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: NH0001465

PUBLIC NOTICE START AND END DATES: September 30, 2011 to November 30, 2011

NAME AND MAILING ADDRESS OF APPLICANT:

Public Service of New Hampshire (PSNH)
P.O. Box 330
Manchester, NH 03105-0330

NAME AND ADDRESS OF FACILITY WHERE DISCHARGE OCCURS:

Merrimack Station
97 River Road
Bow, NH 03301

RECEIVING WATER(S):

Merrimack River (Hydrologic Basin Code: 01070002)

RECEIVING WATER CLASSIFICATION(S): Class B

SIC CODE: 4911 – Electric Power Generation

CURRENT PERMIT	ISSUED:	June 25, 1992
	EXPIRED:	July 31, 1997
	RE-APPLICATION:	March 10, 1997
	SUPPLEMENT TO RE-APPLICATION:	November 1, 2007
	ADDITION TO RE-APPLICATION:	May 5, 2010

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EPA - New England

Clean Water Act NPDES Permitting Determinations for the Thermal Discharge and Cooling Water Intake Structures at Merrimack Station in Bow, New Hampshire

NPDES Permit No. NH 0001465

Executive Summary

Introduction

The United States Environmental Protection Agency ("EPA" or "the Agency") is issuing a new draft National Pollutant Discharge Elimination System ("NPDES") permit under the Federal Clean Water Act ("CWA") to the Merrimack Station power plant in Bow, New Hampshire. Merrimack Station's currently effective NPDES permit (No. NH0001465) was issued by EPA on June 25, 1992 ("the 1992 NPDES Permit"), with an expiration date of June 25, 1997. The 1992 NPDES Permit remains in effect, however, because it was administratively continued as a result of PSNH's timely application for renewal. *See* 40 C.F.R. § 122.6. Once effective, the new permit will supplant the 1992 NPDES Permit.

This Draft Permit Determinations Document presents and explains certain determinations made by EPA in support of the new draft NPDES permit. In particular, this document covers the application of CWA standards to control Merrimack Station's withdrawals of water from the Merrimack River for the facility's cooling needs and its discharges to the river of waste heat absorbed by the cooling water (i.e., thermal discharges). These water withdrawals and discharges result from operation of the facility's "open-cycle" (or "once-through") cooling system.

This document is a key part of the administrative record supporting the new Draft NPDES Permit for Merrimack Station. It is incorporated by reference in the Draft Permit's Fact Sheet and its key determinations are summarized therein. Other determinations (*i.e.*, those not related to thermal discharge and cooling water intake, such as those related to the control of metal cleaning wastewater) needed to support the Draft Permit are presented in the Fact Sheet and other supporting materials in the administrative record.

EPA will be soliciting public comment on the Draft Permit. Therefore, the determinations presented herein are subject to potential revision after EPA considers the comments and information submitted. Any changes will be explained in the documents supporting the Final Permit.

This document was prepared by EPA's New England Regional office in Boston, MA (also known as "EPA Region 1"). In connection with this effort, EPA Region 1 consulted with, and received assistance from, EPA's headquarters office in Washington, D.C., the New Hampshire Department of Environmental Services ("NHDES"), the United States Department of Interior's Fish & Wildlife Service ("USFWS"), and the New Hampshire Fish and Game Department. EPA also retained expert contractors to assist the Agency in its assessment of certain economic/financial issues. Furthermore, EPA also communicated extensively with Merrimack Station's owner and operator, Public Service of New Hampshire ("PSNH"), and carefully considered the views and information that it submitted to the Agency.

This Executive Summary is provided as a convenience to the reader. It touches on some of the key explanations, analyses and conclusions discussed in detail in subsequent sections of this Determinations Document. It is not a substitute for the full analysis.

Merrimack Station, Its Cooling System and the Affected Water Body

As stated above, Merrimack Station is owned and operated by PSNH, which is a subsidiary of The Northeast Utilities System ("NU"). Merrimack Station is a steam-electric power plant with two primary electrical generating units, Units I and II, which began operation in 1960 and 1968, respectively. The facility primarily burns coal and is a base-load plant with an electrical output of approximately 478 megawatts ("MW"). Unit 2 is the larger of the two units with a nameplate rating of 350 MW, while Unit 1 has a nameplate rating of 120 MW.

Merrimack Station is located on the banks of the Merrimack River in Bow, New Hampshire, across the river from the towns of Allenstown, Pembroke and Hooksett, New Hampshire. *See* Fig. 2-1, *infra*. The Merrimack River is both a water of the State of New Hampshire and a water of the United States. It is also an interstate waterway, travelling from central New Hampshire to meet the Atlantic Ocean in Newburyport, Massachusetts. The facility withdraws water from, and discharges water to, the "Hooksett Pool" portion of the Merrimack River. The Hooksett Pool is an approximately 5.8-mile long segment of the river bounded to the north by the Garvin's Falls Dam and to the south by the Hooksett Dam.

As a steam-electric power plant, Merrimack Station uses the "steam cycle" to generate electricity and must have a method of condensing (or cooling) the steam used in the electrical generating process. Some steam-electric facilities use "dry" cooling processes, while others use "wet" cooling processes (either "open-cycle" cooling or "closed-cycle" cooling with "wet cooling towers"). In a typical wet cooling system, the facility withdraws water from a water body through a cooling water intake structure ("CWIS") and uses it to condense the steam. (Other sources of water, such as municipal water or treated wastewater, could be used if adequate volumes of suitable quality water are available.) Through this process, the water absorbs the facility's waste heat and is heated well above ambient water temperatures prior to discharge.

In an open-cycle system, the water and waste heat are discharged back to the water body as a thermal effluent. In a wet closed-cycle system, however, cooling towers are used to chill the cooling water so that it can be re-used for condensing steam. Closed-cycle wet systems actually require some water withdrawals (as "makeup water" is needed to offset evaporative water loss and cooling tower blowdown) and have some thermal discharges (as a result of cooling tower "blowdown"), but they can reduce thermal discharges and water withdrawals by approximately *95 percent* as compared to an open-cycle system.

Merrimack Station currently utilizes an open-cycle cooling system, as mentioned above. The facility has two CWISs through which it withdraws a total design intake flow of 287 million gallons per day ("MGD") of Merrimack River water to use as its cooling medium for condensing steam in its condensers. In this process, the river water absorbs a large amount of heat and its temperature is substantially increased before the facility discharges it back to the river. Merrimack Station disposes of approximately 26.3 trillion British thermal units ("Btus") of waste heat into the river in this manner each year. The thermal effluent is sent through a lengthy open canal prior to discharge to the river, which allows some of the heat to dissipate. In addition, Merrimack Station installed 224 "power spray modules" ("PSMs") in the discharge canal in an effort to provide additional cooling of the thermal discharge under certain meteorological conditions by spraying the heated effluent into the air, after which it is discharged.

Adverse Effects of Cooling System Operations

Merrimack Station's withdrawal of river water for cooling, and discharge of thermal effluent to the river, alter and adversely affect the Merrimack River in a variety of ways. Withdrawals of water from the river kill and injure aquatic organisms in the water as a result of "entrainment" and "impingement." Entrainment occurs when very small organisms in the river water, such as fish eggs and larvae, are pulled with the water through the CWIS screens and into the cooling system. These organisms are subjected to physical impacts, high water temperatures, pressure changes and (potentially) exposure to harmful chemicals, such as chlorine. Impingement occurs when larger aquatic organisms, such as juvenile and adult fish, are caught and held against intake screens until the screens are rotated. Once the screens are rotated, a fish return system is supposed to safely return the organisms to the water. At Merrimack Station, the fish return does not reach the river so no survival of impinged organisms is expected.

At the same time, the facility's thermal discharges alter the river's natural thermal regime, such as its peak temperatures and the timing and range of its temperature variations. Depending on the amount of heat being discharged and conditions in the receiving water, thermal discharges can have a variety of adverse ecological effects because aquatic organisms and water quality may be affected in many ways by water temperature. For example, fish have optimal temperatures for growth. They also display preferences for certain water temperatures and may, if possible, leave or avoid an area if water temperatures exceed their preferred levels. Furthermore, altered water temperatures may benefit certain species at the expense of other species, causing shifts in the make-up of the community of organisms in the affected water. Finally, increasing water temperatures can also affect water quality in many ways, such as by promoting algal growth or contributing to reduced levels of dissolved oxygen.

Regulating Thermal Discharges & Cooling Water Withdrawals under the CWA

The CWA addresses both ends of the wet cooling process: *i.e.*, the withdrawal of water for cooling and the discharge of the thermal effluent. Specifically, cooling water withdrawals through CWISs must satisfy CWA § 316(b), as well as any applicable requirements based on state water quality standards. Discharges of heat must satisfy both technology-based and water quality-based requirements or the requirements of a variance under CWA § 316(a). EPA addresses each of these requirements independently, but brings them together to set permit limits that ensure that all applicable permit requirements will be satisfied. Both thermal discharge requirements and CWIS requirements can end up affecting the operation and design of a facility's cooling system.

Standards Governing Thermal Discharges

The point source discharge of pollutants to a water of the United States is prohibited by CWA § 301(a), unless authorized by an NPDES permit issued under CWA § 402. Heat is defined as a "pollutant" under the CWA. *See* 33 U.S.C. § 1362(6). As stated above, steam-electric power plants with wet cooling systems discharge their waste heat to nearby water bodies and must obtain authorization for these discharges from an NPDES permit.

Technology-Based Requirements – The BAT Standard

As with other pollutants, permit limits for the discharge of heat must, at a minimum, satisfy federal "technology-based" requirements. *See* CWA §§ 301, 304 and 306. More specifically, CWA § 301 requires that thermal discharges be limited consistent with levels achievable using the "best available technology economically achievable … which will result in reasonable further progress toward the national goal of eliminating the discharge of all pollutants" ("BAT"). 33 U.S.C. § 1311(b)(2)(A). *See also* 33 U.S.C. § 1311(b)(2)(F). In determining the BAT, EPA investigates technological options to identify the best performing technology in terms of reducing pollutant discharges and then further assesses the options in light of a number of factors specified in the statute (e.g., cost, non-water environmental effects, energy requirements).

EPA applies technology standards, such as the BAT standard, to industrial categories when it develops national effluent limitation guidelines ("ELGs"). ELGs then govern the permit limits for individual facilities within that industry. If EPA has not developed an ELG for a particular pollutant or a particular industrial category, it develops technology-based requirements for individual permits by using its Best Professional Judgment ("BPJ") to apply the pertinent technology standard(s) on a site-specific basis. *See* 33 U.S.C. § 1342(a)(1)(B) and 40 C.F.R. § 125.3(c)(2). Given that EPA has not promulgated an ELG governing the discharge of heat from steam-electric power plants, the Agency sets technology-based permit limits for thermal discharges based on a BPJ, facility-specific application of the BAT standard.

Water Quality-Based Requirements

In addition to satisfying federal technology-based standards, NPDES permit limits must also satisfy any more stringent requirements needed to comply with state water quality standards ("WQS"). *See* CWA § 301(b)(1)(C). *See also* CWA §§ 401(a)(1), 401(d) and 510. Put differently, when both technology-based and water quality-based standards apply, whichever is more stringent governs the permit limits.

State WQS place the waters of the state into different classifications (e.g., Class A, Class B, etc.). The WQS also specify "designated uses" that water bodies in each class should support (e.g., fishing, primary contact recreation), numeric and narrative criteria that waters in each class should meet, and anti-degradation standards designed to protect existing water quality. NDPES permit limits must prevent discharges that would cause or contribute to violations of the WQS.

For this permit, the State of New Hampshire's WQS are at issue. The state has classified the Hooksett Pool portion of the Merrimack River as a Class B water. Therefore, limits on thermal discharges must prevent non-compliance with Class B designated uses and water quality criteria.

CWA § 316(a) - Thermal Discharge Variances

As an exception to the general rule that permit limits governing discharges of heat are to be derived from technology-based and water quality-based standards, whichever are more stringent, CWA § 316(a) allows permittees to seek a variance from these otherwise applicable limits if certain criteria are met. Specifically, CWA § 316(a) provides, in pertinent part, that:

> ... whenever the owner or operator of any ... [point] source ... can demonstrate to the satisfaction of the Administrator ... that any effluent limitation proposed for the control of the thermal component of any discharge from such source will require effluent limitations more stringent than necessary to assure the pro[t]ection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the body of water into which the discharge is to be made, the Administrator ... may impose an effluent limitation ... for such plant, with respect to the thermal component of such discharge (taking into account the interaction of such thermal component with other pollutants), that will assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on that body of water.

33 U.S.C. § 1326(a). The guiding principle of CWA § 316(a) is that thermal discharge limits may be based on a variance from the otherwise applicable technology-based and water quality-based standards if the limits will nevertheless assure the protection and propagation of the receiving water body's balanced, indigenous population of shellfish, fish, and wildlife ("BIP"). In determining whether the protection and propagation of the BIP will be assured, other environmental stresses must be taken into account.

An existing facility operating under an NPDES permit with thermal discharge limits based on a § 316(a) variance may seek renewal of the variance-based limits by attempting to demonstrate that existing operations have not caused "appreciable harm" to the BIP (a "retrospective" demonstration), or by trying to demonstrate that operations going forward will assure the protection and propagation of the BIP (a "prospective" demonstration). In some cases, an existing facility may attempt both types of demonstrations in seeking renewal of its variance.

Standards Governing Cooling Water Withdrawals

Technology-Based Requirements – The BTA Standard Under CWA § 316(b)

The CWA addresses facilities that take water for cooling from a water of the United States in much the same way that the statute addresses discharges of pollutants. Such facilities are subject to technology-based standards under CWA § 316(b), which requires "that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact." This is referred to as the Best Technology Available ("BTA") standard. In determining the BTA for CWISs, EPA compares technological alternatives, determines which are feasible and which achieve the greatest reductions in adverse environmental impacts (primarily entrainment and impingement), and considers various additional factors such as each option's cost, non-water environmental effects, energy effects, and a comparison of its costs and benefits).

While EPA has promulgated regulations creating categorical BTA requirements under CWA § 316(b) for CWISs at *new* facilities, *see* 40 C.F.R. Part 125, Subpart I, no such categorical requirements are currently in effect for *existing* facilities, such as Merrimack Station. (On April 20, 2011, EPA issued proposed regulations for public comment that would set categorical BTA requirements for existing facilities. While EPA is planning to sign final regulations by July 27, 2011, the Agency cannot be certain exactly when final regulations may be issued and go into effect. *See* 76 FR 22174-22288 (April 20, 2011).) As with setting effluent limits, in the absence of categorical requirements for CWISs, BTA requirements for CWISs are determined on a case-by-case, BPJ basis for individual NPDES permits. *See, e.g.*, 40 C.F.R. § 125.90(b).

Water Quality-Based Requirements

Furthermore, NPDES permits must include any more stringent CWISs requirements needed to comply with any applicable state WQS. New Hampshire's WQS apply to the effects of cooling water withdrawals from the state's waters, stating as follows:

> [t]hese rules shall apply to any person who causes point or nonpoint source discharge(s) of pollutants to surface waters, or who undertakes hydrologic modifications, such as dam construction or water withdrawals, or who undertakes any other activity that affects the beneficial uses or the level of water quality of surface waters.

N.H. Code R. Env-Wq 1701.02(b) (Applicability). *See also id.* 1708.03 (Submittal of Data). Therefore, permit conditions on cooling water withdrawals must comply with (or not interfere with the attainment of) relevant water quality criteria, designated uses, and antidegradation requirements.

Given that withdrawals of water for cooling can result in the entrainment and impingement of aquatic life, such withdrawals must comply with the designated uses and water quality criteria included in the state's WQS for the purpose of protecting aquatic organisms and their habitat.

Permitting History and Existing Permit Conditions

The history of NPDES permitting at Merrimack Station is described in Section 3 of this document. The facility's two primary generating units (Units I and II) began operation with open-cycle cooling in the 1960's, prior to the 1972 enactment of the CWA and its NPDES permitting program. With the advent of the NPDES permit program, however, Merrimack Station's pollutant discharges and withdrawals of river water for cooling became subject to regulation under NPDES permits issued by EPA and certified by the NHDES with respect to compliance with state WQS.

Since the 1960's, state and federal authorities have expressed persistent concern that Merrimack Station's thermal discharges would cause serious harm to aquatic organisms in the Merrimack River. Whether or not closed-cycle cooling should be required at the facility to reduce thermal discharges has been a recurring subject of debate. In 1969, Merrimack Station proposed cooling ponds to make closed-cycle cooling possible, but later obtained approval not to use cooling ponds and, instead, to rely on the above-mentioned extended discharge canal and PSMs to reduce thermal discharges. This approach demonstrated only limited effectiveness at reducing thermal discharges, however, and concerns continued that closed-cycle cooling using cooling towers could be needed at Merrimack Station. Ultimately, closed-cycle cooling was not required, however, and permits were issued that set thermal criteria to guide the use of the PSMs and imposed various narrative conditions requiring protection of the river's water quality and its aquatic life. Approximately 40 years since they were installed, Merrimack Station continues to rely on the extended discharge canal and PSMs to attempt to moderate its thermal discharges.

Merrimack Station's current permit was issued in 1992 and contains thermal discharge requirements based on a CWA § 316(a) variance. The permit requires operation of the PSMs to maintain water temperatures at Merrimack River monitoring station S-4 of 69°F or less, or to limit temperature increases to 1°F when the ambient river temperature exceeds 68°F. Whenever both of these conditions are exceeded at Station S-4, the permit requires operation of all available PSMs. The permit conditions do not, however, prohibit discharges when these conditions are exceeded. Instead, they only require operation of the PSMs under such circumstances. Temperature data indicate that the above-described in-river temperature criteria have regularly been exceeded in the summer under current conditions.

The permit also specifies more generally that discharges must not violate WQS and that the facility's thermal plumes should not block zones of fish passage, alter the river's balanced indigenous population of aquatic organisms, or have more than minimal contact with the surrounding shorelines. *See id.*, Part I.A.1.g. Moreover, the permit calls for monitoring and studies to determine whether different, more protective thermal discharge limits are needed.

Finally, on a BPJ basis, EPA concluded that at the time of the 1992 NPDES Permit, Merrimack Station's CWISs and open-cycle cooling system satisfied the BTA standard of CWA § 316(b). This conclusion was embodied in the permit along with certain additional conditions, such as the requirement that organisms caught on the intake screens be returned to their aquatic habitat.

EPA Determinations for the New Draft NPDES Permit

Thermal Discharges

CWA § 316(a) Variance Determination

PSNH requested renewal of its thermal discharge variance under CWA § 316(a) and a new permit with thermal discharge conditions matching those in the existing permit. Such conditions would be compatible with continued year-round open-cycle cooling at Merrimack Station.

Based on a detailed evaluation of the pertinent data and analyses, however, EPA concluded that:

- PSNH failed to demonstrate that Merrimack Station's thermal discharge has not caused appreciable harm to the Hooksett Pool's BIP;
- To the contrary, the evidence as a whole indicates that Merrimack Station's thermal discharge *has* caused, or contributed to, appreciable harm to Hooksett Pool's BIP. For example:
    - The Hooksett Pool fish community has shifted from a mix of warm and coolwater species to a community now dominated by thermally-tolerant species;
    - The abundance for all species combined that comprised the BIP in the 1960's has declined by 94 percent, and
    - The abundance of some thermally-sensitive resident species, such as yellow perch, has significantly declined.
- PSNH did not demonstrate that its proposed alternative thermal discharge limits – namely, limits consistent with open-cycle cooling – would reasonably assure the protection and propagation of the BIP; and
- PSNH did not demonstrate that thermal discharge limits based on applicable technology-based and water quality-based requirements would be more stringent than necessary to assure the protection and propagation of the BIP.

Therefore, EPA determined that it must reject Merrimack Station's request for a CWA § 316(a) thermal discharge variance. *See* Sections 4, 5 and 6 of this document.

As a result, EPA turned its attention to determining appropriate thermal discharge limits for the facility that will satisfy federal technology-based requirements and any more stringent requirements that may apply based on state WQS.

Technology-Based Requirements under the BAT Standard

EPA has determined that among the available alternatives, converting Merrimack Station's open-cycle cooling system to a closed-cycle cooling system using wet or wet-dry hybrid mechanical draft cooling towers, and operating on a year-round basis, would be the best performing technology for reducing the facility's discharges of its waste heat to the Merrimack River. *See* Section 7 of this document. This technology would be technologically and economically feasible at Merrimack Station and could reduce thermal discharges by 95 percent or more. In light of its capacity to reduce thermal discharges, and having considered a variety of alternatives and the relevant regulatory BAT factors, EPA has determined that this alternative is the BAT for reducing Merrimack Station's thermal discharges.

In particular, EPA considered engineering and technological factors, process effects, cost, the age of the facilities, energy requirements, various secondary environmental effects (e.g., air, noise), and effects on electric rates. EPA found that retrofitting mechanical draft wet cooling towers in a closed-cycle configuration at Merrimack Station would present a complicated, but feasible, construction project. EPA also found that the cost of retrofitting mechanical draft cooling towers for both Units I and II at Merrimack Station would be significant but economically achievable for PSNH. EPA estimated that for Merrimack Station to install hybrid wet-dry mechanical draft cooling towers and operate in a closed-cycle mode year-round to control thermal discharges would result in a total after-tax cash flow cost to PSNH (present value at 5.3 percent) of $111.8 million, with an annual equivalent cost of $9.0 million (at 5.3 percent over 21 years) on an after-tax, nominal dollar basis (i.e., including the effects of inflation). These present value costs are based on after-tax, one-time costs of approximately $52.9 million and after-tax annual expenses (including operations & maintenance expenses and "energy penalties") of approximately $58.9 million.

EPA also recognizes that under New Hampshire's regulated energy market, PSNH may be able to pass all or much of the cost for converting to closed-cycle cooling along to its consumers, but EPA's analysis concludes that this would have only a relatively small effect on consumer electric rates. EPA estimates that the resulting increase in electricity costs per household customer over a 20-year period would range from approximately $0.0018 or 0.18¢ per kWh to $0.0022 or 0.22¢ per kWh. Based on average electricity sales per residential customer, and the estimated range of increases in electricity rates stated above, the estimated increase per household customer in electricity costs over the 20-year period would range from approximately $13.83 annually or $1.15 monthly, to approximately $16.19 annually or $1.35 monthly. These values translate into an estimated increase in the average residential customer bill for 2010 ranging from approximately 1.1 percent to approximately 1.3 percent. EPA does not take *any* resulting increase in electric rates lightly, but judges this increase, both as a dollar amount and as a percentage increase in the current bill, to be affordable and reasonable. Overall, EPA finds that the cost of upgrading Merrimack Station's decades-old cooling system is not only affordable, but it is reasonable in relation to the major reduction in pollutant discharges to the river that the technology can achieve (i.e., a 95% or greater reduction in thermal discharges).

EPA also considered a variety of possible secondary, non-water environmental effects that could result from converting to closed-cycle cooling at Merrimack Station, such as air emissions, sound emissions, and visual effects. Furthermore, EPA considered energy requirements and effects (*i.e.*, reductions in the electricity available for sale by Merrimack Station), the possibility of effects on the reliability of the electrical system, possible traffic safety effects from water vapor plume-induced fogging or icing of roadways, reduced entrainment and impingement of aquatic organisms as a result of reduced water withdrawals, and the possibility of reduced water levels in the river. While EPA found that there could be certain adverse effects with regard to some of these parameters (*e.g.*, reduced energy available for public sale due to the "efficiency and auxiliary energy penalties" associated with closed-cycle cooling), and certain beneficial effects associated with at least one consideration (*i.e.*, reduced entrainment and impingement), EPA did not find that any of the adverse effects, whether taken alone or in combination, were significant enough to disqualify the closed-cycle wet or wet-dry hybrid mechanical draft cooling tower options from being the BAT for thermal discharge reduction.

Having determined that converting to wet or wet-dry hybrid mechanical draft cooling towers in a closed-cycle configuration constitutes the BAT for Merrimack Station, EPA also determined specific thermal discharge limits achievable using this technology. These limits are set forth farther below.

Requirements Based on New Hampshire Water Quality Standards

In consultation with the state, EPA also determined thermal discharge limits necessary to satisfy the NHWQS. *See* Section 8 of this document. This effort was necessary because, among other reasons, of EPA's obligation under CWA § 301(b)(1)(C) to ensure that its permit limits satisfy state WQS. *See also* 33 U.S.C. §§ 3141(a)(1) and (d).

New Hampshire's WQS include a number of provisions that address the effects of discharges on aquatic life and habitat and that address thermal discharges in particular. From these provisions, EPA distilled the following criteria to guide its determination of water quality-based permit limits:

(a) thermal discharges may not be "inimical to aquatic life";

(b) thermal discharges must provide, wherever attainable, for the protection and propagation of fish, shellfish, and wildlife, and for recreation, in and on the receiving water;

(c) thermal discharges may not contribute to the failure of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to, and with only non-detrimental differences in community structure and function from, that of similar natural habitats in the region; and

(d) [a]ny stream temperature increase associated with thermal discharge must not appreciably interfere with fishing, swimming and other recreational purposes.

EPA's analysis concludes that Merrimack Station's current thermal discharges are not satisfying these criteria.

EPA then determined temperatures that need to be maintained *in the river* to adequately protect aquatic life under the state WQS. EPA's analysis focused on resident and diadromous species of fish and the effects of heat on their health and behavior during their different life stages (e.g., as larval, juvenile and adult fish). Ultimately, EPA prepared a table (Table 8.5) identifying specific temperatures not to be exceeded in the Hooksett Pool over the course of each year and the species (and life stage) that is driving that temperature.

In addition, New Hampshire statutory law, N.H. Rev. Stat. Ann. § 485-A:8(VIII), provides that:

> [i]n prescribing minimum treatment provisions for thermal wastes discharged to interstate waters, the department [of environmental services] shall adhere to the water quality requirements and recommendations of the New Hampshire fish and game department, the New England Interstate Water Pollution Control Commission, or the United States Environmental Protection Agency, whichever requirements and recommendations provide the most effective level of thermal pollution control.

This provision has also been incorporated within New Hampshire's WQS. N.H. Code R. Env-Wq 1703.13(b). Given that Merrimack Station discharges to the Merrimack River, an interstate waterway, NHDES is required to prescribe treatment requirements for the facility's thermal discharges that will "adhere" to the "most effective" water quality requirements and recommendations for "thermal pollution control" offered by the listed agencies. In this case, the most effective water quality requirements and recommendations are those developed by EPA in section 8 of this document and they become the state's water quality requirements by operation of state law.

Determination of Thermal Discharge Limits for the New Draft Permit

As explained above, when setting effluent limits for an NPDES permit, EPA determines technology-based and water quality-based requirements and applies whichever are most stringent in order to ensure that both types of standards are satisfied.

Since EPA determined that converting Merrimack Station to closed-cycle cooling using wet or hybrid wet/dry mechanical draft cooling towers is the BAT for controlling thermal discharges, EPA specified thermal discharge limits that could be achieved using that technology on a year-round basis. More specifically, EPA calculated the maximum monthly heat load (in millions of British thermal units per month (MBtus/month)) that Merrimack Station would discharge to the Merrimack River (in its cooling tower blowdown) with closed-cycle cooling in place. Based on this analysis, the technology-based thermal discharge limits are as follows:

Month	Maximum Heat Load (MBtu/ Month)
January	6856
February	5613
March	7428
April	7210
May	6164
June	4064
July	3264
August	3393
September	4396
October	5950
November	7795
December	6920

See Table 9-1, third column. *See also* Draft NPDES Permit Condition I.A.5.b.

Turning to water quality-based requirements, EPA concluded that maintaining specific protective temperatures in the river was necessary to satisfy New Hampshire's WQS. Accordingly, Merrimack Station's thermal discharges must be small enough not to cause river temperatures to exceed the stated values. The data demonstrate that after converting to closed-cycle cooling, the effect of Merrimack Station's thermal discharge on river temperatures will be small (in all cases, less than 0.05°F). This is so even under conditions of maximum hourly temperature and lowest mean river flow.

EPA compared the water quality-based maximum mean ambient river temperatures that would be adequately protective to satisfy New Hampshire WQS with the ambient river temperatures that would result from Merrimack Station's thermal discharges after the facility's conversion to closed-cycle cooling. In all cases, EPA found that the technology-based thermal limits would be more stringent than the water quality-based limits. *See* Table 9.3. This also demonstrates that compliance with the technology-based limits would satisfy state WQS.

Therefore, EPA based the thermal discharge limits included in the new Draft Permit on the technology-based requirements. *See also* Draft NPDES Permit Condition I.A.5.b. These limits set performance standards for the Merrimack Station's thermal discharges based on levels that can be met using the specified BAT, but the permit does not directly mandate that a particular technology be used. Merrimack Station may meet the permit limits using any lawful approach that it chooses. For example, if PSNH found that dry cooling was feasible and decided for some reason that it preferred that technology, the permit does not preclude the company from taking that approach.

Potential Alternative Basis for Thermal Discharge Limits

As discussed above, CWA § 316(a) allows permit limits based on a variance from the otherwise applicable technology-based and water quality-based requirements for thermal discharges if certain criteria are met. PSNH requested such a variance but EPA determined that the company's application for a § 316(a) variance has not met these criteria and must be rejected. EPA focused, therefore, on determining technology-based and water quality-based requirements.

In Section 9.5 of this document, however, EPA explains that thermal discharge limits that satisfy New Hampshire WQS designed to protect aquatic habitat, aquatic organisms and recreational uses may also satisfy the criteria of CWA § 316(a), which require limits that assure the protection and propagation of the receiving water's BIP. If the water quality-based limits do satisfy CWA § 316(a), then EPA would be authorized to include these limits in the permit based on a variance from the more stringent technology-based limits. This would not be the variance requested by PSNH, but would be a variance independently determined by EPA to satisfy CWA § 316(a).

EPA considered making such an independent CWA § 316(a) variance determination in this case. Had the Agency done so, it would have based the Draft Permit's thermal discharge limits on state water quality requirements and a variance under CWA § 316(a) from federal technology-based requirements. EPA ultimately decided, however, not to take this approach for the Draft Permit because it wants to further evaluate and consider public comment on, among other things, the following questions:

(1) Has EPA correctly rejected PSNH's variance request?
(2) Has EPA properly applied New Hampshire's water quality standards, including the biologically-driven standards?
(3) Will limits satisfying New Hampshire's water quality standards also satisfy CWA § 316(a)?

As a result, EPA is affirmatively requesting public comment on these questions and any other matters pertinent to these issues. Moreover, EPA is providing express notice that it plans to further consider this approach for the Final Permit, taking into account any public comments received. EPA will also, of course, be considering whether the technology-based limits included in the Draft Permit should be retained for the Final Permit.

Water Withdrawals for Cooling

Determination of the BTA Under CWA § 316(b)

Merrimack Station withdraws approximately 287 million gallons of water per day from the Merrimack River for its cooling process for generating Units 1 and 2. This withdrawal adversely affects the river by causing the entrainment and impingement of its aquatic organisms.

Entrainment. Merrimack Station currently entrains approximately 3.8 million fish eggs and larvae (predominantly larvae). The facility has also at times entrained juvenile fish. Entrainment levels might be higher still if Hooksett Pool fish populations had not declined as they have.

At Merrimack Station, entrainment is essentially a seasonal problem. Specifically, the facility entrains aquatic organisms primarily from April through August. This is when virtually all fish eggs and larvae are found in the river due to seasonal spawning patterns.

A significant portion of the Hooksett Pool's icthyoplankton may be lost to entrainment by Merrimack Station because the facility tends to withdraw a sizable percentage of the Pool's flow for cooling. Moreover, this percentage grows in the early summer as river levels drop (and larvae are still present). For example, on average, Merrimack Station has withdrawn approximately 19 percent of the available flow in Hooksett Pool during July. It has withdrawn even more during some years and peak day withdrawals as high as 75 percent have been recorded. Even greater percentages of available flow have been withdrawn in August, although larval abundance is typically reduced during that month.

A number of species of importance to the Merrimack River that have suffered significant declines (e.g., yellow perch, white sucker, American shad) are particularly vulnerable to entrainment. Moreover, entrainment of icthyoplankton and other zooplankton may represent a significant reduction in available forage for the fish and other aquatic organisms that typically prey on them. All of this is particularly problematic given the poor health of the Hooksett Pool fish community and its apparent inability to recover under current conditions. Reducing entrainment should not only help facilitate the recovery of the resident fish community, but should also benefit efforts to restore anadromous American shad in the Merrimack River watershed.

Impingement. At Merrimack Station, impingement occurs on a year-round basis, substantial impingement events occur at times, and significant numbers of the fish that are impinged die as a result. Both resident and anadromous fish are impacted by impingement, and rates of impingement might be even higher if fish populations were healthy. Furthermore, the loss of significant numbers of juvenile and adult fish to impingement is likely to combine with other stressors to interfere with the recovery of fish populations.

Evaluation of BTA Options. In order to determine the BTA for minimizing adverse environmental impacts at Merrimack Station on a BPJ basis under CWA § 316(b), EPA evaluated a variety of alternatives with regard to their ability to reduce entrainment and impingement mortality while still providing Merrimack Station with adequate condenser cooling. For example, EPA evaluated Merrimack Station's existing open-cycle cooling system, considering the CWIS design, the volume and velocity of water withdrawals, and the fish return system's effectiveness at safely returning impinged fish to the river. EPA also evaluated a variety of other technological approaches in terms of their ability to reduce entrainment and impingement mortality, as well as in terms of their technological and economic feasibility, operational concerns, cost, secondary environmental effects, energy considerations, and other pertinent factors.

EPA "screened out" some of the options and evaluated others in greater detail, including comparing their costs and benefits. EPA assessed cost based on monetized estimates of one-time and recurring costs to the company ("private costs"). For purposes of cost/benefit comparison, EPA also converted these private costs to "social costs" (i.e., costs to society). Benefits were assessed in terms of the number of organisms saved and a qualitative assessment of the public value of the organisms saved and the aquatic habitat improved. EPA then considered a comparison of the social costs and social benefits in determining the BTA in this case.

EPA determined that the most effective available means of reducing entrainment by Merrimack Station would be to convert both the Unit 1 and Unit 2 cooling systems to closed-cycle cooling using wet or hybrid wet-dry cooling towers. This would reduce water withdrawal volumes and, as a result, entrainment by 95 percent, saving 3.616 million eggs and larvae (out of 3.8 million). No other "available" approach (such as converting to closed-cycle cooling at only one unit or installing a modified screening system) was nearly as effective. At the same time, because of the seasonal nature of the entrainment problem at this facility, EPA also found that operating in a closed-cycle mode only from April through August was *as effective* for reducing entrainment as operating closed-cycle cooling year-round. *See* Tables 12.4 of this document. At the same time, seasonal closed-cycle cooling was significantly less expensive. *See* Tables 12.2 and 12.3 of this document.

In addition, EPA found that closed-cycle cooling is also the most effective method of reducing impingement mortality, but that other substantially less expensive approaches could also achieve major improvements. These other methods include improving the facility's traveling screens and fish return system to increase the rate at which impinged fish are safely returned to the river.

Ultimately, EPA concluded that installing closed-cycle cooling using wet or hybrid wet/dry mechanical draft cooling towers and operating in a closed-cycle cooling mode *from April through August* (i.e., during the entrainment season) is a component of the BTA to minimize entrainment at Merrimack Station. (*See* Section 12 of this document.) This approach would achieve the greatest reduction in entrainment of the available alternatives that were evaluated in detail, and it is affordable and technologically feasible. EPA estimated the total, after-tax present value cost to the company of this option (including certain screening system improvements discussed below) to be $79.2 million, with an equivalent annual cost of $6.4 million per year over 21 years. *Year-round* closed-cycle cooling provides essentially the same entrainment reduction benefit but was rejected as the BTA for entrainment reduction because it was more expensive (with a total, after-tax present value cost of $112.7 million, with an equivalent annual cost of $9.1 million per year over 21 years) without further reducing entrainment. Providing closed-cycle cooling at only one of Merrimack Station's two generating units was rejected because it reduced entrainment far less. *See* Tables 12.3 and 12.4 of this document.

With regard to reducing impingement mortality, EPA first decided that under any circumstance, the BTA includes a number of relatively inexpensive steps that can be taken to improve Merrimack Station's currently ineffective fish return system so that more impinged fish are safely returned to the river. EPA then concluded that although closed-cycle cooling is the most effective technology for reducing impingement mortality in this case, the marginal benefits of operating the closed-cycle cooling year-round did not warrant its additional cost as compared to the less expensive option of installing certain screening system improvements to reduce impingement mortality from September through March. These improvements can provide much of the impingement mortality reduction that closed-cycle cooling would achieve at much lower cost. (Compare Options 4 and 5 in Table 12-2 of this Document, and compare Options 3 and 5 in Table 12-3 of this document.)

As with the determination of technology-based discharge limits under the BAT standard, in evaluating the closed-cycle cooling and screening system technologies under the BTA standard of CWA § 316(b), EPA considered various technological factors, secondary environmental effects, energy considerations, cost (as discussed above), consumer electric rate effects and a comparison of the costs and benefits of the technological approaches. While closed-cycle cooling would have certain adverse effects, and would involve considerable expense, none of these issues justified rejecting the technology. (No serious concerns were raised regarding the screening system improvements.) Given that EPA's analysis of these issues found nothing that disqualified year-round closed-cycle from being the BAT for thermal discharge control, it follows that none of the issues would disqualify *seasonal* closed cycle cooling from constituting the BTA for minimizing adverse environmental impacts from CWIS operation. Furthermore, as EPA explains in Section 12 of this document, in the Agency's judgment, the costs of these improvements to Merrimack Station's decades-old CWISs costs are warranted by the substantial environmental benefits that should result.

In sum, EPA determined that the BTA for Merrimack Station involves closed-cycle cooling using wet or wet-dry hybrid mechanical draft cooling towers from April through August to minimize entrainment. During this time period, the technology would also serve to minimize impingement mortality. Under CWA § 316(b), open-cycle operations would be allowed from September to March, but specific screening system improvements to minimize impingement mortality would be required during any such periods of open-cycle operation. EPA also determined that the BTA required certain fish return system improvements to be installed and operated on a year-round basis.

Based on this BTA determination, EPA crafted a number of specific permit conditions consistent with the use of this combination of technologies. These permit conditions are as follows:

- Units I and II must limit intake flow volume to a level consistent with operating in a closed-cycle cooling mode from, at a minimum, April 1 through August 31 of each year.
    - a low-pressure (≤30 psi) spray wash system for each traveling screen (to remove fish prior to high-pressure washing for debris removal), the location of which has been optimized for transferring fish gently to the return sluice; and
- A new fish return sluice with the following features shall be installed for each CWIS:
    - Maximum water velocities of 3–5 ft/sec within the sluice;
    - A minimum water depth of 4–6 inches at all times;
    - No sharp-radius turns (*i.e.*, no turns greater than 45 degrees);
    - A point of discharge to the river that is slightly below the low water level at all times;
    - A removable cover to prevent access by birds, etc;
    - Escape openings in the removable cover along the portion of the sluice that could potentially be submerged; and

- A slope not to exceed 1/16 foot drop per linear foot, unless the plant can demonstrate that this is not feasible; and
- the fish return sluice will be in place and operational at all times.

While PSNH is most likely to comply with the permit's intake flow requirements using closed-cycle cooling, it is free to meet these permit conditions using any lawful method that it chooses. For example, if PSNH found that dry cooling was feasible and decided for some reason that it preferred that technology, the permit does not preclude the company from taking that approach. As another example, if PSNH was able lawfully to purchase makeup water from a willing seller rather than take it from the Merrimack River, the permit would not prevent it.

EPA considered but ultimately rejected the BTA options proposed by PSNH. Specifically, PSNH proposed to continue its open-cycle cooling operation, but (possibly) to use wedgewire screens with certain specific design features (e.g., mesh size of 1.5 mm or more) from April to July, and to schedule its annual one-month maintenance outage for Unit 2 each year from mid-May to mid-June to reduce entrainment. EPA considered PSNH's proposals in depth but determined that they did not satisfy the BTA standard of CWA § 316(b). EPA rejected the wedgewire screen proposal for a number of reasons, including that it was unlikely to be effective at the Merrimack Station site due to local river conditions. EPA agrees that it makes sense, to the extent feasible, to schedule the annual Unit 2 maintenance outage at a time that will minimize entrainment, but this proposal (with or without wedgewire screens) would be far less effective than operating both units in a closed-cycle cooling mode throughout the entrainment season and EPA concludes that it would not satisfy the BTA standard by itself.

New Hampshire Water Quality Standards

New Hampshire's WQS apply to the effects of cooling water withdrawals from state waters. EPA concludes that continued year-round open-cycle operations, with their associated levels of entrainment and impingement mortality, would not satisfy the state's water quality criterion requiring protection of the integrity of the biological and aquatic community of the Hooksett Pool. At the same time, EPA concludes that the BTA-based permit requirements described above not only satisfy CWA § 316(b), but also satisfy New Hampshire's WQS. As a result, no additional, more stringent CWIS-related permit requirements are needed to satisfy state WQS. At the same time, EPA concludes that it would be inconsistent with the state's WQS to make the permit's CWIS-related requirements significantly less stringent because doing so would allow increased entrainment and impingement mortality that would likely interfere with attaining the state's water quality criterion for protecting the integrity of the river's biological and aquatic community.

Interplay of Thermal Discharge and Cooling Water Withdrawal Permit Limits

For the most part, the draft permit's limits create performance standards for reducing thermal discharges and entrainment and impingement mortality that are based on the capabilities of closed-cycle cooling using wet or hybrid wet-dry mechanical draft cooling towers. (Additional impingement mortality reduction requirements are specified as CWIS design standards.) As explained above, however, the permittee may use any lawful method of meeting those limits.

The draft permit's thermal discharge and cooling water withdrawal limits have separate, independent foundations, and *both sets of limits must be complied with*. Therefore, to the extent that the permittee decided to meet thermal discharge limits by using closed-cycle cooling year-round, this approach would also satisfy the permit's CWIS requirements based on seasonal closed-cycle cooling. In other words, if closed-cycle cooling is in operation year-round to meet thermal discharge limits, then Merrimack Station would also satisfy the permit's requirements for entrainment reduction and impingement mortality control (as long as the required fish return system improvements are also installed). As a result, the facility would not need to install the intake screening system improvements that are only needed if and when open-cycle cooling is used.

The reverse is not true, however. Intake requirements based on seasonal closed-cycle cooling do not excuse the facility from the need to comply with thermal discharge limits based on year-round closed-cycle cooling. If the draft permit's thermal discharge limits were changed, however, so that open-cycle cooling was possible during certain months, then the facility could use open-cycle cooling during those months to the extent that it would also be allowed by the permit's CWIS requirements.