's analysis was based) and that other point sources will also be required to reduce phosphorus loadings, a further increase in the delivery of nitrogen to Narragansett Bay can be expected.

An additional analysis of attenuation in the Blackstone River (Nixon et al. 2005), as pointed out in the comments submitted by The Rhode Island Bays, Rivers, & Watersheds Coordination Team, indicates that attenuation is minimal. In this study, measurements of in-stream nitrogen concentration and stream flow for the period from April 2004 to August 2004 were used to estimate attenuation in the segment of the Blackstone River from Millville, MA to Pawtucket, RI, a distance of 32.5 river miles. The study showed that the average nitrogen load actually increased in the segment, even when the load discharge by the two treatment plants discharging to the segment (Woonsocket and Burriville) were removed. The data indicates that the load from processes adding nitrogen to this segment are greater than the load attenuated or, as Nixon concludes: "The simple interpretation of these results is that we see no direct evidence of DIN attenuation or removal in the lower Blackstone." (Nixon et al. 2005). The data collected during the driest month (August) -- when non point discharges of nitrogen should be minimal and nitrogen removal processes associated with algal growth and biological denitrification should be maximized -- also shows no attenuation in this segment, even when subtracting the average POTWs loadings to the segment (which will undoubtedly be lower than the calculated average load under August conditions). This study shows that the delivery factors estimated by DEM for the Blackstone River from the state line to the Seekonk River may be too low. If the delivery factor estimated in the DEM model (92%) were coupled with the delivery factor from the Nixon report (100%), a delivery factor as high as 92% could be calculated for the UBWPAD discharge.

While scientific study of attenuation is ongoing, EPA must use its judgment to establish nutrient reductions for this discharge necessary to ensure attainment of water quality standards based on the information available now. Based on all the available data and analyses, EPA's judgment is that a delivery factor of 87% for the UBPWAD discharge, based on future conditions associated with required reductions in phosphorus loadings, is within the range of values that could be calculated and is therefore reasonable and appropriate. Accordingly, EPA has used that estimate for establishing water quality-based nitrogen limits in this permit issuance.

Comment #F18: In the course of issuing permit modifications to various dischargers in Rhode Island, RIDEM received comments, and responded to many of those comments. However, they failed to respond or inaccurately responded to numerous comments of the various parties which were central to the resolution of the technical matters associated with the issuance of the permits. These comments are as follows:

A: Numerous comments indicated that extrapolation of the MERL experimental results to the Providence and Seekonk Rivers was inappropriate because of the significantly different conditions between the Rivers and those of Narragansett Bay that the MERL experiments were intended to simulate. In particular, the comments indicated that area

loading rates used by RIDEM were inappropriate because the River systems flush at substantially faster rates than the Bay. Because of this, the concentration of nutrients in the river will be less than in the Bay at the same area loading rate, and the level of algal productivity comparably lower. Comments of the City of Woonsocket, included as Attachment A4, comments of the Commonwealth of Massachusetts included as Attachment A5 and comments of the Narragansett Bay Commission, included as Attachment A6.

In its response to comments, DEM provides no information to refute this observation, or to justify its position. Instead they make a series of erroneous statements that appear to justify their analysis, but in fact do the opposite, as follows:

> In response [to] the Massachusetts Department of Environmental Protection's comment that DEM did not consider the importance of detention time and hydrodynamics of the river system, DEM characterizes the Providence and Seekonk Rivers as "poorly flushed." (RTC, page 13). In reality, according to RIDEM's own work, and as commented upon by the City of Woonsocket, (see comments of the City of Woonsocket), the Providence and Seekonk Rivers flush far more rapidly than does the Bay. Since flushing controls concentrations of nutrients, which control productivity, the use of the MERL experiments are incorrect.

In response to a comment made by the Narragansett Bay Commission concerning the same issue, DEM states that "The behavior of dissolved oxygen and algae (chlorophyll-a) observed in the Providence and Seekonk River systems is very similar to that observed in the MERL experiment." This is, however, not true, as was indicated the City of Woonsocket's comment entitled "Contradictory Data are presented in the Analysis" (see comments of the City of Woonsocket). Those comments pointed out that the MERL studies showed a congruence of low dissolved oxygen and high chlorophyll-a, while the 1995/1996 data relied on by DEM showed high DO with high chlorophyll-a, and low DO with low chlorophyll a.

Response #F18A:

The basic relationship demonstrated by the MERL tank experiments between the primary causal and response variables relative to eutrophication corresponds to what is actually occurring in the Providence/Seekonk River system. EPA recognizes and acknowledged in the Fact Sheet that the MERL tank experiments cannot *completely* simulate the response of chlorophyll a and dissolved oxygen to nitrogen loadings in a complex, natural setting such as the Upper Narragansett Bay. Part of that complexity includes spatial and temporal fluctuations in flushing rates. As is detailed below, EPA took such uncertainties into account in establishing the nitrogen limit in the permit.

The MERL enrichment gradient experiments included a study of the impact of different loadings of nutrients on dissolved oxygen and chlorophyll *a*. *See Evaluation of Nitrogen Targets and WWTF Load Reductions for the Providence and Seekonk Rivers*, RIDEM, December 2004. The experiments were conducted from June 1981 through September

1983 and consisted of 9 tanks (mesocosms), each 5 meters deep and 1.83 meters in diameter. Three tanks were used as controls, and were designed to have regimes of temperature, mixing, turnover, and light similar to a relatively clean Northeast estuary with no major sewage inputs. The remaining six mesocosms had the same regimes, but were fed reagent grade inorganic nutrients (nitrogen, phosphorus and silica) in molar ratios found in Providence River sewage. The six mesocosms were fed nutrients in multiples of the estimated average sewage inorganic effluent nutrient loading to Narragansett Bay. For example the 1X mesocosm nitrogen loading was 2.88 mM N/m^2/day (40 mg/m^2/day) and the 2X was twice that and so on (4X, 8X, 16X) up to a maximum load of 32X. During the study dissolved oxygen, chlorophyll, pH, and dissolved inorganic nutrients were measured in the water column and benthic respiration was also measured. From the collected data the investigators produced times series for oxygen, pH, temperature, nutrients, chlorophyll, and system metabolism (see *Patterns of productivity during eutrophication: a mesocosm experiment*, Oviatt, Keller, Sampou, Beatty).

Both the MERL tank experiments and the data from the Providence/Seekonk River system indicate a clear correlation between nitrogen loadings, dissolved oxygen impairment and chlorophyll *a* levels. Low dissolved oxygen levels, as well as supersaturated dissolved oxygen levels, are indicators of cultural eutrophication. Figures 1 through 3 in the *Evaluation of Nitrogen Targets and WWTF Load Reductions for the Providence and Seekonk Rivers* show the dissolved oxygen measurements taken from MERL tank experiment and demonstrate that the range and variability of DO increases with increased nutrient loading. As described in the text of the report, and shown in Figure 13, the DO in the Seekonk River showed patterns of DO variability similar to that of the high enrichment tanks in the MERL experiments.

Phytoplankton, as measured by chlorophyll *a* levels, is an even stronger response indicator of cultural eutrophication than DO. Coastal areas without high nutrient loads are expected to have chlorophyll *a* levels in the 1 to 3 ug/l range (*Nutrient Criteria Technical Guidance Manual – Estuarine and Coastal Marine Waters*, USEPA, October 2001). Massachusetts has identified chlorophyll *a* levels of less than 3 ug/l as representing excellent water quality and chlorophyll *a* levels similar to the levels in the Providence/Seekonk River system as representing significantly impaired waters (*Massachusetts Estuaries Project – Site-Specific Nitrogen Thresholds for Southeastern Massachusetts Embayments: Critical Indicators*, July 21, 2003 as revised). Peak chlorophyll *a* levels in the Providence/Seekonk River system have exceeded 200 ug/l (see June 29th data in Figure 15 of *Evaluation of Nitrogen Targets and WWTF Load Reductions for the Providence and Seekonk Rivers*). The MERL tank experiments showed a correlation between nitrogen loading rates and chlorophyll *a* levels (see Figures 7, 8, and 9). These results were consistent with RIDEM data from 1995-96, which indicate that mean photoplankton chlorophyll *a* levels in the three Seekonk River monitoring stations ranged from 14 ug/l to 28 ug/l, with the highest levels in the upper reaches of the river and the lowest levels in the lower reaches of the river (see Table 3). These chlorophyll *a* levels correlate with total nitrogen levels and with the dissolved inorganic nitrogen levels shown in Figure 3.

The basic relationship demonstrated by the MERL tank experiments between nitrogen loadings, dissolved oxygen impairment and chlorophyll *a* levels corresponds to what is actually occurring in the Providence/Seekonk River system.[10] EPA recognized, however, that the MERL tank experiments cannot completely simulate the response of chlorophyll *a* and dissolved oxygen to nitrogen loadings in a complex, natural setting such as the Providence/Seekonk River system, and thus does not yield a precise level of nitrogen control required to restore uses in the system. For example, dissolved oxygen in Narragansett Bay is influenced by stratification, which was not simulated in the MERL tank experiment, in which waters were routinely mixed. In a stratified system there is little vertical mixing of water, so sediment oxygen deficits are exacerbated, due to the lack of mixing with higher DO waters above. In addition, the flushing rate used in the MERL tanks is not the same as seen in the Bay. Because the physical model does not generate a definitive level of nitrogen control that can be applied to a real world discharge, but instead a range of loading scenarios which are subject to some scientific uncertainty, EPA was required to exercise its technical expertise and scientific judgment based on the available evidence when translating these laboratory results and establishing the permit limit.

Of the various loadings scenarios available to it, EPA determined that a concentration-based limit of 5 mg/l would be necessary to address the excessive loadings from the facility, which both EPA and Rhode Island have determined are contributing to ongoing water quality impairments in the Narragansett Bay system. An effluent limit of 5 mg/l corresponds to a loading scenario in the Seekonk River of approximately 6.5 times the Bay wide loading at current facility flows and approximately 10 times at 90% design flows. *See, e.g.*, Evaluation of Nitrogen Target and WWTF Load Reductions for the Providence and Seekonk Rivers, RIDEM, December 2004 at 28. Despite the severe nitrogen-related impairments in the receiving waters, EPA opted not to impose a limit based on more stringent loading scenarios at this time in order to account for uncertainties associated with the physical model. (Based on the MERL tank experiments, a nitrogen loading of between 2 times and 4 times the Bay wide loading may be necessary to achieve water quality standards). Even with the recognition of differences between the laboratory and natural environment, the fact that water quality responses to a 10X nitrogen mass loading scenario in the MERL tank experiments resulted in a significant level of impairment was an area of concern for EPA in light of its duty under section 301(b)(1)(C) to ensure compliance with water quality standards. However, when evaluating the adequacy of the limit, EPA was also aware that the particular approach it adopted possesses conservative elements which enhance the protectiveness of the permit beyond that of the 10X mass loading scenario. Specifically, the decision by EPA to impose concentration rather than mass limits will assure that effluent nitrogen concentrations are maintained at consistently low levels and, as a practical matter, will result in actual mass loadings that are kept significantly below the 10X loading scenario

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[10] The correlation between nitrogen loadings, chlorophyll *a* levels, and dissolved oxygen impairment is well documented in the *Nutrient Criteria Technical Guidance Manual – Estuarine and Coastal Marine Waters*, USEPA, October 2001.

for the foreseeable future, as treatment plant flows remain well below the facility's permitted design flow.[11]

When establishing the limit and assessing its protectiveness, EPA took into account the fact that RIDEM has committed to ensuring adequate monitoring and assessment of water quality changes to determine if additional reductions will be necessary to meet water quality standards. RIDEM has, in partnership with several research and academic institutions in Rhode Island, established an extensive monitoring network in order to provide the data necessary to evaluate compliance with water quality standards upon implementation of the recommended nitrogen reductions (*see* RIDEM**,** February 1, 2005 report). This information will be available to check the Region's assumptions regarding the adequacy of the limit. If EPA has erred in navigating the scientific complexities and uncertainties associated with the MERL tank experiments, EPA will be able to further refine the limit in future permitting cycles.

When evaluating whether it had met its obligations under section 301(b)(1)(C) and 401(a)(2) to ensure compliance with applicable water quality standards, including those of affected states, EPA also accounted for the fact that Rhode Island, when assigning permit limits to facilities within its own borders in accordance with its own water quality standards, did not conclude more stringent limits would be necessary or appropriate at this time. Under Rhode Island's permitting approach, limits of 5 mg/l and 8 mg/l have been imposed on various Rhode Island POTWs whose discharges impact Narragansett Bay, and Rhode Island has recommended that similar limits be placed on certain Massachusetts facilities that are impacting the Bay. *See Evaluation of Nitrogen Targets and WWTF Load Reductions for the Providence and Seekonk Rivers*, RI DEM, December 2004. In arriving at its decision to impose a nitrogen effluent limit of 5 mg/l on the UBWPAD facility, EPA regarded Rhode Island's position as additional evidence that the limit was reasonable and sufficiently stringent to comply with the CWA.

EPA in addition determined that no less stringent limit could be imposed that would still ensure compliance with water quality standards in light of the severe existing eutrophic conditions in the Providence/Seekonk River system, indicating that it is significantly overallocated for nitrogen. In so concluding, EPA also weighed the fact that RIDEM has indicated that nitrogen limits as low as the limits of technology (*i.e.*, 3 mg/l) may be necessary to achieve water quality standards, with the caveat that it too has acknowledged uncertainty in the model. *See Evaluation of Nitrogen Targets and WWTF Load Reductions for the Providence and Seekonk Rivers*, RIDEM, December 2004, at p. 27. [12]

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[11] Recent annual average flows from the treatment facility have been as follows: 34 mgd in 2002; 41 mgd in 2003; 36 mgd in 2004; 43 mgd in 2005; 35 mgd in 2006; and 30 mgd in 2007. While the flows demonstrate some variation, due at least in part to inflow/infiltration, flows are well below permitted design flow and there is no upward trend.

[12] In general, the Region adopts a reasonably conservative approach when permitting nutrient discharges. This protective approach is appropriate because, once begun, the cycle of eutrophication can be difficult to reverse given the tendency of nutrients to recycle through the ecosystem. This approach is in line with EPA regulations. The Region is required to impose a limit where the reasonable *potential* exists for violations of water quality standards. *See* 40 C.F.R. § 122.44(d)(1),(5). Moreover, such a limit must