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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NEW ENGLAND - REGION I
5 POST OFFICE SQUARE, SUITE 100
BOSTON, MASSACHUSETTS 02109-3912

FACT SHEET

DRAFT NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT TO DISCHARGE TO WATERS OF THE UNITED STATES PURSUANT TO THE CLEAN WATER ACT (CWA)

NPDES PERMIT NUMBER: **MA0100641**

PUBLIC NOTICE START AND END DATES:

NAME AND MAILING ADDRESS OF APPLICANT:

Board of Water and Sewer Commissioners
Town of Bridgewater Academy Building
Bridgewater, MA 02134

NAME AND ADDRESS OF FACILITY WHERE DISCHARGE OCCURS:

Bridgewater Wastewater Treatment Facility (WWTF)
Morris Avenue
Bridgewater, Massachusetts 02134

RECEIVING WATER(S): **Town River (Taunton Watershed (MA62-13))**

RECEIVING WATER CLASSIFICATION(S): **Class B (Warm Water Fishery)**

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I. Proposed Action, Type of Facility, and Discharge Location

The above named applicant has requested that the U.S. Environmental Protection Agency (EPA) reissue its NPDES permit to discharge from Outfall 001 into the Town River. The facility is an advanced wastewater treatment plant engaged in the collection and treatment of sanitary wastewater.

The existing NPDES permit was issued on December 30, 2003 with an effective date of March 1, 2004 and expired on March 1, 2009. As of March 2, 2009, the expired permit (hereinafter referred to as the "current permit") was administratively extended because the applicant filed a complete application for permit reissuance as required by 40 Code of Federal Regulations (CFR) §122.6. The facility location is shown on Figure 1 of this fact sheet (attached).

II. Description of Discharge

A quantitative description of the discharge in terms of significant effluent parameters based on recent effluent monitoring data may be found in Table 1 of this fact sheet (attached). Figure 2 of the fact sheet (attached) is a flow process diagram of the facility.

III. Receiving Water Description

The Bridgewater WWTF discharges to the Town River Segment MA62-13. Segment MA62-13 runs from the WWTF to the confluence with the Matfield River forming the Taunton River, a length of 2.4 miles.

The Town River has been designated as a Class B water, warm water fishery. The Massachusetts Surface Water Quality Standards (MA SQWS), 314 Code of Massachusetts Regulations (CMR) 4.05(3) (b) states that Class B waters are designated as habitat for fish, other aquatic life and wildlife, including for their reproduction, migration, growth and other critical functions, and for primary and secondary contact recreation. They shall be suitable for irrigation and other agricultural uses and for compatible industrial cooling and process uses. The waters should have consistently good aesthetic value. A warm water fishery is defined in the Massachusetts Surface Water Quality Standards (MA SWQS) at 314 CMR 4.02 as waters in which the maximum mean temperature over a seven day period generally exceeds 20° Celsius during the summer months and are not capable of supporting a year-round population of cold water stenothermal aquatic life.

The Massachusetts 2012 Integrated List of Waters lists this segment of the Town River as Category 3, "no uses assessed."[1] The Taunton River segment just downstream is listed as Category 2, "attaining some uses, other uses not assessed" based on attainment of the "Fish, other Aquatic Life, and Wildlife" use. *Id.* The Taunton River ultimately discharges into Mount Hope Bay, which is located partially in Rhode Island and is listed by both Massachusetts and

[1] Massachusetts Year 2012 Integrated List of Waters, Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 303(d) and 305(b) of the Clean Water Act, Massachusetts Department of Environmental Protection (MassDEP), Division of Watershed Management

Rhode Island as impaired due to nitrogen. The estuarine segments of the Taunton River are also impaired, with dissolved oxygen and pathogen impairments for segments 62-03 and -04.

IV. Limitations and Conditions

The effluent limitations and all other requirements described in Part VII of this Fact Sheet may be found in the draft permit.

V. Permit Basis: Statutory and Regulatory Authority

Congress enacted the Clean Water Act (CWA) "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." CWA § 101(a). To achieve this objective, the CWA makes it unlawful for any person to discharge any pollutant into the waters of the United States from any point source, except as authorized by specified permitting sections of the CWA, one of which is Section 402. *See* CWA §§ 301(a), 402(a).

Section 402(a) established one of the CWA's principal permitting programs, the National Pollutant Elimination System (NPDES). Under this section of the CWA, EPA may "issue a permit for the discharge of any pollutant, or combination of pollutants" in accordance with certain conditions. *See* CWA § 402(a). NPDES permits generally contain discharge limitations and establish related monitoring and reporting requirements. *See* CWA § 402(a)(1)-(2).

Section 301 of the CWA provides for two types of effluent limitations to be included in NPDES permits: "technology-based" limitations and "water quality-based" limitations. *See* §§ 301, 304(b); 40 CFR §§ 122, 125, 131. Technology-based treatment requirements represent the minimum level of control that must be imposed under Sections 402 and 301(b) of the CWA. For publicly owned treatment works (POTWs), technology-based requirements are effluent limits based on secondary treatment as defined in 40 CFR 133.102.

EPA regulations require NPDES permits to contain effluent limits more stringent than technology-based limits where necessary to maintain or achieve federal or state water quality standards. Under Section 301(b)(1)(C) of the CWA, discharges are subject to effluent limitations based on water quality standards. The MA SWQS, 314 CMR 4.00, establish requirements for the regulation and control of toxic constituents and also require that EPA criteria, established pursuant to Section 304 (a) of the CWA, shall be used unless a site specific criteria is established. Massachusetts regulations similarly require that its permits contain limitations which are adequate to assure the attainment and maintenance of the water quality standards of the receiving waters as assigned in the MA SWQS. *See* 314 CMR 3.11(3). EPA is required to obtain certification from the state in which the discharge is located that all water quality standards or other applicable requirements of state law, in accordance with Section 301(b)(1)(C) of the CWA, are satisfied, unless the state waives certification.

Section 401(a)(2) of the CWA and 40 CFR § 122.44(d)(4) require EPA to condition NPDES permits in a manner that will ensure compliance with the applicable water quality standards of a "downstream affected state," in this case Rhode Island. The Rhode Island Water Quality Regulations (RI WQR) also establish designated uses of the State's waters, criteria to protect those uses, and an antidegradation provision to ensure that existing uses and high quality waters are protected and maintained.

In addition, a permit may not be renewed, reissued or modified with less stringent limitations or conditions than those contained in the previous permit unless in compliance with the anti-backsliding requirements of CWA Section 402(o) and 40 CFR §122.44(l). States are also required to develop antidegradation policies pursuant to 40 CFR § 131.12. No lowering of water quality is allowed, except in accordance with the antidegradation policy.

VI. Facility Information

The Bridgewater WWTF serves a population of approximately 16,500, all within the town of Bridgewater. Approximately one-third of the town by area is sewered. The WWTF has no significant industrial users and treats approximately 20,000 gallons per day of septage.

The facility is a Rotating Biological Contactor (RBC) plant that was last upgraded in 1987. A flow diagram of the facility is shown in Figure 2. Influent passes through a comminutor to an aerated grit chamber where ferric chloride is added for phosphorus removal. The flow is then split between two primary clarifiers (except in summer when one clarifier is taken offline for maintenance), then pumped to a train of fourteen RBC units in four stages (six units in the first stage, then four, then two, then two). Flow is then by gravity to two secondary clarifiers, then to an aerated chlorine contact chamber with sodium hypochlorite disinfection and dechlorination by sulfur dioxide. Flow is measured after secondary clarification, and all samples are taken after dechlorination. Effluent is discharged from a 20-inch diameter outfall pipe at the bottom of the Town River (see Figure 1 for location). Sludge is dewatered on two belt filter presses and then composted; the product is a Type I biosolid suitable for land application.

VII. Derivation of Effluent Limits under the Federal CWA and the Commonwealth of Massachusetts Water Quality Standards

A. FLOW

The 12-month rolling average flow limitation of 1.44 MGD in the existing permit has been maintained in the draft permit. This is the design effluent wastewater flow of the facility found in Form 2A, Part A, Section a.6. of the permit application. Sewage treatment plant discharge is encompassed within the definition of "pollutant" and is subject to regulation under the Act. The CWA defines "pollutant" to mean, *inter alia*, "municipal . . . waste[]" and "sewage…discharged into water." 33 U.S.C. § 1362(6).

EPA may use design flow to both determine the necessity for effluent limitations in the permit that comply with the Act, and to calculate the limits themselves. EPA practice is to use design flow as a reasonable and important worst-case condition in EPA's reasonable potential and water quality based effluent limitations (WQBELs) calculations to ensure compliance with water quality standards under Section 301(b)(1)(C). Should the discharge flow exceed the flow assumed in these calculations, the instream dilution would decrease and the calculated effluent limits would not be protective of WQS. Further, pollutants that did not have the reasonable potential to exceed WQS at the lower discharge flow may have reasonable potential at a higher flow due to the decreased dilution. In order to ensure that the assumptions underlying the Region's reasonable potential analyses and derivation of permit effluent limitations remain sound for the duration of the permit, the Region may ensure its "worst-case" effluent wastewater flow assumption through imposition of a permit condition for flow. Thus, the flow limit is a component of WQBELs because the WQBELs are premised on a maximum level of flow. In addition, the flow limit is necessary to ensure that other pollutants remain at levels that do not have a reasonable potential to exceed water quality standands.

Using a facility's design flow in the derivation of pollutant effluent limitations, including conditions to limit wastewater effluent flow, is fully consistent with, and anticipated by NPDES permit regulations. 40 C.F.R. § 122.45(b)(1) provides, "permit effluent limitations...shall be calculated based on design flow." POTW permit applications are required to include the design flow of the treatment facility. *Id.* § 122.21(j)(1)(vi).

Similarly, EPA's reasonable potential regulations require EPA to consider "where appropriate, the dilution of the effluent in the receiving water," 40 C.F.R. § 122.44(d)(1)(ii), which is a function of *both* the wastewater effluent flow and receiving water flow. EPA guidance directs that this "reasonable potential" analysis be based on "worst-case" conditions. EPA accordingly is authorized to carry out its reasonable potential calculations by presuming that a plant is operating at its design flow when assessing reasonable potential.

The limitation on sewage effluent flow is within EPA's authority to condition a permit in order to carry out the objectives of the Act. *See* CWA §§ Sections 402(a)(2) and 301(b)(1)(C); 40 C.F.R. §§ 122.4(a) and (d); 122.43 and 122.44(d). A condition on the discharge designed to protect EPA's WQBEL and reasonable potential calculations is encompassed by the references to "condition" and "limitations" in 402 and 301 and implementing regulations, as they are designed to assure compliance with applicable water quality regulations, including antidegradation. Regulating the quantity of pollutants in the discharge through a restriction on the quantity of wastewater effluent is consistent with the overall structure and purposes of the CWA.

In addition, as provided in Part II.B.1 of this permit and 40 C.F.R. § 122.41(e), the permittee is required to properly operate and maintain all facilities and systems of treatment and control. Operating the facilities wastewater treatment systems as designed includes operating within the facility's design effluent flow. Thus, the permit's effluent flow limitation is necessary to ensure proper facility operation, which in turn is a requirement applicable to all NPDES permits. *See* 40 C.F.R. § 122.41.

The draft permit requires continuous flow measurement, and also requires reporting of the average monthly and maximum daily flows.

<u>7Q10 Data and Dilution Factor</u>

Water quality-based limitations are established with the use of a calculated available dilution. 314 CMR 4.03(3)(a) requires that effluent dilution be calculated based on the receiving water

7Q10. The 7Q10 is the lowest observed mean river flow for 7 consecutive days, recorded over a 10 year recurrence interval. Additionally, the plant design flow is used to calculate available effluent dilution.

The United States Geological Survey (USGS) Gazetteer of Hydrologic Characteristics for the Taunton River Basin (WRI Report 84-4283) lists a 7 day low flow with a recurrence interval of 10-years (7Q10) for the Town River at State Route 18 in Bridgewater (Gage Station No. 01107100) of 2.7 cfs with a drainage area of 55.6 square miles (mi^2), based on measurements in 1966-67. This location is just upstream of the discharge; the drainage area of the Town River at the point of the Bridgewater WWTF is approximately 55.9 square miles.[2] Therefore, the 7Q10 just upstream of the WWTF will be equal to 2.7 x 55.9 / 55.6 or 2.71 cfs. Dilution is calculated as follows:

Qe = Bridgewater WWTF Design Flow: 1.44 mgd = 2.23 cfs

Receiving stream – Town River

Qs = 7 day 10 year low flow (7Q10): 2.71 cfs

Dilution Factor $= (Q_s + Q_e) / Q_e = (2.71 + 2.23) / 2.23 = 2.2$

This is the same dilution factor used in the current permit.

B. CONVENTIONAL POLLUTANTS

Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS)

The BOD and TSS concentration limits in the draft permit are the same as the limits in the existing permit and are based on a waste load allocation (WLA). These limits are more stringent than those required by the secondary treatment requirements of 40 CFR Part 133. The draft permit also contains percent removal requirements of 85% based on secondary treatment requirements. The monitoring frequency is maintained at two times per week.

There have been no violations of the monthly average BOD and TSS limits during the period of January 2011 to December 2013, with a long term average of 8.0 and 10.1 mg/l, respectively. See Table 1. The BOD and TSS removal percentages have averaged 97% and 98% respectively, with no violations during this time period.

Settleable solids

The existing permit requires daily monitoring for settleable solids and requires reporting of the

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[2] Drainage area calculated using USGS Stream Stats for Massachusetts, http://water.usgs.gov/osw/streamstats/massachusetts.html. EPA notes that while the data on which the 7Q10 is based is quite old (two years of data from 1966-67), there is no more recent streamflow data for the Town River on which to base a 7Q10 calculation. For comparison, the USGS StreamStats regression-based prediction for 7Q10 at this location is 1.7 cfs with a 90% confidence interval of 0.28 to 9.63 cfs. As the 7Q10 calculated for the Gazetteer is well within this confidence interval and remains the best available site specific information, this value continues to be used in this permit. EPA welcomes any additional information the facility may wish to provide with respect to this calculation.

weekly average and maximum daily values for each month. EPA has not established a secondary treatment standard for settleable solids and there is no applicable water quality criteria; levels of settleable solids provide a measure of operational control for the facility. As this is an operational measure, EPA as a matter of policy no longer includes monitoring and reporting of settleable solids in NPDES permits. The draft permit eliminates this requirement.

pH

The draft permit includes pH limitations based on MA SWQS, 314 CMR 4.00, and are at least as stringent as pH limitations set forth at 40 C.F.R. §133.102(c). The MA SWQS require that Class B waters shall be in a range of 6.5 through 8.3 standard units. MassDEP generally requires a permit range of 6.5 to 8.3 s.u. as a condition of state certification. The monitoring frequency remains the same at once (1) per day. There were no violations of the pH limit in the period January 2011 to December 2013.

Bacteria

Limitations for bacteria in the existing permit are based upon state water quality standards for Massachusetts. There were no violations of the fecal coliform limit in the period January 2011 to December 2013.

The limits are modified in the Draft Permit to reflect the *E. coli* criteria in the revisions to the MA SWQS, 314 CMR § 4.05(3)(b), approved by EPA in 2007. The monthly average limitation in the draft permit is 126 colony forming units (cfu) per 100 ml, and shall be expressed as a monthly geometric mean. The daily maximum limitation in the draft permit is 409 cfu/100 ml, which represents the 90th percentile of a lognormal distribution with a geometric mean equal to 126 cfu/100 ml. EPA, *1986 Ambient Water Quality for Bacteria*. These limitations are a State certification requirement and are consistent with EPA guidance recommending that no dilution be considered in establishing permit limits for discharges to rivers designated for primary contact recreation. *EPA Memorandum re: Initial Zones of Dilution for Bacteria in Rivers and Streams Designated for Primary Contact Recreation*, November 12, 2008. The monitoring frequency is maintained at two times per week.

C. NON-CONVENTIONAL POLLUTANTS

EPA is required to limit any pollutant or pollutant parameter that is or may be discharged at a level that causes, has reasonable potential to cause, or contributes to an excursion above any water quality criterion. 40 C.F.R. § 122.44(d).

Total Phosphorus

The existing total phosphorus permit limit of 1.0 mg/l average monthly is reduced in the draft permit to 200 ug/l in order to meet the Gold Book target of 100 ug/l to prevent eutrophication in the receiving water.

Eutrophication is an aspect of nutrient overenrichment and is defined as an increase in the rate of supply of organic matter to a waterbody (EPA, 2001). The primary symptoms of nutrient overenrichment include an increase in the rate of organic matter supply, changes in algal dominance, and loss of water clarity and are followed by one or more secondary symptoms such as nuisance/toxic algal blooms and low dissolved oxygen. (EPA, 2001). In freshwater systems such as the Town River, phosphorus is the primary nutrient of concern.

The MA SWQS at 314 CMR 4.00 do not contain numerical criteria for total phosphorus. They include a narrative criterion for nutrients at 314 CMR 4.05(5)(c), which provides that "all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses." They also include a requirement that "[a]ny 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" Id. MassDEP has interpreted the "highest and best practicable treatment" (HBPT) requirement in its standards as requiring an effluent limit of 0.2 mg/l (200 ug/l) for phosphorus.

EPA is not aware of any assessments of eutrophication indicators or conditions downstream of the Bridgewater WWTF. To determine whether the current discharge concentration of 1 mg/l is sufficient to ensure that water quality standards are met, and in the absence of a numeric criterion for phosphorus, EPA looks to nationally recommended criteria and other technical guidance documents. *See* 40 CFR 122.44(d)(1)(vi)(B). EPA has produced several guidance documents which contain recommended total phosphorus thresholds for receiving waters. The *1986 Quality Criteria for Water* ("Gold Book") recommends in-stream phosphorus concentrations of no greater than 50 ug/l in any stream entering a lake or reservoir, 100 ug/l for any stream not discharging directly to lakes or impoundments, and 25 ug/l within a lake or reservoir. EPA has also released "Ecoregional Nutrient Criteria," established as part of an effort to reduce problems associated with excess nutrients in water bodies in specific areas of the country. *Ambient Water Quality Criteria Recommendations: Information Supporting the Development of State and Tribal Nutrient Criteria, Rivers and Streams,* December 2000 (EPA- 822-B-00-022). The published criteria represent conditions in waters in that ecoregion that are minimally impacted by human activities, and thus representative of water without cultural eutrophication. The Bridgewater WWTF is within Ecoregion XIV, Eastern Coastal Plains. The recommended total phosphorus criterion for this ecoregion is 24 ug/l.

EPA has decided to rely on the Gold Book threshold of 100 ug/l rather than the more stringent ecoregion criteria of 24 ug/l, given that it was developed from an effects-based approach, versus the ecoregion criteria that were developed on the basis of reference conditions. The effects-based approach is taken because it is often more directly associated with an impairment to a designated use (i.e. fishing, swimming). The effects-based approach provides a threshold value above which adverse effects (i.e., water quality impairments) are likely to occur. It applies empirical observations of a causal variable (i.e., phosphorus) and a response variable (i.e., chlorophyll *a*) associated with designated use impairments. In contrast, the ecoregion reference-based values are statistically derived from a comparison within a population of rivers in the same ecoregion class. They are a quantitative set of river characteristics (physical, chemical and biological) that represent minimally impacted conditions.

The effects-based Gold Book threshold is a general target applicable in free-flowing streams. As the Gold Book notes, there are natural conditions of a water body that can result in either increased or reduced eutrophication response to phosphorus inputs; in some waters more stringent phosphorus reductions may be needed, while in some others a higher total phosphorus threshold could be assimilated without inducing a eutrophic response. In this case EPA is not aware of any evidence that the Town River is unusually susceptible to eutrophication impacts, so that the 100 ug/l threshold appears sufficient in this receiving water. With respect to factors that can reduce susceptibility, the Gold Book identifies morphometric features (steep banks, great depths and substantial flows), limitation by nutrients other than phosphorus, reduced light penetration where waters are highly laden with natural silts or color, or other naturally occurring phenomena that limit plant growth.[3] EPA is not aware of evidence that any of these factors are reducing eutrophic response in the Town River downstream of the discharge; although the Town River is described as tea-colored in its upper reaches due to the organic inputs from the Hockmock swamp area,[4] the color impacts are less pronounced in this portion of the Town River and there is no evidence that color is reducing plant growth in this area.

Therefore EPA has evaluated the projected instream concentration under current permit limits, and calculated a revised total phosphorus limit based on meeting the Gold Book target of 100 ug/l for preventing eutrophication, applied under 7Q10 conditions. In performing this calculation EPA assumes an upstream receiving water concentration of 0.02 mg/l. While EPA has located no available data for the Town River, sampling in the Wading and Rumford Rivers upstream of treatment plant discharges indicated a range of 0.011 to 0.037 mg/l TP, with a median of 0.020 mg/l, as reported in MassDEP, *Taunton River Watershed 2001 Water Quality Assessment Report – Appendix B, OWM/DWM Water Quality Monitoring Data, Taunton River Watershed 1996* at B4. These data are from 1996, but similar results were reported from (more limited) sampling in 2006 (two samples from Wading River of 0.014 and 0.015 mg/l; one sample from Rumford River of 0.022 mg/l). (MassDEP, personal communication). EPA encourages the facility to provide more site-specific sampling data if available. The mass balance calculation is as follows:

$$(C_d * Q_d + C_s * Q_s) = C_r * Q_r \text{ ; where}$$

C_d = Effluent concentration
Q_d = Design flow of facility = 2.23 cfs
C_s = Median concentration in the Town River upstream of discharge = 0.02 mg/l
Q_s = 7Q10 streamflow in the Town River upstream of discharge = 2.71 cfs
C_r = Receiving water concentration downstream
Q_r = Flow in receiving water downstream = $Q_s + Q_d$

At the current permit limit of 1.0 mg/l, the projected receiving water concentration would be:

$$C_r = \underline{(C_d * Q_d + C_s * Q_s)} = \underline{[(1.0 \text{ mg/l} * 2.23 \text{ cfs} + 0.02 \text{ mg/l} * 2.27 \text{ cfs}]} = 0.46 \text{ mg/l}$$

[3] The Gold Book also includes waters where "technological or cost-effective limitations may help control induced pollutants"; "waters managed primarily for waterfowl or other wildlife" and waters where "phosphorus control cannot be sufficiently effective under present technology to make phosphorus the limiting nutrient". As these factors do not address water body response but instead alternative technological solutions or changes in management goals, EPA does not consider them as altering the threshold necessary to meet the narrative water quality standard.

[4] Doherty, Katherine M., *Town River – 2003 Shoreline Survey Report & Action Recommendations* (Draft 2003).

$$Q_r \qquad\qquad (2.23 + 2.71 \text{ cfs})$$

This is well over the Gold Book target and indicates that current discharges have the reasonable potential to cause exceedances of water quality standards. A revised permit limit based on meeting the Gold Book standard is calculated as follows:

$$\text{Permit limit } (C_d) = \frac{(C_r * Q_r - C_s * Q_s)}{(Q_d)}$$

$$\text{Limit} = \frac{[0.1 \text{ mg/l} * (2.23 + 2.71 \text{ cfs}) - 0.02 \text{ mg/l} * 2.71 \text{ cfs}]}{2.23 \text{ cfs}} = 0.20 \text{ mg/l}$$

This permit limit is also consistent with MassDEP's interpretation of "highest and best practicable treatment" under 314 CMR 4.05(5)(c). The draft permit also includes a load limit of 1.7 lb/day, calculated using the effluent concentration limit and the facility design flow.

The draft permit provides a compliance schedule for meeting the new total phosphorus limit at the earliest practicable time, pursuant to 314 CMR 4.03(1)(b) and 40 CFR 122.47(a)(1).

Ammonia-Nitrogen

The draft permit continues the existing permit's warm weather (April 1 through October 31) average monthly concentration limit for ammonia-nitrogen of 3.0 mg/l, based on a MassDEP Wasteload Allocation to protect DO in the receiving water.

There were no violations of the warm weather limit between January 2011 to December 2013 (see Table 1). The average value for the warm weather monthly average concentration was 1.5 mg/l. Monthly average ammonia-nitrogen values for the warm weather (April through October) ranged between 0.3 and 2.9 mg/l.

EPA also considered whether the existing limit is sufficient to ensure that the discharge does not cause or contribute to ammonia toxicity. High levels of ammonia in the water column can be toxic to fish by making it more difficult for fish to excrete this chemical via passive diffusion from gill tissues. Ammonia toxicity varies with pH and temperature. Ammonia can also lower dissolved oxygen levels by conversion to nitrate/nitrate, which consumes oxygen.

EPA's analysis indicates that the discharge does not have reasonable potential to cause or contribute to a violation of the water quality criteria for ammonia with the current permit limit in effect. The water quality criteria for ammonia are pH and temperature dependent, with the most stringent criteria at higher pH and temperatures. Using the highest pH and temperature measured upstream of the facility (7.2 s.u and 28.9 °C) the chronic criteria for fish (early life stages present) is 2.13 mg/l as a 30-day average concentration. EPA, *1999 Update of Ambient Water Quality Criteria for Ammonia* at 83, 87. Because this is a 30-day average criteria dilution is appropriately calculated using a 30Q10 receiving water flow. 30Q10 flow estimates are not available for the Town River based on the USGS Gazeteer information used for 7Q10 flows as a full streamgage record is not available; however even at the lower 7Q10 flow the expected concentration in the receiving water with the discharge at design flow and the permit limit would be (3 (permit limit) / 2.2 (dilution factor) =) 1.36 mg/l, so there is no reasonable potential to exceed the chronic water quality criteria. The acute criterion is significantly higher (19.7 mg/l with salmonid species present, 29.5 mg/l with salmonids absent, *id.* at 86) so the permit limit is protective of the acute criteria as well.

In the winter (November to March) the permit limit is not in effect; the applicable water quality criteria is calculated using a lower temperature (16° C) for conditions when early life stages are not present for a chronic criterion of 4.90 mg/l. *Id.* at 88. While winter 30Q10 data also is not readily available due to the lack of a full streamgage record, the winter 30Q10 is conservatively estimated to be at least three times the 7Q10 value, based on a ratio of the monthly mean flow for the lowest winter and summer months in the Wading River. USGS, *Gazeteer of Hydrological Characteristics of Streams in Massachusetts-Taunton River Watershed.* This would provide a winter dilution of 6.6, corresponding to an allowable effluent concentration of (6.6*4.9 mg/l =) 32.3 mg/l. The facility's winter effluent concentration has averaged 5.6 mg/l in the 2011-13 period, with a maximum of 23 mg/l and a calculated 95th percentile concentration of 21 mg/l. Therefore there is no reasonable potential to cause an exceedance of the water quality criteria in the winter, and the existing permit limit and season is sufficiently protective.

Total Nitrogen

The draft permit includes a monthly average total nitrogen limit of 5.0 mg/l total nitrogen, and a mass limit of 60 lbs/day based on the concentration limit and the design flow of the treatment facility, in effect for the months of May through October, in order to address cultural eutrophication in the Taunton River Estuary and Mount Hope Bay. In addition to this seasonally-applied numeric limit, the permit requires the permittee to optimize the treatment facility operations for the removal of total nitrogen during the months of November through April using all available treatment equipment at the facility. The basis for this determination is set forth below.

a. Ecological Setting: the Taunton River Estuary, Mount Hope Bay and Estuarine Systems Generally

The saltwater portions of the Taunton River (the "Taunton River Estuary") and Mount Hope Bay are part of the greater Narragansett Bay Estuary system, which covers approximately 147 square miles within Massachusetts and Rhode Island. The Narragansett Bay Estuary is one of only 28 "estuaries of national significance" under the National Estuary Program (NEP), which was established in 1987 by amendments to the CWA to identify, restore and protect estuaries along the coasts of the United States.

Mt. Hope Bay (the Bay) is situated in the northeast corner of Narragansett Bay, lying within both Rhode Island to the south and west and Massachusetts to the north and east. The Bay connects to the East Passage of Narragansett Bay to the southwest, via a deep, narrow channel where the Mt. Hope Bridge crosses over from Aquidneck Island to Bristol Point, and to Rhode Island Sound to the South via the Sakonnet River (actually an embayment) between Tiverton, RI and Aquidneck Island. The Bay covers an area of 13.6 square miles, and has a volume of 53.3 billion gallons at mean low water (MLW). http://www.smast.umassd.edu/MHBNL/report2003.php. The Bay has a tidal range averaging approximately 4.5 feet.

The Taunton River is the largest freshwater source to Mount Hope Bay. It discharges into the Bay from the north at Fall River. The Taunton River Estuary consists of the saltwater portions of the Taunton River, extending from the Braga Bridge at the confluence with Mount Hope Bay upstream to the Route 24 bridge (Taunton/Raynham), approximately four miles upstream of the Taunton WWTP discharge. (MassDEP, 2001). It is the longest river unobstructed by dams in New England, with tidal influence extending upriver approximately eighteen miles. (GeoSyntec, 2006). The Town River combines with the Matfield River to form the Taunton River.

Estuaries are extremely significant aquatic resources. An estuary is a partially enclosed coastal body of water located between freshwater ecosystems (lakes, rivers, and streams; freshwater and coastal wetlands; and groundwater systems) and coastal shelf systems where freshwater from the land measurably dilutes saltwater from the ocean. This mixture of water types creates a unique transitional environment that is critical for the survival of many species of fish, birds, and other wildlife. Estuarine environments are among the most productive on earth, creating more organic matter each year than comparably sized areas of forest, grassland, or agricultural land (EPA, 2001).

Maintaining water quality within an estuary is important for many reasons. Estuaries provide a variety of habitats such as shallow open waters, freshwater and saltwater marshes, sandy beaches, mud and sand flats, rocky shores, oyster reefs, tidal pools, and seagrass beds. Tens of thousands of birds, mammals, fish, and other wildlife depend on estuarine habitats as places to live, feed, and reproduce. Many species of fish and shellfish rely on the sheltered waters of estuaries as protected places to spawn.

Moreover, estuaries also provide a number of recreational values such as swimming, boating, fishing, and bird watching. In addition, estuaries have an important commercial value since they serve as nursery grounds for two-thirds of the nation's commercial fish and shellfish, and support tourism drawing on the natural resources that estuaries supply. (EPA, 1998). Consequently, EPA believes sound environmental policy reasons favor a pollution control approach that is both protective and undertaken expeditiously to prevent degradation of these critical natural resources. Because estuaries are the intermediary between oceans and land, both of these geographic features influence their physical, chemical, and biological properties. In the course of flowing downstream through a watershed to an estuary, tributaries pick up materials that wash off the land or are discharged directly into the water by land-based activities.

Eventually, the materials that accumulate in the tributaries are delivered to estuaries. The types of materials that eventually enter an estuary largely depend on how the land is used. Undisturbed land, for example, will discharge considerably fewer pollutants than an urban center or areas with large amounts of impervious cover. Accordingly, an estuary's overall health can be heavily impacted by surrounding land uses.

Unlike free-flowing rivers, which tend to flush out sediments and pollutants relatively quickly, an estuary will often have a lengthy retention period as up-estuary saltwater movement interacts with down-estuary freshwater flow (EPA, 2001). Estuaries are particle-rich relative to coastal systems and have physical mechanisms that tend to retain particles. These suspended particles mediate a number of activities (e.g., absorbing and scattering light, or absorbing hydroscopic materials such as phosphate and toxic contaminants). New particles enter with river flow and may be resuspended from the bottom by tidal currents and wind-wave activity. Many estuaries are naturally nutrient-rich because of inputs from the land surface and geochemical and biological processes that act as "filters" to retain nutrients within estuaries (EPA, 2001). Consequently, waterborne pollutants, along with contaminated sediment, may remain in the estuary for a long time, magnifying their potential to adversely affect the estuary's plants and animals.

b. Effects of Nutrients on Estuarine Water Quality

The basic cause of nutrient problems in estuaries and nearshore coastal waters is the enrichment of freshwater with nitrogen (N) and phosphorus (P) (EPA, 2001). EPA defines nutrient overenrichment as the anthropogenic addition of nutrients, in addition to any natural processes, causing adverse effects or impairments to beneficial uses of a waterbody. (EPA, 2001).

Eutrophication is an aspect of nutrient overenrichment and is defined as an increase in the rate of supply of organic matter to a waterbody (EPA, 2001). Increased nutrient inputs promote a progression of symptoms beginning with excessive growth of phytoplankton and macroalgae to the point where grazers cannot control growth (NOAA, 2007). Phytoplankton is microscopic algae growing in the water column and is measured by chlorophyll-a. Macroalgae are large algae, commonly referred to as "seaweed." The primary symptoms of nutrient overenrichment include an increase in the rate of organic matter supply, changes in algal dominance, and loss of water clarity and are followed by one or more secondary symptoms such as loss of submerged aquatic vegetation, nuisance/toxic algal blooms and low dissolved oxygen. (EPA, 2001). In U.S. coastal waters, nutrient overenrichment is a common thread that ties together a diverse suite of coastal problems such as red tides, fish kills, some marine mammal deaths, outbreaks of shellfish poisonings, loss of seagrass and bottom shellfish habitats, coral reef destruction, and hypoxia and anoxia now experienced as the Gulf of Mexico's "dead zone." (EPA, 2001). Figure 3 shows the progression of nutrient impacts on a waterbody.

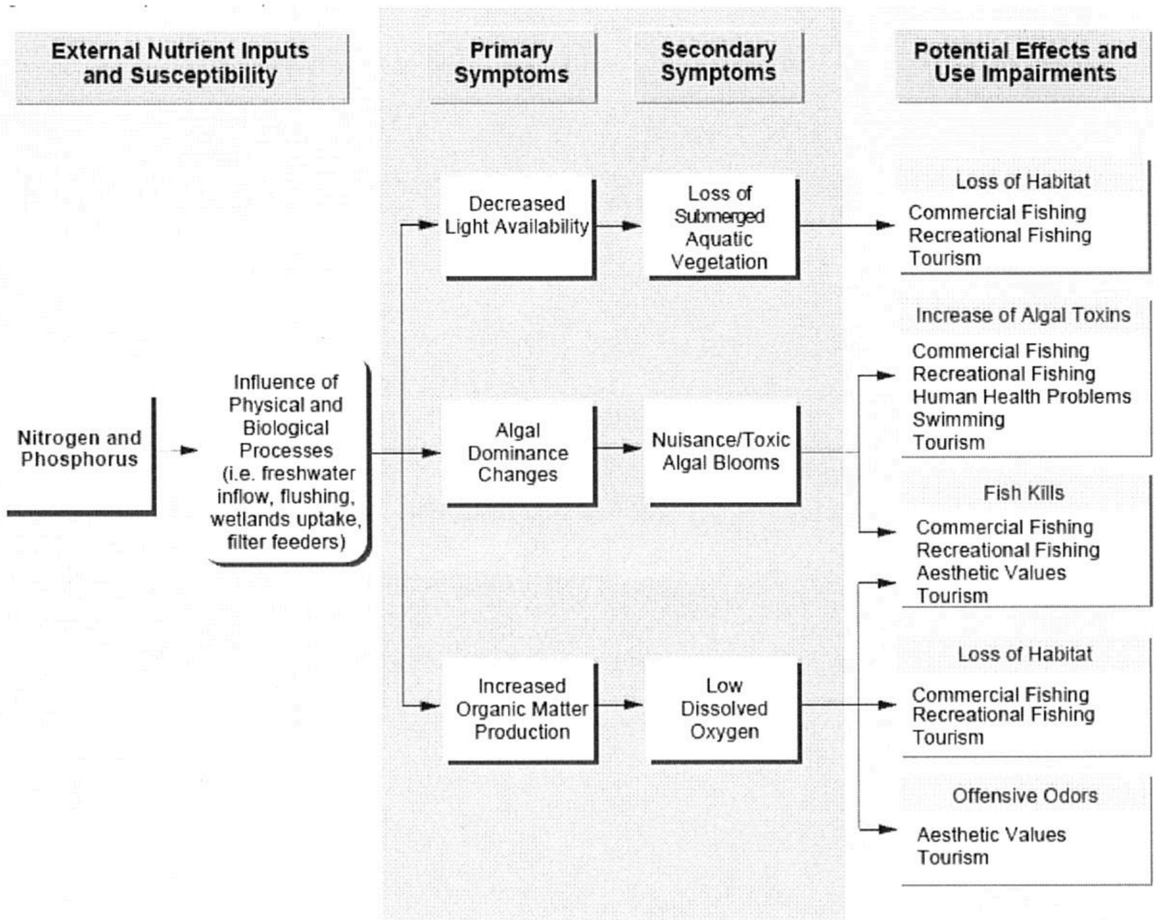

Figure 3. Nutrient enrichment model. Source: Bricker, 1999 as cited in EPA, 2001.

Estuarine nutrient dynamics are complex and are influenced by flushing time, freshwater inflow and stratification, among other factors. The deleterious physical, chemical, and biological responses in surface water resulting from excessive plant growth impair designated uses in both receiving and downstream waterbodies. Excessive plant growth can result in a loss of diversity and other changes in the aquatic plant, invertebrate, and fish community structure and habitat.

Nutrient-driven impacts on aquatic life and habitat are felt throughout the eutrophic cycle of plant growth and decomposition. Nutrient-laden plant detritus can settle to the bottom of a water body. In addition to physically altering the benthic environment and aquatic habitat, organic materials (*i.e.*, nutrients) in the sediments can become available for future uptake by aquatic plant growth, further perpetuating and potentially intensifying the eutrophic cycle.

Excessive aquatic plant growth, in addition, degrades aesthetic and recreational uses. Unsightly algal growth is unappealing to swimmers and other stream users and reduces water clarity. Decomposing plant matter also produces unpleasant sights and strong odors. Heavy growths of algae on rocks can make streambeds slippery and difficult or dangerous to walk on. Algae and macrophytes can interfere with angling by fouling fishing lures and equipment. Boat propellers and oars may also get tangled by aquatic vegetation.

When nutrients exceed the assimilative capacity of a water body, the ensuing eutrophic cycle can negatively impact in-stream dissolved oxygen (DO) levels. Through respiration, and the decomposition of dead plant matter, excessive algae and plant growth can reduce instream DO concentrations to levels that could negatively impact aquatic life. During the day, primary producers (*e.g.*, algae, plants) provide oxygen to the water as a by-product of photosynthesis. At night, however, when photosynthesis ceases but respiration continues, DO concentrations decline. Furthermore, as primary producers die, they are decomposed by bacteria that consume oxygen, and large populations of decomposers can consume large amounts of DO. Many aquatic insects, fish, and other organisms become stressed and may even die when DO levels drop below a particular threshold level.

Nutrient overenrichment of estuaries and nearshore coastal waters from human-based causes is now recognized as a national problem on the basis of CWA Section 305(b) reports from coastal States (EPA, 2001). Most of the nation's estuarine and coastal waters are moderately to severely polluted by excessive nutrients, especially nitrogen and phosphorus (NOAA, 2007; NOAA, 1999, EPA, 2006; EPA, 2004, EPA; and EPA, 2001).

c. Water Quality Standards Applicable to the Taunton River Estuary and Mount Hope Bay

Under the MA SWQS, 314 CMR 4.00, surface waters are divided into water "use" classifications, including Class SA and SB for marine and coastal waters. The Taunton River Estuary and the eastern portion of Mount Hope Bay are classified as SB waters, with designations for Shellfishing (Restricted and Conditionally Restricted Shellfish Areas) and CSO. Class SB waters are designated as a "habitat for fish, other aquatic life and wildlife, including for their reproduction, migration, growth and other critical functions, and for primary and secondary contact recreation. In certain waters, habitat for fish, other aquatic life and wildlife may include, but is not limited to, seagrass. Where designated in the tables to 314 CMR 4.00 for shellfishing, these waters shall be suitable for shellfish harvesting with depuration (Restricted and Conditionally Restricted Shellfish Areas)." 314 CMR 4.05(4)(b). Waters in this classification "shall have consistently good aesthetic value." *Id.*

Class SB waters are subject to class-specific narrative and/or numeric water quality criteria. 314 CMR 4.05(4)(b)1 to 8. DO concentrations in Class SB waters "[s]hall not be less than 5.0 mg/l. Seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained. Where natural background conditions are lower, DO shall not be less than natural background."

The western portion of Mount Hope Bay is designated as a Class SA – Shellfishing water. These waters are designated as an excellent habitat for fish, other aquatic life and wildlife and for primary and secondary contact recreation. In approved areas, they shall be suitable for shellfish harvesting without depuration (Open Shellfish Areas). These waters shall have excellent aesthetic value. With respect to DO, the criteria for class SA waters is "not less than 6.0 mg/. Where natural background conditions are lower, DO shall not be less than the natural background. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained."

Both Class SA and Class SB waters are also subject to additional minimum standards applicable to all surface waters, as set forth at 314 CMR 4.05(5). With respect to nutrients, the MA SWQS provide:

> Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department pursuant to 314 CMR 4.00. 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). In addition, the MA SWQS require:

> Aesthetics – All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum, or other matter to form nuisances; produce objectionable odor, color, taste, or turbidity; or produce undesirable or nuisance species of aquatic life. 314 CMR 4.05(5)(a)

Massachusetts has not adopted numeric criteria for total nitrogen or other nutrients. MassDEP has, however, used a number of indicators in interpreting its narrative nutrient standard. The DEP/SMAST Massachusetts Estuaries Project report, *Site-Specific Nitrogen Thresholds for Southeastern Massachusetts Embayments: Critical Indicators - Interim Report* (Howes et al., 2003) (Critical Indicators Report), was developed to provide "a translator between the current narrative standard and nitrogen thresholds (as they relate to the ecological health of each embayment) which can be further refined based on the specific physical, chemical and biological characteristics of each embayment. This report is intended to provide a detailed discussion of the issue and types of indicators that can be used, as well as propose an acceptable range of nitrogen thresholds that will be used to interpret the current narrative standard." http://www.oceanscience.net/estuaries/pdf/nitroest.pdf.This interpretive guidance has been used in a number of TMDLs for estuarine waters in southeastern Massachusetts.

The Critical Indicators Report finds that the indicators of primary concern to be:

- plant presence and diversity (eelgrass, macroalgae, etc.)
- animal species presence and diversity (finfish, shellfish, infauna)
- nutrient concentrations (nitrogen species)
- chlorophyll-a concentration
- dissolved oxygen levels in the embayment water column

(Howes et al., 2003 at 11). With respect to total nitrogen, it concluded:

It is not possible at this time to put quantitative nitrogen levels on each Water Quality Class. In fact, initial results of the Massachusetts Estuaries Project (Chatham Embayment Report 2003) indicate that the total nitrogen level associated with a particular ecological response can vary by over 1.4 fold (e.g. Stage Harbor versus Bassing Harbor in Chatham MA). Although between embayments nitrogen criteria may be different, it does appear that within a single embayment a consistent quantitative nitrogen criterion can be developed.

However, the Critical Indicators Report provides guidance for indicators, including total nitrogen, for various water quality classes. The nitrogen indicator ranges are based on long-term (>3 yr) average mid-ebb tide concentrations of total nitrogen (mg/L) in the water column. For "Excellent to Good" nitrogen related water quality conditions, equivalent to SA classification, the Report guidance is as follows: "Eelgrass beds are present, macroalgae is generally non-existent but in some cases may be present, benthic animal diversity and shellfish productivity are high, oxygen levels are generally not less than 6.0 mg/l with occasional depletions being rare (if at all), chlorophyll-a levels are in the 3 to 5 µg/L range. . . . For the case study, total nitrogen levels of 0.30-0.39 mg N/L were used to designate "excellent to good" quality areas." Id at 21-22.

For SB waters, the Critical Indicators Report provides the following guidance for indicators of unimpaired conditions, to be refined based on data from the specific embayments: "benthic animal diversity and shellfish productivity are high, oxygen levels are generally not less than 5.0 mg/l with depletions to <4 mg/L being infrequent, chlorophyll-a levels are in the 3 to 5 µg/L range and nitrogen levels are in the 0.39 - 0.50 range. . . . eelgrass is not present . . . and macroalgae is not present or present in limited amounts even though a good healthy aquatic community still exists." Id. at 22.

"Moderate Impairment" is indicated by "Shellfisheries may shift to more resistant species. Oxygen levels generally do not fall below 4 mg/L, although phytoplankton blooms raise chlorophyll a levels to around 10 µg/L. Eelgrass is not sustainable and macro-algae accumulations occur in some regions of the embayment. In the Case Study, embayment regions supporting total nitrogen levels >0.5 mg N/L were clearly impaired." Significant Impairment is indicated by total nitrogen concentrations of 0.6/0.7 mg/l and above. In "severely degraded" conditions, "algal blooms are typical with chlorophyll-a levels generally >20 µg/L, oxygen depletions to hypoxic levels are common, there are periodic fish kills, and macro-algal accumulations occur with both ecological and aesthetic impacts."

In addition to the Massachusetts water quality standards, water quality standards applicable to the Rhode Island portion of Mount Hope Bay must also be satisfied. As in Massachusetts, the Rhode Island portions of Mount Hope Bay are designated SB waters in the eastern portion and SA waters in the western portion of the Bay. Rhode Island, like Massachusetts, has specific numeric criteria for DO in SA and SB waters[5], and narrative criteria for nutrients[6] and

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[5] Rule 8.D.3. Table 3. For waters with a seasonal pynocline, no less than 4.8 mg/l above the seasonal pynocline; below the seasonal pynocline DO concentrations above 4.8 mg/l shall be considered protective of Aquatic Life Uses. When instantaneous DO values fall below 4.8 mg/l, the waters shall not be (1) Less than 2.9 mg/l for more than 24

aesthetics.[7] The Rhode Island portions of Mount Hope Bay, like the Massachusetts portions are listed for impairments due to total nitrogen, dissolved oxygen (as well as fishes bioassessments and temperature impairments linked to the Brayton Point power plant). As discussed below, permit limits designed to meet water quality standards in the Taunton River Estuary and the Massachusetts portions of Mount Hope Bay are expected to achieve water quality standards in Rhode Island.

d. Receiving Water Quality Violations

The Taunton River Estuary and Mount Hope Bay have reached their assimilative capacity for nitrogen and are suffering from the adverse water quality impacts of nutrient overenrichment, including cultural eutrophication. They are, consequently, failing to attain the water quality standards described above. The impacts of excessive nutrients are evident throughout the Taunton River Estuary and Mount Hope Bay.

Section 303(d) of the CWA requires states to identify those waterbodies that are not expected to meet surface water quality standards after implementation of technology-based controls. The State of Massachusetts has identified Mount Hope Bay and the lower reaches of the Taunton River Estuary for impairments due to organic enrichment/low DO, with Total Nitrogen specifically identified as a cause of impairments in Mount Hope Bay.

A three-year water quality monitoring study was conducted by the School for Marine Science and Technology at UMass-Dartmouth (SMAST) and involved monthly sampling at 22 sites across Mount Hope Bay and the Taunton River Estuary from 2004 to 2006 (see Figure 4). This study showed that average chlorophyll-a over the three year period was above 10 ug/l at all monitoring stations across the Taunton River Estuary and Mount Hope Bay. The 20th percentile

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consecutive hours during the recruitment season; nor (2) Less than 1.4 mg/l for more than 1 hour more than twice during the recruitment season; nor (3) Shall they exceed the allowable cumulative DO exposure (Table 3.A).

For waters without a seasonal pycnocline, DO concentrations above 4.8 mg/l shall be considered protective of Aquatic Life Uses. When instantaneous DO values fall below 4.8 mg/l, the waters shall not be: (1) Less than 3.0 mg/l for more than 24 consecutive hours during the recruitment season; nor (2) Less than 1.4 mg/l for more than 1 hour more than twice during the recruitment season; nor (3) Shall they exceed the allowable cumulative DO exposure presented (Table 3.A. and Table 3.B).

[6] Rule 8.D.1(d). Nutrients - Nutrients shall not exceed the limitations specified in rule 8.D.(2) (freshwaters) and 8.D.(3) (seawaters) and/or more stringent site-specific limits necessary to prevent or minimize accelerated or cultural eutrophication.

Rule 8.D.3. None in such concentration that would impair any usages specifically assigned to said Class, or cause undesirable or nuisance aquatic species associated with cultural eutrophication. Shall not exceed site-specific limits if deemed necessary by the Director to prevent or minimize accelerated or cultural eutrophication. Total phosphorus, nitrates and ammonia may be assigned site-specific permit limits based on reasonable Best Available Technologies. Where waters have low tidal flushing rates, applicable treatment to prevent or minimize accelerated or cultural eutrophication may be required for regulated nonpoint source activities.

[7] Rule 8.D.1(b)(iv). Aesthetics - all waters shall be free from pollutants in concentrations or combinations that: iv. Result in the dominance of species of fish and wildlife to such a degree as to create a nuisance or interfere with the existing or designated uses.

DO concentrations for the three year period were below the 5.0 mg/l water quality standard at four of the six sites in the Taunton River Estuary.[8] Table 2, reproduced from SMAST, *Summary of Water Quality Monitoring Program for the Mount Hope Bay Embayment System (2004 – 2006)* at 24 (August 16, 2007).

Table 2. Mount Hope Bay Monitoring Program results as reported in SMAST, 2007.

Table 5. Summary of average levels of primary nutrient related water quality parameters measured in the summers of 2004, 2005 and 2006 in Mount Hope Bay by SMAST Coastal Systems staff.

Station	Total Depth (m)	20% Low* D.O. (mg/L)	Sal (ppt)	PO4 (mg/L)	NH4 (mg/L)	NOX (mg/L)	DIN (mg/L)	DON (mg/L)	PON (mg/L)	TN (mg/L)	DIN/DIP Molar Ratio	Total Chl a (ug/L)
MHB1	10.0	5.02	23.3	0.054	0.052	0.095	0.147	0.299	0.155	0.601	6	11.75
MHB2	8.9	4.94	26.1	0.052	0.047	0.043	0.090	0.312	0.170	0.572	4	13.50
MHB3	5.2	5.49	26.0	0.051	0.037	0.035	0.072	0.282	0.163	0.517	3	14.32
MHB4	3.5	5.61	25.7	0.052	0.026	0.017	0.043	0.308	0.173	0.525	3	14.71
MHB5	5.6	5.20	26.2	0.050	0.029	0.020	0.050	0.294	0.169	0.512	2	14.53
MHB6	3.9	5.09	24.1	0.061	0.049	0.030	0.079	0.359	0.168	0.606	3	12.87
MHB7	4.5	5.94	25.5	0.049	0.023	0.016	0.039	0.308	0.189	0.536	2	17.46
MHB8	5.1	4.93	25.8	0.046	0.022	0.019	0.041	0.280	0.165	0.486	2	15.84
MHB9	ND	ND	19.7	0.062	0.049	0.040	0.089	0.453	0.263	0.805	3	14.02
MHB10	3.2	5.86	25.7	0.048	0.017	0.012	0.027	0.314	0.167	0.508	1	14.11
MHB11	4.9	5.02	26.2	0.043	0.017	0.012	0.029	0.268	0.175	0.472	1	16.23
MHB12	5.0	5.36	26.4	0.049	0.020	0.021	0.040	0.284	0.168	0.493	2	16.12
MHB13	5.9	6.00	26.8	0.045	0.020	0.013	0.033	0.282	0.158	0.473	2	15.40
MHB14	6.5	5.34	27.0	0.044	0.024	0.009	0.033	0.289	0.197	0.519	2	16.78
MHB15	12.9	6.46	27.9	0.035	0.021	0.009	0.029	0.273	0.143	0.445	2	12.68
MHB16	11.2	6.33	27.7	0.043	0.028	0.012	0.039	0.265	0.157	0.461	2	13.02
MHB17	ND	ND	24.6	0.064	0.057	0.026	0.083	0.404	0.181	0.669	3	11.81
MHB18	6.7	4.96	22.3	0.062	0.061	0.136	0.197	0.300	0.156	0.652	7	11.44
MHB19	4.0	4.93	18.7	0.058	0.074	0.201	0.275	0.342	0.178	0.799	10	12.27
MHB20	1.8	5.09	17.5	0.054	0.063	0.144	0.207	0.372	0.192	0.771	8	13.59
MHB21	2.6	4.60	14.2	0.061	0.066	0.350	0.415	0.420	0.219	1.058	15	13.34
MHBMOOR	6.3	5.85	26.8	0.045	0.025	0.013	0.038	0.284	0.181	0.503	2	15.57

* Average of the lowest 20% of recorded values

[8] The six Taunton River stations are MHB 1, 2 and 18-21; MHB 2, 18, 19 and 21 had 20% low DO below 5.0 mg/l for the three year period.

Figure 4. Mount Hope Bay Monitoring Program estuarine stations.

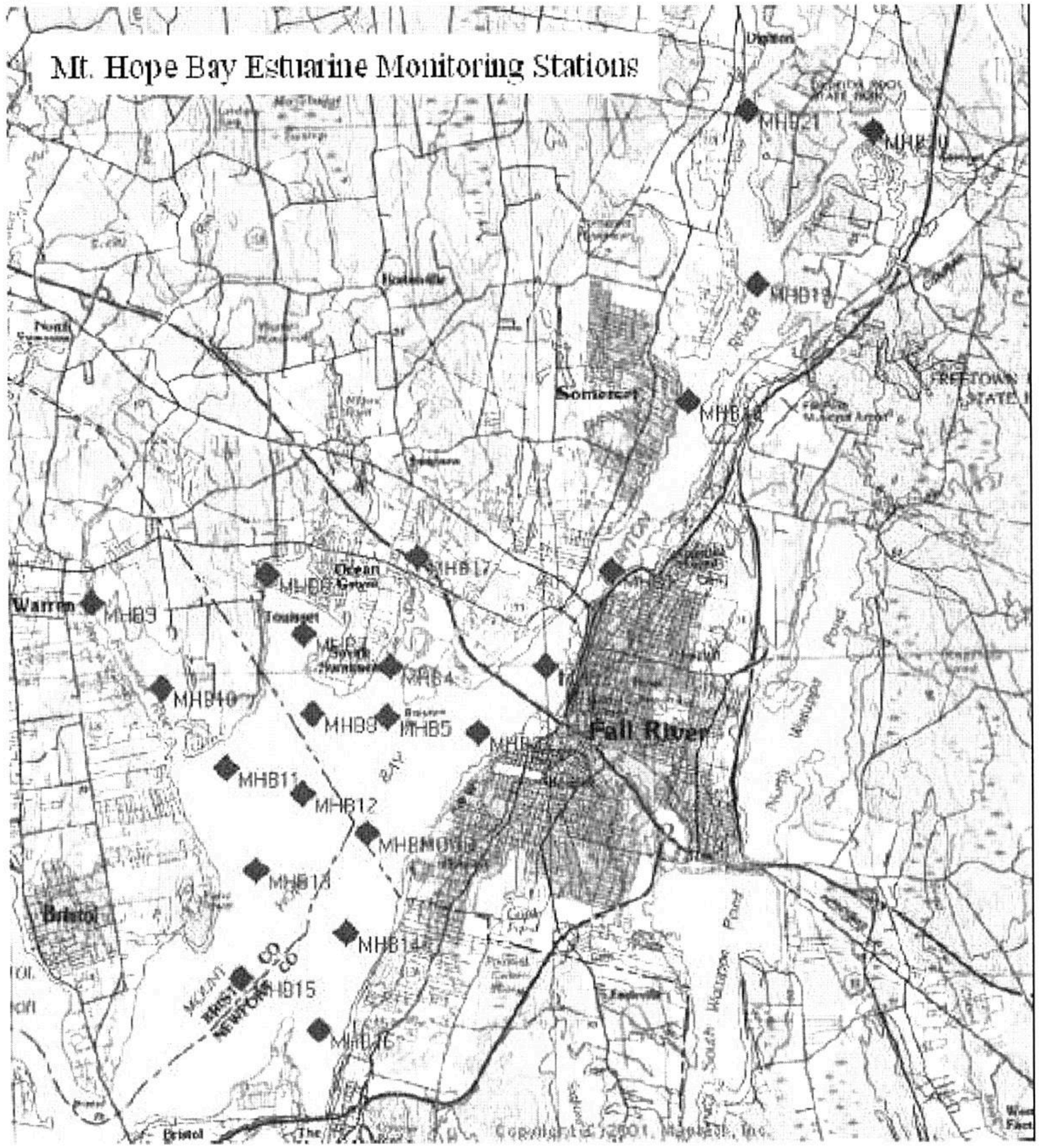

Table 3 below shows the results of the SMAST monitoring for each of the three years of the monitoring program, with the Taunton River stations highlighted. Minimum measured DO concentrations in each year were below 5.0 mg/l at all the Taunton River stations in 2004 and 2006, and a majority of those stations in 2005. In Mount Hope Bay proper, minimum DO concentrations below 5.0 mg/l were encountered at all but one of the Mount Hope Bay stations at least once during the three year period, and at five of the ten stations in both 2004 and 2005. This is compelling evidence of pervasive low DO conditions throughout the Taunton River

Estuary and Mount Hope Bay, given that the sampling was intermittent (and therefore unlikely to capture isolated low DO events) and was not timed to reflect the lowest DO conditions in the waterbody (just before dawn, when oxygen depletion due to respiration is greatest).

Elevated chlorophyll-a concentrations are similarly pervasive based on the SMAST monitoring data. Mean chlorophyll-a concentrations are above the Critical Indicators Report guidelines for unimpaired waters (3-5 ug/l) at every station monitored, in all three of the monitoring seasons. See Table 3. Maximum chlorophyll-a concentrations are routinely above 20 ug/l, far exceeding the chlorophyll concentrations found in unimpaired waters. Again, given the likelihood of intermittent sampling missing the worst conditions in terms of algal blooms, this is compelling evidence of pervasive eutrophic conditions throughout the Taunton River Estuary and Mount Hope Bay.

Total nitrogen concentrations are elevated throughout the system, with a three year average TN concentration above 0.5 mg/l at sixteen of the 22 sites and above 0.45 mg/l at 21 of 22 sites. SMAST, 2007. Total Nitrogen concentrations are generally highest in the tidal rivers, including the Taunton River (e.g. Station 19, TN range 0.66 to 0.99 mg/l). Molar N/P ratios are consistent with nitrogen limitation ($\leq$ 10 at all stations other than MHB21, the uppermost Taunton River station).

Table 3. SMAST Monitoring Data Summarized by Year. Taunton River stations highlighted.

			2004				2005				2006			
Station	**Location**	**State**	**DO min (mg/l)**	**Chl-a max (ug/l)**	**Chl-a mean (ug/l)**	**TN mean (mg/l)**	**DO min (mg/l)**	**Chl-a max (ug/l)**	**Chl-a mean (ug/l)**	**TN mean (mg/l)**	**DO min (mg/l)**	**Chl-a max (ug/l)**	**Chl-a mean (ug/l)**	**TN mean (mg/l)**
1	Taunton River	MA	4.8	24.2	7.8	0.53	5.1	49.2	10.9	0.56	4.1	26.6	10.3	0.74
2	Taunton River	MA	4.7	33.2	9.6	0.53	5.0	16.6	8.2	0.51	3.0	48.6	14.2	0.68
3	MHB proper (61-06)	MA	5.1	65.1	11.9	0.51	5.2	20.0	10.2	0.45	4.8	41.5	16.8	0.60
4	Lee River	MA	4.7	19.5	10.5	0.51	5.1	16.0	10.8	0.48	6.1	28.6	16.3	0.59
5	MHB proper (61-07)	MA	4.7	22.4	10.5	0.48	4.6	22.6	11.7	0.49	5.1	29.7	14.3	0.57
6	Cole River	MA	4.9	26.4	11.1	0.52	4.7	16.0	11.0	0.56	5.3	18.6	8.5	0.74
7	MHB proper (61-07)	MA	3.4	37.2	14.2	0.47	5.3	22.3	13.3	0.54	7.1	24.9	16.2	0.60
8	MHB proper (61-07)	MA	3.8	38.8	12.7	0.46	2.6	27.5	11.8	0.45	5.6	32.7	14.1	0.55
9	Kickamut River	RI	No data	19.1	11.9	0.70	No Data	17.7	9.7	0.73	No data	33.1	13.1	1.03
10	Kickamut River	RI	6.0	12.5	8.5	0.48	5.4	29.9	13.6	0.49	5.4	28.9	14.6	0.57
11	MHB-proper	RI	3.2	26.3	10.4	0.44	4.5	33.2	14.3	0.45	5.5	35.6	17.1	0.53
12	MHB-proper	RI	4.0	29.2	10.8	0.45	4.0	29.6	14.4	0.50	5.4	36.4	14.1	0.52
13	MHB-proper	RI	6.5	25.8	11.2	0.42	4.1	27.9	13.4	0.46	6.2	26.5	13.7	0.53
14	MHB-proper	RI	6.0	36.8	14.2	0.58	6.1	32.4	12.1	0.41	2.1	80.6	19.4	0.57
15	MHB-proper	RI	6.9	23.1	9.8	0.45	6.3	23.6	8.8	0.42	4.3	42.4	14.5	0.46
16	MHB-proper	RI	6.2	25.5	10.5	0.45	6.0	33.3	10.3	0.44	5.3	30.4	14.1	0.50
17	Lee River	MA	No data	9.2	4.7	0.65	No Data	17.3	7.9	0.61	No data	27.2	13.8	0.76
18	Taunton River	MA	4.7	16.1	7.5	0.61	4.4	38.0	9.0	0.60	4.3	12.9	7.2	0.80
19	Taunton River	MA	4.4	27.0	10.8	0.72	4.7	33.2	10.5	0.73	4.6	15.0	5.5	0.99
20	Assonet River	MA	5.1	15.7	9.1	0.72	5.6	27.1	12.2	0.63	4.8	16.9	7.6	0.94
21	Taunton River	MA	3.8	23.1	10.5	0.98	4.1	19.8	10.5	1.04	4.8	14.3	5.9	1.24
MOOR	MHB proper (61-06)	MA	6.3	21.4	11.4	0.51	5.4	19.9	11.5	0.45	2.7	35.4	16.5	0.55

Based on these data, the SMAST report concluded that a Massachusetts Estuaries Project ("MEP") analysis of nitrogen loading was warranted for the Mount Hope Bay/Taunton River complex, stating:

> Given the high population within the watershed and resultant N loading to this down gradient estuary and the observed high chlorophyll levels and oxygen depletions, it is not surprising that nitrogen levels are moderately to highly enriched over offshore waters. The Taunton River estuarine reach, as the focus of upper watershed N loading, showed very high total nitrogen levels (TN) in its upper reach (1.058 mg N L^{-1}) and maintained high levels throughout most of its reach (>0.6 mg N L^{-1}). The main basin of Mt. Hope Bay supported lower TN levels primarily as a result of mixing with incoming waters (generally 0.5-0.6 mg N L^{-1}). This is consistent with the observed oxygen depletions and infauna animal communities. The highest (Moderate) water quality was found at the stations in the main basin and lower reaches of Mt Hope Bay out to the channels to lower Narragansett Bay and the Sakonet River (Figure 6).
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> In general, the Taunton River Estuary, with its large watershed N load and high TN levels, is showing poor water quality due to its high chlorophyll and oxygen depletions. The main basin of Mt. Hope Bay, with its greater flushing and access to higher quality waters of the lower Bay, is showing less impairment with moderate water quality. Finally, the lower basin of Mt. Hope Bay, nearest the tidal "inlet", is generally showing moderate water quality. . . . [T]hese data indicate that the MEP analysis of this system should focus on restoration of the main basin of Mt. Hope Bay and the Taunton River estuarine reach, and that it is likely that restoration of the Taunton River Estuary will have a significant positive effect on the habitat quality of the main basin of Mt. Hope Bay.

To date, the MEP analysis, along with the TMDL that would result from the analysis, has not been completed.[9]

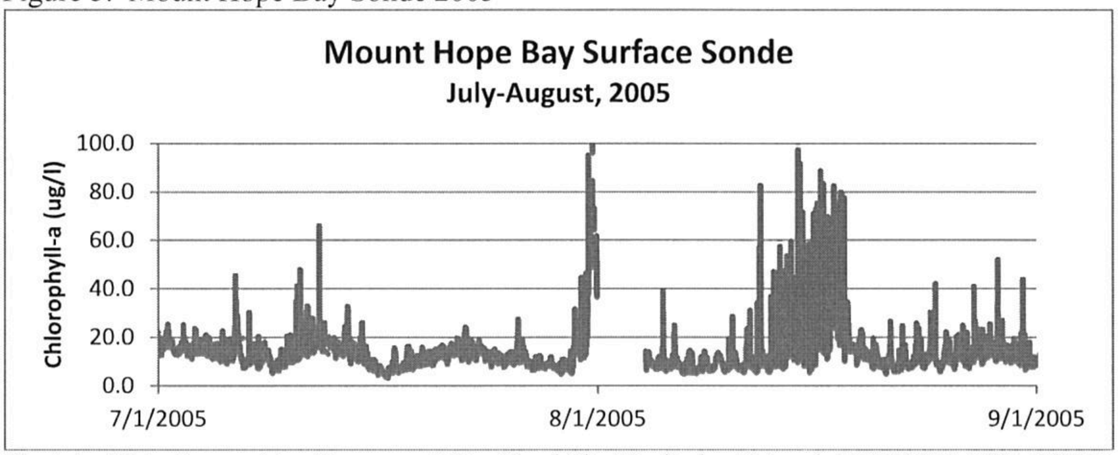
Additional evidence of conditions in Mount Hope Bay is provided from the Narragansett Bay Water Quality Network, fixed monitoring station in the Bay, equipped with two datasondes that measured temperature, salinity, dissolved oxygen and depth at approximately 1 meter from the bottom and 0.5 meters below the surface, and chlorophyll fluorescence at the near surface sonde. (http://www.narrbay.org/d_projects/buoy/buoydata.htm). The datasondes were deployed in the Rhode Island portion of Mount Hope Bay near SMAST site MHB13, from May or June through October, from 2005 through 2011. Analysis of the DO data from the deep sonde at this site in 2005 and 2006 showed multiple events (three in 2005; seven in 2006) of DO depletion below the 4.8 mg/l RI water quality threshold, with individual events lasting between two and twelve days.

[9] EPA is required to issue the permit with limits and conditions necessary to ensure compliance with State water quality standards at the time of permit reissuance. Neither the CWA nor EPA regulations require that a TMDL be completed before a water quality-based 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 C.F.R. § 122.44(d)(1)(vii)(B). Thus, an approved TMDL is not a precondition to the issuance of an NPDES permit for discharges to an impaired waterway; nor does EPA have discretion to wait for the issuance of a TMDL to include effluent limitation on discharges of pollutants that contribute to impairments.

Codiga et al, "Narragansett Bay Hypoxic Even Characteristics Based on Fixed-Site Monitoring Network Time Series: Intermittency, Geographic Distribution, Spatial Synchronicity, and Interannual Variability," *Estuaries and Coasts* 32:621-641 (2009). Two of the 2006 events were characterized as "hypoxic", with DO concentrations less than 2.9 mg/l persisting for over two days. Id.

The sonde data also confirms the occurrence of algal blooms and generally elevated chlorophyll-a concentrations in Mount Hope Bay. The 2005 sonde data, Figure 5, shows multiple events with chlorophyll-a concentrations well above 20 ug/l, and above the maximum concentrations captured with the intermittent SMAST sampling.

Figure 5. Mount Hope Bay Sonde 2005



Charts by EPA. Source data: Narragansett Bay Fixed-Site Monitoring Network (NBFSMN), 2005. 2005 Datasets. Rhode Island Department of Environmental Management, Office of Water Resources. Data available at www.dem.ri.gov/bart

The sonde monitoring also confirms that these water quality violations continue to the present. The most recent published data (for 2011) show elevated chlorophyll-a concentrations, corresponding periods of supersaturated DO at the surface, persistent bottom DO concentrations below 5 mg/l and frequent excursions below 3 mg/l. *See* Figure 6.

Figure 6a. Surface Chlorophyll and DO percent saturation, 2011

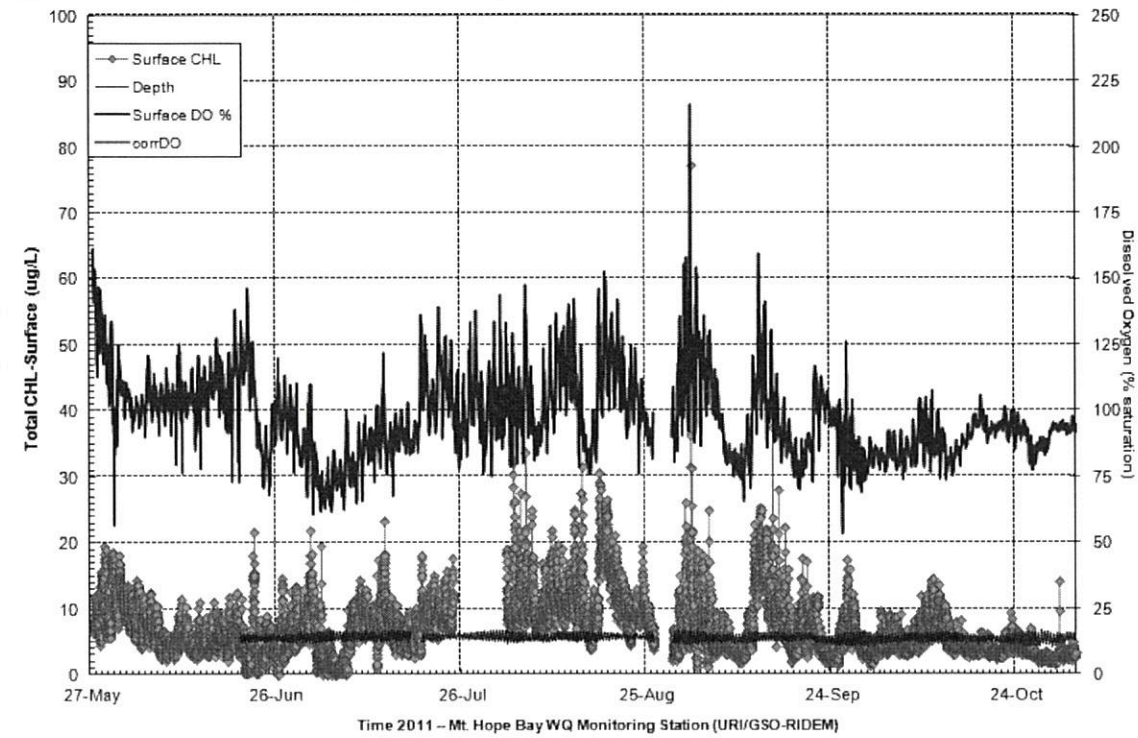
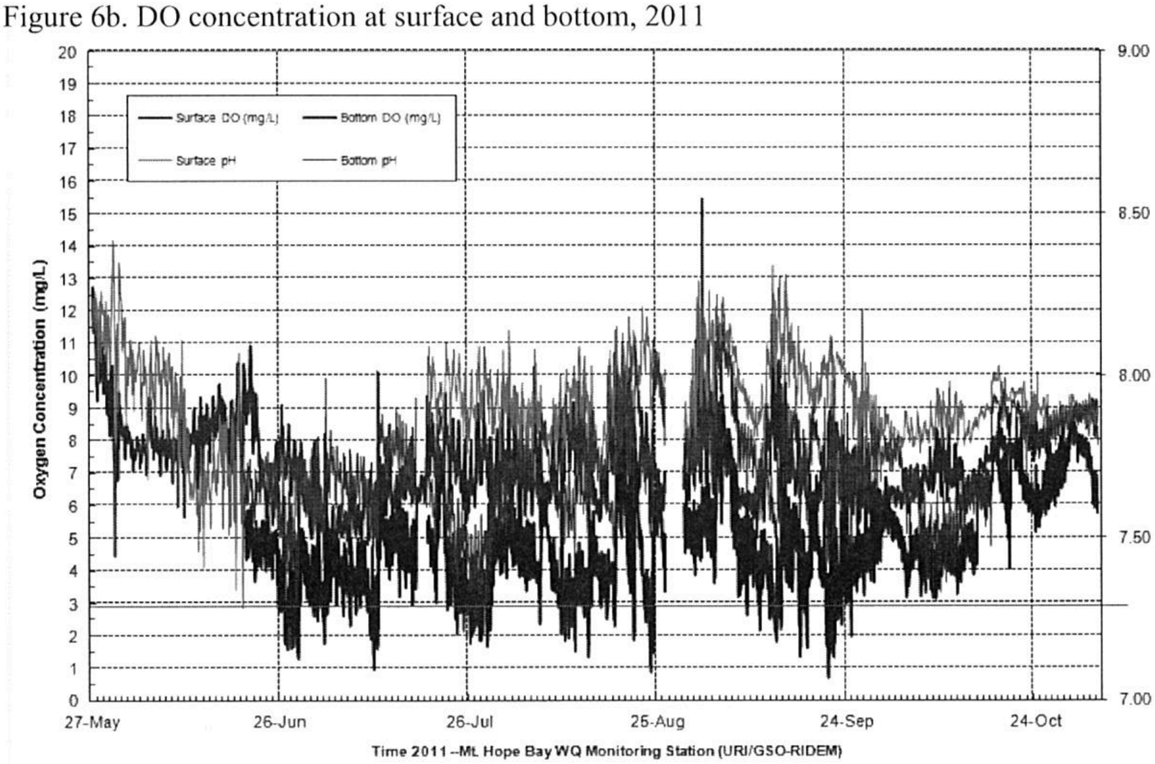


Figure 6b. DO concentration at surface and bottom, 2011



Charts by URI/GSO-RIDEM. Chart and data available at www.dem.ri.gov/bart

Based on these data, EPA has concluded that cultural eutrophication due to nitrogen overenrichment in the Taunton River Estuary and Mount Hope Bay has reached the level of a violation of both Massachusetts and Rhode Island water quality standards for nutrients and aesthetics, and has also resulted in violations of the numeric DO standards in these waters.

e. Reasonable Potential Analysis

Pursuant to 40 C.F.R. § 122.44(d)(1), NPDES permits must contain any requirements in addition to technology-based limits necessary to achieve water quality standards established under Section 303 of the CWA, including state narrative criteria for water quality. In addition, limitations "must control any pollutant or pollutant parameter (conventional, non-conventional, or toxic) that the Director has determined are or may be discharged at a level which will cause, have the reasonable potential to cause, or contribute to an excursion above any water quality standard, including State narrative criteria for water quality" (40 C.F.R. § 122.44(d)(1)(i)). An excursion occurs if the actual or projected instream data exceeds any numeric or narrative water quality criterion.

To determine the extent of the facility's contribution to the violation of the MA SWQS, EPA performed an analysis of nitrogen loading to the Taunton River Estuary using data from the SMAST monitoring program, which included monitoring on the Taunton River and major tributaries to the Taunton River Estuary, in additional to the estuarine stations. The analysis focuses on the Taunton River Estuary because that area shows the greatest eutrophication impacts and greatest nitrogen concentrations. Using the 2004-2005 to representative a "typical year" based on precipitation data,[10] EPA used the USGS LOADEST program to calculate a calculate a seasonal average (June to September) nitrogen load for the Taunton River and each tributary using measured nitrogen concentrations and flow for several discrete events. A description of the LOADEST analysis is provided in Attachment A.

EPA also calculated the point source loads to the Taunton River Estuary derived from wastewater treatment plants based on DMR data from each facility from June through September 2004-05. These include direct discharges to the Taunton River Estuary (Taunton and Somerset WWTPs), and discharges to the tributaries from other POTWs, which are a component of the tributary loads calculated above. For POTWs discharging to tributaries to the Taunton River, an attenuation factor was applied to account for instream uptake of nitrogen. A description of the attenuation calculation is provided in Attachment B. Attenuation was determined to range from four to eighteen percent for the major (> 1 mgd) facilities located on tributaries (eleven percent for Brockton, the largest discharger), with higher attenuation for some of the smaller facilities on smaller tributaries. Table 4 shows the point sources, the receiving stream, their nitrogen discharges and the delivered load to the estuary.

[10] Rainfall during the summers of 2004 and 2005 totalled 17.82 and 11.03 inches respectively (http://weather-warehouse.com/WeatherHistory/PastWeatherData_TauntonMuniArpt_EastTaunton_MA_September.html), compared to a long term average of 15.24 inches (http://www.weather.com/weather/wxclimatology/monthly/graph/02780). The third monitoring year, 2006, was excluded because extremely high rainfall in May and June (over 9 inches per month, or more than twice the long term average) has potential to disturb the "steady-state" assumption that underlies EPA's load analysis.

Table 4. Point Source Discharges and Delivered Loads

WWTF	Design Flow (MGD)	Receiving stream	Average 2004-05 Summer TN discharged (lb/d)	Average 2004-05 Summer TN delivered to Estuary (lb/d)
Direct discharges to Estuary				
Taunton	8.4	Taunton River Estuary	610	610
Somerset	4.2	Taunton River Estuary	349.5	349.5
			Total direct point source load:	959
Upstream discharges				
MCI Bridgewater	0.55	Taunton River	37	33
Brockton	18	Salisbury Plain River	1303	1160
Bridgewater	1.44	Town River	137.5	132
Dighton-Rehoboth Schools	0.01	Segregansett River	1	1
Mansfield	3.14	Three Mile River	375.5	312
Middleboro	2.16	Nemasket River	207.5	191
Wheaton College	0.12	Three Mile River	6	3
Oak Point	0.18	Bartlett Brook	9	8
East Bridgewater High School	0.01	Matfield River	1.5	1
			Total upstream point source load:	1841

Finally, EPA calculated total loads to the estuary and allocated those loads between point sources and nonpoint sources. For upstream loads, nonpoint sources were calculated by subtracting the delivered point source loads from the LOADEST total load. Nonpoint source loads from the watershed area downstream of the SMAST monitoring sites, not accounted for in the LOADEST analysis, were calculated using an areal loading factor derived from the LOADEST loading figures. Direct atmospheric deposition to the Taunton River Estuary was not included in the model as it is a relatively small contribution given the relatively small area of the estuary.[11] The average summer load to the estuary in 2004 to 2005 is 4,228 lbs/day.

Table 5 and Figure 7 show the total watershed nitrogen loads to the Taunton River Estuary. Wastewater treatment plant loads make up 66% of the total nitrogen load. Nonpoint sources make up the remaining 34%. The Bridgewater WWTF load, at 132 lbs/day, is approximately 3.1% of the total nitrogen load.

[11] Atmospheric deposition to the watershed is included in the nonpoint source loading figures.

Figure 7. Taunton River Estuary Loads by Category

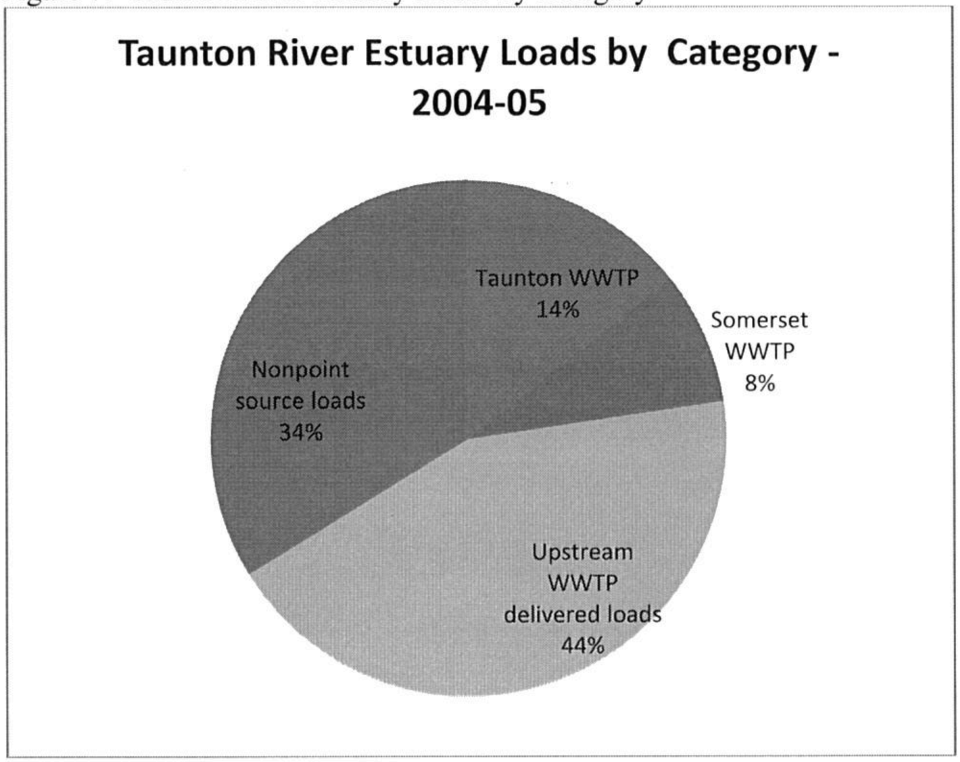


Table 5. Taunton River Estuary Loads by Category

Total loads	**Avg 2004-05 Summer Load (lb/d)**
Taunton WWTP	610
Somerset WWTP	350
Upstream WWTP delivered loads	1841
Nonpoint source loads	1428
Total	4228

On this basis, EPA concludes that the Bridgewater WWTF's nitrogen discharges "cause, have a reasonable potential to cause, or contribute" to nitrogen-related water quality violations in the Taunton River Estuary. Therefore, an effluent limit must be included in the permit.

EPA also notes that there have been some reductions in treatment plant loads since 2004-05, particularly in connection with upgrades to the Brockton AWRF completed in 2010. The Brockton upgrade has reduced its discharge by approximately 800 lb/day, resulting (after attenuation) in about a 712 lb/day or 17% reduction in the total load to the Taunton River estuary. EPA commends this voluntary reduction, which is a significant step (although not sufficient in itself, see section f.ii below) towards achieving the necessary load reductions in this watershed.

f. Effluent limitation calculation

EPA's calculation of an effluent limitation for nitrogen consists of two parts. First, EPA determines a threshold nitrogen concentration in the water body that is consistent with unimpaired conditions. Second, EPA determines the allowable load from watershed sources generally, and this facility specifically, that will result in receiving water concentrations at or below the allowable threshold.

i. Threshold nitrogen concentration

To determine an appropriate threshold concentration, EPA applies the procedure developed by the Massachusetts Estuaries Project of identifying a target nitrogen concentration threshold based on a location within the estuary where water quality standards are not violated, in order to identify a nitrogen concentration consistent with unimpaired conditions. This approach is consistent with EPA guidance regarding the use of reference conditions for the purposes of developing nutrient water quality criteria. The Taunton River Estuary is classified as an SB water and is not a location where eelgrass has historically been found.[12] Therefore the primary water quality parameter considered in determining a sentinel location is DO. EPA notes that concentrations previously found to be protective of DO in other southeastern Massachusetts estuaries have ranged between 0.35 and 0.55 mg/l.[13]

Data from the SMAST monitoring program indicates widespread DO violations at a range of TN concentrations. Table 5 of the SMAST report (Table 2 of this Fact Sheet above) provides the three year period 20% low DO concentration, which was below the 5 mg/l water quality standard at four stations, with long term average TN concentrations ranging from 0.486 to 1.058 mg/l. However, EPA does not consider a three year, 20% low DO to be a sufficiently sensitive indicator of water quality violations because the water quality criteria are based on a minimum DO concentration of 5 mg/l.

Closer examination of the SMAST monitoring data indicates multiple stations with minimum DO violations during the year with corresponding TN mean concentrations below 0.48 mg/l. Indeed minimum DO concentrations of less than 5.0 mg/l were encountered at all but one site (MHB16) during the three year monitoring program. See Table 3.

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[12] Known historic eelgrass locations within Mount Hope Bay are located on the western portion of the Bay, including the mouths of the Kickamuit, Cole and Lee Rivers, and in the Sakkonet River. See Restoration Sites and Historical Eelgrass Distribution in Narragansett Bay, Rhode Island (2001), http://www.edc.uri.edu/restoration/images/maps/historiceelgrass.pdf . Water quality based TN thresholds would be lower in those areas to protect eelgrass habitat. The DO-based thresholds used for development of permit limits will also protect eelgrass in those locations due to much greater dilution of the Taunton River discharges in those areas of the Bay.

[13] See, e.g. MassDEP, *FINAL West Falmouth Harbor Embayment System Total Maximum Daily Loads For Total Nitrogen* (2007) (Harbor Head threshold 0.35 – SA water); MassDEP, *Oyster Pond Embayment System Total Maximum Daily Loads For Total Nitrogen* (2008) (threshold 0.55).

In addition, DO concentrations from the fixed site monitoring station indicate extensive periods with DO below 5.0 mg/l in 2005 and 2006 (the datasonde was not operating in 2004). EPA considers fixed site monitoring to be superior to intermittent sampling data with respect to DO concentrations because the continuous monitoring includes critical conditions and time periods (e.g. early morning DO minimums) that are generally missed in intermittent sampling. The SMAST monitoring station that is closest to the fixed site station is MHB13. The average TN concentration at MHB13 between 2004 and 2006 was 0.473 mg/l, indicating that the threshold concentration must be lower than that value.

On the basis of these data, EPA determined that station MHB16 was appropriate as a sentinel site where dissolved oxygen standards were met, and that a total nitrogen concentration of **0.45** mg/l (the average of 2004-05 concentrations) represents the threshold protective of the dissolved oxygen water quality standard of 5.0 mg/l. Higher TN concentrations are associated with multiple DO violations, based on the available monitoring data. EPA notes that this value is within the range of target nitrogen thresholds previously determined in southeastern Massachusetts embayments, and is also consistent with TN concentration thresholds to protect dissolved oxygen standards identified in other estuaries. See NHDES, 2009.

ii. Allowable TN load

EPA next determined an allowable total nitrogen load from the watershed that would result in TN concentrations at or below the 0.45 mg/l TN threshold. To do so, EPA applied a steady state ocean water dilution model based on salinity, from Fischer et al. (1979). A similar approach was used by the New Hampshire Department of Environmental Services to develop loading scenarios for the Great Bay Estuary (NHDES, 2009). The basic premise is that steady state concentrations of nitrogen in an estuary will be equal to the nitrogen load divided by the total water flushing rate from freshwater and ocean water. Estuaries are complicated systems with variability due to tides, weather, and stream flows. However, by making the steady state assumption, it is not necessary to model all of these factors. The steady state assumption can be valid for calculations based on long term average conditions, which approximate steady state conditions.

Salinity data is used to determine the proportion of fresh and ocean water in the estuary. Freshwater input is calculated from streamflow measurements at USGS gages in the watershed. Then, ocean water inputs are estimated using salinity measurements and the freshwater inputs. The total flushing rate is then used with the target nitrogen threshold to determine the total allowable load to the estuary. For this calculation, salinity at Station MHB19 during 2004-05[14] was used to represent the sentinel location for meeting the target threshold, because it is the uppermost station that appears clearly nitrogen limited based on the Mount Hope Bay Monitoring Program data.

<u>Freshwater Flow</u>: Average freshwater flow input to the estuary in the summers of 2004 and 2005 is shown in Table 6. Freshwater flows at the mouths of the river is determined based on the USGS streamgage data using a drainage area ratio calculation as follows:

[14] As discussed above, 2004-05 represent a typical year.

Flow at mouth = Flow at USGS gage * Drainage area at mouth/Drainage area at gage

Table 6. Average Freshwater Flow 2004-05

	1 Taunton River (Bridge-water) *USGS Gage*	2 Taunton River (area to mouth of estuary minus tributaries) *Drainage Area calculation*	3 Three Mile River (North Dighton) *USGS Gage*	4 Three Mile River (mouth) *Drainage Area calculation*	5 Segre-ganset River (Dighton) *USGS Gage*	6 Segre ganset River (mouth) *Drainage Area calculation*	7 Assonet River (dam) *based on Segregansett*	8 Quequechan River (mouth) *based on Segregansett*	 Total Fresh-water Flow (Sum of Columns 2+ 4+6+ 7+8
Drainage Area	261 sq. miles	410 sq. miles	84 sq. miles	85 sq. miles	10.6 sq. miles	14.9 sq. miles	21.9 sq. miles	30.5 sq. miles	
2004	195 cfs	306 cfs	54 cfs	55 cfs	4.4 cfs	6.1 cfs	9.0 cfs	12.6 cfs	**389 cfs**
2005	217 cfs	341 cfs	55 cfs	56 cfs	4.6 cfs	6.4 cfs	9.4 cfs	13.1 cfs	**427 cfs**
								Average:	**408 cfs**

Salinity: A mass balance equation is applied as follows:

Average salinity at ocean boundary (Rhode Island Sound) = 30 ppt (Kincaid and Pockalny, 2003)
Average salinity at MHB19 in Taunton River Estuary for 2004-05 = 22.35 ppt

Average freshwater flow 2004-05 (Table 6) = 408 cfs

(30 ppt * X cfs + 0 ppt * 408 cfs)/(408 cfs + X) = 22.35 ppt

X = 1,192 cfs ocean water

Nitrogen Target: The nitrogen target load in lbs per day is calculated by combining all water inputs and multiplying by the threshold concentration and the appropriate conversion factors.

(408 cfs + 1,192 cfs)*(0.646)*(8.34)*(0.45 mg/l) = 3,879 lbs/day

The nitrogen concentration at the seaward boundary is 0.28 mg/l (from Oviatt, et al., *Annual Primary Production in Narragansett Bay with no Bay-Wide Winter-Spring Phytoplankton Bloom* (2001). The ocean load can then be calculated:

Ocean load = 1,192 cfs * (0.646)*(8.34)*(0.28 mg/l) = 1,798 lbs/day

Based on the overall flow of the estuary (average of summers 2004 and 2005), the allowable TN load to the Taunton River Estuary, including both ocean and watershed loads, is 3,879 lbs/day.[15] The load from the ocean is 1,798 lbs/day, leaving an allowable load of **2,081** lbs/day from watershed sources. As noted above, actual loads in 2004-05 averaged 4,228 lbs/day. This means a reduction in watershed loads of 2,147, or approximately 51% from the 2004-05 baseline, is required in order to meet water quality standards in the Taunton River Estuary.[16] The Brockton AWRF upgrade already completed has reduced loads by approximately 17%, which while a significant step forward is not expected to be sufficient to achieve water quality standards in the estuary without substantial additional reductions.

The required load reduction is greater than the load discharged from any single facility and can be achieved only through permit limits on multiple facilities. Furthermore, the reduction should be fairly allocated among all discharges to the estuary. EPA notes that all the wastewater treatment plants contributing to the Taunton River are due for permit reissuance, and it is EPA's intent to include nitrogen limits in those permits as appropriate, consistent with this analysis. In doing so, EPA considers not only the facility's current discharges, but their potential discharges under their approved design flows. As this analysis considers summer flows only, an estimated summer flow is calculated at 90% of design flow, consistent with the analysis done by the Rhode Island Department of Environmental Management (RIDEM) for Narragansett Bay facilities. (RIDEM, 2004) See Table 7. This accounts for the fact that a facility discharging at an annual average flow equal to its design flow will average less than design flow during the drier summer months.

For purposes of allocating the required load reduction, EPA first notes that nonpoint sources are unlikely to be reduced by 51% (the overall reduction required in the estuary), and that therefore a higher proportion of the reduction will be allocated to wastewater point sources in the estuary. This is consistent with approaches in approved TMDLs in Massachusetts and elsewhere. EPA considers a 20% nonpoint source reduction to be a reasonably aggressive target for nonpoint source reduction in this watershed based on the prevalence of regulated MS4 stormwater discharges, trends in agricultural uses and population, and potential reductions in atmospheric deposition through air quality programs. EPA notes that should nonpoint source reductions fail to be achieved, permit limits for WWTPs in the watershed shall be revisited to ensure that water quality standards are met.

Using the baseline NPS load of 1,428 lbs/day from 2004-05, a 20% reduction would result in a NPS load of 1,142 lbs/day. This leaves an available load for wastewater discharges of 939 lbs/day. Of the eleven facilities discharging to the watershed, five are minor discharges (< 1 MGD) with a combined load of less than 50 lbs/day. These facilities are considered de minimis contributors for the purposes of this analysis and are not analyzed further here.

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[15] To provide a check on this calculation, EPA calculated the predicted TN concentration in the estuary using calculated loads from 2004-05 using the same mass balance equation. Using the calculated watershed load of 4,228 lbs/day and an ocean load of 1,803 lbs/day as calculated above, the predicted concentration in the estuary is 0.70 mg/l. The monitoring data indicates that the average TN concentration was 0.73 mg/l, within 5% of the predicted value.

[16] Ocean loads are not considered controllable.

To determine an equitable load allocation, EPA first determined the permit limit that would be required to meet the allowable load if a uniform limit were applied to all facilities. While permit limits are generally set to be more stringent on larger dischargers/direct discharges to impaired waters, calculating a uniform limit allows EPA to determine the range of options for permit limits. As shown in Table 7 below, a uniform permit limit on all discharges > 1 MGD in the Taunton would have to be between 3.4 and 3.5 mg/l for the allowable loading threshold to be met. For the largest discharges such as Taunton and Brockton, therefore, a 3.4 mg/l limit represents the upper bound of possible permit limits to meet the water quality requirement. For a lower bound on potential permit limits, EPA notes that the currently accepted limit of technology (LOT) for nitrogen removal is 3.0 mg/l.

Table 7. Delivery Factors and Loads under Permit Limits

WWTF	Design Flow (MGD)	Percent delivered to estuary	Limit assumption: 3.3	Limit assumption: 3.4	Limit assumption: 3.5
Taunton	8.4	100%	208	214	221
Somerset	4.2	100%	104	107	110
Brockton	18	89%	397	409	421
Bridgewater	1.44	96%	34	35	36
Mansfield	3.14	83%	65	67	69
Middleboro	2.16	92%	49	51	52
		Smaller facilities (at 04-05 loads)	46	46	46
		Total	903	929	955

Given the determination that the maximum possible limit for larger facilities is less than 4 mg/l, and that upgrades to meet the most stringent permit limits are more cost-effective at facilities with the highest flows and highest proportion of the load delivered to the estuary, EPA has concluded that a LOT permit limit of 3.0 mg/l is required for the larger dischargers of nitrogen to the estuary. Effluent limits for the smaller dischargers, including the Bridgewater WWTF, are therefore calculated based on an assumption of a 3.0 mg/l on the Taunton and Brockton facilities. This results in a permit limit based on a 5.0 mg/l effluent concentration for the Bridgewater WWTF.

To put this limit in context, Table 8 shows an example permitting scenario that would meet the allowable loading threshold. In this particular example permit limits for the Brockton AWRF (the largest discharger), and Taunton WWTP (the second largest discharge and a direct discharger to the estuary) are based on a 3.0 mg/l effluent concentration. Somerset WWTP (the third largest discharge and a direct discharger to the estuary) at 3.7 mg/l; and the remaining three facilities (Bridgewater, Mansfield and Middleborough) at 5.0 mg/l. Final determinations as to the permit limits on facilities other than the Bridgewater WWTF are being made in each individual permit issuance.

Table 8. Load Allocation Scenario to Meet Load Target

WWTF	Design Flow (MGD)	Percent delivered to estuary	Potential permit limit	Load discharged (lbs/day) at 90%	Load delivered to Estuary
Brockton	18	89%	3.0	405	361
Taunton	8.4	100%	3.0	189	189
Somerset	4.2	100%	3.7	117	117
Mansfield	3.14	83%	5.0	118	98
Middleboro	2.16	92%	5.0	81	74
Bridgewater	1.44	96%	5.0	54	52
Smaller facilities (at current loads)					46
Total					937

For these reasons, EPA has included a monthly average total nitrogen limit of 60 lbs/day mg/l (May to October) in the draft permit, which is a mass load calculated on the basis of a 3 mg/l concentration in the effluent, considered the current limit of technology, at the design flow of 18 mgd. As the water quality analysis is based on total loads to the estuary and is not affected by variations in the amount of flow from the point sources, a mass load-only limit is therefore protective of water quality, and is consistent with 40 CFR 122.45(f).[17] The sampling frequency is two times per week. The permit contains a compliance schedule for meeting the nitrogen limit (See Permit Section 1.F).

Consistent with the seasonal analysis, EPA has not included nitrogen limits for the timeframe of November through March because these months are not the most critical period for phytoplankton growth. As noted earlier, EPA is imposing a condition requiring the permittee to optimize nitrogen removal during the wintertime. The summer limits and the winter optimization requirements will serve to keep the annual discharge load low. In combination, the numeric limitations and the optimization requirements are designed to ensure that the discharge does not cause or contribute to violations of applicable water quality standards, including narrative water quality criterion for nutrients, in accordance with Section 301(b)(1)(C) of the CWA.

EPA also notes that while the permit limit was set based on standards in the Taunton River Estuary, the limit is also protective of water quality standards in Mount Hope Bay under Massachusetts and Rhode Island water quality standards. Mount Hope Bay receives much greater dilution by ocean water, so that the nitrogen concentrations resulting from Taunton River

[17] The May to October seasonal period is consistent with other Narragansett Bay-related nitrogen limits. See Upper Blackstone Water Pollution Abatement District, MA01002369. The Mount Hope Bay Monitoring Program did not include May and October sampling, so those months were not explicitly included in the loading analysis. However, the Narragansett Bay Fixed Site Monitoring Program extends through October and includes limited data at the end of May and supports the need for permit limits in those months. For example, in 2006 chlorophyll-a concentrations in the last week of May averaged 13 ug/l with a maximum of 25 ug/l, with an average DO at the surface sonde of less than 5.0 mg/l. In 2005, chlorophyll-a concentrations from October 1 through 5 averaged 15 ug/l, with a maximum of 45 ug/l; DO concentrations measured at the near-bottom datasonde were less than 5.0 mg/l for approximately 5% of that time.

loadings will be lower in the Bay than the 0.45 mg/l being met in the Taunton River Estuary. While other loads to Mount Hope Bay (particularly the Fall River WWTP) will need to be addressed as well, the reduction in nitrogen loadings from the Taunton River will ensure that those discharges do not cause or contribute to nitrogen-related impairments in Mount Hope Bay.

Total Residual Chlorine (TRC)

Chlorine and chlorine compounds produced by the chlorination of wastewater can be extremely toxic to aquatic life. Effluent limits are based on water quality criteria for total residual chlorine (TRC) which are specified in EPA water quality criteria established pursuant to Section 304(a) of the CWA. The most recent EPA recommended criteria are found in National Recommended Water Quality Criteria: 2002 (EPA-822-R-02-047). The fresh water aquatic life criteria for TRC are 11 ug/l for protection from chronic toxicity and 19 ug/l for protection from acute toxicity.

In its issuance of the existing permit EPA determined that there is reasonable potential for TRC concentrations discharged in the effluent to cause or contribute to an exceedance of the water quality criteria given and calculated an average monthly limitation of 24 ug/l and maximum daily limitation of 42 ug/l for TRC based on the dilution under 7Q10 conditions. The limits are calculated below.

Given:
Acute freshwater criterion 19 ug/l chlorine
Chronic freshwater criterion 11 ug/l chlorine
Dilution factor 2.2

Then:
Acute criterion x dilution factor = Daily Maximum Limit
19 ug/l x 2.2 = 42 ug/l
chronic criterion x dilution factor = Monthly Average Limit
11 ug/l x 2.2 = 24 ug/l

There were no violations of the TRC limit in the period from January 2011 to December 2013. Monitoring frequency is maintained at three times per day.

The draft permit continues the existing permit's requirement that chlorination and dechlorination systems provide an alarm for indicating system interruptions or malfunctions. Any interruption or malfunction of the chlorine dosing system may result in levels of chlorine that are inadequate for achieving effective disinfection, or interruptions and/or malfunctions of the dechlorination system may result in excessive levels of chlorine in the final effluent. The draft permit requires that all interruptions or malfunctions be reported with the monthly DMRs. The draft permit requires that the report include the date and time of the interruption or malfunction, the nature of the problem, and the estimated amount of time that the reduced levels of chlorine or dechlorination chemicals occurred.

Copper

The limits for copper in the existing permit (11 ug/l monthly average, 15 ug/l maximum daily) were calculated based on the chronic and acute criteria set forth in the 1998 *National Recommended Water Quality Criteria*, pursuant to the MA SWQS in effect when the existing permit was issued in 2003. The facility has been unable to meet the limits in the existing permit and has been operating under an interim monthly average limit of 35 ug/l set forth in a compliance order. Since the issuance of the existing permit the Commonwealth of Massachusetts has issued, and EPA has approved, site-specific water quality criteria for copper for the Town River that are less stringent than the prior criteria. The new site specific criteria for copper establish a chronic criterion of 18.1 ug/l(dissolved, "d"),[18] and an acute criterion of 25.7 ug/l(d). The draft permit contains effluent limits of 35 ug/l(total recoverable "tr")(monthly average) and 46 ug/l(tr)(maximum daily). The derivation of these limits is set forth below.

In determining the appropriate effluent limitation in response to this revised standard, EPA must apply the requirements of the revised state standard, as set forth in the MassDEP *Protocol for and Determination of Site-Specific Copper Criteria for Ambient Waters in Massachusetts,* January 2007 (the "site-specific protocol"), and the requirements of the anti-backsliding provisions of the CWA §§ 402(o) and 303(d)(4).

Site-Specific Protocol: In determining effluent limitations under the revised standard, the site-specific protocol allows for relaxation of permit limits to reflect the higher criteria only to the extent required to reflect the actual performance that the facility has been able to achieve. It states:

> [A]s part of the site-specific criteria, all reasonable efforts to minimize the loads of metals, and copper in this case, are part of the criteria revision protocol. So, the Department on a case-by-case basis will develop permit copper limits. Each determination will be based not only on the adjusted concentration resulting from the appropriate multiplier but will reflect the demonstrated level of copper reduction routinely achievable at the facility in order to minimize copper loads and thereby reduce its accumulation in the sediment.

Thus, determination of the appropriate effluent limits under the site-specific protocol requires calculating both (i) the required effluent limits that would meet the numeric criteria (criteria-based limits) and (ii) the actual effluent concentrations achieved by the facility (performance-based limits), and selecting the more stringent of the two.

Anti-backsliding: The reissuance of a permit with less stringent effluent limits must meet the requirements of the CWA's anti-backsliding provision, § 402(o), which allows relaxation of water quality based standards only if they comply with CWA § 303(d)(4), and only if the revised

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[18] Water quality criteria for copper are expressed in terms of dissolved metals. However, permit limitations for copper are expressed in terms of total recoverable metals in accordance with the requirements of 40 CFR § 122.45(c). As such, conversion factors are used to develop total recoverable limits from dissolved criteria. The conversion factor reflects how the discharge of a particular metal partitions between the particulate and dissolved form after mixing with the receiving water. In the absence of site-specific data describing how a particular discharge partitions in the receiving water, a default assumption equivalent to the criteria conversion factor is used in accordance with the *Metal Translator Guidance for Calculating a Total Recoverable Permit Limit from a Dissolved Criterion* (USEPA 1996 [EPA-823-B96-007]). Therefore, a conversion factor of 0.960 was used to convert between total recoverable and dissolved copper concentrations. Dissolved concentrations are denoted $ug/l_{(d)}$, while total recoverable concentrations are denoted $ug/l_{(tr)}$

limit meets current effluent guidelines and will not cause a violation of water quality standards.[19] The Massachusetts antidegradation policy is set forth in 314 CMR 4.04, providing, *inter alia*, "[i]n all cases existing uses and the level of water quality necessary to protect the existing uses shall be maintained and protected."

The analysis under the site-specific protocol addresses the anti-backsliding and antidegradation requirements by relaxing the copper limits to the more stringent of the limits necessary to achieve the revised criteria, or to the limits that have historically been achieved by the facility (unless the facility has historically discharged an effluent concentration lower than the current permit limits, in which those limits are retained). Because any relaxed limits will result in attainment of the site-specific criteria and not be less stringent than the facility's current performance, the facility will not be able to scale back its efforts to reduce copper concentrations in the effluent. Therefore, the less stringent limits will not have the result of exceeding the revised criteria or worsening water quality in the receiving water, and the antidegradation requirement will be met.

As set forth above, the effluent limitations are determined by calculating both (i) the required effluent limits that would meet the numeric criteria (criteria-based limits) and (ii) the actual effluent concentrations achieved by the facility (performance-based limits), and selecting the more stringent of the two. The only exception to this procedure is if the actual effluent concentration is lower than the current (non site-specific) limits, then the current limits are retained in the permit

Criteria-based calculation. The criteria-based limits are calculated based on dilution under 7Q10 conditions, assuming a receiving water concentration of 6 ug/l based on the median receiving water result reported in the WET test reports.:

Calculation of acute limit for copper:
Acute criteria (dissolved) = 25.7 ug/l(d)
7Q10 flow = 2.71 cfs
Design flow = 2.23 cfs
Criteria for total recoverable copper = 25.7 ug/l(d)/0.960 = 26.8 ug/l (tr)
Effluent limit = [(2.23 + 2.71 cfs)*26.8 ug/l – 2.71 cfs * 6 ug/l]/2.23 = 52.1 ug/l

Calculation of chronic limit for copper:
Chronic criteria (dissolved) = 18.1 ug/l(d)
7Q10 flow = 2.71 cfs
Design flow = 2.23 cfs
Criteria for total recoverable copper = 18.1 ug/l(d)/0.960 = 18.85 ug/l (tr)
Effluent limit = [(2.23 + 2.71 cfs)*18.85 ug/l – 2.71 cfs * 6 ug/l]/2.23 = 34.5 ug/l

Performance-based calculation. The level of copper removal routinely achieved by the facility (i.e., the past demonstrated performance of the facility) is determined by a statistical analysis of discharge data submitted by the facility over the three year period from January 2011 through

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[19] The anti-backsliding rule also contains a number of exceptions that are not applicable here. *See* CWA § 402(o)(2); 40 CFR § 122.44(l).

December 2013, using the methodology set forth in the *Technical Support Document for Water Quality-based Toxics Control*, EPA/505/2-90-001 (March 1991) (TSD) (Appendix E). The average monthly and maximum daily limits are based on the 95th and 99th percentile of a lognormal distribution, based on the facility's monthly average effluent data as shown in Table 1. The statistical analysis is shown in Attachment C. These calculations indicate that limits based solely on past performance would result in a monthly average limit of 37 μg/l(tr) and a maximum daily limit of 46 μg/l(tr).

Resulting Effluent Limitation. As noted above, pursuant to the site-specific protocol, effluent limits will be relaxed only to the more stringent of the criteria-based or performance-based limits. In this case the criteria-based limit is more stringent with respect to the chronic criterion, and the performance-based limit is more stringent with respect to the acute criterion. The draft permit therefore includes the criteria-based monthly average and performance-based maximum daily permit limits, as follows:

Monthly average: 35 μg/l(tr)
Maximum daily: 46 μg/l(tr)]

<u>Other metals</u>
EPA also reviewed the facility monitoring data to determine if there is reasonable potential to exceed the water quality criteria for other pollutants. Table 9 shows the concentrations of metals in the Bridgewater WWTF effluent from February 2010 through November 2013 from the analytical testing done in connection with the facility's Whole Effluent Toxicity testing. EPA bases its determination of "reasonable potential" on a characterization of the upper bound of expected effluent concentrations based on a statistical analysis of the available monitoring data. As noted in the TSD, "[a]ll monitoring data, including results for concentrations of individual chemicals, have some degree of uncertainty associated with them. The more limited the amount of test data available, the larger the uncertainty." Thus with a limited data set, the maximum concentration that has been found in the samples may not reflect the full range of effluent concentration. On the other hand, individual high data points may be outliers or otherwise not indicative of the normal range of effluent concentrations.

Table 9. Effluent Analytical Data from Whole Effluent Toxicity Testing

	Effluent Analytical Data (ug/l)						
	Hardness	Al	Cd[1]	Cu	Ni	Pb[1]	Zn
2/15/2011	79	32	ND-0.5	26	8	0.7	36
5/10/2011	92	49	ND-0.5	21	8	0.7	28
8/16/2011	80	26	ND-0.5	18	5	ND-0.5	15
11/15/2011	72	32	ND-0.5	25	5	0.5	21
2/14/2012	69	45	ND-0.5	31	5	0.6	28
5/4/2012	87	25	ND-0.5	16	5	ND-0.5	17
8/13/2012	91	ND-20	ND-0.5	19	4	ND-0.5	15
11/14/2012	76	48	ND-0.5	29	5	2	23
2/11/2013	81	36	ND-0.5	27	4	ND-0.5	26
5/13/2013	91	21	ND-0.5	25	8	ND-0.5	36
6/2/2013	100	40	ND-0.5	25	5	0.5	19
8/12/2013	97	ND-20	ND-0.5	18	5	0.7	22
11/12/2013	82	35	ND-0.5	33	5	ND-0.5	23
Median	82	35	ND-0.5	25	5	1	23
95th percentile[2]		53	ND-0.5	32	8	1.35	38
99th percentile[2]		64	ND-0.5	38	10	1.94	46
Chronic Criterion[3]		87	0.18	18.1	33	1.59	76
Acute Criterion[3]		750	1.23	24.7	296	40.9	76

To account for this, EPA has developed a statistical approach to characterizing effluent variability. As "experience has shown that daily pollutant discharges are generally lognormally distributed," *TSD* at App. E, EPA uses a lognormal distribution to model the shape of the observed data, unless analysis indicates a different distributional model provides a better fit to the data. The model parameters (mean and variance) are derived from the monitoring data.

The lognormal distribution generally provides a good fit to environmental data because it is bounded on the lower end (i.e. you cannot have pollutant concentrations less than zero) and is positively skewed. It also has the practical benefit that if an original lognormal data set X is logarithmically transformed (i.e. Y = ln[X]) the resulting variable Y will be normally distributed. Then the upper percentile expected values of X can be calculated using the z-score of the standardized normal distribution (i.e. the normal distribution with mean = 0 and variance = 1), a common and relatively simple statistical calculation. The p^{th} percentile of X is estimated by

$X_p = \exp(\mu_y + z_p\,\sigma_y)$, where μ_y = mean of Y
σ_y = standard deviation of Y
$Y = \ln[X]$

For the 95^{th} percentile, $z_{95} = 1.645$, so that

$$X_{95} = \mu_y + 1.645\,\sigma_y$$

The 95th percentile value is used to determine whether a discharge has a reasonable potential to cause or contribute to an exceedance of a water quality standard. The combination of the upper bound effluent concentration with dilution in the receiving water is calculated to determine whether the water quality criteria will be exceeded. The *TSD* also includes a procedure for determine such percentiles when the dataset includes non-detect results, as is the case for the Bridgewater WWTF, based on a delta-lognormal distribution. The statistical analyses for the metals with non-detect results (aluminum, cadmium and lead) in the Bridgewater WWTF discharges are set forth in Attachment C.

The resulting effluent concentrations are all lower than the applicable water quality criteria from EPA, *National Recommended Water Quality Criteria 2002*, which have been incorporated into the Massachusetts SWQS, 314 CMR 4.05 (5)(e). For cadmium, nickel, lead and zinc the water quality criteria are hardness dependent. Because the reasonable potential analysis is performed using dilution under 7Q10 conditions, a projected hardness under 7Q10 conditions is calculated using the same mass balance equations and the median hardness of the effluent (82 mg/l) and upstream receiving water (38 mg/l), for a calculated hardness of 58 mg/l. Table 10.

Table 10. Metals Criteria

7Q10 = 1.713 MGD
Design flow = 1.44 MGD
Hardness = 58.095147 mg/L

Metal	m_A	b_A	m_C	b_C	CF acute	CF chronic	Dissolved Criteria		Total Recoverable Criteria	
							Acute Criteria (CMC) (ug/L)	Chronic Criteria (CCC) (ug/L)	Acute Criteria (CMC) (ug/L)	Chronic Criteria (CCC) (ug/L)
Hardness Dependent Metals										
Cadmium	1.0166	-3.9240	0.7409	-4.7190	0.967	0.932	1.19	0.17	1.23	0.18
Chromium III	0.8190	3.7256	0.8190	0.6848	0.316	0.860	365.20	47.50	1155.68	55.24
Lead	1.2730	-1.4600	1.2730	-4.7050	0.870	0.870	35.59	1.39	40.90	1.59
Nickel	0.8460	2.2550	0.8460	0.0584	0.998	0.997	295.75	32.85	296.34	32.95
Silver	1.7200	-6.5900	---	---	0.850	---	1.26	---	1.49	---
Zinc	0.8473	0.8840	0.8473	0.8840	0.978	0.986	73.96	74.57	75.63	75.63

Source: National Recommended Water Quality Criteria 2002
http://www.epa.gov/waterscience/criteria/wqctable/

As the 95th percentile of effluent concentrations are all below the applicable water quality criteria, there is no reasonable potential to cause an exceedance of water quality standards and no permit limits on these metals are necessary.

Toxicity Testing

National studies conducted by EPA have demonstrated that domestic sources contribute toxic constituents to POTWs. These constituents include metals, chlorinated solvents and aromatic hydrocarbons among others. The Region's current policy is to include toxicity testing requirements in all municipal permits, while Section 101(a)(3) of the CWA specifically prohibits the discharge of toxic pollutants in toxic amounts.

Based on the potential for toxicity resulting from domestic and industrial contributions, the low level of dilution at the discharge location, water quality standards, and in accordance with EPA regulation and policy, the draft permit includes chronic and acute toxicity limitations and monitoring requirements. (See, e.g., "Policy for the Development of Water Quality-Based Permit Limitations for Toxic Pollutants", 50 Fed. Reg. 30,784 (July 24, 1985); see also, EPA's *TSD*). EPA Region I has developed a toxicity control policy. The policy requires wastewater treatment facilities to perform toxicity bioassays on their effluents. The MassDEP requires bioassay toxicity testing for state certification.

The MassDEP's Division of Watershed Management has a current toxics policy that requires toxicity testing for all major dischargers such as the Bridgewater WWTF (*Implementation Policy for the Control of Toxic Pollutants in Surface Waters*, MassDEP 1990). In addition, EPA feels that toxicity testing is required to assure that the synergistic effect of the pollutants in the discharge does not cause toxicity, even though the pollutants may be at low concentrations in the effluent. The inclusion of whole effluent toxicity limitations in the draft permit will assure that the Bridgewater WWTF does not discharge combinations of toxic compounds into the Town River in amounts that would affect aquatic or human life.

Pursuant to EPA Region I Policy, and MassDEP's *Implementation Policy for the Control of Toxic Pollutants in Surface Waters* (February 1990), dischargers having a dilution factor less than 10 are required to conduct acute and chronic toxicity testing four times per year unless there are passing results over an extended period of time. A dilution factor of 2.2 was calculated for this facility. In accordance with the above guidance, the draft permit includes an acute toxicity limit (LC50 of > 100%) and a chronic toxicity limit (C-NOEC of > 45 %). The C-NOEC calculations are as follows: (1/dilution factor * 100) = (1/2.2 * 100) = 45 percent.

Toxicity testing shall be performed on the daphnid, *Ceriodaphnia dubia* in accordance with the EPA Region I Toxicity protocol found in the draft permit **Attachment A** for the acute test and **Attachment B** for the chronic test, and the tests will be conducted four times a year. The prior permit's use of the single "chronic (and modified acute)" test has been revised to two separate tests, consistent with the requirement to use approved test methods. The facility has had three recent exceedance of the chronic toxicity limit (see Table 1) and is investigating causes.

EPA and MassDEP may use the results of the toxicity tests and chemical analyses conducted by the permittee, required by the permit, as well as national water quality criteria, state water quality criteria, and any other appropriate information or data, to develop numerical effluent limitations for any pollutants.

VIII. Operation and Maintenance of the Sewer System

EPA regulations set forth a standard condition for "Proper Operation and Maintenance" that is included in all NPDES permits. *See* 40 CFR § 122.41(e). This condition is specified in Part II.B.1 (General Conditions) of the draft permit and it requires the proper operation and maintenance of all wastewater treatment systems and related facilities installed or used to achieve permit conditions.

EPA regulations also specify a standard condition to be included in all NPDES permits that specifically imposes on permittees a "duty to mitigate." *See* 40 CFR § 122.41(d). This condition is specified in Part II.B.3 of the draft permit and it requires permittees to take all reasonable steps – which in some cases may include operations and maintenance work - to minimize or prevent any discharge in violation of the permit which has the reasonable likelihood of adversely affecting human health or the environment.

Proper operation of collection systems is critical to prevent blockages and equipment failures that would cause overflows of the collection system (sanitary sewer overflows, or SSOs), and to limit the amount of non-wastewater flow entering the collection system (inflow and infiltration or I/I[20]). I/I in a collection system can pose a significant environmental problem because it may displace wastewater flow and thereby cause, or contribute to causing, SSOs. Moreover, I/I could reduce the capacity and efficiency of the treatment plant and cause bypasses of secondary treatment. Therefore, reducing I/I will help to minimize any SSOs and maximize the flow receiving proper treatment at the treatment plant. MassDEP has stated that the inclusion in NPDES permits of I/I control conditions is a standard State Certification requirement under Section 401 of the CWA and 40 CFR § 124.55(b).

Therefore, specific permit conditions have been included in Part I.B. and I.C. of the draft permit. These requirements include mapping of the wastewater collection system, preparing and implementing a collection system operation and maintenance plan, reporting unauthorized discharges including SSOs, maintaining an adequate maintenance staff, performing preventative maintenance, controlling infiltration and inflow to the extent necessary to prevent SSOs and I/I related-effluent violations at the wastewater treatment plant, and maintaining alternate power where necessary. These requirements are intended to minimize the occurrence of permit violations that have a reasonable likelihood of adversely affecting human health or the environment.

Several of the requirements in the new draft permit were not included in the existing permit or the previous draft permit, including collection system mapping, and preparation of a collection system operation and maintenance plan. EPA has determined that these additional requirements are necessary to ensure the proper operation and maintenance of the collection system and has included schedules for completing these requirements in the draft permit.

IX. Essential Fish Habitat

Under the 1996 Amendments (PL 104-267) to the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. § 1801 et seq. (1998)), EPA is required to consult with the National Marine Fisheries Services (NMFS) if EPA's action or proposed actions that it funds, permits, or undertakes, may adversely impact any essential fish habitat as: waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (16 U.S.C. § 1802 (10)). Adversely impact means any impact which reduces the quality and/or quantity of EFH (50 C.F.R. § 600.910

[20] "Infiltration" is groundwater that enters the collection system through physical defects such as cracked pipes, or deteriorated joints. "Inflow" is extraneous flow entering the collection system through point sources such as roof leaders, yard and area drains, sump pumps, manhole covers, tide gates, and cross connections from storm water systems.

(a)). Adverse effects may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey, reduction in species' fecundity), site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions. Essential fish habitat is only designated for species for which federal fisheries management plans exist (16 U.S.C. § 1855(b) (1) (A)). EFH designations for New England were approved by the U.S. Department of Commerce on March 3, 1999. The Town River is not covered by the EFH designation for riverine systems, and permit limits on total nitrogen have been included to protect the downstream waters of Mount Hope Bay and the Taunton River Estuary. Therefore EPA has determined that a formal EFH consultation with NMFS is not required.

X. Endangered Species Act

Section 7(a) of the Endangered Species Act of 1973, as amended (ESA) grants authority to and imposes requirements upon Federal agencies regarding endangered or threatened species of fish, wildlife, or plants ("listed species") and habitat of such species that has been designated as critical (a "critical habitat"). The ESA requires every Federal agency, in consultation with and with the assistance of the Secretary of Interior, to insure that any action it authorizes, funds, or carries out, in the United States or upon the high seas, is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. The United States Fish and Wildlife Service (USFWS) administers Section 7 consultations for freshwater species, whereas NMFS administers Section 7 consultations for marine species and anadromous fish.

EPA has determined that no federally-listed or proposed, threatened or endangered species or critical habitat are known to occur in the Town River. Furthermore, the effluent limitations and other permit requirements identified in this Fact Sheet are designed to be protective of all aquatic species, and permit limits on total nitrogen have been included to protect the downstream waters of Mount Hope Bay and the Taunton River Estuary. Therefore EPA has determined that a consultation with USFWS and NMFS is not required.

XI. Monitoring and Reporting

The effluent monitoring requirements have been established to yield data representative of the discharge under authority of Section 308 (a) of the CWA in accordance with 40 CFR §§122.41 (j), 122.44 (l), and 122.48.

The Draft Permit requires the permittee to report monitoring results obtained during each calendar month in the Discharge Monitoring Reports (DMRs) no later than the 15th day of the month following the completed reporting period.

The Draft Permit includes new provisions related to electronic DMR submittals to EPA and the State. The Draft Permit requires that, no later than six months after the effective date of the permit, the permittee submit all DMRs to EPA using NetDMR, unless the permittee is able to demonstrate a reasonable basis, such as technical or administrative infeasibility, that precludes the use of NetDMR for submitting DMRs and reports ("opt-out request").

In the interim (until six months from the effective date of the permit), the permittee may either submit monitoring data to EPA in hard copy form, or report electronically using NetDMR.

NetDMR is a national web-based tool for regulated Clean Water Act permittees to submit DMRs electronically via a secure Internet application to U.S. EPA through the Environmental Information Exchange Network. NetDMR allows participants to discontinue mailing in hard copy forms under 40 CFR § 122.41 and § 403.12. NetDMR is accessed from the following url: http://www.epa.gov/netdmr. Further information about NetDMR can be found on the EPA Region 1 NetDMR website located at http://www.epa.gov/region1/npdes/netdmr/index.html.

EPA currently conducts free training on the use of NetDMR, and anticipates that the availability of this training will continue to assist permittees with the transition to use of NetDMR. To learn more about upcoming trainings, please visit the EPA Region 1 NetDMR website http://www.epa.gov/region1/npdes/netdmr/index.html .

The Draft Permit also includes an "opt-out" request process. Permittees who believe they can not use NetDMR due to technical or administrative infeasibilities, or other logical reasons, must demonstrate the reasonable basis that precludes the use of NetDMR. These permittees must submit the justification, in writing, to EPA at least sixty (60) days prior to the date the facility would otherwise be required to begin using NetDMR. Opt-outs become effective upon the date of written approval by EPA and are valid for twelve (12) months from the date of EPA approval. The opt-outs expire at the end of this twelve (12) month period. Upon expiration, the permittee must submit DMRs to EPA using NetDMR, unless the permittee submits a renewed opt-out request sixty (60) days prior to expiration of its opt-out, and such a request is approved by EPA.

In most cases, reports required under the permit shall be submitted to EPA as an electronic attachment through NetDMR, subject to the same six month time frame and opt-out provisions as identified for NetDMR. Certain exceptions are provided in the permit such as for the submittal of pre-treatment reports and for providing written notifications required under the Part II Standard Permit Conditions. Once a permittee begins submitting reports to EPA using NetDMR, it will no longer be required to submit hard copies of DMRs or other reports to EPA and will no longer be required to submit hard copies of DMRs to MassDEP. However, permittees must continue to send hard copies of reports other than DMRs to MassDEP until further notice from MassDEP.

Until electronic reporting using NetDMR begins, or for those permittees that receive written approval from EPA to continue to submit hard copies of DMRs, the Draft Permit requires that submittal of DMRs and other reports required by the permit continue in hard copy format. Hard copies of DMRs must be postmarked no later than the 15th day of the month following the completed reporting period.

VIII. State Certification Requirements

EPA may not issue a permit unless MassDEP certifies that the effluent limitations included in the permit are stringent enough to assure that the discharge will not cause the receiving water to violate State Water Quality Standards. EPA has requested permit certification by the State pursuant to 40 CFR §124.53 and expects the draft permit will be certified.

XIV. Comment Period, Hearing Requests, and Procedures for Final Decisions

All persons, including applicants, who believe any condition of the permit is inappropriate must raise all issues and submit all available arguments and all supporting material for their arguments in full by the close of the public comment period to Susan Murphy, U.S. Environmental Protection Agency, 5 Post Office Square, Suite 100 (OEP06-1), Boston, MA 02109. Any person prior to such date may submit a request in writing for a public hearing to consider the draft permit to EPA and the State Agency. Such requests shall state the nature of the issues to be raised in the hearing. A public hearing may be held after at least thirty days public notice whenever the Regional Administrator finds that response to this notice indicates significant public interest. In reaching a final decision on the draft permit the Regional Administrator will respond to all significant comments and make these responses available to the public at EPA's Boston office.

Following the close of the comment period, and after the public hearing, if held, the Regional Administrator will issue a final permit decision and forward a copy of the final decision to the applicant and to each person who has submitted written comments or requested notice.

XV. EPA Contact

Requests for additional information or questions concerning the draft permit may be addressed Monday through Friday, between the hours of 9:00 a.m. and 5:00 p.m., to :

Susan Murphy
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5 Post Office Square, Suite 100 (OEP06-1)
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Ken Moraff, Director
Office of Ecosystem Protection
U.S. Environmental Protection Agency

To estimate the TN load to the Taunton River Estuary, the USGS LOADEST computer modeling program was used. This program develops a number of regression equations correlating constituent concentration and streamflow based on an input calibration file listing corresponding data points of these two variables. For each regression equation, three different models are used to estimate the average summer load based on the summer flow record. The first, Adjusted Maximum Likelihood Estimation (AMLE), and the second, Maximum Likelihood Estimation (MLE) are applicable when the calibration model errors, or "residuals," are normally distributed. Normality is determined by the Turnbull-Weiss test. These two estimations will be the same unless there are any censored data points, in which case the AMLE estimate is more accurate. The third model, Least Absolute Deviation (LAD), is used for non-normally distributed data.

The average summer TN load to the Taunton River at Weir Village, as well as to the four tributaries downstream from this point, were modeled by LOADEST using nitrogen concentration data from the Mount Hope Bay Monitoring Program and 2004 and 2005 daily streamflow data either measured by USGS gages, or adjusted proportionally based on drainage area. For days on which more than one concentration was measured, the average concentration was used in the LOADEST calibration file. Days on which the streamflow was 0 cfs were excluded from the dataset.

For all load estimations the best regression equation was automatically selected by the program based on the Akaike Information Criteria (AIC) value. In calculating the summer loads, the regression equation was selected based on the full year of monitoring data (i.e., the equation used to calculate the summer 2004 loads was selected based on a calibration dataset of the entire year 2004 monitoring data).

As described earlier, LOADEST gives load estimations based on three different models. If the calibration residuals were distributed normally, the Maximum Likelihood Estimation (MLE) was chosen. Otherwise, the Least Absolute Deviation (LAD) estimation was chosen. The calibration residuals were considered normal if the p-value of the Turnbull Weiss test was greater than 0.05.

Taunton River at Weir Village	
Year	Load Est. (lb/d)
2004	2659
2005	2289

Three Mile River	
Year	Load Est. (lb/d)
2004	547
2005	403

Segreganset River	
Year	Load Est. (lb/d)
2004	35
2005	34

Assonet River	
Year	Load Est. (lb/d)
2004	49
2005	51

Quequechan River	
Year	Load Est. (lb/d)
2004	85
2005	112

Sum of Loads (lb/d)	
2004	3375
2005	2889

Nitrogen Attenuation

As a result of chemical and biological processes, not all of the nitrogen discharged from each point source reaches the estuary. To determine the delivered nitrogen load, attenuation from each point source was calculated. The governing equation is:

$$L_f = L_i * e^{-kt} \text{ ; where}$$

L_f = the delivered load;
L_i = discharged load;
k = attenuation coefficient; and
t = travel time in days.

Attenuation calculations have been estimated in a number of studies for smaller order streams but generally do not reflect the effluent-dominated stream conditions encountered downstream of the Brockton AWRF (DF (dilution factor) = 1.02) and, to a lesser extent, the Bridgewater (DF 2.2), Mansfield (DF 2.2) and Middleboro (DF 1.9) WWTPs. For example, attenuation coefficients for small streams are given by the NE SPARROW models. Moore et al., *Estimation of Total Nitrogen and Phosphorus in New England Streams Using Statistically Referenced Regression Models*, USGS SIR-2004-5012. The NE SPARROW model indicates that no attenuation would be expected in the Taunton River mainstem, but that the tributaries (with flows ≤ 100cfs) are given an attenuation coefficient of 0.77 day^{-1}.

For the Brockton AWRF, attenuation calculations based on regional regression equations were determined to be insufficient. Using the above analysis with SPARROW regression coefficients, the calculated attenuation of the Brockton AWRF discharge under summer flow conditions is predicted to be approximately 30%. EPA determined that this figure was unreliable for the following reasons:

(1) Use of a 30% attenuation factor for Brockton's load to allocate the total loads at Weir Village from the LOADEST analysis resulted in an implausibly large nonpoint source load per square mile compared to the other tributaries. This would indicate that the point source component of the load is being understated; the likeliest explanation for that is that attenuation of Brockton's load is overstated.[1]

[1] To explain further, monitoring of the Taunton River at Weir Village indicates an average summer load for 2004-05 of 2,474 lbs/day. If the Brockton discharge of 1,303 lbs/day is assumed to be reduced by 30% through attenuation, then 912 lbs/day of the load at Weir Village is due to Brockton. Other WWTPs contribute 330 lbs/day, leaving 1,232 lbs/day attributable to nonpoint sources. Given the drainage area above Weir Village of 358 square miles, this gives an estimated summer nonpoint source loading of 3.4 lbs/day/sq.mi. This is significantly greater than the areal nonpoint source loading found at any other monitoring site in the Mount Hope Bay Monitoring Program, including the Quequechan River (which drains the City of Fall River) as well as the Ten Mile, Assonet and Segreganset Rivers.

(2) Nitrogen data collected by CDM for the Brockton AWRF receiving water study, although not collected for the purposes of attenuation calculations, do not appear to be consistent with significant in-stream attenuation.[2]

(3) The extremely effluent-dominated conditions downstream of the Brockton AWRF discharge are likely outside of the range of conditions used in developing the SPARROW regional regression equations.[3,4]

Because of the large impact of Brockton's discharge on the loading analysis, EPA determined that an improved attenuation estimate was necessary for this analysis, and therefore conducted a monitoring study including sampling and streamflow measurements in the summer of 2012, in order to determine an attenuation rate for Brockton's discharge.

The Matfield River Monitoring Study utilized a Lagrangian sampling program modelled on USGS, *Lagrangian Sampling of Wastewater Treatment Plant Effluent in Boulder Creek, Colorado, and Fourmile Creek, Iowa*, Open File Report 2011-1054 (2011), based on following the same "packet" of water downstream from the AWRF and sampling downstream based on calculated time of travel from the AWRF. Samples were taken at one upstream and four downstream locations on the Salisbury Plain and Matfield Rivers, as well as the two major tributaries (Beaver Brook and Meadow Brook) and the AWRF discharge, and streamflow was measured at three downstream locations. Sampling locations are shown on Figure B-1.

The furthest downstream station (MATF08) was located at the former USGS streamgage site on the Matfield River at Elmwood (USGS 01106500). Time of travel to this site was based on 15-minute streamflow data provided by USGS for summer months prior to discontinuance of data collection at the streamgage in October 2009. These show a clear pattern of influence from the Brocton AWRF's diurnal discharge variation. Figure B-2 shows two 24-hour streamflow records from September 2009 at relatively low (chart A)

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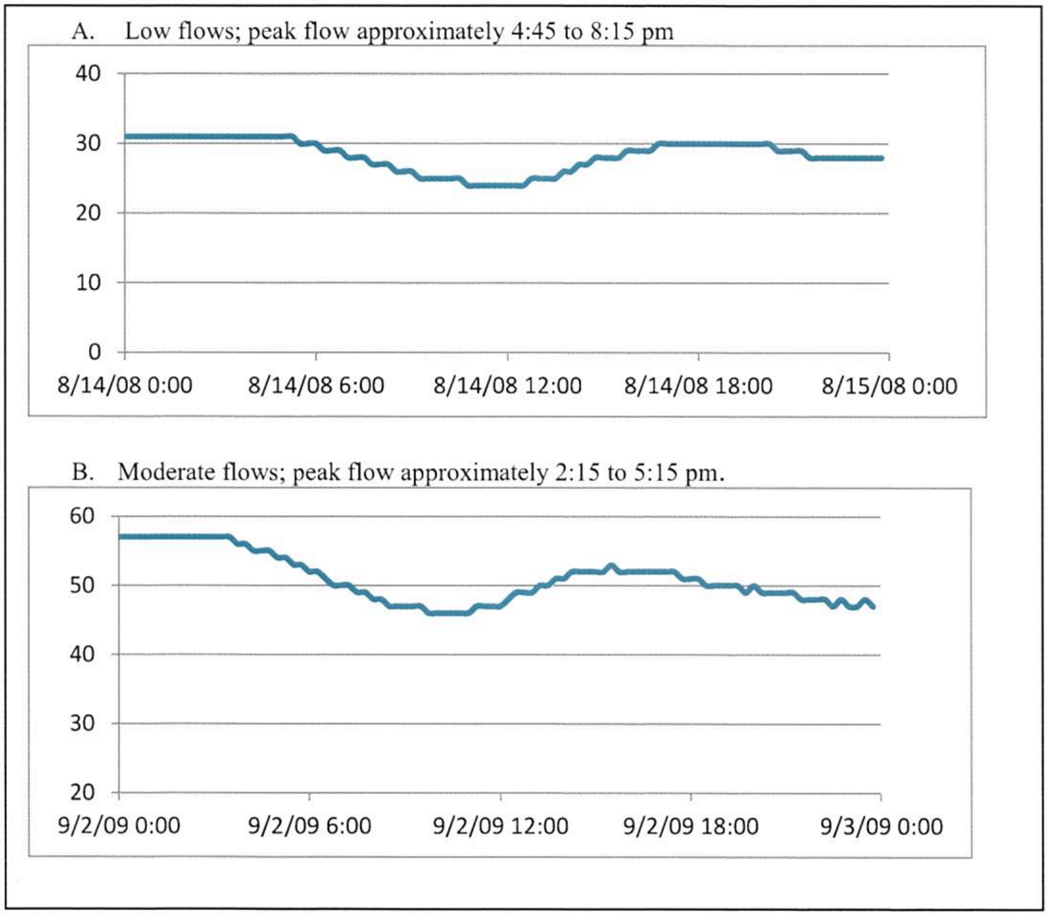
[2] For example, total nitrogen concentrations at the site of the discontinued USGS gage on the Matfield (CDM's station BR1-08) were within 5% of the concentrations found over 4 miles upstream on the Salisbury Plain River (CDM Station BR1-03), indicating on a qualitative level that little attuenuation is occurring once the additional dilution resulting from the confluence of Beaver Brook, Meadow Brook and other minor tributaries and baseflow is accounted for.

[3] Furthermore, the SPARROW regression equations themselves indicate that more wastewater load is passing thought the system than would be indicated by the discharge loads and attenuation coefficient. For the predictor variable 'municipal wastewater facilities' the regression coefficient is 1.11, so that the regression model predicts 11% more in-stream load from WWTPs than is actually discharged. That is, direct application of the SPARROW model would require that Brockton's load be inflated by 11% before applying the attenuation factor in order to calculate Brockton's contribution to the delivered flow.

[4] Available literature also indicates the potential for significant reduction in attenuation rates under high nitrogen concentrations. See Alexander et al, Dynamic modeling of nitrogen losses in river networks unravels the coupled effects of hydrological and biogeochemical processes, *Biogeochemistry* 93:91–116 (2009).

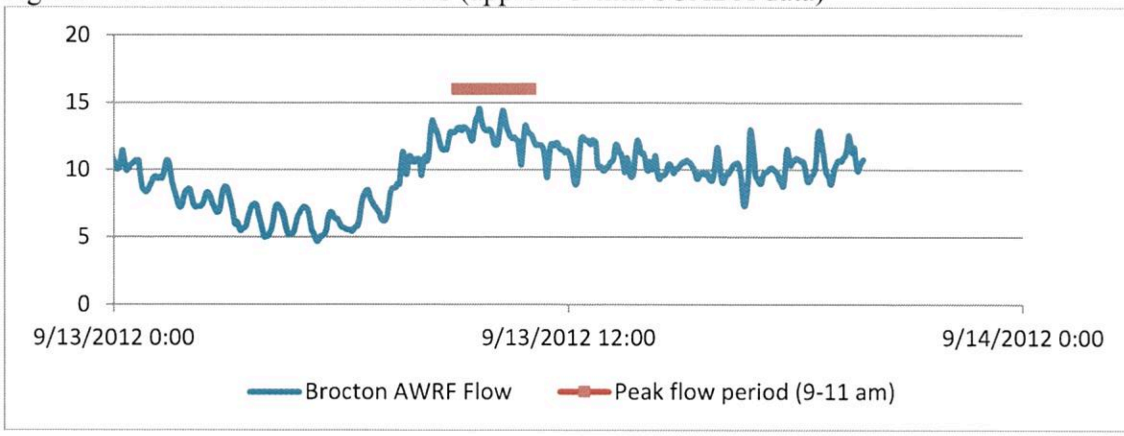
and moderate (chart B) flows. These show a distinct diurnal flow pattern, consistent with wastewater discharges, and a delayed and more spread out pattern under lower flow conditions, consistent with lower stream velocities under those conditions. The time of travel for individual days was determined by comparison of the daily streamflow pattern with the Brocton AWRF discharge data from the facility's SCADA system (measurements approximately every 3 minutes; an example is shown at Figure B-3). Time of travel to the intermediate sites was assumed to be proportional to time of travel to MATF08, based on the distance in river miles to each site.

Figure B-2. USGS 01106500, Matfield River at Elmwood, 15-minute flow data



As can be seen from the Brockton AWRF SCADA data, there is considerable short term variability in the AWRF discharge rate. As explained by the facility, this is due to the interaction of the various pump operations related to facility discharge and is inherent in the operation of the facility. While this variability will tend to dissipate as the plume moves downstream (see smoother pattern in 15-min data from the USGS gage downstream), there is potential for initial load calculations, and thus the attenuation factor, to vary on the order of 5-8% in the short term (on the order of 3 minutes). A time of travel analysis is not expected to be sufficiently precise to capture the exact packet of discharge within the sub-3 minute variability of the discharge. Therefore the analysis focused of following the peak period of Brockton's flows, approximately 9 to 11 a.m. While this provides a lower level of precision than would be ideal, it is sufficient that attenuation on the order of 30% (as predicted using regional regression models) would be apparent.

Figure B-3. Brockton AWRF Flows (approx. 3-min SCADA data)



Monitoring data from sampling stations on the Salisbury Plain and Matfield River are shown in Table B-1. On two of the sampling dates, instream total nitrogen concentrations increase slightly as sampling moves downstream, inconsistent with significant attenuation of nitrogen under those flow conditions (these are the two lowest flow dates). These increases could indicate instream release of nitrogen under low flow conditions. In contrast, in the August sampling a significant reduction in total nitrogen concentration occurred between sites 5 and 8. In general, the reach between sites 5 and 8 saw the most variability, with both load increases and one day of significant load decrease recorded between the two sites. This is likely due to the extensive wetland system the river passes through between these two stations, which appear to provide potential for sizeable release as well as uptake of nitrogen discharges. EPA notes that results showing widely variation attenuation rates under different stream conditions are consistent with the available literature (see, e.g. Smith et al., Nitrogen attenuation in the Connecticut River, northeastern USA; a comparison of mass balance and N2 production modeling approaches, *Biogeochemistry* 87, 311-323 (2008) (differing attenuation in April (zero in both reaches) from August (zero in southern reach, 18% in northern reach)); Vanderburg et al., Field Evaluation of Mixing Length and Attenuation of Nutrients and Fecal Coliform in a Wastewater Effluent Plume, Environmental Monitoring and Assessment (2005) 107: 45–57 (2005) ("Nitrate attenuation is markedly different between the two sampling events.").

Table B-1

Station	Distance Downstream from AWRF (ft)	6/18/2012		7/9/2012		8/13/2012		9/13/2012	
		Flow (cfs)	TN (mg/l)	Flow (cfs)	TN (mg/l)	Flow (cfs)	TN (mg/l)	Flow (cfs)	TN (mg/l)
SALP01	-200	--	1.67	--	2.13	--	1.67	--	1.53
AWRF	0	25.2	4.22	18.3	4.32	22.1	4.82	19.9	4.00
SALP03	6644	37.4	3.26	26.0	3.21	42.2	3.32	25.2	3.43
MATF05	17288	42.1	2.79	26.8	3.22	55.3	2.82	25.8	3.51
MATF08[1]	28742	46.0	3.09	27.7	3.40	63.0	1.64	26.7	3.82

[1] Flow at MATF08 determined from USGS staff gage and most recent shifted rating curve for June, August and September sampling dates. Direct streamflow measurements on 7/9/12 and early morning on 9/13/12 used to confirm shifted rating curve, which is considered highly provisional by USGS since discontinuance of site as active USGS streamgage.

Load reduction percentages were calculated for each sampling station on the Salisbury Plain/Matfield Rivers for each monitoring data and are shown in Table B-2. In general load reductions are on the order of a few percent and, given the uncertainty in the analysis, are consistent with either zero attenuation or a low level of attenuation in the system on all sampling dates but August 13 (when significant attenuation is shown). These calculations indicate that, averaged over the summer, there is attenuation of nitrogen taking place downstream of the AWRF discharge. Average attenuation over the summer for the three reaches were combined to determine a cumulative attenuation percentage from the AWRF to Station MATF08 of 7%. This corresponds to an attenuation coefficient k of 0.28 day^{-1}.

An alternative approach to estimating attenuation from these data was also applied as a qualitative check on this analysis, using chloride concentrations to assess relative changes in TN concentrations using the approach of Vanderburg et al. (2005). This approach uses chloride concentration to determine dilution of the nitrogen discharge, then compares TN predicted based purely on dilution to the measured concentration to determine whether attenuation of nitrogen has occurred. Results using the approach are generally consistent with the above analysis, with no attenuation shown on sampling dates other than August 13.[5]

[5] The chlorides analysis was not used to assess attenuation upstream of site 3 due to the nearly identical chloride concentration of the discharge and upstream flow, which prevents dilution analysis based on chloride concentration.

Table B-2

	6/18/2012			7/9/2012			8/13/2012			9/13/2012		
	Flow (cfs)	TN (mg/l)	Load	Flow (cfs)	TN (mg/l)	Load	Flow (cfs)	TN (mg/l)	Load	Flow (cfs)	TN (mg/l)	Load
Input Loads												
Brockton AWRF	25.2	4.2	572	18.3	4.3	425	22.1	4.8	572	19.9	4.0	428
Upstream of SALP03[1]	12.2	1.7	110	7.8	2.1	89	20.1	1.7	181	5.3	1.5	44
			682			**514**			**753**			**472**
Output Load												
Total load at SALP03	37.4	3.26	**656**	26.0	3.21	**450**	42.2	3.32	**754**	25.2	3.43	**465**
Attenuation percent			**4%**			**12%**			**0%**			**1%**

[1] Flow upstream calculated from flow at SALP03 minus Brockton AWRF flow; concentration upstream from Salisbury Plain River at SALP01, representing 82% of watershed at SALP03.

	6/18/2012			7/9/2012			8/13/2012			9/13/2012		
	Flow (cfs)	TN (mg/l)	Load	Flow (cfs)	TN (mg/l)	Load	Flow (cfs)	TN (mg/l)	Load	Flow (cfs)	TN (mg/l)	Load
Input Loads												
Load at SALP03	37.4	3.3	656.1	26.0	3.2	449.6	42.2	3.3	754.1	25.2	3.4	465.1
Load added between SALP03 and MATF05	4.7	1.0	25	0.7	1.4	5	13.1	1.5	106	0.7	1.0	3
			681			**455**			**860**			**468**
Output Load												
Total load at SALP05	42.1	2.785	**632**	26.8	3.22	**464**	55.3	2.82	**839**	25.8	3.51	**488**
Attenuation percent			**7%**			**-2%**			**2%**			**-4%**

[2] Flow input between SALP03 and SALP05 calculated from flow at SALP05 minus flow at SALP03; concentration of input flow based on concentration of Beaver Brook at BEAB04, representing 91% of additional watershed betwee SALP03 and SALP05.

	6/18/2012			7/9/2012			8/13/2012			9/13/2012		
	Flow (cfs)	TN (mg/l)	Load	Flow (cfs)	TN (mg/l)	Load	Flow (cfs)	TN (mg/l)	Load	Flow (cfs)	TN (mg/l)	Load
Input Loads												
Load at SALP03	42.1	2.8	632.0	26.8	3.2	464.0	55.3	2.8	839.1	25.8	3.5	488.4
Load added between MATF05 and MATF08	3.9	1.6	34	1.0	1.7	9	7.7	2.8	117	0.9	1.5	7
			666			**473**			**956**			**495**
Output Load												
Total load at SALP08[3]	46	3.085	**765**	27.7	3.40	**508**	63	1.64	**555**	26.7	3.82	**549**
Attenuation percent			-15%			-7%			**42%**			-11%

[3] Flow input between SALP08 and SALP05 calculated from flow at SALP08 minus flow at SALP05; concentration of input flow based on concentration of Meadow Brook at MEBR06, representing 77% of additional watershed betwee SALP05 and SALP08

Reach	Average attenuation in reach	Cumulative attenuation	Cumulative delivery factor	k (1/day)
Upstream of SAPB03	4%	4%	96%	
Between SALP03 and MATF05	1%	5%	95%	
Between MATF05 and MATF08	2%	7%	93%	0.28

The calculated value of k (0.28 day^{-1}) was used to determine the delivery factor for the Brockton AWRF and for the Bridgewater, Mansfield and Middleborough WWTPs that also discharge to effluent-dominated streams. For the small facilities discharging to tributaries the New England SPARROW attenuation coefficient was applied. Travel time from each point source to the Taunton River, was calculated using river distance and a calculated average summer velocity,[6] Table B-3 shows the river distance, average velocity, travel time and percent load delivered for each facility.

Table B-3

Facility	River distance on tributary (ft)	Average velocity (fps)	Travel Time (days)	Percent of load delivered
Oak Point	9,613	0.67	0.17	88
MCI Bridgewater	7,665	0.67	0.13	90
Brockton	44,135	1.23	0.42	89
Bridgewater	13,015	1.04	0.14	96
Dighton-Rehoboth Schools	53,385	0.79	0.78	55
Mansfield	62,503	1.1	0.66	83
Middleboro	27,608	1.05	0.30	92
Wheaton College	81,449	1.1	0.86	52
East Bridgewater H.S.	22,976	0.99	0.27	81

EPA notes that the results of this field work confirm the complex nature of nitrogen cycling in the Salisbury Plain and Matfield River, and that continued work developing a water quality model of the Salisbury Plain and Matfield Rivers as contemplated by MassDEP and USGS would assist in informing this analysis and any future TMDL

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[6] Annual average velocities by reach were obtained from the National Hydrography Dataset (NHDPlus), and were used to calculate the average summer velocity based on the following relationship from Jobson, H.E., 1996, *Prediction of traveltime and longitudinal dispersion in rivers and streams*: U.S. Geological Survey Water-Resources Investigations Report 96-4013 (equation 12).

$$V_p = 0.094 + 0.0143 \times (D'_a)^{0.919} \times (Q'_a)^{-0.469} \times S^{0.159} \times \frac{Q}{D_a}.$$

Where $Q'_a = Q/Qa$
Q = summer average flow
Qa = annual average flow
Da = Drainage area

$$D'_a = \frac{D_a^{1.25} \times \sqrt{g}}{Q_a}$$

The NHDPlus average annual velocities were calculated using the Jobson equation where Q=Qa. The Jobson equation can be used to derive a relationship between summer average and annual average velocity:

$V_{summer} = 0.094 + (V_{annual} - 0.094) * (Q/Qa)^{0.531}$

This equation was used to calculate average summer flows for each reach in NHDPlus.

analysis, particularly with respect to attenuation under differing loads as upgrades are implemented. However, at this time no modeling effort is ongoing, and the attenuation analysis performed by EPA is the best available information upon which to develop this permit limit. EPA also notes that the permit limit for the Taunton facility of 3.0 mg/l would remain the same under a wide range of assumptions regarding attenuation of the Brockton discharge. For example, the Fact Sheet notes that, using the 7% attenuation figure, if a uniform permit limit were applied to all facilities in the watershed it would have to be less than 3.5 mg/l. For comparison, if it were assumed that there is zero attenuation of Brockton's discharge, the resulting uniform permit limit would be only slightly higher (approximately 3.7). On the other hand, if the attenuation factor was doubled (approximately 21% attenuation), a permit limit between 3.1 and 3.2 mg/l would need to be applied. (Required permit limits are more stringent if greater attenuation is assumed. This is because the attenuation factor is used in calculating how much of the measured load is from nonpoint sources; a higher attenuation rate means more load is attributed to the (more difficult to control) nonpoint sources, so that greater reduction from point sources is needed to meet the same total load target). As discussed in the Fact Sheet, since the highest possible permit limit is less than 4, and the Taunton WWTP is the second largest discharge and is a direct discharger to the estuary, a permit limit of 3.0 mg/l would still be applied.

Reasonable Potential Analysis
no ND, >10 data points, Lognormal distribution

Date	Cu (ug/L)	*Yi* lnCu (ug/L)
01/31/2011	33	3.4965
02/28/2011	33	3.4965
03/31/2011	20	2.9957
04/30/2011	24	3.1781
05/31/2011	11	2.3979
06/30/2011	17	2.8332
07/31/2011	17	2.8332
08/31/2011	26	3.2581
09/30/2011	23	3.1355
10/31/2011	17	2.8332
11/30/2011	20	2.9957
12/31/2011	38	3.6376
01/31/2012	27	3.2958
02/29/2012	26	3.2581
03/31/2012	23	3.1355
04/30/2012	18	2.8904
05/31/2012	28	3.3322
06/30/2012	24	3.1781
07/31/2012	18	2.8904
08/31/2012	19	2.9444
09/30/2012	24	3.1781
10/31/2012	30	3.4012
11/30/2012	29	3.3673
12/31/2012	33	3.4965
01/31/2013	25	3.2189
02/28/2013	35	3.5553
03/31/2013	25	3.2189
04/30/2013	25	3.2189
05/31/2013	21	3.0445
06/30/2013	16	2.7726
07/31/2013	16	2.7726
08/31/2013	15	2.7081
09/30/2013	26	3.2581
10/31/2013	24	3.1781
11/30/2013	35	3.5553
12/31/2013	34	3.5264

Cu - (Lognormal distribution, no ND)

Estimated Daily Maximum Effluent Concentration	
k = number of daily samples =	36
u_y = Avg of Nat. Log of daily Discharge =	3.15241
s_y = Std Dev. of Nat Log of daily discharge =	0.28627
σ_y^2 = estimated variance = (SUM[$(y_i - u_y)^2$]) / (k-1) =	0.081952778
cv(x)= Coefficient of Variation =	0.090811149
99th Percentile Daily Max Estimate = exp (u_y + 2.326*s_y)	
Estimated Daily Max 99th percentile =	**45.5260 ug/L**
95th Percentile Daily Max Estimate = exp (u_y + 1.645*s_y)	
Estimated Daily Max =	**37.4621 ug/L**

Reasonable Potential Analysis

Nondetects denoted "0"

Date	Pb (ug/L)	Y_i lnPb (ug/L)	$(y_i - u_y)^2$
2/15/2011	0.7	-0.3567	0.0010124
5/10/2011	0.7	-0.3567	0.0010124
8/16/2011	0		
11/15/2011	0.5	-0.6931	0.1356378
2/14/2012	0.6	-0.5108	0.0345844
5/4/2012	0		
8/13/2012	0		
11/14/2012	2	0.6931	1.0363321
2/11/2013	0		
5/13/2013	0		
6/2/2013	0.5	-0.6931	0.1356378
8/12/2013	0.7	-0.3567	0.0010124
11/12/2013	0		

Pb- (Lognormal distribution, ND)

Daily Maximum Effluent Derivation (some measurements < detection limit)	
Detection Limit** =	0.5
u_y = Avg of Nat. Log of daily Discharge (mg/L) =	-0.32486
$S(y_i - u)^2$ =	1.34523
k = number of daily samples =	13
r = number of non-detects =	6
s_y^2 = estimated variance = $(S[(y_i - u_y)^2]) / (k-r-1)$ =	0.22420
s_y = standard deviation = square root s_y^2 =	0.47350
δ = number of nondetect values/number of samples =	0.46154
z 99th percentile=z-score[(0.99-δ)/(1-δ)] =	2.08419
	1.323364216
Daily Max = exp (u_y + z-score*s_y)	
99th Percentile Daily Max Estimate=	**1.9387 ug/l**
95th Percentile Daily Max Estimate =	**1.3522 ug/l**

** Detection limit here is the detection limit that resulted in the greatest number of Non Detects in the dataset

Reasonable Potential Analysis
data with ND, >10 samples, lognormal distribution

Nondetects denoted "0"

Date	Al* (ug/l)	lnAl (ug/l)	$(y_i - u_y)^2$
2/15/2011	32	3.4657	0.0043716
5/10/2011	49	3.8918	0.1295755
8/16/2011	26	3.2581	0.0749433
11/15/2011	32	3.4657	0.0043716
2/14/2012	45	3.8067	0.0755196
5/4/2012	25	3.2189	0.0979555
8/13/2012	0		
11/14/2012	48	3.8712	0.1151562
2/11/2013	36	3.5835	0.0026692
5/13/2013	21	3.0445	0.2374923
6/2/2013	40	3.6889	0.0246569
8/12/2013	0		
11/12/2013	35	3.5553	0.000552

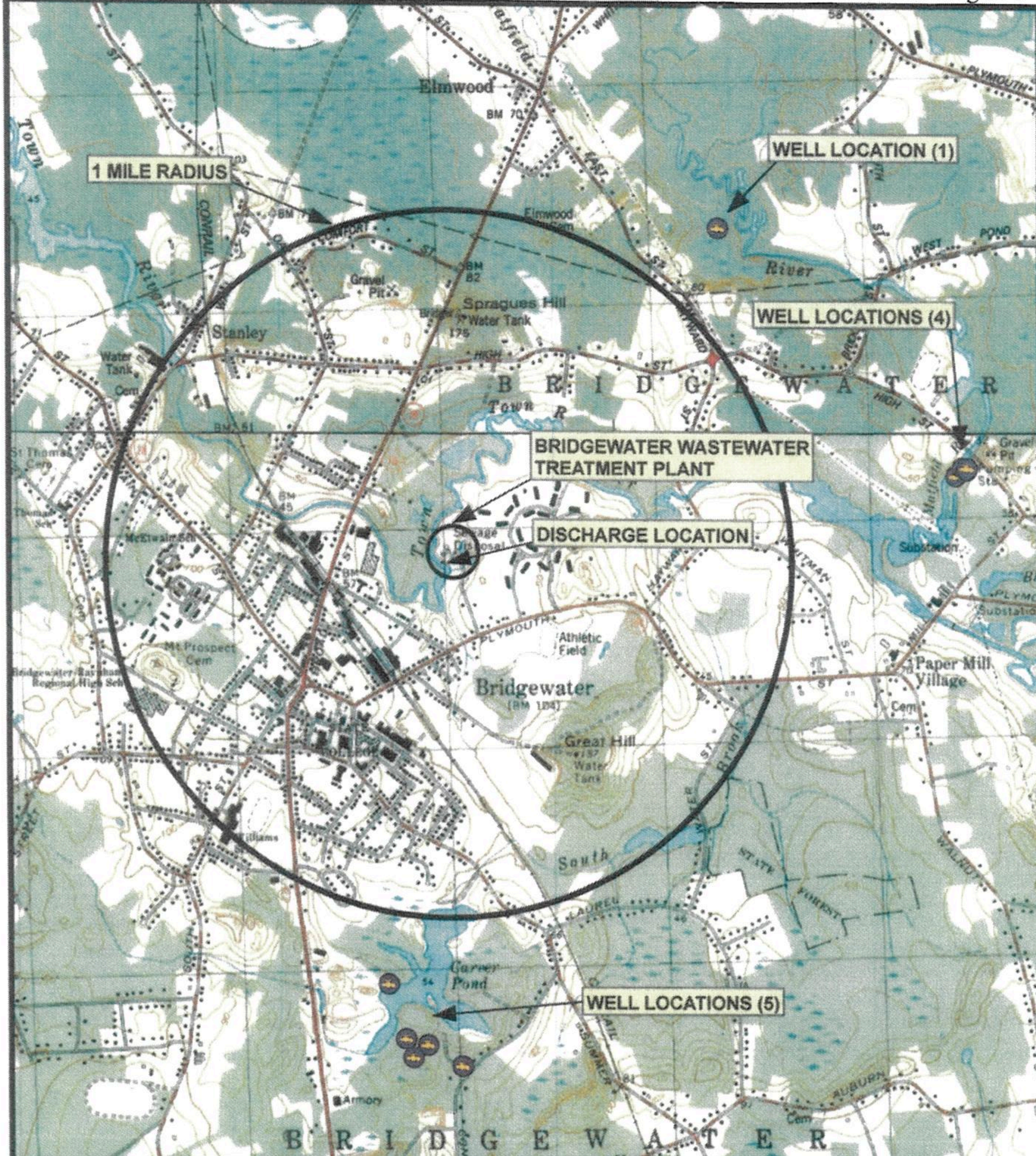
Al- (Lognormal distribution, ND)

Daily Maximum Effluent Derivation (some measurements < detection limit)	
Detection Limit** =	20.0
u_y = Avg of Nat. Log of daily Discharge (mg/L) =	3.53185
$S (y_i - u)^2$ =	0.76726
k = number of daily samples =	13
r = number of non-detects =	2
s_y^2 = estimated variance = $(S[(y_i - u_y)^2]) / (k-r-1)$ =	0.07673
s_y = standard deviation = square root s_y^2 =	0.27700
δ = number of nondetect values/number of samples =	0.15385
z 99th percentile=z-score$[(0.99-\delta)/(1-\delta)]$ =	2.26299
z 95th percentile=z-score$[(0.95-\delta)/(1-\delta)]$ =	1.56245084
Daily Max = exp (u_y + z-score*s_y)	
99th Percentile Daily Max Estimate=	**63.9877 ug/l**
95th Percentile Daily Max Estimate =	**52.7016 ug/l**

** Detection limit here is the detection limit that resulted in the greatest number of Non Detects in the dataset

Monitoring Period End Date	BOD5						TRC (April 1 - October 31)		Fecal Coliform (April 1 - October 31)			Copper	Flow		Nitrate/Nitrite				Total Kjeldahl Nitrogen			
	Average Monthly	Max Daily	Average Montly	Average Weekly	Max Daily	Percent Removal	Average Monthly	Max Daily	Average Monthly	Average Weekly	Max Daily	Max Daily	Average Monthly	Max Daily	Monthly Average	Daily Max	Monthly Average	Daily Max	Monthly Average	Daily Max	Monthly Average	Daily Max
	lb/day		mg/L			%	ug/L		cfu/100mL			ug/L	MGD		lb/day		mg/L		lb/day		mg/L	
01/31/2011	60	78	7	9	9	96	Test Not Required					33	1.045	1.122	176	176	22	22	23	23	2.9	2.9
02/28/2011	99	154	11	15	17	93	Test Not Required					33	1.042	1.722	196	196	26	26	38	38	5	5
03/31/2011	145	213	13	17	17	93	Test Not Required					20	0.995	1.569	168	168	14	14	101	101	8.4	8.4
04/30/2011	73	106	7	9	10	97	< 20	41	31	70	163	24	0.974	1.558	181	193	16.5	17	95	127	8.8	12
05/31/2011	57	122	6	9	13	98	< 20	33	56	103	105	11	0.977	1.262	187	195	20.5	22	42	57	4.6	6
06/30/2011	33	71	4	4	9	98	< 20	32	29	41	192	17	0.981	1.01	142	149	19	19	23	24	3.1	3.2
07/31/2011	30	42	4	6	6	98	< 20	32	4	23	26	17	0.984	1.022	134	134	19.5	20	14	15	2	2.2
08/31/2011	33	43	5	5	6	98	< 20	39	10	25	95	26	0.985	1.047	139	142	19.5	21	16	16	2.25	2.4
09/30/2011	78	142	8	11	12	97	< 20	29	42	178	185	23	0.995	1.423	192	192	22	23	41	47	4.8	5.6
10/31/2011	71	93	8	10	10	98	< 20	23	41	75	227	17	1.014	1.495	184	185	19.5	20	69	78	7.3	8.4
11/30/2011	127	177	12	15	15	96	Test Not Required					20	1.037	1.369	184	184	19	19	34	34	3.5	3.5
12/31/2011	108	171	10	15	15	96	Test Not Required					38	1.064	1.755	216	216	22	22	55	55	5.6	5.6
01/31/2012	73	132	8	11	13	97	Test Not Required					27	1.073	1.256	159	159	19	19	21	21	2.5	2.5
02/29/2012	96	126	11	14	14	96	Test Not Required					26	1.064	1.138	190	190	20	20	55	55	5.8	5.8
03/31/2012	107	162	12	15	15	96	Test Not Required					23	1.038	1.212	160	160	20	20	27	27	3.4	3.4
04/30/2012	54	129	7	11	17	99	< 20	32	42	68	104	18	1.014	1.083	191	198	24	24	44	55	5.55	6.6
05/31/2012	49	105	6	8	12	98	< 20	38	42	84	191	28	1.002	1.135	155	164	20	21	21	22	2.65	2.8
06/30/2012	28	36	4	7	5	98	< 20	41	11	73	31	24	0.999	0.974	171	172	23.5	24	15	18	2.1	2.5
07/31/2012	27	46	4	6	7	98	< 20	42	5	20	23	18	0.994	0.829	146	147	22.5	23	12	14	1.9	2.2
08/31/2012	23	41	3	5	6	98	< 20	24	4	9	20	19	0.99	0.941	145	146	22.5	24	14	15	2.2	2.2
09/30/2012	39	59	5	7	7	98	< 20	28	10	16	32	24	0.981	1.085	224	231	27.5	28	29	30	3.5	3.5
10/31/2012	40	57	5	7	7	98	< 20	27	23	38	174	30	0.965	1.076	209	216	24.5	25	48	48	5.6	5.6
11/30/2012	86	115	10	10	14	97	Test Not Required					29	0.945	1.207	166	166	20	20	63	63	7.6	7.6
12/31/2012	87	131	10	14	14	97	Test Not Required					33	0.924	1.095	199	199	24	24	74	74	9	9
01/31/2013	63	135	7	8	13	98	Test Not Required					25	0.926	1.249	203	203	23	23	25	25	2.8	2.8
02/28/2013	128	207	12	16	19	96	Test Not Required					35	0.942	1.697	200	200	20	20	69	69	6.9	6.9
03/31/2013	178	242	14	17	17	95	Test Not Required					25	0.974	1.912	209	216	24.5	25	71	71	6.6	6.6
04/30/2013	98	129	10	11	11	97	< 20	25	39	82	167	25	0.99	1.288	189	199	19	20	85	89	8.55	9
05/31/2013	49	75	6	9	9	98	< 20	38	30	123	116	21	0.989	1.069	154	178	20	22	34	45	4.4	5.6
06/30/2013	58	102	5	7	8	97	< 20	26	36	54	69	16	1.019	1.824	137	139	15	18	24	33	2.4	2.9
07/31/2013	33	88	4	7	7	97	< 20	37	8	16	17	16	1.029	1.062	131	136	17.5	18	20	25	2.65	3.1
08/31/2013	22	42	4	7	7	99	< 20	40	7	10	16	15	1.024	0.984	145	158	23	24	13	16	2.1	2.7
09/30/2013	59	125	7	12	14	98	< 20	41	7	11	43	26	1.026	1.07	216	226	27	31	27	28	3.4	3.9
10/31/2013	54	70	7	7	9	98	< 20	32	14	16	31	24	1.02	0.943	199	201	28	28	53	56	7.5	7.8
11/30/2013	112	130	16	17	17	97	Test Not Required					35	1.009	1.15	147	147	19	19	147	147	19	19
12/31/2013	113	146	15	18	18	95	Test Not Required					34	1.004	1.106	179	179	22	22	89	89	11	11
Existing Permit Limit	240	Report	20	30	Report	> 85%	24	42	200	400	400	35	1.44	Report	Report	Report	Report	Report	Report	Report	Report	Report
Minimum	22	36	3	4	5	93	< 20	23	4	9	16	11	0.924	0.829	131	134	14	14	12	14	1.9	2.2
Maximum	178	242	16	18	19	99	< 20	42	56	178	227	38	1.073	1.912	224	231	28	31	147	147	19	19
Average	71.9	112.3	8.0	10.4	11.6	97.0	< 20	33.3	23.4	54.0	96.5	24.3	1.0	1.2	175.6	179.4	21.3	21.9	45.3	48.6	5.2	5.6
Number of Exceedences	0	N/A	0	0	N/A	0	0	0	0	0	0	1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Monitoring Period End Date	Ammonia Nitrogen (April 1 to October 31)		Ammonia Nitrogen (November 1 to March 31)		Dissolved Oxygen	pH		Total Phosphorus (November 1 - March 31)		Total Phosphorus (April 1 - October 31)			Settleable Solids			TSS						Ceriodaphnia dubia	
	Monthly Average		Monthly Average		Daily Min	Daily Min	Daily Max	Monthly Average	Monthly Average	Monthly Average	Daily Max	Monthly Average	Montly Average	Weekly Average	Daily Max	Monthly Average	Daily Max	Monthly Average	Weekly Average	Daily Max	Percent Removal	Acute	Chronic
	lb/day	mg/L	lb/day	mg/L	mg/L	SU		lb/day	mg/L	lb/day	lb/day	mg/L	mL/L	mL/L	mL/L	lb/day		mg/L			%	%	
01/31/2011			14	1.87	8.9	6.2	7.2	12	1.62				0.1	0.1	0.1	97	122	12	13	13	97	Test Not Required	
02/28/2011			43	4.91	8.3	6.3	7.4	16	1.81				0.1	0.1	0.1	114	181	13	16	20	97	100	100
03/31/2011			28	2.71	7.8	6.9	7.3	18	1.72				0.1	0.1	0.1	170	221	15	17	18	97	Test Not Required	
04/30/2011	17	1.63			8.2	6.3	7.3			8	10	0.78	0.1	0.1	0.1	95	127	9	11	12	98	Test Not Required	
05/31/2011	8	0.875			8	6.1	6.6			6	7	0.67	0.1	0.1	0.1	92	160	10	16	17	98	100	100
06/30/2011	9	1.2			7.1	6.1	6.9			5	6	0.6	0.1	0.1	0.1	56	86	8	8	11	99	Test Not Required	
07/31/2011	8	1.172			7.1	6	6.9			5	5	0.69	0.1	0.1	0.1	60	72	9	10	10	98	Test Not Required	
08/31/2011	5	0.694			7.2	6	6.8			4	4	0.6	0.1	0.1	0.1	70	87	10	12	13	99	100	100
09/30/2011	26	2.6			6.4	6.3	7			6	8	0.67	0.1	0.1	0.2	91	154	10	12	13	98	Test Not Required	
10/31/2011	6	0.908			6.4	6.4	7.2			7	8	0.71	0.1	0.1	0.1	65	93	7	11	10	99	Test Not Required	
11/30/2011			10	0.942	7.1	6.6	7	11	1.02				0.1	0.1	0.1	84	146	8	10	14	98	100	100
12/31/2011			31	2.9	7.3	6.2	7	24	2.31				0.1	0.1	0.1	105	131	10	12	13	98	Test Not Required	
01/31/2012			2	0.249	7.5	6.5	7	11	1.43				0.1	0.1	0.1	84	112	10	11	12	98	Test Not Required	
02/29/2012			23	2.6	7.3	6.4	7.1	24	2.71				0.1	0.1	0.1	77	98	9	11	11	98	100	100
03/31/2012			40	4.42	7.2	6.5	7.3	21	2.2				0.1	0.1	0.1	96	121	11	13	13	98	Test Not Required	
04/30/2012	24	2.87			6.5	6.2	7.1			7	7	0.82	0.1	0.1	0.1	56	69	7	8	8	99	Test Not Required	
05/31/2012	3	0.337			7	6	6.8			7	8	0.89	0.1	0.1	0.1	105	192	13	17	22	98	100	100
06/30/2012	4	0.578			7.5	6.1	6.7			5	6	0.75	0.1	0.1	0.1	69	88	9	15	12	98	Test Not Required	
07/31/2012	3	0.461			7.1	6	7			4	5	0.68	0.1	0.1	0.1	49	72	8	9	11	99	Test Not Required	
08/31/2012	3	0.498			7	6	6.8			5	7	0.71	0.1	0.1	0.1	59	94	9	10	13	98	100	100
09/30/2012	11	1.413			6.7	6	6.6			7	7	0.84	0.1	0.1	0.2	103	134	13	16	17	98	Test Not Required	
10/31/2012	10	1.308			7.1	6	6.6			6	8	0.78	0.1	0.1	0.1	90	118	11	14	14	98	Test Not Required	
11/30/2012			55	6.82	6.7	6.5	6.9	5	0.68				0.1	0.1	0.1	73	131	9	11	13	98	100	100
12/31/2012			52	6.21	7.2	6.3	6.8	22	2.63				0.1	0.1	0.1	82	105	10	12	12	98	Test Not Required	
01/31/2013			57	6.85	7.9	6.2	6.9	27	3.32				0.1	0.1	0.1	101	132	11	13	13	98	Test Not Required	
02/28/2013			39	3.53	7.4	6.5	7	26	2.27				0.1	0.1	0.1	139	194	13	13	15	98	100	100
03/31/2013			42	3.663	7.2	6.5	7.1	13	1.25				0.1	0.1	0.1	168	242	13	15	16	97	Test Not Required	
04/30/2013	28	2.9			7.3	6.2	6.8			8	10	0.77	0.1	0.1	0.1	108	169	11	14	17	98	Test Not Required	
05/31/2013	18	2.218			7.5	6	7			6	8	0.74	0.1	0.1	0.1	60	89	8	9	11	99	100	6.25
06/30/2013	21	1.97			5.1	6.1	6.8			7	8	0.66	0.1	0.1	0.2	110	204	10	13	14	98	Test Not Required	
07/31/2013	12	1.6			6.4	6	6.7			5	7	0.67	0.1	0.1	0.1	57	96	7	10	10	96	Test Not Required	
08/31/2013	4	0.657			7	6.2	7			5	5	0.7	0.1	0.1	0.1	54	83	9	11	12	98	100	6.25
09/30/2013	23	2.9			6.9	6.1	7.3			7	8	0.87	0.1	0.1	0.1	72	144	9	15	19	98	Test Not Required	
10/31/2013	18	2.7			6.5	6	7.3			7	8	1	0.1	0.1	0.1	85	124	12	12	17	98	Test Not Required	
11/30/2013			164	23	6	6.5	7.5	16	2.13				0.1	0.1	0.1	71	106	10	11	16	97	100	6.25
12/31/2013			98	13.4	6.3	6.5	7.2	16	2.2				0.1	0.1	0.1	67	105	9	10	13	97	Test Not Required	
Existing Permit Limit	36	3	Report	Report	>5.0	6	8.3	Report	Report	12	Report	1	0.1	0.1	0.3	240	Report	20	30	Report	> 85%	100	45
Minimum	3	0.337	2	0.249	5.1	6	6.6	5	0.68	4	4	0.6	0.1	0.1	0.1	49	69	7	8	8	96	100	6.25
Maximum	28	2.9	164	23	8.9	6.9	7.5	27	3.32	8	10	1	0.1	0.1	0.2	170	242	15	17	22	99	100	100
Average	12.4	1.5	46.5	5.6	7.1	6.2	7.0	17.5	2.0	6.0	7.1	0.7	0.1	0.1	0.1	87.1	127.8	10.1	12.3	13.8	97.9	100.0	76.6
Number of Exceedences	0	0	N/A	N/A	0	0	0	N/A	N/A	0	N/A	0	0	0	0	0	N/A	0	0	N/A	0	0	2



BASED ON USGS TOPOGRAPHIC MAP FOR
BRIDGEWATER
MASSACHUSETTS QUADRANGLE
REVISED 1977
10-FOOT CONTOUR INTERVAL

FIGURE 1
WWTP LOCUS PLAN

TOWN OF BRIDGEWATER SEWER DEPT.
NPDES PERMIT
BRIDGEWATER, MASSACHUSETTS

Tighe&Bond

SCALE 1:25,000

AUGUST 2008

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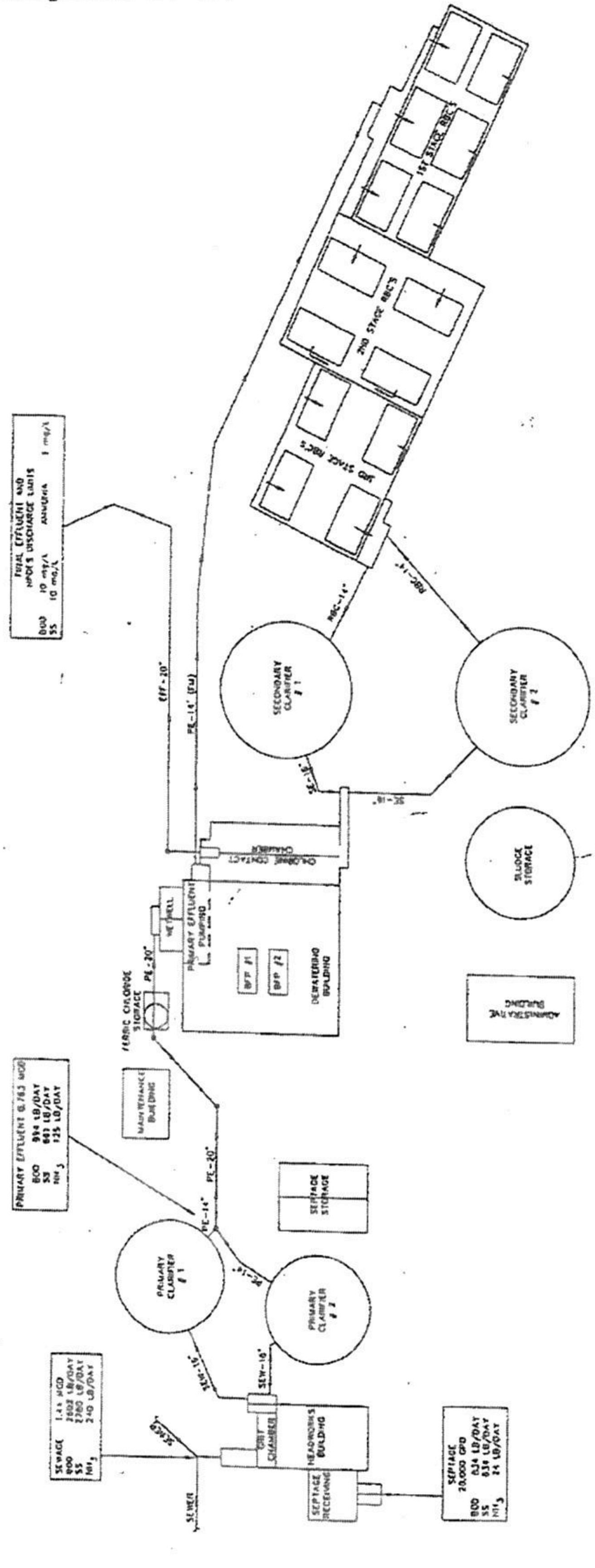
V:\Projects\B\B0455\usgs_wells.mxd



NOTE: COMPOSTING AREA NOT SHOWN

FIG 2
EXISTING WASTEWATER TREATMENT FACILITY