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1.0 Overview

This section of the Responses to Comments addresses comments related to the new NPDES permit's regulation of Merrimack Station's discharges of waste heat (also referred to as "thermal discharges") to the Hooksett Pool section of the Merrimack River. In prior documents, Region 1 has discussed in detail the source and character of the Facility's thermal discharges, as well as the legal requirements governing regulation of such discharges. *See, e.g.*, AR 608 (the Fact Sheet for Merrimack Station Draft Permit ("the 2011 Fact Sheet") (Sept. 29, 2011), pp. 4-11; AR 618 (Attachment D to the 2011 Fact Sheet: Clean Water Act NPDES Permitting Determinations for the Thermal Discharge and Cooling Water Intake Structures at Merrimack Station in Bow, New Hampshire ("the 2011 Determinations Document") (Sept. 29, 2011); AR 1533 (Joint Public Notice for the Reopening of the Public Comment Period for the Draft NPDES Permit for Merrimack Station …) ("the 2017 Public Notice") (August 2, 2017); AR 1534 (Statement of Substantial New Questions for Public Comment (Discussion of Substantial New Questions and Possible New Conditions for the Merrimack Station Draft NPDES Permit that are Now Subject to Public Comment During the Comment Period Reopened by EPA under 40 CFR § 124.14(b)) ("the 2017 Statement") (Aug. 2, 2017). To avoid adding unnecessarily to the already voluminous record for this permit, Region 1 is incorporating these records by reference herein and will try not to repeat material they already cover unless such repetition is necessary to provide a coherent, intelligible discussion of the facts and law related to the issues presented.

1.1 Whether the Final Permit's Thermal Discharge Limits Should be Based on a CWA § 316(a) Variance or on Technology Standards and/or Water Quality Standards.

Comment II.1.1	**AR-846, AR-1548, PSNH; AR-851, CLF et al., AR-1573, Sierra Club et. al.; AR-842, EPRI; AR-1577, EPRI**

EPA received many conflicting comments on whether thermal discharge limits in Merrimack Station's new NPDES permit should be based on a variance under Section 316(a) of the Clean Water Act, 33 U.S.C. § 1326(a), or, instead, on a denial of the Facility's variance request and the application of technology-based and/or water quality-based requirements. Many commenters provided detailed comments on this general subject and EPA responds to the individual comments farther below. Here EPA provides a general overview response.

EPA Response:

Regulating thermal discharges under the CWA is complicated. Discharges of heat are subject to the "best available treatment economically achievable" (BAT) technology standard, *see* 33 U.S.C. §§ 1311(b)(2)(A) and (F); 40 CFR § 125.3(a)(2)(v), but because there are no national effluent limitation guidelines (ELGs) in effect for thermal discharges, any BAT limits must be determined on a site-specific, Best Professional Judgment (BPJ) basis. *See, e.g.,* 33 U.S.C. § 1342(a)(1)(B); 40 CFR § 125.3(c)(3). Such site-specific determinations typically involve difficult engineering, scientific, and economic questions regarding the feasibility, effectiveness, and cost of different technologies for reducing waste heat discharges.

In addition to technology-based requirements, thermal discharge limits must also satisfy any more stringent water quality-based requirements that may apply. *See* 33 U.S.C. § 1311(b)(1)(C); 33 U.S.C. § 122.44(d). *See also* 33 U.S.C. §§ 1341(a)(1) and (d) and 1370. Under state water quality standards, thermal discharges may be subject to both numeric and narrative water quality criteria as well as antidegradation policies and requirements necessary to preserve the existing and designated uses of the water body receiving the thermal discharge. *See, e.g.,* 40 CFR §§ 131.2 and 131.6. State water quality standards may also be subject to certain "general policies," such as those pertaining to "mixing zones," *see* 40 CFR § 131.13, which, subject to certain criteria, allow the state to delineate a zone within which water quality standards do not have to be met, whereas the standards must be met beyond the zone. AR-746, p. 6-15. Applying water quality standards can present difficult scientific questions regarding the site-specific effect of the thermal discharge on water quality in the receiving water (*e.g.*, the magnitude and reach of a discharge's effects on water temperature, dissolved oxygen levels, eutrophication, *etc.*) and on aquatic life and habitat conditions. When both technology-based and water quality-based standards apply, whichever is more stringent governs the permit limits. EPA discussed water quality-based requirements in detail in the 2011 Determinations Document. *See* AR 618, pp. 174-216.

Relevant to this permit, the State of New Hampshire 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. The Standards for Classification of Surface Waters of the State require that:

> any stream temperature increase associated with the discharge of treated sewage, waste or cooling water, water diversions, or releases shall not be such as to appreciably interfere with uses assigned to this class. The waters of this classification shall be considered as being acceptable for fishing, swimming and other recreational purposes and, after adequate treatment, for use as water supplies.

RSA 485-A:8(II). In addition, the standards include several narrative criteria designed to protect aquatic habitat and aquatic life. *See* AR 618, pp. 174-78 (discussing relevant New Hampshire water quality criteria). New Hampshire's water quality standards also allow for the delineation of site-specific mixing zones, subject to certain criteria. NH Code R. Env-Wq 1702.26, 1707.01, and 1707.02 Finally, New Hampshire state law dictates that "in prescribing minimum treatment provisions for thermal wastes discharged to interstate waters, the department 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." RSA 485-A:8(VIII). This provision applies to waste heat discharges to the Merrimack River because it is an interstate water.

Finally, under CWA § 316(a), 33 U.S.C. § 1326(a), dischargers may request alternative, less stringent thermal discharge limits pursuant to a variance from the applicable technology and water quality standards. To obtain a variance under CWA § 316(a), the discharger has the burden of demonstrating that limits based on technology and water quality requirements will be "more stringent than necessary to assure the protection 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" (BIP). 33 U.S.C. § 1326(a); 40 CFR §§ 125.70, 125.72 and 125.73. If this demonstration is made, then the permitting authority may impose alternative, variance-based thermal discharge limits that will assure the protection and propagation of the BIP. *Id.* Once again, evaluating applications and setting limits under CWA § 316(a) can present difficult scientific questions regarding the site-specific effects of a thermal discharge on water quality and habitat quality in the receiving water (*e.g.*, the magnitude and reach of the thermal discharge plume's effect on water temperature, dissolved oxygen levels, eutrophication, *etc*.) and on the condition of the receiving water's aquatic life. *See* 33 U.S.C. § 1326(a); 40 CFR §§ 125.72 and 125.73. In determining whether the protection and propagation of the BIP will be assured, other environmental stresses on the BIP must also be considered. 33 U.S.C. § 1326(a); 40 CFR §§ 125.73(a) and (c)(i). 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 BIP.

As with many aspects of the Merrimack Station permit, determining thermal limits has been made even more complex by changed circumstances at the Facility since publication of the 2011 Draft Permit.[1] Specifically, EPA has needed to consider and evaluate (a) the ramifications of the Facility's much reduced operations and thermal discharges, (b) the Facility's prior submitted thermal discharge data based on a new understanding of how to correctly interpret that data based on clarifications submitted with public comments, (c) new, more recent thermal discharge data, and (d) the many public comments submitted from a variety of opposing perspectives. All of this has combined to lead EPA to revise its prior assessment of thermal discharge limits. Although the legal requirements applicable to thermal discharge regulation have not changed since the 2011 Draft Permit was published, the facts have substantially changed and this has altered the results of EPA's analysis for the Final Permit.

EPA's analysis has been affected and improved by its consideration of public comments on these issues. EPA first received and considered public comments and data submitted related to the thermal discharge issues raised by the 2011 Draft Permit and supporting record. EPA also received, and exercised its discretion to consider, new thermal data and related information and views from commenters after the comment period on the 2011 Draft Permit closed on February 28, 2012. *See* AR 1124. EPA decided that it should consider this post-comment-period material because not only did it appear to have potentially important ramifications for the correct application of CWA standards governing thermal discharge, but the permit was already going to

[1] Since the 2011 Draft Permit was published, determining requirements for cooling water intake structures (CWIS) under CWA § 316(b) has been affected by changed circumstances, such as new regulatory standards, *see* 40 C.F.R. Part 125, Subpart J, the Facility's reduced operations and the development of new intake technology designs and new data on technology effectiveness. Similarly, setting limits for pollutant discharges regulated under the Steam Electric ELGs or the BPJ application of CWA technology standards has also been affected by changed circumstances since publication of the 2011 Draft Permit, including the installation and evaluation of new treatment technologies for use at the Facility and the promulgation of new ELGs applicable to the Facility. *See* 40 C.F.R. Part 423.

be delayed because of legal and factual developments related to other aspects of the permit.[2] EPA knew, therefore, that not considering the late-submitted information would not provide the important benefit of expediting permit issuance because delay for other reasons was unavoidable.

Ultimately, in 2017, EPA decided for many reasons, including reasons related to the regulation of thermal discharges, that it should reopen the public comment period for the permit to share important new information and substantial new questions with the public and provide the public an opportunity to comment on it. *See* AR 1533 and AR 1534. Among the issues that EPA discussed and invited public comment on were the Agency's new understanding of the existing thermal data, the consideration of new thermal data and related biological data, and the implications for thermal discharge limits of Merrimack Station's reduced operations. See AR 1534, pp. 4-5, 7-8, 36-44. EPA again received voluminous comments on a range of issues, including thermal discharge limits. After the public comment period closed on December 4, 2017, *see* AR-1691 (8/17/17 EPA Public Notice of Extension), and during a period of a series of additional delays related to legal developments under the Steam Electric ELGs, both the Facility and Sierra Club have reached out to EPA to discuss and offer their views on various permit issues, including those related to thermal discharges. These communications continued over a period of time and have been documented for the record, and EPA has considered all of the comments and information submitted during this time from all sides. Here the Agency will describe and explain the evolution of its thinking on how to properly set thermal discharge limits for Merrimack Station's Final Permit. More specific comments are responded to farther below.

Merrimack Station Draft Thermal Limits

The thermal discharge limits in the Facility's current permit, which was issued in 1992, were set pursuant to a thermal discharge "variance" granted by EPA under CWA § 316(a), 33 U.S.C. § 1326(a). *See* AR-236 (1992 NPDES Permit), pp. 2-3, 8 and 16; AR-618 (2011 Draft Permit Determinations), pp. 27-28. The permit also regulates thermal discharges under New Hampshire water quality standards. AR-236, pp. 2-3.

In its permit application, PSNH sought renewal of the thermal discharge variance and the associated permit limits. *See* AR-618, p. 28. EPA discussed the application of CWA § 316(a), technology standards, and water quality standards to Merrimack Station's thermal discharges in Sections 4.0 through 9.0 of the 2011 Draft Permit Determinations (AR-618). After reviewing PSNH's permit application and a variety of related thermal and biological data and information, EPA proposed denying PSNH's request for renewal of the CWA § 316(a) variance. *See id.* at Section 6.0. Instead, EPA proposed thermal discharge limits based on applicable technology standards and determined that these limits would also satisfy state water quality standards. *See* AR-618, Sections 7, 8 and 9. More specifically, the proposed Draft Permit limits were based on a site-specific, BPJ application of the BAT technology standard, *see id.* at Sections 7 and 9, *see*

[2] For example, in early 2012, Region 1 learned that Merrimack Station had installed a vapor compression evaporation treatment system (VCE) to treat its flue gas desulfurization (FGD) wastewater, which led to EPA publishing the 2014 Revised Draft Permit. *See* AR 1134, 1135, 1136 and 1137. Moreover, later in 2014, EPA promulgated new regulations governing requirements under CWA § 316(b), 33 U.S.C. § 1326(b), for cooling water intake structures at existing facilities, which required further consideration and evaluation by EPA to ensure satisfaction of the new requirements. *See* 40 C.F.R. Part 125, Subpart J.

also 33 U.S.C. §§ 1311(b)(2)(A) and (F) and 40 CFR § 125.3(c)(2), and on a site-specific analysis of New Hampshire water quality standards. *See* AR-618, Sections 8 and 9. *See also* 33 U.S.C. § 1311(b)(1)(C); 40 CFR § 122.44(d).

As discussed above, under CWA § 316(a), 33 U.S.C. § 1326(a), the permitting agency may base permit limits for thermal discharges on a variance from the otherwise applicable technology-based and water quality-based standards if less stringent limits will nevertheless assure the protection and propagation of the receiving water body's BIP. An existing facility operating under an NPDES permit with thermal discharge limits based on a § 316(a) variance may seek renewal of its 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). *See* 40 CFR § 125.73(c)(1)(i) and (ii). In some cases, an existing facility may attempt both types of demonstrations, which is what Merrimack Station has done in this case. *See, e.g.,* AR 618, p. 78.

In determining whether the protection and propagation of the BIP will be assured, any thermal stress to aquatic life is evaluated in conjunction with any adverse effects from other environmental stresses. *See* 33 U.S.C. § 1326(a); 40 CFR § 125.73(a) and (c)(1). The evaluation under CWA § 316(a) involves considerations such as (a) the scope of the discharger's waste heat discharges (*e.g.*, the amount of heat being discharged, the temperature of the discharge, and the timing and duration of the discharge (*e.g.*, are there seasonal or daily variations?)), (b) the effect of the discharge on ambient conditions (*e.g.*, what portion of the receiving water is affected by the discharge and what is the extent of that effect), and (c) the extent to which the alteration of water temperatures by the discharge affects aquatic life (*e.g.*, whether increased water temperatures affect the ability of aquatic organisms to survive, reproduce, or successfully compete with other native and non-native organisms). EPA will consider information regarding individual species as well as the overall assemblage or community of organisms in the water body receiving the thermal discharge. All of this factors into EPA's judgment about whether or not the protection and propagation of the BIP is assured.

Based on a thorough review of all pertinent data and analyses available at the time of development of the 2011 Draft Permit, EPA determined that:

- PSNH did not demonstrate that Merrimack Station's thermal discharge had not caused prior appreciable harm to the Hooksett Pool's balanced, indigenous population of fish;
- To the contrary, the evidence as a whole indicated that Merrimack Station's thermal discharge had caused, or contributed to, appreciable harm to Hooksett Pool's balanced, indigenous community of fish;
- 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 balanced, indigenous population of shellfish, fish and wildlife in and on Hooksett Pool; and
- PSNH did not demonstrate that its proposed alternative thermal discharge limits – namely, retaining limits consistent with open-cycle cooling – would reasonably assure the protection and propagation of the Hooksett Pool's BIP.

Therefore, as stated above, for the 2011 Draft Permit, EPA proposed rejecting Merrimack Station's request for a CWA § 316(a) thermal discharge variance. *See* AR 618, p. 211. Instead, EPA proposed thermal discharge limits that satisfied both federal technology-based requirements and state water quality standards. *See* AR 618, pp. 121-22, 211-16. In setting technology-based limits, EPA considered the option of setting operating restrictions to control thermal discharges but rejected it because Merrimack Station was a baseload generator and could continue as such while controlling thermal discharges with retrofitted cooling towers. *Id.* at 144-45. In addition, EPA indicated that it was still considering the alternative of setting thermal discharge limits that would require seasonal ambient water temperatures to be maintained at specific locations within the Hooksett Pool based on critical temperatures for fish species present in the Hooksett Pool. *Id.* at 216-17. EPA indicated that such limits might potentially satisfy state water quality standards while providing the basis for a CWA § 316(a) variance from technology standards, and the Agency invited public comment on that possible approach. *Id.*

EPA's denial of PSNH's request for a § 316(a) variance was supported by its assessment of Merrimack Station's § 316(a) Demonstration, including the results of PSNH's fish sampling program from 1967 through 2005, as well as by science-based predictions of adverse thermal effects on representative species of fish in Hooksett Pool that would be likely to occur under the requested thermal discharge conditions. EPA assessed the results of PSNH's fish sampling program from 1967 through 2005 and found compelling evidence of appreciable harm to the balanced, indigenous fish community of Hooksett Pool. EPA next considered whether the thermal discharges from Merrimack Station caused or contributed to appreciable harm to the balanced, indigenous community. This assessment was rooted in analysis of over 21 years of Merrimack River temperature data that documented the effect of the Station's discharge of waste heat, particularly observations of substantial periods during summer when downstream temperatures exceeded levels considered protective of thermally sensitive representative species. See AR-618 at 112-116.

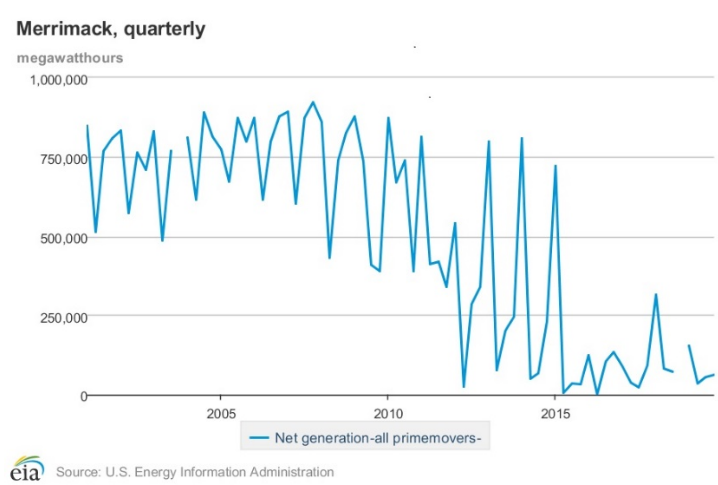
During the public comment period for the 2011 Draft Permit, EPA received numerous comments on the proposed thermal discharge limits and issues related to them. Some commenters supported the proposed permit limits, while others disagreed with the limits and opposed EPA's characterization of the BIP and its rejection of a § 316(a) variance. *See, e.g.*, AR-841, AR-846, AR-851, AR-866, AR-872. EPA has been considering all these comments as part of its effort to develop and issue the new Final Permit to Merrimack Station.

In addition, after the comment period on the 2011 Draft Permit closed on February 28, 2012, new information came to light which raised substantial new questions pertaining to the application of CWA § 316(a) and New Hampshire water quality standards to the development of thermal discharge limits for the Merrimack Station permit. AR-1534, pp. 4-5, 7-8, 36-44. As a result of this, and other, new information and new questions, EPA reopened the comment period in 2017 and issued the 2017 Statement. AR-1534. EPA explained that further submissions of information from PSNH indicated that EPA had misunderstood or misinterpreted certain aspects of the Company's thermal data as presented in the 2007 Normandeau Report, due, in part, to a lack of clarity in the Report itself. *See* AR-1534 at 38. *See also,* AR-1367, AR-872 at 97-98. In particular, PSNH clarified that the temperature data in the 2007 Normandeau Report are *not* the

21-year average of the daily maximum temperatures for each day of the calendar year, as EPA had thought, but rather represent the maximum of the daily averages that occurred on a given calendar day, possibly only one time, during the entire 21 years that monitoring data were collected (between 1984 and 2004). *See* AR-1367.

In order to reassess its interpretation of the data, EPA requested additional thermal data and further clarification of the 21-year data set. *See* AR-1298. In response, PSNH provided the requested data, but also submitted additional reports, including additional data that covered a time period that extended beyond that of the initial 21-year data set and which reflects conditions when Merrimack Station was operating at a much lower capacity factor than was reflected in the prior, older data. *See* AR-1299 through AR-1307. EPA notes that, in its view, the above-mentioned new data reflecting reduced operations was primarily useful for assessing conditions that would be associated with Final Permit limits reflecting this reduced operational profile. EPA found the new data was less helpful for determining limits to accommodate baseload operations, as past permit limits have done and as PSNH had requested. *See* AR-1534, p. 69. That said, EPA considered all the comments and materials submitted by PSNH and other members of the public.

At the time of the 2011 Draft Permit, Merrimack Station operated as a baseload power plant. In other words, to meet demand for electricity, the plant operated on a near-constant basis, with the exception of regularly scheduled maintenance outages. Consistent with this fact, PSNH had applied for NPDES permit conditions based on continued baseload operations and EPA was evaluating permit conditions on this basis. *See* AR-618, pp. 132, 145, 156 n. 51, and 158. Since EPA issued the 2011 Draft Permit for public comment, however, Merrimack Station's electrical generation has diminished substantially, illustrated in the figure below. *See* AR-1369; AR-1396. The Facility now operates, and has for a while been operating, as a "peaking plant" that generates electricity only during peak demand periods that typically occur in the winter and the summer. *See* AR-1369. This is primarily the result of market factors, including the emergence of relatively inexpensive natural gas and the new dominance of that fuel source in the New England market. *See* AR-1396.



As EPA was continuing to work on the permit, New Hampshire deregulated its electricity market and required PSNH to divest of its generating assets, including Merrimack Station (as well as

Schiller Station, Newington Station, and various hydro-electrical facilities). *See* AR-1396; *see also* Section IV(E)(3) below. Since issuance of the 2011 Draft Permit and the 2017 Statement, Merrimack Station was sold to Granite Shore Power, LLC (GSP). Unlike PSNH, which maintained its request for permit conditions based on the possibility of future baseload operations, GSP indicated a willingness to have a permit with appropriate permit conditions reflecting the Facility's current, and planned future, pattern of operations like a peaking plant that helps the region to meet intermittent periods of high demand for electricity. GSP understood that such permit conditions on thermal discharges would limit the plant's operations consistent with that operational profile.

Thus, comments on the Draft Permit, including new fisheries analysis and a more complete, correctly understood temperature dataset, in addition to a substantially different operational profile and new ownership willing to consider a permit not based on baseload operations, all caused EPA to re-consider the appropriate thermal limits for the Final Permit. In its 2017 Statement, EPA explained and described all of these considerations and invited public comment about them. AR-1534, pp. 39, 69. The Agency did, in fact, receive many comments on these topics and it has considered these comments in developing the Final Permit. On this basis, EPA has reassessed whether the Final Permit should retain the 2011 Draft Permit's technology-based and water quality-based thermal limits or, instead, whether the permit should be based on water quality requirements and/or a CWA § 316(a) variance, albeit different from the existing or previously requested variance, that would be protective of the Hooksett Pool's BIP taking into account Merrimack Station's current operating conditions.

Merrimack Station Final Permitted Thermal Limits

In response to comments on the 2011 Draft Permit and the 2017 Statement, and in light of the misinterpretation of key temperature data used to evaluate river conditions in comparison to thermal tolerance information, as well as consideration of reduced operations at Merrimack Station, EPA re-evaluated the temperatures in the Merrimack River needed to assure the protection and propagation of the BIP, including resident and migratory species and life stages of fish when they would be present in the water body. In particular, as explained above, EPA considered whether the substantial reduction in operations (and thermal discharges) with the Facility having transitioned from baseload operations to operations like that of a peaking plant would alter the potential of the thermal plume to affect the aquatic community.

In addition, understood correctly, EPA concluded that the single-day, maximum average temperature over a period of 21 years that PSNH had previously provided to EPA does not provide a useful data point to assess whether to renew the existing thermal discharge variance under CWA § 316(a). The clarifications about the data led EPA to reconsider how thermal data should be evaluated to support the determination of the potential impacts of the thermal discharge. After the 2011 Draft Permit, PSNH submitted new data based on long-term averages of water temperatures recorded in the river. While long-term averages have utility, long-term averages also obscure the more extreme conditions that fish and other aquatic life could be exposed to over shorter, but still biologically significant, periods of time. *See* AR-1534 p. 39-40. Therefore, for the Final Permit, EPA also evaluated daily temperature data received from the Facility in response to an EPA request for additional temperature data described above. *See* AR-

1298. EPA also considered the daily temperature data provided in the Facility's 2017, 2018, and 2019 annual reports.

EPA presented its analysis of the temperature effects from the heated discharges in Section 5.6.3.3 of the 2011 Draft Determinations. *See* AR-618 pp. 86-116. Temperature data available at the time of the Draft Permit, as EPA understood it, indicated that certain life stages of resident and migratory species are exposed to temperatures that could result in lethal and sub-lethal impacts resulting from the discharge of heated effluent from Merrimack Station. *Id*. EPA determined that the most thermally sensitive species in the Merrimack River are yellow perch and American shad. *See id*. pp. 178-180, 208-9. As the most sensitive species, protective temperatures and time periods derived for yellow perch and American shad will also be protective of other species and the BIP. *See id*. pp. 180-196, 201-208, 213, 216. For the Final Permit, EPA reassessed its initial analysis based on the observed, daily Merrimack River temperature data and the protective limits for resident and migratory species, including the most thermally sensitive species, considering periods representative of both baseload and peaking-like operations. *See*, generally, Response to Comment II.3.1.3.

EPA concluded that the analysis for the 2011 Draft Permit, by misunderstanding the maximum temperature value data, tended to overstate the severity of extreme temperature events. However, EPA's review of daily data under baseload operations confirms that temperatures at the end of the discharge canal (Station S0) and downstream from the discharge (Station S4) reach or exceed certain protective temperatures during critical periods in most years and, in some years, the elevated temperatures remained at these levels for much of the summer. Temperature data representative of peaking-like operations, however, indicates that under that operating scenario, extreme temperature events are relatively uncommon and, when they do occur, are limited in duration and severity. EPA's review of the observed, daily temperature data under current operations suggests that variance-based temperature limits drawn from water quality-based protective instream temperatures will satisfy the criteria of CWA § 316(a). EPA received comments suggesting that the instream protective temperatures proposed in the 2011 Draft Determinations, AR 618, pp. 214-216, were too stringent (*e.g*., AR-1554, AR-872), and other comments that these temperatures were not stringent enough (*e.g*., AR-851). EPA considered all these comments and, in some cases, made adjustments to the protective temperatures proposed in the 2011 Draft Determinations Document. *See* Response to Comment II.3.4.7.

The 2011 Draft Determinations Document discussed, and indicated that EPA was still considering, the approach of setting alternative effluent limits drawn from the water quality standards analysis that would both satisfy state water quality standards and would also satisfy CWA § 316(a) by assuring the protection and propagation of the BIP and, as a result, warrant a variance from technology-based requirements. *See* AR-618 pp. 216-217. The Final Permit, based on consideration of all the data and the current facts, takes this approach and establishes limits under a CWA § 316(a) variance that EPA independently determined would satisfy CWA § 316(a) by assuring the protection and propagation of the BIP of the Hooksett Pool. EPA maintains that rejection of the applicant's original variance request is appropriate because continuing baseload operations with open-cycle cooling would not satisfy § 316(a). This is not, however, how the Facility operates anymore. The Final Permit establishes in-stream temperature limits that apply downstream of the discharge canal (Station S4), which, in effect, allows a limited area of the river between the discharge canal and compliance point for initial mixing of the thermal plume while ensuring that temperatures outside this area remain protective of thermally-sensitive species. These limits are based on a CWA § 316(a) variance and are designed to protect the BIP from both chronic, sub-lethal impacts (applied as average weekly limits) and acute mortality (applied as maximum daily limits). *See* Response to Comment II.3.4.7.

EPA received different comments arguing either that EPA *must* or *must not* consider temperature data reflective of the recent decline in Station operations. *See* Response to Comment II.3.2 (and associated sub-comments). EPA agrees that if the recent decline in output, and the resulting decrease in the discharge of heated effluent, are considered as a basis for limits that satisfy the CWA, then the Final Permit must include limits that ensure the Facility continue with such reduced operations and not resume baseload operations after the Final Permit is issued, unless those limits are first changed through the public permit process. As discussed above and in these Responses to Comments, the new owners of Merrimack Station, GSP, indicated a willingness to accept permit limits based on the current (and anticipated future) reduced operations. Such limits are appropriate in this case because EPA's analysis has concluded that thermal discharge limits reflecting this type of operation will satisfy the conditions of CWA § 316(a). Namely, limits based on CWA § 301(b)(2) and 301(b)(1)(C), 33 U.S.C. § 1311(b)(2) and 1311(b)(1)(C), would be more stringent than needed to assure the protection and propagation of the BIP in the Hooksett Pool, and the Final Permit's limits based on critical temperatures to protect fish species and reflecting reduced operations will assure the protection and propagation of the BIP. *See* Response to Comment II.3.1.3, II.3.4 (and associated sub-comments).

From October through April, temperatures from the discharge do not reach or approach levels that would result in acute mortality of any life stages of fish, even under baseload operations. During this period, chronic thermal limits are designed to protect the most thermally-sensitive species and life stages (yellow perch spawning). The Final Permit establishes 7-day average, water quality-based temperature limits beginning October 1 through April 30 and applied at the compliance monitoring location downstream from the discharge (Station S4). The Final Permit requires year-round operation of continuous temperature monitors at the ambient locations (Stations N10 or N5, depending on the time of year) and downstream locations (S4) in addition to the continuous monitor at Station S0.[3]

From May through September, the intermittent and infrequent operation of Merrimack Station limits exposure of fish to temperatures that would result in chronic, sub-lethal impacts and ensures that the conditions in the Merrimack River are protective of the BIP. *See* Responses to Comments II.3.1.3, 3.3.2, 3.4 (and associated sub-comments). To ensure that Merrimack Station maintains this mode of operation, the Final Permit limits the maximum, 45-day rolling average

[3] The effective date of the Final Permit has been changed from the first day of the calendar month immediately following 60 days after signature (in the 2011 Draft Permit) to the first day of the calendar month immediately following 90 days after signature. This adjustment was made to allow the Permittee to install and calibrate new temperature monitoring equipment. To ensure that future monitoring is consistent with the location of available in-stream data, the Final Permit has replaced Attachment B of the 2011 Draft Permit (Map of Monitoring Locations) with the coordinates of monitoring locations in Parts I.A.3 and I.A11.

capacity to 40% from May 1 through September 30.[4] If the Facility exceeds a 40% rolling average capacity within any calendar month from May through September, the Final Permit establishes chronic thermal limits that must be met and are designed to protect the most thermally-sensitive species and life stages (yellow perch eggs, larvae, and adults and American shad larvae). In the event that the capacity factor limit is exceeded, the Permittee must demonstrate that the 7-day average, water quality-based (chronic) temperature limits were met during the reporting period. In addition, to chronic impacts, the Final Permit includes limits designed to protect drifting organisms (*e.g.*, yellow perch larvae, American shad larvae) from lethality during periods when these life stages are present in the Merrimack River. The Final Permit establishes maximum daily (acute) temperature limits that apply at the compliance point (Station S4) from May 1 through July 31 calculated based on an hourly average. *See* Response to Comment II.3.4.7. Finally, EPA recognizes that in-stream temperatures at the compliance point can be influenced by ambient, upstream temperatures or factors other than the thermal effluent. The Final Permit includes a provision that an exceedance of the water quality-based temperature limits when Merrimack Station is not generating a megawatt output will not be considered a permit violation. In addition, the Final Permit limits the rise in temperature based on the 7-day average at the compliance point (Station S4) to no more than 2°C above the 7-day average ambient temperature (at Station N10 or N5, whichever is applicable at the time). This limit applies only when the 7-day average ambient temperature is within 2°C or above the effective, water quality-based temperature limit.

As explained above and in response to comments below, the Final Permit's thermal discharge limits are based on a CWA § 316(a) variance, taking account of the Facility's reduced operations and using the same critical temperature approach identified in the 2011 Determinations Documentation with respect to possible water quality-based limits.[5] EPA has determined that the combination of reduced operations and protective instream temperature limits will assure the protection and propagation of the BIP. As with the limits in the 2011 Draft Permit, the Final

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[4] A rolling average will ensure that effluent limitations (in this case, capacity factor) are met throughout the reporting period, rather than on a single day. EPA evaluated the average rolling capacity for May 1 to September from 2012 through 2019 (when the Station operated at reduced capacity) over 30, 45, and 60 days to determine an averaging period and capacity factor that would be representative of the recent operation of the Facility. EPA evaluated daily temperature data representative of the Facility's recent, reduced operations and concluded that river temperatures typically meet protective temperatures downstream from Station S0. See Response to Comment II.3.1.3. As a result, limiting operations consistent with this recent operation will ensure that the river temperatures downstream of the Facility are consistent with the protective temperatures derived in the 2011 Draft Determinations Document. See AR-618, p. 178-210. A rolling, 45-day average capacity factor of 40% from May 1 through September 30 allows the Facility to continue operate during the summer as it has in recent years (in fact, in most years the 45-day average capacity factor was less than 40%) while limiting the impacts of the thermal plume on the aquatic community. A 30-day rolling average period limits the number of consecutive days of operation more than a 45-day rolling average but allows less time for the river to recover in between operating periods, while a 60-day rolling period would allow the Facility to operate for more consecutive days. A 45-day rolling average strikes a balance between limiting the number of days a facility can operate in a row and requiring sufficient "downtime" when the Facility is not operating to allow the river to recover to ambient temperatures. The capacity factor calculated as a rolling average will reasonably assure the protection and propagation of the BIP.

[5] As a result of the change for the basis of the temperature limits from BAT (i.e., closed-cycle cooling) in the 2011 Draft Permit to a CWA § 316(a) variance in the Final Permit, the Final Permit includes limitations and monitoring requirements on the discharges from Outfalls 001 and 002 (Parts I.A.1 and I.A.2) and certain changes to the limitations and requirements for Outfall 003 (Part I.A.3), including carrying forward the water quality-based limit on dissolved oxygen saturation consistent with the requirements of the 1992 Permit.

Permit's limits are much more stringent than those in the 1992 Permit. EPA has taken into account the Facility's reduced operations but has set specific, in-stream temperature limits and associated conditions that will assure the protection and propagation of the Hooksett Pool's BIP. These limits will not accommodate Merrimack Station returning to the baseload operations and conditions that warranted rejecting the applicant's § 316(a) variance request. The Facility could, of course, seek different limits in a future permit proceeding.

1.2 Introductory Comments

Comment II.1.2 (i)	**AR-1554, LWB Environmental Services, Inc. p. 1**

On Page 40 of its Statement of Substantial New Questions for Public Comment ("Statement") regarding the Merrimack Station draft NPDES permit, EPA included the following request: EPA invites additional public comment addressing the above-discussed issues and materials relevant both to EPA's decision on PSNH's CWA § 316(a) variance application and to EPA's application of New Hampshire's water quality standards with regard to thermal effects. In particular, EPA invites public comment on:

- The import of PSNH's new data submissions for EPA's application of CWA § 316(a) and New Hampshire's water quality standards in developing thermal discharge standards for the Merrimack Station permit;
- The question of how shorter-term and longer-term thermal data should be factored into the evaluation under CWA § 316(a) and New Hampshire's water quality standards of the effects of Merrimack Station's thermal discharge limits for the Merrimack Station permit.

This document responds to EPA's request for comments on these topics, based on the new information provided by PSNH to EPA.

EPA Response:

The comment from LWB Environmental Services, Inc. ("LWB" or "Dr. Barnthouse") is introductory, rather than substantive, and does not require a response.

Comment II.1.2 (ii)	**AR-1552, Normandeau, p. 1**
***See also* AR-1554, LWB, p. 8**	

Normandeau Associates Inc (Normandeau) is submitting these comments as a response to the EPA's "Statement of Substantial New Questions and Possible New Conditions" for both CWA §316(a) with regard to thermal effects on the aquatic communities and §316(b) in regard to the potential installation of wedgewire screens to reduce entrainment at Merrimack Station. For the 316(a) thermal issues, Normandeau is submitting a data report that includes two additional years of fisheries data collected from Garvins, Hooksett and Amoskeag Pools in 2012 and 2013. This report supplements the "*Merrimack Station Fisheries Survey Analysis of 1972-2011 Catch Data*" (Normandeau 2011a), referred to herein as the "1972-2011 Fisheries Report" by updating the observations and results with two additional years (2012 and 2013) of standardized electrofishing data. This 2012-2013 data supplement used the same methodology and analyses as the 1972-2011 Fisheries Report, unless otherwise noted, and is organized into the following three major sections:

1. results and analysis of fish community data collected in Garvins Pool (the thermally uninfluenced impoundment immediately upstream from Hooksett Pool and therefore the appropriate upstream reference), Hooksett Pool and Amoskeag Pool (the impoundment immediately downstream from Hooksett Pool) during 2012 and 2013 (Report Section 2.0),

2. an updated RIS population trends analysis for the 1972-2013 time period that builds on the results first presented in 2007 (Normandeau 2007a), and updated in 2011 (Normandeau 2011a), by adding more recent data collected from Hooksett Pool during the comparable time periods of August and September 2012 and 2013 (Report Section 3.0), and

3. an assessment of biocharacteristics for RIS and other resident fish species during the 2012 and 2013 study periods, that builds on the results first presented in Normandeau 2011a (Report Section 4.0).

In EPA's Substantial New Questions and Possible New Conditions, the agency invited public comment on the question of how shorter-term and longer-term thermal data should be factored into the evaluation under CWA 316(a) and New Hampshire's water quality standards of the effects of Merrimack Station's thermal discharges on the Hooksett Pool and the development of thermal discharge limits for the Merrimack Station permit.
It is Normandeau's position that there needs to be no further analysis of shorter-term or longer-term thermal data because numerous fish and aquatic community analysis conducted over 40 years of Merrimack Station operation have demonstrated there is no appreciable harm to the balanced, indigenous populations of shellfish, fish and wildlife in Hooksett Pool caused by the thermal discharge. An updated summary of these 316(a) studies and results will be presented in Section 2 and the 316(b) comments on the new wedgewire technology will be presented in Section 3.

EPA Response:

This comment is primarily introductory to the rest of Normandeau's comments that follow and does not require an EPA response here. To the extent, there are substantive points made in this comment, it is addressed in responses below.

Comment II.1.2 (iii)	**AR-1557, EPRI, pp. 3-1 to 3-2**

In September 2011, EPA Region 1 issued a draft National Pollutant Discharge Elimination System (NPDES) permit for the Merrimack Station that called for restrictions in the discharge of waste heat to protect the aquatic communities in the Merrimack River, the waterbody receiving

Merrimack's thermal discharge. The need for these restrictions was based on a detailed analysis by EPA of the real and potential biological effects of Merrimack's thermal discharge that was described in Attachment D to this draft permit. Since the release of this draft permit, there has been extensive commenting on the conclusions reached in Attachment D as well as submittal of new information relative to the impacts of Merrimack's thermal discharge. As a result, on August 2, 2017, EPA reopened the comment period on this draft permit. With regard to thermal issues at Merrimack, EPA invited:

- "… additional public comment addressing the … issues and materials relevant both to EPA's decision on PSNH's CWA § 316(a) variance application and to EPA's application of New Hampshire water quality standards with regard to thermal effects. In particular, EPA invites public comment on:
- the import of PSNH's new data submissions for EPA's application of CWA § 316(a) and New Hampshire's water quality standards in developing thermal discharge standards for the Merrimack Station permit;
- the question of how shorter-term and longer-term thermal data should be factored into the evaluation under CWA § 316(a) and New Hampshire's water quality standards of the effects of Merrimack Station's thermal discharges on the Hooksett Pool and the development of thermal discharge limits for the Merrimack Station permit; and
- EPA is considering the above-mentioned material from Dr. Barnthouse, AR-1352, Attachments 2 and 3, and invites the public to review and comment on the import of this new information.
- Moreover, additional public comment is solicited regarding any thermal discharge-related materials submitted to EPA since closure (on February 28, 2012) of the public comment period on the 2011 Draft Permit…"

EPRI's comments begin with a brief review of background information relative to this topic including: (1) the regulation of thermal discharges from steam-electric power plants; (2) relevant standards and criteria relative to Merrimack's thermal discharge; and (3) the current NPDES permit limits for Merrimack. Next, we review and summarize the technical basis for EPA's revised thermal limits in Merrimack's draft permit (2011 and 2014 revision). Thereafter, we review and summarize relevant new technical information submitted subsequent to the 2011 draft permit. Finally, we provide a discussion of key technical issues relative to the potential thermal impacts that EPA may wish to consider in making a final permit determination for the Merrimack Station.

For clarity, throughout this section USEPA refers to the Environmental Protection Agency's Headquarters in Washington, D.C. while EPA refers to the Environmental Protection Agency's Region 1 Office (New England). EPA serves as the Regional Administrator for Merrimack's NPDES permit whereas USEPA provides oversight and guidance relative to the NPDES permitting program.

EPA Response:

This comment introduces EPRI's substantive comments that follow and, as such, does not require an EPA response.

1.3 Current NPDES Permit Requirements

Comment II.1.3	AR-1577, EPRI, p. 3-2 - 3-3

The existing NPDES permit for the Merrimack Station was originally issued in 1992 and was administratively continued thereafter. The fact sheet for this permit reviews the regulatory history associated with § 316(a) decisions for the Station and concluded that:

"…the Regional Administrator granted a 316(a)-variance based upon the previous hydrological and biological studies and upon the absence of detectable environmental impacts upon the local indigenous fish during the during the operating history of the station. It is noted that neither the State nor EPA are aware of any fish kills associated with the thermal plume within the discharge canal or in the main stream of the river itself, since the station began operation."

Further, this permit does not include limits on the thermal discharge but, instead, contains the following provision with regard to temperature:

"… power spray module system shall be operated, as necessary, to maintain either a mixing zone (station S-4) river temperature not in excess of 69ºF, or a station N-10 to S-4 change in temperature (Delta-T) of not more than 1ºF when the N-10 ambient temperature exceeds 68ºF."

This permit finally specified that thermal plume from the Station should not block the zone of fish passage, should not change the balanced indigenous population (BIP) of the receiving water, and should have minimal contact with the surrounding shorelines.
Relative to the use of 69ºF as a regulatory trigger, EPA offers the following explanation:

"The 69°F Tmix is recommended, for the present, since it represents the most environmentally conservative case under the State of New Hampshire's cold water fishery thermal limitations, i.e., 68°F ambient plus 1°F temperature rise." [AR 681 p. 28].

EPA Response:

In this comment, EPRI quotes certain language from the Fact Sheet for the 1992 Permit issued by EPA to Merrimack Station. As such, this comment does not require an EPA response.

1.4 EPA's Draft NPDES Permit

Comment II.1.4	AR-1577, EPRI, p. 3-2 - 3-3

On September 30, 2011, EPA released a draft permit for the Merrimack Station (EPA 2011) for public review and comment[1]. This draft permit required, among other things, for the Merrimack Station to substantially reduce its thermal load to the river.

The stated reason for this requirement was that PSNH:

"…has failed to demonstrate that the plant's past and current thermal discharges have not resulted in prior appreciable harm to the balanced, indigenous population of shellfish, fish, and wildlife in Hooksett Pool of the Merrimack River.

Further, based on its own extensive analysis of thermal data:

"EPA concludes that Merrimack Station has a significant capacity to thermally impact Hooksett Pool. This conclusion is based on the:

- *short length and shallow depths of Hooksett Pool;*
- *significant fraction of shallow water habitat in the lower pool affected by the plume during summer months;*
- *quantity of water withdrawn, heated, and discharged by Merrimack Station;*
- *high and persistent temperatures above ambient associated with the plume under typical summer conditions;*
- *plume's tendency to extend across the entire width of the river;*
- *plume's demonstrated capacity to cause water column stratification, which can contribute to low dissolved oxygen events above Hooksett Dam low flows in Hooksett Pool typical during summer months (i.e., July, August, September)."*

Finally, using fisheries data EPA concluded that:

"…the evidence as a whole indicates that Merrimack Station's thermal discharge has caused, or contributed to, appreciable harm to Hooksett Pool's balanced, indigenous community of fish."

Based on the above information, EPA rejected PSNH's request for a § 316(a) variance continuation at the Merrimack Station and imposed the significantly reduced thermal loading limit in the draft permit.

The analysis of the effects of Merrimack's thermal discharge on the aquatic community consisted of a predictive and a retrospective (No Prior Appreciable Harm) assessment as described in EPA's Draft § 316(a) Technical Guidance. The predictive assessment was based on EPA's understanding of the thermal exposures together with information on thermal sensitivities of representative fish species. The retrospective assessment compared the current fish community to that reported from the Hookset Pool of the Merrimack River in the 1960s.

In April 2014, EPA issued a revised draft permit for Merrimack. This revision technology-based requirements limiting pollutant discharges from Merrimack Station's flue gas desulfurization

(FGD) system. In this revised draft permit, EPA did not alter its analysis and conclusions regarding thermal issues at the Station.

[1] AR – 618.

EPA Response:

This comment is intended to summarize EPA's stated rationale for rejecting PSNH's request for renewal of the CWA § 316(a) variance-based thermal discharge limits in Merrimack Station's 1992 permit. As a summary of EPA's stated rationale, this comment does not require an EPA response. EPA points out, however, that it did not determine the 2011 Draft Permit's thermal discharge limits based on the same factors that were the basis of rejecting the requested CWA § 316(a) variance. The proposed thermal discharge limits were based on a BPJ application of the BAT technology standard and the conclusion that such limits would also satisfy New Hampshire water quality standards.

1.5 Forty-Five Years of Comprehensive Study Concerning CWA § 316(a) and New Hampshire Water Quality Standards Demonstrates the Absence of Appreciable Harm to the Hooksett Pool BIP and that PSNH's Existing Thermal Variance Should Be Extended

Comment II.1.5	**AR-1548, PSNH, p. 8**
See also AR-846, PSNH, p.7	

Section IV, Part B. of EPA's Statement requests additional public comment concerning PSNH's CWA § 316(a) variance application and EPA's application of New Hampshire water quality standards concerning Merrimack Station's thermal effects on the Hooksett Pool portion of the Merrimack River.[24] As discussed below, the information submitted by PSNH since its 2012 comments and now in response to the specific questions in EPA's Statement corroborates that Merrimack Station's thermal discharge is not causing appreciable harm to the BIP of Hooksett Pool. These comments respond to the Statement's specific questions concerning the new thermal information and data submitted by PSNH since 2011, and EPA's questions concerning the significance of the Asian clam, a ubiquitous invasive species found throughout the United States and spreading throughout New Hampshire. As explained below, Hooksett Pool hosts a successful BIP unharmed by Merrimack Station's thermal influence or the Asian clam. PSNH urges EPA to use this opportunity presented by its Statement to reconsider its arbitrary and capricious denial of PSNH's 316(a) variance request in 2011. As discussed below, the data submitted to date, as corroborated by the new data and analyses submitted with these comments, compel a finding that PSNH has more than met its burden of showing its operations have not caused and are not causing appreciable harm to the BIP of Hooksett Pool.

[24] AR-1534 at 40

EPA Response:

EPA's 2011 Draft Permit proposing denial of PSNH's application for renewal of its existing CWA § 316(a) thermal discharge variance was neither arbitrary nor capricious, as PSNH suggests. Instead, EPA carefully considered the relevant information and reached, and explained, a rational decision in light of this information and the applicable law. EPA also does not agree that new data indicates that the BIP in the Hooksett Pool has not been harmed by Merrimack Station's past thermal discharges. *See* Responses to Comments II.3.1.3 and II.4.4 (and associated sub-comments). Furthermore, EPA does not agree that the Asian clam, which PSNH correctly labels an "invasive species," should be considered "ubiquitous" and unaffected by the facility's past thermal discharges. *See* Responses to Comments II.5.0 (and associated sub-comments).

Comments on the Draft Permit, including new fisheries analysis and a more complete, correctly understood temperature dataset, in addition to a substantially different operational profile and new ownership willing to consider a permit not based on baseload operations, all caused EPA to re-consider the appropriate thermal limits for the Final Permit. EPA has reassessed whether the Final Permit should retain the 2011 Draft Permit's technology-based and water quality-based thermal limits or, instead, whether the permit should be based on water quality requirements and/or a CWA § 316(a) variance, albeit different from the existing or previously requested variance, that would be protective of the Hooksett Pool's BIP taking into account Merrimack Station's current operating conditions.

1.6 Merrimack's 316(a) Variance

Comment II.1.6	**AR-1573, CLF et al, p. 3**

The current Permit includes a 316(a) variance that permits Merrimack to operate without complying with numeric effluent limitations on thermal discharge based on the level of control achievable through use of the best available technology. Instead the permit specifies that discharges should not violate any applicable water quality standards. Permit. I.A.1.b. In addition, the Permit also requires that thermal plumes from the station should not block the zone of fish passage, should not change the balanced indigenous population of the receiving water, and should have minimal contact with the surrounding shorelines. Permit Part I.A.1.g.

[1] For a full background of Merrimack's recent permitting history see Comment Letter of Conservation Law Foundation regarding EPA's 2011 Draft Permit, AR 851 (Feb. 28, 2012), and Comment Letter of Earthjustice, Environmental Integrity Project, and Sierra Club to EPA's 2011 Draft Permit, AR 866 (Feb. 28, 2012) . Notably, Merrimack has been operating under a NPDES permit issued over twenty years ago. Comment Letter of Conservation Law Foundation at 7.

EPA Response:

EPA agrees that Merrimack Station's 1992 NPDES permit includes thermal discharge limits based on a CWA § 316(a) variance rather than on technology-based standards. The commenter has also correctly identified certain narrative conditions in the permit. The 1992 Permit also addressed thermal discharges in Part 1.A.11. EPA has addressed comments on narrative water quality-oriented conditions for the Final Permit in Response to Comment II.6.4.3 and 6.4.4.

1.7 2011 Draft Permit and EPA's Response

Comment II.1.7	**AR-1573, CLF et al, pp. 3-5**
See also AR-851, CLF, pp. 5-6 and Exhibit 1	

EPA issued a new Draft Permit for Merrimack Station on September 30, 2011. AR-609. The Comment period for the Draft Permit ended on February 28, 2012. After reviewing comments, EPA issued the Revised Draft Permit on April 18, 2014. AR-1136. The Comment period for the Revised Draft Permit ended on October 22, 2014. AR-1137.

In the Draft Permit, EPA rejected Merrimack's request for a CWA § 316(a) thermal discharge variance. EPA concluded that Eversource had not demonstrated that Merrimack Station's thermal discharge has not caused prior appreciable harm to Hooksett Pool's BIP of fish. *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 ("Attachment D") at 121.[2] CLF supported the 2011 Draft Permit's denial of PSNH's request for a renewal of its CWA Section 316(a) variance, and the determination that year-round use of wet or wet-dry hybrid mechanical draft cooling towers in closed cycle configuration is the best available technology (BAT) for controlling thermal discharge at Merrimack Station (CLF 2012 comments 5,6, Exhibit 1 p. 1)

To the contrary, EPA found that the evidence as a whole indicates that Merrimack Station's thermal discharge has caused, or contributed to, appreciable harm to Hooksett Pool's BIP of fish. Attachment D at 121. In addition, EPA found that Eversource had not demonstrated that thermal discharge limits based on applicable technology-based and water quality-based requirements would be more stringent than necessary to assure a BIP. And Eversource had not demonstrated that its proposed alternative thermal discharge limits would reasonably assure the protection and propagation of the BIP on Hooksett Pool. *Id*. After rejecting Eversource's request for a 316(a) variance, EPA determined that, based EPA's Best Professional Judgment ("BPJ") a closed-cycling cooling system using "wet" cooling towers would be the BAT standard for thermal discharges at the Merrimack Station. *Id* at 122.

However, EPA never finalized the Revised Draft Permit and on August 2, 2017, in response to requests by Eversource, re-opened the public comment period for the Revised Draft Permit on a limited set of topics including, among other things, topics related to Merrimack River water temperatures and associated thermal impacts on aquatic species because Eversource presented new summaries of existing data and new arguments to EPA related to EPA's denial of the 316(a) variance.

In particular, at issue is the interpretation of a statistical summary of Merrimack River water temperature data provided by Eversource in a 2007 probabilistic thermal modeling report prepared by the biological consulting firm Normandeau Associates (the "Normandeau Report").

In a September 4, 2015 letter, Eversource argued EPA had misinterpreted the water temperature data, in part because the Normandeau Report was unclear. Eversource explained that the temperature data in the Normandeau Report Appendix A are not the 21-year average of the daily maximum temperatures for each day of the calendar year, but instead simply represent the maximum of the daily averages that occurred on a given calendar day. Eversource argues that EPA's misunderstanding is important because it contributed to EPA drawing inaccurate conclusions regarding Merrimack River water temperature data and, by extension, the nature and extent of the Merrimack River thermal plume.

In further support of its request that EPA reconsider its proposed denial of Eversource's request to renew the Merrimack 316(a) variance, on December 22, 2016, Eversource submitted a new temperature dataset for EPA's consideration, along with a CORMIX thermal plume modeling report.

Finally, Eversource submitted a report by Normandeau comparing benthic life near the Merrimack Station over several decades. AR-870. In reviewing this report, EPA became aware of the presence of non-native organisms in Hooksett Pool, particularly the highly invasive Asian clam (*Corbicula fluminea*). EPA began an inquiry that included field investigations confirming the presence of Asian clams and noting, at least qualitatively, that they are abundant in and near the Merrimack plume, rarer downstream, and not observed upstream of Merrimack's plume. EPA also reviewed two academic journal articles reporting on studies concluding that, in the St. Lawrence and in the Connecticut River, Asian clams had higher winter survival rates within the influence of the power plants' thermal discharge than in ambient areas, and that the elevated temperatures appeared to affect the clam's reproductive success, growth, and abundance.

[2] Except as otherwise specified, for the purpose of this comment letter, the owner and operator of Merrimack Station is referred to as "Eversource." The company had previously been known as Public Service of New Hampshire ("PSNH").

EPA Response:

This comment seeks to recount the history of this permit proceeding, particularly as it relates to the consideration and development of the permit's thermal discharge limits. EPA agrees with some aspects of this comment but feels other aspects would be more accurate if described differently. We address the latter aspects here.

First, it should be noted that the Revised Draft permit issued by EPA in 2014 only addressed new proposed effluent limits and related requirements for Merrimack Station's flue gas desulfurization (FGD) wastewater. *See, e.g.,* AR 1135, 1136, and 1137. Other provisions of the 2011 Draft Permit were left as is.

Second, the commenter correctly recites that EPA rejected Merrimack Station's request for renewal of its CWA § 316(a) variance and the associated thermal discharge limits. EPA notes, however, that it also indicated that it was still considering whether thermal discharge limits based on state water quality standards would, in some respects, be less stringent than applicable technology-based limits but nevertheless adequate to satisfy the standards of CWA § 316(a). If so, EPA explained, then such water quality-based limits could be granted based on meeting water quality requirements, as per CWA § 301(b)(1)(C), and being granted a CWA § 316(a) variance from technology-based requirements. See AR 618, § 9.5.

The commenter correctly notes that EPA again reopened the public comment period for the draft permit in 2017. While the 2014 Revised Draft permit only addressed new proposed limits for FGD wastewater, the reopened comment period in 2017 allowed public comment on a variety of issues. The commenter suggests that EPA reopened the comment period solely "because Eversource presented new summaries of existing data and new arguments to EPA related to EPA's denial of the 316(a) variance." In fact, EPA reopened the comment period for a number of reasons, including, for example, EPA's promulgation of new regulations applicable to Merrimack Station's cooling water intake structures and its discharges of FGD wastewater and bottom ash transport water as well as substantial changes in the manner of the Facility's operations (*i.e.*, changing from a baseload generator to an intermittent generator). Moreover, EPA did not reopen the comment period because Eversource provided new "summaries of existing data" and new arguments; rather, EPA decided that it should take additional comment in light of Eversource having provided information indicating that its previously submitted data had been misunderstood (due to its having been presented unclearly by the Facility). *See* AR 1534.

Having decided that reopening the comment period was necessary for various reasons, EPA specified an array of substantial new questions for which it welcomed public comment. *See* AR 1534, pp. 3-5. *See also* 40 CFR §§ 124.10, 124.14(c). EPA did not reopen the comment period lightly, as the Agency is, and has been, acutely aware of how lengthy this permit proceeding has been, albeit for a variety of necessary reasons (*e.g.*, multiple changes in applicable legal requirements have required multiple permit requirements to be reassessed and then reassessed again). Nevertheless, EPA concluded that reopening the comment period in 2017 was the correct thing to do under the circumstances.

1.8 The Hickey Report and the Nedeau Report

Comment II.1.8	**AR-1573, Sierra Club et al., p. 5**

Attached to this letter are two reports created in response to EPA's reopening of the comment period for the Revised Draft Permit's 316(a) thermal discharge limitations. The first is Review of Available Water Temperature Data and Thermal Plume Characterizations related to Merrimack Power Station in Bow, NH (Hickey, Shanahan 2017) ("Hickey Report") which analyzes Eversource's recent information submittals related to temperature data, the thermal plume in Hooksett Pool, and the request to reconsider a 316(a) thermal variance. The second is Potential Role of Merrimack Station's Thermal Effluent on Asian Clams, Native Mussels, and Ecology of the Merrimack River (Nedeau 2017) ("Nedeau Report") which analyzes Merrimack's effect on Asian Clams in Hooksett Pool, the Merrimack River, and connected waterways.

EPA Response:

EPA has reviewed and considered the two reports referenced in the above comment and addresses the reports and comments therein in the Responses to Comments below. *See, e.g.*, Responses to Comments II.3.3.5, 3.4.2, and 3.4.4.

2.0 Applicable Legal Requirements for Thermal Discharges

2.1 Relevant Legal Standard

Comment II.2.1	AR-1548, PSNH, pp. 9-13

Under CWA § 301, because Merrimack Station is a discharger of heat, it must satisfy both technology based standards and water quality standards, or obtain a variance from these standards under CWA § 316(a).[25] With respect to technology based standards, CWA § 301 requires that these standards reflect the "best available technology economically achievable . . . which will result in reasonable further progress toward the national goal of eliminating the discharge of all pollutants."[26] Additionally, CWA § 301(b) places more stringent requirements on a discharger if needed to meet state water quality standards.[27] However, "a basic technological approach to water quality control [cannot] be applied in the same manner to the discharge of heat as to other pollutants."[28] Thus, § 316(a) of the CWA authorizes EPA to grant variances for thermal discharges from "any point source otherwise subject to the provisions of section [301] . . . of [the CWA]."[29] Merrimack Station has in the past demonstrated that a § 316(a) variance from the technology based and water quality standards was appropriate; therefore, its current permit contains thermal discharge requirements based on a § 316(a) variance.[30]

CWA § 316(a) allows EPA to grant a variance from the § 301 standards described above whenever:

> [T]he owner or operator ... can demonstrate ... 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 protection 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 ....[31]

EPA may instead impose alternative effluent limitations on thermal discharges "that will assure the protection and propagation of a [BIP] of shellfish, fish, and wildlife in and on that body of water."[32] BIP is not defined by statute or regulations; however, "balanced, indigenous community" (which the regulations state is synonymous with BIP) is defined as:

> [A] biotic community typically characterized by diversity, the capacity to sustain itself through cyclic seasonal changes, presence of necessary food chain species and by a lack of domination by pollution tolerant species. Such a community may include historically non-native species introduced in connection with a program of wildlife management and species whose presence or abundance results from substantial, irreversible environmental modifications.[33]

As explained by EPA in its Fact Sheet for the 2011 Draft Permit, non-indigenous species that historically were not present in Hooksett Pool but appeared later in time should not be included in analysis of the BIP, except to consider how their presence has affected, if at all, the balanced indigenous community.[34]

The Environmental Appeals Board ("EAB") has summarized the § 316(a) variance determination process as follows:

> [R]eading CWA sections 301 and 316(a) together, the statute and regulations in effect establish a three- (and sometimes four-) step framework for obtaining a variance: (1) the Agency must determine what the applicable technology and WQS-based limitations should be for a given permit; (2) the applicant must demonstrate that these otherwise applicable effluent limitations are more stringent than necessary to assure the protection and propagation of the BIP; (3) the applicant must demonstrate that its proposed variance will assure the protection and propagation of the BIP; and (4) in those cases where the applicant meets step 2 but not step 3, the Agency may impose a variance it concludes does assure the protection and propagation of the BIP.[35]

EPA has promulgated regulations describing the factors, criteria, and standards for the establishment of effluent standards issued under a § 316(a) variance.[36] These regulations restate the requirements of § 316(a) and require the applicant to demonstrate that an alternative effluent limitation will "assure the protection and propagation of a balanced, indigenous community. ..."[37] For existing sources, this demonstration is based on the "absence of prior appreciable harm."[38]

Existing sources can show that there has been no appreciable harm in one of two ways: either by demonstrating that "no appreciable harm has resulted from the normal component of the discharge taking into account the interaction of such thermal component with other pollutants and the additive effect of other thermal sources to [the BIP]," *i.e.*, a retrospective demonstration,[39] or by demonstrating that "despite the occurrence of such previous harm, the desired alternative effluent limitations (or appropriate modification thereof) will nevertheless assure the protection and propagation of [the BIP]," *i.e.*, a prospective demonstration.[40] PSNH has demonstrated that no appreciable harm has resulted from its prior thermal discharges through a retrospective analysis.

"Appreciable harm" is not defined in EPA's regulations. However, EPA has attempted to give some meaning to the term in case law and guidance documents. In a 1974 guidance document for § 316(a), EPA describes "appreciable harm" as damage to the BIP resulting in a "substantial increase" of nuisance or heat tolerant species, a "substantial decrease" in formerly indigenous species, a "substantial" reduction of trophic structure, "reduction of the successful completion of life cycles of indigenous species," an "unaesthetic appearance, odor or taste of the waters," and "elimination of an established or potential economic or recreational use of the waters."[41] Importantly, EPA explains that "[i]t is not intended that every change in flora and fauna should be considered appreciable harm."[42]

Importantly, not all levels of impacts to a fish community rise to "appreciable harm." In fact, EPA's own guidance plainly states that some level of impact is acceptable.[43] Both the EAB and EPA Region 1 have confirmed this interpretation.[44] In sum, an existing discharger is entitled to a § 316(a) variance if, as noted above, it shows it has evaluated the typical indicators of long-term thermal effects (*e.g.*, abundance, diversity, community composition) in an appropriate manner, and determined there is no reasonable indication of thermal impacts attributable to the discharge in question.

PSNH has demonstrated that no appreciable harm has resulted from thermal discharges from Merrimack Station. Furthermore, the new data confirms that continuation of PSNH's § 316(a) variance at Merrimack Station will continue to assure the protection and propagation of the BIP; therefore, EPA should renew the variance.

[25] 33 U.S.C. § 1311.

[26] *Id.* at § 1311(b)(2)(A).

[27] *Id.*

[28] *See, e.g.*, *Appalachian Power Co. v. Train*, 545 F.2d 1351, 1356 (4th Cir. 1976).

[29] 33 U.S.C. § 1326(a).

[30] AR-236.

[31] 33 U.S.C. § 1326(a).

[32] *Id.*

[33] 40 C.F.R. § 125.71(c) (2017).

[34] AR-618 at 47 ("These species, and others that appeared later, should not have been included in an analysis of the balanced, indigenous community, except to explain how their presence may have affected the indigenous community."); *id.* at 52 ("Data provided in the Fisheries Analysis Report for the 2000s included (warmer water-favoring) species not present in Hooksett Pool in the 1960s and, therefore, not considered part of the balanced, indigenous community.").

[35] *In re: Dominion Energy Brayton Point, L.L.C. (formerly USGen New England, Inc.) (Brayton Point Station)*, 12 E.A.D. 490, 500 (EAB 2006) ("*Brayton Point I*").

[36] *See* 40 C.F.R. §§ 125.70-73.

[37] *Id.* at § 125.73(a).

[38] *Id.* at § 125.73(c)(1).

[39] *Id.* at § 125.73(c)(1)(i). In such a retrospective analysis, the existing discharger must demonstrate that it has appropriately evaluated the typical indicators of long-term thermal effects and determined there is no indication of "appreciable" thermal impacts on the BIP attributable to the discharge in question. *See Brayton Point I,* 12 E.A.D. at 553 (when looking at trends, § 316(a) determination only assigns to station those effects actually caused by station). Because ecosystems are dynamic and "changes occur continually due to natural processes and stresses," the focus of a retrospective § 316(a) demonstration's long-term assessment of fish must be on those changes that are reasonably, but definitively, attributable to a particular thermal discharge, not simply on changes alone. *In re Pub. Serv. Co. of Ind., Inc. (Wabash River Generating Station, Cayuga Generating Station)*, NPDES Appeal No. 78-6, 1979 WL 22675, at *7, 1 E.A.D. 590, 601 (EAB Nov. 29, 1979) ("*Wabash*").

[40] *See Brayton Point I*, 12 E.A.D. at 553 (citing 40 C.F.R. §125.73(c)(1)(i)-(ii)).

[41] *See* AR-1195 at 23.

[42] *Id.* Additionally, in *Brayton Point I*, 12 E.A.D. at 565 n.118, the EAB included a footnote stating that "[w]e note that the word 'measurable' is a synonym for 'appreciable.'" (citing The Doubleday Roget's Thesaurus in Dictionary Form 31 (Sidney I. Landau & Ronald J. Bogus, eds., 1977)). In response to comments on a § 316(a) variance request, EPA provided that a thermal discharge must cause a significant delay in the recovery of a BIP of fish, shellfish, and wildlife to qualify as appreciable harm. *See* AR-561 at III-8. Moreover, in response to comments regarding Brayton Point's final NPDES permit, EPA provided that "even significant adverse effects on a few species do not necessarily require a finding of appreciable harm to the BIP that would preclude a § 316(a) variance," EPA agreed "to the extent that the commenter is saying that even significant adverse effects on a few species might not create a 100 percent inviolate requirement that no § 316(a) variance could be issued." *Id.* at III- 35; *Brayton Point I*, 12 E.A.D. at 575 (providing that a permitting authority should select a temperature that "represent[s] an acceptable level of impact but [does] not represent a zero impact temperature") (citation omitted); *In re Dominion Energy Brayton Point, L.L.C. (formerly USGen New England, Inc.)*, 13 E.A.D. 407 (EAB 2007) (providing that an applicant is not required to show "no effects" to prove no prior appreciable harm).

[43] *See, e.g.*, AR-1180 at 23 (reductions in macroinvertebrate community diversity and standing crop "*may* be cause for denial of a 316(a) waiver" but applicant can still otherwise show no prior appreciable harm).

EPA Response

This comment discusses the standard for reviewing an application for issuance and renewal of CWA § 316(a) variance. It cites to a variety of sources in support of its discussion. EPA agrees with much of it but not necessarily with all of it. The Agency continues to hold the views about the applicable standards that it presented in its analyses in support of the Draft Permit. *See, e.g.*, AR 618, pp. 18-23. That said, EPA mentions a few specific points here.

The comment's concluding paragraph asserts that PSNH's submissions "demonstrated that no appreciable harm has resulted from thermal discharges from Merrimack Station … [and] the new data confirms that continuation of PSNH's § 316(a) variance at Merrimack Station will continue to assure the protection and propagation of the BIP …." EPA disagrees with these assertions regarding the effects of the Facility's past thermal discharges as a baseload generator using an open-cycle cooling system and regarding whether the CWA § 316(a) variance reflected in the 1992 Permit should be renewed at this time. For the 2011 Draft Permit, EPA determined, instead, that PSNH's retrospective demonstration did not establish that there was no prior appreciable harm to the BIP from Merrimack Station's thermal discharges when operating as a baseload facility. *See* 40 CFR § 125.73(c)(1)(i).

That said, as explained in other responses, Merrimack Station is no longer a baseload generator and now operates like a peaking plant with intermittent operations in the winter and summer months. Based on more recent information reflecting the Facility's reduced operations, EPA has determined that the thermal discharges associated with such operations are not currently causing appreciable harm to the BIP and that the protection and propagation of the BIP of the Hooksett Pool will be assured going forward with the thermal discharge-related requirements included in the Final Permit. These permit limits are designed to maintain thermal discharge levels consistent with those associated with the current intermittent operations and which GSP indicates are expected to continue into the foreseeable future. These conclusions are discussed in more detail below. While the Facility may continue to hold the view that its renewal of the past variance would also satisfy CWA § 316(a), it has agreed with EPA that the new thermal discharge requirements in the Final Permit will also do so.

EPA also does not agree with the comment's statement that if the permit applicant "determines" that the protection and propagation of the BIP is assured after certain evaluations, then it is "entitled" to a variance under CWA § 316(a). The applicant for a CWA § 316(a) variance bears the burden of demonstrating "to the satisfaction of the Administrator" that the effluent limits in the absence of the variance would be more stringent that necessary to assure the protection and propagation of the BIP, and that the requested less stringent limits will assured the protection and propagation of the BIP. 33 U.S.C. § 1326(a); 40 CFR § 125.73(a). In addition, thermal discharge effects must not be considered in isolation; they must be considered in combination with the effects of other pollutant discharges and environmental stressors. S*ee* 33 U.S.C. § 1326(a); 40 CFR §§ 125.73(a) and 125.73(c)(1). If such a showing is made, then the statute provides that EPA "may" grant a variance with alternative thermal discharge limits. 33 U.S.C. § 1326(a). S*ee also* 40 CFR § 125.70(a). The statute and regulations do not establish an entitlement to a variance based on the permittee's own judgment as to whether the statutory standard has been satisfied.

EPA also notes that the comment seems to suggest that an absence of prior appreciable harm could be established by a prospective demonstration. Perhaps this is a matter of semantics, but EPA does not think a *prospective* demonstration can establish that a discharge did not cause *prior* appreciable harm; a prospective demonstration tries to establish that a variance is warranted by demonstrating that the proposed discharge will assure the protection and propagation of the BIP going forward.

2.2 Applicable Water Quality Standards and Criteria for Merrimack

Comment II.2.2	**AR-1577, EPRI, p. 3-3**

The State of New Hampshire defines the waters of the Merrimack River in the vicinity of the Station as Class B. Class B is the second highest quality, considered acceptable for fishing, swimming and other recreational purposes and, after adequate treatment, for use as water supplies.

The State does not have numeric temperature criteria for its surface waters. Instead, it relies on the following general narrative standard:

"There shall be no disposal of sewage or waste into said waters except those which have received adequate treatment to prevent the lowering of the biological, physical, chemical or bacteriological characteristics below those given above, nor shall such disposal of sewage or waste be inimical to aquatic life or to the maintenance of aquatic life in said receiving waters."

Further, with respect to discharge of heat, New Hampshire Code of Administrative Rules requires:

"Any stream temperature increase associated with the discharge of treated sewage, waste or cooling water, water diversions, or releases shall not be such as to appreciably interfere with the uses assigned to this class."

EPA Response

This comment summarizes certain aspects of New Hampshire water quality standards pertaining to the regulation of thermal discharges. EPA regards the discussion in the comment to be incomplete, however, and continues to understand the relevant New Hampshire water quality requirements in the manner discussed in EPA's "Clean Water Act NPDES Permitting Determinations for the Thermal Discharge and Cooling Water Intake Structures at Merrimack Station in Bow, New Hampshire" (September 30, 2011) (the 2011 Determinations Document), issued together with, and in support of, the 2011 Draft Permit. *See* AR 618, pp. 174-78. EPA notes in particular that the comment fails to reference either N.H. Rev. Stat. Ann. § 485-A:8(VIII) or N.H. Code R. Env-Wq 1703.13(b).

2.3 Clean Water Act Section 316(a)

Comment II.2.3	**AR-1573, Sierra Club et al., pp. 1-2**

Heat is defined as a pollutant under the Clean Water Act ("CWA"). 33 U.S.C. § 1362(6). 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. Permit limits for thermal discharges must, at a minimum, satisfy federal technology-based requirements, as well as any more stringent requirements based on state water quality standards that may apply. *See* 33 U.S.C. § 1311(b)(1)(C). CWA § 316(a) provides for an exception – a variance – from the general requirement that NPDES permits include effluent limits that, at a minimum, satisfy federal technology-based standards, and that also satisfy any more stringent requirements based on state water quality standards that apply. Section 316(a) authorizes the permitting agency to grant a variance and impose less stringent thermal discharge limits if the permittee can demonstrate that "any effluent limitation proposed for the control of the thermal component of any discharges…will require effluent limitations more stringent than necessary to assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife." 33 U.S.C. § 1326(a). Any 316(a) variance must "assure the protection and propagation of a balanced, indigenous population ["BIP"] of shellfish, fish, and wildlife in and on the body of water." *Id.*; 40 C.F.R. § 125.70.

The permittee has the burden of proof in persuading the permitting authority that the non-variance limits are more stringent than is needed and that an alternative set of limitations will be sufficient to protect the BIP. 33 U.S.C. § 1326(a); 40 C.F.R. § 125.73(a).

EPA Response

This comment fairly summarizes CWA requirements applicable to thermal discharges. EPA discussed these CWA requirements in detail in its Determination Document issued in support of the 2011 Draft Permit. *See* AR 618, pp. 16-26.

2.4 Regulation of Thermal Pollution under Clean Water Act

Comment II.2.4	AR-1577, EPRI, p. 3-2

The Clean Water Act clearly defines heat as a pollutant. Thus, the discharge of heat to the Nation's waters is prohibited unless explicitly authorized by a National Pollutant Discharge Elimination System (NPDES) permit. However, Congress recognized the unique nature of thermal pollution, including rapid dissipation and lack of accumulation, and included a special variance process in Section 316(a):

"With respect to any point source otherwise subject to the provisions of section 301 or section 306 of this Act, whenever the owner or operator of any such source, after opportunity for public hearing, can demonstrate to the satisfaction of the Administrator (or, if appropriate, the State) 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 projection [sic] 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 (or, if appropriate, the State) may impose an effluent limitation under such sections on 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."

In September 1974 and May 1977, USEPA issued draft guidance for the § 316(a) variance process (USEPA 1974 and 1977). Although never finalized, these draft documents are still commonly used as guidance for the conduct of demonstration studies as part of the application for a § 316(a) variance.

EPA Response

The commenter suggests that Congress took note that heat discharged to waters of the United States dissipates rapidly and does not accumulate and that this led Congress to create the variance process in CWA § 316(a). To be clear, EPA would add that the speed with which waste heat dissipates, and does or does not accumulate, is all relative and will vary from case to case. This is why Congress enacted CWA § 316(a) so that permitting authorities could evaluate the effects of particular thermal discharges and decide whether or not a variance should be granted. The effects of the thermal discharge, and whether heat dissipates rapidly or accumulates, will depend on, among other things, how much heat is being discharged, how cold the receiving water is, whether it is deep or shallow, fast-flowing or slow-moving or impounded.

In addition, EPA notes that on August 6, 2019, the Agency's Office of Water issued a policy memorandum titled, "Office of Water Policy for Draft Documents." https://www.epa.gov/sites/production/files/2020-02/documents/ow_policy_for_draft_documents_to_ow_program_directors_signed_002.pdf (website last visited on April 3, 2020). This memorandum, at p. 1, states that, "… effective immediately, all draft documents that were issued more than two years ago and have not been finalized are hereby rescinded." Based on this policy memorandum, the two draft guidances cited by the commenter have been rescinded and will not be cited to support these responses to comments. EPA also later produced a list of rescinded guidance documents which did not include the two draft guidance documents cited by the commenter, but the policy memorandum by its terms has rescinded the draft guidance documents, regardless of whether they were included in the list.

2.5 316(a) Variance Demonstration Requirements

Comment II.2.5	**AR-1573, Sierra Club et al., pp. 2-3**

A "balanced, indigenous population" ("BIP") is defined by EPA regulations to mean "a biotic community typically characterized by diversity, the capacity to sustain itself through cyclic seasonal changes, presence of necessary food chain species and by a lack of domination by pollution tolerant species." 40 C.F.R. § 125.71(c). Moreover, normally "such a community… may not include species whose presence or abundance is attributable to alternative effluent limitations imposed pursuant to section 316(a)." *Id.* To determine the BIP for a local waterway, EPA must consider what species would inhabit the receiving water body if it were not degraded by thermal discharges. For example, the presence of a large population of a heat resistant species that is caused by thermal discharges authorized under a previous 316(a) variance would indicate that the variance had not adequately protected and preserved the BIP.

The regulations and guidance allow for different types of 316(a) demonstrations which may include "any information [the permitting authority] deems relevant" and which may vary depending on site specific characteristics. 40 C.F.R. § 125.73(b).

An existing discharger may show that their proposed 316(a) variance is more stringent than necessary to protect and preserve a BIP by demonstrating the "absence of prior appreciable harm in lieu of predictive studies." 40 C.F.R. § 125.75(c)(1). Under this approach, normally referred to as a "Retrospective Analysis," an existing discharger must show that "no appreciable harm has resulted from the normal component of the discharge." 40 C.F.R. § 125.75(c)(1)(i). However, if there is some previous harm, the existing discharger may still obtain a 316(a) variance if it shows that the "desired alternative effluent limitations (or appropriate modifications thereof) will nevertheless assure the protection and propagation" of a BIP. 40 C.F.R. § 125.75(c)(1)(ii). This approach is quite similar, if not identical, to the central BIP standard under 40 C.F.R. § 125.75(a). This type of showing is referred to as a "Prospective Analysis."

In 1977, EPA issued a technical guidance manual to guide the development of 316(a) demonstrations. Although forty years have elapsed since its creation, EPA has never updated this manual and continues to rely upon it in evaluating 316(a) variance requests. The EPA manual provides guidance for identifying the appropriate level of information in demonstrations and in scoping thermal, fisheries, and other surveys to support the assessment of potential adverse impacts.

EPA Response:

EPA agrees with the commenter's general description of the standards applied under EPA regulations when reviewing a request for renewal of a CWA § 316(a) variance. EPA also agrees with the commenter's general characterization of the 1977 draft guidance document, but this draft guidance document has recently been rescinded by EPA. .

On August 6, 2019, the Agency's Office of Water issued a policy memorandum titled, "Office of Water Policy for Draft Documents." https://www.epa.gov/sites/production/files/2020-02/documents/ow_policy_for_draft_documents_to_ow_program_directors_signed_002.pdf (website last visited on April 3, 2020). This memorandum, at p. 1, states that, "… effective immediately, all draft documents that were issued more than two years ago and have not been finalized are hereby rescinded." Based on this policy memorandum, the draft guidance cited by the commenter has been rescinded and EPA will not cite to it to support these responses to comments. While EPA later produced a list of rescinded guidance documents which did not include the specific draft guidance document cited by the commenter, the earlier policy memorandum by its terms has rescinded the draft guidance document regardless of whether it was included in the list.

2.6 What is a Balanced Indigenous Population?

Comment II.2.6	AR-1577, EPRI, pp. 3-2 to 3-3

40 CFR § 125.71 defines "balanced, indigenous population of shellfish, fish and wildlife" as synonymous with "balanced, indigenous community" meaning:

"a biotic community typically characterized by diversity, the capacity to sustain itself through cyclic seasonal changes, presence of necessary food chain species and by a lack of domination by pollution tolerant species. Such a community may include historically non-native species introduced in connection with a program of wildlife management and species whose presence or abundance results from substantial, irreversible environmental modifications. Normally, however, such a community will not include species whose presence or abundance is attributable to the introduction of pollutants that will be eliminated by compliance by all sources with section 301(b)(2) of the Act; and may not include species whose presence or abundance is attributable to alternative effluent limitations imposed pursuant to section 316(a)." [§ 125.71]

The terms balanced, indigenous population (BIP) and balanced, indigenous community (BIC) are used interchangeably in the § 316(a) variance literature.

EPA Response:

This comment essentially repeats, as EPA explained in the 2011 Determinations Document, AR 618, pp. 18-20, that neither the CWA nor EPA regulations define BIP, but EPA's regulations provide a definition of BIC and indicate it is synonymous with BIP. EPA agrees with the comment.

3.0 Temperature Data Review and Re-Analysis

Comment II.3.0	AR-1548, PSNH, p. 60

PSNH appreciates EPA's reconsideration of the temperature data, which was previously misinterpreted and which misrepresentation led to an incorrect § 316(a) determination and denial of a thermal variance for Merrimack Station. The temperature data, when correctly interpreted, helps explain what 40+ years of actual biological data and analyses concerning the fish and macroinvertebrate communities, as well as New Hampshire water quality, already show—that Merrimack Station's thermal discharge has not caused appreciable harm to the BIP of Hooksett Pool, and the variance should be granted.

EPA Response:

In response to PSNH's new explanation of its data submission, EPA reevaluated how it used the 21-year temperature data set in its evaluation of Merrimack Station's thermal discharge, and the discharge's potential to impact the biological community of Hooksett Pool. EPA agrees that the Agency incorrectly understood the data to represent maximum temperatures averaged over the 21-year period, owing to "a lack of clarity in the Report itself," as Eversource acknowledged. AR-1367. Since the issuance of the Draft Permit, in response to comments received and because of the misinterpretation of the data, EPA received and reviewed actual daily temperature data from PSNH.

Upon review of the daily data, it was clear to EPA that mean, minimum, and maximum average daily temperatures over a 21-year period do not adequately support PSNH's request for renewal of the existing CWA § 316(a) variance. Relying solely on (21-year) averages of daily averages is not an appropriate way to assess the existing and potential environmental impacts from Merrimack Station's thermal discharge because such averages over a lengthy period of time could mask periodic, or seasonal, temperature excursions that could harm the biological community. In support of the Final Permit limits, EPA evaluated the actual daily temperature data from the period beginning in 2004 and extended through May 2019 (as well as additional operational and fish abundance data) to determine whether a variance under CWA § 316(a) should be granted for the Facility's thermal discharges. *See* Responses to Comments in Section II.3.1. As discussed further in these Responses to Comments, although EPA did at the time of the 2011 Draft Permit misunderstand what the data in PSNH's 21-year data set represented, EPA's decision was based on a variety of data, and the Agency later reconsidered the relevant issues based on a correct understanding of the 21-year data set and other information. Based on this assessment, EPA does not agree with the comment's statement that the Agency's proposed denial of PSNH's variance application, as detailed in the 2011 Determinations Document, was in error. Moreover, EPA disagrees with the comment's statement that the record shows that Merrimack Station's past thermal discharges while operating as a baseload generator with an open-cycle cooling system did not appreciably harm the Hooksett Pool's BIP.

3.1 Long-Term Temperature Data Set

3.1.1 EPA's Misinterpretation of Key Temperature Data In Its 2011 Draft Permit Further Undermines the Agency's Decision to Deny PSNH's Request for a Thermal Variance

Comment II.3.1.1	AR-1548, PSNH, pp. 41-42
See also AR-872, Normandeau, pp. 96-100, 111-117, 125; AR-1573, Sierra Club et al. p. 4	

As EPA acknowledged in its Statement, EPA denied PSNH's request for a thermal variance from the requirements of § 316(a) based on a material misinterpretation by EPA of temperature data contained in Appendix A of Normandeau's April 2007 report, "A Probabilistic Thermal Model of the Merrimack River Downstream of Merrimack Station."[201] Appendix A of the 2007 Report tabulates "Historical Maximum, Minimum and Mean Average Daily Temperature as Measured at Merrimack Station Monitoring Stations N10, S0 and S4 and Predicted at Monitoring Station A-0 for Merrimack during the 1 April to 1 November period of 1984-2004."[202] EPA seeks comment concerning the import of this misinterpretation and concerning PSNH's new data submissions since closure of the 2012 comment period, as well as how shorter and longer-term thermal data should be factored into EPA's evaluation of the effects of Merrimack Station's thermal discharges on Hooksett Pool and EPA's development of thermal discharge limits for Merrimack Station.[203]

As EPA recognizes in its Statement, PSNH acknowledges that EPA's misunderstanding and misinterpretation of this data may have stemmed from a lack of clarity in Normandeau's April 2007 report. Nonetheless, EPA's interpretative error is substantial and permeates the entirety of its 2011 Fact Sheet and § 316(a) determination. When correctly interpreted, these data provide the minimum, average, and maximum daily average temperatures on a given calendar day that occurred typically only one time during the 21 years monitoring data was collected between 1984 and 2004.[204] By assuming the maximum daily average temperatures reported in Appendix A represented the 21-year average for each calendar day, EPA greatly overstated the actual river temperatures to which fish were exposed during those years. Indeed, based on this error, EPA concluded that the temperatures exceeded thermal tolerance criteria for alewife, American shad, yellow perch, and white sucker. When correctly interpreted, the data shows that most of the thermal tolerance limits used in EPA's analysis were never exceeded on dates at which the species and life stages in question are present in the river.[205] Compounding the error, EPA did not consider that, with respect to the RIS and their thermal tolerances, the area and volume of the Pool affected by the plume is negligible. Finally, EPA's confusion of a short term, 24-hour average value with a long term average does not yield a new data point of significance. Forty-five years of actual study demonstrate an absence of prior appreciable harm to the fish and macroinvertebrate communities and water quality of Hooksett Pool. Theoretical temperature tolerance thresholds pulled from a patchwork of academic reports cannot supersede the exhaustive, hands-on studies of every component of the aquatic ecosystem in the waterbody.

[201] *See* AR-1534 at 38.

[202] AR-10, Appendix A-2 through A-8.

[203] *See* AR-1534 at 40.

[204] *See* AR-10, Appendix A-2 through A-8.

[205] *See* AR-1300 at 13. And in those few instances in which EPA's criteria were exceeded, the number of dates on which they were exceeded, and the durations of the period when any exceedances occurred, were much smaller than was asserted by EPA and do not support a finding of appreciable harm. LWB 2017 Response at 2.

EPA Response:

Eversource comments that EPA's misinterpretation of the temperature data "permeates the entirety of its 2011 Fact Sheet and § 316(a) determination." EPA explained in its 2017 Statement that it would re-evaluate the conclusions from the 2011 Draft Determinations Document that were based on the Agency's original interpretation of the temperature data and would re-evaluate the use of the data in its assessment of the variance request. *See* AR-1534 p. 39. EPA first clarifies the error in its interpretation of the data, and then responds to the implications of the error on the § 316(a) variance determination for the Draft and Final Permits.

The temperature tables in Appendix A of Normandeau's 2007 Report include the title "Average Daily Maximum, Minimum and Mean Water Temperatures Measured at Monitoring Stations N-10, S-0, and S-4 and Predicted at A-0 for Merrimack Station for the 1 April – November Period of 1984 through 2004." *See* AR-10. These tables are also presented in the Determination Document as Appendix A. EPA understood this data to reflect the average daily minimum, mean, and maximum temperature for each day from April 1 to October 31 over a period of 21 years. *See* AR-1534 p. 38. The "average daily mean water temperature" would be calculated as the average of the mean daily temperature values reported for that day over 21 years. Similarly, EPA interpreted the "average daily maximum temperature" would be calculated as the average of 21 reported maximum temperature values for that day. This interpretation is consistent with the data format used to present temperature values in PSNH's annual environmental monitoring reports as far back as 1991 (*see, e.g.*, AR-298). The annual reports have consistently presented temperature data in a tabular format that includes the maximum temperature recorded (and time sampled,) the daily average temperature, and the minimum temperature recorded (and time sampled) for each day of the monitoring period. Accordingly, EPA interpreted the "Average Daily Maximum, Minimum and Mean Water Temperature" in Normandeau's 2007 Report to be the average of the maximum daily temperatures (and minimum and mean) consistent with the temperature data provided in its annual reports.

In its comments on the 2011 Draft Determinations Document (AR-872), Normandeau pointed out that EPA evaluated thermal impacts using a maximum water temperature documented to have occurred once in 21 years, not on an annual basis. *See* AR-872 p. 95. *See also* Response to Comment II.3.1.4. EPA understood this comment to mean that it may have mistakenly interpreted the "Average Daily Maximum, Minimum and Mean Water Temperatures' as presented in Appendix A of the 2007 Report. On September 4, 2015, after the public comment period, PSNH sent EPA a letter acknowledging that "EPA based its decision to reject PSNH's request for a thermal discharge variance due, at least in part, to what we now recognize as a misinterpretation of some of the key thermal results presented in Normandeau Associates ('Normandeau') April 2007 report entitled A Probabilistic Thermal Model of the Merrimack River Downstream of Merrimack Station (the 'Report')." *See* AR-1367. In its letter, PSNH clarified the errors in the interpretation of Normandeau's data, and recognized that "any misinterpretation of the data by the agency is due to a lack of clarity in the Report itself … and we regret that it was not presented better." *Id*. p. 2. Eversource verified Normandeau's comments that, in fact, the "average daily maximum temperatures" used in EPA's analysis are not 21-year averages of the daily maximum temperature, but the maximum value of the daily average temperature which occurred in a single year of the 21-year period. This an important distinction and EPA agreed that it had indeed misinterpreted the temperature data set provided in Normandeau's 2007 Report. *See* AR-1534 p. 39.

As explained in EPA's 2017 statement (AR-1534 p. 38), EPA requested additional information in response to PSNH's 2015 letter to clarify any potential uncertainty or confusion concerning the temperature data. *See* AR-1298. EPA requested a re-analysis of the temperature data to include the annual daily water temperature from the annual monitoring reports (in spreadsheet format rather than pdf), and a re-calculation of the 21-year data as average daily "instantaneous maximums" "instantaneous minimums" and "daily means." *See Id*. p. 3. In response to this request, Eversource submitted a new review of EPA's §316(a) determination from LWB (AR-1300), daily recorded temperature data for the period beginning 2002 through 2015, and the calculations EPA requested for the period 2002 through 2015. *See* AR-1299. PSNH responded that it presented values for the new time period (2002 through 2015, rather than Normandeau's original time period of 1984 through 2001) because the records from 1984 through 2001 were "not maintained in the normal course of business" and that generating electronic spreadsheets of this data would "require a significant amount of time and manpower for little to no benefit." *See Id*. p. 4. For the Final Permit, and in response to the comments received on the 2011 Draft Permit and 2017 Statement, EPA evaluated actual temperature data received in response to this request. EPA also considered the temperature data provided in the Facility's 2017, 2018, and 2019 annual reports.[6] *See* AR-1302; 1303; 1304; 1305; 1306; 1307; 1607; 1657; and 1658.

PSNH comments that denial of its request for a thermal variance under § 316(a) was based on a "material misinterpretation" of the temperature data. EPA acknowledges that, due to misleading titles in the tables, the data was incorrectly interpreted as average daily maximum temperatures. At the same time, the 2017 Statement explains that EPA's consideration and analysis of this temperature data was only part of the basis of the Agency's rejection of PSNH's proposed § 316(a) variance. AR-1534 p. 38. PSNH recognized this in its letter to EPA, stating that the Agency's "decision to reject PSNH's request for a thermal discharge variance [was] due, *at least in part*, to what we now recognize as a misinterpretation of some of the key thermal results…." AR-1367 (emphasis added). While the temperature data was a major component of EPA's

[6] Consideration of the actual, daily temperature data is consistent with comments received from CLF and Sierra Club that EPA consider the long-term, comprehensive continuous monitoring data for the three locations in the Merrimack River instead of relying on high-level summaries that hide peak temperatures and variation over time. *See, e.g.*, AR-1575 p. 9.

evaluation of the potential thermal impacts of the plume on the BIP (*see* AR-618, p. 78-116) the Agency also considered a substantial volume of fisheries data. Based on this fisheries data, EPA concluded that a significant change to the Hooksett Pool's balanced, indigenous population was evident and, moreover, that PSNH's analysis of fish population trends did not support its claim that Merrimack Station's thermal effluent had not appreciably harmed the BIP of the Hooksett Pool. *See* AR-618, p. 39-78. These two, distinct analyses together supported EPA's initial determination to deny the § 316(a) variance for Merrimack Station. Having said that, the 2017 Statement makes clear that EPA intended to re-evaluate conclusions from the 2011 Draft Determinations Document that were based on the original interpretation of the temperature data. EPA provides this re-evaluation in response to comments below.

PSNH comments that, due to the error in interpreting the maximum average temperatures, EPA greatly overstated the actual river temperatures to which fish were exposed during those years. PSNH adds that, when correctly interpreted, the data shows that most of the thermal tolerance limits used in EPA's analysis were never exceeded on dates when the species and life stages in question are present in the river. EPA's review of the actual, reported daily temperatures in the Merrimack River support the conclusions from the 2011 Draft Determinations Document in some cases, and show that in other cases EPA did unknowingly overstate some of the river temperatures to which fish were exposed. EPA addresses this issue in more detail in Response to Comment II.3.1.3, below.

PSNH also comments that EPA "did not consider that, with respect to the RIS and their thermal tolerances, the area and volume of the Pool affected by the plume is negligible." PSNH provides no supporting information or reference for this statement but raises the issue in other comments referencing the 2016 CORMIX model and additional analysis provided by LWB. EPA addresses the model and supporting analysis in detail in Responses to Comments II.3.3.3 and 3.3.4. EPA notes here, however, that PSNH did not provide an evaluation of the area and volume of the thermal plume for the 2011 Draft Determinations Document, and not did provide the necessary information for EPA to characterize the area and volume of the plume while developing the Draft Permit.

Finally, PSNH comments that the "confusion of a short term, 24-hour average value with a long term average does not yield a new data point of significance." Understood correctly, the single, maximum 24-hour average temperature for each calendar day over a period of 21 years does not provide a useful data point to assess PSNH's request to renew its existing thermal discharge variance under CWA § 316(a). The 2017 Statement, however, indicates that the clarifications about the data led EPA to reconsider how thermal data can support development of protective temperature limits. While long-term averages have utility, long-term averages can obscure the more extreme conditions that fish and other aquatic life could be exposed to over shorter, but still biologically significant, periods of time. *See* AR-1534 p. 39-40. PSNH does not explain its statement or comment on the issues raised in the 2017 Statement about the importance of exposure to high temperatures over shorter periods of time. As in the 2011 Draft Determinations Document, evaluation of the thermal impacts for a § 316(a) variance determination should consider "any information contained or referenced in any applicable thermal water quality criteria and thermal water quality information published by the Administrator under section 304(a) of the Act, or any other information he deems relevant." 40 CFR § 125.73(b). In other words, EPA maintains that fisheries data and analysis, applicable water quality criteria, and water quality standards must be considered *in combination with* the actual daily temperature data and knowledge of the thermal tolerance of the fish species in Hooksett Pool. This Response to Comments addresses comments and new analyses received during, and subsequent to, the public comment period for the 2011 Draft Permit. EPA addresses each of these issues in detail in the Responses to Comments below. *See, e.g.*, Response to Comments in Section II.3.1, 3.2, 3.3, and 4.0.

3.1.2 EPA's Interpretative Error is Substantial and Permeates Its Entire § 316(a) Analysis

Comment II.3.1.2	AR-1548, PSNH, pp. 42-45

PSNH's consultant, Normandeau, first identified the agency's interpretive error in its February 2012 Comments on EPA's Draft Permit for Merrimack Station.[206] It was not until PSNH submitted its September 4, 2015 letter to EPA, however, that the agency appreciated the gravity of its misinterpretation. The maximum temperature values provided in Appendix A of Normandeau's 2007 Thermal Model Report represented the maximum daily average that occurred on a given calendar day typically only one time during the 21 years monitoring data was collected between 1984 and 2004. EPA incorrectly construed these values as the 21-year average of the daily maximum temperatures for each day of the calendar year (*i.e.*, the "averaged daily maximum"). Normandeau's individual-day data tables in Appendix A do not offer any analyses with respect to the duration specific temperatures occurred on any given day, much less whether such durations spanned multiple days.

As explained in PSNH's September 4, 2015, letter to EPA, two examples illustrate the magnitude of EPA's error in its interpretation of the 21-year data set.[207] On page 120 of EPA's 2011 Fact Sheet (Attachment D) for the Draft Permit, EPA states: "The averaged daily maximum water temperature exceeded 83.0°F (28.3°C) . . . every day at Station S-4 from June 15 to September 10."[208] But this statement is incorrect. While it was proper for EPA to conclude from Appendix A to Normandeau's 2007 report that at some point in time during the 21-year data record the maximum daily water temperature at downstream Monitoring Station S4 exceeded 83°F at least one time on each given calendar day between June 15 and September 10 during the 21-year monitoring period, it was not correct to assert from the Appendix that these temperatures occurred on consecutive days in every year or even consecutively on any given days in any single year during this 21-year period. Second, the maximum water temperature values reported for Hooksett Pool Monitoring Stations N10, S0, or S4 (A0 is predicted) in Appendix A of Normandeau's 2007 Report do not represent actual, consecutive maximum daily mean temperatures occurring within the same year. Specifically, PSNH explained in its September 4, 2015 letter:

> [T]he maximum daily water temperature at downstream Monitoring Station S-4 in the Hooksett Pool on August 10th during the period 1984 through 2004 was 94.1°F. Although not reported in Appendix A, this single maximum daily water temperature among all 21 years of recorded data at Monitoring Station S-4 actually

> occurred on August 10, 1988. The maximum water temperature for August 11th among all 21 years of Monitoring Station S-4 data was 93.6°F, but this temperature occurred almost three years earlier, on August 11, 1985 . . . . EPA therefore erred in assuming that the maximum temperatures are consecutive within the same year and in using the Appendix A data in this manner.[209]

EPA's misinterpretation of Normandeau's 2007 Thermal Model Report is a cornerstone of the agency's 2011 Fact Sheet and its entire § 316(a) analysis.[210] EPA acknowledges this in its 2011 Fact Sheet: "Given its spatial and temporal coverage, EPA considered this data set [from the 2007 Normandeau Thermal Model Report] to be representative of actual thermal conditions in Hooksett Pool, and used it to assess potential temperature effects on certain species and lifestages . . . ."[211] What follows is a representative sample of instances in the 2011 Fact Sheet in which EPA relied upon its misinterpretation of the data in a manner that calls into question the agency's assertions and/or conclusions:

- Fact Sheet at 84-85: Comparing the 21-year Normandeau data set to Applied Science Associates, Inc.'s 2009 temperature study period and discrediting the 2009 data as not representative of typical river conditions by utilizing the misinterpreted Normandeau data;
- Fact Sheet at 89: Incorrectly asserting that the averaged maximum temperatures at Station S4 exceeded 84°F every day from June 25 to September 8;
- Fact Sheet at 93: Incorrectly asserting that that the average maximum temperature at Station S4 exceeded 85°F every day from June 25 to September 3;
- Fact Sheet at 93-94: Incorrectly asserting that the averaged maximum temperatures at Station S0 reached 92.9°F in mid-June;
- Fact Sheet at 104: Incorrectly asserting that the average daily maximum water temperatures at Station S0 ranged from a low of 79.2°F on May 3 to a high of 94.3°F on June 12;
- Fact Sheet at 105: Incorrectly asserting that temperatures "well exceeding" 89.6°F at Station S0 continue for the duration of the yellow perch larval period;
- Fact Sheet at 106: Referencing average daily maximum water temperatures and incorrectly asserting that they were at or exceeding certain threshold temperatures annually during discrete time periods;
- Fact Sheet at 107: Incorrectly asserting the averaged daily maximum temperature exceeded 82.4°F at Station S4 every day from June 10 to September 10 from 1984 to 2004;
- Fact Sheet at 112-13: Incorrectly referencing averaged daily maximum temperatures at S0 and S4 as exceeding certain thresholds on certain dates;

- Fact Sheet at 115: Incorrectly asserting that average daily maximum temperatures exceeded 85.8°F every day at Station S4 from June 25 to September 1;

- Fact Sheet at 119: Incorrectly referencing averaged daily maximum temperatures at S0 as exceeding certain thresholds on certain dates;

- Fact Sheet at 203: Incorrectly referencing averaged daily maximum temperatures at S0 as exceeding certain thresholds on certain dates;

- Fact Sheet at 204: Incorrectly asserting that the difference between maximum ambient river temperatures and average maximum temperatures at the mouth of the discharge canal "routinely exceeded" a certain threshold; and

- Fact Sheet at 206: Incorrectly asserting that the averaged maximum recorded temperatures at Station S0 reached 92.9°F in mid-June for the 21-year data set.

There are other instances of EPA relying on its misinterpretation of this data in the Fact Sheet and/or administrative record that are not readily apparent from the text. Nevertheless, it is clear from the above examples that this misinterpreted temperature data is foundational to the agency's § 316(a) analyses and conclusions and must be revisited by EPA.

[206] AR-1534 at 38 (citing AR-10, Appendix A-2 through A-8).

[207] *See* AR-1367 at 2.

[208] AR-618 at 120.

[209] AR-1367 at 2.

[210] *See generally* AR-618.

[211] *Id.* at 81-82.

EPA Response:

PSNH comments that EPA's misinterpretation of Normandeau's 2007 Thermal Model Report is a cornerstone of the Agency's entire § 316(a) analysis and, as a result, the assertions and/or conclusions of the analysis are called into question. PSNH also provides a "representative sample of instances" from the 2011 Draft Determinations Document where erroneous conclusions were based on this misinterpretation of data.

EPA acknowledges that the temperature data at issue was an integral part of its analysis of the Facility's thermal impacts in the 2011 Determinations Document and, therefore, a key factor in its proposed decision to reject PSNH's requested variance under CWA § 316(a). (As PSNH's consultants have acknowledged, though it is not mentioned in the above comment, EPA's misinterpretation of the data resulted from the misleading or unclear way in which it was presented by the Facility.) EPA's misinterpretation of temperature data (due to a lack of clarity in presentation) does not, however, necessarily support either that PSNH's proposed § 316(a) variance should be granted or that the BIP will be protected. Instead, it supports a re-examination of the in-stream temperature data and the potential of the Facility's thermal discharge to impact the biological community of Hooksett Pool for the Final Permit. Consistent with that, in the comment above, PSNH lists examples where the maximum temperature led EPA to conclude that conditions in the Merrimack River are unsuitable for various life stages and species and suggests that, as a result of these errors, the temperature data and conclusions from the 2011 Draft Determinations Document must be revisited.

In response, EPA *has* undertaken such a re-examination, as discussed in these Responses to Comments. Moreover, EPA discussed the data misinterpretation issue in the 2017 Statement and specifically invited additional public comment on that issue and the question of how to factor short-term and long-term data into the evaluation. AR 1534, p. 39-40. EPA has considered the comments submitted in response and factored them into its re-examination. EPA has also looked at the most recent temperature data available.

Plainly, the Agency's misinterpretation of the single maximum average daily value in 21 years as the average maximum daily temperature over 21 years resulted in an overestimate of the number of days that certain threshold values would be exceeded. As one example, PSNH references EPA's conclusion that "the averaged daily maximum water temperature exceeded 83.0°F (28.3°C) – the temperature Merrimack Station identified as an avoidance temperature for yellow perch - every day at Station S-4 from June 15 to September 10." AR-618 at 120. EPA now understands that AR-10 (Appendix A) demonstrates only that the maximum daily temperature at Station S4 exceeded 83°F during at least one of the 21 years of record on each calendar day between June 15 and September 10. As PSNH points out, temperatures exceeding 83°F may or may not have occurred in every year or on consecutive days in any single year. In fact, the summary data (AR-10 Appendix A), which only provides the range (*i.e.*, minimum and maximum) and average daily temperatures over 21 years provides no information about conditions in the river during any given year.

Still, when ambient river temperatures are elevated and river flow decreases, as can occur during the summer months at times, the plant's thermal effects on the lower Hookset Pool can be profound, particularly when the plant is operating both units. Such conditions occurred in 2004, a year when extensive fish sampling was conducted in August and September by Normandeau. Data shows that mean daily water temperatures at Station S0 exceeded the yellow perch avoidance temperature (28.3ºC) every day between June 21 and September 19, 2004 (excluding several days in July when Unit 2 was taken offline). The mean daily temperature at Station S4 also frequently exceeded 28.3°C during this period. Notably, the S4 mean daily temperature reached or exceeded 83°F for two weeks between July 31 through August 13 (See Figure II.1, below). While PSNH is correct that the maximum daily average data provided in AR-10 (Appendix A) and referenced in the 2011 Draft Determinations Document does not indicate that elevated temperatures occurred on consecutive days in every year or even consecutively on any given days in any single year during this 21-year period, EPA's re-evaluation of the daily temperature data from the annual reports demonstrates that river temperatures at Station S0 and even S4 were, indeed, higher than protective temperatures for thermally-sensitive species for many consecutive days or weeks in some years.

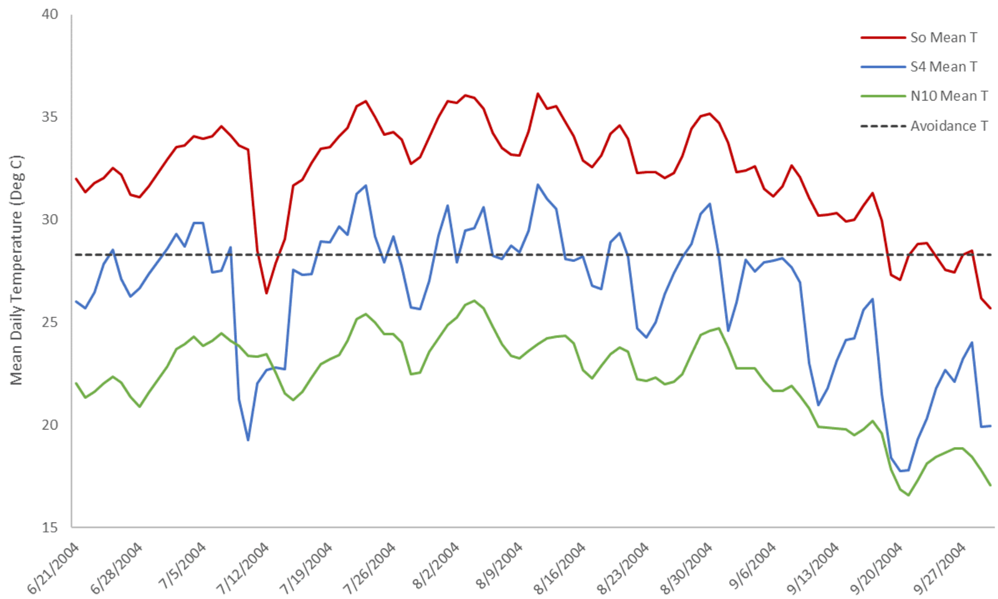

Figure II.1. Mean daily (24-hour average) temperature (deg C) at Stations S0 (discharge), S4 (downstream), and N10 (ambient) from June 21 through September 30, 2004 compared to the yellow perch avoidance temperature (28.3°C).

Fisheries data for 2004 presented in Normandeau's 2007 Fisheries Analysis Report (AR-3) suggests that the fish may have responded to the elevated temperatures in the thermal plume by avoiding the lower pool. According to the report, fish abundance in general was much lower in the "thermally-influenced" zone downstream from the plant's discharge with a total catch-per-unit-effort (CPUE) of 22.00 compared to 79.30 in the "ambient" zone upstream from the thermal discharge. For yellow perch, whose abundance was already low pool-wide, the CPUE was almost seven times lower in the thermally-influenced zone (CPUE 1.22 v. 0.18). AR-3, p. 62-63. Examining data over a single year, rather than relying solely on long-term averages, EPA demonstrates that thermal impacts from Station operation can result in river temperatures above exclusionary limits and these temperatures may result in behavioral changes (e.g., avoidance) in resident fish populations.

Thermal stress that extends for prolonged periods during a season, particularly the critical summer season when many fish utilize thermal conditions to optimize their ability to grow in length and weight, and to mature, can cause adverse effects to fish populations sensitive to those conditions. While EPA was initially confused by Normandeau's mislabeled temperature data, daily temperature data representative of baseload Station operation support EPA's conclusions that, in at least some years, the thermal discharge from Merrimack Station has resulted in elevated temperatures in the lower Hooksett Pool that can impact the aquatic community.

Reviewing the temperature data from Normandeau's 2007 Report and the updated data provided in 2016, two additional things became clear: (1) Merrimack Station's submission of individual day maximum temperatures over the 21-year period did not adequately support its request for renewal of the existing CWA § 316(a) variance; and (2) relying solely on (21-year) averages of daily average temperature data is not the best representation of the environmental impacts from Merrimack Station's thermal discharge because 21-year average values mask periodic, or seasonal, temperature excursions that reflect unsuitable conditions for the aquatic community.

For the Final Permit, EPA evaluated actual daily temperature data reported in the Environmental Monitoring Program Annual Reports. *See* AR-1715. In particular, in Responses to Comments 3.1.3 and 3.1.4, below, EPA addresses specific inconsistencies identified by PSNH's consultants that result from the error in interpreting the data and re-examines the conclusions from the 2011 Draft Determinations Document using daily, observed maximum and mean temperatures instead of relying only on long-term summary data that masks periods of prolonged elevated temperatures in any given year.

3.1.3 EPA's Misinterpretation of Representative Data Substantially Overstates Actual Temperatures to Which Aquatic Species Were Exposed

Comment II.3.1.3	**AR-1548, PSNH, pp. 46-51**
See also AR-1300, LWB, pp. 11-14, 34-37; AR-1554, LWB, pp. 1-2; AR-872, Normandeau, pp. 95-101, 106-108, 112, 118-119; AR-851, CLF, pp. 20-21, AR-1577, EPRI, pp. 3-3 to 3-8, 3-13 to 3-14	

EPA relied on the erroneous interpretation of the temperature data in evaluating the thermal effects on fish, comparing critical temperature values from scientific literature for various life stages of fish to temperatures from Appendix A for two stations: Stations S0, at the end of the Merrimack Station discharge canal, and Station S4, a thermally influenced station downstream from the canal. PSNH's consultant, Dr. Barnthouse, reviewed EPA's misapplication of this temperature data and summarized his findings in a report entitled "Review of technical documents related to NPDES Permitting Determination for the Thermal Discharge and Cooling Water Intake Structures at Merrimack Station," which was submitted to the agency in February 2016.[212] This report sets out a representative sample of EPA's errors in its Attachment D to the 2011 Draft Permit and explains how EPA's analyses must be revised to account for the actual temperature data included in Appendix A of Normandeau's 2007 Thermal Model Report. These examples are discussed below and provide further proof EPA must revisit the entirety of the agency's § 316(a) analysis.

First, three of the species evaluated by EPA—the alewife, American shad, and Atlantic salmon—do not reproduce naturally in the Merrimack River and therefore would be present in the Hooksett Pool solely because of upstream stocking efforts.[213] Eggs and larvae from the three species could only be present in the waterbody segment due to potential drift following spawning, according to Dr. Barnthouse.[214] Juveniles of these three species would only be present in the Hooksett Pool for a discrete period of time as they pass through during outmigration.[215]

As to the alewife species, EPA's assertion that Merrimack Station's discharge creates an "unsuitable habitat" based on the agency's comparison between a temperature observed to be lethal to alewife larvae (94.1°F) and what EPA misinterpreted as the average maximum temperature recorded at Station S0 on a given date when herring larvae were collected in entrainment samples at the station (also 94.1°F) is likewise erroneous.[216] As explained above, this 94.1°F was the singular highest average temperature observed at Station S0 on one given date during a 21-year period, not the average maximum temperature for that date over all 21 years.[217] EPA's use of this singular day data-point in a 21-year period to support a conclusion of appreciable harm provides "an unrealistically conservative analysis."[218]

Dr. Barnthouse also successfully refutes EPA's use of temperature data from S4 to maintain that temperatures at the monitoring Station are higher than the published, preferred temperatures of alewife juveniles and therefore Merrimack Station's thermal discharge creates an unsuitable habitat for juvenile alewives. These temperatures occur at S4 only between June 25 and September 4. Years of historical impingement data collected by PSNH, in fact, reveal that outmigrating juvenile alewives do not pass by Merrimack Station until early September through October. EPA's analysis is therefore arbitrary and capricious and cannot reasonably be used to support a conclusion of appreciable harm.

Further, Dr. Barnthouse notes EPA incorrectly applied temperature data from Normandeau's 2007 report to assess the effects, if any, of Merrimack Station's thermal discharge on American shad.[219] Utilizing laboratory-derived thermal tolerance limits, EPA provides on page 93 of its 2011 Fact Sheet that the habitat at Station S4 is an unsuitable habitat for juvenile American shad because the average maximum temperature at that station from Appendix A exceeds the maximum tolerance limit from published literature on "every date from June 25 to September 3."[220] This conclusion, like many others in the 2011 Fact Sheet, is incorrect due to EPA's misinterpretation of the temperature data. Applying average daily temperatures over the 21 year period, between June 25 and September, temperatures at S4 were well below the tolerance limit (85°F) for American shad.[221] The data, when correctly interpreted, "means that on average the habitat at Station S-4 was suitable for American shad on all days throughout this period, although during exceptionally warm years temperatures outside the preferred range occurred on some days."[222] EPA's analysis of acute mortality due to thermal plume exposure is also invalid, according to Dr. Barnthouse, "because it assumes that juvenile shad are acclimated to cool temperatures found upstream of the discharge (Station N-10), swim or drift downstream to Station S-0, and remain within the plume long enough to die. In reality, any juvenile [American] shad approaching the plume would simply avoid the elevated temperatures altogether."[223]

Misinterpretation of temperature data from Normandeau's 2007 Thermal Model Report by EPA also renders ineffectual the agency's assessment of Merrimack Station's thermal discharges on the survivability of yellow perch larvae, according to Dr. Barnthouse. EPA utilizes thermal tolerance limits from literature to support its assertion that temperatures at Station S0 would cause appreciable harm to yellow perch larvae.[224] In fact, mean daily temperatures at Station S0 did not exceed any of the thermal limits discussed by EPA between May 1 and June 14, which is the time yellow perch larvae were collected in Normandeau's ichthyoplankton survey, and neither the mean nor the maximum average daily temperature exceeded these limits at Station S4.[225] EPA's analysis of effects of thermal exposure on juvenile and adult yellow perch is equally flawed based on the agency's misinterpretation of temperature maximums provided in Appendix A of Normandeau's 2007 report.[226] Specifically, EPA claims in its 2011 Fact Sheet that the average daily maximum water temperature at Station S4 exceeded the avoidance temperature of yellow perch on every day from June 15 to September 10, in each of the 21 years in the data set.[227] This is incorrect. Correctly interpreted, the maximum temperature listed in Appendix A from June 15 to September 10 was reached in only one year out of the 21-year data set and these maximums often were not reached in the same or even sequential years.[228]

As a result of EPA's erroneous interpretations, the entirety of EPA's yellow perch reproduction discussion in the agency's 2011 Fact Sheet is necessarily flawed. EPA specifically asserts that yellow perch are attracted to the thermal refuge of the discharge canal during winter months, which may result in premature spawning in the canal and may impair reproductive ability due to the lack of a "chill period" necessary for complete development of the species' gonads.[229] As explained by Dr. Barnthouse, this supposed "chill period" hypothesis for yellow perch is highly speculative and EPA's premature spawning theory is "highly unlikely."[230]

EPA's misapplication of the temperature data in Normandeau's 2007 report also resulted in its erroneous evaluation of the effects of Merrimack Station's thermal discharge on the white sucker population.[231] As to larvae and juveniles, EPA improperly compares what it perceives are the average maximum temperatures at Stations S0 and S4 to laboratory-derived thermal tolerance limits to conclude thermal discharges from Merrimack Station are causing appreciable harm to white suckers at these life stages.[232] Looking only at the mean average daily temperatures, Dr. Barnthouse explains:

> [T]emperatures at Station S-0 would have begun to exceed the lethal temperature for white sucker larvae on or about June 22, near the end of the period during which white sucker larvae are present in the vicinity of Merrimack Station. At Station S-4 downstream from the discharge, the average temperature would never exceed the thermal tolerance limit. Similarly, the average daily temperatures at Station S-4 never exceeded the thermal tolerance limit identified by EPA for juvenile and adult [yellow] perch . . . .[233]

Although a discrete set of maximum average daily temperature values at Station S4 during exceptionally warm periods did exceed the tolerance limit for white sucker in the 21-year data set, these exceedances are immaterial because electrofishing samples discussed by EPA on page 114 of its 2011 Fact Sheet reveal the distribution of white suckers during the summer is primarily upstream from the thermal discharge.[234] These fish may prefer cooler water upstream of the discharge, according to Dr. Barnthouse, and simply avoid the lower portions of the Hooksett Pool during these times, although other habitat characteristics besides temperature could explain this distribution.[235]

[212] *See* AR-1300.

[213] *Id.* at 12.

[214] *Id.*

[215] *Id.*

[216] AR-618 at 88.

[217] *See* AR-1300 at 12.

[218] *Id.*

[219] *See* AR-1300 at 12-13.

[220] AR-618 at 93.

[221] AR-1300 at 13.

[222] *Id.*

[223] *Id.*

[224] *See, e.g.*, AR-618 at 100, 180-81.

[225] AR-1300 at 13-14.

[226] AR-1300 at 14.

[227] *See, e.g.*, AR-618 at 106.

[228] AR-1300 at 14.

[229] AR-618 at 100-102.

[230] *See* AR-1300 at 13 (citing Carlander (1997) as support for the fact that yellow perch prefer to spawn over vegetation or submerged branches, which would not be present in Merrimack Station's discharge canal).

[231] *See* AR-1300 at 14.

[232] *See, e.g.,* AR-618 at 112-13.

[233] AR-1300 at 14.

[234] AR-618 at 114.

[235] *See* AR-1300 at 14.

EPA Response:

Section 5.6.3 of the 2011 Draft Determinations Document considered the thermal impacts of the discharge from Merrimack Station on nine representative important species (RIS) of the balanced, indigenous population (BIP), which is represented by a suite of resident and migratory species. In the comment, PSNH summarizes findings from LWB's 2016 assessment of how the misapplication of the Normandeau temperature data influenced EPA's consideration of the thermal impacts on the RIS. *See* AR-1300. The comment above, as well as the 2016 Report (AR-1300), LWB's comments on the 2017 Statement (AR-1554), and Normandeau's comments on the 2011 Draft Permit (AR-872) present examples of analyses and conclusions from the 2011 Draft Determinations Document that, according to the commenters, are incorrect due to the misinterpretation of the temperature data (discussed in detail in Responses to Comments II.3.1.1 and 3.1.2). EPA addresses the comments in detail below.

PSNH's comment and supporting document (AR-1300 at 12) appear to suggest that alewife, American shad, and Atlantic salmon should not be included in the BIP because they do not reproduce naturally in the Merrimack River and would be present in the Hooksett Pool solely because of upstream stocking efforts. First, alewife, American shad, and Atlantic salmon are native to the Merrimack River and stocking of these species is an effort to *restore* their populations.[7] *See* AR-618 at 87, 90, 94. In keeping with the objective of the Clean Water Act, which is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (33 U.S.C. § 1326(a)), EPA considered the BIP of the Merrimack River to include species that were historically part of the indigenous population and are currently the focus of efforts to restore natural populations. The Agency's approach is consistent with 40 CFR § 125.71(c). Neither the comment nor the supporting report cite to any EPA guidance or regulation to support its statement that alewife, American shad, and Atlantic salmon should not be considered simply because they are stocked, especially when stocking of these species is an effort to restore their natural populations to the river. EPA also received comments expressing the contrary view that anadromous species must be included in the analysis of thermal impacts. *See* AR-851 p. 20-21. LWB comments that it is unknown whether "significant numbers of early life stages of any of these species are present in Hooksett Pool…where they could be exposed to the thermal discharge from Merrimack Station." AR-1300 at 12. Yet, alewife and American shad eggs, larvae, and juveniles have been observed during biological sampling in the Hooksett Pool and, as a result, could be exposed to the thermal discharge from Merrimack Station. *See* AR-2, AR-1550. *See also* AR-618, p. 89, AR-203, AR-226, AR-227 AR-228. In its comments on the 2011 Draft Permit, Normandeau comments that American shad were documented successfully spawning in Hooksett Pool during a 1978 study and juvenile American shad were captured during sampling in July and August that year. *See* AR-872 at 96, 99. Normandeau's comments also indicate that the timing of observations of juvenile American shad at the Amoskeag Pool suggests that they developed in Hooksett Pool. *See* AR-872 at 97. The information reviewed for the 2011 Draft Permit the comments submitted on the 2011 Draft Permit support the inclusion of American shad and alewife as part of the BIP.[8]

In the 2011 Draft Determinations Document, EPA focused on what the Agency had thought were long-term average maximum daily temperature data because this data (as misinterpreted) demonstrated consistent exceedances of certain protective threshold temperatures and, as a result, supported EPA's conclusion that the thermal discharge under the requested variance would not be sufficiently protective of the BIP. As explained above, EPA misunderstood the maximum daily average temperature data from Appendix A in AR-10 due to the misleading or unclear way in which the data was presented. *See* AR-1534 pp. 38-39 and Responses to Comments II.3.1.1 and 3.1.2. The "maximum daily average" that EPA understood as the 21-year average maximum temperature on a given day is actually the maximum average daily temperature that occurred on a single date over the 21 years. As the comments point out, this misunderstanding led EPA to, in some cases, overstate the duration of exposure to temperatures above certain thresholds in the 2011 Draft Determinations Document. PSNH, LWB, and Normandeau all provide examples from the Draft Determinations Document where EPA

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[7] For the Final Permit, EPA focuses on American shad and alewife because Atlantic salmon stocking was terminated in 2016 in New Hampshire. https://www.wildlife.state.nh.us/fishing/profiles/atlantic-salmon.html. In addition, as explained in the Determination Document, American shad and yellow perch are the most thermally sensitive species, and thermal limits derived for the protection of these species will also be protective of Atlantic salmon.

[8] The current Federal Energy Regulatory Commission (FERC) license for hydroelectric projects on the Merrimack River (AR-1671) requires fish passage for anadromous fish to be operational within three years after the passage of a threshold number of fish at the Amoskeag Dam (which has an operational fish ladder). The number of river herring at the Amoskeag Dam surpasses this threshold during the 2016 migration season. At the time, Eversource initiated consultation with state and federal agencies to begin the process of installing upstream passage at the Hooksett and Garvins Falls Dams. https://lowimpacthydro.org/hooksett-lihi-162/

misinterpreted the data, but the comments lack sufficient evidence to support the contrary conclusion, namely, that the life stages and species *are* protected from exposure to elevated temperatures in the thermal plume. After indicating where EPA's interpretation of the temperature data was in error, both LWB and Normandeau rely on long-term average temperatures provided in 2007 (the "2007 data") (AR-3 Appendix A), which spanned the years from 1984 to 2004 or the revised data provided in 2016 ("2016 data") (AR-1299), which spanned the years from 2002 through 2015. In EPA's view, the comments highlight the shortcomings of relying on average temperature values summarized over many years of data. The values illustrate only the average value over many years of data but do not demonstrate how the thermal plume could impact the BIP in any given year. Long-term average temperatures mask occurrences of daily temperatures that exceed protective temperatures on a given day or grouping of days in any year(s). The exceedance of protective temperatures over multiple days and/or in consecutive years represent conditions could harm the biological community. In responding to comments on thermal conditions in the Merrimack River, EPA evaluated available, daily temperature data from Stations N10, S0, and S4 over the period from April 2004 through May 2019 from Merrimack Station's Annual Monitoring Reports and daily generating data (MWh) for Merrimack Station Units 1 and 2 for the years 2004 through 2019 from EPA's Air Markets Program Database.[9] *See* AR-1715. As PSNH suggests, this range of years provides years that are representative of past, current, and likely future operation of the Station and, as such, are suitable for examining the thermal impacts of the Station on the BIP.

Alewife

The Determination Document concluded that Merrimack Station's discharge creates unsuitable habitat for alewife larvae because the maximum temperature at Station S0 on June 11, when alewife larvae have been observed in the Merrimack River, reached a level that is potentially lethal to larvae even after limited exposure (34.5°C). See AR-618 p. 88. EPA's understanding of Normandeau's temperature data (AR-10) indicated that the average daily maximum temperature at Station S0 on June 11 over 21 years reached 34.5°C (94.1°F), which EPA maintains would indicate that the habitat is not suitable. In fact, the data demonstrates that the maximum average daily temperature reached 34.5°C in at least one of the 21 years. LWB comments that the average daily maximum S0 temperature on June 11 from 2002 through 2015 was 27.8°C (82°F) and that the average daily maximum S0 temperature did not reach 34.5°C until July 16. *See* AR-1300 at 34. *See also* AR-872 p. 95-6. However, that the average, maximum daily (or mean daily) temperature over fourteen years does not reach 34.5°C does not indicate how often river temperatures may have reached lethal temperatures in any given year. In addition, the 2016 average temperature data likely underestimates the actual temperature of the effluent when the Station is operating because it combines years in which the Station was operating as a baseload plant (2002 through about 2010) with years when operations were similar to a peaking plant (2011 to 2015) and the Facility was likely not operating for much of the summer.[10] *See* Response to Comment II.3.2.2, 3.2.3.

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[9] https://ampd.epa.gov/ampd/

[10] EPA reviewed the difference in the calculated 21-year average of the mean daily temperature at Stations S0 and S4 from the 2007 Normandeau data (from 1984 to 2004) and the revised 2016 data (from 2002 to 2016). Average temperatures in the 2016 dataset were typically 1°C to 3°C lower than the average on the same day in the 2007

Instead of relying on long-term averages, EPA reviewed daily temperature data over the period from 2004 through 2018. Maximum daily temperatures in early to mid-June rarely reached levels that would be lethal to alewife larvae and mean daily S0 temperatures never reached 34.5°C. Still, there are times when the maximum daily temperature at Station S0 may not be suitable for alewife larvae when this life stage is likely to be present. For example, the maximum daily temperature reached 34.5°C on June 10 through June 12 in 2008, and on June 8 and 9 in 2011 At the same time, the highest daily maximum temperature at Station S4 was 28.4°C when the daily mean at Station S0 exceeded 34.5°C (on June 10, 2008). On days when the S0 temperature reached 34.5°C, the temperature decreased between 7.1 and 9.3°C in the approximately 2,000 feet between Station S0 and S4. EPA estimated the drift time at about 60 minutes assuming a minimum river velocity of about 0.5 fps. *See* AR-618 p. 189-90, AR-872 p. 99. A drifting larval alewife would only be exposed to potentially acutely lethal temperatures for a portion of the time it takes to travel from Station S0 to S4, and, given the overall decrease in temperature, such exposure would likely be for a sufficiently short duration and distance not to result in mortality. Re-examining river temperatures in June when alewife larvae are present suggests that temperatures are generally not high enough to cause lethality in late May and June. *See* AR-1306. In addition, maximum temperatures in 2008 and 2011 were reached only when the Station was operating at relatively high capacity (more than 80%). Prior to 2012, when the highest temperatures were observed, Merrimack Station operated near capacity in early to mid-June. Since 2012, Merrimack Station has operated, at most, 5 days between June 1 and June 15, and frequently only operates one of the two units. Recent temperature data suggests that under current operating conditions, river temperatures will be protective of alewife larvae when they are likely to be present.

According to PSNH, LWB's analysis refutes EPA's 2011 conclusion that juvenile alewives are not protected during the period when they may be present, which PSNH asserts is early September through October. The Agency's 2011 Determinations Document (AR-618 pp. 89, 206) states that out-migration of alewives typically occurs in September and October, consistent with PSNH's description, but also points out that juvenile and young-of-year river herring have been collected in late August (See AR-3, pp. D-52-53). *Id*. at 89. Both commenters characterize the out-migration period as early September through October, and LWB states that "impingement of alewives at Merrimack Station has been documented no earlier than September 3." AR-1300 at 35. *See also* AR-228. Neither PSNH nor LWB refute Normandeau's 2006 fisheries data that demonstrates the presence of juvenile alewives in late August. If PSNH's own studies have demonstrated the presence of juvenile alewife in the Merrimack River in late August, EPA's consideration of river temperatures from late August and early September in its evaluation of thermal impacts to juvenile alewife cannot be "arbitrary and capricious."

In the 2011 Draft Determinations Document, EPA concluded that the daily average maximum temperature at Station S4 exceeded 28.9°C (84°F) (the avoidance temperature for juvenile alewife) on every date from June 25 through September 8. *See* AR-618 p. 89. Again, the 2007 Normandeau data actually demonstrates only that the maximum S4 temperature exceeded 84°F on every day from June 25 through September 8 in at least <u>one</u> year during the 21-year period.

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dataset, likely because the revised 2016 data includes recent years when Merrimack Station transitioned to substantially reduced operations during the summer during the years from 1984 to 2004.

Based on the 2016 averaged data summary, LWB states that the average maximum temperature only exceeded 28.9°C on 14 days between July 16 and August 10, which is before juvenile alewife would be migrating. *See* AR-1300 p. 35, AR-1299. LWB and PSNH conclude that temperatures will be protective during the period in which alewives would be migrating past Merrimack Station. *See id*. EPA reviewed *daily* temperature data over the period from 2004 through 2018. The maximum daily temperature at Station S0 and S4 frequently exceeds 28.9°C after August 10 through early September, including as late as September 22 (at Station S4) and September 28 (at Station S0). Daily data from 2010 demonstrate that the mean daily temperature at S4 during that year was above 28.9°C from August 13 through August 22 and again from August 31 through September 9, and that the maximum daily temperature exceeded 28.9°C for nearly the entire period from August 10 through September 9 (Figure II.2, below). The daily data demonstrates that, in contrast to the LWB's analysis and consistent with EPA's conclusion in the 2011 Draft Determinations Document, temperatures in the river are above the protective temperature during the period when outmigrating juvenile alewife are present.

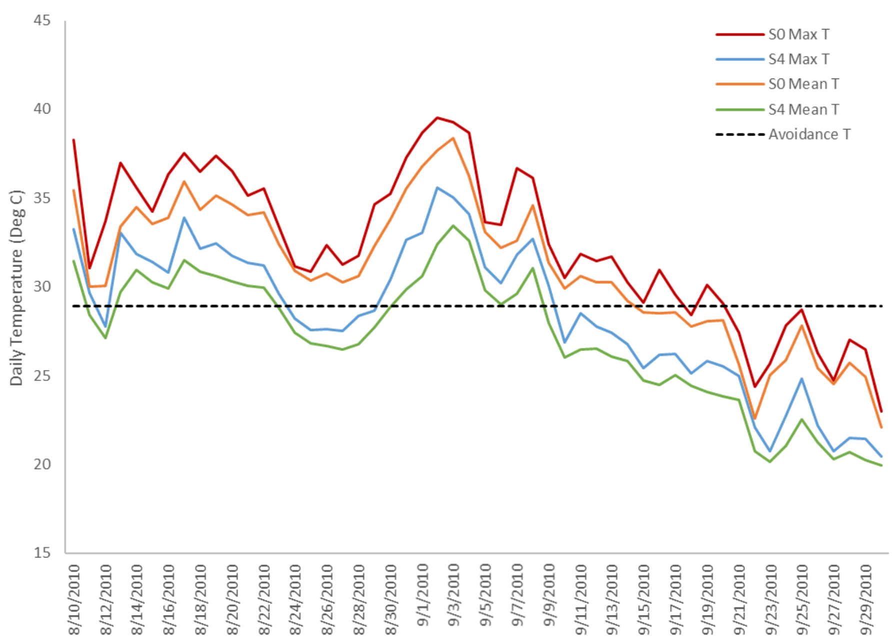

Figure II.2. Mean and maximum daily (24-hour average) temperature (deg C) at Stations S0 (discharge) and S4 (downstream) from August 10 through September 30, 2010 compared to the juvenile alewife avoidance temperature (28.9°C).

At the same time, EPA acknowledges that juvenile alewives could potentially avoid higher temperatures if the plume were sufficiently limited to allow areas of passage. The 2016 data demonstrate that the average daily temperature at Station S0 is less than the avoidance temperature of 28.9°C (84°F) on each day beginning on September 5, which indicates that river temperatures at S0 appear to be suitable for juvenile alewives by the end of the first week of September. When operating as a baseload plant, such as in 2010, the sustained, elevated temperatures could potentially exclude juvenile alewife from habitat downstream of the Merrimack Station for sustained periods, including when juveniles are outmigrating and must travel through the lower Hooksett Pool. However, under current operations (like a peaking plant) Merrimack Station operates infrequently in August and September, and, as a result, the temperature at Station S4 is typically well below the avoidance temperature for juvenile perch. As an example, Figure II.3 presents the mean and maximum observed temperatures at Stations S0 and S4 in August and September 2016, when the capacity of the Station was, on average, 9%. Excursions of protective temperatures for juvenile alewives are limited in duration and extent. This data suggests that, under current operations, the thermal plume is unlikely to impact juvenile alewives because juveniles can avoid the plume and will not be excluded from potentially suitable habitat for extended periods of time.

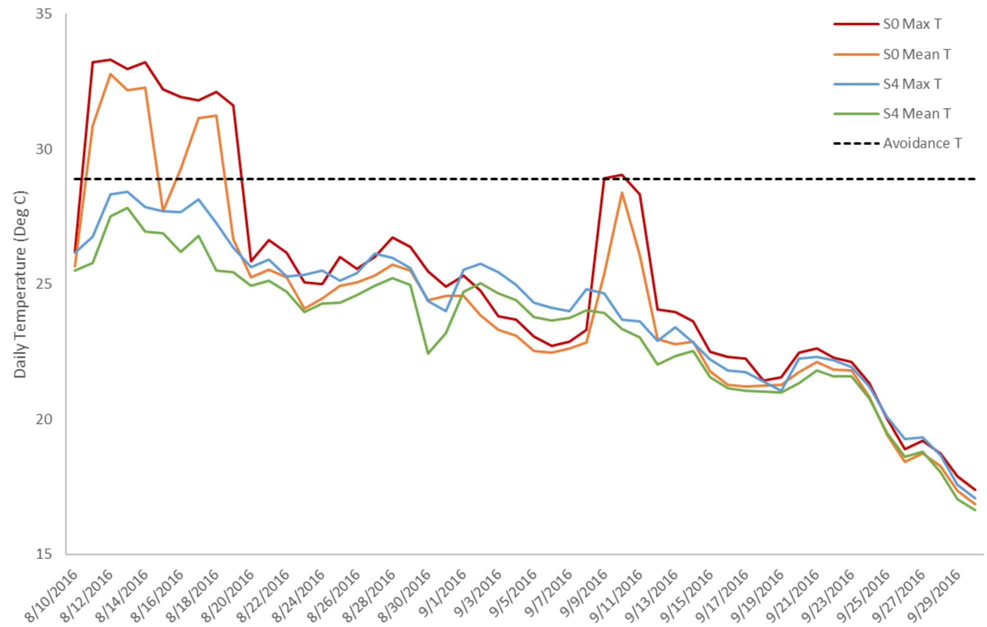

Figure II.3. Mean and maximum daily (24-hour average) temperature (deg C) at Stations S0 (discharge) and S4 (downstream) from August 10 through September 30, 2016 compared to the juvenile alewife avoidance temperature (28.9°C).

American Shad

In the 2011 Draft Determinations Document, EPA concluded that Station S4 is unsuitable habitat for juvenile American shad because maximum daily temperatures exceeded 29.4°C (the tolerance limit for juvenile American shad) on every date from June 25 through September 3. *See* AR-618 p. 93. Comments from PSNH and LWB indicate that the average daily S4 temperatures between June 25 and September 3 over the 21-year period were well below 29.4°C. *See* AR-1300 at 35-6. *See also* AR-872 p. 96. PSNH maintains that, on average, and when correctly interpreted, "the habitat at Station S-4 was suitable for American shad on all days throughout this period, although during exceptionally warm years temperatures outside the preferred range occurred on some days." LWB's 2016 review of the temperature data (2002 through 2015) indicates that the average maximum temperature at Station S4 reached 29.4°C on six dates between July 18 and August 5. *See also* AR-872. pp. 97-8. Review of daily temperature data from 2004 through 2018, however, indicates that the mean and maximum S4 temperatures frequently reach or exceed 29.4°C between June 25 and September 3 when Merrimack Station is operating, in some instances for durations more than 30 days (e.g., 2005, 2010).

Normandeau also comments that, based on the mean average daily temperature (rather than just the maximum), Station S0 did not reach the lethal temperature identified for larval American shad (33.3°C) at all in June and only on 10 dates in July, and that the mean average daily temperature at Station S4 is well below the lethal temperature for all dates in June and July. *See* AR-872 pp. 98-9. Yet, EPA's review of daily temperature data from 2004 through 2018 indicates that the mean, maximum, and minimum S0 temperatures reach or exceed 33.3°C in July, when Merrimack Station is operating, in some cases for 25 days or more (e.g., 2004, 2007, 2010, 2011). The mean daily temperature at Station S4, however, is typically below lethal temperatures, though mean temperatures did reach or exceed 33.3°C on 8 days in 2010. In addition, the maximum S0 temperature has rarely reached 33.3°C at Station S0 since 2014, and S4 temperatures have not reached lethal temperatures since 2010.

While EPA overestimated the duration that the maximum temperature at S4 exceeded certain thresholds (due to a misunderstanding of the data), PSNH, Normandeau, and LWB, by relying only on long-term average data, plainly underestimate the severity and duration of exceedances of the protective temperature for juvenile and larval American shad due to the thermal plume during the period when they are likely present in the Merrimack River. Again, however, the potential impacts of the thermal plume on American shad have changed substantially since Merrimack Station transitioned to reduced operations like that of a peaking plant. As an example, Figure II.4 presents the mean and maximum daily temperature at Station S4 in 2018, which is representative of average operation in August and September and includes 6 dates in July when exceeded protective temperatures for larval American shad at Station S0. Under current operations, temperatures at Station S4 rarely reached or exceeded protective temperatures for juvenile American shad and exceedances that did occur were limited in duration. EPA concludes that the thermal plume under current operations is unlikely to impact juvenile American shad because juveniles are likely to avoid the plume for the limited period when it is present downstream of the discharge and will not be excluded from potentially suitable habitat for extended periods of time. EPA has also determined, in response to this and other comments received, that acute mortality is not likely to occur as a result of exposure to the thermal plume because, as just noted, American shad juveniles are mobile, will likely avoid extreme temperatures that may occur in the relatively limited segment from S0 to S4, and because under current operations it is uncommon for river temperature to exceed the acutely lethal temperature. In addition, an acute mortality limit at Station S4 will ensure that conditions in the river are protective of American shad larvae and will not result in acute mortality. *See* Response to Comment II.3.4.7.

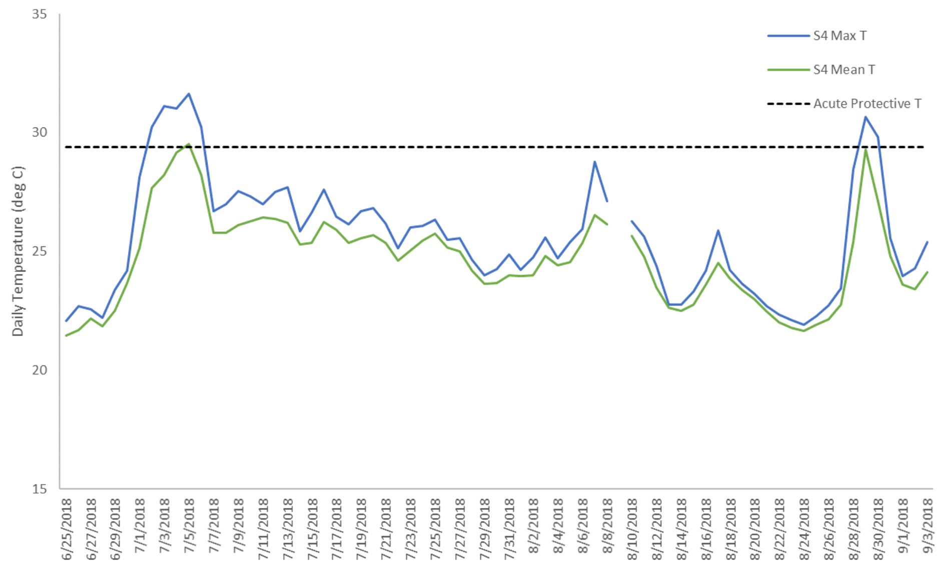

Figure II.4. Mean and maximum daily (24-hour average) temperature (deg C) at Station S4 (downstream) from June 25 through September 3, 2018 compared to the acute protective temperature for juvenile American shad (29.4°C).

Yellow Perch

In the 2011 Draft Determinations Document, EPA concluded that yellow perch larvae were likely to have been exposed to potentially lethal temperatures in the thermal plume. *See* AR-618 p. 104-5. Based on its review of the 2007 Normandeau data, temperatures at Station S0 exceeding 31.3°C can begin as early as May 20 and extend through the end of the larval period (June 15). *See id*. PSNH and LWB comment that, correctly interpreted, the average, mean daily temperatures at Station S0 did not exceed any of the thermal limits discussed by EPA between May 1 and June 14 and neither the mean nor the maximum average daily temperature exceeded tolerance limits at Station S4 during this period. *See also* AR-872 p. 107. EPA's review of daily temperature data from 2004 through 2018 confirms that the mean and maximum S4 temperatures did not exceed 31.3°C between May 1 and June 14; however, the maximum and mean daily temperature at Station S0 did reach or exceed 31.3°C in 2005, 2008, 2010, and 2011, and the maximum daily S0 temperature exceeded 31.3°C in 2007 and 2013. Therefore, in contrast to the comment, the daily data suggest that, while not persistent, temperatures at Station S0 have reached or exceeded potentially lethal temperatures for yellow perch larvae in some years from May through June 14. In many cases, Station S4 temperatures were 26°C or less when the Station S0 temperature exceeded 31.3°C, suggesting that the duration of exposure to potentially lethal temperatures would be limited. However, on multiple days in 2008 and 2011, yellow perch larvae acclimated to temperatures of 22°C to 23°C were exposed to mean daily S0 temperatures at 34°C or more. Wismer and Christie (AR-95) observed lethality of yellow perch larvae under similar conditions in as little as 10 minutes, which suggests that, at least during some periods when the Station is operating as a baseload plant, yellow perch larvae may be exposed to temperatures at durations that could result in lethality. *See* AR-618, p. 104.

When operating like a peaking plant, from 2012 through 2018, the Facility operates infrequently during May and June. Since 2012, the maximum daily river temperature at Station S0 has only reached 31.3°C on one date (6/2/2013). On this single date, the temperature at Station S0 reached or exceeded 31.3°C for a duration of 6 hours, during which time the Station S4 temperature ranged from 19°C to 21°C, which indicates that yellow perch are unlikely to be exposed to lethal temperatures that could result in mortality during the period when they will be present in the Merrimack River under current operation conditions. Moreover, the Final Permit includes an acute mortality limit at Station S4 of 29.3°C from May 1 through May 31 and 30.9°C from June 1 through June 21 to assure that conditions in the river are protective of yellow perch eggs and larvae and will not result in acute mortality. *See* Response to Comment II.3.4.7.

In the 2011 Draft Determinations Document, EPA concluded that temperatures at Station S4 reached or exceeded the avoidance temperature for yellow perch juvenile and adults (28.3°C) every day from June 15 to September 10. *See* AR-618 p. 106. Correctly interpreted, the maximum temperature from June 15 to September 10 was reached at Station S0 in at least one year out of this 21-year data set but not necessarily in the same or sequential years. LWB comments that, based on the average daily temperature data over the period from 2002 through 2015 (received in 2016), the 14-year average mean daily temperature at Station S4 did not exceed 28.3°C (83°F) on any calendar day during this period and the average daily maximum temperature reached or exceeded 28.3°C on 22 calendar days between July 16 and August 10. LWB also comments that juvenile and adult yellow perch would avoid the plume during the hottest part of the day when the S4 temperature exceeds the avoidance temperature. *See also* AR-872 p. 107-8. EPA notes that there are only 26 dates between July 16 and August 10, so the data shows the maximum average daily S4 temperature over the period 2002 through 2015 exceeded 28.3°C nearly all of the time between July 16 and August 10. EPA's review of daily temperature data from 2004 through 2011 indicates that the mean and maximum S0 and S4 temperatures steadily exceed 28.3°C between June 15 and September 10 in most years under baseload conditions, consistent with the analysis in the 2011 Draft Determinations Document. As an example, Figure II.5 illustrates persistent temperatures at the discharge and downstream that exceed the avoidance temperature for juvenile and adult yellow perch for the entire summer period. Even if adults and juveniles can avoid the plume by staying, as LWB suggests, in the cooler water upstream of the discharge, the thermal plume from Merrimack Station plainly caused a portion of Hooksett Pool to be unsuitable for yellow perch for the entire summer in multiple years.

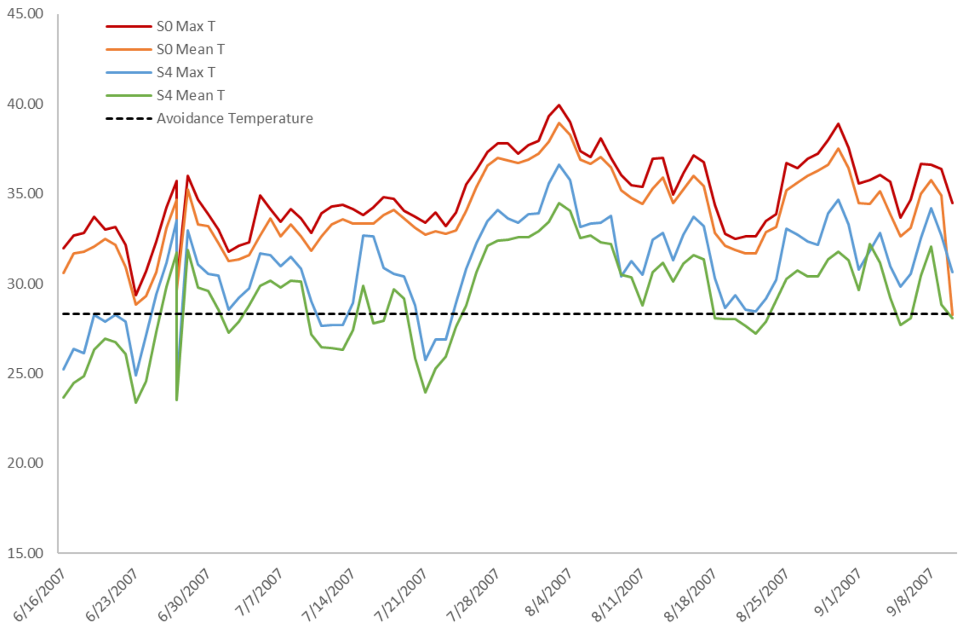

Figure II.5. Mean and maximum daily (24-hour average) temperature (deg C) at Stations S0 (discharge) and S4 (downstream) from June 16 through September 10, 2007 compared to the juvenile and adult perch avoidance temperature (28.3°C).

However, the potential impacts of the thermal plume on juvenile and adult yellow perch have changed substantially since 2012 when Merrimack Station transitioned to a peaking plant. Figure II.6 illustrates that, under current operating conditions (in 2016, which is representative of above average operating capacity compared to recent summers), the mean and maximum daily temperature at Station S0 only occasionally reached or exceeded avoidance temperatures for yellow perch and exceedances that did occur were limited to a few days. The mean daily temperature at Station S4 did not exceed avoidance temperatures for yellow perch and the maximum temperature rarely exceeded the avoidance temperature. The data suggests that, under current operations, juvenile and adult yellow perch are likely to avoid the plume and will not be excluded from potentially suitable habitat for extended periods of time. EPA has also determined, in response to this and other comments received, that acute mortality is not likely to occur as a result of exposure to the thermal plume first because under current operations it is uncommon for river temperatures to exceed the acutely lethal temperature between Stations S0 and S4 and second, because yellow perch juveniles are mobile and can avoid the relatively rare extreme temperature events that may occur for limited periods of time in the segment of the river between Stations S0 and S4. *See* Response to Comment II.3.4.7. Finally, PSNH and LWB comment that protective temperatures for yellow perch maturation during the winter is "highly speculative." EPA addresses comments on protective temperatures during the yellow perch maturation period in detail in Response to Comment II.3.4.7.

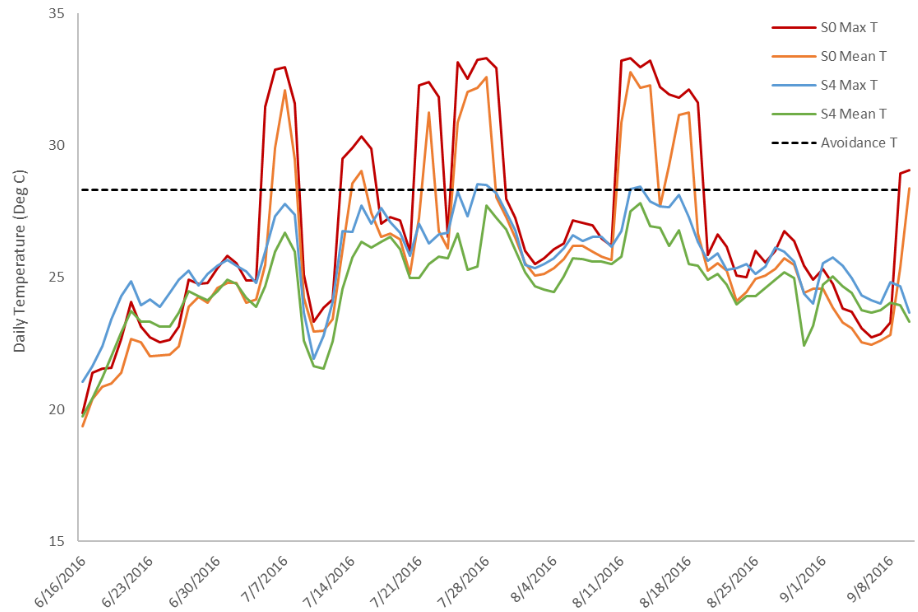

Figure II.6. Mean and maximum daily (24-hour average) temperature (deg C) at Stations S0 (discharge) and S4 (downstream) from June 16 through September 10, 2016 compared to the juvenile and adult perch avoidance temperature (28.3°C).

White Sucker

In the 2011 Draft Determinations Document, EPA concluded that maximum daily temperatures at Station S0 and S4 exceeded lethal temperatures for white sucker larvae (30°C - 31.7°C) when larvae are present in the Merrimack River. *See* AR-618 p. 112. Correctly understood, however, the 2007 Normandeau report data only showed that the maximum temperature from June 4 to July 2 reached potentially lethal temperatures on each day in at least one year out of the 21-year data set and did not necessarily reach that level on multiple days in the same year or in sequential years. According to LWB, the 2016 temperature data show that the average daily maximum temperature during all dates between June 4 and July 2 never exceeded the white sucker upper incipient lethal temperature at either station. *See* AR-1300 p. 36-7. Reviewing the daily temperature data for June 4 to July 2 for the years 2004 through 2018, however, demonstrates that the daily maximum and mean temperature at S0 frequently exceeded 31.7°C in every year from 2004 to 2011 on multiple, consecutive days (except in 2006, when there was only one exceedance of 30°C). The mean daily temperature at Station S4 exceeded 31.7°C on only two dates (at the end of July in 2007) over the entire period, while the maximum daily S4 temperature exceeded 31.7°C in three of the years (on 2 consecutive days in 2004, 6 days in 2007, and 7 days in 2010). As an example, Figure II.7 presents the mean and maximum daily temperatures at S0 and S4 for this time period in the year 2007. Re-examining the observed daily temperature data supports the 2011 Draft Determinations Document's conclusion that white sucker larvae could be exposed to potentially lethal temperatures in the thermal plume during the period when they are likely to be present, including, in some years, in early to mid-June when surface-feeding yolk-sac larvae are expected to be present. *See* AR-618 p. 113-14. At the same time, temperatures fell, on average, 4°C to 10°C between Stations S0 and S4, and temperatures were typically below the UILT by Station S4, suggesting that the duration of exposure to potentially lethal temperatures would be limited in most cases. In addition, temperatures have not exceeded the UILT at Station S4 since 2012, when operations transitioned to a peaking-like plant, with a single exception (maximum daily temperature on 7/2/2018). As a result, EPA concludes that the Final Permit's limits, which include an acute mortality limit at Station S4, will ensure that conditions in the river are protective of white sucker larvae and will not result in acute mortality. *See* Response to Comment II.3.4.7.

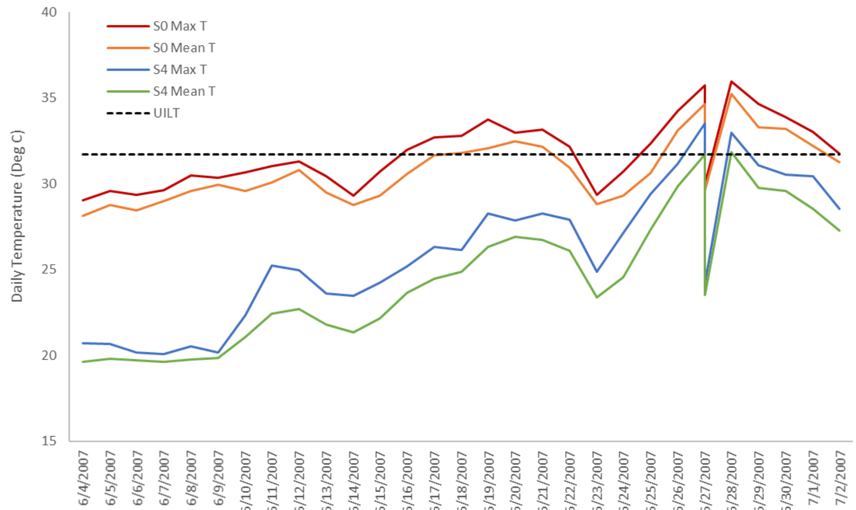

Figure II.7. Mean and maximum daily (24-hour average) temperature (deg C) at Stations S0 (discharge) and S4 (downstream) from June 4 through July 2, 2007 compared to the larval white sucker lethal temperature (31.7°C).

In the 2011 Draft Determinations Document, EPA concluded that maximum daily temperatures at Station S4 routinely exceeded avoidance temperatures for white sucker juveniles and adults (29.9°C) every day from June 25 to September 1, while average maximum temperatures at Station N10 remained below 29.9°C. *See* AR-618 p. 112. Correctly understood, the 2007 Normandeau report data only showed that the maximum temperature from June 25 to September 1 exceeded avoidance temperatures on each of those days in at least one year out of the 21-year data set, but did not necessarily do so on multiple days in the same year or in sequential years. According to LWB, the 2016 report presenting the average of the multi-year temperature data shows that the average daily maximum temperature at Station S4 reached 29.4°C (85°F) on only 3 dates during July, and never exceeded the avoidance temperature (29.9°C). *See* AR-1300 p. 37. *See also* AR-872 p. 112. Yet, reviewing the actual, observed daily temperatures demonstrates that the daily maximum and mean temperature at S4 routinely exceeded 29.9°C between June 25 to September 1 in 2004, 2005, 2007, 2010, and 2011, albeit not every day. Figure II.8, from 2007, supports the 2011 Draft Determinations Document's conclusion that daily maximum and, in some cases, mean S4 temperatures reach avoidance temperatures for juvenile and adult white sucker for large portions of the summer.

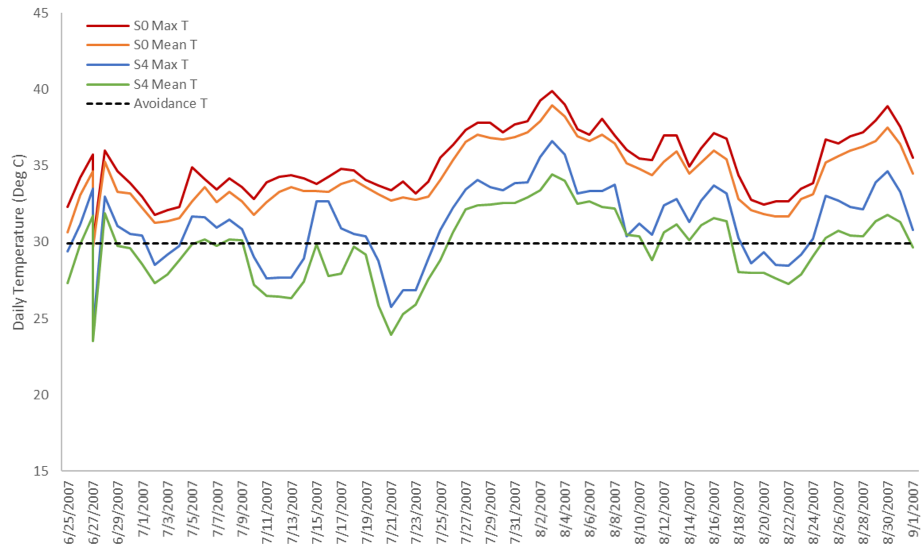

Figure II.8. Mean and maximum daily (24-hour average) temperature (deg C) at Stations S0 (discharge) and S4 (downstream) from June 25 through September 1, 2007 compared to the avoidance temperature for juvenile and adult white sucker (29.9°C).

LWB points out that white sucker adults and juveniles can avoid the thermal plume, for instance, by staying upstream of the discharge where ambient temperatures are in the preferred range. According to LWB, "these fish may prefer cooler water upstream from the discharge than warmer water below the discharge, although other habitat characteristics besides temperature could explain this distribution." AR-1300 p. 14. Electrofish sampling in 2010 and 2011 (when the Facility was operating at a relatively high capacity) supports this assertion as catch-per-unit-effort (CPUE) for white sucker north of the discharge was more than four times higher than the CPUE at stations south of the discharge. *See* AR-871, p. 42 (where Group IIB2 is represented mainly by stations in northern Hooksett Pool and IIB1 is represented mainly by stations in southern Hooksett Pool). White sucker adults and juveniles can avoid the plume, but persistent, elevated temperatures downstream of the discharge could exclude these fish from this habitat for nearly the entire summer. Under current operating conditions (*i.e.*, operating like a peaking plant from 2012 through 2018), however, the maximum daily river temperature at Station S4 reached 29.9°C on several occasions but, with the exception of July and August 2012, the duration of the event was limited (5 days or less) and the mean daily S4 temperature did not exceed 29.9°C. The change in operations of the Station since 2012 has decreased the number and duration of events when the temperature at Station S4 reaches or exceeds the white sucker avoidance temperature, which suggests that the habitat downstream the discharge would typically be available to, and protective of, white sucker juveniles and adults. There was no difference in the CPUE for white sucker in the northern and southern sections of Hooksett Pool during electrofish sampling in 2012 and 2013, when the Facility ran 5-15 days in August and September. *See* AR-1551, p. 19.

Summary

LWB conclude that the revised (2016) thermal data do not support the conclusions reached by EPA in the 2011 Draft Determinations Document and that, in most cases, actual exposure temperatures in recent years have been lower than the protective temperatures proposed in the

Draft Determination. *See* AR-1300 p. 37. LWB also concludes that, in the "few cases" where protective temperatures were exceeded, the number of dates and durations of exceedances were much smaller and do not support a finding of appreciable harm. *Id*. EPA considered LWB's comments on the misinterpretation of the maximum temperature data in the 2011 Draft Determinations Document, considered the data in the 2016 report that LWB relies on, and then re-evaluated the conclusions from the Determination based on review of the reported daily temperature data from 2004 through 2018. In most cases, the daily temperature data supports the conclusions from the 2011 Draft Determinations Document and refutes LWB's conclusions, which are based on long-term average temperature data that masks persistent, extreme temperature events that occur over long periods and in multiple years. In particular, LWB's analysis is flawed because the averaging period used (2002 through 2015) includes several years when the Station is operating like a peaking plant and, as such, is not representative of the actual thermal discharge from the Station when it is generating electricity. The discharge temperature is significantly lower when the Station is not operating. EPA's review of the daily temperature data from when Merrimack Station was operating as a baseload plant (e.g., 2004 through 2011), support the conclusions from the 2011 Draft Determinations Document and suggest that the thermal plume could result in appreciable harm to the BIP by causing river temperatures to exceed potentially lethal temperatures and possibly resulting in acute mortality, or avoidance temperatures and causing fish to be excluded from habitat downstream of the Station.

However, LWB correctly states that protective temperatures have been met in recent years, because these years represent peaking operations when the Station has not generated electricity for the majority of the spring and summer. *See* Responses to Comments II.3.4.1, 3.4.3. If future operations are consistent with operations from recent years, which are similar to that of a peaking plant, temperatures in the river will continue to be protective of the life stages and species of fish discussed above. However, the fact that the impact of the thermal plume is substantially less severe under current operations does not obviate the need for permit limits on thermal discharges. Instead, it is a reason for limits that will reflect the reduced operations and limit the Facility to future operations consistent with these operations going forward. As discussed in these Responses to Comments, the new owners of Merrimack Station, GSP, indicated a willingness to accept permit limits based on the current (and anticipated future) reduced operations. Furthermore, such limits are appropriate because EPA's analysis has concluded that thermal discharge limits reflecting this type of operation will satisfy the conditions of CWA § 316(a). Namely, limits based on CWA § 301, 33 U.S.C. § 1311 – i.e., technology-based limits under CWA § 301(b)(2) and water quality-based limits under CWA § 301(b)(1)(C) – will be more stringent than needed to assure the protection and propagation of the BIP in the Hooksett Pool, and the Final Permit's limits reflecting reduced operations and maintaining instream protective temperatures for the most temperature-sensitive native species will assure the protection and propagation of the BIP. *See* Responses to Comments in II.3.4. The Final Permit will continue to require monitoring of thermal discharges and, if needed, permit conditions can be revisited in future permit modifications or renewals.

3.1.4 The New Information Is Insufficient to Alter EPA's Denial of a 316(a) Thermal Variance: The Normandeau Report

Comment II.3.1.4	AR-1573, Sierra Club et al., pp. 5-7
See also AR-1575, Hickey and Shanahan	

Eversource's clarification of the Normandeau Report should not alter EPA's denial of the 316(a) variance. The question of whether the data presented are 21-year averages or 21-year maximums or minimums is trivial and irrelevant. The underlying point is that neither 21-year averages nor 21-year extremes are a suitable basis for evaluating thermal discharge impacts. Eversource should produce the actual temperature data, not statistical summaries of it. The Normandeau Report's probabilistic models are not valid or credible substitutes for the underlying temperature data, which Eversource has failed to produce. The Normandeau Report is not suitable for evaluating dynamic thermal plumes and potential effects on aquatic species and therefore cannot support a conclusion that a 316(a) variance would assure the protection and propagation of a BIP.

Eversource's clarification that the tables in Appendix A of the Normandeau Report expressed the maximum and minimum temperature for each day over a 21-year period as opposed to the *average* maximum and *average* minimum temperature for each day over a 21-year period cannot cure the fundamental problem with relying on the Normandeau Report as support for a 316(a) demonstration. To the contrary, Eversource's need to clarify the data shows precisely why relying on the Normandeau Report's summary of data is misleading and imprecise.

The Normandeau Report contains a probabilistic thermal modeling evaluation and daily statistical summary tables for a 21-year period. Hickey Report at 8. To create each average daily entry, the average daily temperatures for each of 21 years on the same date are averaged. *Id*. However, daily statistical summaries "mask river temperature fluctuations over time making it impossible to see temperature fluctuations that would be apparent in the continuous temperature measurements." *Id.* For example, large, short term temperature variations that can harm aquatic organisms are not detectable in daily summary statistics. The Normandeau Report used these summaries to model the thermal plume in Hooksett Pool.

The Hickey Report concluded that "the Normandeau [Report's] probabilistic thermal modeling analysis [is] ill-suited for supporting a 316(a) demonstration and concur[ed] with EPA's rejection of the report." Hickey Report at 9. Specifically, there was not a need for a probabilistic thermal model of the study area, rather there was a need for a clear presentation of available temperature data. The "model is ill-suited to support a 316(a) demonstration because it uses long-term averaging and model prediction to replace presentation of temperature measurements." *Id*. As a result, the Normandeau Report "has hidden peak water temperatures and temperature fluctuations experienced by aquatic species in Hooksett Pool from review." *Id.*

Moreover, a comparison of the model's predictions and the actual temperature data shows the limits of the model. According to the Normandeau Report's probabilistic thermal model there should be less than one day in every one-hundred year period that exceeds 90º F at two of the monitoring stations; however, a review of the average daily water temperature showed that, in 14 out of 20 years, temperatures exceeded 90º F on at least one day, and often more. Hickey at 9. This review of the field data from the Merrimack Station "strongly contradict[s] the probabilistic model predictions." *Id.* The model is simply not accurate at predicting the real-world characteristics of Merrimack Station's thermal plume.

Therefore, the clarification of the data underlying the Normandeau Report should not alter EPA's denial of the 316(a) variance because "the misunderstanding relative to maximum and minimum temperatures in Appendix A tables is inconsequential. However defined, the 21-year statistical summaries do not represent useful or appropriate temperature data submittals in a 316(a) demonstrations context." Hickey Report at 9-10.

EPA Response:

In the Determination Document, EPA focused on what the Agency had thought were long-term average maximum daily temperature data because this data (as understood by EPA) demonstrated persistent exceedances of certain threshold temperatures protective of RIS and, as a result, supported EPA's conclusion that the thermal discharge under the requested variance would not be sufficiently protective of the BIP. As discussed in response to the comments above, EPA misunderstood the maximum temperature data from Appendix A in AR-10 because of the ambiguous or misleading way in which it was presented. In an effort to correct this error, and in response to a §308 request from EPA (AR-1298), PSNH compiled and submitted average daily minimum, mean, and maximum temperatures on each date from April 1 through October 31.[11] *See* AR-1306. PSNH and its consultants have presented average temperature data from Appendix A of the 2007 Report (AR-10) and average temperature data submitted in 2016 in response to EPA's request (AR-1299) to refute statements from the Determination Document.

The commenter, with support from a 2017 Review of Available Water Temperature Data and Thermal Plume Characterizations related to the Merrimack Power Station in Bow, NH ("Hickey Report" AR-1575), indicates that neither 21-year averages nor 21-year extremes are a suitable basis for evaluating thermal discharge impacts and recommends that the final determination examine the actual temperature data, not statistical summaries. As the comment suggests, long-term average daily mean (or maximum) data indicates only that the average of the daily mean (or maximum) temperature on a given day over 21 years was below certain temperature thresholds.

[11] EPA requested the daily temperature data (instantaneous minimum, maximum, and daily average) for April 1 – October 31 over the 21 years of the initial 2007 Normandeau study (1984-2004) and the calculated 21-year daily average, average of the instantaneous daily maximum, and average of the instantaneous daily minimum temperatures for each date. See AR-1298. PSNH did not provide the requested data. In its response, PSNH instead calculated the daily average, average daily maximum, and average daily minimum for the years 2002 through 2015. PSNH asserts that the 1984-2001 data was not electronically available and was not necessary because the more recent data is "more representative of actual operations at Merrimack Station." AR-1299. EPA has considered this data as it represents the current and likely future operation of the Station, but, as explained in response to comments above, the 2016 dataset and calculations provided are not directly comparable to the initial 2007 data (as in AR-1300) because it excludes the years 1984-2001 and adds the years 2005-2015. In particular, the years 2011-2015 represent periods when Merrimack Station was operating at very low capacity in summer and rarely in spring and fall months.

Long-term average temperatures do not necessarily demonstrate that the thermal discharge is protective because summarizing 21 years of data could mask occurrences where protective temperatures are exceeded on a given day in any year(s). The exceedance of protective temperatures over multiple days and/or in consecutive years represent conditions that could harm the biological community. Consistent with the comment, for the Final Permit, EPA evaluated available, daily temperature data from Stations N10, S0, and S4 over the period from April 2004 through May 2019 from Merrimack Station's Annual Monitoring Reports and daily generating data (MWh) for Merrimack Station Units 1 and 2 for the years 2004 through 2019 from EPA's Air Markets Program Database.[12] *See* AR-1715.

Finally, CLF and Hickey comment that Normandeau's probabilistic thermal modeling analysis is ill-suited for supporting a 316(a) demonstration. See AR-1575 p. 9. The comment recognizes that the 2011 Draft Determinations Document rejected the probabilistic model for the purposes of supporting the proposed § 316(a) variance. *See* AR-618 p. 83. Normandeau (AR-850) calculated the probability of occurrence of downstream temperatures under "typical" conditions and "extreme" ambient river temperature and flows (assuming the Station was operating at baseload output), and then compared these downstream temperatures to three temperature thresholds identified as being within the avoidance or upper incipient lethal temperature range of resident important species (RIS): 86°F, 90°F, and 95°F. *See* AR-10 at 14-16. EPA has considered, but not ultimately relied on, the probabilistic model and subsequent updates in developing the limits for the Final Permit. As the comment and Hickey Report correctly recognize, the model does not accurately predict temperatures in Merrimack Station's thermal plume.

Normandeau's model predicts that while the temperature as Station S0 (at the end of the discharge canal) would exceed the temperature thresholds under typical (*i.e.*, 1 in 4 years) and extreme (*i.e.*, 1 in 100 years) conditions, the downstream temperature of Station S4 would exceed only the 86°F threshold and only under extreme conditions. EPA evaluated these predictions in comparison to daily river temperatures from May 1 through September 30 for the years 2004 through 2010, when the Station's operating capacity during the summer was typical of a baseload plant. On average, the mean daily temperature at Station S0 exceeded the 86°F threshold about 60% of the time on an annual basis and the 90°F threshold about 37% of the time. The temperature exceeded the 95°F threshold about 12% of the time. In 2007 and 2010, which are representative of warmer years, the 95°F threshold was exceeded on more than 30 days and in both years the maximum duration was about 2 weeks. In addition, the mean daily river temperature at Station S4 exceeded the 86°F threshold nearly every year between 2004 and 2010 (except for 2009), and exceeded the 90°F threshold in 2005, 2007, 2008, and 2010. The maximum daily S4 temperature exceeded the 90°F threshold in every year except for 2006 and exceeded the 95°F threshold in 2007, 2009, and 2010.

EPA's review supports the comment's argument that the actual daily temperature data representative of the thermal plume when the Station is operating as a baseload facility does not support either the predictions of the probabilistic thermal model or Normandeau's conclusion that river temperatures do not exceed selected in-river, RIS-specific threshold temperatures under typical conditions. Under the conditions of the model (representative of baseload operations), the

[12] https://ampd.epa.gov/ampd/

temperature at Stations S0 and S4 exceed avoidance temperatures for certain RIS species in most years and exceed the upper incipient lethal temperature (UILT) for certain RIS species in some years. *See also* AR-1575 p. 13-14; Response to Comment II.3.1.3. That said, recent temperature data, which reflects the Station's transition from a baseload to a peaking-like plant, demonstrates a substantial decline in the occurrence of extreme temperatures that could cause avoidance or mortality of RIS species and life stages. *See* Response to Comments II.3.3.1 and 3.4.7. The Final Permit establishes both protective temperature limits based on the thermal tolerance of RIS species and operational limits that ensure continued operation like a peaking plant during the summer.

3.2 Analyses of Shorter and Longer-Term Exposure Temperatures

Comment II.3.2(i)	**AR-1548, PSNH, pp. 56-60**
See also AR-1554, LWB, pp. 3-5	

In its Statement, EPA invites comment on the question of how shorter term and longer thermal data should be factored into EPA's evaluation under § 316(a) and New Hampshire's water quality standards of the effects of Merrimack Station's thermal discharge on Hooksett Pool and the development of thermal discharge limits for the Merrimack Station permit. The Statement includes the following rationale for considering temperatures reached on only a single day out of a 21-year time series as being relevant to the permit:

> While considering long-term averages has utility for evaluating thermal discharge impacts, looking *only* at long-term averages would obscure more extreme conditions that fish and other aquatic life might be exposed to over shorter, but still biologically significant periods of time. For example, such shorter, but impactful periods could occur during the summer when the plant is in full operation during low river flow and high ambient temperature conditions. Such temperature and flow extremes would be masked by only considering the data averaged over the full 21-year period. Consequently, in response to PSNH's clarification of the data it had submitted, EPA is now also reevaluating the effects of shorter-term thermal conditions, particularly on species that may be especially sensitive to such temperature excursions in relation to their ability to survive and compete with more thermally-tolerant species.[260]

Because over forty-five years of analysis of the fish, shellfish and wildlife in Hooksett Pool demonstrates an absence of prior appreciable harm, analysis of the river temperatures, long or short term, can only provide a theoretical explanation for why Merrimack Station's thermal discharge has not caused appreciable harm to the Hooksett Pool BIP. Short term temperatures are even less relevant to a permitting decision for a number of reasons.

First, as explained in Dr. Barnthouse's Comments to EPA's Statement, for an exposure duration of only 24 hours, "the chronic thermal tolerance data relied on in most of EPA's thermal effects analyses are not relevant. Only data on acute lethality related to short-term exposures would be relevant to such an evaluation."[261] Dr. Barnthouse explains that "Upper Incipient Lethal Temperature (UILT) values have historically been the most common measures of acute thermal effects in fish"[262] and those values for the RIS are provided in Appendix C of Normandeau 2007a.[263] Dr. Barnthouse continues:

> None of the other values provided in Appendix C or other sources utilized by EPA would be relevant to an analysis of short-term exposures. Even the UILT values are of questionable relevance, for two reasons. First, the exposure durations in thermal mortality experiments are typically 4-7 days (EPRI 2011) and most likely understate temperatures that could be tolerated for a period of only 24 hours. Second, the values themselves are strongly influenced by experimental conditions, especially acclimation temperature. EPRI (2011) found that UILT estimates for the same species can vary by 10°C or more depending on acclimation temperature. Evaluating the potential exceedance of these highly uncertain UILT values during rare, high-temperature events would not provide credible evidence for appreciable harm.[264]

Second, EPA ignores the fact that fish (except eggs and larvae) detect and simply avoid regions where temperatures are elevated to potentially harmful levels.[265] Dr. Barnthouse references EPRI's explicit recognition of this reality: "'It is important to note that none of the laboratory methods accurately reproduces what happens in the field where fish are exposed to spatially and temporally varying thermal fields and have the ability to select specific locations.'"[266] In fact, "'fish kills from heat are rare in nature and generally occur only when escapement is blocked or when the coolest water available to fish exceeds the lethal temperature or is deficient in oxygen.'"[267] These are not the conditions present in the vicinity of the Merrimack Station discharge, according to Dr. Barnthouse.[268] And, given the listed avoidance temperatures for the species at issue are equal to or lower than the corresponding UILTs,[269] it is safe to assume fish simply avoid the affected water during these rare events until the temperature declines to a more suitable level.[270]

Third, as discussed above with respect to the CORMIX modeling performed by Enercon and Dr. Barnthouse's analysis of the plume's effect on RIS, only a small fraction of the fish present in the Hooksett Pool would be exposed to the thermal plume from Merrimack Station. Even with respect to the mid-summer period—the one most relevant for addressing EPA's contention that "shorter, but impactful periods could occur . . . when the plant is in full operation during low river flow and high ambient temperature conditions"[271]—the plume affects only a minimal portion of Hooksett Pool where fish theoretically might be affected. As explained by Dr. Barnthouse:

> Enercon (2016) calculated the percent of the river area and volume between the mouth of the discharge canal (Station S0) and Hooksett Dam within which the plume temperature would exceed 80°F, 83°F, and 87°F. The two lower temperatures, 80°F and 83° would not have exceeded the UILT of any of the

> relevant species listed in Appendix C of Normandeau (2007b). The highest temperature, 87°F, exceeds the listed UILT for yellow perch, however at this temperature the plume includes only 0.02% of the area and 0.01% of the volume of the river between the discharge canal and Hooksett Dam. Since 87°F is within the range of avoidance temperatures listed for this species (79° F - 88°F), any yellow perch encountering this plume temperature would be expected simply to avoid it.[272]

Finally, any speculation that short-term high temperature exposures might impair the ability of thermally-sensitive species to survive and compete with more thermally tolerant species is disproven by the actual data from over many years of study of the fish communities present in the Hooksett, Garvins, and Amoskeag Pools of the Merrimack River. The actual data shows "there is no evidence that species with low thermal tolerances have been replaced by species with higher thermal tolerances."[273]

[260] AR-1534 at 39-40. It was EPA's misinterpretation of the Normandeau data set that led to its incorrect application of the temperature data. EPA was not actually advancing such a conservative analysis in its 2011 Fact Sheet. In fact, in its Statement, EPA states that it "did not think that such single-day data would be particularly useful for assessing the effects of thermal discharges on the aquatic community." *Id.* at 39. Nevertheless, the agency has specifically sought comment in its Statement regarding whether such single-data can provide a useful metric in the § 316(a) analysis. *See id.* at 39-40. It does not.

[261] LWB 2017 Response at 3.

[262] *Id.* (referencing a report from the Electric Power Research Institute ("EPRI"), Thermal Toxicity Literature Evaluation, Report No. 1023095, Palo Alto, CA (2011) (hereinafter ("EPRI (2011)"). This 2011 EPRI report is attached hereto as Exhibit 10.

[263] AR-11, Appendix C.

[264] LWB 2017 Response at 3-4.

[265] *Id.* at 4.

[266] *Id.* (quoting EPRI (2011)).

[267] *Id.* (quoting K.E.F., Hokanson, *Temperature Requirements of Some Percids and Adaptations to the Seasonal Temperature Cycle*, JOURNAL OF THE FISHERIES RESEARCH BOARD OF CANADA 34, 1524-1550 (1977)).

[268] *Id.*

[269] *See* AR-11, Appendix C.

[270] LWB 2017 Response at 4.

[271] AR-1534 at 39-40.

[272] LWB 2017 Response at 5. The reference to Normandeau 2007b in the LWB 2017 Response refers to the report identified as Normandeau 2007a in these comments. Dr. Barnthouse identifies a report by its year of publication and, as necessary, the "a," "b," etc. nomenclature for reports authored in the same year. Whichever report appears first in his report receives the "a" designation, the second is designated as "b," and so forth. This designation method may not always match how PSNH has identified the same reports in these or previous comments submitted to EPA.

[273] *Id.*

EPA Response:

EPA addresses this and the related comment from LWB in a single response below.

Comment II.3.2(ii)	AR-1554, LWB, pp. 2-5

On page 39 of its Statement, EPA provides its rationale for considering temperatures reached on only a single day out of a 21-year time series as being relevant to the permit:

> "While considering long-term averages has utility for evaluating thermal discharge impacts, looking only at long-term averages would obscure more extreme conditions that fish and other aquatic life might be exposed to over shorter, but still biologically significant periods of time. For example, such shorter, but impactful periods could occur during the summer when the plant is in full operation during low river flow and high ambient temperature conditions. Such temperature and flow extremes would be masked by only considering the data averaged over the full 21-year period. Consequently, in response to PSNH's clarification of the data it had submitted, EPA is now also reevaluating the effects of shorter-term thermal conditions, particularly on species that may be especially sensitive to such temperature excursions in relation to their ability to survive and compete with more thermally-tolerant species."

There are four reasons why EPA's proposed reevaluation will not provide useful information relevant to a permitting decision.

<u>Acute lethality is the only endpoint that is relevant to exposure periods as short as a single day, and laboratory-derived lethal temperatures may not be relevant to field conditions</u>

EPA's proposed reevaluation is based on the highest 24-hour average temperature observed on each date from April through October over the 21-years of data provided in Appendix A to Normandeau (2007a). For an exposure duration of only 24 hours, the chronic thermal tolerance data relied on in most of EPA's thermal effects analyses are not relevant. Only data on acute lethality related to short-term exposures would be relevant to such an evaluation. Upper Incipient Lethal Temperature (UILT) values have historically been the most common measures of acute thermal effects in fish (EPRI 2011). UILT values for the species addressed in EPA's §316 Determination are provided in Appendix C of Normandeau (2007b). None of the other values provided in Appendix C or other sources utilized by EPA would be relevant to an analysis of short-term exposures. Even the UILT values are of questionable relevance, for two reasons. First, the exposure durations in thermal mortality experiments are typically 4-7 days (EPRI 2011) and most likely understate temperatures that could be tolerated for a period of only 24 hours. Second, the values themselves are strongly influenced by experimental conditions, especially acclimation temperature. EPRI (2011) found that UILT estimates for the same species can vary by 10°C or more depending on acclimation temperature. Evaluating the potential exceedance of these highly uncertain UILT values during rare, high-temperature events would not provide credible evidence for appreciable harm.

<u>Fish can detect and avoid regions with potentially harmful temperatures</u>

Except in the case of eggs and larvae, fish can detect and avoid regions where temperatures are elevated to potentially harmful levels. EPRI (2011) stated that: “It is important to note that none of the laboratory methods accurately reproduces what happens in the field where fish are exposed to spatially and temporally varying thermal fields and have the ability to select specific locations.” Moreover, Hokanson (1977) stated that “fish kills from heat are rare in nature and generally occur only when escapement is blocked or when the coolest water available to fish exceeds the lethal temperature or is deficient in oxygen.” These are not the conditions present in the vicinity of the Merrimack Station discharge. As shown in Figures 3-5 of Enercon (2016) the station’s thermal plume is confined to the right (when facing downstream) bank of the river, leaving ample habitat available for fish to escape regions with elevated temperatures. Appendix C of Normandeau (2007b) provides avoidance temperatures for all of the species addressed in EPA’s §316 Determination. In all relevant cases the listed avoidance temperatures are equal to or lower than the corresponding UILTs[2]. During the rare events that EPA has proposed to evaluate, fish would simply avoid the affected water until the temperature declined to a more suitable level.

<u>Only a small fraction of the fish present in the Hooksett Pool are exposed to the thermal plume from Merrimack Station</u>

Enercon (2016) performed an analysis of the behavior of Merrimack Station’s thermal plume over three representative seasonal periods: early spring, when river flows are high and ambient river temperatures are relatively low; late spring, when ambient river temperatures are rising and flows are falling, and mid-summer, when ambient river temperatures are high and flows are low. LWB (2016b) evaluated the impacts of these three plume scenarios on the fish species present in Hooksett Pool. The mid-summer period is the most relevant for addressing EPA’s contention that “…shorter, but impactful periods could occur during the summer when the plant is in full operation during low river flow and high ambient temperature conditions.” Enercon’s calculations were made based on average ambient river conditions and plant operational parameters for the years 2006-2015. The analysis for the mid-summer period was performed using average ambient conditions and plant operations over the week of July 29-August 4.

Enercon (2016) calculated the percent of the river area and volume between the mouth of the discharge canal (Station S0) and Hooksett Dam within which the plume temperature would exceed 80°F, 83°F, and 87°F. The two lower temperatures, 80°F and 83° would not have exceeded the UILT of any of the relevant species listed in Appendix C of Normandeau (2007b). The highest temperature, 87°F, exceeds the listed UILT for yellow perch, however at this temperature the plume includes only 0.02% of the area and 0.01% of the volume of the river between the discharge canal and Hooksett Dam. Since 87° F is within the range of avoidance temperatures listed for this species (79° F - 88°F), any yellow perch encountering this plume temperature would be expected simply to avoid it.

<u>There is no evidence that "thermally sensitive" species have been or are being replaced by more thermally tolerant species</u>

EPA justified its proposed evaluation of short-term high-temperature exposures in part by speculating that such exposures might impair the ability of temperature-sensitive species to survive and compete with more thermally tolerant species. However, as discussed below, intensive biological study spanning 40+ years of the fish communities present in the Hooksett, Garvins, and Amoskeag pools of the Merrimack River show that there is no evidence that species with low thermal tolerances have been replaced by species with higher thermal tolerances.

> 2 No avoidance temperature was listed for Atlantic salmon, however, this species is not relevant to the permit because Atlantic salmon are not currently being stocked in the Merrimack River.

EPA Response to Comment II.3.2(i) and II.3.2.(ii):

In response to EPA's invitation to comment on the question of how long-term and short-term thermal data should be factored into EPA's evaluation under §316(a), the commenter asserts that temperatures reached on only a single day out of a 21-year time series are not relevant to the permit and provides four reasons why the "proposed re-evaluation" will not be useful.

At the outset, the comment misconstrues the referenced passage from EPA's 2017 statement (AR-1534) as a "rationale for considering temperatures reached on only a single day out of a 21-year time series as being relevant to the permit." That is not what EPA said or meant. The Statement explains that temperature and flow extremes over shorter, but impactful periods, can impact fish and other aquatic life. See AR-1534 p. 39-40. PSNH argues (in footnote 260) that the 2017 Statement recognized that single-day data would not be particularly useful for assessing the effects of thermal discharges and agrees that single-day data does not provide a useful metric. EPA maintains that while a single exceedance of protective temperatures on a single date in 21 years may not be a meaningful metric for assessing the impact of the plume on the BIP, exceeding protective temperatures on multiple, consecutive days and in sequential years may indicate that, at a minimum, there may be areas of the river habitat that the thermal discharge has made unsuitable for certain species and life stages during particular time periods. EPA has explained in responses to comments above that river temperatures at Stations S0 and S4 have reached or exceeded temperatures that could cause avoidance or mortality for some species and life stages. *See, e.g.*, Response to Comment II.3.1.3. In fact, the daily monitoring data demonstrate that, contrary to the commenter's conclusions based on the long-term, average temperature data, extreme temperature events were observed in most years that the Station was operating as a baseload plant and often for days or weeks at a time. The long-term averages presented by LWB and Normandeau effectively obscure these extreme temperature events and the commenters conclude, based on such a 21-year average, that the thermal plume has a negligible impact on the river. EPA maintains that review of observed mean daily and maximum daily temperature data during the years 2004 through 2019 is a more appropriate means of evaluating the impact of the thermal plume on the BIP than relying on long-term (21-year) averages.[13] *See also, e.g.*, Response to Comment 3.1.2 and 3.1.3. (As noted above, EPA

[13] There can be impacts from exposure to high temperatures beyond the acutely lethal effects, even, for instance, for mobile organisms that may be able to avoid the plume. The 2011 Draft Determinations Document explains that water temperature affects fish in many ways, including their metabolic rate, energy reserves, growth, reproduction, migration, egg maturation, incubation success, inter- and intraspecific competitive ability and resistance to parasites, diseases, and pollutants. *See* AR-618 at 29. Therefore, exposure to elevated temperatures can cause adverse effects to fish at the sub-lethal level if they disrupt one or more of the many requirements critical to fish growth, survival, spawning success, migration, etc. As an example, if elevated temperatures in the nearshore shallows cause juvenile

also requested daily temperature data for the years 1984 to 2004 – having reviewed the averaged data for those years in the 2007 Normandeau report submitted by PSNH – but PSNH did not provide the requested data, stating that it did not have it electronically and it was therefore very difficult to compile.)

LWB first asserts that only the upper incipient lethal temperatures (UILTs) in the Normandeau (AR-3 Appendix C) are "relevant to an analysis of short-term exposures." EPA addresses additional comments on the derivation of protective temperatures in Response to Comment II.3.4.7. LWB also argues that laboratory studies of UILTs are based on exposure durations of 4-7 days (citing EPRI 2011) and most likely understate temperatures that could be tolerated for shorter periods (e.g., 24 hours). *See* AR-1554 at 3. The protective temperatures proposed in the 2011 Determinations Document were derived consistent with EPA's 1986 Water Quality Criteria ("Gold Book"), which establishes a maximum protective temperature for short exposures based on species-specific equations. EPA used this method to derive protective short-term temperatures for species in the Merrimack River considering that the time period when the organisms would be exposed to temperatures that may cause acute lethality is likely to be considerably shorter than 24 hours.[14] *See e.g.*, AR-618 p. 190. EPA looked to a wide range of studies to determine appropriate temperatures for protecting the BIP. Several of the studies referenced in the 2011 Determinations Document (*e.g.*, Wismer and Christie, AR-196) observed lethality at exposures of as little as 10-30 minutes, not 24 hours or 4-7 days, as LWB suggests. *See* AR-618 at 187, 203. The agency realizes that it may not be possible to accurately predict acclimation temperature or exposure time for organisms in Hooksett Pool and, as such, we cannot be certain how closely the critical temperatures identified in laboratory studies would be mirrored in Hooksett Pool. Nevertheless, the studies referenced in the 2011 Determinations Document suggest that mortality and/or sub-lethal effects to early life stages of yellow perch and American shad could occur at temperatures that have been observed in the thermal plume. In light of the available data, EPA derived protective temperatures for thermally sensitive species and life stages consistent with the methods described for setting water quality criteria in EPA's Gold Book.

EPA's review of recent, observed daily temperature data highlights the value of evaluating all of the available temperature data and refutes LWB's comment that exceedances of UILT values as a result of the thermal plume are rare. Between 2004 and 2011, the mean daily temperature at Station S0 exceeded 33.5°C (the temperature at which Klauda et al. (AR-62) observed significant mortality of larval American shad after an exposure of 15 minutes) in six of the years and at durations up to 12 days. This data undermines LWB's characterization that exceedances occur during "rare, high-temperature events" or that the UILT values are not relevant to this permitting decision. Since 2012, the mean daily temperature at Station S0 exceeded 33.5°C in 2012, 2013, and 2018 at shorter durations.

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fish to abandon the relative safety of their preferred habitat for cooler, deeper water they will likely be exposed to more predators. AR-618 p. 82. Such temperature excursions would likely not be captured with data summaries presenting average temperatures over a 21-year period.

[14] EPA also based the long-term protective limits on the Gold Book recommended weekly average temperature, which may be calculated one of several ways. In the 2011 Draft Determinations Document, EPA determined this value by adding to the physiological optimum temperature a factor calculated as one-third of the difference between the UILT and the optimum temperature. See, e.g., AR-618 p. 186.

The recent temperature data indicates that the shift from baseload to operating like a peaking plant has changed the thermal plume by decreasing both the magnitude and duration of peak temperatures. Exceedances of UILTs at Station S0 occur less often now that Merrimack Station operates like a peaking plant. *See* Response to Comment II.3.1.3. EPA also recognizes that Station S0 is located in the discharge canal (just prior to the confluence with the River) and the thermal plume will experience some mixing once it combines with the Merrimack River. The observed daily Station S4 temperatures representative of recent operations at the plant indicate that temperatures at this location and downstream will not cause mortality of juvenile fish. A review of the daily temperature data indicates that the maximum daily temperature at Station S4 exceeded 30.9°C between August 1 and September 30 nearly every year between 2004 and 2011 but, since 2012, has been exceeded on just 8 days in 2012 and 3 days in 2018, and at no time was the mean daily S4 temperature greater than 30.9°C. *See* AR-1715.

In addition, LWB comments that mobile organisms can detect and avoid regions where temperatures are elevated to potentially harmful levels and that a thermal review by EPRI recognized that "none of the laboratory methods accurately reproduces what happens in the field where fish are exposed to spatially and temporally varying thermal fields and have the ability to select specific locations." AR-1554 at 4 (referencing AR-1558). EPA reviewed the EPRI Report (AR-1558) and recognizes that laboratory-derived temperature criteria may not necessarily represent precisely the conditions that fish encounter in the field. However, neither the commenters nor EPRI specify how protective temperatures for fish should be derived if not with thermal tolerance data. Moreover, both EPRI and LWB, as well as Normandeau and PSNH, continue to reference thermal tolerance data in their comments on the Draft Permit and in the supporting analyses. EPRI observed that the upper incipient lethal temperature (UILT) is among the most conservative of the laboratory methods reviewed. Given that the Final Permit imposes acute (maximum daily) limits downstream of the discharge, and in light of the unavoidable uncertainty involved in predicting the exact temperature of the discharge when it meets the river, how warm ambient temperatures will be, how fast the river is flowing, and the duration of heated discharge on any given day, a conservative approach based on the UILT is warranted recognizing that the statutory standard in 316(a) is to provide reasonable *assurance* of the protection and propagation of the BIP.

Mobile organisms like juvenile and adult fish are likely able to limit exposure to elevated or potentially lethal temperatures in the thermal plume either by remaining in cooler areas of the Hooksett Pool for the relatively short periods when the plume is present or, in this case, by staying at depth beneath the relatively shallow, surface-oriented plume. The ability to avoid the thermal plume should ensure that juvenile and adult fish can avoid exposures to potentially lethal temperatures. However, it is important to consider the size and duration of the thermal plume. If a thermal plume forces extensive avoidance of an area it can mean that the value of the habitat has been degraded, as organisms that should inhabit the area are unable to. Moreover, while a fish that can exhibit a behavioral response to a thermal plume may avoid lethal temperatures, not all organisms can avoid a plume. Drifting and sessile organisms, for instance, will not be able to avoid the plume and adults of nest guarding species may be unable to avoid a plume during spawning or rearing. *See* AR-1589, Chapter 15. EPA agrees that fish kills from heat are relatively infrequent, likely to occur only when escape to cooler water is blocked, and have not been documented to have occurred at Merrimack Station. *See* Responses to Comments II.3.1.3, 3.4.7. The recent operational changes discussed in the comment result in a thermal plume that is limited in duration, allows river temperatures to return to ambient levels, and ensures that habitat downstream from Merrimack Station is not unsuitable for fish for long periods of time during the summer. *See* Response to Comment II.3.3.2.

LWB comments that only a small fraction of the fish present in the Hooksett Pool would be exposed to the thermal plume from Merrimack Station based on CORMIX modeling performed by Enercon in 2016. The model and supporting analysis (AR-1352) indicates that the plume affects only a minimal portion of Hooksett Pool where fish theoretically might be impacted. EPA addresses comments on the CORMIX model in Responses to Comments II.3.3.3, 3.3.4, and 3.3.5. The CORMIX model and associated evaluation are not appropriate for demonstrating either the characteristics of the thermal plume or the potential impacts on aquatic life. In particular, the input values for effluent flow and temperature are not representative of any actual operating conditions at Merrimack Station. As such, EPA has not relied on either report either to decide whether to grant PSNH's request for a § 316(a) variance or to establish thermal limits in the Final Permit.

Finally, LWB comments that many years of study of the fish communities present in the Hooksett, Garvins, and Amoskeag Pools demonstrates there is no evidence that "thermally sensitive" species have been or are being replaced by more thermally tolerant species. Normandeau's 2007 fisheries report presents sampling data for the ambient and thermally-influenced sections of Hooksett Pool, and both electrofishing and trapnet sampling clearly demonstrate notably lower abundance levels in the thermally-influenced section for coolwater species such as yellow perch and white sucker. *See* AR-3, pp. 20, 22, 62, 63. This apparent avoidance of the thermally-influence section of Hooksett Pool during the summer months by these thermally-sensitive coolwater species factored into EPA's initial determination that Merrimack Station had caused, or contributed to, appreciable harm to the Hooksett Pool BIP. *See* Response to Comment II.4.4.1. During electrofish sampling in 2010 and 2011, Normandeau found generally that, within Hooksett Pool, the communities upstream and downstream of the discharge were fairly similar but the stations upstream of the discharge had a greater abundance of fallfish, white sucker, and yellow perch (coolwater species) and the thermally-influenced section downstream of the Facility had higher abundance of bluegill and largemouth bass (warmwater species). *See* AR-871, p. 20, 42. In 2012 and 2013, when the Facility was operating at less than 30% capacity in August and September, fallfish and white sucker (both coolwater species) were as abundant as or more abundant in the Hooksett Pool stations downstream of the discharge than in the northern stations, which supports EPA's conclusions that the thermal plume under peaking-like operations will not impede movement of fish in Hooksett Pool or exclude fish from certain areas. *See* AR-1551, p. 19.

In sum, the comment's arguments that analysis of short-term data is not relevant to the establishing thermal limits for the Final Permit are not persuasive. EPA agrees that a single exceedance of a protective temperature in a single year may not indicate that the thermal plume has an impact on the BIP, but this is not what EPA suggested and is not the case in the Merrimack River. EPA's review of daily temperature data from 2004 through 2019 indicates that, when operating as a baseload plant, the thermal plume from the Station frequently exceeded protective temperatures over multiple days and in consecutive years. This analysis highlights the importance of relying on the actual, observed temperature values and the shortcomings of summarizing temperature data over many years. Temperature data from more recent years when the Facility has operated like a peaking plant, shows lesser and less frequent instances of water temperatures exceeding protective levels.

3.2.1 No Further Analysis of Shorter-term or Longer-term Thermal Data is Necessary

Comment II.3.2.1	**AR-1552, Normandeau, p. 1**

In EPA's Substantial New Questions and Possible New Conditions, the agency invited public comment on the question of how shorter-term and longer-term thermal data should be factored into the evaluation under CWA 316(a) and New Hampshire's water quality standards of the effects of Merrimack Station's thermal discharges on the Hooksett Pool and the development of thermal discharge limits for the Merrimack Station permit.
It is Normandeau's position that there needs to be no further analysis of shorter-term or longer-term thermal data because numerous fish and aquatic community analysis conducted over 40 years of Merrimack Station operation have demonstrated there is no appreciable harm to the balanced, indigenous populations of shellfish, fish and wildlife in Hooksett Pool caused by the thermal discharge. An updated summary of these 316(a) studies and results will be presented in Section 2 and the 316(b) comments on the new wedgewire technology will be presented in Section 3.

EPA Response:

In response to the comment that 45 years of analysis of the fish, shellfish and wildlife in Hooksett Pool demonstrates an absence of prior appreciable harm, EPA does not agree that all the data provided point to a conclusion supporting the absence of prior appreciable harm. *See* Responses to Comments II.4.4 (and associated sub-comments). As explained in those responses, EPA maintains that the information available at the time of the Draft Permit demonstrates that the plant caused or contributed to prior appreciable harm as a result of the thermal discharge from the plant's baseload operations. EPA has since considered additional information in comments and supporting studies and, in particular, has re-examined the potential impacts of the thermal plume on river temperatures as a result of the substantial changes in the operation of the Station since the Draft Permit and initial § 316(a) demonstration were submitted. *See* Response to Comment II.3.1.3 and 3.2. EPA has not changed its prior conclusions on the basis of new information and analysis, but it has further assessed thermal discharge issues in light of the Facility's much reduced operations.

3.2.2 EPA's Evaluation of PSNH's Variance Request Should be Premised on the Last 10 Years of Data Because They More Accurately Reflect Plant Operations

Comment II.3.2.2	**AR-1548, PSNH, pp. 51-53**

To the extent EPA considers temperature data in its permitting analysis, use of the last 10 years of plant and Merrimack River data PSNH previously provided to EPA[239] is in accordance with EPA's standards for issuing NPDES permits. For example, the 2014 final § 316(b) rule and regulations provide that studies, analyses, and/or data from the most recent 10-year period are most relevant for NPDES permit determinations and older data may only be considered if the permittee is able to demonstrate the data remains relevant and representative of current conditions at the facility.[240] With respect to the latter consideration, the opposite is true. Data from beyond this 10-year period is no longer representative of current conditions at Merrimack Station.

Merrimack Station has also changed significantly over the past decade with the installation of a scrubber system for the facility's two coal-fired boilers. The station's Clean Air Project went into commercial service in 2011 and included the installation of a wet flue gas desulfurization treatment technology, wastewater treatment systems (including the secondary wastewater treatment system), limestone and gypsum handling and storage equipment, and chimney equipment. The total project cost exceeded $400 million and has substantially altered the layout of Merrimack Station. The 2002 through 2015 data set PSNH previously provided to EPA[241] includes several years both before and after completion of the Clean Air Project, and is more representative of current plant operations than other historical years, including but not limited to the 1984 to 2004 data set EPA requested from PSNH in 2015.[242]

Apart from using design intake flow ("DIF") to determine a facility's applicability to the overall rulemaking, the final § 316(b) rule principally relies upon the three-year and/or five-year average actual intake flow ("AIF") (i.e., the actual volume of water withdrawn) to determine which facilities subject to the rule must submit a number of comprehensive studies with an NPDES permit application.[243] EPA correctly utilizes data from the most recent, relevant actual operations of a facility (i.e., the last three to five years of operation) in this § 316(b) context to formulate its permit decisions.

EPA's own NPDES Permit Writers' Manual similarly supports use of recent historical, average effluent data (i.e., the last three to five years of data) when establishing technology- based limitations for other pollutants of concern.[244] This is corroborated by the agency's NPDES application Form 2C for wastewater discharges, which requires all sampling required by the Form to have been completed "no more than three years before submission" of the application.[245] Indeed, CWA § 402(b)(1)(B) provides that NPDES permits are to be issued "for fixed terms not exceeding five years,"[246] meaning any permittee seeking to renew its permit is required to submit new effluent data prior to the expiration of its current permit—giving permit writers an opportunity to regularly revisit this average effluent data. For all of these reasons, to the extent EPA considers temperature data at all—despite the 40+ years of biological studies demonstrating no prior appreciable harm to the BIP—EPA's standards and practices in the NPDES program make clear that this most recent dataset is the appropriate one for EPA's § 316(a) analysis.

[239] *See* AR-1305; AR-1306; AR-1307.

[240] *See* 40 C.F.R. §§ 122.21(r)(6)(ii)(A), (r)(7).

[241] *See* AR-1305; AR-1306; AR-1307.

[242] *See* AR-1298.

[243] *See, e.g.,* 79 Fed. Reg. 48,300, 48,308-09 (Aug. 15, 2014).

[244] *See, e.g.,* EPA, NPDES Permit Writers' Manual, § 5.2.2.5, at 5-30 (Sept. 2010) (providing that permit writers can establish permit conditions using data from the past 3 to 5 years and that the goal in selecting the relevant data set is for it to be "representative of the actual [permit conditions] likely to prevail during the next term of the permit"); *see also* 55 Fed. Reg. 47,990, 48,020 (Nov. 16, 1990) (codified at 40 CFR pts. 122, 123, and 124) (in responding to a public comment regarding NPDES permit application requirements, EPA agreed with the commenter that "any information requested [in the application] should be limited to a period of three years[.]").

[245] EPA, Application Form 2C–Wastewater Discharge Information, EPA Form 3510-2C, at 2C-1 (Aug. 1990), available at https://www3.epa.gov/npdes/pubs/3510-2C.pdf.

[246] 33 U.S.C. § 1342(b)(1)(B).

EPA Response:

Having carefully considered the above comments by Merrimack Station, EPA agrees with some of the points made and disagrees with others. The Facility comments that in developing thermal discharge limits, EPA should consider more recent thermal data associated with current plant operations. The Facility notes that EPA's Permit Writer's Manual (2010) suggests that permit writers should focus on data representative of operating conditions that will prevail during the permit term. More specifically, the comment urges that EPA focus on "[t]he 2002 through 2015 data set PSNH previously provided to EPA … [which] is more representative of current plant operations than other historical years."

EPA recognizes that Merrimack Station's operational profile has changed over the last five to ten years, going from a baseload facility to one that operates only intermittently (*i.e*., "peaking"), primarily in the winter and summer. The Facility may operate at a high level when it is called upon to generate electricity, but this happens much less frequently now than when the 2011 Draft Permit was issued. While some winter and summer operations may be likely each year, how many and which days the facility will be called upon during those seasons is dependent upon weather and other factors that are unpredictable. The Facility also makes money by remaining available to provide electricity when it is needed. Not only is this Merrimack Station's current mode of operation, but it has been the Facility's operational profile for a number of years now and GSP has indicated to EPA that it plans and expects for the Station to continue in this manner for the foreseeable future.

EPA agrees that it should develop permit limits based on the Facility's planned for and likely operating profile, and based upon consideration of, among other relevant matters, recent data representative of current and anticipated future operating conditions. *See also* AR-1534 at 39. Writing permit limits based on current operating conditions makes sense as long as they address how the Facility plans to operate going forward and the Facility has indicated that it can accept a permit developed on that basis. (PSNH, conversely, requested permit limits based on baseload operations.) Writing permit limits based on current, reduced operations would be inappropriate and ineffectual if after the permit was issued the Facility could resume operating at a higher level and cause greater adverse effects. Therefore, EPA has designed permit limits that are consistent with Merrimack Station's current intermittent operations and will, where appropriate, prevent significantly greater operations that would cause significantly greater adverse environmental effects that have not been evaluated as the basis for the permit limits. These permit limits are intended to provide appropriate flexibility to the Facility while protecting the environment consistent with legal requirements. If the Facility wishes to change its operations in a way that requires different permit limits, it can always seek permit changes in the future.

Still, EPA does not agree that it is inappropriate in this case for EPA also to consider older thermal and biological data. Merrimack Station has requested renewal of its previous thermal discharge variance under CWA § 316(a). This request was submitted based upon the Facility's baseload operations. In assessing this request, EPA must assess whether the existing thermal discharge has caused "appreciable harm" to the BIP of the Hooksett Pool. *See* 40 CFR § 125.73(c)(1)(i).[15] This necessarily involves a look at historical data. *See* Permit Writers Manual, p. 5-43. Contrary to the Facility's comments, EPA found that thermal discharges associated with Merrimack Station's prior baseload operations did cause appreciable harm to the BIP. At the same time, however, EPA has concluded that permit limits allowing for the facility's current, intermittent operations will provide reasonable assurance of the protection and propagation of the BIP going forward. These two conclusions have both contributed to the thermal discharge permit conditions designed by EPA for the final Merrimack Station permit.

While the Facility points to EPA's regulations under CWA § 316(b) to support the idea that EPA should only consider data collected in the last 10 years, EPA disagrees. First, the regulations under CWA § 316(b) do not govern the review of thermal discharge limits. Second, even under the CWA § 316(b) regulations, EPA does not preclude consideration of older data. Rather, EPA's regulations allow for the consideration of older data if it is still representative or otherwise relevant to the assessment. As explained above, consideration of the older thermal and biological data is relevant to the inquiry under CWA § 316(a) in this case because this data is representative of continued, year-round operation of the Station and the requested variance reflected this operation. EPA has considered both new and old data in their appropriate context.

The Facility also comments that it has added significant additional air pollution control equipment in recent years – such as wet flue gas desulfurization scrubbers – and that the facility layout has changed as a result. EPA is aware of these changed conditions, but they are not relevant to the assessment under CWA § 316(a) of the effects on the BIP of the Hooksett Pool from the Facility's thermal discharges. The comment provides no justification as to why the changes should be considered in the context of thermal discharges.

Finally, while Merrimack Station points to EPA's Permit Writers Manual (p. 5-30) to support its argument that EPA should focus on the newer data and expected future operational conditions, EPA notes first that the discussion cited by the Facility addresses technology-based limits not CWA § 316(a) variance-based limits, which are discussed in a different part of the Manual. *See id.*, at pp. 5-42 – 5-43. Furthermore, as discussed above, EPA has considered the newer data and

[15] If there has been prior appreciable harm from an existing thermal discharge, EPA still considers whether proposed thermal discharge variance-based limits will assure the protection and propagation of the BIP. 40 C.F.R. § 125.73(c)(1)(ii).

anticipated future operating conditions in developing the new thermal discharge limits for the permit. Indeed, EPA has developed permit limits that reflect the anticipated reduced operations which is consistent with the Permit Writers Manual. *See id*., at pp. 5-30, 5-37 – 5-39 (development of variable, "tiered" permit limits to address variable production levels).

3.2.3 EPA must not consider any drop in output at Merrimack Station

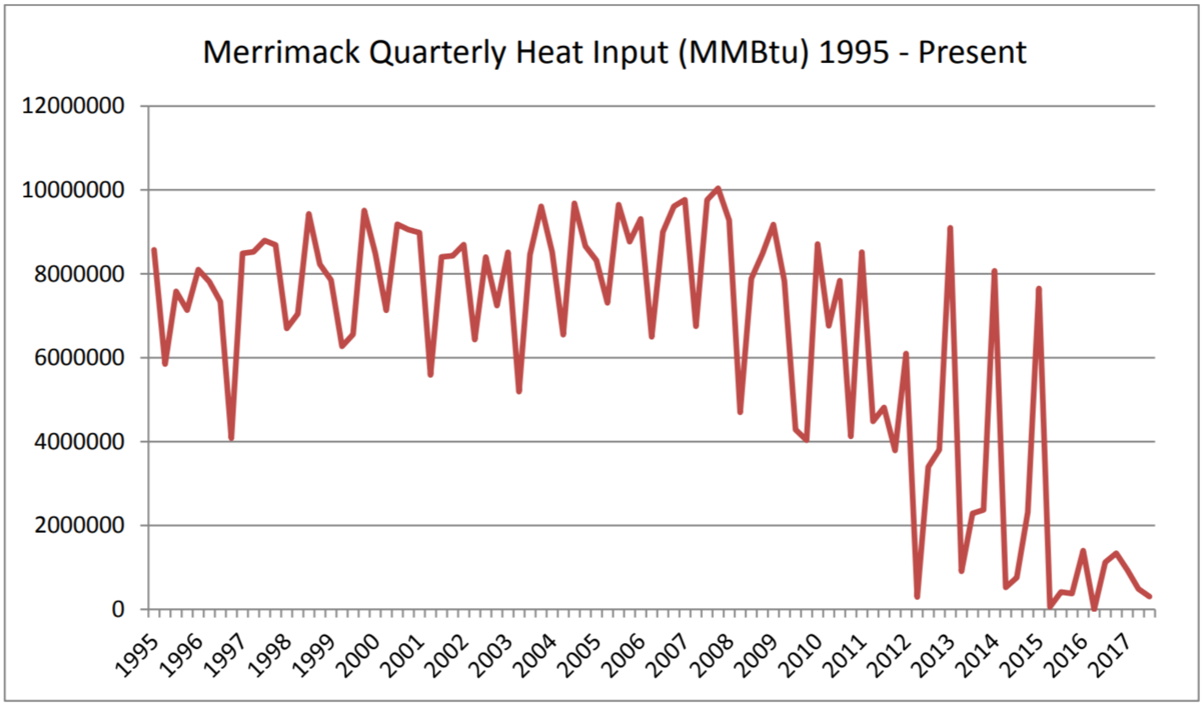
Comment II.3.2.3	AR-1573, Sierra Club et al., pp. 25-27

EPA must not give any consideration for any current "substantial drop" in Merrimack's operation in determining NPDES permit limits for the facility, for three main reasons. First, NPDES permits are set based on the facility's potential pollution, not historical performance. Unless coupled with operation restrictions, discharge limits may not be set based on what level of operation EPA suspects Merrimack might engage in, but only on what level of operation it is allowed.

Second, as EPA implicitly recognizes, while Merrimack's annual capacity factor may be lower in recent years than in years further back, it still operates quite heavily for short periods of time in the winter and in the summer. Setting limits based on annual output would improperly ignore Merrimack's high level of operations, and concomitant environmental impacts, during those periods of time. This would be particularly troublesome given the seasonality of the thermal impacts described above, where it is precisely the thermal pollution Merrimack causes during the winter that provides a toehold for invasive species and threatens the balanced indigenous population of aquatic species in the Merrimack river.

Third, the unfortunate fact is that EPA is extremely slow in issuing NPDES permits for large facilities in New Hampshire, and for Merrimack in particular. These comments are submitted as part of the third round of comments solicited by EPA on this one permit, in a process that started over five years ago. Indeed, Merrimack has been operating under a permit that expired two decades ago, and was issued a quarter-century ago. Although Commenters certainly hope that EPA will finalize this permit soon, and will thereafter hew to the five-year permit review cycle mandated by Congress, the history of this permit and this plant raises the possibility that whatever permit EPA does finalize for Merrimack may govern the plant's operation for many years to come. Just as Merrimack's operation has changed considerably in the past, it is possible that it will vary considerably in the future.

Figure 1: Merrimack Quarterly Heat Input, 1995-Present[21]



As such, it would be both irresponsible and contrary to law for EPA to set NPDES permit limits for Merrimack based on an assumption that, because the facility currently operates at a relatively low capacity utilization, certain wastestreams and pollution levels are unlikely to be relatively high in the future and therefore need not be limited.

Further, even an enforceable permit mechanism to "lock in" Merrimack's operation levels from 2016 and 2017 would be insufficient to prevent adverse impacts on the river's ecosystem. The only way for EPA to take into consideration any "substantial drop" in Merrimack's operations would be to ensure that such reduced operations are written into the permit itself through operation restrictions. However, Merrimack's current relatively low annual capacity factor is coupled with significant swings in operation, including quarterly heat inputs characteristic of operations when Merrimack operated more continuously. Restricting Merrimack to operate in the future as it does currently would do little to nothing to address the negative environmental impacts the plant poses to the receiving waters discussed elsewhere in these comments. Accordingly, EPA should not give consideration to Merrimack's current overall capacity utilization as it finalizes the plant's long-overdue NPDES permit.

[21] Data taken from EPA's Air Markets Program Data, *available at* https://ampd.epa.gov/ampd/.

EPA Response:

The commenter expresses opposition to permit limits that consider Merrimack Station's reduced operations, but also suggests that such limits should not be used "[u]nless coupled with operation restrictions …." The commenter also states that limits should not be based on how much the facility "might" operate, but on how much it is allowed to operate. The commenter notes that even if the Facility's overall operations are reduced, it can still operate at high levels during the winter and summer, which the commenter states are both seasons of concern (in winter, due to invasive species that favor warmer water, and in summer, due to inhospitably warm temperatures for fish in the river). The commenter also expresses concern that development of permits for facilities like Merrimack Station have taken a long time and that a permit taking into account the Facility's reduced operations could become inappropriate and problematic if those operations become more frequent again in the future but the permit was not adjusted quickly in response. The commenter states that it would inappropriate and unlawful to fail to limit the Facility's discharges based on the assumption that it does not operate much when it could then operate more again in the future but would not be addressed by the permit. Finally, the commenter states that "[t]he only way for EPA to take into consideration any 'substantial drop' in Merrimack's operations would be to ensure that such reduced operations are written into the permit itself through operation restrictions." The commenter further states that basing limits on the annual capacity factor would not help environmentally due to the significant swings in operations that have happened over the course of a year on a shorter-term basis.

EPA agrees with this comment in certain respects, but not in others. Ultimately, the Agency believes the Final Permit's limits are consistent with the comment. The Agency's response follows.

EPA has considered the option of limiting thermal discharges based on operational restrictions since the 2011 Draft Permit. *See* AR 618, pp. 144-45. Ultimately, EPA rejected this option because, at that time, Merrimack Station provided electricity to the grid as a baseload operator and there were technologies available to limit the Facility's thermal discharges, as needed, without adversely affecting electrical output. *Id.* In 2017, EPA explained that one of the reasons that it reopened the comment period was that the Facility was no longer a baseload operator and, instead, operated more like peaking plant, and the Agency was considering, and invited public comment regarding, whether thermal discharge limits should be developed that took account of the Facility's much reduced operations. AR 1534, pp. 5, 8, 39, 40, 68-69. EPA requested comments on the subject but indicated that it was not currently planning changes on this basis because Merrimack Station was still seeking "permit limits based on the Facility operating at full capacity," as a baseload generator, and because the Facility still operated at full capacity at times, albeit infrequently. *Id*., p. 69.

Later still, however, as discussed in these Responses to Comments, the new owners of Merrimack Station, GSP, indicated a willingness to accept permit limits based on the current (and anticipated future) reduced operations. EPA agrees with the commenter that this does not obviate the need for permit limits on thermal discharges. Instead, it is a reason for limits that will reflect the reduced operations and limit the Facility to future operations consistent with these operations going forward to the extent they will satisfy the CWA. Such limits are appropriate in this case because EPA's analysis has concluded that thermal discharge limits reflecting this type of operation will satisfy the conditions of CWA § 316(a). Namely, limits based on CWA § 301, 33 U.S.C. § 1311, will be more stringent than needed to assure the protection and propagation of the BIP in the Hooksett Pool, and the Final Permit's limits based on critical temperatures to protect fish species and reflecting reduced operations will assure the protection and propagation of the BIP.

Consistent with the comment, EPA's permit will not allow the Facility to simply shift to higher level operations, such as baseload operations, at will. The Facility could not meet the limits operating in that manner. To increase operations, the Facility would either have to install treatment equipment to enable it to meet the thermal discharge limits while increasing generation or apply for and obtain new permit conditions. Also consistent with the comment, EPA recognizes that the Facility can experience significant swings in operations over a short period of time. EPA has written permit limits that allow these swings up to a point, but then restrict them to assure protection and propagation of the BIP. Again, the commenter states that that "[t]he only way for EPA to take into consideration any 'substantial drop' in Merrimack's operations would be to ensure that such reduced operations are written into the permit itself through operation restrictions." This is what EPA's Final Permit does.

3.3 Thermal Models

3.3.1 ASA Comments on EPA's Evaluation of 2010 Thermal Study

Comment II.3.3.1	**AR-848, ASA, pp. 1-4**

[*In the Determination Document at 83 (paragraph 2)*] The purpose of the modeling described in Crowley et al. (2010) was to document model calibration and verification of a three-dimensional, hydrothermal computer model applied to the Hooksett Pool in the Merrimack River. A significant field program conducted by Normandeau Associates, Inc. in 2009 acquired an extensive data set which provided the most complete information on the thermal structure of the River. For that reason, the 2009 period was chosen for model calibration and verification. Before any hydrothermal model can be used to predict extreme events it must be shown to accurately reflect observations, which the 2010 report successfully showed. Additional model runs using the validated model for average and extreme years (higher water temperature, lower river flow) for different periods of combined biological and environmental significance were subsequently performed (Crowley, et al., 2012). Furthermore, EPA's rejection of NAIs 2007 report was in reference to the use of A0 as a monitoring station, not a rejection of the thermal characterization of the Hooksett Pool which was the subject of the ASA statement of agreement between ASA's 2010 report and Normandeau's 2007 report.

[*In the Determination Document at 84 (paragraph 1)*] USEPA fundamentally misinterpreted the purpose of the 2009 model simulations. As stated in the previous response, the purpose of the modeling described in Crowley et al. (2010) was to document successful model calibration and verification of a three-dimensional, hydrothermal computer model applied to the Hooksett Pool in the Merrimack River using the most extensive data set available (2009). ASA did not propose that the 2009 period was typical, only that the most extensive data set available for model calibration and verification was taken in 2009. Additional model runs for average and extreme years were subsequently performed (Crowley et al., 2012).

[*In the Determination Document at 84 paragraph 2)*] Again, USEPA misinterpreted the purpose of using the 2009 data set, i.e., to successfully calibrate and verify the model. ASA did not propose that the 2009 period was typical, only that an extensive data set was available for model calibration and verification. Again, average and extreme years were subsequently modeled.

[*In the Determination Document at 85 (paragraph 1)*] ASA did not imply that the 2009 period was the warmest period only that the most extensive data set was used, typical of good modeling practice. In 2009 the plume was somewhat smaller and typically was oriented more to the west side of the Pool. As above, the purpose of the modeling described in Crowley et al. (2010) was to document model calibration and verification. A joint probability analysis was subsequently conducted to identify average and extreme years based on river temperature and flow (Crowley et al., 2012).

[*In the Determination Document at 85 (paragraph 2)*] USEPA fundamentally misinterpreted the goal of the study as noted above. The subsequent study analyzed environmental conditions to determine years with typical and extreme periods.

[*In the Determination Document at 85 (paragraph 3)*] ASA's modeling successfully captured the magnitude of temperature change and spatial extent of the plume's influence in 2009 as documented by its report. ASA did not seek to imply that 2009 period was a typical year, as stated above. Additional model runs using the validated model for average and extreme years for difference periods of combined biological and environmental significance were subsequently performed (Crowley et al., 2012).

EPA Response:

In its comment ASA responds to EPA's analysis of the 2010 thermal model (AR-99) indicating that EPA fundamentally misinterpreted the purpose of this study, which the comment states was to document successful model calibration and verification of a three-dimensional, hydrothermal computer model applied to the Hooksett Pool in the Merrimack River using the most extensive data set available. EPA explained in the 2011 Draft Determinations Document that the predictions from the 2010 model, including that the plume is largely confined to the western side of the Hooksett Pool and tends to stratify in the upper half of the water column is inconsistent with the five-year study of the plume from the 1970's. *See* AR-618, p. 83. ASA's comment does not address this inconsistency.

ASA repeatedly comments that EPA "fundamentally misinterpreted the goal of the study" which was to document successful model calibration and verification. The 2010 model explains that modeling calibration and validation time periods are chosen that "best represent the conditions for which further use of the model is planned." In this case, ASA explains that the model was calibrated for summer conditions when the largest plant impact occur, and river is at low flow, high water, and air temperatures. *See* AR-99 p. 31. The 2010 model was validated using a dataset from July 2009 when ambient temperatures were more than 2°C cooler than average July ambient temperatures from 1984 through 2004 and river flows that were about 3 times higher than the 15-year average. *See* AR-618 pp. 84-85. ASA explains that the time period was chosen because the necessary data (river temperature and current data) was available and not because it was representative of a typical year. In addition, EPA agrees that comparisons show the model's predicted temperatures are relatively consistent with the observed temperatures during the calibration period (AR-99 pp. 51-54) and validation period (AR-99 pp. 51-54), suggesting that the model was able to accurately reflect observations during this time period.

The comment claims that the purpose of the modeling was to document successful model calibration and verification, which the Report demonstrates was accomplished. *See* AR-99 pp. 86-87. That was not, however, the sole purpose of the Report. The calibrated model was used to simulate an extreme case scenario reflective of the greatest impact of the Station at a time representative of low river flow, high ambient river and air temperatures, and maximum Station heat rejection. *See* AR-99 pp. 72-88. ASA concluded that in the extreme case scenario, the temperature rise above background due to the Station ranged from 7°C at Station S0 West, down to approximately 2°C (3.6°F) at Station A0. See *Id*. p. 88. The model supports Normandeau's assessment from its Thermal Plume Study that Station A0 represents the location where the plume is fully mixed.[16]

In response to the comment, EPA evaluated how accurately the 2010 model predicts observed values based on reported temperature data from 2004 through 2018. The extreme case scenario timeframe selected was from July 24 through August 3, 2007. The rise in temperature from Station N10 and S0, based on the daily mean observed values from July 24 through August 3, 2007, ranged from 8.6°C to 11.1°C with a weekly average of 9.3°C. This is 2-4°C higher than the 2010 model predicted. The 2010 model also predicted a maximum increase of 10°C at Station S0 along the west side of the River (AR-99 p. 79), but reported values in July and August from 2004 through 2018 indicate that the rise in temperature at Station S0 frequently exceeds 10°C. *See* AR-1715. The mean rise in temperature for the entire month of August was 10.4°C in 2004 and 10.5°C in 2008. The reported values for Station S0 are collected inside the discharge canal and do not account for any mixing that may occur prior to the location of the modeled temperature S0 at the western side of the Merrimack River. The model does predict a rise in temperature of over 9.5°C in the discharge canal based on Figure 8-7. AR-99 p. 79. The 2010 model predicts an average rise in temperature of 3.5°C to 4°C at Station S4 along the western side of the River under the extreme scenario. *See* AR-99 at 80. The daily mean observed rise in temperature at Station S4 values from July 24 through August 3, 2007, ranged from 4.2°C to 5.7°C with a weekly average of 4.7°C, suggesting that the 2010 model slightly underpredicts the observed temperatures downstream. *See* AR-1715. However, since 2012, which is reflective of current observations, the mean monthly rise in temperature for July and August has ranged from 0°C (no rise in temperature) to 2.5°C. *See id*.

EPA considered the 2010 ASA Model in response to the comment and recognizes that the modeling accurately predicts observed temperatures in 2009. Comparing the model results from the "extreme scenario" to observed daily temperature data from 2004 to 2018 suggests that the

[16] The comment correctly asserts that EPA rejected Normandeau's proposal (in AR-10) that Station A0 should be the compliance point for ambient temperatures because it is representative of fully mixed conditions. *See* AR-618 at 83. It is unsurprising that the plume is fully mixed at Station A0, which is located in the tailrace of the Hooksett Dam and benefits from mixing as it flows over the dam. However, the impacts of the thermal plume on the BIP occur before it is fully mixed and, in this case, allowing the thermal plume to persist for the length of the Merrimack River from the discharge canal to Station A0 is not acceptable.

"extreme" conditions modeled frequently occur during July and August. In other words, the "worst-case" conditions in the model are actually typical of the impact from the plume in summer when the Station is operating at full capacity. More recent data, however, indicates that the thermal plume's impacts (the rise in temperature at Stations S0 and S4) are substantially less than the model predicts based on current, infrequent summer operation of the plant.

3.3.2 Adequate Fish Passage as Evidence of No Appreciable Harm

Comment II.3.3.2	AR-872, Normandeau, pp. 35-43

A joint probability was developed using Hooksett Pool river flow and water temperature for each of four one-week biological periods of interest using a 21-year data set (ASA 2012). These biological periods were defined as early-spring (May 7-14), late-spring (June 1-7), summer (August 7-13) and fall (September 24-30). For each biological period, a single year representative of average (approximately 50th percentile of temperature-flow occurrence) and extreme (approximately 90th percentile of temperature-flow occurrence) conditions was selected for modeling (ASA 2012). The previously calibrated and validated hydrothermal model was run for both maximum plant and no plant conditions to estimate the temperature rise in the river from the plant. Figures of the results showing surface temperatures and cross sections at previously established stations S0 (located just downstream of the confluence of the plant discharge canal and the River) and S4 (located approximately 2,000 ft. downstream from S0) were provided by ASA to Normandeau at times reflecting the median environmental condition for the biological period. The median environmental condition was characterized as the time at which the upstream temperatures were at the 50th percentile for that period.

- Visual representations of the modeled temperature rise above ambient conditions (ΔT) at an instance that reflects the median environmental condition from the seven day simulated period during the early-spring and late-spring biological periods at Monitoring Stations S-0 and S-4 are presented in Figures 2-2, 2-3, 2-6 and 2-7 for an average year (approximately 50th percentile of temperature-flow occurrence) and Figures 2-4, 2-5, 2-8 and 2-9 for an extreme year (approximately 90th percentile of temperature-flow occurrence). As evidenced by these figures, an adequate zone of passage exists for both resident and transient anadromous fish species moving between the portions of Hooksett Pool upstream and downstream of Merrimack Station's cooling canal.
- Visual representations of the modeled temperature rise above ambient conditions (ΔT) at an instance that reflects the median environmental condition from the seven day simulated period during the summer (August 7-13) biological period at Monitoring Stations S-0 and S-4 is presented in Figures 2-10 and 2-11 for an average year (approximately 50th percentile of temperature-flow occurrence) and Figures 2-12 and 2-13 for an extreme year (approximately 90th percentile of temperature-flow occurrence). As evidenced by these figures, a zone of passage within 6°C to 10°C of ambient exists for resident fish species moving between the portions of Hooksett Pool upstream and downstream of the thermal discharge.
- Visual representations of the modeled temperature rise above ambient conditions (ΔT) at an instance that reflects the median environmental condition from the seven day

simulated period during the fall (September 24-30) biological period at Monitoring Stations S-0 and S-4 is presented in Figures 2-14 and 2-15 for an average year (approximately 50th percentile of temperature-flow occurrence) and Figures 2-16 and 2-17 for an extreme year (approximately 90th percentile of temperature-flow occurrence). As evidenced by these figures, an adequate zone of passage exists for resident fish species moving between the portions of Hooksett Pool upstream and downstream of the thermal discharge. During the average year (approximately 50th percentile of temperature-flow occurrence), an adequate zone of passage is evident from the ambient or near ambient water temperatures throughout much of the river cross sections at S-0 and S-4. In an extreme year (approximately 90th percentile of temperature-flow occurrence), temperatures at S-0 and S-4 ranged from approximately 6°C to 10°C above the ambient water temperature.

In sum, evidence for the ability of fish species to move around and past the thermal plume associated with the Merrimack Station discharge is supported by radio-telemetry studies as well as thermal modeling data, both of which indicate that an adequate zone of passage exists for resident and migratory fish under the majority of conditions present in Hooksett Pool.

EPA Response:

The comment argues that modeling of the thermal plume demonstrates there is adequate zone of passage for resident and migratory fish under the "majority" of conditions in Hooksett Pool. The modeling data submitted by ASA in 2012 (AR-850) is built on the three-dimensional, hydrothermal computer model developed by ASA in 2010 (AR-99) to predict the behavior of the thermal plume at baseload operation under "average" and "extreme" conditions based on flow and upstream river temperatures.

The model predicts that impacts from the thermal plume during the early spring (May 7-14) and late spring (June 7-14) are relatively limited in both average and extreme (high ambient temperature and low flow) years. The model's predictions are similar to the 2010 scenarios in that the predicted rise in temperature within the discharge canal is high (more than 10°C) but the plume mixes rapidly once it joins the Merrimack River. *See* AR-850 pp. 14-18. Under both average and extreme conditions, the model predicts that the plume is most evident on the western side of the river near the discharge canal and appears to be mixed at the Station S4 transect with temperatures typically no more than 4°C above ambient.[17] The plume is not predicted to reach the river bank on the opposite shore at the S0 transect under conditions representative of early or late spring.

During the summer period (August 13-20), the model predicts a higher rise in temperature at Station S0 in an average year, with a detectable bank-to-bank rise in temperature as high as 10°C on the western bank and about 6°C above ambient on the eastern bank. *Id*. p. 18. The model again predicts that the plume is fully mixed at the Station S4 transect with temperatures about 6-

[17] EPA notes that the 2012 ASA model did not present any tabular data and the figures used a blue-gray gradient scale that is very difficult to differentiate at lower temperature increments. The values in the response are estimated from the figures and text. EPA wonders why ASA did not replicate the same blue-to-red gradient scale used in the 2010 Report (AR-99) which depicted the thermal plume and temperature increments more clearly.

7°C above ambient. *Id*. p. 19. The model predictions for the extreme year resemble the average year predictions but the predicted rise in temperature at the S0 and S4 transects is curiously lower. Neither ASA nor Normandeau offer any explanation as to why the predicted temperatures under extreme environmental conditions (lower flows, higher ambient temperatures) would be lower in August when ambient data demonstrates that temperatures rise as river flows decrease. *Id*. p. 10.

During the fall period (Sep 24-30) in an average year, the model predicts the rise in temperature from the plume woud be limited to the western side of the river and fully mixed at transect S4 with temperatures less than 4°C above ambient. *Id*. at 20-21. In an extreme year, the model predicts the thermal plume could be 12°C or higher than ambient near the discharge canal and extend bank-to-bank at transect S0 with temperatures on the eastern bank 10°C above ambient. *Id*. at 22. The model predicts the plume is fully mixed at transect S4 with temperatures from bank-to-bank as high as 10°C above ambient under extreme conditions. *Id*. at 23. Normandeau argues that the model demonstrates an adequate zone of passage for resident and migratory fish to pass Merrimack Station, but the average summer scenario and the extreme fall scenario show that fish will be exposed to temperatures as high as 10°C above ambient from bank-to-bank and surface to bottom at Station S0 and 6-7°C at Station S4. The model does not predict an adequate zone of passage under all conditions (*e.g*., in summer and fall) because fish would likely avoid such extreme temperature differences.

EPA reviewed daily temperature during the four periods identified by Normandeau over the years 2004 through 2018 (2019 for May) to determine if the model accurately predicts temperatures at Stations S0 and S4. In early spring (May 7-14), the average rise in temperature (based on maximum daily observed temperatures) at Station S0 was 6°C to 11°C when the Station was operating but has not exceeded 5°C since 2012. The maximum average rise in temperature at Station S4 reached as high as 6°C (in 2010) but since 2012 has not exceeded 1°C. Similarly, in late spring (June 7-14), the average rise in temperature (based on maximum daily observed temperatures) at Station S0 was 8°C to 11°C when the Station was operating, while the temperature rise at Station S4 remained less than 4°C in the same period. Since 2012, the rise in temperature at Station S0 reached 6°C (in 2017) but the temperature at Station S4 has consistently been less than 1°C above ambient. The observed rise in temperature due to the thermal effluent from Merrimack Station in late spring is, on some occasions, higher than the model predicts, but the relatively high flows during this period likely facilitates mixing to ensure that Station S4 temperatures remain protective. In summer (August 13-20), the average rise in temperature (based on maximum daily observed temperatures) at Station S0 was about 6°C to 11°C when the Station under baseload operations with temperatures at Station S4 typically 2° to almost 7°C above ambient. Since 2012, however, the maximum average 7-day rise in temperature reached 5°C (in 2016) but the maximum rise in temperature at Station S4 remained at or below 1°C. The observed, average 7-day temperature at Station S0 in fall (Sep 24-30) tended to be within 6° to 9°C of ambient under baseload conditions, though the maximum rise in temperature reached 11°C in 2008. The maximum rise in temperature at Station S4 reached 5°C in 2004 and 2005 but was typically less than 2°C. Merrimack Station has not operated during this week in September and the temperature difference at Stations S0 and S4 from ambient is negligible.

EPA's review of the average, 7-day rise in temperature suggests that, when operating as a baseload plant, Station S0 and/or S4 temperatures can reach or exceed the temperatures the model predicts during all of the time periods that Normandeau evaluated. Temperature data and thermal modeling indicate that in spring, when certain anadromous species, such as American shad, may be moving past the Facility, low ambient temperatures and higher river flows combine to ensure that an adequate zone of passage is likely available beneath the surface-oriented plume and on the eastern side of the river. Similarly, an adequate zone of passage exists under most conditions in fall when juvenile alewives may be migrating past the Facility. Under current, operations (*i.e.*, more like a peaking plant), the Facility operates at low capacity during spring and fall. However, neither the thermal modeling nor the actual temperature data clearly demonstrate that an adequate zone of passage is available under conditions when the Facility is operating at full capacity and ambient temperatures are highest (e.g., summer), particularly during years with low river flow. If temperatures are at or above avoidance levels across the river in July and August, it may impede movement of resident fish past the Facility and exclude fish from available foraging and refuge habitat near the discharge canal. If these conditions persist for weeks or even months, as can occur under baseload operations, there may be sub-lethal impacts on growth, competition, and survival. Since 2012, however, the Facility operates infrequently in July and August and, when it does operate, it is typically for short durations (one week or less). If the Facility operates at high capacity during July and August in years with low flow and high ambient temperatures, resident fish may avoid moving past the Facility due to temperatures in the thermal plume. However, the Final Permit's operational limits will ensure that the duration of the event is limited such that protection and propagation of the BIP is assured.

3.3.3 Application of CORMIX Provides Further Evidence That No Appreciable Harm Has or Will Occur Due to Merrimack Station's Thermal Discharge

Comment II.3.3.3	**AR-1548, PSNH, pp. 53-56**
See also AR-1554, LWB, pp. 6-7; AR-1352, Enercon, Attachment 2; AR-1352, LWB, Attachment 3	

Compounding its erroneous interpretation of the data and resulting analyses, EPA also failed to consider that the thermal plume impacts only a negligible percentage of the surface area and habitat volume where the RIS can be expected to be found. In December 2016, PSNH submitted two reports that, in combination, demonstrate the thermal plume from Merrimack Station does not affect more than a negligible fraction of the fish habitat present downriver from the Station's thermal discharge and has had no measurable impacts on the fish community in Hooksett Pool.[247] Using CORMIX modeling software long supported by EPA and used as a tool in EPA's NPDES permit writing process, Enercon modeled the thermal plume within the Merrimack River, and characterized the area and volume the plume occupies within the waterbody.[248] Enercon's CORMIX modeling utilizes for its inputs fish species-specific temperature criteria (*i.e.*, thermal limits) provided in Tables 1 through 3 of Dr. Barnthouse's report entitled "Influence of Merrimack Station's Thermal Plume on Habitat Utilization by Fish Species Present in Lower Hooksett Pool" ("Habitat Report"),[249] as well as plant operational data and Merrimack River flow rate, temperature, and relevant wind speed data from the last ten years (2006-2015).[250] The CORMIX thermal plume model was used to calculate average plume characteristics over the period 2006-2015 for three representative time periods: early spring (May 2 – May 8), late spring (June 9 – June 15), and mid-summer (July 29 – August 4).[251]

Utilizing the CORMIX outputs from the modeling and considering the thermal effects data compiled in Normandeau 2007a, Dr. Barnthouse identified regions within the river that would be excluded from use by one or more of the RIS due to the presence of the plume.[252] Species chosen for the analysis consisted of those discussed in Normandeau 2007a and in EPA's § 316(a) Determination, including Alewife, American Shad, smallmouth bass, largemouth bass, pumpkinseed, yellow perch, fallfish and white sucker.[253] Thermal benchmarks and lifestages expected to be present in lower Hooksett Pool during the above-referenced three time periods were considered. In EPA's § 316(a) determination, it did not address whether the amount of habitat exposed to elevated temperatures is large enough to adversely affect the population to which these species belong. In contrast, Dr. Barnthouse explicitly addressed the quantity of habitat that would be denied to each RIS population by exposure to a thermal plume (consistent with the pertinent inquiry—the effect on the BIP).[254]

Based on a conservative analysis of the CORMIX output, Dr. Barnthouse concluded that "the thermal plume from the Merrimack Station [does not] affect more than a negligible fraction of the fish habitat present downriver from the cooling water discharge" and, thus, "that Merrimack Station's thermal discharge has had no measurable impacts on the fish community in the Hooksett Pool."[255] As would be expected, the temperature of the water within the plume is highest at the point of discharge (Station S0) and declines as the plume dissipates and diffuses outward as it moves downriver. The overwhelming majority of Hooksett Pool remains at temperatures below the thermal tolerances of the RIS. Specifically, Dr. Barnthouse concluded:

> In none of the cases examined using the CORMIX model would the thermal plume from the Merrimack Station affect more than a negligible fraction of the fish habitat present downriver from the cooling water discharge. On average, 0.48% of the surface area and 0.19% of the habitat volume present between Station S0 and Hooksett Dam would be affected during the early spring period. For the late spring period, at most 0.27% of the surface area and 0.09% of the habitat volume present between Station S0 and Hooksett Dam would be affected. For the mid-summer period, at most 3.47% of the area and 0.88% of the volume present between Station S0 and Hooksett Dam would be affected.[256]

As a result of the small proportion of the available habitat within the Pool that is influenced by the thermal plume, "measurable impacts on the fish community would not be expected and none have, in fact, been found."[257] As such, the thermal plume analysis supports the conclusion from the fish surveys reported by Normandeau[258] and analyzed by Dr. Barnthouse.[259] It would be improper for EPA to deny PSNH's request for a variance based on isolated temperature data points that cannot reasonably signify appreciable harm to the BIP.

[247] *See generally* AR-1352, Attachment 2 & Attachment 3.

[248] *See id.*, Attachment 2.

[249] *See id.*, Attachment 3 at 9-12.

[250] *See generally id.*, Attachment 2.

[251] These three periods were chosen as representative of the early spring period when river flows are high and ambient temperatures are relatively low, the late spring period when ambient temperatures are rising rapidly, and the mid-summer period when river temperatures are high and flows are low. *See id.* at 2-4.

[252] *See id.*, Attachment 3 at 2-8.

[253] *See id.* Atlantic salmon was not included because the Merrimack River Atlantic salmon restoration program has been terminated. *See id.* at 1.

[254] *See id.* at 5-8.

[255] *Id.* at 7-8.

[256] *Id.* at 7.

[257] *Id.* at 8.

[258] *See* AR-11; AR-871.

[259] *See* AR-1300.

EPA Response:

EPA addresses this and the related comment from LWB in a single response below.

3.3.4 The Area of Habitat Affected by the Thermal Plume is Negligible

Comment II.3.3.4	AR-1352 Attachment 3, LWB, pp. 3, 7-8

This approach to thermal effects analysis is substantially different from, and more ecologically realistic than the approach taken by EPA in its §316 Determination for Merrimack Station. EPA's approach relied on comparisons between thermal effect criteria for the most sensitive life stage of each species expected to be present in the river on a given date and the measured or predicted temperatures at Stations S0 (the end of the Merrimack Station discharge canal) and S4 (downriver from the discharge point)[1]. EPA did not estimate the area or volume of habitat within which these temperatures would be exceeded, or whether the habitat present at these stations would still be suitable for use by other life stages or species. EPA's approach considers only whether the most thermally sensitive organisms expected to be exposed to the discharge at stations S0 and S4 might be affected. It does not address whether the amount of habitat exposed to elevated temperatures is large enough to adversely affect the populations to which these organisms belong. In contrast, the approach utilized in this report explicitly addresses the quantity of habitat that would be denied to each RIS population by exposure to the thermal plume. This focus on populations rather than on individual organisms is consistent with the "balanced indigenous population" concept embodied in §316a of the Clean Water Act.

These [calculated] values of habitat area affected by the thermal plume (AR-1352 attachment 3 p. 7) does not account for the fact that approximately half of the available fish habitat present in Hooksett Pool is upriver from the plant and unaffected by the station's thermal discharge. They also do not account for the fact that a substantial fraction (of the negligible fraction) of the habitat influenced by the plume is of low quality and not extensively used by many fish species.

Habitat mapping performed by Normandeau (AR-871) showed that most of the river bottom between Station S0 and Hooksett Dam consists of sand, silt, and clay. This type of substrate is not suitable spawning habitat for vegetation-oriented species like yellow perch, or for nest-building species like bass and pumpkinseed.

[1] Barnthouse (2016) identified numerous errors in EPA's thermal effects analysis; even if all those errors were corrected EPA's general approach would still be inadequate for addressing the impact of the thermal discharge on RIS populations.

EPA Response to Comments 3.3.3 and 3.3.4:

Since the issuance of the Draft Permit in 2011, PSNH, in addition to supplementing thermal models provided for the Draft Permit (*see* AR-99, AR-805), also submitted an entirely new technical report (AR-1352 Attachment 2) that uses CORMIX modeling software to quantify the size and location of the thermal plume for three sets of biologically relevant time periods identified by LWB: early spring, late spring, and mid-summer. PSNH also submitted an additional report from LWB (AR-1352 Attachment 3) that evaluated the results of the CORMIX model to characterize the influence of the thermal plume on habitat utilization by fish in Hooksett Pool. Based on these reports, PSNH comments that only a small proportion of the available habitat within the Pool is influenced by the thermal plume, which supports fisheries data and analysis submitted by Normandeau (AR-11, AR-871) and LWB (AR-1300) indicating that the thermal impacts from Merrimack Station have not caused, and would not in the future cause, appreciable harm to the BIP. EPA has reviewed each of these studies and, as explained below, finds that neither the CORMIX model nor the analysis provided by LWB present an accurate representation of the thermal conditions that can affect the biological community of the Hooksett Pool and that can occur, particularly during low flow, high temperature conditions during the summer when the plan is operating at or near full capacity.

To assess thermal impacts during the three selected time periods, Enercon used historical plant and ambient data from the years 2006 – 2015 averaged over the 10-year time frame and over the time period of each case. In this way, the input values in the CORMIX model have been averaged three times: 1) as a mean daily average calculated from 15-minute observations; 2) as a ten-year average daily value for each day; and 3) as a weekly average value of the three, weekly time periods of interest (May 2 – May 8, June 9 – June 15, and July 29 – August 4). The result of all this averaging is that temperature conditions associated with critical periods of low river flow, high ambient temperatures, and full plant operation are blended in with higher flow, lower ambient temperatures, and periods when one or neither units are operating.[18] The CORMIX model output does not reflect worst-case or extreme temperature events that can and do occur in Hooksett Pool. Periods of acute thermal conditions may last several days or even weeks and can adversely affect fish and other organisms sensitive to those temperatures for the duration of the

[18] EPA recognizes it may be appropriate to use historical average values to represent ambient environmental conditions like wind speed and air temperature, but inputs representative of the thermal discharge (*e.g.*, effluent temperature, effluent flow) should be based on worst-case conditions because this most accurately reflects actual conditions that organisms could experience in any given year. EPA consistently requires model inputs to include worst-case conditions in other permitting decisions based on CORMIX. *See, e.g.*, Northeast Gateway MA0040266 and University of Massachusetts MA0040304.

high temperature event. As noted in Begon et al. (AR-1453), for many species, distributions are accounted for not so much by average temperatures as by occasional extremes, especially occasional lethal temperatures that preclude its survival.

Moreover, the CORMIX model's inputs for the effluent temperature (based on average data from 2006-2016) are not representative of the actual thermal impacts from the Station's effluent. In each of the three time periods, the effluent temperature value is below the actual observed effluent temperature when the Station is operating. When the Station was not operating, which was most of the time in the years 2012 through 2016, the effluent temperature is below the average effluent temperature value used as the CORMIX input. In other words, the input values for the CORMIX model are based on long-term averages not representative of conditions when the Station is either operating or not operating, but instead are representative of some relative effluent temperature in between what is actually occurring. As a result, the model results are not helpful for calculating the dimensions of the thermal plume or evaluating the potential impacts of the plume on the BIP. A better demonstration would have used actual, observed effluent and ambient temperature data for a single time period representative of the Station's thermal plume while generating electricity and the thermal plume representative of the current operations (limited or no electrical generation).

Beyond the fundamental flaw in the model as a result of using average data not representative of the actual thermal effluent from the Station, EPA identified additional problems and/or questions related to the CORMIX model, including the following:

- only the summary file was provided for review, not the more detailed and informative prediction file;
- the model seems to mix ºC and ºF in calculations (for example, the ambient and discharge temperatures are given in °C but the water quality standard specified for the mixing zone parameter is given in °F (*See* AR-1352 Attachment 3, Case 1);
- does not appear to account for the fraction of river flow that is redirected into the plant and used for cooling the condensers when calculating dilution; discharge dimensions used in the model do not come close to reflecting the actual dimensions;
- the discharge angle used (90º) may not reflect the actual discharge angle because the discharge canal is not perpendicular to the river;
- important shallow areas near shoreline (<6' deep) are not captured in crude geometry of model; and
- actual in-river temperature data collected downstream from the plant shows a distinct plume remaining well beyond the distance identified in the model results.

For the reasons described above, the CORMIX Modeling Technical Report (AR-1352 Attachment 2) and the biological evaluation of the results (AR-1352 Attachment 3) do not demonstrate that the plume does not affect "more than a negligible fraction of the fish habitat present downriver" from the Station's thermal discharge and "has had no measurable impacts on the fish community in Hooksett Pool."

Finally, LWB criticizes EPA's evaluation in the Determination Document because EPA did not estimate the area or volume of habitat within which these temperatures would be exceeded, or whether the habitat present at these stations would still be suitable for use by other life stages or species. The applicant for a CWA § 316(a) variance (in this case of the 2011 Draft Permit, PSNH) bears the burden of demonstrating "to the satisfaction of the Administrator" that the effluent limits in the absence of the variance would be more stringent that necessary to assure the protection and propagation of the BIP, and that the requested less stringent limits "will assure" the protection and propagation of the BIP. 33 U.S.C. § 1326(a); 40 CFR § 125.73(a). If such a showing is made, then the statute provides that EPA "may" grant a variance with alternative thermal discharge limits. 33 U.S.C. § 1326(a); 40 CFR § 125.70(a). To the extent that the comment identifies deficiencies in EPA's evaluation, the burden for estimating the area or volume of the thermal plume and impacts on habitat lies with the applicant. PSNH submitted two thermal models of the plume: a probabilistic thermal model (AR-10) and a three-dimensional hydrothermal model of the study area (AR-99). Neither study established the area or volume of the plume nor did ASA and/or Normandeau identify the impacts of the thermal plume of fish habitat. LWB comments that most of the habitat influenced by the plume is of low quality and not extensively used by many fish species, but electrofish maps from the 2010 and 2011 Normandeau study demonstrate that, while much of the nearshore between Station S0 and Station S4is sand/silt/clay, there was woody debris and submerged aquatic vegetation present, particularly on the eastern bank. AR-871, p. 235. Downstream of Station S4, nearshore habitat was again dominated by silt/sand/clay but also had small areas of submerged aquatic vegetation and woody debris, as well as areas of rip-rap (particularly along the eastern bank). *Id*., p. 236. These recent surveys suggest that there is suitable nearshore habitat for juvenile fish downstream of the discharge in areas that, under certain conditions, could be impacted by the thermal plume. LWB's comment makes very specific claims about how much habitat area is affected by the thermal plume, but these estimates are based on the CORMIX modeling results, which, as EPA has explained above, are not persuasive because they do not represent actual conditions at the Station.

3.3.5 CORMIX Thermal Plume Modeling Technical Report

Comment II.3.3.5	**AR-1573, Sierra Club et al., pp. 7-8**
See Also AR-1575, pp. 3, 6-13.	

EPA also invited comments on a CORMIX thermal plume modeling report submitted to EPA on December 22, 2016. The CORMIX modeling application in the report used the far-field component of the CORMIX model to predict the extent of the thermal plume in Hooksett Pool resulting from the Merrimack Station's thermal discharge. Based on this model, the CORMIX report asserts that the model "results are valid to inform the biological evaluations" of the "influence of Merrimack Station's thermal plume on habitat utilization by fish species present in lower Hooksett Pool." Hickey at 11.

After a preliminary review of the CORMIX model, the Hickey Report concluded that the thermal plume modeling application is "inadequate for delineating the thermal discharge plume in

Hooksett Pool" for a number of reasons. Hickey Report at 10. These reasons include, but are not limited to: the model relies on averaged data over a 10-year period; CORMIX is a steady-state model and is incapable of simulating dynamic conditions; the model relies on assumptions regarding the river's characteristics that are not representative of Hooksett Pool; and the model was not calibrated to field data. Hickey at 10. Similar to Eversource's use of the probabilistic modeling in the Normandeau Report, a CORMIX thermal plume modeling analysis was unnecessary in light of the fact that Eversource has relevant temperature data taken from the Merrimack River. Instead of a model, Eversource need only present a "clear and compelling presentation of available Merrimack River temperature measurements" in order to map and analyze the thermal plume at the Merrimack Station. Hickey at 11.

In sum, the Hickey Report "strongly disagree[d] that the results of this modeling analysis are appropriate or sufficient to support a biological impact analysis [and found] that the CORMIX analysis did not contribute to thermal plume characterization." Hickey at 11. Therefore, EPA should disregard the CORMIX analysis and not alter its decision to deny Eversource's request for a 316(a) variance.

EPA Response:

In the comment, CLF presents a summary of conclusions from its evaluation (AR-1575, the "Hickey Report) of the 2016 CORMIX model (AR-1352 Attachment 2) and accompanying biological evaluation of the impact of the thermal plume in Hooksett Pool (AR-1352 Attachment 3). CLF concludes that the results of this modeling analysis are inappropriate or insufficient to support a biological impact analysis and that the CORMIX analysis did not contribute to thermal plume characterization. *See* AR-1575 p. 11.

As discussed in Response to Comments II.3.3.3 and 3.3.4, above, EPA generally agrees with CLF's assessment and has also concluded that the CORMIX model and associated evaluation are not appropriate for demonstrating either the characteristics of the thermal plume or the potential impacts on aquatic life. In particular, the input values for effluent flow and temperature are not representative of any actual operating conditions at Merrimack Station. As such, EPA has considered but not relied on either report either to decide whether to grant PSNH's request for a § 316(a) variance or to establish thermal limits in the Final Permit. For the Final Permit, as CLF suggests, EPA has looked primarily to the relevant daily temperature data from 2004 through 2019 rather than to the thermal plume modeling analyses.

3.4 NPDES Permit Limits for Temperature at Merrimack

3.4.1 Appropriateness of Technology for Point Source Category

Comment II.3.4.1	**AR-851, CLF, pp. 5, 11-16**

CLF supports EPA's denial of PSNH's request for a renewal of tis CWA Section 316(a) variance and EPA's determination that year-round use of wet or wet-dry hybrid mechanical draft cooling towers in closed cycle configuration is the best available technology ("BAT") for controlling thermal discharge at Merrimack Station.[23]

* * * * * *

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." 33 U.S.C. §§ 1311(b)(2)(A) & (F). As set forth *supra* at 6, in the absence of a NELG governing the discharge of heat from steam-electric power plants, EPA correctly set technology-based permit limits based on a BPJ, facility-specific application of the BAT standard. *See* 33 U.S.C. § 1342(a)(l)(B); 40 C.F.R.§ 125.3(c)(2).

Applying the BAT standard, EPA must take into account (i) the age of the equipment and facilities involved; (ii) the process employed; (iii) the engineering aspects of the application of various types of control techniques; (iv) process changes; (v) the cost of achieving such effluent reduction; (vi) non-water quality environmental impact (including energy requirements); and (vii) such other factors as EPA deems appropriate. *See* 33 U.S.C. § 1314(b)(2)(B); 40 C.F.R. 125.3(d). EPA must also consider "(i) the appropriate technology for the category or class of point sources of which the applicant is a member, based upon all available information; and (ii) any unique factors relating to the applicant." 40 C.F.R. 125.3(c)(2).

EPA has broad discretion to determine which control technology is "the best available technology economically achievable." "To be technologically available, it is sufficient that the *best operating facilities* can achieve the limitation .... To demonstrate economic achievability, no formal balancing of costs and benefits is required; ... BAT should represent a commitment of the maximum resources economically possible to the ultimate goal of eliminating all polluting discharges." *Natural Res. Def. Council, Inc. v. U.S. E.PA*., 863 P.2d 1420, 1426 (9th Cir. 1988) (internal quotations and citations omitted) (emphasis supplied).

A technology is "available" where there is evidence that its use is practicable within the relevant industry, even if such technology is not yet in use in the relevant industry. *Hooker Chems. & Plastics Corp. v. Train*, 537 P.2d 620, 636 (2d Cir. 1976) ("That no plant in a given industry has adopted a pollution control device which could be installed does not mean that the device is not 'available.'"). The use of technology is "economically achievable" if it is affordable by other plants in the industry. *BP Exploration & Oil, Inc. v. EPA*, 66 P.3d 784, 790 (6th Cir. 1995); *NRDC v. EPA*, 863 F.2d 1420, 1426 (9th Cir. 1990).

To determine economic achievability under the BAT test, EPA must take into account a number of factors, one of which is "the cost of achieving such effluent reduction." 33 U.S.C. § 1314(b)(2)(B). For EPA to find that a particular technology is "economically achievable," it need only "consider" the potential costs involved. *Id*. EPA is not required to compare costs to benefits of the chosen BAT. *See, e.g., E.P.A. v. Nat'l Crushed Stone Ass'n*, 449 U.S. 64, 71 (1980); *Texas Oil & Gas Ass'n v. U.S. E.P.A*., 161 P.3d 923, 936 n.9 (5th Cir. 1998). EPA's consideration of costs is adequate so long as the determination based on that consideration is rational in light of the economic evidence in the administrative record. *Dominion Energy Brayton Point* at *17 (E.P.A. 2006); *Gov't of D.C. Mun. Separate Sewer Sys*., 10 E.A.D. 323, 348 (E.P.A. 2002).

* * * * * *

In addition to the BAT standard, to the extent more stringent requirements must be implemented in order to satisfy state water quality standards ("WQS"), such limits must be included in the NPDES permit. 33 U.S.C. § 1311(b)(l)(C).

In addition to the statutory BAT factors, EPA must consider "the appropriate technology for the category or class of point sources of which the applicant is a member, based upon all available information ... " 40 C.F.R. § 125.3(C)(2)(i). EPA has assembled ample evidence that CCC is an appropriately and widely used technology in the steam electricity generating sector.[76]

Merrimack Station applied to the New Hampshire Water Supply and Pollution Control Commission (WSPCC) for its first thermal permit in 1969.[77] That same year, before the first permit issued, PSNH conceded that "closed circuit" operation would be necessary during some seasons to ensure compliance with New Hampshire law.[78] Yet PSNH sought and obtained instead permission from WSPCC to rely on a system of spray modules and an elongated discharge canal.[79] After installation in 1972, NHFGD and the WSPCC warned several times that the spray and canal technology was inadequate.[80] During EPA's 1992 consideration of the most recent NPDES permit the agency had "significant concerns" about violations of thermal limitations.[81]

PSNH has evaded for far too long the requirement to install CCC as BAT with which many of its industry peers have already complied. In December 2009, EPA compiled a list of fifty-three coal-fired power plants that have already retrofitted with CCC.[82] A 2011 Electric Power Research Institute ("EPRI") study identified eighty-two such retrofits.[83] As EPA noted, only twenty-five percent of steam electric generating plants used CCC in 1955, but that number grew to seventy-five percent by 1997.[84] CCC is an appropriate, and highly successful, technology for reducing thermal pollution from coal-fired power plants.

[23] As discussed infra at pp. 23-31, the CWA's Best Technology Available Standard, see U.S.C. §§ 1326(a), (b), for Merrimack Station's cooling water intake structures also requires application of wet or wet-dry hybrid mechanical draft cooling towers operated in a closed cycle configuration.
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[76] *Id*. at 134-137.
[77] *Id*. at 9.
[78] *Id*.
[79] *Id*.
[80] *Id*. at 10-12.
[81] *Id*.
[82] AR 596, EPA, Power Plant Units with Closed-Cycle Cooling Retrofits (Dec. 8, 2009) (using 2005 data).
[83] See EPRI, National Cost Estimate for Retrofit of U.S. Power Plants with Closed-Cycle Cooling, Technical Brief, 1 (2011), http://my.epri.com/portal/server.pt?Abstract_id=000000000001022212.
[84] Attachment D at 136 n. 26.

EPA Response:

The above comment fairly summarizes CWA requirements for establishing technology-based effluent limitations based on best professional judgement in the absence of national effluent guidelines. EPA agrees with the comment's references to the permitting history and that retrofitting from open-cycle to closed-cycle cooling can be a viable technological approach for managing waste heat, or intake structure effects, at some power plants. *See* AR-618 p. 121-174. For the 2011 Draft Permit, EPA proposed on a site-specific, BPJ basis that mechanical draft wet or hybrid wet-dry cooling towers in a closed-cycle configuration constitutes the BAT for the control of thermal discharges by Merrimack Station. *See id*. pp. 169-74. EPA maintains that conclusion.

That said, EPA's Final Permit limits are different from those proposed in the 2011 Draft Permit because the Final Permit's limits are based on a CWA § 316(a) variance rather than technology and water quality standards. A CWA § 316(a) variance allows for thermal effluent limits less stringent than technology-based and/or water quality-based limits if the less stringent limits will assure the protection and propagation of the BIP of the receiving water. CWA § 316(a) decisions are based on site-specific facts and EPA's Final Permit sets thermal limits for Merrimack Station based on a CWA § 316(a) variance decision that is based on the relevant facts and science for this facility, after considering the record and public comments. Finally, the comment (footnote 23) also raises the issue of EPA's draft determination of closed-cycle cooling for the best technology available (BTA) under CWA § 316(b). EPA also responds in detail to comments on the determination of the BTA, including consideration of the relative costs and benefits of closed-cycle cooling and alternative technologies and other relevant factors required by the 2014 Final Regulations for Existing Cooling Water Intake Structures, in Responses to Comments III.5.2.1, 5.2.2, 5.2.3 and 5.3.

3.4.2 Water-quality Based Limits

Comment II.3.4.2	AR-851, CLF, pp. 18-19

New Hampshire's surface water quality regulations have as their purpose the protection of public health and welfare, enhancement of water quality, protection of fish, shellfish, and wildlife, and preservation of public uses, including drinking water, agriculture, recreation, and industry. *See* N.H. Code Admin. R. ("Env-Wq") 1701.01. The regulations apply to all point source dischargers, *see* Env-Wq 1701.02, and require that thermal discharges to Class B waters be regulated in accordance with RSA § 485-A:8. *See* Env-Wq 1703.13. RSA 485-A:8, II provides that "[a]ny stream temperature increase associated with the discharge of treated sewage, *waste or cooling water*, water diversions, or releases shall not be such *as to appreciably interfere with the uses assigned* to this class." RSA 485-A:8, II (emphasis supplied). The statute also provides that, "[i]n prescribing minimum treatment provisions for thermal wastes discharged to interstate waters, the department 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*." *Id*. at VIII (emphasis supplied). The New Hampshire regulations, therefore, require the "most effective" control of thermal pollution. Section 1703.19(a) also requires that "surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region." Taken together, these narrative water quality standards require the most effective control of thermal pollution sufficient to ensure that the receiving water will have a balanced, integrated community of organisms, comparable to that of similar habitats in the region-i.e., those not subject to thermal pollution discharges.

In order to ensure that the technology-based thermal discharge limits would also result in compliance with New Hampshire's Water Quality Standards, EPA developed water quality based thermal discharge limits for comparison.[92] The water quality-based limits were based on temperatures necessary to protect fish species in the Hooksett Pool at various stages of their lifecycle.[93] EPA analyzed resident and diadromous fish species separately.[94] EPA chose the most temperature sensitive species from each category as a way to ensure protection of the entire fish community. Put another way, if the temperature limits are sufficient to protect the most thermally sensitive species, at the most thermally-sensitive stage of its lifecycle, then the limits also will ensure protection of less sensitive fish species. EPA chose yellow perch as the most thermally sensitive resident fish species, and American shad, Atlantic salmon, and Alewife at various life stages as the most thermally sensitive diadromous species.[95]

For the most part, EPA’s analysis and conclusions with respect to protective fish temperatures were reasonable and supportable. Normandeau reported that the salmon smolts were not inhibited in their downstream migration by Merrimack Station's thermal discharge. However, as the Henderson Report notes, EPA's decision to use the most temperature sensitive resident (yellow perch) and diadromous (American shad, Atlantic salmon, and alewife) species as a proxy for protectiveness of other less heat tolerant species was appropriate.[96] However, EPA's analysis is too limited to assure that its water quality-based temperature limits will assure the protection and propagation of the BIP in the Hooksett Pool. Specifically, EPA's analysis, while focusing on the physiological requirements of single fish species at their various life stages, did not adequately consider competitive interactions between species.[97] For example, EPA based its water quality-based temperature limit between October 1st and November 4th on the protective temperature for yellow perch juveniles set at 28.4°C (83.1°F). This temperature limit is above the upper bound of physiological optimum temperatures for maximum growth rates identified by EPA for yellow perch juveniles of 28°C (82.4°F).[98] A temperature above the physiological optimum for growth has the potential to alter the competitive outcomes between coolwater and warmwater species, such as yellow perch and bluegil1.[99] Accordingly, EPA has not demonstrated that the water quality-based temperature limits it chose would be sufficiently protective of cool water species that are in competition with increasing populations of more thermally tolerant species in the Hooksett Poo1.[100]

Additionally, PSNH's attempt to demonstrate Merrimack Station's thermal plume would not inhibit the migration of anadromous species like Atlantic salmon should be given no weight. In 2006, Normandeau conducted a salmon tagging study that involved radio-tagging salmon smolts released above the Merrimack Station and tracing their movement past the plant's discharge point. As the Henderson Report notes, the smolts "passage downstream and past the thermal discharge could have simply been the response of a disoriented and scared fish" as a result of their being anesthetized and having a radio tag inserted into their stomachs for the purposes of the study.[101] Such a study is far from the rigorous scientific study needed to show that migratory fish are not inhibited by Merrimack Station's thermal discharge, especially when the evidence is that in-River temperatures in the summer regularly reach levels that cold-water migratory fish are known to avoid.[102]

[92] Attachment D at 174.
[93] *Id* at 178-79.
[94] *Id* at 179.
[95] *Id* at 180, 198.
[96] Henderson Report at 10.
[97] *Id*.
[98] Attachment D at 192.
[99] Henderson Report at 11.
[100] *Id*.
[101] *Id* at 13.
[102] Henderson Report at 14 (concluding that Normandeau's salmon tagging study "is an unsuitable basis on which to support a claim that the thermal discharge will not interfere with salmon smolt migrations").

EPA Response:

EPA generally agrees with the comment's summary of applicable State water quality standards. EPA provided a detailed discussion of water quality-based temperature limits in the 2011 Draft Determinations Document. *See* AR-618, pp. 174-210. The 2011 Draft Determinations Document explains that New Hampshire water quality standards do not specify numeric temperature criteria but do specify narrative criteria for heat designed to be applied on a case-by-case basis to protect the existing and designated uses of the water body. EPA identified several criteria based on New Hampshire's water quality standards to guide its determination of water quality-based temperature 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.

See AR-618, pp. 177-78, 216. To determine thermal discharge limits necessary to satisfy State water quality standards, EPA identified the species most sensitive to elevated temperatures, identified protective temperatures for each life stage of selected sensitive species, and the time periods when these life stages are expected to be present in Hooksett Pool. By protecting the most temperature-sensitive species, the protection and propagation of the waterbody's community of aquatic organisms should be reasonably assured and water quality standards satisfied. *See id*. p. 178.

The commenter generally agrees with EPA's approach but asserts that focusing on the physiological requirements of single fish species at their various life stages may ignore competitive interactions between species. As an example, the comment argues that the protective temperature for yellow perch juveniles (28°C) is above the upper bound of physiological optimum for this species and has the potential to alter the competitive outcomes between yellow perch and warm water species, such as bluegill.

Yellow perch juveniles are the most thermally tolerant phase of the life cycle of yellow perch. McCormick (1976) found maximum growth rates at 28°C. Hokanson (1977) identifies 24.7°C as the physiological optimum for yellow perch based on studies using juveniles. EPA calculated an upper limiting temperature (28.4°C) using the method identified in the Gold Book. This upper limiting temperature is above the physiological optimum calculated in the 2011 Draft Determinations Document (26.4°C). EPA maintains that a weekly average limit of 28.4°C at Station S4 in October will be protective of yellow perch juveniles. Temperatures in the thermal plume are highest where the discharge canal meets the Merrimack River (Station S0) and decrease as the plume travels downstream. Under baseload operation during the month of October, the temperature decreased 3° to 10°C as the plume traveled from Station S0 to S4, which indicates that generally the plume will be quickly mixed when it joins the Merrimack River during October. River temperatures will continue to decrease downstream of Station S4 as the plume becomes fully mixed. Therefore, compliance with a weekly average temperature of 28.4°C at Station S4 ensures that the plume is at or better than the optimal range for yellow perch juveniles downstream of Station S4. Competitive interactions of yellow perch juveniles could be affected if the entire Hooksett Pool were at a temperature of 28.4°C because that is, as the comment points out, at the upper range for this species and might favor more thermally tolerant species. However, the thermal limits proposed in the 2011 Draft Determinations Document would ensure that, at most, only a small area of the river would be impacted by the plume and most of the Pool would be unaffected or at temperatures that are within the optimal range. Even water quality standards allow a limited area and volume of the river to be designated as a mixing zone within which water quality standards may be exceeded, but New Hampshire's water quality standards do not set specific instream temperature limits for the river.

Moreover, while EPA maintains that the proposed temperature would be protective of juvenile yellow perch, the effective temperature limit would be the most stringent water quality-based temperature limit proposed for the time period from October 1 through November 1, which would actually be 25.1°C (for adult yellow perch) and would also be sufficiently protective of juvenile perch. Finally, in recent years Merrimack Station has rarely operated in October (the highest average monthly capacity since 2012 was about 4% in 2015). Figure II.9 demonstrates the actual daily temperatures at Stations S0 and S4 in October 2015 which was the highest capacity year for the month of October since the Facility transitioned to operating like a peaking plant. Since 2012, the average rise in temperature at Station S4 as compared to Station N10 (ambient) was less than 0.5°C. Therefore, no problems are anticipated for yellow perch, or other species, during that time frame and EPA's limits for the Final Permit are sufficiently protective.

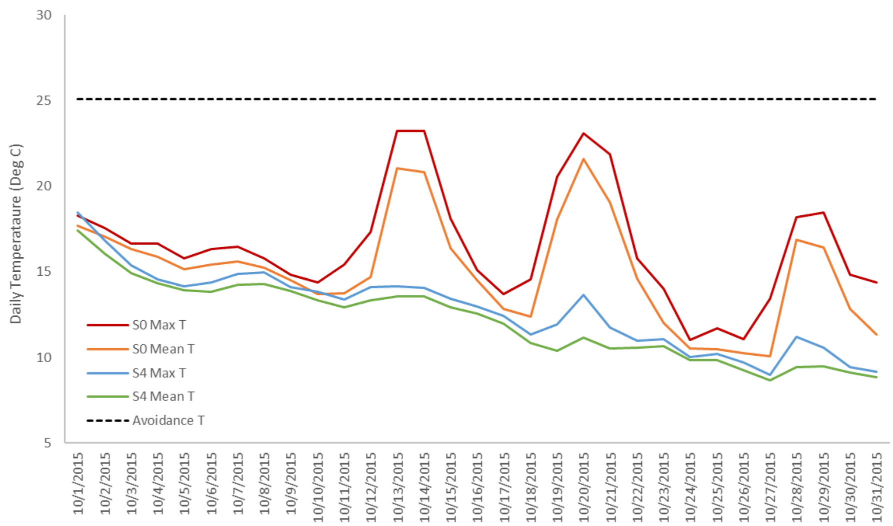

Figure II.9. Mean and maximum daily (24-hour average) temperature (deg C) at Stations S0 (discharge) and S4 (downstream) from October 1 through October 31, 2015 compared to the adult yellow perch avoidance temperature (28.9°C).

The comment also asserts that studies, particularly Normandeau's 2006 salmon tagging study, have not demonstrated that the thermal plume will not impede migration of anadromous species like Atlantic salmon past Merrimack Station. *See also* AR-852, p. 13-14. The 2011 Draft Determinations Document determined that Atlantic smolts, which remain near the surface during migration, could come into contact with the thermal plume. However, protective temperatures for yellow perch would be more stringent than those for Atlantic salmon smolts (22.5C) during the period when smolts would be migrating (May 1 to May 31). For this reason, EPA maintains that outmigrating smolts could be exposed to elevated temperatures in the plume but will be protected by the proposed water quality-based limits for yellow perch. In addition, current operations have been extremely limited during the month of May (the highest average monthly capacity is 4% in 2013) when Atlantic smolts would be migrating, suggesting that the potential to be impacted by the plume has substantially decreased since the 2011 Draft Permit was issued as a result of the current operating status of the Station. Finally, New Hampshire has ceased stocking Atlantic salmon in waters statewide.

In response to comments on the proposed water quality-based limits, EPA has reviewed and, in some cases, adjusted the protective temperatures proposed in the 2011 Draft Determinations Document. Response to Comment II.3.4.7 discusses the protective temperature limits in the Final Permit and explains any adjustments to protective temperatures proposed in the 2011 Draft Determinations Document. The protective temperatures derived for the Final Permit are based on a 316(a) variance and will assure the protection and propagation of the Hooksett Pool's BIP. While the Final Permit's thermal discharge limits are based on a CWA § 316(a) variance and require instream limits to be met at Station S4 downstream from the discharge canal, which effectively delineates an area for initial mixing of the thermal plume, the temperature limits that apply at the edge of this area are the same as the water quality-based temperature limits discussed in the 2011 Draft Determinations Document with the exception of three limits. *See* AR

618, pp. 213-16. EPA adjusted the 7-day average and the maximum daily limit for yellow perch larvae and the maximum daily limit for American shad larvae based on new information using the same approach as the derivation of limits in 2011. See Response to Comment II.3.4.7.

Comment	**AR-851, CLF, p. 21**
See also AR-852, Henderson, pp. 10-11	

In any event, the issue is academic here where the technology-based BAT limits EPA has proposed are, in fact, not more stringent than necessary to assure the protection and propagation of the BIP, and limits based solely on the applicable New Hampshire WQS would not be sufficient to assure the protection and propagation of the BIP.

EPA has established technology-based water temperature limits based on BAT and water quality-based protective fish temperatures.[115] In all but two instances where the temperature limits are the same, (American Shad Larva (acute) June 16-July 31 and Yellow Perch Adult Reproduction November 5-December 31), the technology-based standards are more stringent.[116] In three instances, the maximum mean temperature for current operations is lower than what would be permitted under the water quality-based limits:[117]

Time Period	Relevant Species and Lifestage	Water Quality-Based Max. Mean Protective Temp Degrees F	Current Operations Max. Mean Temp. Degrees F	No. of Degrees F Water Quality-Based Standard Is Warmer than Current Operations
May 9 – May 27	Yellow Perch Egg	64.4 (18°C)	62.8	1.6
May 28 – June 15	Yellow Perch Larva	70.3 (21.3°C)	70.2	0.1
Oct 1 – Nov 4	Yellow Perch Juvenile	83.1	65.8	17.3

Since the current water temperatures have been far too warm to assure the protection and propagation of the BIP, these facts strongly suggest that the water quality-based protective fish temperatures are not sufficiently protective. As the Henderson Report concludes, the fact that EPA's water quality-based temperature limits are set at levels above temperatures caused by current operations when there is strong evidence that the thermal plume caused by current operations has appreciably harmed the BIP in the Hooksett Pool demonstrates either that EPA's water quality-based temperatures are not sufficiently protective or that those limits, while they may satisfy New Hampshire's water quality standards, do not satisfy§ 316(a).[118] Either explanation is grounds for rejecting them as an alternative basis for a§ 316(a) variance. The Henderson Report gives one reason why EPA's water quality-based temperatures are not sufficiently protective: EPA's analysis did not adequately consider the temperature effects on competitive outcomes between coolwater and warmwater species.[119] Because there is direct field evidence that the current temperature regime is not sufficiently protective of the BIP, and EPA's water quality-based temperature limits in some cases are higher than the current regime, water quality-based limits cannot serve as an alternative basis for granting a§ 316(a) variance.

[113] See Attachment D at 121.
[114] *Id*. (emphasis added).
[115] Compare Attachment D, p. 215, Table 9-3 (technology-based temperature limits) with p. 213, Table 9-2 (NH water quality-based temperature limits).
[116] *Id*. at Table 9-3.
[117] *Id*. at Table 9-3.
[118] Henderson Report at 10-11.
[119] *Id*. at 11.

EPA Response:

The comment urges that instream temperature limits proposed by EPA based on New Hampshire WQS would be insufficient to assure the protection and propagation of the BIP and should not be used to set permit limits under CWA § 316(a). The commenter also states that technology-based limits are more stringent than the water quality-based limits in "all but two instances," though EPA notes that, in fact, the technology-based limits are more stringent than, or as stringent as, the water quality-based limits in each case. *See* AR 618, pp. 214-15.

The comment then goes on to compare the reported instream water temperatures resulting from the Facility's baseload operations, s*ee id.* at 215, to EPA's proposed protective, water quality-based temperatures (AR-618, p. 215) and concludes that the latter cannot be adequately protective to satisfy CWA § 316(a) because the BIP was not protected under past conditions and the baseload-based values are lower than the water quality-based values in some cases. *See id.* EPA disagrees.

The comment appears to misunderstand the information presented in Table 9-3 of EPA's 2011 Determinations Document. *See id.* at 215. First, Table 9-3 compares proposed water quality-based temperature limits with temperatures predicted to result from using closed-cycle cooling at both units. In all cases, the technology-based limits based on closed-cycle cooling values are as stringent as or more stringent than the water quality-based limits, which demonstrates that in the absence of a CWA § 316(a) variance, technology-based standards would govern the permit's thermal discharge limits.

In addition, Table 9-3 enables the reader to compare an estimate of existing thermal conditions (in 2011) based on full capacity generation using open-cycle cooling with the water quality-based and technology-based limits. Specifically, the table includes estimates of the temperatures that result from once-through operations, calculated as the highest 7-day average of reported mean daily temperatures over 21 years at Station S4. EPA did not reject the Facility's requested variance based on specifically on a finding that the maximum 7-day average temperatures at Station S4 under current operations would not protect the BIP, as the comment suggests.[19] EPA

[19] The interpretation of the data presented in Table 9-3 of the 2011 Draft Determinations Document suffers from the same limitations that CLF has leveled against PSNH – namely, that long-term averages are not adequate to evaluate the impacts of the thermal plume because extreme temperature events are masked when averaging data over many years. In this case, the "Max. Mean Temp. Current Operations" data was calculated based on the 21-year average values which masked years in which the average weekly water quality-based limits were exceeded. *See* Response to Comment II.3.1.3.

rejected PSNH's requested renewal of the existing CWA § 316(a) variance because, based on the Agency's analysis of the record, EPA concluded that PSNH had not shown that there was no prior appreciable harm to the BIP from thermal discharges under the existing variance, and because PSNH had not demonstrated that thermal discharge limits based on applicable water quality and technology requirements would be more stringent than necessary to assure protection of the BIP. AR-618, p. 121.

The commenter argues that because the water quality-based limits were set in some instances at levels higher than the temperatures predicted to have resulted from baseload operations, and because the BIP was not adequately protected in the past, then the water quality-based limits necessarily cannot be adequate to satisfy CWA § 316(a). EPA does not agree. It simply means that during some specific periods of time during the year, even the baseload open-cycle operations could satisfy water quality-based standards and would have satisfied the standard of CWA § 316(a). Nevertheless, EPA was correct to reject the requested variance renewal to allow baseload operations with open-cycle cooling throughout the year. Indeed, EPA found that when operating as a baseload plant with open-cycle cooling, the Facility's thermal discharges caused river temperatures at Station S4 to exceed protective temperatures, and even reach or exceed lethal temperatures, for multiple days in some years. Thus, under baseload, open-cycle cooling operations, the Facility could not meet all the water quality-based limits identified as necessary to assure protection and propagation of the BIP.

For the Final Permit, EPA has reassessed the water quality-based limits while also taking account of the Facility's much reduced operations and thermal discharges. From this, EPA has determined that, under Merrimack Station's current operation, effluent temperature limits less stringent than the 2011 Draft Permit's technology-based limits, but roughly equivalent to the water quality-based limits, are sufficiently stringent to ensure the protection and propagation of the BIP. The Final Permit's temperature limits, therefore, are set under a CWA § 316(a) variance and are largely consistent with the water quality-based limits proposed in the 2011 Draft Determinations Document, *see* AR 618, pp. 215-17, which, for some limits, allowed for initial mixing in a limited area of the river (*i.e.*, the distance from Station S0 to Station S4). For the period from October 1 through April 30 the Final Permit includes 7-day average temperature limits at Station S4 consistent with the water quality-based, protective temperatures derived in the 2011 Draft Determinations Document. From the period beginning May 1 through September 30, the Final Permit also includes a limitation on the capacity factor, which ensures that the current mode of operating the Facility continues during the next permit cycle and will enable the Permittee to meet the permit's temperature limits that are set to ensure the protection and propagation of the BIP but are less stringent than the technology-based limits proposed in the 2011 Draft Permit, which were based on closed-cycle cooling.

The Facility's change to operating like a peaking plant since issuance of the 2011 Draft Permit has reduced the occurrence of extreme temperature events, which in some years during baseload operations had caused temperatures to exceed protective levels for weeks or months at a time and led EPA to conclude that, under those conditions, the protection and propagation of the BIP would not be assured. With the limitation on capacity factor, the Station can operate at baseload (*i.e.*, 2 units), at most, 18 days in a row from May through September, after which the Facility could have no thermal discharges for approximately 30 days during which the river would have time to recover.[20] Under the worst-case scenario at which Merrimack Station was called upon to run at full capacity, the Facility could operate up to 68 total days from the period between May 1 through September 30, with about 30 days between each operational period. Alternatively, the Facility could operate Unit 1 (which is 25% of total capacity) continuously from May 1 through September 30 under the Final Permit. EPA reviewed available temperature data for days on which only Unit 1 was operating and found that temperatures at Station S4 are typically consistent with the water quality-based protective temperatures when only Unit 1 is operating. This limited operation is consistent with the Facility's current peaking-like operations and, in combination with acute (maximum daily), water quality-based temperature limits at Station S4, will ensure that the impacts of the thermal plume are limited in duration and severity such that protection and propagation of the BIP is assured. If the Station is called upon to operate more during this period such that it would exceed the above-discussed operational limits, the Final Permit would allow it only if the Facility also meets chronic (average weekly), water quality-based temperature limits at Station S4 that will protect the BIP from sub-lethal effects from the thermal plume. If the Facility's discharges raise water temperatures to the point that it would not meet these limits with full-scale operation, then it would have to reduce or stop generation in order to meet the limits and avoid permit violations.

3.4.3 § 316(a) Variance

Comment II.3.4.3	**AR-851, CLF, p. 21**

EPA specifically has requested comment on the question whether it should waive the inclusion of technology based thermal discharge limits in the final permit and instead establish water quality-based limits, approved via a 316(a) variance. EPA suggests that it may independently determine that the water quality-based limits satisfy the variance criteria of § 316(a), even though PSNH did not request a variance on such grounds. EPA does not interpret the law as requiring EPA to do so, however.

EPA lacks authority to establish such a variance in these circumstances, where PSNH has failed to satisfy its burden of proof that the proposed technology based thermal discharge limits are more stringent than necessary to assure the protection and propagation of the BIP. Consistent with CWA § 316(a), the EAB in *Dominion Energy Brayton Point* defined the predicate for EPA to, *sua sponte*, fashion and impose its own variance:

(1) the Agency must determine what the applicable technology and WQS-based limitations should be for a given permit;

[20] EPA calculated a 45-day rolling average beginning on May 31 (the last day of the first reporting period) assuming the Facility begins operating at 100% capacity on May 1 and including the output from April 17 to April 30 (assuming 0% capacity on these days). If the Facility begins operating at full capacity on May 1 it could continue to operate for 18 days and shutdown (0% capacity) for the following 27 days in order to meet a 45-day rolling average capacity of 40% on May 31. (If capacity was greater than 0% at the end of April, the Facility would be able to operate fewer consecutive days in May to meet the rolling average capacity factor.) EPA estimated that the Facility could operate at full capacity over four, separate 18-day events from May 1 through September 30 with an average of 27 days at 0% capacity separating each event.

(2) the *applicant* must demonstrate that these otherwise applicable effluent limitations are more stringent than necessary to assure the protection and propagation of the BIP;
(3) the *applicant* must demonstrate that its proposed variance will assure the protection and propagation of the BIP; and
(4) in those cases where the applicant *meets step 2 but not step 3*, the Agency may impose a variance it concludes does assure the protection and propagation of the BIP.

Dominion at 500 (emphasis supplied). Any EPA discretion independently to impose such a variance is plainly *contingent on the applicant's satisfaction of the burden of proof for the second step*. That makes sense, since the rationale here is to provide EPA with some discretion where an applicant successfully shows that proposed limits are too stringent, yet fails to demonstrate that its own proposed variance is adequately protective.

Finding that PSNH failed to meet its burden of proving that its thermal discharge has not caused prior appreciable harm to the BIP, EPA has properly rejected PSNH's request for a renewal of its existing 316(a) variance.[113] PSNH has therefore not satisfied Dominion's third step.

EPA has also determined that "PSNH has not demonstrated that thermal discharge limits based on applicable technology-based *and* water quality-based requirements (see Sections 7, 8 and 9, *supra*) would be more stringent than necessary to assure the protection and propagation of the balanced, indigenous population of shellfish, fish and wildlife in and on Hooksett Poo1."[114] Indeed, PSNH appears to have made no showing whatsoever that the proposed technology-based limits would be overly stringent; therefore, Dominion's second step is not satisfied, and EPA may not independently establish a variance.

Further, the Fourth Circuit Court of Appeals has rejected the argument that compliance with water quality standards is *prima facie* evidence of compliance with section 316(a). *Appalachian Power Co. v. Train*, 545 F.2d 1351, 1372 (1976). As well, EPA's first guidance document for 316(a) demonstrations explained that the 316(a) test "is distinct from the multiple statutory objectives of water quality standards ... [t]herefore, compliance or noncompliance with standards alone is not a sufficient demonstration." EPA, Draft 316(a) Technical Guidance Thermal Discharges 9 (Sep. 30, 1974).

EPA Response:

EPA agrees with certain aspects of the above comment. The statute and regulations place the "burden" of establishing qualification for alternative thermal discharge limitations under a CWA § 316(a) variance on the permit applicant. The permit applicant must demonstrate that the otherwise applicable technology-based and water quality-based thermal discharge limits are more stringent than necessary to assure the protection and propagation of the receiving water's BIP *and* that the applicant's requested alternative thermal discharge limits are sufficient to assure protection and propagation of the BIP. 33 U.S.C. § 1326(a). *See also* 40 CFR § 125.73(a). If the Agency agrees that the technology-based and water quality-based limitations are more stringent than necessary to protect the BIP, but determines that the applicant's proposed effluent limitations are not stringent enough, then EPA *may* decide to issue a variance based on a set of alternative limits different from those proposed by the applicant. *See Dominion*, 12 EAD at 500

n. 13, 552 n. 97. *See also id.* at 571-72. In such a case, EPA must demonstrate that *its* proposed variance-based limits will meet the CWA § 316(a) standard. *Id.* at 568, 572.

For the 2011 Draft Permit, EPA concluded, based on its review and analysis of the Facility's retrospective and prospective demonstrations and the available data and scientific information, that the Facility demonstrated neither that its past thermal discharges had not appreciably harmed the BIP of the Hooksett Pool (a retrospective demonstration) nor that its requested thermal limits – *i.e.*, renewal of the 1992 Permit's variance limits based on thermal discharges from baseload operations using open-cycle cooling technology – would assure the protection and propagation of the BIP in the future (a prospective demonstration). *See* AR 618, pp. 120-21. Thus, for the 2011 Draft Permit, EPA developed thermal discharge limits based on technology standards (with retrofitted closed-cycle cooling as the Best Available Technology (BAT)) and water quality standards. *Id*. at 214-16. *See* Responses to Comments III.5.2 and 5.3. At the same time, EPA indicated that it was still considering whether it could and should set instream thermal limits based on seasonal critical temperatures for fish species representative of the BIP. EPA explained such limits would be based on satisfying both state water quality standards and a CWA § 316(a) variance from technology standards. *See id.* at 215-17. EPA expressly invited public comment on this option and CLF has done so. Obviously, this approach involved a prospective assessment of whether the proposed limits would protect the BIP in the future despite having found that the applicant had not carried its burden in a retrospective analysis to establish that past discharges had not caused appreciable harm to the BIP. *See* 40 CFR § 125.73(c)(1)(ii).

Moving forward, and after considering public comment and new data and analysis, including the corrected understanding of earlier-submitted temperature data, EPA retains its conclusions about PSNH's retrospective demonstration. If the Agency *had* changed its view, it could simply have renewed the existing variance-based limits secure in the knowledge that the Facility discharged far less waste heat now than it did before. Since the Agency maintained its conclusions about the retrospective demonstration, however, it has now focused on a prospective assessment and, in particular, the questions raised by the alternative approach identified in the 2011 Draft Determinations Document and by the issues discussed in the 2017 Statement. EPA has assessed whether new thermal discharge limits could be set that would assure the protection and propagation of the BIP going forward considering both critical temperatures for fish species representative of the BIP *and* the Facility's much-reduced operations. *See* AR 618 at 212-17; AR 1534, pp. 39-41, 68. This is rational and reasonable given that the Facility's operational profile and the scope of its thermal discharges has been reduced so significantly since issuance of the 2011 Draft Permit for public review. It would have been irrational and unreasonable simply to ignore the facts regarding the Facility's altered operations and thermal discharges.

EPA reviewed a large volume of material in the record submitted from all parties, and now finds that the record establishes that the 2011 Draft Permit's thermal discharge limits based on technology and water quality standards *would* be more stringent than needed to assure the protection and propagation of the BIP. *See* Responses to Comments II.3.1.3, 3.4.7, 4.4.1, 6.3.4. In addition to reassessing the prior submitted data, EPA evaluated more than 10 years of actual, daily temperature data, comparing conditions at the time of the 2011 Draft Permit under baseload, open-cycle cooling operations to conditions under the current, reduced operations (still using open-cycle cooling). EPA again considered the thermal variance originally sought by

PSNH, which was based on continued baseload operations using open-cycle cooling under the 1992 Permit's CWA § 316(a) variance and continues to conclude that those limits would not be sufficient to assure protection of the BIP. Even though the Facility's operations are now much reduced, EPA could not grant the requested variance limits solely on that basis because the requested limits would allow the Station to resume baseload operations in the future. S*ee* AR 1534, p. 69.

After rejecting the requested variance limits, EPA did not decide simply to impose the technology-based and/or water quality-based effluent limits in the Final Permit. EPA, instead, elected to develop site-specific variance-based limits that it has determined *will* assure the protection and propagation of the BIP as required by CWA section 316(a). For the Final Permit, EPA has developed a stringent set of thermal discharge limits that grow out of the alternative water quality-based limits that EPA stated it was still considering in the 2011 Draft Determinations Document. AR 618, p. 216-17. EPA has determined that the Final Permit's limits will assure the protection and propagation of the BIP. These CWA § 316(a) variance-based limits set instream temperature limits based on critical temperatures for fish species representative of the Hooksett Pool's BIP and take into account the Facility's current and expected future operational mode similar to that of a peaking plant. From discussions with the GSP, EPA understands that the Facility is willing to accept these permit limits developed on this basis.

Merrimack Station's "capacity" to adversely impact the Hooksett Pool's fish community if operating as a baseload, open-cycle power plant remains essentially unchanged since the 2011 Draft Permit, but Merrimack Station no long longer operates in that manner. The Facility's precipitous reduction in operation over the past 10 years, particularly during the critical summer months, has much reduced the thermal plume's influent on Hooksett Pool. *See* Response to Comment II.3.1.3. The temperature and operational limits established in the Final Permit are designed to ensure that future operations reflect current conditions and do not cause excessive and prolonged thermal conditions in the pool that would result in appreciable harm to the BIP. Therefore, EPA expects Hooksett Pool's BIP to be protected going forward, but the Final Permit also requires fish studies to be continued to verify that the BIP remains protected.

Based on the *Dominion* decision by EPA's EAB, the commenter argues that EPA cannot set different CWA § 316(a) variance-based limits than those requested by the applicant because the applicant's application failed to persuade EPA that technology-based limits were more stringent than needed to assure the protection and propagation of the BIP. *See* 12 EAD at 500. EPA disagrees. While EPA continues to conclude that PSNH's retrospective demonstration does not convince EPA that the Facility's past discharges did not cause appreciable harm to the BIP or that renewal of the existing variance would satisfy CWA § 316(a), EPA has also considered the full record, including not only the original application but also public comments and additional data and analysis in the record, and the Agency now concludes that the record demonstrates that technology-based and water quality-based limits *would* be more stringent than necessary to assure the protection and propagation of the BIP. While EPA may not have been required to devise its own variance-based limits, *see Dominion,* 12 EAD at 500 n. 13, it is reasonable and appropriate for the Agency to have done so based on these facts. *Id.* at 572.

Indeed, decision-making in the present case follows the pattern upheld in *Dominion*. In both cases, EPA found that the applicant failed to establish that its prior variance-based discharges had not caused appreciable harm to the BIP. S*ee Dominion*, 12 EAD at 555, 572. Similarly, in both cases, the original variance applications alone did not establish that technology-based and water quality-based requirements would be more stringent than necessary, but the record before the Agency reviewed as a whole persuaded it that such requirements would be more stringent than necessary and the Agency then developed a different set of variance-based limits more stringent than the limits initially proposed by the applicant that would be sufficient to satisfy CWA § 316(a) and assure the protection and propagation of the BIP. The EAB upheld those EPA-generated variance-based limits in *Dominion*, and EPA's limits in the Final Permit are appropriate in this case as well.

Finally, the commenter points to *Appalachian Power*, 545 F.2d at 1372, and an EPA Draft Guidance document from 1974 to argue that compliance with water quality standards does not *necessarily* constitute compliance with CWA § 316(a). EPA does not suggest otherwise, but also notes that in some cases limits that satisfy state water quality standards may also satisfy CWA § 316(a). EPA has clearly explained that limits based on a CWA § 316(a) variance could be less stringent than the requirements of state water quality standards. EPA also explained in the 2011 Draft Determinations Document that New Hampshire's water quality standards included several biologically-oriented narrative criteria that, essentially, set standards similar to those under CWA § 316(a). *See* AR 618, pp. 216-17. Thus, the same limits that satisfy those narrative water quality standards could also satisfy CWA § 316(a). *Id*.

3.4.4 Merrimack's Prospective Analysis is Insufficient

Comment II.3.4.5	**AR-1573, Sierra Club et al, pp. 10-13**
See also AR-1575, Hickey and Shanahan	

Eversource has failed to show that, under a prospective analysis, the "alternative effluent limitation desired by the discharger, considering the cumulative impact of its thermal discharge together with all other significant impacts on the species affected, will assure the protection and propagation" of the BIP. 40 CFR § 125.75(a), (c)(1)(ii).

EPA has previously determined that Eversource has failed to demonstrate that BAT- or WQS-based discharge limits would be more stringent than necessary to assure protection of the BIP or that its suggested alternative thermal discharge limit would reasonably assure the protection of the BIP. Attachment D at 121. The evidence supporting EPA's conclusion is substantial and well documented. *See id.* at 116-121. As described above, Eversource's new information is not relevant to, and should not alter, EPA's previous determination.

Moreover, the Hickey Report details further failings in Eversource's 316(a) demonstrations. Hickey Report at 5-6. Significantly, contrary to EPA's Guidance Manual, Eversource has never submitted a complete 316(a) demonstration because Eversource has not created or submitted a "comprehensive document that pulls the thermal plume information together and presents it clearly." Hickey at 5. More specifically, Eversource failed to include or provide the following four components in its demonstration as required by EPA's Guidance: (1) the discharge vicinity in the study domain; (2) the impact of additive or synergistic effects of heat combined with other existing thermal or other pollutants in the receiving waters; (3) detailed graphs of the discharge plum under multiple conditions; (4) tables or illustrations of ambient river flows and velocities and river temperature and thermal gradients over time. Hickey at 6-7. Eversource has failed to provide any of this information in its 316(a) demonstration. *Id.*

"Instead, [Eversource] appears to have substituted complex statistical models . . . in place of temperature data presentations and thermal plume characterizations that are recommended by" EPA Guidance. Hickey at 7. Hickey notes that the "lack of available water temperature measurement data in the administrative record is so severe that EPA was forced to rely on 21-year averaged statistical summaries in assessing thermal impacts." *Id.* This is "wholly insufficient to support characterization of thermal plums as part of a 316(a) demonstration." *Id*

In addition, Eversource's reliance on the CORMIX model is insufficient as a prospective analysis of the future effects of a 316(a) variance. As described above, the CORMIX model is inadequate for delineating the thermal discharge plume in Hooksett Pool for multiple reasons. Hickey at 12. *Supra* at 7-8. The "CORMIX far-field model does not appear to be an appropriate modeling tool for simulating a thermal plume resulting from a time-varying thermal discharge into a river with time-varying flows and non-uniform dimensions (i.e., with bends and large variations in width and depth)." Hickey at 11. Thus, using the CORMIX model at the Merrimack Station, with its time-varying flows, discharges, and non-uniform dimensions, is insufficient and inappropriate to support a BIP analysis. *Id.*

The Nedeau Report provides additional evidence that Merrimack Station's thermal discharges, if allowed to continue, will further harm the Hooksett Pool BIP by continuing to provide Asian Clams with the warm waters they require to establish a significant foothold in the watershed from which they can spread to connected waterways. Nedeau Report at 3-4. Notably, the Asian Clam's strong source population in Merrimack Station's thermal plume "puts the entire region at risk of further invasion" by allowing the species to acclimate and spread. Nedeau Report at 4. This is important because the Asian Clam has a detrimental effect on native freshwater ecosystems and native freshwater mussels. Nedeau Report at 4. Native freshwater mussels are among the most endangered faunal groups in the world and the decline and loss of native bivalves has enormous implications for ecosystem health. *Id.* at 4. The Nedeau Report provides further evidence that granting Eversource a thermal variance would continue the changes in, and further erode, the BIP of Hooksett Pool and beyond.

With respect to prospective harm in and beyond the Hooksett Pool, we take this opportunity to draw EPA's attention to two more studies that further support EPA's concerns about the impact of Merrimack's thermal plume on the spread of invasive Asian clams in the Merrimack. The first study (Mitchell et al., 1996) is attached to this comment letter. It examines density of quagga and zebra mussels in the thermal plume of the Nanticoke Generating Station on the Canadian side of Lake Erie, concluding that the mussels are found in greater abundance in the plume, particularly along the bottom in the reach of the winter plume, and the authors hypothesize that invasive quagga mussels in Lake Erie benefit from the plume and that it appears that the Nanticoke plume was likely one of the first sites colonized by the mussels – that thermal plume may have been a major launching point for the quagga mussel invasion of North America.

Mitchell and his co-authors identified an even earlier study of invasive Asian Clams in Virginia. Graney et al., 1980. "The influence of thermal discharges and substrate composition on the population structure and distribution of the Asiatic clam, Corbicula fluminea, in the New River, Virginia." Nautilus, 94:130–135. This study observed that Asian clams reached higher densities in the thermally enriched waters of a thermal discharge in Virginia. Twenty-seven years ago, they suggested that plumes from such discharges may provide Asian Clams a warm water refuge from winter temperatures that allowed them to extend their northern range and acclimate to new conditions. Thus, EPA's concerns about the potential role of the Merrimack thermal plume in supporting the survival and spread of invasive species are well-supported by the literature.

Eversource also has failed to carry its burden by not addressing the thermal implications of its recent operating history as a "peaker" plant that runs intermittently. As EPA observed in 2011, abrupt shutdowns in the colder seasons could cause "cold shocks", i.e., a relatively rapid reduction in discharge temperature, which can lead to the physiological impairment of fish and even to death. Attachment D at 349. EPA noted that studies "show that acclimation to cooler temperatures, at least for fish, is considerably slower (e.g. days versus hours) than acclimation to warmer temperatures." *Id.* In this regard, Merrimack's practice of operating sporadically in the winter months poses a threat to the BIP.

Thermal shock is an important consideration and one that has been masked by Eversource's daily averaging of the continuous data set. Even with an averaged data set, however, there is evidence that Merrimack's sporadic operations greatly affect water temperatures in the Hooksett Pool. Hickey Report Figures 11-13 show sharp changes in water temperature that correspond with reduced discharge from Merrimack. And these figures are based on temperature changes in summer months, when the difference between discharge temperatures and ambient temperatures is much less that in winter. Eversource has not provided data for the winter months when the change in temperature from shutting down operations would likely be even greater than the average changes observed in the summer months. Again, Eversource has failed to provide adequate data – in this case, to determine whether its operating history causes thermal shocks that harm the BIP.

Eversource has failed to carry its burden with a prospective analysis that its alternative discharge limitations were reasonable to protect the BIP or that BAT and WQS standards would be more stringent than necessary to assure protection of the BIP. Indeed, not only has Eversource failed to carry its burden of showing that it can assure protection of a BIP, the preliminary comparison of river temperatures with known thermal tolerances for native species in the Hickey Report strongly suggests that the existing variance has degraded the BIP and will pose continuing and rising harms to the BIP. EPA should, again, reject Eversource's request for a § 316(a) thermal discharge variance.

EPA Response:

Sierra Club comments that PSNH failed to carry its burden to demonstrate that its alternative discharge limitations will protect the BIP and that BAT and WQS standards would be more stringent than necessary to assure protection of the BIP. The comment also asserts that a preliminary comparison of river temperatures with known thermal tolerances suggests that the existing variance has degraded the BIP and will pose continuing and rising harms to the BIP. See also AR-1575. Based on this analysis, Sierra Club concludes that EPA should reject the request for a § 316(a) thermal discharge variance.

According to the comment, PSNH's prospective analysis is inadequate because it failed to provide certain components in its demonstration "as required" by a 1977 Draft EPA's 316(a) Technical Guidance Manual. Neither statute nor regulations include criteria requiring that specific types of studies be provided in either a retrospective or prospective assessment under § 316(a). 40 CFR §§ 125.72, 125.73. The 1977 Draft 316(a) Guidance Manual referenced in the comment and the Hickey Report was never finalized and imposes no regulatory requirements for assessing completeness of a § 316(a) demonstration. This is not necessarily to say that the analyses identified in the comment would not be beneficial, and indeed other § 316(a) demonstrations have included such analyses. Rather, a § 316(a) demonstration would not be deemed incomplete or inadequate simply based on omission of these certain components because no specific types of documentation are mandated.

According to the comment, the Hickey Report notes that the "lack of available water temperature measurement data in the administrative record is so severe that EPA was forced to rely on 21-year averaged statistical summaries in assessing thermal impacts" which is "wholly insufficient" to support characterization of thermal plume. EPA used the 21-year dataset because, as it understood at the time, the Agency believed, based on evaluation of what it understood to be the average maximum daily temperature over 21 years, that the impacts of the thermal plume on thermally sensitive species and life stages could be severe and extensive during certain biologically important periods, particularly during larval development and during the warmest months. Since issuance of the 2011 Draft Permit, EPA has been informed that the data presented as the "daily average maximum" was the single highest average daily value over 21-years on any given date. As a result, EPA overestimated the extent of certain extreme temperature events in the 2011 Draft Determinations Document. *See* Response to Comment II.3.1.3. However, as the comment and Hickey Report point out, long-term average temperatures mask occurrences of daily temperatures that exceed protective temperatures on a given day in any year(s). The exceedance of protective temperatures over multiple days and/or in consecutive years represent conditions could harm the biological community. In responding to comments on thermal conditions in the Merrimack River, EPA evaluated available, daily temperature data from Stations N10, S0, and S4 over the period from April 2004 through May 2019 from Merrimack Station's Annual Monitoring Reports and daily generating data (MWh) for Merrimack Station Units 1 and 2 for the years 2004 through 2019 from EPA's Air Markets Program Database. *See* AR-1715.

EPA's review of the reported temperature data (instead of 21-year summaries) demonstrates that, when operating as a baseload plant at relatively high capacity year-round, the thermal plume can reach or exceed protective temperatures for resident and migratory species for extended periods of time and in consecutive years. EPA determined that continuing to allow Merrimack Station to habitually exceed the protective temperatures of species and life stages in the Hooksett Pool for extended periods of time, as is would if the requested variance was granted, will not ensure protection of the BIP. *See* Responses to Comments II.3.1.3 and 3.4.7.

The commenter asserts that the 2016 CORMIX model submitted by PSNH and prepared by Enercon is insufficient to assess the potential thermal impacts under a § 316(a) variance, as detailed in the Hickey Report. AR-1575. Hickey reviewed the 2016 CORMIX model and, consistent with EPA, concluded the model is inadequate for delineating the thermal discharge plume in Hooksett Pool. *See id*. p. 9. *See also* Responses to Comments II.3.3.3, 3.3.4, and 3.3.5. In particular, Hickey also recognized that the model used temperature data averaged over a 10-year period which is not reflective of "worst-case" conditions when the Station operates at baseload capacity. EPA has not based its evaluation of alternative effluent limitations under § 316(a) on the 2016 CORMIX model or LWB's assessment of the model results.

The comment also asserts that the Nedeau Report (AR-1574) demonstrates that thermal discharges from Merrimack Station will further harm the Hooksett Pool BIP by providing thermal refuge for Asian Clams. EPA agrees that the presence and, more importantly, the abundance of Asian clams downstream from Merrimack Station's thermal discharge appears to be directly related to the plant's discharge. However, abundance of Asian clam in the lower Hooksett Pool does not yet appear to be causing appreciable harm based on the available the data before EPA to date. EPA has determined that, based on the existing information, the Final Permit's chronic, average weekly temperature limit for the winter period will ensure protection of the BIP. EPA agrees that additional monitoring of Asian clams in Hooksett Pool is warranted. The continued monitoring and assessment of the clam's presence, prevalence, and impacts on the BIP will be required, as specified in the permit. EPA responds in detail to comments on Asian clams in Reponses to Comments in Section II.5 of this document.

According to the comment, thermal shock is an important consideration and one that has been masked by Eversource's daily averaging of the continuous data set. EPA agrees generally that fish species which have become acclimated to artificially elevated water temperatures and then subjected to a rapid decrease in temperature may suffer stress or shock related to that rapid change.

EPA raised concerns about the attractive influence of elevated water temperatures in Merrimack Station's discharge canal during winter months, particularly regarding their potential to adversely affect the spawning success of yellow perch. *See* AR-618, pp. 100-02. A fish's body temperature would increase in response to elevated water temperature and that, in turn, could raise a fish's metabolism and cause an increased feeding rate. AR-59, pp. 1533-1534). The ability to feed in the discharge canal may be constrained by the canal's small size relative to the habitat available in Hooksett Pool, to which it's connected. Therefore, fish might not find sufficient forage in the discharge canal were they to stay there for prolonged periods and they might need to leave the discharge canal in search of forage. It is also unclear, however, from the limited data that exist, whether fish enter the discharge canal and stay there throughout the winter. Also, the Final Permit limits discharge temperatures so that temperatures at Station S4 will not be greater than 8ºC throughout the winter (November 1 – April 1) to ensure that temperatures in Hooksett Pool remain protective of yellow perch reproduction requirements.

Finally, decreasing demands for Merrimack Station's electricity has resulted in minimal-to-no need for the Facility to operate during much of the Fall (October – early December). This allows resident species to adjust naturally to colder ambient temperatures throughout Hooksett Pool, and would prevent fish from maintaining an artificially high body temperature as they might if the plant was operating continuously from summer to winter. So, while some fish are likely to be attracted to the Facility's elevated water temperatures, the potential for cold shock to occur would be limited to only those fish within the canal and not the Hooksett Pool proper where the plume's temperature drops fairly quickly as it comes in contact with the ambient river water and dissipates. Therefore, going forward, even if the Facility shuts down abruptly during the winter months, EPA does not expect there to be more than minimal impacts associated with cold shock, and such impacts would not likely affect any species at the population level and would not harm the BIP.

For the Final Permit, EPA has determined that, under the current operation of Merrimack Station, specific alternative effluent temperature limits are sufficiently stringent to ensure the protection and propagation of the BIP. These temperature limits are being set under a CWA § 316(a) and are consistent with, and largely track, the water quality-based limits proposed in the 2011 Draft Determinations Document (AR 618, pp. 212-16) allowing for a limited area of the river for initial mixing (*i.e.*, the distance from Stations S0 to S4). The Final Permit also limits the Facility's capacity factor from May 1 to September 30, which ensures that the current operation of the Station continues during the next permit cycle. By limiting the capacity, the Permittee will be able to meet temperature limits that will ensure the protection of the BIP but are less stringent than the technology-based limits proposed in the 2011 Draft Permit, which required installing closed-cycle cooling. Of course, since the Facility is now operating like a peaking plant, rather than a baseload plant, it will operate far less than either set of limits might allow. During the warmest periods, the Final Permit's limits on operation, in combination with acute (maximum daily), water quality-based temperature limits at Station S4, will ensure that the impacts of the thermal plume are limited in duration and severity such that the BIP is protected. If the Station exceeds this capacity, causing it to operate more during this period, the Final Permit requires the Permittee to meet chronic (average weekly), water quality-based temperature limits at Station S4 that will protect the BIP from sub-lethal effects of the thermal plume.

3.4.5 Predictive Assessment: Assessing Thermal Exposures at Merrimack

Comment II.3.5.6	**AR-1577, EPRI, pp. 3-14 to 3-16**

The predictive assessment of Merrimack's thermal discharge begins with determining the magnitude and extent of potential exposures of the RIS to elevated temperatures from the discharge in the Merrimack River. EPRI believes that there are two important factors that should be considered in defining these exposures.

First, the potential thermal exposures should reflect likely operation of the Merrimack Station over the upcoming NPDES permit period (typically five years). As clearly demonstrated in ISO New England (2017), the Station no longer operates as a base-loaded facility as it had prior to

2010. Hence, temperature monitoring data collected prior to the draft NPDES permit (2011) does not reflect current conditions. The Merrimack Station operates principally as a peaking facility operating only when economic dispatch requires. A re-graphing of the generation data provided in ISO New England (2017) reveals a distinct seasonal pattern in operation (Figure 1). This graph clearly illustrates a substantial decline in the electrical generation at Merrimack since 2007 throughout the year except during winter. Hence, the magnitude and extent of thermal exposures to the aquatic community during most of the year are likely to be much lower than when Merrimack was operating as a baseload facility. During spring and summer, when biological productivity and potential for thermal stress is highest, Merrimack is typically operating at a capacity factor of less than 20 percent. That is only a small fraction of generating capacity of this facility prior to the 2011 draft NPDES permit. Only during winter, when natural gas availability constraints limit operation at other generating facilities is Merrimack called to run often. However, biological stresses from elevated temperatures at this time of the year should be minimal owing to low river water temperatures.

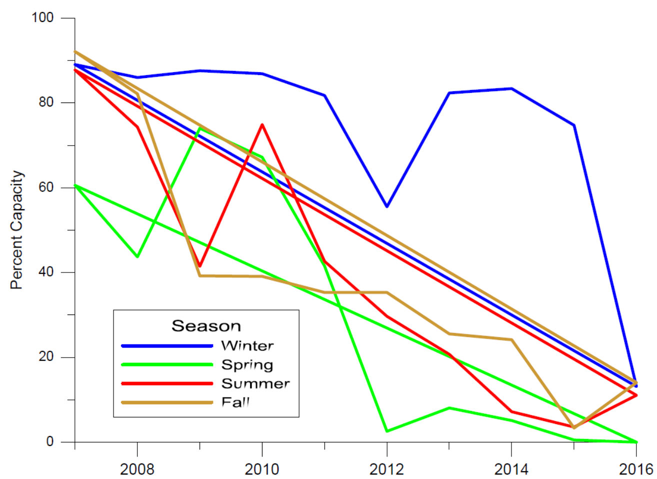

Figure 3-1. Trends in electrical generation by season at the Merrimack Station, 2007 - 2016.

Second, as in many states, NH Water Quality regulations allow for a mixing zone to all for discharged pollutants to mix with the receiving waters provided that the mixing zone:

"(a) Meets the criteria that surface waters shall be free from substances in kind or quantity that:

- *Settle to form harmful benthic deposits;*
- *Float as foam, debris, scum or other visible substances;*
- *Produce odor, color, taste or turbidity that is not naturally occurring and would render the surface water unsuitable for its designated uses;*
- *Result in the dominance of nuisance species; or*
- *Interfere with recreational activities;*

(b) Does not interfere with biological communities or populations of indigenous species;

(c) Does not result in the accumulation of pollutants in the sediments or biota;

(d) Allows a zone of passage for swimming and drifting organisms;

(e) Does not interfere with existing and designated uses of the surface water;

(f) Does not impinge upon spawning grounds or nursery areas, or both, of any indigenous aquatic species;

(g) Does not result in the mortality of any plants, animals, humans, or aquatic life within the mixing zone;

(h) Does not exceed the chronic toxicity value of 1.0 TUc at the mixing zone boundary; and

(i) Does not result in an overlap with another mixing zone.

[sic] *Within these designated mixing zones, water quality criteria do not apply. Use of mixing zones for thermal discharges is a very common practice and included in numerous NPDES permits at facilities nationwide.*

While it is unclear if a formal mixing zone has been incorporated within Merrimack's NPDES permit, it is reasonable that one could be requested and granted. If this is the case, all evaluations of the potential for thermal effects (other than acute mortality) should be based on temperatures outside the mixing zone.

The final step in the predictive assessment is comparison of the thermal exposures to thermal tolerance information for the RIS. Some key issues that EPRI believes need to be considered in applying thermal tolerance data include:

1. It is important to remember that most of the thermal tolerance data is based on laboratory studies. Numerous studies have found that laboratory-based studies do not accurately reflect effects observed in the real world (EPRI 2011).

2. Use of thermal tolerance information to predict thermal discharge effects do not consider the well-documented capability of motile organisms (e.g., fish) to avoid areas of thermal stress.

3. Predictive analyses presume that organisms are exposed to elevated temperatures continuously. Except for non-motile organisms, this is simply not the case. Aquatic organisms actively and passively move in and out of areas of higher temperatures. Hence, exposures to elevated temperatures are often short and can be substantially less than the durations used in thermal tolerance studies.

The peaking nature of Merrimack's current operation means that discharge temperatures can widely fluctuate following electrical demand, often over a 24-hour period. Hence, exposed organisms are afforded a recovery period between periods of thermal exposure. Bevelhimer and Fortner (2007) found: "Laboratory results suggest brief forays near critical temperatures are not necessarily harmful and recovery can be 100% after return to tolerable temperatures." Hence, the cycling nature of Merrimack's current operation might substantially reduce the biological effects of thermal discharges even though peak temperatures might approach those expected under baseline operation.

EPA Response:

CWA § 316(a) authorizes alternative thermal effluent limits when it is demonstrated to EPA that the technology- and water quality-based effluent limits are more stringent than necessary and that the alternative limits will assure the protection and propagation of the receiving water's BIP. 33 U.S.C. § 1326(a); 40 CFR 125.73(a). Thermal discharge limits based on a § 316(a) variance must assure that the receiving water's BIP will be safe from harm from the thermal discharge, and that the thermal discharge will not interfere with the BIP's ability to increase or spread naturally in the water. *See* AR-618 p. 18.

EPRI offers what it believes should be a "predictive assessment" of Merrimack's thermal discharge, including discussion of the current operating status of the Station, mixing zone regulations, and the magnitude and extent of potential exposures of Resident Important Species (RIS) to the thermal plume. EPRI continues that when applying thermal tolerance data, the evaluation should consider the limitations of laboratory-derived limits and the ability of organisms to actively or passively avoid exposure to the plume for durations that would result in stress and/or mortality.

EPA generally agrees with EPRI's characterization as one method of determining if the proposed limits would be protective of the balanced, indigenous population. Indeed, EPA essentially provided its own assessment consistent with this recommendation in the Draft Determination, including a comparison to protective temperatures of the most thermally-sensitive resident and migratory species, using data provided in PSNH's demonstration. *See* AR-618 p. 86-115. EPA notes that PSNH provided only an assessment based on predictive modeling of the thermal plume rather than an assessment of the temperatures in the Merrimack River in comparison to thermal tolerance for RIS species, despite having more than 20 years of daily data. *See* AR-618 p. 79-85. In response, EPA provided its own evaluation of the potential thermal exposures of RIS species to the thermal plume and EPRI points to no deficiency in EPA's assessment of the thermal tolerance data for the 2011 Draft Permit. However, as explained in Response to Comments above, EPA re-evaluated the potential exposures to the thermal plume for the Final Permit considering the actual daily mean and maximum temperature data (as opposed to long-term averages) at three continuous monitoring stations representative of both baseload operations (2004 through 2011) and more recent, peaking-like operations indicative of the substantial reduction in plant operations, particularly during the summer. *See* Response to Comment II.3.1.3.

EPRI comments that the predictive assessment of thermal exposures should reflect the current operation of the Merrimack Station and follows that the temperature monitoring data collected prior to the 2011 Draft Permit does not reflect current conditions. In particular, the Station currently operates relatively infrequently during the summer when the potential for severe thermal impacts was highest based on EPA's evaluation. *See* AR-618 at pp. 118-119. EPA considers the permit limits requested by the permittee and PSNH requested renewal of the existing CWA § 316(a) variance that is reflected in the 1992 Permit and would have allowed thermal discharges associated with baseload operations using open-cycle cooling. Therefore, for the 2011 Draft Permit, EPA reviewed and responded to this request and considered what limits would be needed to address a baseload operating scenario. EPA was aware that the Facility's operations were much reduced after 2012 and in the 2017 Statement, EPA identified that it was considering the implications of the change and invited public comment on the subject. AR 1534, pp. 4-5, 7-8, 34-36, 68-69. EPA also noted that, at that time, PSNH was still requesting permit limits to address baseload operations. *Id*. at 69.

This later changed when GSP purchased the Facility and indicated that it was currently operating like a peaking plant, expected to continue operating that way in the future, and was willing to accept appropriate permit limits based on such operations. Given GSP's willingness to accept permit limits on that basis, rather than seeking permit limits based on an unanticipated future baseload operations scenario, EPA agrees that it should develop limits that account for the Facility's likely operating profile and are based upon consideration of, among other relevant matters, recent data representative of current and anticipated future operating conditions. *See also* AR-1534 at 39, 69. *See also* Responses to Comments II.3.2.2, 3.2.3. Writing permit limits based on current operating conditions makes sense as long as they address how the Facility will operate going forward. Writing permit limits based on current, reduced operations would be inappropriate and ineffectual if after the permit was issued the Facility could simply resume operating at a higher level and cause greater adverse effects that were evaluated in developing the permit.

Therefore, EPA has designed permit limits consistent with Merrimack Station's current intermittent operations and will, where necessary, prevent significantly greater operations that would cause significantly greater adverse environmental effects. Such limits are appropriate because EPA's analysis has concluded that thermal discharge limits reflecting this type of operation will satisfy the conditions of CWA § 316(a). Namely, limits based on CWA § 301, 33 U.S.C. § 1311, will be more stringent than needed to assure the protection and propagation of the BIP in the Hooksett Pool, and the Final Permit's limits reflecting reduced operations and protective critical temperatures will assure the protection and propagation of the BIP. These permit limits are intended to provide appropriate flexibility to the Facility while also protecting the Merrimack River and the BIP consistent with legal requirements.

EPRI also comments that a predictive assessment should consider the concept of a mixing zone and, if a mixing zone is considered, thermal effects (other than acute mortality) should be assessed based on temperatures *outside* the mixing zone. EPRI correctly observes that New Hampshire Surface Water Quality Standards allow for designation of a limited area or volume of the surface water as a mixing zone. *See* Env-Wq 1707.01(b). In this case, however, the Facility has not requested a mixing zone from the state and the state has not formally delineated a mixing zone for the new permit.

Nevertheless, the concept of a "mixing zone" in the generic sense can be used "as a mechanism for dealing with thermal discharges pursuant to section 316(a) of the Act." *In Re Sierra Pac. Power Co.*, U.S. EPA, Decision of the Gen. Counsel No. 31, at 2 (Oct. 14, 1975). *See* AR-618 p. 23. A "mixing zone" is a term of art under the CWA that refers to a tool used in the application of state water quality standards. S*ee* 40 CFR § 131.13. A "mixing zone" under state water quality standards is designated by the State and, in New Hampshire, would be subject to specific state criteria listed at Env-Wq 1707.02, as referenced in the comment. At the same time, the legislative history of CWA § 316(a) indicates that allowing an area in which thermal mixing occurs was an idea that can be used in designing permit limits for a CWA § 316(a) variance. AR-618 p. 23. Using the concept of a mixing zone in the context of CWA § 316(a) is not defined in the Act or implementing regulations and is not subject to the specific criteria for "mixing zones" in the state regulations. Whether under CWA § 316(a) or state mixing zone requirements, the analysis would identify an initial zone of mixing within which certain temperatures may be exceeded, and also an additional zone where temperature limits may not be exceeded. In addition, if needed, temperature levels could be set not to be exceeded in *any* part of the receiving water.

To satisfy § 316(a), the limits and area of mixing must work together to assure the protection and propagation of the BIP. *See* 39 Fed. Reg. 36,178 (October 8, 1974). The 1992 Merrimack Station Permit, which includes thermal limits based on a 316(a) variance, already, in effect, allowed an area of mixing at Part I.A.11.b ("The power spray module system shall be operated, as necessary, to maintain either a mixing zone (station s-4) temperature not in excess of 69°F…"). In addition, the "weekly average" water quality-based protective temperatures developed for the 2011 Draft Determinations Document proposed a compliance point at Station S4. *See* AR-618 p. 212-215. This monitoring location is approximately 2,000 feet downstream from the end of the discharge canal and, as such, demonstrates that EPA considered the mixing concept at the time of the 2011 Draft Determinations Document. For the Final Permit, EPA also applied the concept of an initial mixing area in developing thermal discharge limits based on a 316(a) variance. Again, the compliance point is Station S4.

Finally, EPRI comments that application of the thermal tolerance data should consider the limitations of laboratory-derived estimates for real world conditions and the ability of organisms to avoid long exposures to the thermal plume either by actively avoiding the plume (for mobile organisms) or because organisms are not continuously exposed to elevated temperatures.[21] In its evaluation of the potential for exposure to the thermal plume for the Final Permit, EPA did consider that mobile organisms can avoid the plume and that, with appropriate discharge limits, the exposure time of drifting organisms will tend to be less than the duration that would result in mortality. *See* Responses to Comments II.3.1.3, 3.2(ii), 3.4.7. The protective temperatures proposed in the Determination Document were derived consistent with EPA's 1986 Water Quality Criteria ("Gold Book"), which establishes a maximum protective temperature for short exposures based on species-specific equations. EPA used this method to derive protective short-term temperatures for species in the Merrimack River considering that the time period when the organisms would be exposed to temperatures that could cause acute lethality is likely to be considerably shorter than 24 hours. *See e.g.*, AR-618 p. 190.

EPA looked to a wide range of studies to determine appropriate temperatures for protecting the BIP. Several of the studies referenced in the Determination Document (e.g., Wismer and Christie, AR-196) observed lethality at exposures of as little as 10-30 minutes, not 24 hours or 4-

[21] EPA does not agree that laboratory studies should be ignored in all cases, if that was the commenter's point. EPA believes that laboratory studies may provide useful information for assessing possible thermal effects on fish, but it is important to understand their limitations and limiting factors. EPA notes EPRI presents a quote from Bevelhimer and Fortner (2007) that itself relies on laboratory studies.

7 days, as LWB suggests. *See* AR-618 at 187, 203. The agency realizes that it may not be possible to accurately predict acclimation temperature or exposure time for organisms in Hooksett Pool and, as such, we cannot be certain how closely the critical temperatures identified in laboratory studies would be mirrored in Hooksett Pool. Nevertheless, the studies referenced in the Determination Document suggest that mortality and/or sub-lethal effects to early life stages of yellow perch and American shad could occur at temperatures that have been observed in the thermal plume. In light of the available data, EPA derived protective temperatures for thermally sensitive species and life stages consistent with the methods described for setting water quality criteria in EPA's Gold Book.

3.4.6 Setting Appropriate NPDES Permit Limits for Temperature at Merrimack

Comment II.3.4.6	AR-1577, EPRI, p. 3-17

In addition to determining the acceptability of a 316(a) variance for Merrimack, the draft 2011 NPDES permit sets limits to the thermal discharges from the Station as none had been included in previous permits. EPRI believes there are some key issues that should be considered:

1. The thermal limits should account for allowable mixing zones and ensure protection of the BIC at the edge of the mixing zone but necessarily at [sic] Permit limits should be designed to protect the aquatic community being exposed within the Hooksett Pool at the present time, not species that might have inhabited the Pool in the past or might occur in the area in the future. Significant and adverse changes in the aquatic community, if any, that might occur in the future requiring more stringent thermal discharge limits should be addressed in future NPDES permit modifications. EPRI believes that given the recent detection of Asian clam in Hooksett Pool upstream and downstream of the thermal discharge, EPA should consider monitoring the species as part of future facility NPDES permit modifications. Further, that EPA may wish to study the Asian clam upstream and downstream of the thermal discharge for its potential direct correlation with the facility discharge, and its presence quantitatively assessed for adverse impacts to the BIC.

2. EPA may wish to consider numeric water quality criteria and/or permit limits established at [sic] for other thermal discharges to receiving waters with similar aquatic communities when establishing limits for Merrimack.

There is a wealth of new information relative to the assessment and regulation of thermal discharges in addition to the items listed above that has become available since the development of the 2011 draft NPDES permit. Much of this is summarized in EPRI (2012, 2016). We encourage consideration of all of this new information when setting appropriate NPDES permit limits for the Merrimack Station.

EPA Response:

EPRI lists several issues that it believes should be considered when setting temperature limits for the Final Permit. EPA has considered these issues to the extent that they are relevant to setting permit limits that will be protective of the BIP. EPA has considered the application of a mixing area for the setting temperature limits in the Draft and Final Permits. *See* AR-618 p. 23. The Final Permit limits, which are based on a § 316(a) variance, require the Permittee to meet protective temperatures at Station S4 downstream from the Facility, which provides a limited area for thermal mixing based on EPA's assessment of critical temperatures and biological effects from the Facility's thermal discharge.

EPA has also considered the effect of the thermal plume on Asian clam populations in the Merrimack River. EPA has determined that, based on the existing information, the Final Permit's chronic, average weekly temperature limit for the winter period will ensure protection of the BIP. *See* Responses to Comments II.5.9.1 and II.5.9.2 (and associated sub-comments). The Final Permit requires monitoring and assessment of the clam's presence, prevalence, and impacts on the BIP. Finally, EPRI comments that EPA should consider temperature limits established for "other thermal discharges" and vaguely comments that EPA should consider new information relative to regulation of thermal discharges available in the Report attached to the comments. See, generally, AR-1589, AR-1596. 96. EPA has reviewed the attached Reports and considered effluent limitations established for other thermal discharges under § 316(a) in developing variance-based temperature limits for the Final Permit. *See, e.g.,* Responses to Comments II.6.3.1, 6.3.3.

For the Final Permit, EPA has determined that, under the current operation of Merrimack Station, the specified alternative effluent temperature limits are sufficiently stringent to ensure the protection and propagation of the BIP. The temperature limits set under a CWA § 316(a) variance for the Final Permit largely track the water quality-based limits proposed in the Draft Permit Determinations Document allowing for a limited area of the river for initial mixing (i.e., the distance from Stations S0 to S4). *See* AR 618, pp. 212-17. The Final Permit also includes a limitation on the capacity factor during the warmest months, which ensures that the current operation of the Station continues during the next permit cycle. Limiting the capacity will ensure that the Permittee is able to meet temperature limits that will ensure the protection of the BIP, although the limits are in some respects less stringent than the technology-based limits proposed in the 2011 Draft Permit, which required installing closed-cycle cooling. During the warmest periods, the Final Permit's limits on operation, in combination with acute (maximum daily), water quality-based temperature limits at Station S4, will ensure that the impacts of the thermal plume are limited in duration and severity such that the BIP is protected. If the Station exceeds this capacity, causing it to operate more during this period, the Final Permit requires the Permittee to meet chronic (average weekly), water quality-based temperature limits at Station S4 that will protect the BIP from sub-lethal effects of the thermal plume.

EPA disagrees with EPRI's comment temperature limits should be designed to protect whatever aquatic community is currently present, rather than the BIP that might have inhabited the Pool in the past or might occur in the area in the future. Moreover, EPRI does not elaborate on how its comment is relevant to the BIP at issue in this permitting decision, and it does not request any change to the permit based on this comment. The Draft Determination defined the BIP for the Merrimack River in detail. *See* AR-618 pp. 30-36. It is plain from this discussion that just any aquatic community present in the Hooksett Pool is not necessarily representative of the BIP. The Draft Determination explains that the BIP cannot be dominated by pollution-tolerant species or species whose presence or abundance is attributable to § 316(a) variance-based permit limits. *See id*. pp. 19-21. For example, § 316(a) cannot be read to mean that a balanced indigenous population is maintained where the species composition, for example, shifts from a thermally sensitive to thermally tolerant species. Such shifts would be "at war with the notion of 'restoring' and 'maintaining' the biological integrity of the Nation's waters." *Id*. p. 20 citing *In Re Pub. Serv. Co. of Ind., Wabash River Generating Station* 1979 EPA App. LEXIS 4, 1 E.A.D. 590 (EAB 1979). Thus, EPA also does not agree that "significant and adverse changes in the aquatic community" requiring more stringent thermal discharge limits should only be addressed in future.

EPA received and addressed a number of comments on what community constitutes the BIP for the Merrimack River. In light of the comments and supporting documents received, EPA considers that the appropriate BIP for evaluating a CWA § 316(a) variance for Merrimack Station is best reflected in the following communities: (i) the Hooksett Pool biotic community of the 1970s; (ii) the present Garvins Pool fish community, and (iii) the ambient section of Hooksett Pool for assessing the benthic invertebrate community in the thermally affected section downstream. EPA considered changes in historical trends *and* comparisons with adjacent, present-day fish communities uninfluenced by the thermal discharge in a comprehensive evaluation of the fish community. EPA addresses detailed comments on the BIP in Responses to Comments II.4.1 and 4.2 (and associated sub-comments).

3.4.7 EPA's Alternative Thermal Tolerance Limits

Comment II.3.4.7(i)	**AR-1548, PSNH, p. 51**

PSNH's submissions also demonstrate that the thermal tolerance limits EPA used to establish water-quality based thermal standards were in many cases incorrect or inappropriately applied.[236] Limits that are not supported by the literature cited by EPA include the winter limit for yellow perch maturity (8°C), yellow perch egg development (18°C), long-term exposure for yellow perch larvae (21.3°C), and long-term exposure for yellow perch juveniles and adults (25.1°C).[237] Dr. Barnthouse provides that limits EPA inappropriately applied include the short- term limit for yellow perch larvae, the short-term limit for yellow perch juveniles and adults, and both the short-term and long-term limits for American shad larvae and juveniles.[238]

[236] *See, e.g.,* AR-1300; LWB 2017 Response.

[237] *See* AR-1300 at 22-30.

[238] *See id.*

Comment II.3.4.7(ii)	**AR-1300, LWB pp. 21-32**

Among resident species, EPA identified yellow perch as the most sensitive and established limits for each of the following life stages: (1) adult reproductive condition, (2) spawning stage, (3) egg stage, (4) larval stage, (5) juvenile stage, and (6) adult stage (non-reproductive). Temperature limits were defined for each of these stages, to be applied during the period in which that life stage was present in the river.

Among anadromous species, EPA identified certain life stages of American shad and river herring as being potentially more sensitive than yellow perch, and established temperature limits for these species and life stages as well.

As discussed below, these limits are more restrictive than is necessary to protect the relevant populations present in the Hooksett Pool, given the wide range of thermal environments inhabited by all of these species, and especially given the limitations on test methodologies discussed by EPRI (2011a).

Comment II.3.4.7(iii)	**AR-872, Normandeau, pp. 95-101, 106-108, 112, 118-119**

[Responding to Determination Document p. 91] On page 12 of Stier and Crance (1985), the authors state that "[o]ptimal near-surface water temperatures for American shad egg and larval development range from 15 to 25º C. Temperatures below 10º C and above 30º C are unsuitable."

Responding to Determination Document p. 92] Rather than rely on flow data from the middle of August, which likely represents a low flow period when larval shad would not be drifting through Hooksett Pool, USEPA should use the more appropriate value it calculated for June (Section 8.3.1.4b of the §316 Determination Document). This value is 0.55 ft/second, which would result in a transit time of 60 minutes and 36 seconds. In addition, USEPA reported the incorrect value from Table 2 in the 1976 Normandeau report Merrimack River Anadromous Fisheries Investigations: Annual Report for 1975 (Normandeau 1976b). The correct surface current speed in the proximity of the Station's thermal discharge was 0.17 knots (0.29 ft/sec) and would produce an estimated transit time of less than two hours.

[Responding to Determination Document p. 93] A review of Klauda et al. (1991) reveals that the 50% mortality in 88.9° F (31.6° C) water was following 96 hours of continuous exposure. Klauda et al. (1991) cites Marcy (1976a) and states that "young American shad avoid effluent temperatures greater than 30º C by swimming below the power plant outflow." Based on this, it is reasonable to conclude that juvenile American shad in Hooksett Pool would behave in a similar fashion. Evidence for such behavior is provided by the successful spawning and growth of American shad in Hooksett Pool during 1978 and again in 2002.

[Responding to Determination Document p. 94] USEPA does not mention that Moss (1970) observed captive juvenile shad exposed to rapid temperature increases of 4ºC above acclimation in a tank study. In addition, Moss (1970) concluded that young shad are behaviorally capable of avoiding potentially lethal temperature changes. It is reasonable to conclude that juvenile shad in Hooksett Pool are capable of avoiding prolonged exposure to elevated thermal conditions, based on both tank (Moss 1970) and field (Marcy 1976a, Normandeau 1979c) observations, and the capture of juvenile shad in the pool in during August in 2010 and 2011.

[Responding to Determination Document p. 94] Massman (1963) suggests that juvenile American shad can readily feed on both terrestrial and aquatic insects. Ross et al. (1997) observed juvenile American shad in riverine nursery habitat readily feed on a variety of prey from both aquatic and terrestrial origin. Based on these studies, it is reasonable to conclude that American shad in Hooksett Pool would not be limited to feeding on surface drift of terrestrial insects within only thermally influenced portions of Hooksett Pool when they could also consume aquatic insects below the surface or feed on surface drift in the upper half of Hooksett Pool. American shad are free to move about the entire 5.8 miles of Hooksett Pool and, as demonstrated by Moss (1970) and Marcy (1976a), are behaviorally capable of avoiding potentially lethal temperature changes.

[Responding to Determination Document p. 95] Atlantic salmon smolts typically move downstream at night (Hesthagen and Garnas 1986, McCormick et al. 1998, Moore et al. 1998) and as a result, foraging is most likely limited. Radiotelemetry equipment was deployed at the Hooksett Dam during 2003 and 2005 to monitor smolts following their passage at Merrimack Station, and there were no delays to downstream migration due to Hooksett Dam. The radio-tagged smolts released in upper Hooksett Pool moved successfully and rapidly past the Station's thermal discharge and lower Hooksett Pool (Normandeau 2006a).

[**Responding to Determination Document p. 119**] Normandeau questions USEPA's use of drift rates calculated using data from the middle of August, which is the lowest flow period time of the year, rather than the value it calculated for June (as discussed in Section 8.3.1.4b of the §316 Determination Document). Using the lower flows from August is inappropriate because yellow perch, white sucker and American shad larvae are not present in Hooksett Pool during August. Moreover, use of August data creates an artificially slow drift time for larvae between S0 and S4 and suggests longer exposures to elevated water temperatures than may be occurring. In addition, USEPA inexplicably makes little to no mention of the ΔT for river flow moving the 2,000 ft between Monitoring Station S0 and S4.

EPA Response to Comment II.3.4.7(i), (ii), and (iii):

PSNH comments that the thermal tolerance limits (also referred to in the Responses to Comments as "critical temperatures") EPA used to establish water-quality based thermal standards were in many cases incorrect or inappropriately applied, citing comments made by LWB (AR-1300), for specific life stages of yellow perch and American shad. *See* AR-618 at 174-210. Upon review of the comments made by LWB and a re-evaluation of the bases developed and presented in the Draft Determination, EPA concludes that some of the comments warranted revisions to certain temperature limits or compliance periods set in the draft permit, whereas other comments did not. EPA addresses PSNH's comment, as well as the related comments and analysis provided by LWB, (AR-1300) below.

Yellow perch - Maturation

PSNH and LWB (AR-1300) question EPA's selection of 8°C as the maximum winter temperature for proper gonadal development in yellow perch. EPA used data presented in Hokanson (1977) (AR-59) and the 21-year average of the daily mean from Normandeau 2007 (AR-3) for late October and early April to establish the appropriate temperature and chill duration for Hooksett Pool. The limited available data indicated ambient water temperatures dropped to 8°C in late October/early November and were typically at or below 8°C through April

20. Ambient temperature monitoring is not available for the period from November through early April because PSNH removed the monitoring equipment upstream from the thermal discharge during winter months due to icing concerns. EPA evaluated the limited available winter ambient data to establish 8°C as the appropriate temperature for yellow perch maturation. *See* AR-618 at 180-81. According to LWB, Hokanson is based on laboratory conditions and ignores that under natural conditions, fish would be exposed to temperatures much lower than 8°C for portions of the winter. Hokanson (1977) found that spawning success was maximized at temperatures of 4°C – 6°C. Yellow perch exposed to these temperatures reached 95% (6°C) to 100% (4°C) spawning success with an exposure of 160 days. *See* AR-59, Figure 1.

LWB's comments provide new information from monitoring at the Hooksett Dam during December through April indicating that winter temperatures drop to as low as 2°C in Hooksett Pool and remain at or below 5°C through mid-April. *See* AR-1300 at 22-3. LWB states that "[i]n the Merrimack River and other systems inhabited by yellow perch, temperatures are lower than 8.0°C for a large part of the winter." *Id*. This data, coupled with the results from Hokanson (1977) suggest that winter ambient temperatures in Hooksett Pool are less than 8°C for extended periods, which supports a conclusion that a somewhat shorter chill period duration and still be protective of yellow perch maturation.

LWB then urges that EPA's proposed limit of 8ºC is more stringent than necessary to protect yellow perch maturation. He suggests that Hokanson (AR-59) identified 10ºC as the maximum winter temperature for gonadal maturation and that EPA did not justify the need for a more stringent limit. LWB further suggests that a limit of 10°C from November 15 through April 1 would ensure that ambient downstream temperatures are "within the envelope" of temperatures in which yellow perch are known to successfully reproduce. AR-1300 at 23. As LWB points out, Hokanson identified 10ºC as the maximum winter temperature. EPA explained in the Determination Document that spawning was twice as successful at 8ºC as compared to 10ºC for the same chill duration. *See* AR-618 at 181. Furthermore, while the ambient winter temperatures yellow perch are exposed to throughout their range can reach 10ºC in lower latitudes, temperatures in Hooksett Pool are at or below 8ºC, and probably lower than 6ºC, for most of the winter period, as LWB recognizes in his comments. In other words, while the comments potentially support limiting the duration of the chill period (to something less than 166 days proposed in the Draft Determination) raising the temperature limit to 10ºC would be less protective of proper gonadal development for yellow perch in Hooksett Pool and, moreover, based on PSNH's own analysis, the proposed temperature limit of 8°F can be met in winter.

That said, EPA also concludes that the compliance period for the winter "chill period" limit protective of yellow perch maturation can be modified to better reflect updated ambient temperature data. The 2011 Draft Determination proposed a compliance period from November 1 to April 20, whereas the Final Permit includes a compliance period from November 1 through March 31. The Final Permit retains the average weekly temperature limit of 8ºC at Station S4, which is representative of ambient water temperatures. Despite a shorter chill period, the gonadal development in yellow perch should be enhanced by exposure to actual winter water temperatures considerably colder than 8ºC for much of the winter. As LWB comments, the ambient temperature typically drops below 8°C towards the end of October, but there may be some years where the ambient temperature in early November exceeds 8°C. The Final Permit includes a provision that limits the rise in temperature at Station S4 to no greater than 2°C as compared to the ambient temperature at Station N10 (or N5) when the ambient temperature is within 2°C of, or greater than, the effective weekly average temperature limit. Under there limited instances, the rise in temperature limit replaces the 7-day average temperature limit. This provision provides the Permittee with flexibility to meet the effective permit limits during transitional periods for ambient temperatures in the river.

Yellow perch spawning

LWB comments that "an upper temperature limit [of 12°C] that cannot be exceeded" for yellow perch spawning is not supported by the scientific literature; the comments cite additional sources not evaluated in the Determination Document suggesting that spawning is possible at temperatures as high as 18.5°C. *See* AR-1300 at 24. In response to the comments, EPA again reviewed Hokanson (1977) and Wismer and Christie (1987). *See* AR-59; AR-196. Hokanson (1977), referencing unpublished data by Jones et al., stated that although viable ova were produced at temperatures up to 18.6°C, 80% of all viable spawnings were produced between 6.2 and 16.0°C, and gamete viability was highest at 8-11°C. Wismer and Christie (1987) observed a spawning temperature range of 7-15°C and identified 12.0°C as the optimum spawning temperature. EPA finds neither of these two references to provide a compelling argument to raise the temperature limit above 12.0°C, but rather, to support EPA's conclusion that 12°C is an appropriate optimal temperature. Additionally, as EPA discussed in the 2011 Draft Determinations Document, Kreiger et al. (1983) found water temperature suitability for yellow perch spawning dropped dramatically at temperatures above 12ºC. *See* AR-618 at 182; AR-63. Moreover, LWB incorrectly identifies the proposed temperature limit of 12°C as an "upper temperature limit that cannot be exceeded." In fact, this limit is an average weekly temperature calculated as a 7-day average beginning on the first day of the reporting period (*i.e.*, calendar month) and is not an instantaneous limit that "cannot be exceeded." Given that the temperature limit is an average weekly value, an optimal, or preferred target, rather than a critical maximum, is a more appropriate value for the protection of yellow perch spawning.

LWB also comments that a temperature maximum at Station S4 is not necessary because this location is not suitable spawning habitat. Station S4 is located in an unvegetated area of the channel and my not be utilized as spawning habitat by yellow perch, which spawn predominantly in at least moderately vegetated near-shore areas. *See* AR-1300 at 24. The comment is not supported by data provided by Normandeau and several citations used by LWB. LWB comments that because Station S-4 is unvegetated it may not provide suitable habitat, however, spawning also occurs over submerged branches. According to the commenter, citing Krieger et al. (1983), and Carlander (1997), "… yellow perch spawn predominantly in at least moderately vegetated littoral (near-shore) areas, often over vegetation or submerged branches." While Normandeau's 2011 study (AR- 869) of the physical habitat in Hooksett and adjacent pools did not identify sub-aquatic vegetation close to Station S4 (though it is at S-0), woody debris is depicted along both the eastern and western shorelines extending from the plant's discharge canal south to the Hooksett Dam. Even if suitable habitat was not found right at Station S-4, the notion that applying a protective temperature there would be un-necessary reflects a misunderstanding of the compliance point. Station S4 was chosen as the compliance monitoring location in the Final Permit in part because it has been consistently monitored under the 1992

Permit, resulting in a long-term dataset suitable for establishing permit limits, and, importantly, because Station S4 is intended to be representative of ambient river temperatures in Hooksett Pool downstream of the temperature probe, including nearshore spawning habitat. In other words, even if the habitat right at Station S4 is not suitable for spawning, meeting the protective temperature limits at Station S4 will ensure that nearshore spawning habitat at and downstream from the Station S4 transect is also protected.

While EPA has not proposed altering the average weekly temperature for yellow perch spawning, EPA did reconsider the time periods identified in the Determination Document. *See* AR-618 at 209-10. EPA based the proposed biologically important time periods, in part, on the 2007 Normandeau data that, as explained above, was misinterpreted. *See*, *e.g.*, Response to Comment II.3.1.1. In response to the misunderstanding about that data, EPA reviewed more recent observed daily temperature data from January 2004 - May 2019, which is reflective of current operations. See AR-1715. The review of the complete dataset, rather than just averages and ranges, indicates that the dates for biologically important periods could be adjusted to better reflect current ambient conditions. In addition, the end date for the "chill period" for yellow perch maturation has been adjusted from April 20 to March 31. Based on this period, the time period for yellow perch spawning begins on April 1. This increases the overall spawning period by 12 days, but both the start and finish dates of the period are earlier than in the 2011 Draft Determinations Document.

Yellow perch egg development

LWB (AR-1300, p. 24-25) references additional studies to assert that a higher temperature (21°C) than EPA proposed in the 2011 Determinations Document (18°C) would be protective of yellow perch eggs. LWB argues that the study EPA relied on (Koonce et al. (1977), AR-62) incubated eggs at a constant temperature, while under natural conditions eggs would be spawned at low temperatures which increase over time until hatching. Hokanson (1977) and Koonce et al. (1977) observed tolerances up to 21°C for early embryonic stages. EPA reviewed these studies and found they do not support increasing the temperature to 21°C. LWB comments that Hokanson reported a temperature tolerance range of 3.7 to 21°C, however, the study observed early stage yellow perch egg survival of 80% or greater at a temperature range from 6° to 18°C and a steep decline in survival from 60% to 0% at 21ºC. *See* AR-59 at 1531, Figure 4. Koonce et al. (1977) depicts daily mortality rates for various life stage phases. For the "cleavage egg" phase, mortality jumped from 16% at 18ºC to 70% at 21ºC. *See* AR-62 at 1904. EPA recognizes that river temperatures are not static during this time period but maintains that a temperature limit of 18ºC is appropriate and well-support by the scientific literature.

LWB then comments that, based on the 2007 Normandeau data, average daily temperatures at Station S4 were below 18°C until May 30 and did not exceed 21°C until June 11, well after the end of the yellow perch egg development period. According to LWB, the temperature data suggests that eggs would most likely be exposed to temperatures within the optimal range (*i.e.*, no greater than 18°C) for the entire development period. The 2007 Normandeau data and the updated data for the period from 2002 to 2015 both confirm that the average daily mean temperature at Station S4 was less than 18°C through May 30, which further supports maintaining this temperature as a permit limit because it is representative of natural conditions.

EPA also examined recent daily temperature data for the years 2012 through 2019. Observed mean daily temperatures at Station S4 did exceed 18°C at the end of May in some years. For example, in 2015 and 2016, the mean daily temperature at Station S4 exceeded 18°F on May 26 and remained above the limit, even reaching as high as 22.6°C on May 30, 2015. Merrimack Station was not operating during this period in either year, suggesting that the relatively higher temperatures were caused by naturally warmer conditions each year. As LWB suggests, during these naturally warm years it is likely that spawning would begin earlier and eggs would still be at optimal temperatures for the entire incubation period. *See* AR-1300 at 25; AR-59 at 1542. Finally, LWB comments that Station S4 is not located in spawning habitat and, as such, a limit for eggs at this location is unnecessarily conservative. As explained above, the monitoring location is a compliance point that is representative of downstream conditions and a limit met at this location will be protective of downstream habitat, not just at that monitoring location.

LWB's comments do not justify increasing the average weekly temperature limit deemed protective of yellow perch eggs from 18 to 21°C. Indeed, the references and data cited in his comments support maintaining the limit of 18°C.

Like the earlier lifestages discussed so far, EPA has also adjusted the time period for compliance with the protective limit for yellow perch egg development. Where the Draft Determination had proposed May 19-27 as the period for egg development, the Final Permit has adjusted the compliance period to May 1 – May 31 to reflect EPA's review of the complete temperature data under current conditions and to align with the changes to the time periods for earlier life stages, as explained above. In addition, the Final Permit includes a provision that limits the rise in temperature at Station S4 to no greater than 2°C as compared to the ambient temperature at Station N10 (or N5) when the ambient temperature is greater than, or within 2°C of, the effective weekly average temperature limit. This provision provides the Permittee with flexibility to meet the effective permit limits during transitional periods for ambient temperatures in the river, such as during the end of May when the temperature may naturally reach or exceed 18°C during warm years.

Yellow perch larval stage – chronic limit

PSNH and LWB comment that the value of 21.3°C for protecting yellow perch larvae from May 28 through June 15 is unrealistically low for several reasons: 1) ambient temperatures have exceeded 21.3°C and the maximum average daily temperature exceeded 21.3°C every date between May 25 and June 15 over the 21 year dataset; 2) the choice of optimal temperature is questionable; and 3) the proposed criterion was "not to be exceeded" but did not specify an averaging period, while the Gold Book, which informed calculation of the limit, states that the value is a weekly average temperature. *See* AR-1300 at 26-27.

Turning first to comments on the appropriate value for protecting yellow perch larvae, the commenter argues that 18°C (the temperature EPA selected to represent the physiological optimum in its formula for calculating the chronic temperature limit) is not a physiological optimum but a temperature at which no mortality was observed in a laboratory experiment. *See* AR-618 at 186; AR-62. LWB asserts based on Hokanson (1977) that 20°C would be a more reasonable physiological optimum temperature. *See* AR-1300 at 27, AR-59. Using 20°C as the optimum temperature in the Gold Book formula results in a chronic (weekly) limit of 22.7ºC. [22] Koonce et al. (1977) does not present 18°C as a physiological optimum temperature for larval growth and EPA agrees, therefore, that it may be more stringent than necessary for calculating the chronic limit. As LWB points out, Hokanson (1977) suggests that feeding and survival of "well-fed" percid larvae is optimal at 20°C. Therefore, for the Final Permit, EPA applied a physiological optimum temperature of 20°C and an upper incipient lethal temperature of 28°C to calculate a chronic limit of 22.7ºC for protecting yellow perch larvae.

The commenter also points out that the maximum average daily temperature exceeded 21.3°C under ambient conditions (*i.e.*, at Station N10) every day from May 25 – June 15 at least once in the 21 years covered in the 1984-2004 data set. *See* AR-3. As PSNH points out, however, this data point "represents the maximum average daily temperature that occurred on a given calendar day typically only one time during the 21 years monitoring data was collected between 1984 and 2004," and it does not demonstrate that this value was reached "on consecutive days in every year or even consecutively on any given days in any single year during this 21-year period." AR-846 at 43. That ambient daily mean temperatures reached or exceeded 21.3°C on a single date over 21 years does not establish that a less stringent temperature would be protective of larval yellow perch. Indeed, the mean daily S4 temperature averaged over the years 2002 through 2015 did not reach 21.3°C until June 19 based on the updated values provided by PSNH. *See* AR-1299. In most years, temperatures in early to mid-June appear to be within the preferred range for yellow perch larvae, especially since the Facility transitioned to operating like a peaking plant. However, under baseload operations, temperatures in early June could exceed this temperature. *See* Response to Comment 3.1.3.

The Determination Document (Table 8-5 at 209) indicates that the maximum protective temperature for yellow perch larvae from May 28 to June 15 is intended to be a weekly average, not, as LWB describes, a "value not to be exceeded." The Final Permit requires that the weekly average limit of 22.7°C shall be calculated as a 7-day average beginning on the first day of the calendar month. In addition, the Final Permit adjusts the compliance period to June 1 – June 21 to reflect EPA's review of the complete temperature data under current conditions, to align with the changes to the time periods for earlier life stages, and to be consistent with 2017 entrainment data submitted by Normandeau indicating that yellow perch larvae are present in Hooksett Pool through the week beginning June 19.[23] *See* AR-1550. The Final Permit also includes a provision

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[22] Barnthouse also comments that even 22.7°C is more stringent than necessary to protect yellow perch larvae because Hokanson (1977) shows that water bodies in which the average temperature in mid-June exceeds both 21.3°C and 22.7°C are still "within the temperature envelope" that supports healthy yellow perch populations. AR-1300 at 27. The figure referenced by Barnthouse to support this statement (AR-59, Figure 9) does not speak to the presence of yellow perch larvae or the temperature's suitability to this most temperature-sensitive life stage. Instead, it demonstrates the seasonal temperature envelope describing temperature limits for adaptation of juvenile and adult yellow perch at 35 streams in the southern part of the native range of this species, many of which are likely to represent naturally higher temperatures than Hooksett Pool. It does not support a higher temperature for protection of yellow perch larvae. *See* AR-59 at 1541.

[23] The compliance period extends until June 21 to align with the 7-day averaging period for each weekly average temperature value.

that limits the rise in temperature at Station S4 to no greater than 2°C as compared to the ambient temperature at Station N10 (or N5) when the ambient temperature is more than, or within 2°C of, the effective weekly average temperature limit. This provision provides the Permittee with flexibility to meet the permit limits even when ambient temperatures in the river reach or exceed 22.7°C.

Yellow perch larval stage – acute limit

LWB generally argues that the acute, maximum protective temperature that EPA identified for yellow perch larvae (29.3°C) is overly stringent because EPA proposes Station S0 as the compliance point, which ignores that the thermal plume would be diluted and drifting larvae would be exposed to a decreasing temperature profile as they transit between Stations S0 and S4. *See* AR-1300 at 27-8. EPA agrees that there is a well-documented decrease in temperature between Station S0, where the temperature essentially reflects thermal effluent prior to mixing with the river, and S4, approximately 2,000 feet downstream from the mouth of the discharge canal. After carefully considering the intention of the acute limit for the protection of drifting larvae, EPA concluded that moving the compliance point for the acute limit from Station S0 to S4 is reasonable to account for mixing of the plume during the relatively short exposure period while continuing to provide protection for yellow perch larvae.

LWB also comments that the only larvae exposed to temperatures recorded at S0 are those which have been entrained through the plant's cooling water system, and they are already assumed to be dead. *See* AR-1300 at 28. EPA agrees that only larvae that have been entrained would literally be present *at* Station S0, which is located just inside the discharge canal, but larvae drifting near the surface along the western shoreline at the confluence of the discharge canal would be exposed to temperatures close to or equaling those recorded at S0. These larvae could be exposed briefly to temperatures exceeding the acute limit when drifting past Station S0 but would also experience declining temperatures as they drift downstream. The short-term exposure to relatively higher temperatures at Station S0 is one reason EPA has elected to maintain the proposed 2ºC buffer from temperatures that have been demonstrated to cause lethality to yellow perch larvae. *See* AR-618 at 190.

Considering these comments and reviewing the more current ambient temperature set (2004-May 2019) (AR-1715) for Hooksett Pool during May and June prompted EPA to re-examine the acute temperatures and compliance period for protecting larval yellow perch from acute lethality. Laboratory studies of temperature tolerance acclimate fish at a constant temperature, but under natural conditions fish are exposed to a range of temperatures and acclimation temperatures increase as the river naturally warms during May and June. *See* AR-1300 at 29-30. *See also* AR-59 at 1544. Beitenger and Bennett (2000) (AR-726) observed that higher acclimation temperatures typically correspond with higher temperature tolerances of fish species during controlled survival studies. *See* AR-618 at 187. The studies used to derive an acute protective temperature for yellow perch larvae in the 2011 Determinations Document had larvae acclimated at 15°C. *See* AR-618 at 187. Ambient conditions (as represented by Station N10) in Hooksett Pool during the month of May range from about 10°C (on May 1) to about 18°C (on May 31), but average ambient temperatures increase to 18°C in June and reach an average of 22.5°C by the end of June.

In the Merrimack River, larval yellow perch are acclimated to higher ambient temperatures in June than in May, which suggests that the thermal tolerance of larvae in June would also be higher. EPA determined, therefore, that it is appropriate to divide the yellow perch larval period (May 1 through June 21) into two segments: 1) May 1 to 31 with a maximum daily (acute) temperature limit of 29.3ºC representative of the lower acclimation temperature; and 2) June 1 through June 21 with a maximum daily (acute) temperature of 30.9°C representative of a higher acclimation temperature. As explained in the 2011 Determinations Document, the June acute temperature is derived using the methodology from EPA's Gold Book. *See* AR-618 at 190. EPA considers this small increase in the acute temperature limit warranted for the June compliance period since ambient temperatures at that time are generally at or above 20.0ºC. The derivation of both temperature limits includes a 2ºC buffer from temperatures that have been demonstrated to cause lethality to yellow perch larvae consistent with recommendations from the Gold Book and National Academy of Sciences (1973). *See* AR-175.

American shad larval stage – acute limit

LWB's comments regarding acute temperature limits for larval American shad were similar to those made for larval yellow perch (*i.e.*, that monitoring the temperature limit at Station S0 ignores that the thermal plume would be diluted and drifting larvae would be exposed to a decreasing temperature profile as they transit between Stations S0 and S4). *See* AR-1300 at 31-32. In consideration of those comments, EPA again concluded that moving the compliance point for acute temperature limits downstream to Station S4 was warranted. *See* discussion of short-term protective temperatures for yellow perch larvae, above.

EPA's consideration of public comments and more current and complete temperature data (2004-May 2019) (AR-1715) for Hooksett Pool from May through July prompted the Agency to re-examine the temperatures for protecting larval American shad from acute lethality. *See*, *e.g.*, AR-872, pp. 97-100. In calculating the acute limit for the 2011 Draft Determinations Document, EPA used 31.5°C as a temperature causing lethality but noted that American shad larvae survived short-term (15-minute) exposures at 31.5°C and the value could be revised upon further review. *See* AR-618 at 203. According to Klauda et al. (AR-61), American shad larvae acclimated to 20.5°C survived a 15-minute exposure to 31.5°C, but suffered significantly greater mortality when exposed to 33.5°C. Site-specific studies on American shad larvae conducted by Normandeau Associates for Merrimack Station in 1975 (AR-182) demonstrated that significant mortality occurs at temperatures greater than 33.3ºC, though the precise temperature that caused mortality was not identified.

EPA has concluded that temperatures causing lethality from Klauda et al. (1991) and Normandeau's 1975 study (AR-183) should be used to establish an appropriate lethal temperature for American shad larva. Therefore, 33.3°C has been selected as the lethal temperature and a 2ºC buffer was subtracted from that value to help prevent lethality to American shad larvae that come in contact with the plant's thermal plume as they drift past the mouth of the discharge canal. The Final Permit establishes a maximum daily (acute) temperature limit of 31.3°C for the protection of American shad larvae. American shad larvae are expected to be present in Hooksett Pool from May through July. *See* AR-618 at 202. However, the acute temperature limits established for yellow perch eggs (29.3°C) from May 1 to 31 and yellow perch larvae (30.9°C) from June 1 to June 22 are more stringent than, and therefore supplant, the acute temperature limit for American shad larvae during these periods. The compliance period for the acute temperature limit of 31.3°C begins on June 22 after the yellow perch larval period and extends through July 31. The compliance point for the acute limit for larval shad is Station S4 consistent with the other temperature limits in the Final Permit.

EPA has concluded that the CWA § 316(a) variance-based, maximum daily limits in the Final Permit are protective of the BIP. As explained above, the maximum daily temperature limits, which are effective from May 1 through July 31, are designed to protect drifting organisms like yellow perch and American shad larvae from mortality. The maximum daily limit at Station S4 is set 2°C lower than the estimated upper incipient lethal temperature on which the limit is based (yellow perch or American shad) and this provides a buffer for drifting organisms as they travel the 2,000 feet from Station S0 to Station S4. However, under certain conditions (*e.g.*, in a low flow year, when ambient temperatures are high and the Facility is operating both units or just Unit 2), there could be elevated temperatures from the end of the discharge canal (Station S0) 2,000 feet downstream to Station S4 (and potentially beyond) that could possibly result in some mortality (*i.e.*, at or above the upper incipient lethal temperature) to drifting organisms. Upper incipient lethal temperatures are based on laboratory studies in which aquatic organisms acclimated to a specific temperature are exposed to high temperatures for a certain duration. The maximum daily temperature limit for thermally-sensitive larval species was derived from conservative estimates of acclimation temperature and duration of exposure. In most cases, the combination of acclimation temperature, the maximum daily limit at Station S4 (including the 2°C buffer), and the duration of exposure for a drifting organism traveling from S0 to S4 will be sufficiently protective to prevent mortality and, as a result, will reasonably assure the protection of the BIP. However, there could possibly be certain limited circumstances where drifting organisms exposed to elevated temperatures between Stations S0 and S4 could suffer mortality. In the event that the maximum daily limit is exceeded at Station S4, the Final Permit requires that the Facility take action (*e.g.*, reduce electrical generation) to reduce its thermal discharge and come back into compliance with the maximum daily limit within 3 hours of the excursion. This lag-time is necessary to allow the Facility to take action and for the consequence of that action to be measurable in the river. EPA finds that occurrence of the combination of conditions under which lethality could potentially occur will be limited and unusual under the limits of the Final Permit and considering the recent operations at the Facility. These reduced operations, together with the acute temperature limits (set at 2°C less than the lethal limit) and the requirement to take action to come into compliance within 3 hours of excursion, will minimize lethality of drifting organisms and reasonably assure the protection of the BIP.

Yellow perch juvenile and adult stages – chronic limits

LWB (AR-1300, p. 28-30) comments that a thermal limit of 25.1°C during the summer months is not necessary to protect juvenile and adult yellow perch and that this temperature has often been exceeded at Station N10 (representative of ambient conditions). *See* AR-1300 at 28-30. LWB offers that, based on the 2007 Normandeau temperature data, the maximum daily average temperature at Station N10 equaled or exceeded 25.1°C on 10 dates in June and every date in July and August. *See* AR-1300 at 28-29. As PSNH points out, however, this data point demonstrates only that the average daily temperature reached or exceeded 25.1°C in one of the 21 years of the dataset (from 1984 through 2004), and does not demonstrate that this value was reached "on consecutive days in every year or even consecutively on any given days in any single year during this 21-year period." As PSNH also explained, "the individual-day data tables in Appendix A do not offer any analyses with respect to the duration specific temperatures occurred on any given day, much less whether such durations spanned multiple days." AR-846 at 43. That ambient daily mean temperatures reached or exceeded 25.1°C on a single date over 21 years is not a persuasive basis for arguing that a less stringent temperature would be protective of adult yellow perch. The average daily mean temperature at Station N10 over the period from 1984 through 2004 (AR-3) never reached 25.1°C in June, July, or August (AR-3, Appendix A) and reached 25.1°C on only a single day (August 4) over the period from 2002 through 2015 (AR-1299).

Based on this comment, EPA reviewed the observed daily mean ambient temperatures from 2004 to 2018 (AR-1715). This data set is more refined than a summary of average data over many years and provides additional information on changes between months and years. Ambient conditions in Hooksett Pool remained below 25.1ºC for the month of June; however, the daily mean temperature at Station N10 exceeded 25.1ºC during July and August in all but two years between 2004 and 2018 (in 2014 and 2017). In four of those years, the ambient temperature was higher than 25.1°C more than 40% of the time during July and August and ambient temperatures remained above 25.1°C for more than one week. In 2010, ambient temperatures exceeded 25.1°C on 44 days, with the longest duration lasting 28 consecutive days. In 2011, the mean daily temperature at Station N10 exceeded 25.1°C for 30 consecutive days. Temperatures at this station are recorded approximately one foot beneath the surface but data collected in Hooksett Pool during electrofish sampling in 2004 and 2005 demonstrated relatively uniform water temperatures throughout the water column in ambient sections of the pool. *See* AR-3, Appendix B-1.

EPA calculated an upper limiting temperature for adult yellow perch of 25.1°C using the Gold Book method, an upper incipient lethal temperature of 32.2°C[24], and a physiological optimum temperature of 21.5°C (calculated as the mid-point of the reported range of optimal temperatures from 19°C to 24°C). See AR-618 at 194-95. LWB comments that Hokanson (AR-59, p. 1544) identified 25.1ºC as the physiological optimum for yellow perch. According to Hokanson (AR-59, p. 1535), however, laboratory studies used to derive the physiological optimum were typically based on *juvenile* perch, which is the most thermally tolerant life stage. *See* AR-618, pg. 192. The physiological optimum temperature used to derive the upper limiting temperature in the Draft Determination was the midpoint of the optimum temperature range for *adult* yellow perch identified in Krieger at al. (1983). See AR-63. The most recent daily temperature data suggests that typical summer temperatures in Hooksett Pool may exceed temperatures that EPA calculated as protective of adult yellow perch even in sections of the river not affected by the plant's thermal discharge. Yellow perch inhabit Hooksett Pool even with summer temperatures exceeding 25.1°C and EPA has decided it is not reasonable to establish a temperature limit that

[24] The 2011 Thermal Toxicity Literature Evaluation, submitted with EPRI's comments on the 2017 Statement, also recommended an upper incipient lethal temperature of 32.3°C, consistent with the value used in the 2011 Draft Determinations Document. See AR-1596 at 3-6.

cannot be met even under natural conditions. Therefore, the Final Permit establishes an additional limitation that requires the weekly average temperature at Station S4 to be no more than 2°C above the weekly average ambient temperature in the event that the ambient temperature is more than, or within 2°C from, the effective weekly average temperature limit. This provision provides the Permittee with flexibility to meet the effective permit limits when ambient temperatures in the river may reach or exceed 25.1°C under natural conditions and addresses LWB's comments that the upper limiting temperature for adult yellow perch in the Merrimack River may be higher than 25.1°C.

LWB, pointing to Figure 9 of Hokanson (1977), AR-59, comments that yellow perch are found in a wide range of temperature between 15°C and 30°C and indicates that 50% of yellow perch populations inhabit environments warmer than the daily average temperature (over 21 years) at Station N10. *See* AR-1300 at 29. Further, LWB comments that 5% of yellow perch populations inhabit environments warmer than the average daily temperature at Station S4.
Hokanson's Figure 9 (AR-59) describes the range of seasonal temperature limits for adaptation of yellow perch among 35 stations in the southern part of the native range of this species, primarily from the upper Mississippi River drainage and Atlantic coastal streams from Maine to North Carolina. *See* AR-59 at 1541. Many of the stations in the dataset were located south of Hooksett Pool where perch are likely acclimated to higher temperatures and resulting in a higher overall "seasonal temperature envelope." As Hokanson states, "fish stocks control their acclimatization temperature and optimize their physiological performance along a finite temperature gradient of each habitat." AR-59 at 1544. Yellow perch in Hooksett Pool are adapted to the natural conditions in the waterbody, whether or not there are populations of yellow perch that tolerate higher temperatures in other waterbodies. The intent of the temperature limits in the Final Permit are to ensure that ambient temperatures throughout Hooksett Pool are protective of yellow perch and that the thermal discharge from the Station does not limit access to habitat in the lower Hooksett Pool at certain times of year. As explained in the 2011 Draft Determinations Document, fisheries data from 2004 and 2005 suggested that "[a]dult yellow perch largely abandon the southern portion of Hooksett Pool during summer conditions. This suggests that adult yellow perch are being effectively precluded from habitat downstream of the discharge canal in summer." AR-618 at 194. While yellow perch abundance continues to be low in the section of Hooksett Pool downstream of the Station, based on data collected in 2012 and 2013 (*See* AR-1551 p. 16 and 19), total abundance in Hooksett Pool increased such that long term trends analysis no longer detects a significant decrease in abundance for yellow perch (*See* AR-1551, p. 35). The average weekly temperature limit of 25.1°C and option of complying with the rise in temperature limit if ambient temperatures exceed 25.1°C will protect yellow perch adults in the Hooksett Pool by maintaining ambient conditions.[25]

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[25] Barnthouse comments that the range of temperatures reported as being optimal for American shad is broad, owing to the wide geographic range of this species. By using the mid-point of this optimal range to calculate a long-term, protective temperature of 26°C for American shad larvae, Barnthouse argues that the Permittee could be in violation of permit limits even when the observed temperature is within the range of optimal temperatures. *See* AR-1300 at 31. Barnthouse comments that Greene et al. (AR-56) lists three studies where 26°C was within the range identified as either optimal or suitable for American shad larvae. Indeed, Greene et al. reviewed one study with an upper optimal temperature of 26.5°C; the second observed an upper optimal temperature of 25°C. Three additional studies listed as having ranges "suitable" for shad larvae all include an upper temperature of 26.2°C up to 30°C. However,

Yellow Perch juvenile and adult stages – acute limits

LWB comments that a short-term temperature limit intended to protect juvenile yellow perch from acute lethality is not necessary because conditions that could cause such fish kills are not present in the vicinity of the Merrimack Station discharge. *See* AR-1300 at 29; AR-59 at 1544. LWB similarly comments that no short-term temperature limit is necessary to protect juvenile American shad because this life stage is capable of avoiding the thermal plume. *See* AR-1300 at 32; AR-68. EPA agrees that fish kills from heat are relatively infrequent, likely to occur only when escapement to cooler water is blocked and have not been documented to have occurred at Merrimack Station. In addition, the operational changes at the Station result in a thermal plume that is limited in duration, which allows river temperatures to return to ambient levels more rapidly. The observed daily Station S4 temperatures representative of recent operations at the plant indicate that temperatures at this location and downstream will not cause mortality of juvenile fish. A review of the recent daily temperature data indicates that the mean daily temperature at Station S4 exceeded 30.9°C between August 1 and September 30 as much as 20-30% of the time prior to 2012, but has not been exceeded once since 2012. *See* AR-1715. The maximum daily temperature at Station S4 exceeded 30.9°C in August and September nearly every year between 2004 and 2011 but has been exceeded in just two years since. *See id*. Finally, juveniles are mobile and can avoid the thermal plume either by remaining in cooler areas of the Hooksett Pool for the relatively short periods when the plume is present or by staying at depth beneath the relatively shallow, surface-oriented plume. Therefore, the Final Permit does not establish an acute temperature limit for juvenile yellow perch or American shad in August or September.

3.4.8 Climate Warming Impacts

Comment II.3.4.8	AR-851, CLF, pp. 29-30

Several studies have been done on the potential effects of climate warming on fish thermal habitat in streams, and they have recognized the potential for global warming to change the streams' thermal regimes.[159] For cold and cool water species, like many of the indigenous species in the Hooksett Pool, rising temperatures due to global warming will have the effect of reducing available habitat. One study, conducted by researchers from the University of Minnesota, predicted an eleven to twenty-two percent decrease in streams thermally suitable for cool water

this review also observed that "water temperatures above 27ºC are capable of causing abnormalities or a total cessation of larval American shad development" and "[f]ew larvae have been found living in temperatures above 28°C. AR-56 at 20. While EPA might have considered adjusting the long-term protective temperature for American shad larvae upwards by a few tenths of a degree (but still less than 27°C), any limit for this species and life stage is superseded by the long-term limits for yellow perch during the period when larval shad would be expected to be present in Hooksett Pool. The biologically relevant period for American shad larvae is from May 1 through July 31. The Final Permit establishes long-term (chronic), average weekly temperature limits for yellow perch eggs (18°C), larvae (22.7°C), and adults (25.1°C) during the entire period for American shad larvae that are more stringent than the proposed protective limit for American shad. For this reason, there are no chronic (average weekly) temperature limits established for American shad in the Final Permit.

fishes.[160] Not only will suitable habitat decrease for cool water fishes, rising stream temperatures will make the habitat more suitable for warm water fishes such as large mouth bass, which then compete with cool water fish such as yellow perch for available forage.

Rising temperatures, winter snowpack declines, increased frequency of spring/summer droughts, and changes in stream flow patterns could lead to decreases in water supply during the summer and fall.[161] Decreases in water supply would further exacerbate the present thermal impact that Merrimack Station's discharge has on Hooksett Pool that includes:

- Significant fraction of shallow water habitat in the lower pool affected by the [thermal] plume during summer months;
- High and persistent temperatures above ambient associated with the [thermal] plume under typical summer conditions;
- [Thermal] plume's tendency to extend across the entire width of the river; [Thermal] plume's demonstrated capacity to cause water column stratification, which can contribute to low dissolved oxygen events above Hooksett Dam; and,
- Low flows in Hooksett Pool typical during summer months (i.e., July, August, September).[162]

Further, Merrimack Station's large volumes of water withdrawal would likely exacerbate the problems associated with more frequent spring and summer droughts causing lower water levels. EPA found that "water withdrawal at a rate significant enough to cause water from the discharge canal to flow upstream clearly has the potential to affect the Hooksett Pool environment. ... Merrimack Station's current operations typically redirect up to 62 percent of the available flow under low-flow conditions. EPA regards this to be a large fraction of the available river flow."[163] If ambient river temperatures rise as a result of climate warming, Merrimack Station's thermal discharge limits will need to be adjusted downward to assure the protection and propagation of the BIP, especially cool water fish. EPA should take this into consideration in determining if its current protective fish temperatures will be protective enough under shifting thermal regimes.

[159] See, e.g., AR 735, Omid Mohseni, et al., Global Warming and Potential Changes in Fish Habitat in U.S. Streams, 59 Climatic Change 389-409 (2003).
[160] *Id*. at 398.
[161] Confronting Climate Change in the U.S. Northeast Science, Impacts, and Solutions report by Northeast Climate Impacts Assessment Synthesis Team, 63 (2007), http://www.climatechoices.org/assets/documents/climatechoices/confronting-climate-change-in-the-u-snortheast.pdf.
[162] Attachment D at 39.
[163] *Id*. at 38.

EPA Response:

The comment recommends that, when determining if current protective fish temperatures will be protective enough under shifting thermal regimes, EPA consider that thermal discharge limits may need to become more stringent to assure the protection and propagation of the BIP if ambient river temperatures rise as a result of climate warming. While EPA cannot anticipate the precise effects of rising temperatures on the Merrimack River, if ambient temperatures increase as the comment predicts, these changes will likely favor species with a greater tolerance to heat. Incremental changes would be expected to occur over long periods, and it is not known if and when changes will become apparent in Hooksett Pool. In addition, the effect of rising temperatures even on warmwater species is uncertain given that the effects may be cumulative (e.g., the combined effect of rising temperatures and changes in competition with other warmwater species). For example, the abundance of largemouth bass (a warmwater species) in Hooksett Pool has been relatively stable since the 1970s, but abundance of pumpkinseed, the most abundant warmwater species in Hooksett Pool during the 1970s, has declined. *See* AR-618 p. 59-61. Competition with bluegill, an introduced species first observed around 1995, may have contributed to the decline in pumpkinseed. This species is a direct competitor for spawning habitat and is more heat tolerant than pumpkinseed. *See id*. The §316(a) variance-based temperature limits in the Final Permit are sufficiently stringent to assure the protection of the BIP including the most thermally sensitive resident and migratory species and life stages. The Final Permit also requires continuous temperature monitoring and additional biological monitoring to ensure that the temperature limits are met and that the BIP continues to be protected, including under shifting thermal regimes. EPA will re-assess the § 316(a) variance for each permit renewal and, as appropriate, take any climate warming into account and adjust the temperature limits to ensure the BIP remains protected.

4.0 Status of the BIP

4.1 Standards of a CWA § 316(a) Variance

4.1.1 Studies PSNH and its Consultants Have Submitted from 1969 through 2017 Demonstrate the Absence of Appreciable Harm and Support PSNH's Request for Renewal of Its § 316(a) Variance

Comment II.4.1.1	**AR-1548, PSNH, pp. 13-21**
See also AR-1552, Normandeau, pp. 2-3; AR-872, Normandeau, pp. 8-10; AR-1577, EPRI, pp. 3-3 to 3-8; AR-841, UWAG, pp. 67-69	

To understand the context of the new submissions—which corroborate the absence of any appreciable harm to the Hooksett Pool BIP—it is important first to briefly consider PSNH's numerous submissions to EPA in support of its permit and renewal applications. Before issuance of the 2011 Draft Permit, PSNH provided EPA with the following comprehensive studies spanning from 1969 through 2010:

- The Effects of Thermal Releases on the Ecology of the Merrimack River (Normandeau 1969);[45]
- The Effects of Thermal Releases on the Ecology of the Merrimack River - Supplemental Report No. 1 (Normandeau 1970);[46]
- Merrimack River Monitoring Program: A Report for the Study Period 1971 (Normandeau 1972);[47]
- Merrimack River Monitoring Program: A Report for the Study Period 1972 (Normandeau 1973a);[48]
- Merrimack River: Temperature and Dissolved Oxygen Studies 1972 (Normandeau 1973b);[49]
- Merrimack River Monitoring Program: A Report for the Study Period 1973 (Normandeau 1974);[50]
- Merrimack River Monitoring Program 1974 (Normandeau 1975a);[51]
- Merrimack River Ecological Studies: Impacts Noted to Date; Current Status and Future Goals of Anadromous Fish Restoration Efforts; and Possible Interactions Between Merrimack Station and Anadromous Fishes (Normandeau 1975b);[52]
- Merrimack River Monitoring Program 1975 (Normandeau 1976a);[53]
- Merrimack River Anadromous Fisheries Investigations: Annual Report for 1976 (Normandeau 1976b);[54]
- Further Assessment of the Effectiveness of an Oil Containment Boom in Confining the Merrimack Generating Station Discharge to the West Bank of the River (Normandeau 1976c);[55]
- Merrimack River Monitoring Program 1976 (Normandeau 1977a);[56]
- Final Report: Merrimack River Anadromous Fisheries Investigations 1975-1976 (Normandeau 1977b);[57]
- Merrimack River Thermal Dilution Study 1978 (Normandeau 1978);[58]
- Merrimack River Monitoring Program 1978 (Normandeau 1979a);[59]
- Merrimack River Monitoring Program: Summary Report (Normandeau 1979b);[60]
- Merrimack River Anadromous Fisheries Investigation 1978 (Normandeau 1979c);[61]
- Phase I Preliminary Report – Information Available Related to Effects of Thermal Discharge at Merrimack Station on Anadromous and Indigenous Fish of the Merrimack River (Stetson-Harza 1993);[62]

- Merrimack Station: Thermal Discharge Modeling Study (Normandeau 1996);[63]
- Merrimack Station (Bow) Fisheries Study (Normandeau 1997);[64]
- Merrimack Station Thermal Discharge Effects on Downstream Salmon Smolt Migration (Normandeau 2006a);[65]
- Merrimack Station Fisheries Survey Analysis of 1967 through 2005 Catch and Habitat Data (Normandeau 2007a);[66]
- Entrainment and Impingement Studies Performed at Merrimack Generating Station from June 2005 through June 2007 (Normandeau 2007b);[67]
- A Probabilistic Thermal Model of the Merrimack River Downstream of Merrimack Station (Normandeau 2007c);[68]
- Biocharacteristics of Yellow Perch and White Sucker Populations in Hooksett Pool of the Merrimack River (Normandeau 2009a);[69]
- Biological Performance of Intake Screen Alternatives to Reduce Annual Impingement Mortality and Entrainment at Merrimack Station (Normandeau 2009b); and
- Modeling the Thermal Plume in the Merrimack River from the Merrimack Station Discharge (ASA 2010)[71].

In 2012, in addition to PSNH's own comments concerning the 2011 Draft Permit, Normandeau Associates, Inc. ("Normandeau") submitted extensive Comments on the Draft Permit demonstrating the absence of appreciable harm to the BIP of Hooksett Pool and identifying numerous errors in EPA's § 316(a) determination.[72] Also, as part of PSNH's Comments to the 2011 Draft Permit, PSNH submitted the following reports and analyses related to the fish and macroinvertebrate communities and water quality of the Hooksett Pool substantiating this conclusion, including:

- Merrimack Station Fisheries Survey Analysis of the 1972-2011 Catch Data (Normandeau 2011a);[73]
- Historic Water Quality and Selected Biological Conditions of the Upper Merrimack River, New Hampshire (Normandeau 2011b);[74]
- Changes in the Composition of the Fish Aggregation in Black Rock Pool in the Vicinity of Cromby Generating Station from 1970 to 2007 (Normandeau 2011c);[75]
- Quantification of the Physical Habitat within Garvins, Hooksett, and Amoskeag Pools of the Merrimack River (Normandeau 2011d);[76] and
- Comparison of Benthic Macroinvertebrate Data Collected from the Merrimack River near Merrimack Station (Normandeau 2012a).[77]

As explained in PSNH's 2012 Comments, these studies demonstrate through multiple, different methods that Hooksett Pool is a BIP and the thermal discharge of Merrimack Station has not caused appreciable harm.[78] They include a comparison of fish species in Hooksett Pool for an over forty year period, an analysis of the biocharacteristics of fish species in Hooksett, Garvins, and Amoskoeg Pools, and examination of the benthic macroinvertebrate communities in Hooksett and Garvins Pools. These studies were performed consistent with EPA's own guidance[79] and often at the direction and under the oversight of EPA, New Hampshire Department of Environmental Services ("NHDES"), the Federal Energy Regulatory Commission, the U.S. Fish and Wildlife Service, the New Hampshire Department of Fish and Game, and the Merrimack Station Technical Advisory Committee ("TAC").[80] These studies demonstrate the current aquatic community in the Hooksett Pool meets all the characteristics of a BIP—namely, Hooksett Pool is characterized by (1) diversity at all trophic levels, (2) the capacity to sustain itself through cyclic seasonal changes, (3) the presence of necessary food chain species, and (4) non-domination by pollution-tolerant species.[81] Further, PSNH has met its burden of showing the operation of Merrimack Station has not caused appreciable harm to the Hooksett Pool BIP.[82]

After submitting its 2012 Comments, PSNH continued its analyses and supplied additional technical documentation and temperature data supporting its § 316(a) variance request, including the following:

- Letter from Linda T. Landis to Mr. Eric P. Nelson dated February 29, 2016 re: Response to November 30, 2015 EPA Region 1 CWA Section 308 Information Request Merrimack Station Temperature Data (including more recent and more detailed temperature data from 2002 through 2015, including the period after PSNH's completion of the Clean Air Project that is more representative of current plant operations);[83]
- Review of technical documents related to NPDES Permitting Determinations for the Thermal Discharge and Cooling Water Intake Structures at Merrimack Station, Lawrence W. Barnthouse, Ph. D., LWB Environmental Services, Inc. (LWB Feb. 2016);[84]
- Response to USEPA CWA § 308 Letter by Enercon and Normandeau (Enercon/Normandeau Feb. 2016);[85]
- CORMIX Thermal Plume Modeling Technical Report, PSNH Merrimack Station Units 1 & 2 Bow, New Hampshire, Enercon Services, Inc. (Dec. 2016);[86]
- Influence of Merrimack Station's Thermal Plume on Habitat Utilization by Fish Species Present in Lower Hooksett Pool, Lawrence W. Barnthouse, Ph. D., LWB Environmental Services, Inc. (Dec. 2016).[87]

These submissions included analyses from Dr. Lawrence W. Barnthouse, a highly regarded scientist with a wealth of experience in § 316(a) matters. Dr. Barnthouse reviewed EPA's § 316 determination as well as the extensive reports and analyses prepared by Enercon and Normandeau.[88] After identifying several flaws underlying EPA's § 316(a) determination that Dr. Barnthouse found invalidated its conclusions, Dr. Barnthouse determined that "operation of Merrimack Station has caused no appreciable harm to the BIP present in the Hooksett Pool."[89] Enercon and Normandeau also provided a comprehensive analysis of the detailed temperature data supplied by PSNH for the period 2002 through 2015. When comparing the average monthly mean temperatures between the 1984 through 2001 and 2002 through 2015 periods, the 2002 through 2015 data set (the period more representative of current plant operations) yielded "equivalent or lower downstream temperatures."[90]

PSNH's December 2016 submission included expert analysis of the relevant temperature data of Merrimack Station's thermal effluent, including CORMIX thermal plume modeling that calculated average plume characteristics over the period 2006-2015 for three representative time periods: early spring (May 2 – May 8), late spring (June 9 – June 15), and mid-summer (July 29-August 4).[91] Based on this analysis, in none of the cases examined would the thermal plume from Merrimack Station affect more than a negligible fraction of the fish habitat present downriver from the cooling water discharge.[92]

Now, with these comments, PSNH is submitting additional support for its § 316(a) variance request and in specific response to EPA's Statement, including the following:

- Normandeau Associates, Inc., 2012-2013 Data Supplement to the Merrimack Station Fisheries Survey Analysis of 1972-2011 Catch Data (Dec. 2017) ("Normandeau 2017a");[93]
- Normandeau Associates, Inc., Response to EPA's "Statement of Substantial New Questions and Possible New Conditions" (Nov. 2017) ("Normandeau 2017 Response");[94]
- Lawrence W. Barnthouse, Ph. D., LWB Environmental Services, Inc., Analysis of Merrimack Station Fisheries Survey Data for 2010-2013 (Dec. 2017) ("LWB 2017 Analysis");[95]
- Lawrence W. Barnthouse, Ph. D., LWB Environmental Services, Inc., Response to EPA's "Statement of Substantial New Questions for Public Comment" (Dec. 2017) ("LWB 2017 Response");[96]
- Enercon Services, Inc., Response to Environmental Protection Agency's Statement of Substantial New Questions for Public Comment (Dec. 2017) ("Enercon 2017 Comments");[97]
- Dr. Terry Richardson, AST Environmental, The Asian clam (Corbicula Fluminea) and its relationship to the balanced indigenous population ("BIP") in Hooksett Pool, Merrimack River, New Hampshire (Nov. 2017) ("AST Report");[98] and
- Dr. Robert F. McMahon, Review of the Asian clam (Corbicula Fluminea) and its relationship to the balanced indigenous population ("BIP") in Hooksett Pool, Merrimack River, New Hampshire (Dec. 2017) ("McMahon Review").[99]

Collectively, through decades of study and analysis, PSNH has submitted a comprehensive and scientific history of the Merrimack River and biota in the vicinity of Merrimack Station that conclusively demonstrates that Merrimack Station's thermal discharge has not caused prior appreciable harm to the fish or invertebrate communities or their representative populations. PSNH has satisfied its burden for renewal of its thermal variance. EPA has failed to meet its burden to "convincingly negate[] by outside evidence" PSNH's satisfaction of its § 316(a) burden.[100] Instead, contrary to Region 1's own previously stated practice,[101] EPA denied continuation of the 316(a) variance and proposed a permit that would require construction and installation of a cooling tower that cannot be economically justified by any rational cost-benefit analysis. This draconian requirement is based on speculation and error pointed out by PSNH and Normandeau in their 2012 Comments and attachments.[102] This error is further confirmed by the new data and analyses submitted by PSNH since 2012 and with these Comments—the Merrimack Station thermal discharge has not caused appreciable harm to the BIP of Hooksett Pool.

[44] *See, e.g., Wabash*, 1 E.A.D. at *7 (some level of harm to individual species is acceptable where community as whole remains relatively stable); *Brayton Point I*, 12 E.A.D. at 574 n.138, 139 (upholding EPA Region 1's analysis, which accommodates adverse effects but not to the extent that they would interfere with protection and propagation of BIP).

[45] AR-181.

[46] AR-285.

[47] AR-1141.

[48] AR-1150.

[49] AR-1149.

[50] AR-1148.

[51] AR-1147.

[52] AR-1146.

[53] AR-1145.

[54] AR-1155.

[55] AR-1151.

[56] AR-1159.

[57] AR-1156.

[58] AR-1184.

[59] AR-198.

[60] AR-364.

[61] AR-1203.

[62] AR-191.

[63] AR-184.

[64] AR-201.

[65] AR-7.

[66] AR-11.

[67] AR-2.

[68] AR-10.

[69] AR-12.

[70] AR-246.

[71] AR-99.

[72] AR-872.

[73] AR-1153.

[74] AR-1172.

[75] AR-1171.

[76] AR-1173.

[77] AR-1174. The majority of these reports focus on the Merrimack River fish community, in accordance with the well-established biological assessment approach of using fish assemblages as indicators of overall ecological condition. EPA's own technical framework document for the development and implementation of large river bioassessment programs describes the many advantages of using fish assemblages as a direct measure of biological condition relative to biological integrity, noting that fish are relatively long-lived, mobile, feed at every trophic level (*e.g.*, herbivores, omnivores, and predators), and can be relatively easy to identify to species. *See, e.g.,* AR-1164 at 3-4.

[78] *See* AR-846 at 7-60.

[79] *See* AR-1195 at 46-62.

[80] The TAC is the group of fish and ecosystem experts from various federal and state agencies established under the current NPDES permit to advise EPA and NHDES.

[81] *See* AR-846 at 17-34; 40 C.F.R. §125.71(c).

[82] *See* AR-846 at 36-59.

[83] *See* AR-1299 through 1307.

[84] AR-1300.

[85] AR-1305.

[86] AR-1352, Attachment 2.

[87] *Id.*, Attachment 3.

[88] *See* AR-1300.

[89] *Id.* at 44.

[90] AR-1305 at 3.

[91] *See* AR-1352, Attachment 3.

[92] AR-1352, Attachment 3 at i ("The survey data show that Merrimack Station's thermal discharge has had no measurable impacts on the fish community in the Hooksett Pool."). PSNH adopts and incorporates these February 2016 and December 2016 submissions as part of these comments as if fully set forth herein.

[93] This report is attached hereto as Exhibit 3.

[94] This report is attached hereto as Exhibit 4.

[95] This report is attached hereto as Exhibit 5.

[96] This report is attached hereto as Exhibit 6.

[97] This report is attached as Exhibit 1.

[98] This report is attached hereto as Exhibit 7.

[99] This report is attached hereto as Exhibit 8.

[100] *See* AR-1180 at 17.

[101] *See, e.g.*, U.S. EPA Region 1, Clean Water Act NPDES Permitting Decisions for Thermal Discharge and Cooling Water Intake from Kendall Station in Cambridge, MA, 316(a) and (b) Determination Document (June 8, 2004)

("Mirant Kendall Determination"), at 34-35 (question under § 316(a) is what informed scientific judgment would be without speculation about evidence not in record). This document is attached hereto as Exhibit 9.

EPA Response:

PSNH's comment largely serves as a list of the numerous studies, reports, and assessments submitted to EPA in support of its request for a CWA § 316(a) variance prior to the 2011 Draft Permit, during the public comment period for the Draft Permit, during the public comment period for the 2017 Statement, and in the interim period between 2012 and 2017. EPA has reviewed and considered each of the many submissions by PSNH and its consultants that are cited in this comment, primarily in Sections II.3, II.4, and II.5. The comment also states in conclusory fashion that its submissions (a) demonstrate that Merrimack Station's thermal discharges have not appreciably harmed the Hooksett Pool's BIP, and (b) reveal errors in EPA's analyses in support of the Agency's proposed denial of the Facility's request for renewal of its CWA § 316(a) variance. EPA disagrees. The Agency's responses to comments in this document address in detail the specific issues raised by PSNH, including issues related to the various studies and reports listed in the comment. These issues include, but are not limited to, the following: (i) alleged flaws underlying the draft § 316(a) determination invalidate its conclusions (Response to Comment II.3.1 and associated sub-comments); (ii) claims that the thermal plume from Merrimack Station affects a negligible fraction of the fish habitat present downriver from the cooling water discharge (Response to Comment II.3.3.3 and 3.3.4); (iii) arguments that the thermal discharge from Merrimack Station has not caused appreciable harm to the BIP (Response to Comment II.4.5 and associated sub-comments); and (iv) the suggestion that the current aquatic community in the Hooksett Pool meets all the characteristics of a BIP (Response to Comment II.4.2, 4.3, and associated sub-comments).

While PSNH concludes that EPA's denial of the requested § 316(a) variance was contrary to Region 1's own previously stated practice and that the proposed technology-based permit limits would require construction and installation of a cooling tower that cannot be economically justified by any rational cost-benefit analysis, EPA disagrees with PSNH's conclusions about EPA's analyses for the 2011 Draft Permit. At the same time, EPA also points out that it has prepared new analyses, building on the 2011 analyses, and revised the 2011 Draft Permit's thermal discharge limits to set the limits for the Final Permit. One significant reason for the changes reflected in the Final Permit's thermal discharge limits is the Facility's reduced operations and thermal discharges that are noted in the comment above.

Turning back to EPA's 2011 analysis, the Agency's denial of PSNH's proposed variance was based on a rigorous, but reasonable, analysis of the available information and a reasoned determination that the applicant's demonstration did not carry its burden to demonstrate that the requested "alternative" effluent limits would assure the protection and propagation of the Hooksett Pool's BIP. *See* AR-618, p. 39-121. EPA's analysis in the 2011 Draft Permit Determinations Document, AR 618, was not "contrary to prior practice." The comment's reference to EPA's permitting decision for Kendall Station (MA) (AR-1557) does not support the claimed inconsistency.

PSNH's comment attempts to convert *its* "burden" under CWA § 316(a) to demonstrate to the satisfaction of EPA that technology-based and water quality-based standards are more stringent than necessary to assure the protection and propagation of the BIP, *see* AR 618, p. 24, into an *EPA* burden to "convincingly negate[] by outside evidence" PSNH's conclusions. PSNH supports its attempt to shift the "burden of proof" onto EPA by citing to a 1977 Draft Guidance document by EPA, AR 1180, but this reference to the draft guidance is unavailing. First, in an August 6, 2019, memorandum, EPA's Office of Water retracted all draft guidance documents more than 2 years old that had not yet been finalized, so this draft guidance document is no longer a persuasive authority. Second, even if the draft guidance was still good authority, it states that an applicant has carried *its* burden, if "the Regional Administrator/Director concludes that the summary rationale is convincing, it is supported sufficiently by the other sections of the demonstration, and is not convincingly negated by outside evidence …," AR 1180, p. 17, but EPA did not find the summary rationale in PSNH's application to be convincing or supported sufficiently by other sections of the demonstration, and did find its claims to be convincingly negated by other information. EPA's assessment and analysis of the relevant issues is set forth in detail in the 2011 Draft Determinations Document, AR 619, Chapters 4 - 9. EPA has made adjustments to its analysis in light of public comments and new information and analysis and has presented its final conclusions here in these Responses to Comments. The Agency has well met its burden under the CWA and APA.

As to the issue of the amount of data that is needed to support a § 316(a) variance, there is no question that PSNH's demonstration was voluminous. EPA's decision to reject the variance was not based on a lack of information or any specific deficiency in the information – EPA reviewed and considered all the material cited in the comment. EPA rejected the requested variance because, after considering the body of evidence as a whole, EPA determined that Merrimack Station's thermal discharge had caused appreciable harm to the Hooksett Pool's BIP and had not shown that thermal discharge limits based on applicable technology-based and water quality-based requirements would be more stringent than necessary to assure the protection of the BIP. *See* AR-618, p. 120-121.

Finally, PSNH's argument that cooling towers "cannot be economically justified by any rational cost-benefit analysis" is not relevant in the context of CWA § 316(a) because neither the statute nor regulations make economic or technological considerations part of the decision or analytical criteria. Even with regard to setting technology-based effluent limits under the BAT standard, the courts, including the United States Supreme Court, have consistently read the statute and its legislative history to indicate that while Congress intended EPA to consider costs in setting BAT limit, it did not require the Agency to perform a cost-benefit analysis or any other type of economic balancing test when applying that standard. *See* AR-618, p. 128-130 (citing *Nat'l Crushed Stone Ass'n*, 449 U.S. at 71). Following long-standing Agency practice, EPA considered the cost of technology in its BPJ, case-by-case determination of the technology-based thermal discharge limits under BAT for Merrimack Station's Draft Permit but did not rely upon a comparative cost-benefit analysis. *See* AR-618, pp. 147-156.

4.1.2 What Is the Appropriate "Balanced Indigenous Community" for Merrimack?

Comment II.4.1.2	AR-1577, EPRI, pp. 3-8 to 3-10

Based on their analysis of temperature and biological data, EPA concluded that Merrimack's thermal discharge "…caused, or contributed to, appreciable harm to Hooksett Pool's balanced, indigenous community of fish." Their analysis is consistent with a Type III demonstration (USEPA 1974) consisting of addressing Absence of Prior Appreciable Harm (Retrospective Analysis) and the Protection of Representative Species (Predictive Assessment). EPRI's comments on each are discussed below.

A retrospective analysis is another term for the No Prior Appreciable Harm Demonstration as defined in EPA's draft Technical Guidance. Such an analysis involves comparison of the existing aquatic community in areas exposed to the thermal plume (but outside allowable mixing zone) to that expected to occur if there was no thermal discharge.

The New Hampshire water quality standards require that the discharge of waste (including heat) not *"…be inimical to aquatic life or to the maintenance of aquatic life in said receiving waters."* This appears to be similar to (albeit potentially less restrictive than) the requirement in a § 316(a) variance to assure the protection and propagation of balanced indigenous population/community. Thus, by meeting the requirements for a § 316(a) variance, the NH water quality standards are also being met.

Accordingly, EPA's regulations provide for issuance of alternative thermal effluent limitations if *"…a balanced indigenous community of shellfish, fish, and wildlife"* (not necessarily particular populations within the community) will be maintained.[3] These regulations define a balanced indigenous community as:

> *"…a biotic community typically characterized by diversity, the capacity to sustain itself through cyclic seasonal changes, presence of necessary food chain species, and non-domination of pollutant-tolerant species."*

"Indigenous" generally refers to species that would normally be found at the site, although it is not restricted to only truly native species, since managed, introduced species are often included. The meaning of the term "indigenous" was explained by Congressman Clausen during House consideration of the Conference Report on the Clean Water Act on 4 October 1972:

> *"Indigenous" shall be interpreted to mean growing or living in the body or stretch of water at the time such determination is made.*[4]

EPA has interpreted the term more restrictively, but also acknowledges that "indigenous" does not mean communities that would exist in a water body only if it were in a pristine condition. In the preamble to its proposed 316(a) rules, EPA said:

> *An "indigenous" population may contain species not historically native to the area which have resulted from major irreversible modifications to the water body (such as hydroelectric dams) or to the contiguous land area (such as deforestation attributable to urban or agricultural development) or from deliberate introduction in connection with a program of wildlife management. To*

qualify for an exemption under Section 316(a), it is therefore not necessary to show that the discharge is compatible with a population which may have existed in a pristine environment, but which has not persisted.[5]

EPA thus would make reversibility of environmental modifications the test for determining what communities should be considered "indigenous" to the area. If modifications "cannot reasonably be removed or altered," then an "indigenous" community will include resulting "species not historically native to the area."[6] On the other hand, "an altered community which has resulted from pollution that will be corrected by compliance by all sources with Section 301(b)" [i.e., effluent limitations and standards] will not be considered "indigenous."[7]

The term "balanced" derives from long-standing knowledge that most natural aquatic communities are composed of many species of organisms without an overwhelming number of any one of them. Ecologists have developed several formal indices of this community structure (e.g., indices of diversity, evenness, or richness). To be balanced, USEPA has indicated that an aquatic community must not be "dominated by pollution-tolerant species whose dominance is attributable to polluted water conditions."[8] However, species diversity at each trophic level is not required,[9] and some changes in species composition and abundance are consistent with a balanced community.

In EPRI's opinion, this definition makes it clear that the BIC is that would exist at the present time in the receiving waterbody absent the thermal discharge and, thus, reflect whatever hydraulic, chemical, habitat and other conditions exist at the time the permit is being issued. The community may include species that are introduced (either purposefully or not) provided that the occurrence of these species is not solely a result of the heated effluent.

At the Merrimack Station, the appropriate BIC would be that expected to occur in the Hooksett Pool if the Station had never been constructed but containing all other natural and manmade alternations existing at present. For existing facilities like Merrimack, the BIC is clearly a hypothetical construct. However, it appears reasonable that one could look to other areas of the River not affected by the thermal plume (but containing similar habitat and water quality). Ideally, it would be best to look at the aquatic community in the immediately upstream pool, taking into account differences between the two pools, to define the BIC. It might also be possible look at the community within the Hooksett Pool unaffected by the thermal discharge to define the BIC. However, in this case care would need to be applied to ensure that the thermal plume was not affecting motile organisms and thus, potentially affecting upstream areas as well.

In addition, a "balanced, indigenous community" appears directly analogous to "biological integrity" as included in New Hampshire's Water Quality Standards definitions:

"Biological integrity" means the ability 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 that of similar natural habitats of a region." (Env-Wq 1702.08).

This definition refers to a comparison *"…to that of similar natural habitats of a region*". This further reinforces the idea that in assessing the potential for a BIC, the comparison should be to contemporaneous community from another location with all other habitat characteristics being the same.

The Asian clam (*Corbicula fluminea*) identified in Hooksett Pool in 2011 downstream of the Station's discharge canal (see AR-870) is a nonindigenous aquatic species and not "historically native to the area". However, this species has also been recently identified upstream of the discharge canal, in one case 12 miles upstream, in addition to being confirmed in seven freshwater ponds in southern New Hampshire. Thus, a thermal discharge like Merrimack's is not a prerequisite for the Asian clam to become established and its presence in Hooksett Pool not necessarily solely the result of the Station's heated effluent. Evidence from Normandeau 2012 (see AR-870 and AR-872) and Barnthouse 2016 (see AR-1300) indicates that a BIC is present in Hooksett Pool and the biological integrity of the aquatic system is intact.

3 40 C.F.R., 125.73(a); 44 Fed. Reg. 32,952 (7 June 1979).
4 Senate Comm. On Public Works, 93rd Cong., 1st Session, 1 A Legislative History of the Water Pollution Control Act Amendments of 1972 at 264 (Comm. Print 1973).
5 39 Fed. Reg. 11,435 (28 March 1974). See also USEPA, Proposed Guidelines for Administration of the 316(a) Regulations (Draft 18 April 1974)
6 USEPA, 316(a Technical Guidance - Thermal Discharges (Draft 30 September 1974)
7 39 Fed. Reg. 36,178 (8 October 1974)
8 39 Fed. Reg. 11,435 (28 March 1974). See also 40 C.F.R. 125.71(c), 44 Fed. Reg. 32,951-52 (7 June 1979).
9 See 39 Fed. Reg. 36,178 (8 October 1974), explaining that USEPA's final 316(a) regulations were modified from the proposed regulations "to delete the suggestion that diversity must be present at all trophic levels."

EPA Response:

EPRI's comment above summarizes its understanding of the definition of "balanced, indigenous population" (BIP) under CWA § 316(a) and its relationship to other similar terms under New Hampshire water quality standards. EPA discussed these issues in the 2011 Draft Determinations Document and maintains the views expressed there. *See* AR-618 pp. 18-23, 174-78, 216-17. EPA also points to its detailed responses to other, similar comments regarding the meaning of the term "balanced, indigenous population" under CWA § 316(a) and similar terms under state water quality standards. *See also, e.g.,* Response to Comment II.1.0 (and associated sub-comments).

EPA agrees with EPRI that New Hampshire's water quality standards contain narrative criteria related to controlling the effects of thermal discharges and protecting aquatic life that have similarities to the standard under CWA § 316(a).[26] Again, EPA discussed this in the 2011 Draft Determinations Document. *See* AR 618, pp. 174-78, 216-17.

[26] EPA notes that that EPRI suggests that the New Hampshire water quality criterion barring discharges of waste – which include waste heat – "inimical" to aquatic life is similar to, but "potentially less restrictive than," CWA § 316(a)'s standard for protecting a receiving water's BIP. EPA agrees that there are similarities between the two standards but also notes that the New Hampshire standard could potentially be even more stringent than the CWA § 316(a) standard and that, ultimately, EPA would look to New Hampshire if a definitive interpretation is needed. EPA also notes that other New Hampshire water quality criteria directed at maintaining the biological integrity of

EPRI also offers its views about how to characterize the appropriate BIP for Hooksett Pool under CWA § 316(a). The comment cites remarks by Representative Clausen from the legislative history of the CWA seem to support the idea that *whatever* community of organisms is living in the receiving water at the time a CWA § 316(a) variance application is being evaluated can be considered the "indigenous" community for the receiving water. EPA does not agree with that suggestion – and Representative Clausen may not have meant that – and the commenter correctly notes that EPA has not interpreted the term "indigenous" that way under CWA § 316(a). EPA's interpretation is evident in its regulations, *see* 40 CFR § 125.71(c), and past decisions and is consistent with the discussion in the Conference Committee report related to the enactment of CWA § 316(a), as discussed in the 2011 Draft Determinations Document. AR 618, pp. 18-23.[27] EPRI further states its opinion that under CWA § 316(a), the BIP is the community of organisms that would exist at the present time in the receiving waterbody *absent the thermal discharge* and may reflect the hydraulic, chemical, habitat and other conditions that exist at the time the permit is being issued. EPRI continues that the community may include species that are introduced (either purposefully or not) provided that the occurrence of these species is not solely a result of the heated effluent. EPA agrees with some aspects of this comment and again notes that it discussed how it defines the BIP in the 2011 Draft Determinations Document and it continues to hold the views expressed there. *See* AR 618, pp. 18-23. EPA again notes that the contours of a BIP under CWA § 316(a) are addressed in the definition of "balanced indigenous community" in 40 CFR § 125.71(c).

Consistent with the comment, EPA recognizes that the BIP can under some circumstances include introduced species. *See* AR-618, p. 20. EPRI comments that the Asian clam (*Corbicula fluminea*) has been identified in Hooksett Pool downstream of the Station's discharge canal, in one case 12 miles upstream of the discharge canal, and in seven freshwater ponds in southern New Hampshire. See AR-870. EPRI also states that, because this species has been identified in areas absent a thermal discharge, the heated effluent is "not a prerequisite for the Asian clam to become established" and its presence in Hooksett Pool not necessarily solely the result of the Station's heated effluent. EPRI does not explain if it thinks Asian clam should be included in the

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aquatic habitats also express requirements similar to the standard under CWA § 316(a). EPA discussed these in the 2011 Draft Determinations Document. *See* AR 618, pp. 175-76.

[27] The comment recognizes that CWA § 316(a) and EPA regulations allow for alternative thermal discharge limits if the balanced, indigenous community of organisms in the receiving water can be maintained, but the commenter emphasizes that this does "not necessarily [require that] particular populations within the community … be maintained." The intent of this comment is ambiguous, but EPA has considered it and responds here. While the Agency has clearly stated that CWA § 316(a) does not bar alternative limits that would cause *any* thermally-induced effects or mortality to individual organisms, it is difficult to see how under EPA regulations, 33 U.S.C. § 125.71(c), alternative limits would satisfy CWA § 316(a) despite *eradicating* a species that is part of the preexisting BIP. Indeed, the comment goes on to suggest that EPA's regulatory definition of BIC (which is synonymous with BIP), *see* 40 C.F.R. § 125.71(c), "makes it clear that the BIC is that would exist at the present time in the receiving waterbody absent the thermal discharge." Under that reading, alternative thermal limits could not wipe out a species and still satisfy CWA § 316(a). Perhaps the commenter only meant that CWA § 316(a) would not preclude alternative thermal discharge limits that caused some shift in relative abundance among species that made up the community preexisting the alternative limits. EPA agrees that this could possibly be so in a particular case but each CWA § 316(a) variance calls for careful case-by-case analysis and weighing of the effects to determine if the statutory standard is met. *See* AR 618, pp. 20-21.

BIP or not, but its statement that the presence of this invasive species is not solely the result of the discharge may indicate that the commenter thinks that it would not be excluded from the BIP. EPA notes, however, that under 40 CFR § 125.71(c), it is not just a matter of whether an organism could exist even without the alternative thermal discharge limits, it is also a question of whether the abundance of that species is promoted by the alternative limits. *See id.* (a BIC/BIP will exhibit "a lack of domination by pollution tolerant species," and "may not include species whose presence or abundance is attributable to alternative effluent limitations imposed pursuant to section 316(a)").

In any event, EPA does not think that Asian clam should properly be considered part of the BIP. New Hampshire regulations make it illegal to import, possess or release Asian clams in the state (Administrative rules NHFG FIS 803.04, NHFG FIS 804.03, NHFG FIS 805.01). In 2012, NHDES issued an Environmental Fact Sheet: Asian Clams in New Hampshire describing how to control or eradicate the spread of this species and how large populations of Asian clams can severely alter lake or riverine food webs by "directly competing with existing native fish and shellfish species for food and space." AR-1408. If true, this kind of impact clearly has the potential to adversely alter the BIP of Hooksett Pool. Because New Hampshire Fish and Game classifies Asian clam as an invasive species whose spread must be controlled or eradicated, and because populations of Asian clams have been observed to directly compete with, and potentially impact, native fish and shellfish, EPA does not consider this species part of the BIP for Hooksett Pool. Further analysis will be needed as to whether the presence or abundance of Asian clams in Hooksett Pool would be attributable to the Final Permit's thermal discharge limits set under a CWA § 316(a) variance and which reflect the Facility's reduced operations and thermal discharges in recent years and going forward.

The comment concludes that evidence from Normandeau 2012 (AR-870 and AR-872) and LWB 2016 (see AR-1300) indicate that a BIC is present in Hooksett Pool, the biological integrity of Hooksett Pool is intact, and the community within the Pool can be considered the BIP. EPRI comments that one could look to areas of the river not affected by the thermal plume and offers that another reference point could be the community upstream from the effluent or the community within areas of the Pool unaffected by this discharge. In light of comments and supporting documents received since the 2011 Draft Permit, EPA has made some adjustments to the reference points it has used to evaluate effects on the BIP and now considers that the proper BIP for evaluating Merrimack Station's § 316(a) variance request is best reflected in the following three communities: (1) the Hooksett Pool biotic community of the 1970s; (2) the current Garvins Pool fish community, and (3) the benthic invertebrate community in the ambient section of Hooksett Pool. Looking at both changes in historical trends and comparisons with an adjacent fish community not influenced by a thermal discharge provides a comprehensive approach for EPA's evaluation of the fish community.

4.1.3 What are the Appropriate Criteria to be used in Assessing Community Balance at Merrimack?

Comment II.4.1.3	**AR-1577, EPRI, pp. 3-11 to 3-13**

To demonstrate that a balanced indigenous community exists necessitates a case-by-case evaluation in the context of the waterbody and its biota. According to USEPA (1977), the following are evidence of community imbalance:

- Blocking or reversing short or long-term successional trends of community development.
- A flourishing of heat-tolerant species and an ensuing replacement of other species characteristic of the indigenous community.
- Simplification of the community and the resulting loss of stability.[10]

If a community is stable, not dominated by heat-tolerant species, and follows normal development patterns, it is balanced. In summary, a balanced, indigenous population (or community) is a stable, normally functioning community that is not dominated by heat-tolerant species and is consistent with the reasonably permanent environmental conditions of the water body, given potential water quality improvement.

Further, the legislative history of § 316(a) and the subsequent judicial and administrative decisions applying it make clear that the performance standard – the protection and propagation of a balanced, indigenous community – is not a complete lack of effects on that community. Some effects of added heat are to be expected. For example, EPA has recognized that "*[e]very thermal discharge will have some impact on the biological community of the receiving water,*" and therefore that "*[t]he issue is the magnitude of the impact and its significance in terms of the short-term and long-term stability and productivity of the biological community affected.*"[11] In general, EPA has determined that a community need not be protected from mere disturbance, but that communities will be adequately protected if "appreciable harm" is avoided.[12][13]

According to USEPA, "appreciable harm" occurs if a thermal discharge causes such phenomena as the following:

- Substantial increase in abundance or distribution of nuisance species or heat-tolerant community not representative of the highest community development achievable in receiving waters of comparable quality.
- Substantial decrease of formerly indigenous[14] species, other than nuisance species.
- Changes in community structure to resemble a simpler successional stage than is natural for the locality and season in question.
- Unaesthetic appearance, odor, or taste of the waters.
- Elimination of an established or potential economic or recreational use of the waters.
- Reduction of the successful completion of life cycles of indigenous species, including those of migratory species.
- Substantial reduction of community heterogeneity or trophic structure.[15]

Finally, the standard of proof under § 316(a) is one of reasonable assurance, not scientific certitude, because there are seldom, if ever, cases where such certitude is achievable in the quantification of environmental effects or their significance to biological communities. USEPA has described this standard of proof as follows:

> *The study must provide reasonable assurance of protection and propagation of the indigenous community. Mathematical certainty regarding a dynamic biological situation is impossible to achieve, particularly where desirable information is not obtainable. Accordingly, the Regional Administrator (or Director) must make decisions on the basis of the best information reasonably attainable. At the same time, if he finds that the deficiencies in information are so critical as to preclude reasonable assurance, then alternative effluent limitations should be denied.*[16]

USEPA has applied the "reasonable assurance" standard in numerous decisions implementing §316(a).[17]

Again, the guidance provided by USEPA for defining lack of appreciable harm appears to be similar to that used in New Hampshire Water Quality Standards:

> *"Differences from naturally-occurring conditions shall be limited to non-detrimental differences in community structure and function. (Env-Wq 1703.19)"*

Again, implying that some changes are allowed without adversely affecting biological integrity provided that they lead to "*…non-detrimental differences in community structure and function."*

10 USEPA, 316(a)Technical Guidance - Thermal Discharges (Draft 30 September 1974) at 18-19.
11 Boston Edison Company (Pilgrim Station Units 1 and 2), NPDES Permit Determination No. MA0025135 (Decision of the Regional Administrator, 11 March 1977) at 17.
12 A draft 316(a) guidance document jointly prepared by USEPA, the Nuclear Regulatory Commission, and the U.S. Fish and Wildlife Service states: "The Regional Administrator (or Director) will find the demonstration successful if: 2. There is no convincing evidence that there will be damage to the balanced, indigenous community, or community components, resulting in such phenomena as those identified in the definition of appreciable harm." USEPA, NRC, and FWS, 316(a) Technical Guidance Manual (Draft 11 December 1975) at 100.
13 USEPA's proposed 316(a) rules suggested that "appreciable harm" would occur whenever a balanced, indigenous population was "disturbed." Proposed 40 C.F.R. 122.8(a), 39 Fed. Reg. 11,437-38 (28 March 1974). Following the public comment period, USEPA revised this aspect of the rules, saying: "Comments from representatives of diverse interests suggested that the statute requires the inquiry to focus on harm to the community rather than to species; that 'disturbance', was a more rigorous test than called for by law. The regulations being promulgated today make it clear that the demonstration is concerned with the question of prior appreciable harm to--not 'disturbance' of--the community."
14 The original meaning of this nonsensical term "formerly indigenous" may have been "formerly abundant indigenous species"
15 USEPA, 316(a) Technical Guidance - Thermal Discharges (Draft 30 September 1974) at 23 (emphasis added); USEPA, NRC, and FWS, 316(a) Technical Guidance Manual (Draft 11 December 1975) at 105 (emphasis added).
16 USEPA, 316(a) Technical Guidance - Thermal Discharges (Draft 30 September 1974) at 8.
17 Public Service Company of New Hampshire (Seabrook Station Units 1 and 2), NPDES Appeal No. 76-7 (Decision of the Administrator, 10 June 1977) at 22; Public Service Company of New Hampshire, et al., (Seabrook Station Units 1 and 2), NPDES Appeal No. 76-7 (Decision on Remand, 4 August 1978) at 22; Boston Edison Company (Pilgrim Station Units 1 and 2), NPDES Permit Determination No. MA0025135, Decision of the Regional Administrator, 11 March 1977) at 15-16; Boston Edison Company (Pilgrim Station Units 1 and 2), NPDES Appeal No. 78-7 (Initial Decision, 26 July 1978) at 4-5.

EPA Response:

In its comment, EPRI provides its opinion on the appropriate criteria for assessing the BIP and determining if appreciable harm has occurred. EPRI largely draws from prior determinations, regulations, and guidance documents from EPA or other federal agencies. EPA notes that several of these draft guidance documents, including the 1974 Draft 316(a) Technical Guidance – Thermal Discharges and the 1977 Draft Interagency 316(a) Technical Guidance Manual and Guide for Thermal Effects Sections of Nuclear Facilities Environmental Impact Statements – have been rescinded by EPA's Office of Water. *See* Memorandum from David Ross, EPA Assistant Adm'r (Aug. 6, 2019) (AR-1739). EPA explained in the 2011 Draft Determinations Document what the appropriate criteria are for assessing the BIP and the standards for determining if appreciable harm has occurred. See AR-618, pp. 16-39. EPRI offers no comments on EPA's assessment of this issue nor does the comment request any changes to the Draft Permit. EPA discusses the BIP and evaluation of appreciable harm in the context of this permitting decision in response to detailed comments below. The commenter also points to similarities between the standard under CWA § 316(a) and certain provisions from New Hampshire's water quality standards. EPA discussed New Hampshire water quality criteria geared to protecting aquatic life in the 2011 Draft Determinations Document. *See* AR 618, pp. 174-78.

4.2 EPA's Consideration of the 1960s Fish Community in Hooksett Pool as the BIP for the Draft Determination

4.2.1 EPA's Denial of PSNH's Request for a Variance Remains Premised on an Egregiously Flawed Finding That the Hooksett Pool in the Late 1960s Constitutes the BIP

Comment II.4.2.1 (i)	**AR-1548, PSNH, pp. 38-41**
See also AR-846, PSNH, pp. 7, 14-17, AR-872, Normandeau, pp. 13-21; AR-868, Normandeau; AR-1552, Normandeau, pp. 4, 6-7, 15-16; AR-841, UWAG, p. 69	

EPA's Statement is silent concerning a fatal flaw behind its 2011 Draft Permit—namely, that its rejection of PSNH's § 316(a) variance request is based on a comparison of Hooksett Pool in 2011 to its condition in the late 1960s, when the Merrimack River was in its most polluted condition in its recorded history and one of the most polluted rivers in the country. In its 2011 Draft Permit, EPA found "the resident biotic community identified during sampling conducted from 1967 to 1969 to best represent the [BIP] . . . ."[189] Erroneously, EPA concluded that a river impaired by uncontrolled, pre-CWA releases of raw sewage, waste from wood and paper processing and textile mills, other phosphates and pollutants[190] could represent a BIP, and, using that baseline, denied PSNH's request for a thermal variance based on its finding that the current habitat of Hooksett Pool is "no longer able to support the fish community that existed in the 1960s, or early 1970s."[191] As described in Normandeau 2011b, during the period selected by EPA for its BIP determination, the Hooksett Pool was severely impaired as a result of uncontrolled releases of raw sewage and other phosphates:

> Historic observations of this contamination give a picture of a river contaminated beyond our current comprehension: sewage so dense that a single drop contains "dangerous" levels of bacteria; coliform bacterial counts exceeding 1 million per 100 ml for several cities; toxic metals and wastes including phenol and cyanide found in the river; suspended solids covering the river bottom and decomposing, causing gas to bubble up "as if the river were cooking"; and a predominant smell of rotten egg from hydrogen sulfide, which can ruin painting on boats and houses (Wolf 1965).[192]

In his February 2016 analysis, Dr. Larry Barnthouse described this conclusion as one of three significant flaws that invalidate EPA's conclusion that the operation of Merrimack Station with once-through cooling has caused appreciable harm to the BIP of Hooksett Pool.[193] Referring to EPA's 1997 Draft § 316(a) Guidance, Dr. Barnthouse specifically noted EPA's quotation that, "[a] determination of the indigenous population should take into account all impacts of the population except the thermal discharge."[194] EPA's failure to consider the Merrimack River's highly polluted condition during the 1960s and its transition to the greatly improved conditions in more recent years failed this guidance. As explained by Dr. Barnthouse:

> As required by the Clean Water Act, all of the untreated discharges identified in the USDI (1966) report ceased by 1972. The resulting improvements in water quality, which are documented in Normandeau's (2011a) report, would have been expected to lead to biological changes in the Merrimack River, including replacement of highly pollution-tolerant species by species with lower pollution tolerance. An increase in the number of species present in the community would be expected (Rapport et al. 1985). Rather than being limited to those species present at the time Merrimack Unit 2 was constructed in 1968, the BIP should include species whose presence in the river may have been facilitated by implementation of the pollution control requirements of the Clean Water Act.[195]

Improvements in water quality likewise are reflected in Normandeau's comparison of the benthic invertebrate data collected in 1972 and 1973 to data collected in 2011.[196] As explained by Dr. Barnthouse, information on the composition of benthic invertebrate communities is routinely used to assess the extent of impairment of aquatic communities (if any) due to potential stressors such as habitat degradation and pollutant discharges.[197] Considering the data against five benthic community indices (taxa richness, the Hilsenhoff Biotic Index, Ratio of EPT abundance to Chrinomidae abundance, percent contribution of dominant taxon to the total number of organisms in each sample, and EPT richness), Dr. Barnthouse determined, as did Normandeau, that biological conditions have improved since the 1970s.[198]

Thus, to the extent EPA attributes all changes in abundance levels of some fish species to thermal discharges from Merrimack Station,[199] it ignores the effect of the improvements to water quality resulting from the CWA. Not surprisingly, as explained by PSNH in its 2012 comments, the fish community of the Hooksett Pool in the 1960s timeframe does not meet the required characteristics of a BIP.[200] Thus, it was inappropriate to use a 1967-based fish community that existed in sewage and phosphate polluted waters to assess whether there has been appreciable harm to the Hooksett Pool. EPA's conclusions regarding the effects of Merrimack Station's thermal discharge are therefore irredeemably flawed.

[189] AR-618 at 31.

[190] *See* AR-1172 at 3; AR-872 at 14 (citing USGS 2003, "As late as the mid-1960s, more than 120 million gallons per day of untreated or minimally treated wastewater were discharged into the Merrimack River.") (citation omitted); *see also* AR-1245; AR-1246; AR-1247; AR-1248.

The effect of this contamination on the aquatic biota of the river is well-documented. *See* AR-872 at 15-17 (discussing U.S. Department of Interior study measuring nutrient levels, total and fecal coliform, dissolved oxygen and biological oxygen demand levels that indicate harm to the biotic community from the pollution levels of the river).

[191] AR-618 at 118.

[192] AR-1172 at 3.

[193] AR-1300 at 43. The other, two flaws identified by Dr. Barnthouse are: (1) EPA's over-reliance on classification of fish as "coolwater" or "warmwater" when interpreting population trends, and (2) its erroneous interpretation of Merrimack River temperature data when evaluating effects of thermal exposures on representative fish species. *Id.*

[194] AR-1300 at 3 (quoting AR-444 at 74).

[195] *Id.* at 4.

[196] *Id.* at 4-6.

[197] *Id.* at 4.

[198] *Id.* at 5-6.

[199] *See, e.g.,* AR-618 at 59 (alleging that the Station's thermal discharge caused yellow perch population decline); *id.* at 60 (alleging that the Station's thermal discharge caused pumpkinseed population decline); *id.* at 74 (alleging "dominance of heat-tolerant species in Hooksett Pool [is] indicative of appreciable harm to the balanced, indigenous community").

[200] AR-846 at 13-17.

EPA Response:

EPA addresses this, the related comment from Normandeau, and other associated comments in a single response below.

Comment II.4.2.1 (ii)	**AR-846, PSNH, p. 7, 14-17** **AR-872, Normandeau, p. 13-21, 90-91** **AR-1552, Normandeau, p. 4, 6-7, 15-16**

PSNH (AR-846 at 13-17) and Normandeau (AR-872 pp. 17-21 *and elsewhere in their comments*) disagree [with EPA] that the BIP is represented by the 1967-1969 data. PSNH (AR-846 p. 14) comments that EPA failed to demonstrate how the fish community in the Hooksett Pool in the 1960s constituted a BIP because protection of that community, which was dominated by pollution-tolerant species as a result of the poor water quality of the Hooksett Pool, would require resumption of massive discharges of raw sewage and other pollutants.

Similarly, Normandeau (AR-1552, pp. 6-7) states that, as defined in 40 C.F.R. § 125.71(c), the term "balanced, indigenous community" is synonymous with the term "balanced, indigenous population" in the CWA and means a biotic community typically characterized by (1) diversity, (2) the capacity to sustain itself through cyclic seasonal changes, (3) the presence of necessary food chain species and (4) a lack of domination by pollution-tolerant species. Such a community may include historically non-native species introduced in connection with a program of wildlife management, as well as species whose presence or abundance results from substantial, irreversible environmental modifications. Normally, however, such a community will not include species whose presence or abundance is attributable to the introduction of pollutants that will be eliminated by compliance by all sources with CWA §301(b)(2).

PSNH also comments (AR-846, p.7, 14) that EPA's analysis under CWA § 316(a) was incorrectly based on a BIP from a period of time when the Merrimack River was one of the most heavily polluted rivers in the country and was severely impaired due to uncontrolled releases of raw sewage, as well as waste from industrial discharges such as wood and paper processing mills and textile mills. PSNH comments that "EPA's conclusion that every change that has occurred to the Hooksett Pool is attributable to Merrimack Station's thermal discharge, and that these changes indicated 'appreciable harm' to the BIP is therefore fatally flawed." *Id*., p. 7.

According to Normandeau, the USEPA's selection of the 1967-1969 Hooksett Pool fish community as the BIP for Hooksett Pool is flawed and does not provide an appropriate basis for USEPA's determinations presented in the §316(a) Determination Document, because the available data show that the aquatic community in the Hooksett Pool during those years was not "balanced," but rather was dominated by fish and macroinvertebrate species able to tolerate the severe pollution present in the Merrimack River prior to the improvements in water quality that followed the 1972 enactment of the CWA. USEPA does not mention, let alone consider in any reasoned, technically sound manner, either the significant systemwide pollution that existed in the Merrimack River during the 1960s or the fact that improvements in water quality can dramatically alter aquatic communities. Instead, the Agency focuses solely on the potential impacts of the thermal releases into Hooksett Pool after Unit 2 came on-line in May 1968. However, unbiased, accurate analysis of the 40 years of ecological monitoring in and on the Merrimack River in the vicinity of Merrimack Station demonstrates that the changes in abundance of the resident biota of Hooksett Pool that occurred from the 1960s to the present were not caused by the Station's thermal discharge, but by the dramatic improvements to Merrimack River water quality that began in earnest in 1972. According to the commenters, the lack of fish species considered to be intolerant to pollution, and the lack of species representing the filter feeder or herbivore trophic guilds in the 1967-69 community, reflects the high degree to which Hooksett Pool water quality was impaired during this timeframe.

Normandeau comments (AR-1552, p.4) that one of the most significant flaws in USEPA's §316(a) analysis is the Agency's selection of the 1967-1969 fish community as the Hooksett Pool BIP, and its failure, in making this selection, to account in any way for the severe, non-thermal discharge-related water quality impairments that adversely affected the Merrimack River during the 1960s. In its desire to link all of the changes that have occurred in Hooksett Pool since the 1960s to Merrimack Station's thermal discharge after May 1968 (when Unit 2 came on-line), USEPA has overlooked both these severe water quality impairments and how pollution of that magnitude negatively impacts and alters biological communities. Evidence of the Merrimack River's poor water quality during the 1960s is well-documented in the ecological reports produced during the 1960s and 1970s. Moreover, USEPA, PSNH and Normandeau specifically discussed at a 2006 meeting the potential impacts of the Merrimack River's non-thermal discharge-related water quality impairments during the late 1960s on the biological community in Hooksett Pool. Nonetheless, despite these facts, USEPA does not raise this issue once in the Draft NPDES Permit, the §316(a) Determination Document and again failed to mention this issue in this latest Substantial New Questions Document. This is puzzling, given that the improvement of Merrimack River water quality is likely the greatest ecological change to have occurred in the river over the past forty years.

EPA Response:

EPA reviewed these comments and accompanying historical water quality, benthic macroinvertebrate, and fish community data in, and in proximity to, Hooksett Pool to assess whether EPA should modify the community of aquatic life used as a baseline or reference point for evaluating PSNH's thermal variance request under §316(a) of the CWA to determine if the requested alternative thermal discharge limits would assure the protection and propagation of the BIP.

As discussed in the 2011 Draft Determinations document, EPA and NHFGD concluded that the relevant community of aquatic organisms to use as a reference point for assessing impacts to the BIP would be comprised of all species that existed in Hooksett Pool immediately prior to start-up of Merrimack Station's Unit 1, in 1960. AR-618, p. 31. Data was unavailable, however, to represent this pre-Merrimack Station thermal discharge baseline, as biological sampling did not commence until 1967. This biological sampling did, however, capture the period before and just after the substantial increase in Merrimack Station's thermal discharges that accompanied the commencement of Unit 2 operations in 1968. Therefore, EPA considered the biotic community identified during sampling conducted from 1967-1969 to provide a reasonable, and the best possible, representation of the baseline BIP for Hooksett Pool for the purpose of assessing whether PSNH's requested alternative thermal discharge limits would assure the protection and propagation of the BIP. AR-618, p. 34-5. While EPA and NHFGD considered the Hooksett Pool fish community of the 1960's to represent the baseline BIP, the agencies' analysis of impacts also focused on comparisons between the fish communities of the 1970s, 1990s, and 2000s, since these were the communities evaluated by Normandeau for PSNH's 316(a) demonstration and which were studied most thoroughly.[28]

The commenter's suggestion that EPA attributed "all changes" in the aquatic community over time to thermal discharges from Merrimack Station is incorrect; EPA never stated or adopted such a conclusion. The 2011 Draft Determinations Document explains that fish may be subjected to multiple natural and anthropogenic stressors that individually, or in combination, appreciably harm their populations. *See* AR-618, p.118-121. However, based on the body of evidence available (and presented by PSNH) at the time, EPA concluded that Merrimack Station's thermal discharge had caused, or contributed to, appreciable harm to Hooksett Pool's balanced, indigenous community of fish. *See id*. In other words, EPA found that PSNH had not carried its burden under CWA § 316(a) to demonstrate that its past thermal discharges under the existing CWA § 316(a) variance had not caused appreciable harm to the BIP.

Comments from Normandeau and PSNH that EPA ignored or overlooked, that the water quality of Hooksett Pool was impaired in the 1960s are false. PSNH provided a comprehensive list of the numerous studies and reports covering the period from 1969 to 2010 that were submitted prior to the 2011 Draft Permit in Comment II.4.1.1. While there is water quality data included in these documents, it is not a focus of any of the reports nor is it "well documented" in these reports that the Hooksett Pool or the larger Merrimack River had poor water quality to the extent that the fish community at the time was affected to the extent that PSNH and Normandeau characterize in their comments. Notably, neither PSNH nor the authors offered any demonstration among these 27 reports and documents that the poor water quality in the Merrimack River would have justified disqualifying the 1960s fish community in Hooksett Pool from representing the baseline BIP for this analysis. Contrary to the comments, there are numerous examples in these reports indicating that PSNH and Normandeau considered fish data from the 1960s acceptable for use in its CWA § 316(a) variance assessment, including, but not limited to:

- Normandeau's Fisheries Analysis Report states (AR-11 at p. 25) that electrofishing and trapnet sampling from 1967 – 2005 was examined, and that a nonparametric Mann-Kendall test was applied to examine the "…consistent 1967-2005 time series of fisheries data for significant increasing or decreasing trends in annual total catch per unit of effort for each RIS."
- In the same report (AR-11, p. 25-27) Normandeau excluded sampling data from Hooksett Pool between 1967 to 1969 from its long-term trends analysis due to stated concerns about inconsistencies in gear and sampling methods, and poor record-keeping.

[28] As should be evident from this response, data simply does not exist to characterize the Hooksett Pool BIP prior to industrialized pollution of the water body, or even prior to the beginning of Merrimack Station's discharges of waste heat to the Pool. PSNH did not provide such data in its variance application and EPA was not able to locate such data in its research. Faced with unavoidable scientific uncertainty regarding how best to characterize the baseline BIP, EPA took what it concluded was a reasonable approach, which was to look to the aquatic community that predated the operation of Merrimack Station Unit 2. This made sense because the advent of Unit 2 operations brought a consistent and substantial increase in the Facility's discharges of thermal waste to Hooksett Pool. EPA explained its approach in the 2011 Draft Determinations Document to provide an opportunity to comment on it. EPA has considered those comments and responds to them here.

Normandeau did not, however, suggest that data from this period should not be used due to pollution effects on the fish community at that time. From this report, which EPA relied heavily on for the development of the draft permit, Normandeau appeared to consider fish data from the 1960s appropriate for use in the § 316(a) analysis.

- In its "Merrimack River Monitoring Program Summary Report," dated March 1979 (AR-364, p. 97), Normandeau states that: "Hooksett Pool supports a diverse, warm-water finfish community. Fishery surveys from 1967 to 1978 have indicated the continued abundance of the dominant species: smallmouth bass, pumpkinseed, golden and common shiner, white sucker and brown bullhead. The resident populations appear to be healthy and reproduce successfully." Again, in this report, Normandeau did not suggest that the aquatic community in the Hooksett Pool had suffered from intense water pollution in the 1960s or was otherwise in poor condition, or that the aquatic community of the 1960s and 1970s should be distinguished from each other due to greater adverse effects from water pollution during the earlier decade.

According to Normandeau (AR-1552, p. 4), the effect of water quality impairments during the 1960s on the biological community was discussed during a meeting in 2006. EPA believes Normandeau is referring to a meeting that took place on October 5, 2006. EPA has no written record of any discussion about pollution other than thermal pollution from the plant with respect to the CWA § 316(a) variance. While a comment could have been made by Normandeau on this matter during the meeting, the topics of the meeting, according to Normandeau (AR-100), were: Merrimack Station Compliance with 316(a) (including Retrospective RIS Trends Analysis, Downstream Passage, Merrimack River Thermal Environment, Alternative Thermal Limits for Renewed 316(a) Variance), and Merrimack Station 316(b) Impingement Study (First Year Impingement Results). Of the 55 slides presented to EPA during that 2006 meeting (and included in the printed document), not one mentions poor water quality in the 1960s affecting the Hooksett Pool fish community.

In the nearly five years between the October 2006 meeting and the 2011 Draft Permit, PSNH and its consultants submitted four additional reports to EPA in support of the Facility's CWA § 316(a) demonstration, including the primary supporting document for PSNH's § 316(a) analysis ("*Merrimack Station Fisheries Survey Analysis of 1967 through 2005 Catch and Habitat Data,*" AR-11). None of these four reports mention historical pollution being an important factor to consider when evaluating the BIP. If PSNH regarded this issue to be as critical to the analysis in 2006 as the comments now suggest, one expects that there would have been a discussion or demonstration of the issue in its submissions in support of its request for renewal of its CWA § 316(a) variance.

While PSNH did not adequately raise any concerns about the 1960s fish community and poor water quality prior to the 2011 Draft Permit, the commenters clearly express such concerns during the 2011 and 2017 public notice periods. The Hooksett Pool fish community of the late 1960s immediately prior to and following the start-up of Merrimack Station's Unit 2 best reflects the community least influenced by the plant's full thermal effects, but certain other water quality parameters reflected a system impacted by chronic pollution. EPA agrees generally that data suggests that water quality in the Merrimack River during the 1960s was likely impaired and may have affected this fish community. Elevated nutrient and bacteria levels, as well as periods of depressed dissolved oxygen (DO), indicate that eutrophic conditions existed in the 1960s. Results from bottom dredging conducted in 1964 indicates that benthic conditions were also degraded (*See* AR-1246, p.12-14), although other studies conducted by Normandeau indicated that these conditions were in a moderate state of recovery by 1968 (*See* AR-868, p. 19-20).

Changes in the fish community can arise from both the improvement in some water quality parameters and degradation of others. While some species may be tolerant of degraded conditions such as low DO, they can also be highly sensitive to elevated temperatures. Therefore, in order to evaluate a fish community that both existed during a time period relatively close to the 1960s, but also reflects notable improvements in water quality, EPA has for the Final Permit focused more on the Hooksett Pool fish community of the 1970s in its comparison with fish community data from the 2000s. *See II.4.2.2 for a more detailed discussion*. This shift acknowledges the difficulty in separating the effects of chronic degraded water quality conditions with the added stressors associated with thermal pollution. It should not, however, be construed as EPA allowing or supporting the discharge of pollutants to an already impaired system without regard to whatever biological community existed at the time. The 2011 Draft Determinations Document explains that the BIP must satisfy the listed indices of an ecologically healthy community of organisms and cannot be dominated by pollution-tolerant species or species whose presence of abundance is attributable to § 316(a) variance-based permit limits or pollutant discharges that will be eliminated pursuant to technology-based limitations under § 301(b)(2). *See* 40 CFR § 125.71(c); AR-618 p. 20.

The question remains, however, as to whether the possibility that the water quality of the Merrimack River in the 1960s affected the fish community supports PSNH's conclusion that EPA's analysis of its request for renewal of its CWA § 316(a) variance application was flawed. The cornerstone of Merrimack Station's CWA § 316(a) variance request, which informed much of the analysis presented in the 2011 Draft Determinations Document, was Normandeau's April 2007 Fisheries Analysis Report. AR-3. This analysis looked exclusively at comparisons between the Hooksett Pool fish communities of the 1970s (1972-1974, 1976) and 2000s (2004, 2005). The 2011 Draft Determinations Document carefully considers this analysis to help EPA identify the baseline condition in the Merrimack River. The 2011 Draft Permit Determination states:

> Merrimack Station's demonstration, as presented in the Fisheries Analysis Report, is organized into three major sections. The first provides a current assessment of the fish community in Hooksett Pool based on fish sampling conducted during 2004 and 2005. The second presents the results of a fish population trend analysis based on comparable abundance trapnet and electrofish data collected through the Merrimack River Fisheries Survey between 1972 and 2005. The third presents an assessment of the relationship between the Station's thermal discharge and nine species of fish observed in the Merrimack River in the vicinity of the Station.
>
> In this section of the Determination Document, EPA reviews each section of Merrimack Station's demonstration. This review typically presents a summary of Merrimack Station's conclusions, as expressed in the Fisheries Analysis Report, followed by EPA's evaluation of the Station's analysis. In some cases, EPA

> provides the results of its own analyses utilizing data provided by Merrimack Station and/or information from published scientific literature. These reviews and analyses collectively form the basis of EPA's conclusions on the adequacy of Merrimack Station's demonstration. These conclusions are presented in Section 5.7. Section 5 also presents EPA's assessment on the status of the Hooksett Pool balanced, indigenous community, based largely on Merrimack Station's fisheries data collected over 40 years,

AR-618, p. 30. While much attention (and numerous comments) have targeted EPA's identification of the 1960s fish community as the baseline BIP, in reality EPA focused mostly on the fish community of the 1970s as the point of comparison since Normandeau used that community for evaluating long-term population trends. The data and analyses in the Fisheries Report (AR-3), and the conclusions based on them, as presented in the 2011 Draft Determinations Document, are still relevant to the question of appreciable harm to the BIP. The data and analyses from that report also reflect changes to the BIP that occurred while Merrimack Station was still operating as a baseload facility.

EPA received comments and new information regarding the presence and abundance of benthic invertebrates in Hooksett Pool, including a report that includes "then and now" comparisons from data collected in the 1970s and 2011 (AR-870). The 2011 Draft Determination Document focused primarily on the historical fish community in its assessment of thermal impacts because PSNH had provided predominantly fish data in its §316(a) demonstration. At the same time, EPA notes that benthic macroinvertebrates are typically much less mobile than fish and differences in their abundance within the ambient and thermally-influenced areas in Hooksett Pool can provide useful information on possible thermal effects from the discharge to this important biological community in Hooksett Pool.

EPA has reviewed numerous comments and supporting documents since the 2011 Draft Permit, including additional, recent studies and analyses of the aquatic community present in the Merrimack River. After reviewing all these reports and comments, for the Final Permit, EPA considers the baseline BIP for evaluating Merrimack Station's CWA § 316(a) variance request to be best reflected in the following three communities: (1) the Hooksett Pool biotic community of the 1970s; (2) the current Garvins Pool fish community, and (3) the benthic invertebrate community in the ambient section of Hooksett Pool. *See* Responses to Comments II.4.3 (and associated sub-comments). Looking at both changes in historical trends and comparisons with an adjacent fish community not influenced by a thermal discharge provides a comprehensive approach for EPA's evaluation of the fish community. This approach is similar to a "Before-After-Control-Impact" study design often used in assessing anthropogenic impacts to biological communities (Larson et al. 2018) (AR-1774). EPA finds that this multi-faceted approach is a reasonable and appropriate way to evaluate the questions at hand recognizing that any approach may be imperfect because we cannot roll back time and run a controlled experiment on the BIP in Hooksett Pool in order to more directly define the effect of the Merrimack Station thermal discharge on the BIP. In response to this unavoidable scientific uncertainty, EPA has reasonably defined the baseline BIP in multiple scientifically valid ways to provide the point of comparison for the appreciable harm assessment under CWA § 316(a).

4.2.2 The Aquatic Community in Hooksett Pool in the 1960s was Dominated by Pollution Tolerant Species

Comment II.4.2.2 (i)	AR-846, PSNH, pp. 16-17; AR-1554, LWB, pp. 5-6

As explained above, EPA regulations mandate that a BIP "will not include species whose presence or abundance is attributable to the introduction of pollutants that will be eliminated by compliance by all sources with section 301(b)(2)." 40 C.F.R. § 125.71(c). A review of the fish community of the Hooksett Pool in the 1967-1969 timeframe clearly demonstrates that 37 percent of the total fish catch from the Hooksett Pool during that time were of pollution-tolerant species.

> A review of species-specific tolerance to environmental perturbation (Barbour et al. 1999) for the fish species observed in Hooksett Pool during 1967-1968 reveals that the Hooksett Pool fish community during those years consisted only of fish species listed as tolerant or intermediate in tolerance to pollution (Table 2- 3)…Of the sixteen fish species collected during 1967-1968, five are considered tolerant to pollution, including brown bullhead, white sucker, golden shiner, yellow bullhead, and American eel (Table 2-2; Barbour et al. 1999). Those five tolerant species accounted for 37% of the total fish catch from Hooksett Pool collected during 1967-1968. In addition, the 1967-1968 Hooksett Pool fish community was composed solely of species considered to be members of the generalist, insectivore and piscivore trophic guilds.

See Normandeau Comments at 20. In addition, there were no pollution-intolerant species present during that timeframe.

> The lack of any fish species considered to be intolerant to pollution, and the lack of any fish species representing the filter feeder or herbivore trophic guilds, in the 1967-1969 Hooksett Pool fish community reflects the high degree to which Hooksett water quality was impaired by pollutants other than heat in the late 1960s.

Id. It follows then that the fish community in the Hooksett Pool in the 1960s timeframe was attributable to the heavy pollution, was dominated by pollution tolerant species, and was therefore, not a BIP.

EPA Response

EPA addresses this and related comments from Normandeau in a single response below.

Comment II.4.2.2 (ii)	AR-1552, Normandeau, p. 4-6, 9-14
See also ARA-872, Normandeau, p. 10-20	

The fish community in Hooksett Pool has changed dramatically when compared between 1967-1969 and the present day, with the number of fish species increasing from 16 in the late 1960's to 27 fish species currently inhabiting the pool (Table 2-1). However, by not providing an accurate picture of the current fish community in Hooksett Pool in the Draft NPDES Permit, USEPA obscures the obvious differences, including the nearly doubling of fish species found in the pool and the addition of species that are highly sensitive to pollution. Many of the fish species in the current Hooksett Pool fish community could not have survived the conditions

found in the Hooksett Pool of 1967-1969. The high numbers of Yellow Perch, Pumpkinseed, White Sucker, Brown Bullhead and Golden Shiners captured in 1967-1969 were in abundance because the Hooksett Pool fish community was shaped by the severely impaired water quality that existed in the Merrimack River at the time. Even so, USEPA inappropriately bases the bulk of its §316(a) analysis on that community in an attempt to demonstrate that the drop in abundance for these species was caused solely by the Station's thermal discharge into Hooksett Pool. Omitting any discussion about the dramatic improvements in Merrimack River water quality in the Draft NPDES Permit or the §316(a) Determination Document allows USEPA to advance the false argument that all of the changes to the Hooksett Pool BIP since the 1960s are solely attributable to Merrimack Station's thermal discharge. Indeed, the changes to the Hooksett Pool fish community that have occurred over the decades as water quality has so significantly improved should not be characterized as a negative outcome. Rather, because of these water quality improvements, the aquatic community that exists in Hooksett Pool today is healthier and far more diverse than the community that existed during the 1960s.

USEPA determined that the fish community observed in Hooksett Pool during 1967-1969 should serve as the BIP to which the current Hooksett Pool fish community should be compared to assess the potential impacts of Merrimack Station's thermal discharge. In so doing, USEPA

Table 2-1. Common name and percent composition for fish captured in Hooksett Pool during 1967-1968 (trapnet and electrofishing), and 2004-2005 (trapnet and electrofishing) / 2010-2013 (electrofishing).

Hooksett Pool Fish Community 1967-1968		Hooksett Pool Fish Community 2004-2013	
Common Name	**Percent Comp.[1]**	**Common Name**	**Percent Comp.[2]**
Pumpkinseed	31.7%	Spottail Shiner	23.7%
Yellow Perch	22.9%	Largemouth Bass	17.5%
Brown Bullhead	15.4%	Bluegill	12.6%
White Sucker	12.5%	Smallmouth Bass	10.3%
Golden Shiner	7.3%	Fallfish	8.9%
Redbreast Sunfish	4.7%	Redbreast Sunfish	7.7%
Smallmouth Bass	2.1%	White Sucker	3.9%
Yellow Bullhead	1.5%	Yellow Perch	3.6%
Chain Pickerel	1.2%	Pumpkinseed	3.5%
American Eel	0.4%	Alewife	1.4%
White Perch	<0.1%	Common Shiner	1.1%
Walleye	<0.1%	Rock Bass	1.0%
Largemouth Bass	<0.1%	Golden Shiner	0.9%
Fallfish	<0.1%	Chain Pickerel	0.7%
Madtom sp.	<0.1%	American Eel	0.7%
Common Shiner	<0.1%	Black Crappie	0.6%
		Tessellated Darter	0.5%
		American Shad	0.4%
		Sunfish family	0.3%
		Margined Madtom	0.3%
		Eastern Silvery Minnow	0.1%
		Yellow Bullhead	0.1%
		Atlantic Salmon	<0.1%
		Brown Bullhead	<0.1%
		Brown Trout	<0.1%
		Common Carp	<0.1%
		Eastern Blacknose Dace	<0.1%
		White Perch	<0.1%

1 - Based on electrofish and trapnet data from 1967 and 1968

2 – Based on electrofish and trapnet data from 2004-2005 and electrofish data from 2010-2013

either ignored or overlooked the fact that the abundance of pollution-tolerant fish species in Hooksett Pool was higher in 1967-1969 than under current conditions because of the ability of those species to survive in an aquatic habitat impaired by conventional and toxic pollutants.

The Hooksett Pool fish community and relative abundance as sampled by boat electrofishing and trap nets during 1967-1968 and described by Wightman (1971) is presented in Table 2-2. For reference, Table 2-3 presents the Hooksett Pool fish community and relative abundance as sampled by boat electrofishing and trap nets during the 2000s and described by Normandeau (2007a, 2011a, 2017a).

Table 2-2. Percent composition, USEPA trophic guild and tolerance classifications for fish captured in Hooksett Pool during 1967-1968 (trapnet and electrofishing).

Hooksett Pool Fish Community 1967-1968			
Common Name	**Percent Comp.[1]**	**Trophic Guild[2]**	**Tolerance[2]**
Pumpkinseed	31.70%	Generalist	Intermediate
Yellow Perch	22.90%	Piscivore	Intermediate
Brown Bullhead	15.40%	Generalist	Tolerant
White Sucker	12.50%	Generalist	Tolerant
Golden Shiner	7.30%	Generalist	Tolerant
Redbreast Sunfish	4.70%	Generalist	Intermediate
Smallmouth Bass	2.10%	Generalist	Intermediate
Yellow Bullhead	1.50%	Generalist	Tolerant
Chain Pickerel	1.20%	Piscivore	Intermediate
American Eel	0.40%	Piscivore	Tolerant
White Perch	<0.1%	Piscivore	Intermediate
Walleye	<0.1%	Piscivore	Intermediate
Largemouth Bass	<0.1%	Piscivore	Intermediate
Fallfish	<0.1%	Generalist	Intermediate
Madtom sp.	<0.1%	Insectivore	Intermediate
Common Shiner	<0.1%	Generalist	Intermediate
Total	**16 Species**	**3 Guilds**	**2 Tolerance Levels**

1 - Based on electrofish and trapnet data from 1967 and 1968
2 - Barbour et al. 1999
3 - Based on electrofish and trapnet data from 2004-2005 and electrofish data from 2010-2013.

A review of species-specific tolerance to environmental perturbations (Barbour et al. 1999) for the fish species observed in Hooksett Pool during 1967-1968 reveals that the Hooksett Pool fish community during those years consisted only of fish species listed as tolerant or intermediate in tolerance to pollution (Table 2-2). USEPA's own definition of "balanced, indigenous community" (i.e., BIP) provides that a BIP does not include species whose presence or abundance is attributable to the introduction of pollutants that will be eliminated by compliance by all sources with CWA §301(b)(2) (40 CFR §125.71(c)). Of the sixteen fish species collected during 1967-1968, five are considered tolerant to pollution, including Brown Bullhead, White Sucker, Golden Shiner, Yellow Bullhead and American Eel (Table 2-2; Barbour et al. 1999). Those five tolerant species accounted for 37% of the total fish catch from Hooksett Pool collected during 1967-1968. In addition, the 1967-1969 Hooksett Pool fish community was composed solely of species considered to be members of the generalist, insectivore and piscivore trophic guilds. The lack of any fish species considered to be intolerant to pollution, and the lack of any fish species representing the filter feeder or herbivore trophic guilds in the 1967-1969 Hooksett Pool fish community reflects the high degree to which Hooksett Pool water quality was impaired by pollutants other than heat in the late 1960s.

The five most abundant fish species collected in Hooksett Pool during the 1967-1968 fish sampling – Pumpkinseed, Yellow Perch, Brown Bullhead, White Sucker and Golden Shiner – represented 89.8% of the total catch. All of these fish are known for their capability to withstand low DO conditions (Holtan 1990, Fox 1994, Trial et al. 1983, Scarola 1987, Twomey et al. 1984,

Table 2-3. Percent composition, USEPA trophic guild and tolerance classifications for fish captured in Hooksett Pool during 2004-2005 (trapnet and electrofishing) / 2010-2013 (electrofishing).

Hooksett Pool Fish Community 2004-2013			
Common Name	Percent Comp.[3]	Trophic Guild[1]	Tolerance[2]
Spottail Shiner	23.7%	Insectivore	Intermediate
Largemouth Bass	17.5%	Piscivore	Intermediate
Bluegill	12.6%	Generalist	Tolerant
Smallmouth Bass	10.3%	Piscivore	Intermediate
Fallfish	8.9%	Generalist	Intermediate
Redbreast Sunfish	7.7%	Generalist	Intermediate
White Sucker	3.9%	Generalist	Tolerant
Yellow Perch	3.6%	Piscivore	Intermediate
Pumpkinseed	3.5%	Generalist	Intermediate
Alewife	1.4%	Filter feeder	Intermediate
Common Shiner	1.1%	Generalist	Intermediate
Rock Bass	1.0%	Piscivore	Intermediate
Golden Shiner	0.9%	Generalist	Tolerant
Chain Pickerel	0.7%	Piscivore	Intermediate
American Eel	0.7%	Piscivore	Tolerant
Black Crappie	0.6%	Piscivore	Intermediate
Tessellated Darter	0.5%	Insectivore	Intermediate
American Shad	0.4%	Filter feeder	Intermediate
Sunfish family	0.3%	Generalist	Intermediate
Margined Madtom	0.3%	Insectivore	Intermediate
Eastern Silvery Minnow	0.1%	Herbivore	Intolerant
Yellow Bullhead	0.1%	Generalist	Tolerant
Atlantic Salmon	<0.1%	Piscivore	Intolerant
Brown Bullhead	<0.1%	Generalist	Tolerant
Brown Trout	<0.1%	Piscivore	Intolerant
Common Carp	<0.1%	Generalist	Tolerant
Eastern Blacknose Dace	<0.1%	Generalist	Tolerant
White Perch	<0.1%	Piscivores	Intermediate
Total	**27 Species**	**5 Guilds**	**3 Tolerance Levels**

1 - Based on electrofish and trapnet data from 1967 and 1968
2 - Barbour et al. 1999
3 - Based on electrofish and trapnet data from 2004-2005 and electrofish data from 2010-2013.

Becker 1983). Three of those species – White Sucker, Brown Bullhead and Golden Shiner – are also classified as tolerant to pollution (Barbour et al. 1999). It stands to reason that the increased abundance of these five fish species in Hooksett Pool during the 1960s is attributable to their ability to withstand pollutants that were greatly reduced following the 1972 enactment and subsequent enforcement of the CWA and parallel state clean water regulations.

EPA Response:

Normandeau and PSNH state that the aquatic community of the 1960s was dominated by fish species whose abundance is attributable to their ability to withstand pollutants and, as such, cannot be considered the BIP for Hooksett Pool. PSNH and Normandeau also reiterate comments about EPA's 316(a) analysis that have been addressed in Responses to Comments above and, in this comment, offer additional lines of evidence to support their claims that the 1960s community was pollutant tolerant. EPA addresses the comments about the fish community data and what it means in terms of whether the 1960s aquatic community can appropriately be considered the BIP for the purposes of Merrimack Station's § 316(a) variance.

PSNH and Normandeau comment that 37% of the total fish catch from the Hooksett Pool during 1967-1968 were of pollution-tolerant species and there were no pollutant intolerant species. EPA notes that the five species PSNH and Normandeau focus on as "pollutant tolerant" were not the most abundant species in Hooksett Pool at the time. Instead, more than 54% of the total catch was comprised of yellow perch and pumpkinseed, which are not classified as pollution tolerant. In addition, Normandeau's 2011 Report demonstrates that there were more pollution-tolerant species present in Hooksett Pool in 2011 than in 1972. AR-3, p. 58. In addition, as a percentage of all fish caught, pollution-tolerant species were the most abundant in 1995 (42.0%) and lowest during 1973 (5.2%) which does not support Normandeau's argument that pollution-tolerant species dominated in the 1960s and that the shift in the fish community from the early 1970s on was a reflection of improved water quality.

According to Normandeau, many of the fish species in the current Hooksett Pool fish community could not have survived the conditions found in the Hooksett Pool of 1967-1969. Normandeau claims that the high numbers of Yellow Perch, Pumpkinseed, White Sucker, Brown Bullhead and Golden Shiners captured in 1967-1969 reflect the "severely impaired water quality" that existed in the Merrimack River at the time. This argument is not supported, however, by Normandeau's 2011 Report (AR-871) or the reference Normandeau uses in its most recent classifications of freshwater fish species (Halliwell, *et al.* (1999), (AR-1779). Normandeau lists the relative abundance of fish species collected in Garvins, Hooksett, and Amoskeag pools during the four-year period, 2008-2011. AR-871, p. 100. Of the 24 species collected in Garvins Pool, just upstream from Hooksett Pool, 3 of the 6 species that Normandeau alleges can only survive in "severely impaired" water quality (yellow perch, pumpkinseed, and white sucker) are among the most abundant. Furthermore, Halliwell et al. (1999) identifies pumpkinseed, yellow perch, brown bullhead, golden shiner, and white sucker as among the most commonly encountered fish species in Northeastern wadeable streams, lakes, and ponds. In other words, many of the same species identified by Normandeau as dominating Hooksett Pool in the 1960s due to "severely impaired" water quality were well-represented in Garvins Pool in 2008-2011, which Normandeau has indicated should be considered an appropriate surrogate for the Hooksett Pool BIP (See Comment II.4.3.3(iii) and are among the most common species observed in lakes, ponds, and river throughout the entire Northeast. There are also more "tolerant" species listed in Table 2-3 (from Hooksett Pool in 2011) than there were in 1972, a mere four years after the period in the 1960s identified by Normandeau as being heavily polluted. AR-871, pp. 58,73.

The data Normandeau presented in Table 2-2 (above) combines sampling data caught by both electrofishing and trap net methods. Normandeau criticized the efficacy and reliability of trap net sampling, especially sampling from the Hooksett Pool in the 1960s. Species such as white sucker, brown bullhead, and golden shiner were more abundant in the 1960s trap net sampling compared to electrofishing. Conversely, species such as largemouth bass appear to be less susceptible to trap netting. NHFGD's "Merrimack River Thermal Study" (Wightman 1971) mentions this sampling gear bias in its discussion of fish sampling in the 1960s, and Normandeau chose not to use trap net data for purposes of assessing species abundance in 2007 (AR-3) because it felt the data were unreliable. Normandeau criticizes trap net sampling conducted by NHFGD from 1967-1969 because "[a] breakdown of catch by species and date is not provided ... effort is not documented in the text and a balanced sample design does not appear to be maintained as data was compared across time and monitoring stations…" AR-3, p. 27.

In its comment Normandeau points to abundance data combining electrofish and trapnet sampling as compelling evidence that pollution-tolerant species dominated Hooksett Pool in the 1960s. However, this conclusion is not supported by electrofishing data (and, as stated above, Normandeau criticized the trapnet sampling as unreliable). The five most common species collected during electrofishing sampling in Hooksett Pool from 1967-1969 were pumpkinseed, yellow perch, smallmouth bass, red breasted sunfish, and largemouth bass (Wightman 1971) (AR-1). Using the pollution tolerance guild information used in Table 2-3, above (AR 3, p. 72), none of these species are listed as pollution-tolerant. Combining data from the two sampling techniques to calculate relative abundance masks the true results of each technique individually. For example, Normandeau identifies the relative abundance of largemouth bass in Hooksett Pool in 1967-1968 to be less than 0.1 percent when the two sampling data sets are combined, but electrofishing alone showed that largemouth bass represented over 40 percent of all fish caught in the southern (thermally-influenced) portion of Hooksett Pool in 1968, the year Unit 2 came on line, and approximately 10 percent in the northern, ambient section of the pool (Wightman 1971). Normandeau's inconsistent approaches to applying the trapnet data in order to make its point is not scientifically sound.

Normandeau also comments that the 1967-1969 Hooksett Pool fish community was composed "solely of species considered to be members of the generalist, insectivore and piscivore trophic guilds," and that the lack of any fish species representing the filter feeder or herbivore trophic guilds reflects the high degree to which Hooksett Pool water quality was impaired by pollutants other than heat in the late 1960s. In a footnote to its Table 2-2, Normandeau identifies EPA's trophic guild and tolerance classifications as presented in the agency's bioassessment protocols. In developing these protocols, EPA reviewed seven literature sources to select, based on the consensus of these sources, the feeding guild or pollution tolerance classification to which each fish species belonged. For species where the consensus was not unanimous, the alternative designations were listed as "exceptions." However, Normandeau uses none of the trophic guilds identified by EPA (and most of the literature sources reviewed) for the nine most abundant species identified in this table, which represent 98.1 percent of all fish caught. Instead, Normandeau selected from the trophic guild exceptions. While Normandeau suggests that the Hooksett Pool was dominated in the 1960's by "generalists" – species that can feed on a variety of forage – none of the dominant species (collected by electrofishing) fall into the generalist trophic guild presented in Normandeau's 2007 Fisheries Analysis Report (AR-3). For example, EPA's protocol identifies pumpkinseed, the most abundant species in Table 2-3, as an "insectivore," but Normandeau selects from the exceptions and labels pumpkinseed a "generalist," though the exceptions also include "piscivore."

Normandeau also comments that the lack of members of the filter feeder or herbivore trophic guilds in the 1967-1969 fish community is evidence of the impaired nature of the waters and impact on the community at the time. However, the 2010-2013 data (Table 3-2) lists only three additional species that occupy these guilds. Two of these species, alewife and American shad, are anadromous species that once ascended Merrimack River to spawn. Their absence in the 1960s, as now, is likely related more to State and/or federal stocking efforts and improvements in dam passage (including at Amoskeag Dam) rather than to improvements in water quality. Shad and alewives account for a relatively low percent of the overall catch.

The only species listed in the "herbivore guild" found in Hooksett Pool is the Eastern silvery minnow. According to Scarola (1987), the only water body where this species was found in New Hampshire (at least until 1987 (the book's second edition)) was the Connecticut River. The first documented Eastern silvery minnows in Hooksett Pool were captured in 2004 when 14 individuals were caught during electrofish sampling. As such, it's unlikely that this species would have been present in Hooksett Pool in the 1960s regardless of the water quality. While EPA agrees that it is generally desirable to have increased diversity in feeding guilds, the capture of only three individuals from 235 sampling events in 2010 and 2011 (combined) raises doubts that the Eastern silvery minnow is becoming established as a resident species in Hooksett Pool following its first documented appearance in 2004.

Changes in water quality may not be the only, or even the primary, cause for certain changes in the fish community from the 1960s. It is possible that factors other than water quality (or conditions that result from pollution, such as low dissolved oxygen) influenced the change in abundance of several of these species, including pumpkinseed and yellow perch. One such factor, as explained in the 2011 Draft Determinations Document, may have been the introduction and increase in thermal effluent from Merrimack Station. Another may have been that certain species' reproductive and/or feeding strategies enhance their ability to compete with other species and maintain robust populations as water quality improves. Normandeau recognized this possibility in its report, "Merrimack Station (Bow) Fisheries Study (Normandeau 1997" (AR-201). According to Normandeau, the decrease in yellow perch abundance between the 1970s and 1995 and concurrent increase in bluegill abundance may have been related to their "common preference for benthic food items," which could potentially lead to food competition between the two species. Normandeau comments that "[i]f food items are limiting, competition for benthic food resources may partially explain the reduction in yellow perch abundance." AR-201, p. 25. Normandeau does not suggest in this report that improved water quality in Hooksett Pool is responsible for declines in yellow perch abundance.

In sum, PSNH and Normandeau argue that relative abundance from the 1960s indicates that this community was dominated by pollution-tolerant species and further, that these species could not survive except for the severely impaired water quality of the Merrimack River at the time. Yet, from EPA's review, the data referenced in the comment does not support the conclusion that the 1960s community was "dominated" by pollutant-tolerant species. The community characterized in the most recent fisheries data is not dramatically different than the historical community in terms of the balance of "pollutant tolerant" species or in terms of the trophic guilds present. Moreover, the presence of "pollution intolerant" species, or herbivore and filter feeders, may be related to factors other than water quality, as may the decline in yellow perch. At the same time, EPA recognizes that the water quality in Hooksett Pool has shown some improvements since the 1960s (see Response to Comment 4.2.3) and that the current community has higher diversity. EPA has considered fisheries data evaluated for the 2011 Draft Permit (*i.e.*, from the 1960s, 1970s, 1990s, and 2000s) as well as recent (2010-2013) data from Hooksett and Garvins pools for the Final Permit.

Comment II.4.2.2 (iii)	**AR-1300, LWB, p. 3**

LWB comments that while it might seem reasonable to base a 316(a) determination on a "before" vs. "after" comparison of the kind relied on by EPA, in this case the transition of the Merrimack River from highly polluted conditions prevalent prior to 1970 to the greatly improved conditions present in more recent years represents a significant complicating factor (p.3). LWB Environmental Services, Inc., provides the following quotation from EPA's 1977 draft §316(a) Guidance:

> For purposes of a 316(a) demonstration, distribution and composition of the indigenous population should be defined in terms of the population which would be impacted by the thermal discharge caused by the alternative effluent limitation proposed under 316(a). A determination should take into account all impacts on the population except thermal discharge. Then the discrete impact of the thermal discharge on the indigenous population may be estimated in the course of a 316(a) demonstration. In order to determine the indigenous population which will be subject to a thermal discharge under an alternative 316(a) effluent limitation, it is necessary to account for all non-thermal impacts on the population such as industrial pollution, commercial fishing, and the entrapment and entrainment effects of any withdrawal of cooling water through intake structures under the alternative 316(a) effluent limitation. The above considerations will then make it possible to estimate the true impact of the thermal discharge on the population.

The commenter then urges that the above paragraph makes it clear that in evaluating the effects of Merrimack Station's thermal discharge it is necessary to account for the potential effects of other stressors, in particular, water pollution. The commenter further states that:

> [a]s noted by EPA in its 2011 Draft Permit (AR-618, p. 22), EPA regulations require applicants seeking alternative effluent limitations to evaluate the cumulative impact of the proposed thermal discharge together with other stressors affecting the Balanced Indigenous Population (BIP). Logically, the same requirement should be placed on EPA when performing an independent evaluation of the applicant's data.

EPA Response:

As the 2011 Draft Determinations Document explains, the potential effects of other stressors (*e.g.*, water pollution other than heat, adverse impacts entrainment and impingement of aquatic life by the power plant's cooling water intake structures) should be considered when evaluating the specific impacts associated with the thermal discharge on the BIP. AR-618, pp. 19-20. And, as noted by this comment, EPA regulations *require* applicants seeking alternative effluent limitations to evaluate the cumulative impact of the proposed thermal discharge together with other stressors affecting the BIP. EPA considered all the information provided by the applicant, but PSNH provided no such evaluation with its request for a thermal variance prior to the 2011 Draft Permit. PSNH has since submitted relevant information (such as LWB's 2016 Assessment, AR-1300) by which to evaluate the potential that the 1960s BIP was affected by the water quality at the time. EPA has considered this information and addresses it in responses to comments below.

Comment II.4.2.2 (iv)	**ARA-851, CLF, p. 9**
See also AR-852, Henderson	

EPA identified PSNH's failure to include fish data from the 1960s as the demonstration's "greatest deficiency" (AR-618 p. 78). The effect PSNH was trying to achieve by excluding fish data from the 1960s is obvious: the 1960s fish data best represents the pre-impact balanced, indigenous population in the Hooksett Pool, and without it, the decline in fish species does not appear as dramatic as it truly is (*See* AR-852). EPA easily saw through this improper manipulation of the data by PSNH and correctly included the 1960s data in its analysis.

PSNH's approach is inconsistent with the requirements of the CWA's implementing regulations, which provide that:

> Normally, however, [the BIP] will not include species whose presence or abundance is attributable to the introduction of pollutants that will be eliminated by compliance by all sources with section 301(b)(2) of the Act; and *may not* include species whose presence or abundance is attributable to alternative effluent limitations imposed pursuant to section 316(a).

40 C.F.R. 125.71(c) (emphasis supplied). Accordingly, the BIP "explicitly excludes certain currently present species whose presence or abundance is attributable to avoidable pollution or previously-granted section 316(a) variances." *Dominion Energy Brayton Point* at 48. Further, "[b]y requiring a showing that the BIP has not been harmed by the existing discharger's prior discharges, [C.F.R. 125.73(c)(1)] implicitly suggests that the population under consideration is not necessarily just the population currently inhabiting the water body but a population that may have been present but for the appreciable harm." *Id*. (*citing* Wabash, 1 E.A.D. at 592-5). Section 316(a), therefore, "cannot be read to mean that a [BIP] is maintained where the species composition, for example, shifts from…thermally sensitive to thermally tolerant species." *Id*. at 49.

EPA Response:

EPA agrees that the aquatic community prior to the startup of Unit 1 in 1960 could be the best representation of the BIP in Hooksett Pool absent the thermal discharge from Merrimack Station. See AR-618, p. 31. However, as discussed above, there was no data characterizing the community at that time. In the 2011 Draft Determinations Document, EPA considered the aquatic community from 1967-1969, which were the earliest years for which data were available, coincident with Unit 2 startup, representative of the biotic community prior to the increase in heated effluent. *Id*. While the BIP for evaluation under § 316(a) may not be attributable to alternative limitations imposed pursuant to section 316(a), the BIP should also be characterized by a lack of domination by pollution tolerant species. 40 CFR § 125.71(c). New information submitted during the public comment period demonstrates that water quality in the Merrimack River in the 1960s may well have been impaired and that these conditions may reflect a fish community impacted by poor water quality. *See* Comments and Responses in II.4.2.2 and 4.2.3. While the fish community in the late 1960s represents the BIP prior to a substantial increase in the thermal effluent from the Station and is still the best representation of the pre-thermal impact BIP, it may also reflect degraded conditions due to other types of pollution.

In response to the comments and new information, EPA has considered how to assess effects on the BIP of the Hooksett Pool from multiple perspectives. EPA has considered a long-term assessment including fisheries data from the 1960s and 1970s, as in the 2011 Draft Determinations Document and in Normandeau's long term trends analyses (AR-3). In addition, however, EPA has also evaluated the condition of the BIP in light of new fish data collected in Garvins Pool and throughout Hooksett Pool in 2010-2013, which was submitted during the public comment period for the 2011 Draft Permit. *See* Responses to Comment 4.3 (and associated sub-comments).

4.2.3 Consideration of 1960s Water Quality Data and the BIP

Comment II.4.2.3 (i)	**AR-846, PSNH, pp. 14-16**
See Also AR-872, Normandeau, pp. 14-17; AR-868, Normandeau; AR-1300, LWB, pp. 3-4	

EPA's reasons for choosing the 1967-69 time period – earliest data available, volume of heated cooling water discharged tripled in 1968 after Unit 2 came online – ignore the fact that the water quality of the Hooksett Pool during that time period was severely impaired due to uncontrolled releases of raw sewage and other phosphates. In fact,

> [h]istoric observations of this contamination give a picture of a river contaminated beyond our current comprehension: sewage so dense that a single drop contains "dangerous" levels of bacteria; coliform bacterial counts exceeding 1 million per 100 ml for several cities; toxic metals and wastes including phenol and cyanide found in the river; suspended solids covering the river bottom and decomposing, causing gas to bubble up "as if the river were cooking"; and a predominant smell of rotten egg from hydrogen sulfide, which can ruin painting on boats and houses (Wolf 1965).

Normandeau Assoc., Inc., "Historic Water Quality and Selected Biological Conditions of the Upper Merrimack River, New Hampshire" 3 (2012) ("Normandeau 2011b"); see also U.S. Department of the Interior, Report on Pollution of the Merrimack River and Certain Tributaries (Aug. 1966).

As explained in Normandeau 2011b, the Merrimack River, during the 1960s, was polluted by waste from "wood and paper processing mills and textile mills," as well as by untreated sewage from towns situated along the river. Normandeau Associates, Inc. Comments on EPA's Draft Permit for Merrimack Station, Feb. 2012, at 14 ("Normandeau Comments"). "As late as the mid-1960s more than 120 million gallons per day of untreated or minimally treated wastewater were discharged into the Merrimack River." Normandeau 2011b at 3 (citing USGS 2003).

The effect of this contamination on the aquatic biota of the river is well-documented. See Normandeau Comments at 15 (discussing U.S. Department of Interior study measuring nutrient levels, total and fecal coliform, dissolved oxygen and biological oxygen demand levels that indicate harm to the biotic community from the pollution levels of the river). Notably, this contamination, and its resulting nutrient loading to the river, caused a reduction of oxygen available to the biota.

> USDI (1966) notes the sources of pollution to the river were mainly sewage and industrial waste that contain a variety of "obnoxious components," including oxygen "demanding" materials which limit fish and aquatic life by removing [dissolved oxygen] from the water. Other "greasy substances" in the water form surface scums, settleable solids and sludge deposits, and other suspended materials can make the water turbid, limiting light penetration.

Id. at 15.

Clearly, the fish community of the Hooksett Pool in the 1967-1969 timeframe was so impaired by pollution that any improvement in water quality would affect the fish community. However, EPA ignores improvements in water quality that occurred in the Hooksett Pool as a result of the CWA. See Id. at 13-17. EPA instead attributes all changes in abundance levels of some fish species to thermal discharges from Merrimack Station. See, e.g., Determination at 59 (alleging that Station's thermal discharge caused yellow perch population decline); Id. at 60 (alleging that Station's thermal discharge caused pumpkinseed population decline); Id. at 72-74 (alleging "dominance of heat-tolerant species in Hooksett Pool [is] indicative of appreciable harm to the balanced, indigenous community").

In fact, as discussed more fully below, the fish community of the Hooksett Pool in the 1960s timeframe does not meet the required characteristics of a BIP. Thus, it is clearly inappropriate to use a 1967 based fish community that existed in sewage and phosphate polluted waters to assess whether there has been appreciable harm to the Hooksett Pool. EPA's conclusions regarding the effects of Merrimack Station's thermal discharge are therefore flawed.

EPA Response:

EPA addresses this and related comments from Normandeau in a single response below.

Comment II.4.2.3 (ii)	**AR-1552, Normandeau, p. 7-9; AR-1300, LWB, p. 4; AR-285, Normandeau**

The Report *Historic Water Quality and Selected Biological Conditions of the Upper Merrimack River, New Hampshire* (AR-868,) which PSNH submitted in 2012 as part of its response to and comments on the Draft NPDES Permit, documents the nature and substantial extent of the water pollution that had already impaired the Merrimack River as of May 1968, the month when Merrimack Station's Unit 2 commenced operation, and when, according to USEPA, Merrimack Station's thermal discharge began to cause appreciable harm to the aquatic community in Hooksett Pool (Normandeau 2011b). This historical pollution predating Unit 2's operations significantly altered the river's water quality, especially with respect to nutrients, and had a corresponding impact on resident biota. As noted by Wolf (1965):

> Historic observations of this contamination give a picture of a river contaminated beyond our current comprehension: sewage so dense that a single drop contains "dangerous" levels of bacteria; coliform bacterial counts exceeding 1 million per 100 ml for several cities; toxic metals and wastes including phenol and cyanide found in the river; suspended solids covering the river bottom and decomposing, causing gas to bubble up "as if the river were cooking"; and a predominant smell of rotten egg from hydrogen sulfide, which can ruin painting on boats and houses (Wolf 1965).

The sources of contamination were many and included waste from wood and paper processing mills and textile mills (wool and cotton fiber mills) that were situated along the river. However, one of the major sources of significant pollution came from the constant release of untreated sewage wastes into the river (Normandeau 2011b). In 1964, no town in New Hampshire on the mainstem of the Merrimack River treated its wastes (Wolf 1965). As late as the mid-1960s, more than 120 million gallons per day of untreated or minimally treated wastewater were discharged into the Merrimack River (USGS 2003). The effects of this waste effluent impacted all the aquatic biota in the river, including in Hooksett Pool. The effects of this type of sustained nutrient enrichment, and the resulting enhancement of primary producers, ultimately enhances secondary and tertiary productivity (deBruyn et al. 2003).

The United States Department of the Interior ("USDI") measured nutrient levels (nitrogen and phosphate), total and fecal coliform, dissolved oxygen ("DO") and biological oxygen demand ("BOD") levels in the Merrimack River during 1965 (USDI 1966). Levels of ammonia and nitrate were substantially elevated (approaching and exceeding 1 mg/L) in the Concord to Manchester reach of the river, and total phosphorous levels in excess of 0.1 mg/L to near 1 mg/L were recorded. These values indicate a high level of nutrient loading in the Merrimack River during that time period. In addition to the USDI data collected during 1965, sampling in Hooksett Pool during 1969 also demonstrated elevated nutrient levels, with both total phosphorous and total nitrogen levels significantly greater than what would be expected for uncontaminated waters in northeast rivers (Normandeau 2011b). Figure 3-1 (originally presented in Normandeau 1979b) presents the seasonal mean nitrate and phosphate concentrations recorded in Hooksett Pool for the period 1967-1978, when the river was at its most polluted state. In addition to the elevated nutrient levels, total and fecal coliform levels were also elevated (USDI 1966). High BOD readings, indicative of a high level of organic material in the river, were present when measured during the January-April period, with lower levels measured during the summer months (USDI 1966). Lower summer BOD combined with low DO is indicative of significant organic pollution in the river (Normandeau 2011b).

The reduction in oxygen available to Merrimack River biota that was caused by the nutrient loading to the river was the most important effect on the system as a whole. USDI (1966) notes the sources of pollution to the river were mainly sewage and industrial waste that contained a variety of "obnoxious components", including oxygen "demanding" materials that limited fish and aquatic life by removing DO from the water. Other "greasy substances" in the water formed surface scums, settleable solids and sludge deposits, and other suspended materials made the water turbid, limiting light penetration. Industrial wastes can contain chemical or toxic substances that can kill fish and aquatic organisms or promote slime growth.

USEPA and most states consider DO levels below 5 mg/L as detrimental to most temperate freshwater ecosystems (Normandeau 2011b). The DO levels measured during 1965 in the upper Merrimack River were often below 5.0 mg/L during the June through September period throughout the river reach between East Concord and Manchester, NH (USDI 1966). Minimum DO values of 2.8 mg/ L were measured during September at Garvins Falls Dam, just upstream from Hooksett Pool. Low levels of DO were also recorded during studies conducted in Hooksett Pool during the late 1960s, and it was reported in 1969 that rhythmic, daily oxygen pulses, resulting from photosynthetic and respiratory activity of aquatic organisms, ranged up to 80% during days with low flows (Normandeau 1970). Concentrations of DO during the daytime were usually well above 5 mg/L and at times as high as 10 mg/L or higher, but during the evening would fall to as low as <1 mg/L, depending on conditions (Normandeau 1969). Large diurnal changes in DO levels are indicative of a eutrophic condition, caused by high levels of nutrients such as nitrates and phosphorous being discharged into a waterbody (Normandeau 2011b). High nutrient levels result in enhanced primary productivity, which causes large phytoplankton blooms. These phytoplankton blooms were primarily responsible for the large diurnal changes in DO levels recorded in Hooksett Pool during the 1960s, which ranged from supersaturated conditions recorded during the day (due to photosynthesis) to values approaching zero during pre-dawn hours. Eutrophication can decrease biodiversity and change species composition and dominance for all aquatic biota. It can increase growth of gelatinous zooplankton, decrease epiphytic algae and change macrophyte biomass and composition (Smith et al. 1999). It is evident from these data that the pollution levels present in the Merrimack River, and in particular in Hooksett Pool, during the late 1960s were harmful to the resident aquatic biota. Indeed, trout, salmon and other fish species sensitive to low DO levels could not survive in the Merrimack River during the 1960's. Tests conducted by the New Hampshire Water Supply and Pollution Control Commission in 1968 demonstrated that Brook Trout placed in live boxes and lowered to the bottom in Hooksett Pool at Station N-10, 0 and S-17 resulted in mortalities to all fish at every station (Normandeau 1969).

In the 1960s, New Hampshire Water Use Classification and Quality Standards included Classes A through D for rivers, based primarily on dissolved oxygen, coliform bacteria and pH, among other parameters. When the USDI issued its report in 1966, New Hampshire had not yet classified the Merrimack River, but it was expected to do so by June 1967 according to the Federal Water Pollution Control Act (USDI 1966). Had the river been classified as of June 1967, the USDI data would have supported a Class D rating – a level of water pollution unheard of today.

An annual monitoring program conducted in Hooksett Pool between 1971 and 1978 observed that DO levels were higher than those measured during 1965, 1967 and 1968. During the mid-1960s, DO levels had averaged in the mid-3 mg/L range during low flow conditions at the Garvins Falls Dam. By 1972, DO values remained above 6.4 mg/L at Hooksett Pool Monitoring Station N-10. Hooksett Pool water quality was beginning to improve during the 1970s, with the reduction in nutrient loading (Figure 2-1) acting as a major driving force behind those improvements (Normandeau 2011b).

As stated in Normandeau (1979b), "[n]itrite, nitrate, orthophosphate and total phosphate concentrations decreased by an order of magnitude from 1971 to 1972. Municipal and industrial pollution abatement activity in the upper Merrimack River basin prior to 1971 was most likely responsible for this decrease in Hooksett Pond nutrient concentration."

EPA Response:

PSNH and Normandeau generally summarize the results of Normandeau's 2011 Report "*Historic Water Quality and Selected Biological Conditions of the Upper Merrimack River, NH*" (AR-868) which itself is a review of historical water quality assessments. PSNH and Normandeau comment that it is evident, based on the data summarized in the report, that pollutant levels in Hooksett Pool in the 1960s were harmful to resident aquatic biota. EPA agrees generally with the comment that poor water quality conditions during the 1960s resulting from harmful practices such discharging poorly treated wastewater and untreated sewage to the river would likely have affected fish and other biological communities present at the time.

The comments and associated reports demonstrate that Hooksett Pool water quality in the 1960's showed evidence of elevated levels of some pollutants and that, to some extent, levels of certain pollutants have improved since this time period. For example, reductions in concentrations of total and fecal coliform since the 1960s are indicative of the installation of wastewater treatment facilities and their improved capabilities over time. See AR-868, p. 16-21. Sources of pollution such as wood and paper processing, wool and textile mills, and, particularly, septic and sewage discharges, likely contributed to the elevated nutrient levels that were likely an important contributor to depressed DO levels. EPA also agrees that certain water quality parameters, such as nutrient levels, have improved in the Merrimack River since the 1960s. Indeed, such improvements are expected given that these sorts of water quality problems helped to spark enactment of the federal Clean Water Act of 1972, 33 U.S.C. §§ 1251 *et seq.*, and that the various programs implemented under the statute, including the National Pollutant Discharge Elimination System (NPDES) permit program, have had substantial success in forcing reductions in pollutant discharges. Accordingly, reduced industrial and municipal pollutant discharges under the CWA has undoubtedly resulted in improved water quality in the Merrimack River, though the levels of degradation during the 1960s, and the nature and pace of improvements since that time, has likely varied from location to location.

According to Normandeau, DO levels less than 5 ppm have essentially been eliminated from the upper Merrimack River. See AR-868, p. 15-21. DO levels may have been improving even in the late 1960s. According to Normandeau's 1969 report (AR-181), all samples of DO concentration at two of the three Hooksett Pool stations were above 5.0 ppm in 1968, the minimum state criterion for meeting Class B standards. Concentrations did drop to a minimum of 4.8 ppm at Station-0, where the Facility's thermal discharge enters the river,[29] but averaged 6.6 ppm during the sampling period conducted from June through September 1968. There were 42 days of "low flow" conditions in 1968 with flows below 1,000 cfs in Hooksett Pool, according to Normandeau's Supplemental Report No. 1. AR-285, p. 8. These data indicate that, even under

[29] Merrimack Station's thermal discharge was itself likely contributing to low DO concentrations, given the low DO levels at the point of the thermal discharge and the fact that warmer water cannot hold as much DO as cooler water.

the "worst case" conditions (i.e., high ambient temperatures and low-river flow) experienced in the summer of 1968, average DO concentrations still met the minimum state criteria. Normandeau's data suggest that water quality, at least as reflected by DO concentrations, was improving as early as 1967.

Normandeau's comments on the biological impacts related to depressed DO levels in Hooksett Pool are inconsistent with some of its conclusions expressed when it initially assessed these physical-chemical parameters. In its Supplemental Report No. 1 (AR-285, p. 36), Normandeau concluded that even though daily oxygen pulses ranged up to 80 percent during days with low flows, they resulted from photosynthetic and respiratory activities of aquatic organisms, and did not approach levels (at Station S-0) considered to be harmful to the ecological balance of the Merrimack River. Furthermore, Normandeau stated that during high flows, DO (percent saturation) fluctuated as little as 20 percent (AR-285).

In addition, DO concentrations tended to drop during summer low flow (and warmer water) periods under existing conditions in the 1960's, indicating that DO levels during these periods may have been even further depressed in areas of Hooksett Pool affected by the plant's thermal plume. Temperature stratification and associated DO depression in areas of Hooksett Pool downstream of Merrimack Station's thermal discharge have been documented since Unit 2 first came online in 1968. Normandeau's first thermal effects analysis report (AR-181) points out a significant and consistent difference between DO concentrations taken at Station S-17 (just above Hooksett Dam) in 1968 at the surface and at depth. AR-181, p. 96. This monitoring occurred just after Unit 2 came online in May 1968 and continued through early September. The report goes on to state that the variation between bottom and surface DO's was not as apparent at the north station, upstream of the plant's thermal discharge. *Id*. This DO depression at depth occurred where thermal stratification apparently resulted from Merrimack Station's buoyant thermal plume.

EPA agrees that DO levels have generally improved in the upper Merrimack River since the 1960s, but portions of Hooksett Pool has continued to fail state standards for DO concentration and/or saturation, as repeatedly documented by NHDES water quality assessments. *See* https://www.des.nh.gov/organization/divisions/water/wmb/swqa/index.htm. In addition, data collected since 1968 suggests Merrimack Station's surface-oriented thermal plume has consistently caused, or contributed to, DO depressions during summer, low-flow conditions. As previously described in the response to Comment #3, DO depressions within the thermally-influenced portions of Hooksett Pool were documented in 1968, following the start-up of Merrimack Station's Unit 2. Merrimack Station's Annual Report for 2011 (AR-1610), which was developed by Normandeau, reported that the daily average DO concentration at the plant's cooling water intake for Unit 2 (Station N-5) fell below 5.0 ppm for 10 of the 11 days between August 18-28, 2011.

Normandeau comments that biochemical oxygen demand (BOD) is reflective of decreases in dissolved and suspended organic matter in the river. See AR-868. P. 16-21. EPA agrees that, in general, decreased BOD levels would be associated with improving water quality, particularly increased levels of DO, but Normandeau provides no evidence to support the comment that BOD has decreased in Hooksett Pool, or even in the upper Merrimack River as a whole. In its 2011

Water Quality Report (AR-868, p. 17), Normandeau cites its own 1969 report which states that heavily polluted rivers such as the Merrimack generally have an abundance of dissolved substances that impose oxygen demand (BOD). There is no other mention of BOD in that report except for four tables that include BOD values collected in the 1960s, 1970s and 2003. According to Table 9 (p.18) in the 2011 Water Quality Report, the highest BOD level recorded in 1965 was 5.4 ppm. In 1967 and 1968, the BOD values were 2.28 ppm and 1.84 ppm, respectively. In 2003, the values were a low of "<2"ppm and a high of 12 ppm. The 2003 data does not support the comment that BOD has improved since the 1960s, but rather it suggests that BOD levels more than 40 years later are higher than those recorded in 1965.

Normandeau and PSNH comment that nutrient loading, characterized by high levels of nitrogen and phosphorus, was indicative of eutrophic conditions in Hooksett Pool in the 1960s. *See also* AR-868, p. 16-21. LWB also comments that nitrate and phosphate, although not directly toxic to aquatic life, are plant nutrients that stimulate plant growth and sometimes cause blooms of harmful algae. *See* AR-1300, p. 4. EPA agrees that eutrophication is caused by high nutrient levels and that nutrient levels in Hooksett Pool dropped substantially between the late 1960s and early 1970s, but they have not changed significantly since then, according to Normandeau's 2011 Water Quality Report (AR-868, p. 19). Data on nitrogen and phosphorous concentrations in the Merrimack River during the 1960s are limited, but the 2011 Water Quality Report (AR-868, p. 20) indicates that nitrate and phosphate concentrations in the vicinity of Merrimack Station declined by approximately 90% between 1967 and 1972. Normandeau argues that phosphorus in the Upper Merrimack River peaked in 1968 and has declined since then. While 1968 may have been a peak, as the 2011 Water Quality Report indicates, phosphorus concentrations have remained steady since the 1970s when much of the fisheries data evaluated in the 2011 draft Determinations Document was collected. *See* AR-868, p.19. Nitrate levels have also remained consistent with those in the 1970s. In 2003, nitrate was measured at 0.170 mg/l, which is within the range of samples taken between 1971 and 1978, and phosphate levels (TOP/PO4) in 2003 exceeded six of the eight years sampled in the 1970s.

The US Army Corps of Engineers study (USACOE 2012) referenced in the 2011 Water Quality Report (AR-868) provides more data on total phosphorus and orthophosphates concentrations in the Upper Merrimack and Pemigewasset River Study. According to the USACOE report, total phosphorus downstream of Concord, which includes the Garvins, Hooksett, and Amoskeag impoundments, were above EPA recommended levels for streams flowing into impoundments (USACOE 2012). As the report explains, measuring orthophosphates along with total phosphorus provides an idea of how much of the nutrient is bio-available for algal growth. Garvins, Hooksett, and Amoskeag impoundments all had significantly higher orthophosphate concentrations compared to the rest of the river samples (USACOE 2012). However, the amount of algae observed in this area did not reflect these elevated orthophosphate concentrations, suggesting that algal growth was inhibited by some other factor, but not the lack of bio-available phosphorous (USACOE 2012). The report concludes that higher than average flows in the impoundments in the summer of 2009 likely prevented excessive algal growth that could have contributed to stressed DO conditions (USACOE 2012).

Normandeau comments that the increased diversity and abundance of macroinvertebrates is indicative of the absence of concentrated sources of pollution. *See* AR-868, p. 15-21. EPA agrees that increased diversity and abundance is often indicative of good water quality, but new information provided by Normandeau suggests that Hooksett Pool's macroinvertebrate community may have been impacted by the appearance and abundance of the invasive Asian clam (*Corbicula fluminea*). *See Sections II.4.4.5 and II.5 for a detailed discussion on macroinvertebrates and Asian clams*.

Finally, Normandeau states that Hooksett Pool in 1967-1969 would have been classified as a "Class D water" by the State of New Hampshire, although acknowledges that the state never actually assigned it that classification. EPA does not consider the posited hypothetical change in classification in and of itself to be strong evidence of improved water quality. Prior to 1991, Hooksett Pool was considered a Class C water (usable only for non-contact recreational purposes, such as fishing and boating, and for some industrial purposes) but it was legislatively upgraded to Class B in by the state in 1991, as were all Class C waters. Normandeau's Merrimack Monitoring Program Summary Report, states that while low DO concentrations are partially responsible for non-attainment of the legal B classification for this river segment, DO concentrations measured in Hooksett "Pond" during this survey have rarely declined below Class B (6 ppm and 75 percent saturation) levels during the past seven years (1972-1978) (Normandeau 1979). DO excursions below state standards apparently occurred then, as they continue to do, in the impounded sections of the Merrimack River, namely the Garvins, Hooksett, and Amoskeag pools, according to NHDES water quality assessments (NHDES 2008, 2010, 2012). Furthermore, while substantial reductions in phosphorous between the 1960s and 1970s clearly represent important improvements in reduced pollutant loadings, the repeated failure to meet state water quality standards within the impounded portions of the upper Merrimack River, including Hooksett Pool, does not support the argument that water quality improved dramatically since the 1970s. Therefore, EPA does not find compelling the argument that water quality improvements since the 1960s alone explain changes in Hooksett Pool's biological communities. *See* https://www.des.nh.gov/organization/divisions/water/wmb/swqa/2018/index.htm

In sum, EPA agrees with the comments that the sampling of certain water quality parameters during the 1970's, including nutrient concentrations, indicated marked improvements over sampling results from the 1960s. From the information provided by Normandeau's documents and comments, it appears that water quality in Hooksett Pool, as measured by the physical-chemical parameters sampled, were, for the most part, suitable for sustaining a BIP during the 1970s. At the same time, many water quality problems, including low DO concentrations, have persisted in Hooksett Pool beyond even the 1970s.

4.2.4 Current Water Quality in Hooksett Pool

Comment II.4.2.4	**AR-872, Normandeau, pp. 94, 118**
See also AR-868, Normandeau, pp. 15-16	

[Responding to AR-618, p. 82-83 and p. 119] Normandeau disagrees with EPA's assertion that Hooksett Pool's water quality is currently impaired. This is an odd assertion given that the State granted a CWA § 401 certification to PSNH for the Merrimack Hydroelectric Project (which comprises the Garvins Falls, Hooksett, and Amoskeag Dams and Hydroelectric Stations) following the completion of water quality monitoring in 2002 and 2003 (Gomez and Sullivant 2003). In addition, a recently released Army Corps of Engineers report stated that water quality within Merrimack River impoundments is good (USACOE 2011). These governmental actions are not consistent with the contention of poor water quality in Hooksett Pool.

The Gomez and Sullivan (2003) report explains why low DO was measured on this one date in 2002. According to the report, these were worst-case conditions due to very low flows (below the 95% exceedance interval for low flows), there was no rainfall, and there were above normal air temperatures. Because this was a diurnal study, the low DO values measured were near dawn, when BOD would have caused the low DO readings. Gomez and Sullivan (2003) identify the cumulative effects of a wastewater discharge into the river above Hooksett Dam as a possible cause.

EPA Response:

EPA's statements in the 2011 Draft Determinations Document that Hooksett Pool's water quality was impaired at that time were based on NHDES's water quality assessments, which had repeatedly concluded that areas within Hooksett Pool failed to meet state water quality standards based on the documented non-attainment of certain pollution parameters identified in the assessments, including DO concentration and saturation. In the last six assessments (2008, 2010, 2012, 2014, 2016, 2018), NH DES's Final Attainment Status of impaired waters (also referred to as the "303d list"), the Merrimack River within Hooksett Pool (upstream of the plant) is listed as being in "Severe Impairment" for DO concentration and saturation (See NHRIV700060302-25-02, NH DES website).

The Final 2018 Section 303(d) Surface Water Quality List indicates that the aquatic life integrity designated use in the Merrimack River upstream of the discharge (Segment NHRIV700060302-25-02) is impaired for dissolved oxygen and dissolved oxygen saturation.[30] The Hooksett Pool impoundment (Segment NHIMP700060802-02), which begins just downstream of the discharge, is listed as "good" for dissolved oxygen and "likely good" for dissolved oxygen saturation but "likely bad" for turbidity and due to nonnative fish, shellfish, or zooplankton. The segment downstream of Amoskeag Dam (NHRIV700060802-14-02) is "severely impaired" for dissolved oxygen saturation but "good" for dissolved oxygen. It is also listed as "poor" for aluminum and E. coli (recreational designated uses), "likely bad" due to nonnative fish, shellfish, or zooplankton, and "poor" for pH and mercury. The "likely bad" status due to the presence of nonnative fish, shellfish, or zooplankton may due to the presence of non-native organisms in Hooksett Pool; in particular, the Asian clam (*Corbicula fluminea*). The existence of this highly invasive species was first brought to EPA's attention by Normandeau during the public comment period for the 2011 Draft Permit in the report "Comparison of Benthic Macroinvertebrate Data Collected from the Merrimack River near Merrimack Station During 1972, 1973, and 2011," dated January 2012." (Normandeau 2012a). The presence of the Asian clam, notably limited to areas of Hooksett Pool within the plant's thermal influence, is discussed in greater detail in Section 5 of this document.

[30] https://www.des.nh.gov/organization/divisions/water/wmb/swqa/2018/index.htm

The Gomez and Sullivan study provides data for the lower portions of Hooksett Pool that are not reflected in the State's water quality assessment covering 2002-2003. This report presents temperature and DO data collected in July and August, 2002, at stations in the Amoskeag Pool, Hooksett Pool, and Garvins Pool. The data not only clearly captures thermal stratification in Hooksett Pool downstream from the plant's thermal discharge, but also associated DO depressions that fall below the state's limit of 5.0 ppm (Gomez and Sullivan 2003). According to the Gomez and Sullivan study (2003), during monitoring in July 2002, DO concentrations in Garvins Pool never dropped below 7.1 ppm, and were never below 6.8 ppm in Amoskeag Pool. In Hooksett Pool, while surface DO levels were similar to Garvins and Amoskeag pools (7-8 ppm), DO levels began dropping at a depth of about 1 meter (3 feet) and continued to drop steadily towards the bottom where concentrations ranged from 4.9-5.6 ppm. Temperatures in Garvins Pool during this time period ranged from approximately 24.4° - 26.1°C (75.9°- 79.0°F) at the surface, while in Hooksett Pool, temperatures ranged from 27.2°-29.9°C (80.1°-85.8°F) at the surface. Temperatures in Garvins Pool typically decreased by no more than 1°C between the surface and the bottom, but in Hooksett Pool they dropped by as much as 2.9°C (5.2°F) between the surface and the bottom, consistent with the effects associated with a buoyant thermal plume.

In August 2002, DO depressions in Hooksett Pool were even more extreme. DO concentrations at the surface in all three pools ranged between approximately 6.6-8.1 ppm, and both Garvins and Amoskeag pools demonstrated fairly uniform DO concentrations throughout the water column. In contrast, DO concentration levels in Hooksett Pool dropped dramatically at depth; eight of nine samples were less than 5.0 ppm at the bottom with five of the samples at or below 4.0 ppm. The lowest observed value (3.5 ppm) was collected at 8:00 am when DO depressions can occur naturally due to lack of photosynthesis overnight combined with the respiration of aquatic organisms. However, excursions below state water quality standards for DO concentration did not just occur in the early morning hours. A bottom DO level of 3.9 ppm was observed at 3:00 pm (Gomez and Sullivan, 2003) when photosynthesis should be near the highest daily levels. The sampling in Hooksett Pool occurred just above the Hooksett Dam, roughly 2.9 miles downstream from where Merrimack Station discharges its heated cooling water into the river. This information provides further evidence that the plant's thermal plume can affect the entire lower half of Hooksett Pool.

Gomez and Sullivan (2003) concluded that the river was experiencing extremely low flow conditions during the summer of 2002, but that the water columns in both Garvins Pool and Amoskeag Pool were very well mixed and oxygenated, and had temperature and DO that followed typical daily patterns. In Hooksett Pool, on the other hand, thermal stratification was occurring and DO levels fell below 5.0 ppm. The report goes on to state that:

> [t]he temperature regime in this impoundment is dictated somewhat by the cooling water used at Merrimack Station upstream of the dam. It is unusual to see lower dissolved oxygen levels in the cooler portion of the water column at Hooksett because colder water has the potential to hold more dissolved oxygen.

Gomez and Sullivan (2003) present possible causes for the low DO levels at the bottom of the Hooksett impoundment including temperature increases from the cooling water discharge upstream (*i.e.*, Merrimack Station), extremely low river flows, a lack of submerged aquatic vegetation at the sampling site, and the cumulative effects of wastewater treatment plant discharges into the river above Hooksett Dam.

EPA was not able to locate the 2011 Draft U.S. Army Corps of Engineers report referenced in Normandeau's comment (AR-872, p. 118) as stating that water quality within Merrimack River impoundments is "good." EPA reviewed the subsequent version of that Draft report but could find no such general conclusion (AR-1254, Upper Merrimack and Pemigewasset River Study, Field Program 2009-2012, Draft Data Report, September 2012). EPA did, however, find in that report useful information on temperature, DO, and nutrients in Hooksett Pool and adjacent impoundments during the 2009-2010 sampling period, which are discussed below. EPA has also provided detailed discussion of other water quality data and believes that this more detailed discussion is of more importance to the analysis for this permit than any generalized statement that the Corps may or may not have made about whether or not water quality in the Merrimack's impoundments was "good."

According to the Upper Merrimack and Pemigewasset River Study report, two low-flow events in 2010 were captured (July 27 and September 21,) and one high-flow event in 2012 (May 17). The report identifies notable temperature increases of approximately 3°C (5.4°F) and 6°C (10.8°F) during the low flow events, which it attributes to Merrimack Station's cooling water discharge (ACOE 2012). Figure 4-12e of the report, depicts the significant variation in temperature from the surface to the bottom in Hooksett Pool during the two low-flow events. During the second low-flow event (September 21, 2010), the high temperature stratification (>6°C (10.8°F)) is associated with depressed DO percent saturation levels that fall below the state standard of 75 percent, though DO concentration remained between 6-7 ppm. DO levels measured during the high flow event (May 17, 2012) were generally at or near saturation, demonstrating the comparatively greater effect thermal stratification can have on DO during low-flow events compared to high-flow events.

4.3 Evaluation of Historical and Recent Fisheries Data

4.3.1 A Thorough Review of the Totality of the Evidence Submitted Demonstrates that the Aquatic Community Currently in the Hooksett Pool is a BIP and that No Appreciable Harm to that BIP has Resulted from Merrimack Station's Thermal Discharge

Comment II.4.3.1	**AR-1548, PSNH, pp. 21-26**
See also AR-1300, LWB; AR-1554, LWB, pp. 5-6; AR-1153, Normandeau	

In its Statement, EPA advises it is "reevaluating the effects of shorter-term thermal conditions, particularly on species that may be especially sensitive to such temperature excursions in relation to their ability to survive and compete with more thermally-tolerant species."[103] As demonstrated in the submissions of Normandeau, Enercon and Dr. Barnthouse since the 2012 Comments, speculation based on a comparison of abstract temperature data with theoretical fish tolerance thresholds developed in laboratory studies is not only unwise but is also unnecessary. The actual data from 40+ years of intensive biological study demonstrates Hooksett Pool is a BIP and that river temperatures, short and long-term, have not caused appreciable harm to the fish community of Hooksett Pool. PSNH has met its thermal variance burden through multiple, mutually supporting analyses that, taken together, clearly demonstrate an absence of harm caused by the operation of Merrimack Station. These include analyses of fish community composition, long-term trends in the abundance of representative important fish species ("RIS"), and key biological characteristics of the fish belonging to these species. Many of these analyses compared the fish community in Hooksett Pool to the communities present in the adjacent upstream (Garvins) and downstream (Amoskeag) Pools.

From 1972 through 1978, Normandeau, on behalf of PSNH and under the direction of the TAC, performed thermal and biological monitoring, including electrofish sampling, in the Hooksett Pool to characterize the river biota for the purpose of detecting potential long-term trends relating to the Station's operations.[104] It repeated the same thermal and biological monitoring and sampling program during 1995 and again during 2004, 2005, 2010, 2011, 2012, and 2013 to obtain additional annual observations of the fish communities present in the Merrimack River, including the RIS selected and approved by the TAC.[105]

The four years of sampling from 2010 through 2013 are especially relevant, because these surveys included Garvins and Amoskeag Pools as well as Hooksett Pool.[106] During all four years, samples were collected at the same 24 stations (6 in Garvins Pool, 12 in Hooksett Pool, and 6 in Amoskeag Pool), during the months of August and September. The same sampling procedures were used at every station during each of these 4 years. In addition, in 2012, spring sampling was conducted in all three Pools to obtain information concerning the spawning condition of 2 species of interest—white sucker and yellow perch—species EPA had identified as being thermally sensitive that have declined in abundance because of Merrimack Station's thermal discharge.[107] As explained by Dr. Barnthouse:

> These surveys provide a high-quality data set for evaluating whether the operation of Merrimack Station is causing observable adverse changes in the fish community of the Hooksett Pool, as compared to communities in upstream and downstream pools. Examples of such changes would be comparatively low or high abundance of thermally sensitive fish species, anomalous values of community metrics, or impaired reproductive condition. Absence of these types of changes would indicate that the fish community in Hooksett Pool is not being affected by station operations.
>
> The fact that the surveys included both upstream and downstream pools is especially important. If only the upstream Garvins Pool had been sampled, any differences between Hooksett and Garvins Pools could be due to natural upstream-downstream gradients in physical and biological conditions, not due to Merrimack Station's thermal discharge. The existence of such gradients was recognized more than 100 years ago (e.g., Shelford 1911), and is well- established in the ecological literature (Vannote et al.

> 1980). According to these ecological principles, the fish communities in Garvins, Hooksett, and Amoskeag pools should be different, but should differ in ways that are consistent with the expected upstream to downstream gradient in environmental conditions. Specifically, Garvins and Amoskeag Pools should be less similar to each other than either is to Hooksett Pool. Finding that these pools are *more* similar to each other than to Hooksett Pool would indicate that Hooksett Pool deviates from the expected gradient and could be adversely affected by Merrimack Station.[108]

In his 2016 report, Dr. Barnthouse considered statistical analyses of trends data for 15 resident fish species set out in Normandeau 2011a and the report's comparisons between the fish communities present in Garvins, Hooksett, and Amoskeag Pools.[109] Similar to Normandeau's finding of no appreciable harm, Dr. Barnthouse found Merrimack Station's thermal discharge has caused no appreciable harm to the BIP of Hooksett Pool. Among his other findings supporting no appreciable harm, Dr. Barnthouse concluded:

> Taxa Richness, meaning the number of different fish species collected, has increased from 12 species collected in 1972 to 19 species collected in 2011. Except for the anomalous year 1995 when bluegill dominated the electrofishing catch, species diversity as measured by the Shannon Diversity Index has increased since the 1970s. Since environmental stress has been frequently found to decrease taxonomic richness and diversity (Rapport et al. 1985), these increases could be responses to improved water quality in the Merrimack River. They are definitely inconsistent with the expected effects of thermal stress, which would be to decrease richness and diversity. Normandeau (2011b) also found that the percent of species classified as "generalist feeders," another indicator of environmental degradation, has decreased. The percent of species classified as pollution-tolerant has varied but not noticeably changed. ***Taken together, these community-level results support a conclusion that there has been no appreciable harm to the BIP due to the operation of Merrimack Station.***[110]

Further, Dr. Barnthouse found the "most revealing results" presented in Normandeau's 2011b report to be its comparisons of the relative abundance of species and "catch-per-unit- effort" ("CPUE") between the fish communities in Garvins, Hooksett, and Amoskeag Pools.[111] Except for a few occasionally abundant species such as tessellated darter (Garvins Pool, 2010) and margined madtom (Amoskeag Pool, 2012), the most abundant species during all four years were species discussed in EPA's § 316 Determination and identified as RIS by Normandeau.[112] Within each Pool, the same species tended to dominate numerically in most or all four years.[113] All three Pools consisted of a mix of warmwater, coolwater, and warmwater/coolwater species.[114] Three coolwater species were numerically dominant in Garvins Pool, as compared to 2 in Hooksett Pool and 1 in Amoskeag Pool. Although this pattern suggests a potential upstream-downstream gradient in thermal tolerance, examination of the percent contribution of coolwater species to the total catch does not support the existence of such a gradient. During the years 2010-2013, the percent contributions of coolwater fish to the total catch in Hooksett Pool is actually higher than in Garvins Pool for three of the four years.[115] Further, although no upstream-downstream trends in thermal tolerance are evident in the survey data, there is a clear trend in taxonomic composition, specifically in dominance of the fish community by members of the family Centrarchidae.[116] Centrarchids collected in the Garvins, Hooksett, and Amoskeag Pools during 2010-2013 include black crappie, bluegill, largemouth bass, pumpkinseed, redbreast sunfish, rock bass, and smallmouth bass. Four of the five most abundant species in Amoskeag Pool are centrarchids, as are four of the six most abundant species in Hooksett Pool. The trend is clear. For all four years, centrarchids contributed the greatest percentage of the total fish community in Amoskeag Pool and the least in Garvins Pool. Hooksett Pool was intermediate with respect to percent centrarchids in all four years.[117] Upstream-downstream gradients in abundance of individual fish species are also apparent in the fish community survey data. Total CPUE was highest in Garvins Pool, lowest in Amoskeag Pool, and intermediate in Hooksett Pool.[118]As explained by Dr. Barnthouse:

> This result implies that there is a clear upstream-downstream gradient in fish abundance within these three pools, consistent with established ecological principles. Abundance is highest in the upstream Garvins Pool, lowest in downstream Amoskeag Pool, and intermediate in Hooksett Pool.[119]

[101] *See, e.g.,* U.S. EPA Region 1, Clean Water Act NPDES Permitting Decisions for Thermal Discharge and Cooling Water Intake from Kendall Station in Cambridge, MA, 316(a) and (b) Determination Document (June 8, 2004) ("Mirant Kendall Determination"), at 34-35 (question under § 316(a) is what informed scientific judgment would be without speculation about evidence not in record). This document is attached hereto as Exhibit 9.

[102] *See* AR-846; AR-1170.

[103] AR-1534 at 40.

[104] *See* AR-1150; AR-1149; AR-1148; AR-1147; AR-1146; AR-1145; AR-1155; AR-1151; AR-1159; AR-1156; AR-198; AR-364; AR-1203. The full title of the Normandeau reports covering the span of 1969-2012 are provided on pages 13-16 of these comments.

[105] *See* AR-184; AR-1153; Normandeau 2017a.

[106] *See id.*

[107] *See id.*

[108] LWB 2017 Analysis at 1-2.

[109] AR-1300 at 16-18.

[110] Id. at 16-17 (emphasis added).

[111] *Id.* at 17.

[112] LWB 2017 Analysis at 2-4.

[113] *Id.* at 4.

[114] *Id.*

[115] *Id.*

[116] *Id.* The centrarchids are among the most diverse and abundant groups of freshwater fish in North America. *Id.*

[117] *Id*. at 4-6.

[118] *Id*. at 6.

EPA Response:

PSNH comments that it "repeated the same thermal and biological monitoring and sampling program during 1995 and again during 2004, 2005, 2010, 2011, 2012, and 2013" that was performed from 1972-1978. EPA notes first that the recent biological sampling program was similar to, but not the same as, the sampling from the 1970s. Most significantly, Normandeau eliminated trapnet fish sampling beginning in 2010. Trapnet sampling was part of the original fish sampling study design developed by NHFGD in the 1960's and had been adopted by the TAC for sampling conducted in the 1970s, 1995, and 2004 and 2005. Trapnet sampling had provided an important data set for understanding changes in fish abundance independent of electrofishing sampling. Normandeau's Fisheries Survey Analysis for the period 1967-2004 (AR-3) revealed an 89.5 percent drop in abundance for all species combined that comprised the Hooksett Pool fish community in the 1970s compared to the 2000s community (2004, 2005) based on trapnet sampling it had conducted. Normandeau then claimed that this sampling method is not appropriate for riverine locations, but the reason it was used in the first place was because Hooksett Pool (commonly referred to as Hooksett "Pond" in early reports) is more lacustrine (lake-like) than riverine due to being impounded on both ends. *See*, *e.g.*, AR-1, AR-198.

LWB applies Vannote et al.'s (1980) (AR-1553, p. 2) "River Continuum Concept" to argue that a clear upstream-downstream gradient in fish abundance within the Amokseag, Hooksett, and Garvins Pools is consistent with a finding of no appreciable harm. The Vannote et al. (1980) study addressed structural, functional, and biological characteristics of a "lotic" system, specifically in reference to "natural, unperturbed stream ecosystems," though the authors suggest the concept could possibly apply to systems affected by unnatural disturbances (*e.g.*, impoundments). In EPA's view, these concepts do not appear to be directly applicable to the three pools in the Merrimack River, which have been created by, and are managed as, three hydroelectric projects. In addition, the scale of the upstream-downstream gradient as LWB has applied it is much smaller than that discussed in the Vannote et al. (1980) study. Fish sampling around Merrimack Station targets roughly 15 miles of a heavily altered section of a 117-mile river, whereas in Vannote et al. (1980), the authors were comparing differences in river segments that vary considerably in size and other structural characteristics moving from the headwaters down to the mouth of a river system. In contrast, the structural characteristics of Garvins, Hooksett and Amoskeag Pools are similar, according to studies conducted by Normandeau (AR-869). Therefore, the upstream-downstream gradient concept does not seem applicable to differences in fish communities found between these three river impoundments in relatively close proximity to each other. Vannote et al. (1980) also suggests that fish communities along the river shift from coolwater species low in diversity to more diverse, warmwater communities (AR-1777, p. 133), but the fish communities of these three pools do not consistently follow that pattern, according to Normandeau's most recent fisheries report (AR-1551).

LWB comments (AR-1300, pp. 16-17) that the observed increase in species diversity and richness, evident in the diversity indices used in several of the recent reports (e.g., AR-1300, AR-

1554, AR-1552, AR-1153, AR-1551) are “inconsistent with the expected effects of thermal stress, which would be to decrease richness and diversity.” This argument is not supported by the expectation by Vannote et al. (1980) that natural systems further upstream would have coolwater fish communities *low* in diversity. Conversely, warmer systems downstream would tend to have greater biodiversity than colder systems, all other things being equal. LWB points to Rapport et al. (1985) in support of higher diversity being a desirable indicator of community health, and often it is, but Rapport considers the effects of pollution more generally, and not the effects of thermal pollution, specifically.

PSNH comments, based on supporting analysis by LWB and Normandeau, that community-level results, including taxa richness, species diversity as measured by the Shannon Diversity Index, the percent of species classified as “generalist feeders,” and comparisons of relative abundance and “catch-per-unit- effort” (“CPUE”), between the fish communities in Garvins, Hooksett, and Amoskeag Pools collectively support a conclusion that there has been no appreciable harm to the BIP due to the operation of Merrimack Station. One question regarding the utility of species richness or diversity in Normandeau’s most recent fisheries analysis (AR-1551) is the fact that Hooksett Pool had twice the number of sampling sites as either Garvins or Amoskeag pools (12 vs. 6). This means there was twice the number of chances to catch a novel or rare species. EPA addresses each of these arguments in detail in Response to Comment II.4.4.1. Generally, many of the arguments put forth do not support a finding of “no appreciable harm” due to Merrimack Station’s operations.

At the same time, EPA acknowledges that the lack of decreasing trends in abundance for coolwater species considering the most recent data from 2010-2013 suggests thermal conditions in Hooksett Pool may be improving for the resident species most sensitive to elevated temperatures from the Facility’s thermal discharge. In addition, the proportion (in relative abundance) of warmwater species to coolwater species in Garvins Pool and Hooksett Pool is similar and suggests that the Garvins Pool fish community can provide another viable point of comparison to represent the BIP. EPA also considers the Hooksett Pool fish community of the 1970s to provide an acceptable representation of the proper BIP.

EPA has evaluated the data from more recent years since Merrimack Station shifted its operational profile to more like a seasonal peaking facility rather than that of a baseload generator. This evaluation indicates that the new operational profile is, not surprisingly, associated with lower water temperatures in the river. These lower water temperatures should provide habitat conditions that provide reasonable assurance of the protection and propagation of the BIP going forward (*i.e.*, prospectively) and, as a result, support granting permit limits based on a CWA § 316(a) variance that are consistent with the Facility’s reduced thermal discharges.

4.3.2 Current Fish Communities in Hooksett Pool

Comment II.4.3.2	**AR-864, PSNH, pp. 17, 33** **AR-872, Normandeau, pp. 21, 33, 46, 59**

Normandeau (AR-872, p. 21) and PSNH (AR-864, p.17) comment that, based on the biological sampling data from 1972-2011, the current community in Hooksett Pool is the proper BIP for considering PSNH's request for a thermal variance. According to PSNH and Normandeau, the current aquatic community in Hooksett Pool is characterized by (1) diversity at all trophic levels, (2) the capacity to sustain itself through cyclic seasonal changes, (3) the presence of necessary food chain species, and (4) non-domination by pollution tolerant species and, therefore, meets all of the characteristics of a BIP as defined by the regulations at 40 CFR 125.71(c) (AR-864, p.17; AR-872, p. 21, 46).

PSNH comments that EPA incorrectly selected the compromised fish community that survived in the toxic pollutant-impaired Hooksett Pool of the 1960s as the BIP and did not take into consideration and appropriately evaluate all of the fish, macroinvertebrate and other aquatic sampling data from 1972-2011 (AR-864, p. 33). PSNH maintains that if this data had been evaluated, EPA would have concluded that the current fish community in the Hooksett Pool is the proper BIP for the purpose of considering PSNH's variance renewal request (AR-864, p. 33).

PSNH and Normandeau agree with EPA that the resident fish in Hooksett Pool comprise a single population due to their high mobility and lack of barriers from moving around the entire pool. Normandeau's analyses of fish communities in Garvins, Hooksett, and Amoskeag pools is based on 2008-2011 data from sampling points throughout these entire pools. According to Normandeau, fish species in Hooksett Pool comprise a single population and it is, therefore, unclear why, in Section 5.6.2.1 (AR-618, p. 42) of the 2011 Draft Determinations Document, EPA presents the results of its own analysis of fish captured in the ambient and thermally-influenced zones of Hooksett Pool (AR-872, p. 59).

EPA Response:

The evaluation of thermal effects from Merrimack Station on Hooksett Pool's fish community has included an assessment of the fish assemblages in both the ambient and thermally-influenced sections of the pool since thermal impact assessments were first conducted by Normandeau and NHFGD in the 1960s. There is no written record EPA is aware of that explains why NHFGD and Normandeau Associates did not also use Garvins Pool as a reference for making comparisons in the initial studies, instead of focusing the assessment on comparisons between the different zones of the Hooksett Pool itself, but this study design has been continued throughout the 1970s, in 1995, and again in 2004 and 2005. Indeed, the commenters' own approach to assessing long-term impacts to the Hooksett Pool fish community was described in Normandeau's comprehensive 2007 Fisheries Analysis Report as follows:

> If a statistically significant negative (decreasing) trend was observed, it was interpreted with respect to whether the Station's thermal discharge may be a contributing factor by examining the time series trend in a subset of the data representing the population of the RIS [Representative Important Species] in the Thermally-influenced portion of Hooksett Pool compared to the population if the RIS in the ambient water upstream from the influence of Merrimack Station's thermal discharge. Finding no significant trend over time or finding a significant

> increasing trend was considered to statistically support a finding of "no prior appreciable harm.

AR-3, p. 25. Clearly, Normandeau embraced this approach to evaluating thermal impacts within Hooksett Pool (*i.e.*, comparing thermally-influenced versus ambient sections of the Pool) for the past 40 years, up until 2007. Normandeau also used it in its consulting work supporting the Vermont Yankee power plant's request for a CWA § 316(a) variance, in which it assessed impacts to the "lower" Vernon Pool by comparing results from that area with those from sample sites *upstream* of the plant's thermal discharge (See Normandeau 2004). Even Normandeau's analysis for a June 2009 report on the biocharacteristics of yellow perch and white sucker populations in Hooksett Pool (Normandeau 2009) evaluated differences between the "ambient" and "thermally-influenced" portions of Hooksett Pool. As explained in the 2011 Draft Determinations Document, EPA did not agree with Normandeau's conclusions that demonstrated declines in fish abundance, both within the thermally-influenced and ambient sections of Hooksett Pool, reflected impacts other than those from the plant's thermal discharge. Given a fish's ability to move anywhere within the pool, EPA argued that a decline in "populations" in both segments of the pool could indeed reflect impacts related to the plant's effects in the thermally-influenced segment. Thus, while EPA and Normandeau did not agree on the ramifications of this information, both agreed that it was reasonable to compare the results from areas of the Hooksett Pool upstream and downstream of Merrimack Station's thermal discharge.

EPA still maintains that a *decrease* in abundance of a particular species in both the ambient and thermally-influenced sections of Hooksett Pool does not, by itself, demonstrate that factors other than the plant's thermal discharge are causing the decline, particularly for more mobile species. But comparisons with similar communities in water bodies unaffected by thermal discharges that are in close proximity to Hooksett Pool can provide an additional opportunity to evaluate how the species or community is faring in the absence of thermal affects. It also provides a means to assess how the fish community in the ambient portion of Hooksett Pool compares to these other "ambient" reference locations.

Normandeau decided to sample again in 2010 and 2011, but added two new sampling stations to the upper (ambient) section of Hooksett Pool. In doing so, there was for the first time an equal number of sampling stations in the ambient and thermally-influenced zones, which would be more appropriate for conducting comparisons between the two segments of Hooksett Pool. Additionally, six stations were sampled in Garvins Pool and Amoskeag Pool. Despite this apparent effort to standardize sampling in all four river segments (i.e., from north to south: 6 stations each in Garvins Pool, the ambient zone of the Hooksett Pool, the thermally-influenced zone of the Hooksett Pool, and Amoskeag Pool), Normandeau did not provide an analysis differentiating between the ambient and thermally-influenced sections of Hooksett Pool in its Fisheries Survey Analysis of 1972-2011 Catch Data report (Normandeau 2011). Instead, for the first time since 1967, and without providing an explanation for changing the analytical approach, Normandeau lumped all the data from the ambient and thermally-influenced sections together under "Hooksett Pool." Fortunately, Normandeau did provide fish sampling results for the north (ambient) and south (thermally-influenced) portions of Hooksett Pool in its 2017 fisheries report (ARA-1551, pp. 16 and 19).

There are clearly distinctions in the fish assemblages found in the upper (ambient) and lower (thermally-influenced) segments of Hooksett Pool, based on both electrofish and trapnet data. Normandeau's cluster analysis demonstrates that the fish community in the upstream (ambient) section of Hooksett Pool more closely resembles that of Garvins Pool than it does the community found in the lower (thermally-influenced) portion of Hooksett Pool. (*See* AR-871, pp.19-20).

4.3.3 EPA Should Have Considered the Adjacent Garvins Pool as the Point of Reference for its Appreciable Harm Determination

Comment II.4.3.3 (i)	**AR-846, PSNH, pp. 34-36**
See also AR-872, Normandeau, pp. 21, 83, 113	

As demonstrated in § IV.A.2 above, the current fish community in the Hooksett Pool is a BIP. A comparison to assess appreciable harm is therefore unnecessary. However, instead of analyzing the current fish community in the Hooksett Pool with respect to the characteristics of a BIP, EPA decided to compare the current fish community with that of the Hooksett Pool in the 1960s. This was improper – comparing the current fish population with that of the 1960/1970 timeframe ignores the "corresponding changes to the river's indigenous aquatic populations" resulting from improved water quality of the river. See id. If EPA wanted to confirm the lack of appreciable harm evidenced by the existence of a BIP in the Hooksett Pool, it should have instead used the fish community in the Garvins Pool as a point of reference. Such a comparison also confirms that no appreciable harm has resulted from thermal discharges at Merrimack Station. The EAB has recognized the flexibility with which EPA can and should consider the BIP. In Wabash, the EAB stated that the definition of BIP "is in the nature of a guideline: it describes important factors to be weighed and considered, but it does not spell out an all-inclusive checklist of criteria that lends itself to rote application." As PSNH's consultants have concluded, the Garvins Pool is a much more appropriate BIP upon which EPA should have based its analysis.

The Garvins Pool shares similar characteristics with the Hooksett Pool

The Garvins Pool is located immediately upstream of the Hooksett Pool approximately 2 ½ miles north of Merrimack Station (with PSNH's FERC-licensed Garvins Falls Hydroelectric facility forming the border between the two pools) and shares similar characteristics: "Physical habitat types within both the Garvins and Hooksett impoundments were surveyed during 2010 (Normandeau 2011d). "Sand/silt/clay was the abundant substrate type within both pools, followed by boulder and woody debris." Normandeau Comments at 84. Like the Hooksett Pool, the Garvins Pool has experienced improved water quality and associated environmental changes. The one key difference between the Hooksett Pool and the Garvins Pool is that the Garvins Pool has not been subject to Merrimack Station's thermal discharge. Thus, the current fish community in the Garvins Pool Provides a more appropriate point of comparison that may allow the identification of trends in Hooksett Pool that are potentially due to Merrimack Station's thermal discharge . . . [T]he biocharacteristics data collected during this 2008-2011 sampling confirms that when compared to the fish community in Garvins Pool, the fish community in Hooksett Pool in general, and individual species in Hooksett Pool in particular, is diverse, healthy and productive. Id. at 21-22.

This approach of using a reference, or control, water body from which to determine impacts from the thermal discharge is widely accepted.

The EAB and EPA have both acknowledged instances in which it is appropriate to "use a nearby water body unaffected by the existing thermal discharge as a reference area." See Letter from EPA Region 4 to North Carolina Department of Environment and Natural Resources (Nov. 16, 2010). For Duke's Cliffside Station, EPA concludes that "[e]xamination of an appropriate reference area may be applicable in this case," relying on the EAB"s decision in Brayton Point I, 12 E.A.D. 490 (2006). In Brayton Point I, EPA relied on a "hypothetical community" of fish, i.e., a fish community that may have existed before the plant began operation. There, the issue was whether EPA should have instead used a nearby fish community as a reference point, rather than the hypothetical community it chose. Unlike the Garvins Pool, however, the nearby fish community considered in Brayton Point I was found by EPA to have been impacted by the plant's thermal discharge. Here, the Garvins Pool (being upstream and separated by a dam from the Hooksett Pool) clearly has not been affected by Merrimack Station's thermal discharge; therefore, use of it as a reference area is supported and appropriate. EPA recognizes the need for using a reference or control water body in other contexts as well. For instance, when determining Total Maximum Daily Loads ("TMDLs"). In its "Protocol for Developing Sediment TMDLs," EPA states, "Where local experience has been gained in applying sediment indicators, it is often possible to identify target conditions through analysis of historical conditions or reference stream conditions in relatively high quality parts of the watershed." See US EPA Office of Water, Protocol for Developing Sediment TMDLs EPA 841- B-99-004 (1st ed. 1999), available at www.epa.gov/owow/tmdl/sediment/pdf/sediment.pdf. EPA should have looked to the Garvins Pool to assess whether the thermal discharge from Merrimack Station had caused appreciable harm to the BIP of the Hooksett Pool.

EPA Response:

EPA addresses this and related comments from Normandeau in a single response below.

Comment II.4.3.3 (ii)	**AR-1552, Normandeau, p. 15-16**
AR-867, Normandeau	

Rather than designate the compromised fish community that survived in the conventional and toxic pollutant-impaired Hooksett Pool of the 1960s as the Hooksett Pool BIP, USEPA should find that the current fish community in Garvins Pool provides an appropriate point of comparison that may allow the identification of trends in Hooksett Pool that are potentially due to Merrimack Station's thermal discharge. The current fish community in Garvins Pool meets USEPA's definition of "balanced indigenous population," because it is a community characterized by (1) diversity at all trophic levels, (2) the capacity to sustain itself through cyclic seasonal changes, (3) the presence of necessary food chain species, and (4) non-domination by pollution-tolerant species (40 C.F.R. §125.71(c)).

A spatial comparison among the fish communities sampled in Garvins, Hooksett and

Amoskeag Pools during the years of 2010, 2011, 2012, and 2013 was performed using the Bray-Curtis percent similarity index (Normandeau 2011a; Normandeau 2017a). This analysis showed that differences existed among the fish communities of each of the three pools, and that there was a trend of decreasing similarity among pools moving downriver from Garvins Pool to Hooksett Pool to Amoskeag Pool. Comparing the 2010 fish communities, the Bray-Curtis similarity was greater between Garvins and Hooksett Pools (64.4%) than it was between Garvins and Amoskeag Pools (23.4%). Results for subsequent sampling years produced a comparable trend; Garvins and Hooksett Pool values of 43.2%, 61.5% and 72.8% and Garvins and Amoskeag Pool values of 23.4%, 41.0%, and 65.8% for the years 2011, 2012, and 2013, respectively. Differences in community similarity of fish residing in a regulated river have been observed elsewhere for spatially separated segments (Pegg and McClelland 2004; Pegg and Taylor 2007). These results indicate that the fish community in Garvins Pool, which is not subject to Merrimack Station's thermal discharge, is not wholly distinct from the fish community in Hooksett Pool.

Garvins Pool, located immediately upstream of Hooksett Pool (the two pools are separated by Garvins Falls Dam), is uninfluenced by the Station's thermal discharge but has similarly benefited from the significant water quality improvements that have occurred in the Merrimack River since 1972. The pool is contained within the natural banks of the Merrimack River and extends approximately eight miles upstream of the Garvins Falls Dam to near Sewalls Falls (PSNH 2003). There are discrete differences between Garvins and Hooksett Pools in habitat and physical area. The Garvins Pool impoundment has a surface area of approximately 640 acres at full pond versus 350 acres at full pond for Hooksett Pool (PSNH 2003). Additionally, abundance of submerged aquatic macrophytes is greater in Garvins Pool than in Hooksett Pool, and fish in Garvins Pool have access to productive oxbow and backwater habitats that are not available in Hooksett Pool. Backwater habitat in riverine systems serve as important nursery and spawning areas for resident fish species. Nonetheless, sand/silt/clay is the dominant substrate type within both pools, followed by boulder and woody debris (Normandeau 2011d), and both pools have undergone similar environmental changes over the last four decades due to improved water quality and the introduction of non-native species. Merrimack River fisheries sampling was undertaken during 2008 and 2009 to examine and compare biological characteristics of two fish species, Yellow Perch and White Sucker, among Garvins, Hooksett and Amoskeag Pools (Normandeau 2009a). Additional sampling was undertaken from 2010 through 2013 to provide a current assessment of the whole fish community in Garvins, Hooksett and Amoskeag Pools (Normandeau 2011a; 2017a). As discussed in detail below, the biocharacteristics data collected during this 2008-2013 sampling confirms that when compared to the fish community in Garvins Pool, the fish community in Hooksett Pool in general is diverse, healthy and productive, as are individual species in Hooksett Pool.

EPA Response to Comments II.4.3.3 (i) and (ii):

The commenter identifies the current Garvins Pool aquatic community, which is just upstream from Hooksett Pool and the Garvins Falls Dam and not influenced by any thermal discharge, as constituting the proper reference BIP for Hooksett Pool. EPA agrees that Garvins Pool would be a potentially appropriate reference point for comparison with Hooksett Pool, but since the first fisheries studies were conducted by NHFGD in the 1960s, with subsequent studies conducted by

Normandeau in the 1970s and early 2000s, Garvins Pool was never used as a reference point, and no fisheries data from Garvins Pool were submitted to EPA by PSNH or Normandeau prior to the release of the draft permit in September 2011. It should also be noted that there was no recommendation made in any of the reports submitted prior to EPA's release of the 2011 Draft Permit that Garvins Pool be used as a proxy for the Hooksett Pool BIP instead of looking at the long-term changes in *the fish community of Hooksett Pool*. Focusing on the Hooksett Pool's fish community makes sense, of course, as at least one aspect of an assessment of whether Merrimack Station's thermal discharges caused prior appreciable harm to the BIP in the receiving water. *See Dominion*, 12 EAD at 557 (discussion 40 CFR § 125.73(c)(1)(i) and (ii)). Fish community comparisons were also provided by the commenter for the Black Rock Pool of Schuylkill River, in Pennsylvania (AR-867), but EPA found too many differences with this fish community over 290 miles away (southwest) to make it a suitable proxy for the Hooksett Pool BIP.

Two reports submitted by Normandeau after the 2011 Draft Permit was issued present the results of additional Hooksett Pool fisheries studies conducted in 2010-2011 (AR-871) and 2012-2013 (AR-1551). These reports also provide the first ever comparisons between the Hooksett Pool fish community and that of Garvins Pool, immediately upstream. These reports also evaluated the fish assemblage data from the ambient portion of Hooksett Pool, comparing it to both the lower, thermally-influenced portion of Hooksett Pool, as well as Garvins Pool. Garvins Pool is considerably longer than Hooksett Pool (9.8 miles vs. 5.8 miles), yet Normandeau decided to collect only half the number samples collected in Hooksett Pool (6 vs. 12) without explanation. Furthermore, only the middle two miles of Garvins Pool were sampled, omitting important back water areas, and locations in closer proximity to the two dams that define the pool. However, with four years of data now available for comparison (2010-2013), Garvins Pool can provide a contemporary comparison of adjacent, similar waterbodies. They are not, of course, identical waterbodies and each has its own characteristics and circumstances (*e.g.*, the Concord, NH, wastewater treatment plant discharges to Garvins Pool upstream of the Garvins Falls Dam).

There are certain benefits and limitations to using the Garvins Falls "community" for purposes of representing Hooksett Pool's "balanced indigenous community" when assessing the plant's thermal variance request. While Garvin's Pool is not ideal for the reasons mentioned above, as an impounded portion of the Merrimack River bordering Hooksett Pool upstream of the influence of Merrimack Station's thermal plume, it could be a useful reference site for comparisons with Hooksett Pool biological communities. Therefore, EPA has evaluated the new information provided by Normandeau to ensure available habitat types were similar in both pools, that the sampling conducted adequately supported the analyses and conclusions presented, and to determine whether the Garvins Pool fish community should be considered an appropriate BIP proxy for that of Hooksett Pool. EPA's evaluation of the Merrimack Station's §316(a) variance request for the Final Permit considers both the original comparison of the 1970s Hooksett Pool fish community with that of the 2000s, as well as comparisons of these communities that include additional data from 2010-2013.

4.3.4 Fisheries Data Analysis

Comment II.4.3.4 (i)	AR-1577, EPRI, p. 3-13; AR-1554, LWB, pp. 5-6

The terms “warmwater”, “coolwater” and “coldwater” for classifying fish species has a long history in the common vernacular. However, in the scientific literature, there are no generally accepted criteria for assigning fish species to these three classes. “Warmwater” generally refers to fish species that are best adapted to water temperatures >70°F (e.g., sunfishes and basses, catfishes) whereas “coldwater” species refer to those that are best adapted to water temperatures <60°F (e.g., trouts and salmons). The term “coolwater” is more nebulous and is often used to refer to species that do not cleanly fall into one of the other two categories.

Most fish species can be found over wide ranges in water temperatures and do not always fall into such neat categories as described above. Hence, there are often differences as to how fisheries scientists assign species to these categories. Hence, EPRI believes use of such categorizations in evaluating the protection and propagation of the BIC is fraught with uncertainty.

LWB comments (AR-1554, pp 5-6) that EPA asserted in its §316 Determination that “coolwater” species in the Hooksett Pool were replaced by more thermally tolerant “warmwater” species after startup of Merrimack Station. However, as noted both by Kendall (1978) and EPRI (2011) classification of species as “coolwater” or “warmwater” is based primarily on geographic ranges, not on thermal tolerance data. As noted by LWB (2016a), all of the species discussed in the §316 Determination are widely distributed throughout eastern North America, from Canada to the U.S. mid-Atlantic or even Gulf Coast states. Each species inhabits a wide variety of thermal regimes and possesses a wide range of thermal tolerances. Of the species that EPA asserted had declined since the 1970s, only chain pickerel, yellow perch, and white sucker have been classified as “coolwater” species. Yellow bullhead has been classified as a “warmwater” species, and brown bullhead and pumpkinseed have been classified as both “coolwater” and “warmwater” by different authorities.

EPA Response:

By the commenter’s (EPRI) own description, a species whose temperature preference falls between 60-70ºF would not be captured under the coldwater or warmwater guild. As EPA described in the 2011 Draft Permit (AR-618, p. 33), citing Morrow and Fischenich (2000)(AR-72, p. 5), coolwater species tend to have upper lethal limits that are similar to, or slightly lower than, those of warmwater species, but require cooler average temperatures during the growing season. Given that the central question of this review is whether or not Merrimack Station is causing, or contributing to, the appreciable harm to the BIP through its discharge of waste heat, understanding which species are the most sensitive to elevated temperatures throughout each lifestage is critically important. That said, the specific temperature requirements of certain species in Hooksett Pool is what classifies them as being particularly vulnerable to increased water temperatures, not whether they are labeled “coolwater” species.

LWB suggests that because a species has a wide geographic distribution it must have a wide temperature tolerance. Clearly, many species do have a wide distribution, in part thanks to intentional or accidental introductions from areas outside their native range. But just because a species is present in a particular location doesn’t mean it’s well-suited for the thermal conditions of that area. In this §316(a) thermal variance request, EPA focused on ensuring that the indigenous community of fish species in Hooksett Pool is protected, which means ensuring the preferred ambient temperatures of these species are sufficiently maintained, thus assuring the protection and propagation of the BIP, including enabling these species to survive and thrive through each lifestage.

Comment II.4.3.4 (ii)	**AR-872, Normandeau, p. 8, 70, 116**
See also AR-1300, LWB, p. 8-11	

According to Normandeau, the majority (10 of 16) of fish species captured in Hooksett Pool during the 1960s were warmwater species. Wightman (1971) and Normandeau (1969) state clearly that the Hooksett Pool fish community during the 1960s was a warm water fishery. Normandeau comments that the Hooksett Pool community is still composed of a mix of warmwater and coolwater species, and that 15 of the 16 fish species recorded in Hooksett Pool during the 1960s are still present.

LWB comments that EPA classified pumpkinseed as a warmwater species, although it is identified elsewhere as a coolwater species, citing Carlander (1977) and Eaton and Scheller (1996). The other species that show substantial declines between 1972 and 2005, according to the electrofishing data, were yellow perch, white sucker, brown bullhead, chain pickerel, and yellow bullhead. Of these, only chain pickerel, yellow perch, and white sucker are generally recognized as coolwater species. Brown bullhead has been classified variously as either a coolwater or warmwater species, and yellow bullhead is generally recognized as a warmwater species. The other species identified by EPA as part of the BIP are a mix of coolwater and warmwater species, all of which fluctuated in abundance during the time period examined without apparent trend.

EPA Response:

EPA agrees there were more warmwater species present in Hooksett Pool in the 1960s than cool or coldwater species, although, as LWB comments, some species such as pumpkinseed and brown bullhead have also been classified as coolwater species. The presence of these warmwater species is likely due, at least in part, to the reduction in flow velocities and increased water temperature related to the impoundments formed by the placement of dams along this stretch of the Merrimack River, especially the Garvins Falls (built in 1901) and Hooksett dams (built in 1927) that define Hooksett Pool. The dams not only dramatically altered what was once a riverine environment, converting the Hooksett Pool river segment to an impoundment that more closely resembles pool (or "pond" as it was referred to in the 1960s and 1970s), but the dams also inhibited or prevented the migration of fish to and from the pool, as well.

The continued presence, if not at the same relative abundance, of most of the species that existed in Hooksett Pool in the 1960s is encouraging since it suggests that there is potential for the fish community to once again reflect conditions unaffected by the influence of Merrimack Station's thermal discharge. Since the plant's discharge can affect up to roughly half of Hooksett Pool, the total disappearance of otherwise common fish species would not be expected since the upstream portion of the pool remains as a thermal refuge from the influence of the plant's heat. *See*

Response to Comment II.4.4.1. EPA recognizes that the introduction or appearance of new fish species in the pool prevents re-establishment of the precise historic BIP, however, restoring thermal conditions within the pool sufficient to allow the most temperature-sensitive resident species to compete with all other species is needed to restore balance to the existing fish community so that the BIP's protection and propagation is assured.

Comment II.4.3.4 (iii)	**AR-872, Normandeau, p. 74, 84, 104-6, 109**

In response to EPA's comparison of pumpkinseed and bluegill catch in Garvins Pool during electrofishing by NHFGD in August 2007 (Section 5.6.3.3e of the 2011 Draft Determinations Document, p. 99), Normandeau comments again that relative abundance is not representative of abundance because it is influenced by abundance of other species, and goes on to provide CPUE data from its 2010 and 2011 electrofishing sampling to support its argument of decreased pumpkinseed abundance compared to bluegill in Hooksett Pool. Normandeau argues that bluegill have become a major component of the Garvins Pool fish assemblage absent any thermal influence. Normandeau believes bluegills rose in abundance in Garvins Pool due to their ability to outcompete other fish species, including yellow perch and pumpkinseed, once water quality in the river improved. Normandeau also argues that the greater abundance of pumpkinseed in Garvins Pool can be explained by greater habitat diversity in Garvins Pool, as compared to Hooksett Pool, including oxbow and backwater areas inundated with the submerged aquatic vegetation preferred by pumpkinseed.

Normandeau comments that EPA incorrectly attributed the decrease in abundance of pumpkinseed in Hooksett Pool to the increase in Merrimack Station's thermal discharge resulting from Unit 2 coming on-line in 1968. Normandeau comments that the heat tolerance of bluegill is similar to pumpkinseed, not "considerably higher" as EPA states in the 2011 Draft Determinations Document. Normandeau contends that pumpkinseed are as thermally tolerant as bluegill and thermal additions are not needed for bluegill to outcompete pumpkinseed. For example, according to Normandeau, in Pennsylvania, pumpkinseed continued to dominate the fish community below Cromby Generating Station's thermal discharge more than 15 years after two generating units came on-line and were observed surviving and spawning in temperatures as high as 97°F.

Normandeau states that where competition for forage and/or habitat exist, bluegill will out-compete pumpkinseed. Normandeau also states, however, that pumpkinseed are more capable of withstanding lower DO levels and fluctuating environmental conditions than other species, such as bluegill, which allows them to survive in fluctuating and low DO environments that effectively eliminate other species, such as bluegill. According to Normandeau, if the decline in pumpkinseed abundance was solely due to Merrimack Station's thermal discharge, then a large decline would have been observed over the ten-year period immediately following Unit 2 coming on-line (1968-1978). Normandeau comments that the observed reduction in organic pollution since the 1970s and subsequent decline in submerged aquatic vegetation beds likely was a greater contributor to the decrease in pumpkinseed abundance.

EPA Response:

Regarding the comment on using relative abundance for assessing actual abundance, EPA agrees that it should not be used by itself for evaluating changes in actual abundance of any particular species. EPA discussed the limitations and potential misinterpretation of relative abundance (and the similar "rank abundance" metric) in the 2011 Draft Determinations Document. AR 618, p. 67. Nevertheless, this metric does illustrate well how species are faring relative to each other. This is an important consideration when evaluating thermal effects on a BIP from power plants discharges since altering temperature in an aquatic environment can affect how different species compete for forage, juvenile refugia, spawning habitat, etc. EPA has considered both relative and actual abundance (CPUE) in its evaluation of aquatic biological communities in Hooksett Pool.

Regarding the comment that bluegill has become a major component of Garvins Pool fish assemblage, this species represents only 4.1 percent of the Garvins Pool community based on the average of data collected by the commenter in 2010 and 2011 (AR-871, p.32, 36). EPA typically considers a relative abundance of 5 percent or greater to be "numerically dominant," so bluegill does not fall into that category. Regarding the comment that bluegills rose in abundance in Garvins Pool due to their ability to outcompete other fish species, including yellow perch and pumpkinseed, when water quality in the river improved is not supported by the commenter's sampling data, which suggests they are not outcompeting yellow perch, and are only slightly more abundant that pumpkinseed. According to sampling conducted in Garvins Pool from 2010-2014, the mean relative abundance was 11.7 percent for blue gill, 11.0 percent for yellow perch, and 7.8 percent for pumpkinseed.

Normandeau also argues that the greater habitat diversity in Garvins Pool, as compared to Hooksett Pool, including oxbow and backwater areas inundated with the submerged aquatic vegetation (SAV) preferred by pumpkinseed, is less likely to limit pumpkinseed abundance. This may be true, but no sampling was conducted by Normandeau in the extensive oxbow and backwater areas where SAV is heavily inundated. For reasons not explained in the report, Normandeau sampled only six stations within a two-mile stretch in the central portion of Garvins Pool, which is approximately 9.8 miles long. If these important habitats had been sampled, the abundance of pumpkinseed may have indeed been higher, and more species may have been captured.

Regarding comments on the heat tolerance of bluegill and pumpkinseed, after reviewing additional information on thermal tolerance of these species, EPA agrees with the comment that the thermal tolerance of these two species are similar enough that habitat *avoidance* related to temperature is not likely to be a factor involving competition between these two species. In fact, attraction to the thermal plume during most months, and interspecies competition that may result, may be more of a factor when contemplating to what degree, if any, Merrimack Station's thermal discharge contributed to the significant decline in pumpkinseed abundance in Hooksett Pool.

Normandeau comments that if the decline in pumpkinseed abundance was solely due to Merrimack Station's thermal discharge, then a large decline would have been observed over the ten-year period immediately following Unit 2 coming on-line (1968-1978). Yet, EPA notes that pumpkinseed abundance *did* decline dramatically during the 1970s. In just five years, pumpkinseed CPUE in Hooksett Pool dropped by almost half (48%) from 37.65 in 1972 to 19.45 in 1976, based on the 1970s data that Normandeau used for conducting its trends analysis (AR-

3). By 1995, the next year that sampling was conducted, pumpkinseed CPUE had dropped to 0.95. *Id*. Further, EPA never suggested that the decline in pumpkinseed abundance was "solely" due to Merrimack Station's thermal discharge. The 2011 Draft Determinations Document, AR 618, p. 100, stated that a reasonable argument can be made that increased thermal discharges related to the operation of Unit 2 contributed to the decline of pumpkinseed by altering the thermal environment in much of Hooksett Pool, in combination with the introduction of the more heat-tolerant, non-native bluegill.

4.3.5 Macroinvertebrates in 1960s

Comment II.4.3.5 (i)	AR-1552, Normandeau, pp. 13-14

Further evidence of the polluted nature of Hooksett Pool during the 1960s is evidenced by macroinvertebrate sampling conducted during that time period. Macroinvertebrate communities are useful indicators of anthropomorphic perturbation due to their limited mobility. They are unable to avoid adverse environmental conditions and are often eliminated from areas where stresses exceed tolerance levels. In response to stressed conditions, the macroinvertebrate community often shifts towards high numbers of a few tolerant taxa. Data from USDI (1966) clearly indicates that pollution in the Merrimack River was adversely affecting the river's macroinvertebrate community. Less than 15 miles of the Merrimack River, from a total of 115 miles studied, contained benthic organisms.

A review of shoreline kick net samples collected at Hooksett Pool Monitoring Stations N-10, S-0, S-4 and S-16 during 1972 revealed low values for Ephemeroptera/Plecoptera/Trichoptera (EPT) richness, taxa richness and EPT/Chironomid ratio, all of which can be attributed to the low water quality conditions in Hooksett Pool prior to the Clean Water Act (Normandeau 1973a). Kick net data collected in October 2011 at these same monitoring stations (N-10, S-0, S-4 and S-16) showed that EPT richness had increased by 150-300% from 1972, and taxa richness had increased from 7-10 species in 1972 to 21-23 species in 2011 (Normandeau 2012a). The 2011 EPT/chironomid ratios were also higher than their 1970s counterparts, as would be expected from samples collected in a river with improved water quality and habitat tolerated by more pollution-sensitive species (Normandeau 2012a). Benthic samples collected by ponar during 1972, 1973 and 2011 at Monitoring Stations N-10, S-0, S-4 and S-16 also show indications of improved riverine conditions over time, although these are not as dramatic as the shoreline samples, likely due to the sand substrate typically inhabited by tolerant organisms even in pristine conditions (Normandeau 2012a).

EPA Response:

EPA received comments on how changes in the benthic macroinvertebrate community in Hooksett Pool since the 1960s reflect improved water quality. In addition to these comments, a detailed study of macroinvertebrates was conducted by Normandeau in 2011. The results of this study, and a comparison to similar studies conducted in 1972 and 1973, were submitted in a report during the comment period. EPA reviewed these comments and the new report, as well as previous studies conducted in Hooksett Pool, in order to evaluate changes in the macroinvertebrate community over time related to water quality, including the thermal effects from Merrimack Station. The Agency discusses these comments and materials further in responses below.

Comment II.4.3.5 (ii)	AR-868, p.19-21

Normandeau comments that according to a US Department of the Interior (USDI) report from 1966, benthic organisms were "totally absent" in the lower 57 miles of the river, and less than 15 miles of the total 115 miles of the Merrimack River that was studied contained benthic organisms (AR-868, p. 19).

Normandeau further comments that, according to its 1969 report (Normandeau 1969), large variations in mussel productivity were found, with the section of the river south of the Station discharge canal more productive than to the north. Normandeau adds that its 1969 report characterized the Hooksett Pool as being in a moderate stage of recovery from past pollution, based on sampling conducted in 1967 and 1968" (AR-868, p. 21).

Normandeau also references macroinvertebrate information from the 1990s, based on sampling conducted by the Upper Merrimack River Local Advisory Committee, Merrimack River Watershed Council and NH DES in the published report, "The State of the Upper Merrimack River 1995-1997" (Normandeau-HWC 21). Normandeau comments that according to this report, sensitive taxa were found to be present at all 11 sites sampled between Franklin and Bow, although sensitive species declined downstream of Concord. Normandeau concludes that significant changes in aquatic biota have clearly occurred in the upper Merrimack River since the mid-1960s (AR-868, p. 21).

EPA Response:

EPA agrees that water quality throughout portions of the Merrimack River was historically degraded to the degree that the benthic biological communities were impacted, and that the river's water quality has generally improved in more recent years. However, the approximate location of the southern (downstream) end of Hooksett Pool is at river-mile 81, which is 24 miles upstream of the upstream end of the area described in the USDI report. Therefore, regarding Normandeau's reference to the USDI report describing the total absence of benthic organisms in the lower 57 miles of the river, the area in question did not include Hooksett Pool. As a result, it cannot be the basis for firm or specific conclusions about Hooksett Pool conditions.

The USDI report that Normandeau references is Part II of a six-part study of the Merrimack River and selected tributaries. Part III (Stream Studies - Biological) was not mentioned in any comments received, but EPA reviewed it to better understand the biological conditions that existed at that time of the study (1964-1965). The Part III study included eight stations sampled in Hooksett Pool using a Petersen dredge. According to the report (USDI 1966c), stations sampled closest to Garvins Falls Dam produced only an "impoverished" assemblage of bottom fauna, consisting of a few sludgeworms and midgefly larvae indicative of a zone of moderate pollution. The report further states that sediments 2.63 miles upstream of Hooksett Dam were composed mostly of silt and organic sludge, with leeches and omnivorous snails dominating.

Snails were particularly abundant (USDI 1966c). Sampling of the stream bed 0.19 miles upstream from Hooksett Dam produced sediment samples that were black and had a septic odor, and consisted chiefly of sand, silt, and organic sludge (USDI 1966c). Only a few midgefly larvae and dragonfly nymphs were found in these sediments, and only a few predatory leeches (USDI 1966c). The report suggests that other insects such as mayflies and caddis flies could not tolerate the septic conditions of the sediments and overlying waters and concluded that the conditions found indicated gross to moderate pollution existed in this section of the Merrimack River.

This USDI report provides site-specific evidence that benthic conditions in Hooksett Pool, and upstream of Hooksett Pool, during the mid-1960s were still degraded due to anthropogenic sources of pollution. However, these findings differ from those presented in Normandeau's 1969 report. According to Normandeau's study, not only were a variety of macrofauna collected at all stations during sampling conducted in 1967 and 1968 (as Normandeau's comments reflect), but included in the samples was *Spongilla lacustris*, a benthic species which the report states "is characteristically intolerant of pollution…." This species was collected in isolated patches along the length of the study area (p. 195) (Normandeau 1969). This 1969 Normandeau report - the most complete and comprehensive survey to-date of this section of the Merrimack River, according to Normandeau – concluded that this area of the Merrimack River (*i.e.*, Hooksett Pool) was in a stage of moderate recovery from pollution characteristic of this flow (p. 189). Taken together, the findings in these studies would suggest that improvements in the benthic conditions of Hooksett Pool began between 1965 and 1967.

In response to Normandeau's comments on the macroinvertebrate sampling results presented in the published report, "The State of the Upper Merrimack River 1995-1997," EPA reviewed the report, as well as a subsequent report published by the Upper Merrimack Monitoring Program, in 2010. A water quality assessment of the upper Merrimack River was conducted from 1995-1997 by the Upper Merrimack Monitoring Program (UMMP 2000). Site 11 of this study was located one half-mile below Garvins Falls Dam in Hooksett Pool, approximately two miles upstream from Merrimack Station's discharge canal. The study looked at several water quality parameters, as well as benthic macroinvertebrate diversity. Based on this assessment, this site received a ranking of 3.0, indicating "fair" river quality (UMMP 2000).

The water quality assessment of the upper Merrimack River that was conducted from 1995-1997 by the Upper Merrimack Monitoring Program was continued through 2007 and published in the report "State of the Upper Merrimack River 1995-2008." Again, Site 11 of this study was located one half-mile below Garvins Falls Dam, in Hooksett Pool. The study monitored *E. coli* and benthic macroinvertebrates. *E.coli* bacterial data from 1996 through 2008 indicate bacterial contamination along this river reach (UMMP 2010). Organism density fluctuated, but community composition remained relatively stable over the 11-year period (UMMP 2010). The number of sensitive macroinvertebrate species (EPT richness) at this site range from 33-88 percent, with an average of 51 percent. Anything above 50 percent is considered to be "non-impaired", or "excellent." Based on the overall macroinvertebrate health assessment, however, this site received a ranking of 2.0, indicating "poor" river quality, down from the fair rating (3.0) it received in 1997(UMMP 2010).

Normandeau comments that "significant" changes in aquatic biota have clearly occurred in the upper Merrimack River since the mid-1960s. EPA agrees that benthic conditions have generally improved, but that evidence of stressors to water quality remains, as these studies and water quality monitoring by NH DES and others attest to.

EPA has concluded that the comments it received related to water quality in the Merrimack River during the 1960s warranted a re-review of available water quality and fisheries data to better understand conditions during that time period and reassess the suitability of using the fish community of the 1960s as the BIP. Based on this reevaluation, EPA has decided there is sufficient uncertainty in distinguishing between changes in the biological communities associated with degraded water quality and those associated with the plant's thermal effects. Therefore, consistent with these comments, EPA has focused more on comparisons between the benthic community of the 1970s and 2000s. See Reponses to Comments II.4.4.5.

4.3.6 Submerged Aquatic Vegetation in the 1960s

Comment II.4.3.6	AR-872, Normandeau, pp. 114-115

According to Normandeau, presence-absence data implies a decline in the overall extent of SAV in Hooksett Pool between the 1970s and the most recent data collected in 2002 and 2010. Normandeau suggests that the large nutrient inputs from sewage discharges in the 1960s enhanced the presence of algae and SAV.

Normandeau suggests that the absence of SAV at the discharge canal in 1972-1974 is most likely disturbance-related from the 1972 canal dredging. Normandeau points out that aquatic spike rush (*Eleocharis* sp) was very abundant on the west side of Station 0 in 1971, but not recorded in 1972, 1973, or 1974. Large SAV beds were mapped in this location in 2002 and 2010 (AR-868, p. 21).

EPA Response:

Normandeau suggests that large nutrient inputs from sewage discharges in the 1960s enhanced both growth of algae and the presence of SAV, but EPA concludes that the latter is unlikely since the health of SAV is closely related to its ability to photosynthesize underwater. As Normandeau comments (AR-868, p. 19), eutrophication favors growth of plants such as macro-algae and plankton over more complex plants, and algal blooms can reduce water clarity and, in turn, ambient light to SAV. SAV species are complex plants that tend to suffer from reduced water clarity due to eutrophication. Increases in algae production would be expected with increased nutrient availability (especially phosphorous in freshwater), but that would likely cause a decrease in water clarity which, in turn, would likely impair SAV's ability to photosynthesize. Increased algal growth on the SAV leaves would further inhibit photosynthesis. The reduction of SAV, not an increase, is a common water quality indicator of nutrient enrichment.

Normandeau also comments (AR-1552, pp. 15-21) that Hooksett Pool has maintained the continued presence of SAV beds required for fish habitat, albeit only in certain locations and with variable densities. SAV is important fish habitat, especially for juvenile fish and, as discussed above, is an important indicator of water quality since it requires good water clarity to photosynthesize. However, Normandeau's own studies from the 1970s, 2002, and 2012 indicate that SAV habitat within Hooksett Pool has declined. AR-868, p. 21. According to Normandeau's analysis, SAV was present at 76 percent of the sites sampled in two years or more during the 1970s, 60 percent of stations sampled were within SAV beds in 2002, and only 50 percent of stations sampled were within SAV beds in 2010. (AR-868, p. 16). This notable decline in SAV does not support Normandeau's contention that water quality has improved in Hooksett Pool over conditions in the 1970s.

While the loss of SAV habitat since the 1970s clearly does not support the argument that water quality has improved between the 1970s and now, there also appears to be no clear connection between the plant's thermal discharge and the loss of SAV, as SAV is also diminished in areas of the Hooksett Pool upstream of Merrimack Station's thermal discharge. In addition, EPA agrees that the loss of aquatic spike rush may have resulted from mechanical disturbance of the substrate associated with dredging.

4.4 Appreciable Harm

Comment II.4.4	AR-1552, Normandeau, pp. 4-6

Merrimack Station is seeking a renewal of its existing thermal discharge variance under CWA §316(a) as part of USEPA's renewal of the Permit. CWA §316(a) provides that a permit applicant may demonstrate that any effluent limitation proposed for the thermal component of a discharge is more stringent than necessary to assure the protection and propagation of the balanced, indigenous population ("BIP") of shellfish, fish and wildlife in and on the body of water into which the discharge is made. Applicants with an existing thermal discharge, such as the Station, may demonstrate that the existing discharge is protective of the BIP by evaluating the BIP over a series of years during which the discharge occurred, and showing an absence of appreciable harm (40 C.F.R. §125.73(c); USEPA 1977). Contrary to USEPA's unfounded assertions, the data and analyses presented in the many reports prepared by Normandeau since 1969 and submitted to USEPA, NHDES and, after 1992, the other members of the Technical Advisory Committee (TAC) demonstrate that Merrimack Station's thermal discharge has not resulted in appreciable harm to the BIP in Hooksett Pool, and that the thermal discharge limits in the existing Permit adequately assure the protection and propagation of that BIP

EPA Response:

In the 2011 Draft Permit Determinations Document, EPA presented its analysis supporting the 2011 Draft Permit and the Agency's decision to reject PSNH's request for renewal of the CWA § 316(a) variance associated with the 1992 Permit. *See* AR 618, Sections 4.0, 5.0, 6.0 and 9.0. *See also id.* at 28. The variance for the 1992 Permit set thermal discharge requirements that effectively allowed the Facility to discharge the waste heat associated with baseload operations using open-cycle cooling. *Id.* at 27-28. In the 2011 Draft Determinations Document, EPA concluded that the Facility did not carry its burden to demonstrate either that the existing thermal discharge under the existing CWA § 316(a) had not caused prior appreciable harm to the Hooksett Pool's BIP, or that despite such prior appreciable harm, the protection and propagation of the BIP would be assured going forward with renewal of the existing variance. *See id.* at Section 6.0. *See also* 40 CFR §§ 125.73(c)(1)(i) and (ii).

In response to the many comments and supporting documents received in response to its analyses in support of the 2011 Draft Permit, EPA revisited the question of whether Merrimack Station demonstrated that no appreciable harm to the BIP of Hooksett Pool has resulted from the Facility's thermal discharges under the CWA § 316(a) variance-based limits in the 1992 Permit. 40 CFR § 125.73(c)(1)(i). In this re-evaluation, the Agency has not only considered comparisons of historical fish communities (1970s, primarily) with those of the early 2000s (2004, 2005), but has also considered newer fish community data collected from 2010-2013, and the possible implications decreased operations at Merrimack Station. Additionally, it has looked at the biological community more broadly to include the macro-invertebrate community, both from a historical perspective, as well as on the basis of comparisons between the current communities within Hooksett Pool representing both ambient and thermally-influenced areas. Finally, having received and reviewed four years of sampling data and analysis for the Garvins Pool fish community, EPA agrees with comments that the current Garvins Pool fish community represents one acceptable proxy for the Hooksett Pool BIP and, as such, EPA has evaluated comparisons of these two communities, as well.

EPA's responses to comments related to appreciable harm are included below, as well as in other applicable responses found elsewhere in this document.

4.4.1 No Appreciable Harm to the Hooksett Pool Fish Community

Comment II.4.4.1	**AR-1552, Normandeau, pp. 15-22, 24-26**
See also AR-1548, PSNH, pp. 27-38; AR-846, PSNH, pp. 17-27, 29-30, 32-34, 37, 47, 53-59; AR-1554, LWB, pp. 5-7; AR-1300, LWB; AR-872, Normandeau, pp. 23-27, 46, 80, 83, 84	

EPA Introduction to this group of comments and responses.

As indicated in the box immediately above, EPA has grouped together here several comments by PSNH and its consultants that address a common set of issues. EPA has reviewed these comments and the documents they reference and provides responses below. In an effort to retain the detailed comments below as presented, EPA has broken these comments out into subparts and has inserted its responses to those subparts within this list or group of comments. EPA also references other responses where additional discussion on these topics can be found. PSNH reiterates these comments made by Normandeau, which are also included here (*see* AR-1548, pp. 27-38; AR-846).

Normandeau Comment (i):

CWA §316(a) provides that a permit applicant may demonstrate that any effluent limitation proposed for the thermal component of any discharge is more stringent than necessary to assure the protection and propagation of the BIP in and on the body of water into which the discharge is made. Applicants with an existing thermal discharge may demonstrate that the existing discharge is protective of the BIP by evaluating the BIP over a series of years during which the discharge occurred, and showing an absence of appreciable harm (40 C.F.R. §125.73(c); USEPA 1977). Here, support for a finding of "no appreciable harm" to the fish community in Hooksett Pool from Merrimack Station's thermal discharge is provided through assessment of trends in abundance and an examination of the health and condition of fish species within the waterbody segment, as well as by comparison of these metrics from an appropriate reference BIP, the current fish community in Garvins Pool.

USEPA's finding of appreciable harm is clearly incorrect because properly interpreted, the data show that over time, there have not been (1) appreciable decreases in any coolwater fish species in Hooksett Pool, (2) appreciable increases in warmwater species in Hooksett Pool, (3) appreciable decreases in the diversity of species in Hooksett Pool (as discussed in detail below, the Shannon Diversity Index value shows that the current fish population in Hooksett Pool is more diverse now than it was forty years ago), or (4) appreciable increases in the abundance of generalist feeders or pollution-tolerant species in Hooksett Pool (Normandeau 2011a; Normandeau 2017a). In fact, when compared to Garvins Pool – the thermally uninfluenced impoundment immediately upstream from Hooksett Pool, and the proper reference to compare to Hooksett Pool – the biocharacteristics of the fish population in Hooksett Pool in general, and of the individual species in Hooksett Pool in particular, indicate no appreciable harm to the BIP (Normandeau 2011a; Normandeau 2017).

EPA Response:

EPA has carefully considered the comments and supporting documents received by the commenter and others related to the question of appreciable harm, and has provided detailed responses above, in II.4.4, and below in this response (II.4.4.1)**.**

Normandeau Comment (ii):

There has been no appreciable harm to the BIP in Hooksett Pool based on decreases in any coolwater species. Aquatic habitat that has been adversely impacted by a thermal discharge characteristically contains a higher abundance of fish species that are tolerant of warmer water, and a lower abundance of fish species that prefer cooler water. Merrimack Station's thermal discharge has not adversely impacted the abundance and distribution of fish in Hooksett Pool (the area of the Merrimack River from which Merrimack Station withdraws cooling water and into which it discharges heated effluent). If the Station's thermal discharge adversely impacted the abundance and distribution of fish in Hooksett Pool during 1972-2013, it would be expected that the abundance of resident coolwater species in the pool (as estimated by standardized electrofish sampling efforts conducted between 1972 and 2013), should have significantly decreased over time. However, no such significant decrease in abundance was observed for any of the five coolwater fish species resident in Hooksett Pool. The abundance of one coolwater fish, Black Crappie, has increased significantly in Hooksett Pool since its introduction and first detection during 2004. The lack of significantly decreasing trends for the other native and resident coolwater fish species (Chain Pickerel, Fallfish, White Sucker and Yellow Perch) are not consistent with the hypothesis that Merrimack Station's thermal discharge has caused appreciable harm to the BIP in Hooksett Pool (Normandeau 2017a).

EPA Response:

According to the commenter's most recent fisheries report (AR-1551, p. 27), with the addition of the 2012 and 2013 sampling data, trends in abundance for yellow perch and chain pickerel no longer show statistically significantly declines. EPA views this as good and encouraging news since declines in both species were significant up through 2011. *See* AR-871, p. 225.

Normandeau comments that Merrimack Station's thermal discharge has not adversely impacted the abundance and distribution of fish in Hooksett Pool, but fisheries data provided to EPA, up to its issuance of the 2011 Draft Permit, did not support this statement. Normandeau's 2007 fisheries report presents sampling data for the ambient and thermally-influenced sections of Hooksett Pool, and both electrofishing and trapnet sampling clearly demonstrate notably lower abundance levels in the thermally-influenced section for coolwater species such as yellow perch and white sucker. *See* AR-3, pp. 20, 22, 62, 63. This apparent avoidance of the thermally-influence section of Hooksett Pool during the summer months by these thermally-sensitive coolwater species factored into EPA's determination that Merrimack Station had caused, or contributed to, appreciable harm to the Hooksett Pool BIP. EPA still considers this valid and compelling evidence of appreciable harm at that time, but new fisheries data suggest conditions may be improving, possibly in response to dramatic reductions in operations at Merrimack Station.

EPA questions the comment that black crappie abundance has increased significantly. It appears that the analysis included years in the 1970s and 1995 when the species was not captured. This resulted in the use of five data points (in catch per unit effort, or CPUE) of "0.0" before black crappies were actually caught in 2004 or considered part of the Hooksett Pool resident fish community (See AR-1551, p.34).

Mean CPUE (per 1,000 ft) of black crappie captured by electrofishing in Hooksett Pool during August and September of select years. From Table 3-3, AR-1551, pg. 34

1972	1973	1974	1976	1995	2004	2005	2010	2011	2012	2013
0.00	0.00	0.00	0.00	0.00	0.05	0.10	0.27	0.15	0.09	0.01

EPA did not run its own analysis, but the CPUE values provided in the table from 2004 and later do not seem to indicate a significant increase in abundance. EPA would not consider black crappie part of the BIP anyway given its relatively recent arrival in Hooksett Pool, but it does view this coolwater species' ability to persist as an encouraging sign that Hooksett Pool may be more habitable for coolwater species, generally.

Normandeau Comment (iii):

There has been no appreciable harm to the BIP in Hooksett Pool based on increases in warmwater species. As estimated by the same standardized electrofish sampling efforts, there have not been significant increases in abundance for nine of the ten warmwater fish species resident in Hooksett Pool during the 1972-2013 time period. Abundance of the native Pumpkinseed has significantly decreased and abundance of Rock Bass has significantly increased since its introduction and first detection during 1995 sampling. There were no significant differences in the abundance of Rock Bass within Garvins and Hooksett Pools during the period of comparable sampling in those locations (2010-2013) indicating Rock Bass in Hooksett Pool have not increased at a rate greater than that in the thermally uninfluenced Garvins Pool. The lack of a significant increase in the abundance of any warmwater fish species other than Rock Bass during the period of comparable sampling is not consistent with the hypothesis that Merrimack Station's thermal discharge has caused appreciable harm to the BIP in Hooksett Pool (Normandeau 2017a).

EPA Response:

While EPA notes the significant increase reported for Rock Bass abundance, EPA would not expect to see a steady increase in the abundance of any particular warmwater species over time since each is largely competing with other warmwater species for limited forage and spawning habitat. More telling would be a collective change in relative abundance of warmwater species versus coolwater species over time, but EPA does not see such a comparison in Normandeau's last two fisheries reports (AR-871 and 1551).

Normandeau Comment (iv):

There has been no appreciable harm to the BIP in Hooksett Pool based on a decrease in diversity of the fish community. Based on the 1972-2013 electrofish sampling efforts, the highest Shannon diversity index values for the Hooksett Pool fish community observed were in 2011 and 2013. Moreover, all of the per year diversity index values from the sampling years in the 2000s were higher than the values from the sampling years in the 1970s, indicating that the diversity of the fish community in Hooksett Pool – and therefore the biological health of that community – has generally increased, not decreased, over the past forty years. Community evenness values for each year of comparable sampling between 1972 and 2013 indicate the current Hooksett Pool fish community is distributed more equitably among species than the community during the 1970's which was dominated by a limited number of fish species. Examination of richness, diversity and evenness values for each year of comparable sampling supports a finding that Merrimack Station's thermal discharge has not reduced the diversity of the fish community in Hooksett Pool. These findings support the hypothesis that Merrimack Station's thermal discharge has not caused appreciable harm to the BIP in the Hooksett Pool (Normandeau 2017a).

EPA Response:

EPA agrees that increased diversity can reflect improved water quality, but it can also reflect changes that are not necessarily beneficial to the resident indigenous community. EPA has commented various times throughout this document, that increased diversity is not necessarily a positive indicator when evaluating impacts to a fish community from heat. It's widely known that the most diverse aquatic systems in the world exist in tropical or subtropical regions. According to Vannote et al. (1980) (AR-1777), in large river systems fish populations show a shift from coolwater fish species low in diversity [upstream] to more diverse warmwater communities [further downstream]. So, having a diverse community dominated primarily by warmwater species does not necessarily represent the proper BIP when coolwater species once represented a larger percentage of that resident community. The more important question related to changes in diversity would be how do changes in the number and abundance of warmwater species compare to the number and abundance of coolwater species.

Differences in diversity and species richness data for a single water body over time can also be influenced by changes in sampling effort and/design. Similarly, these metrics can be affected when sampling in multiple water bodies. Such changes occurred when Normandeau conducted fish sampling in Hooksett and Garvins pools from 2010-2013. *See Comment II.4.4.5(iv) for a detailed discussion of sampling disparities between Hooksett and Garvins pools.* These inconsistencies raise questions as to whether differences in species richness are truly comparable, or instead reflect results associated with inconsistent sampling effort or sampling locations lacking adequate representation of varied habitats within a waterbody.

Normandeau Comment (v):

There has been no appreciable harm to the BIP in Hooksett Pool based on an increase in generalist feeders. The percentage of generalist feeders in a fish community increases as the physical and chemical habitat deteriorates (Barbour et al. 1999). The percentage of generalist feeders was highest in Hooksett Pool in 1976 and lowest in 2010 across the 1972-2013 data set. The decrease in percent generalist feeders from the 1970's to present can be attributed to the decrease in abundance of Pumpkinseed, a generalist feeder that represented more than 50% of the Hooksett Pool fish community in the early 1970's. Decreases in Pumpkinseed are linked to improved water quality leading to decreases in submerged aquatic habitat and subsequently an increase in competition with Bluegill, a species that could not survive the low DO levels that existed in the pool in the early 1970's. The reduced percentage of generalist feeders in Hooksett Pool from 1972 to 2013 supports a finding that Merrimack Station's thermal discharge has not caused appreciable harm to the BIP in Hooksett Pool.

EPA Response:

While it may reflect changes associated with effects from pollutants other than heat, the generalist category is not unique to any particular temperature guild. As such, EPA doesn't consider this information particularly helpful, except perhaps to provide general information on differences of the feeding guilds related to changing water quality. Interestingly, however, Normandeau's 2017 Fisheries Report (AR-1551, p. 36) lists the percentage of generalist feeders in Hooksett Pool as being 74.65% in 1972 and 73.5% in 2013. These data do not support the argument that there has been a decrease in generalist feeders, or a substantial improvement in water quality as reflected by such a decrease, and it does not support a finding of no appreciable harm.

EPA also takes issue with Normandeau's classification of pumpkinseed as a "generalist." In 2007 (AR-3, pp. 72, 105), Normandeau identifies pumpkinseed as an "insectivore," based on EPA's "Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers, Second Edition." AR-1164. In developing these protocols, EPA reviewed seven literature sources to select, based on the consensus of these sources, which feeding guild or pollution tolerance classification each fish species belonged. For species for which the consensus was not unanimous, the alternative designations were listed as "exceptions." In its 2012 comments (AR-872 p. 18), Normandeau changed the classification of pumpkinseed to from "insectivore" to "generalist," still citing EPA's rapid bioassessment publication. In a footnote to its Table 2-2 (p.18), Normandeau identifies EPA's trophic guild and tolerance classifications as presented in the agency's bioassessment protocols. Of the nine most abundant species identified in this table, representing 98.1 percent of all fish caught, Normandeau uses none of the trophic guilds identified by EPA (and most of the literature sources reviewed) as being the most appropriate classification for these species. Instead, Normandeau appears to select from the trophic guild exceptions. For example, pumpkinseed, which at 31.7 percent is the most abundant species, is listed as an "insectivore" in EPA's protocols, but Normandeau selects "generalist" from the exceptions, which also includes "piscivore."

Normandeau changed its literature source altogether for classifying trophic guilds and pollution tolerance in its more recent 2011 fisheries report (AR-871). While no "pollution" tolerance classifications changed for any of the five species listed, pumpkinseed and redbreast sunfish move from the "insectivore" to the "generalist" feeder guild, using this new resource (Halliwell et al. 1999). This selection of alternative classifications may be an attempt to strengthen the "pollution" argument but is at odds with the classifications in EPA's protocols.

Normandeau Comment (vi):

Aquatic habitat that has been adversely impacted by a thermal discharge characteristically contains a higher percentage of pollution-tolerant individuals. Following a peak in the percentage of pollution-tolerant fish (primarily Bluegill) during the 1995 sample year, the percentage of pollution-tolerant fish observed during 2010 through 2013 are similar to the range of percentages observed during the 1970's. It should be noted that although the Bluegill is considered "Tolerant" to pollution, it could not survive in Hooksett Pool in the 1960's because it could not tolerate the low dissolved oxygen (DO) levels that existed at the time. Indeed, fish such as Pumpkinseed and Yellow Perch are actually considered "Intermediate" in pollution tolerance, but these fish were able to survive and reproduce in the severe pollution that existed at the time because they could withstand the low DO levels. The uniform dominance of Bluegill within both Hooksett and the thermally uninfluenced Garvins Pool based on the electrofishing sampling conducted from 2010-2013 demonstrate that the Bluegill didn't become abundant in Hooksett Pool due to thermal input as EPA speculated because this fish is just as abundant in Garvins Pool. In 2013, Bluegill was the dominant fish captured in both Garvins Pool (32% of catch) and Hooksett Pool (24% of catch). These findings support the hypothesis that Merrimack Station's thermal discharge has not caused appreciable harm to the BIP in the Hooksett Pool (Normandeau 2011a; 2017a).

EPA Response:

EPA disagrees with the assertion that an aquatic habitat that has been adversely impacted by a thermal discharge characteristically contains a higher percentage of pollution-tolerant individuals unless the pollutant being considered is heat. Heat tolerant species are not typically classified "pollution-tolerant" simply for their tolerance to heat. That said, the presence of a widespread surface-oriented thermal plume can exacerbate DO conditions at depth under low-flow conditions by inhibiting vertical mixing with more DO-enriched surface waters. This condition is similar to low DO associated with eutrophic conditions. Such an incident was documented in Hooksett Pool during the summer of 2002. *See* Response to Comment II.4.2.3 for a detailed description.

Beyond the question of whether abundance of pollution-tolerant species is or is not related to appreciable harm in the context of § 316(a), the commenter's own analysis demonstrates that there were more pollution-tolerant species present in Hooksett Pool in 2011 than there were in 1972, a mere four years after the period in the 1960s identified by Normandeau as being heavily polluted. *See* AR-871, p.73. Normandeau's comment that the percentage of pollution-tolerant fish observed during 2010 through 2013 are similar to the range of percentages observed during the 1970's is not supported by its own data. According to data provided in Normandeau's 2011 report (AR-871, p. 73) and 2017 report (AR-1551, p. 22), the percentage of pollution-tolerant species in Hooksett Pool during the 1970s averaged 8.5% while in the 2000s (2010-2013) they averaged 19.8%, more than twice as high. These data do not support the commenter's argument that the percent of pollution-tolerant species in Hooksett Pool over time is evidence of a lack of appreciable harm.

Regarding Normandeau's comments on the appearance and abundance of bluegill in Hooksett and Garvins pools, EPA discusses the characteristics and relevance of bluegill in more detail in the response to comment 4.3.4. While bluegill relative abundance in Garvins Pool was indeed 32% in 2013, it was only 6.9% in 2012. Over the 4 years of comparison sampling (2010-2013), bluegill relative abundance in Hooksett Pool averaged only slightly higher than in Garvins Pool (15% vs. 11.7%). *See* AR-1551, p. 33.

Once introduced to Garvins Pool, it's no surprise that bluegill would become established. The commenter provides an explanation in its Fisheries Analysis Report (*See* AR-3, p. 108) for why bluegill might dominate. According to Normandeau, citing Scarola (1987), the spawning period for bluegill spans a longer period of time than the sunfish species native to New Hampshire. Also, a female bluegill can, on average, lay more than four times the number of eggs produced by a female pumpkinseed, and a male bluegill may raise two to three broods per season. The report goes on to state that, in addition to being more prolific spawners, the larger bodied bluegill will also compete with the pumpkinseed for spawning habitat, as both prefer to nest in gravelly substrate. *See also* Response to Comment II.4.3.4.

With the benefit of additional sampling in Hooksett Pool (2010-2013) and the inclusion of Garvins Pool fish community data, EPA agrees that bluegill abundance appears to be similar between both pools. Still, the relative abundance of bluegill in Garvins Pool averaged over 4 years (2010-2103) was marginally greater (11.7%) than that of pumpkinseed (7.8%) over the same time period. In Hooksett Pool during the same period, however, bluegill relative abundance was three times greater than pumpkinseed (15% versus 4.8%). Differences in habitat and food availability between the two pools, as mentioned in earlier comments, may explain why pumpkinseed appear to do better in Garvins Pool than in Hooksett Pool. However, this difference does not rule out some influence related to the Facility's thermal discharge, as well. On a positive note, pumpkinseed relative abundance in 2013 was, at 13.2%, the highest it's been, by far, since sampling was conducted in 1976. While referred to in negative terms in multiple comments received by Normandeau and PSNH, this indigenous sunfish species may be showing signs that its relative abundance in Hooksett Pool is beginning to stabilize.

Normandeau Comment (vii):

A review of warmwater and coolwater species compared between Hooksett Pool and Garvins Pool indicates that there has been no appreciable harm to the BIP in the Hooksett Pool. As noted above, aquatic habitat that has been adversely impacted by a thermal discharge characteristically contains a higher abundance of fish species that are tolerant of warmer water, and a lower abundance of fish species that prefer cooler water. However, a comparison of the 2010 through 2013 fish communities in Hooksett Pool and Garvins Pool (the thermally uninfluenced impoundment immediately upstream from Hooksett Pool) shows no clear pattern consistent with the hypothesis that Merrimack Station's thermal discharge has caused an increase in the abundance of warmwater species or a decrease in the abundance of coolwater species in the pool. The EPA stated numerous times in the draft permit that the rise of Bluegill and Spottail Shiner abundance in Hooksett Pool was due to the thermal input from the Station because these fish can tolerate warm water and even suggested that these two fish species should not be included in certain analyses of fish abundance because they were not part of the 1960's fish community. However this hypothesis was rejected after four years of fisheries sampling in Garvins Pool, the thermally uninfluenced impoundment immediately upstream from Hooksett Pool. Spottail Shiner was the dominant fish species in Garvins Pool in electrofish samples in 2010 (51% of catch), 2011(45%) and 2012 (46%), and in 2013 Bluegill was the dominant fish collected, representing 32% of total catch in Garvins Pool (Normandeau 2011a; Normandeau 2017a). Fallfish, a coolwater fish, was the dominant fish species collected in Hooksett Pool in 2011 electrofish sampling and represented 20% of the total catch that year. Fallfish had significantly higher CPUE in Hooksett Pool electrofish sampling compared to Garvins Pool in 2011, 2012 and 2013. Additionally, White sucker, a coolwater fish, had significantly higher CPUE in Hooksett Pool electrofish sampling compared to Garvins Pool in 2010, 2011 and 2013. These comparisons, therefore, support the hypothesis that Merrimack Station's thermal discharge has not caused appreciable harm to the BIP in the Hooksett Pool (Normandeau 2011a; Normandeau 2017a).

According to LWB (AR-1554, p. 7) data compiled by Normandeau (2017b) shows that Garvins, Hooksett, and Amoskeag Pools all support a mix of "warmwater" and "coolwater" species. Comparing these three pools across the four years 2010-2013, the percent of all fish collected that were classified as "coolwater" was actually higher in thermally-influenced Hooksett Pool than in the upstream Garvins Pool for 3 of the 4 years (AR-1553, p.5, Table 5).

Hence, to the extent that there is any meaningful distinction between "coolwater" and "warmwater" fish species, the available data provide no evidence that the thermal discharge from Merrimack Station has caused "coolwater" species in Hooksett Pool to be replaced by "warmwater" species.

EPA Response:

EPA reviewed the breakdown in coolwater and warmwater species relative abundance for Garvins and Hooksett pools over the sampling period 2010-2013 and found, on average, the two pools have very similar proportions of warmwater and coolwater species, based on data provided in Normandeau's two most recent fisheries reports (AR-871 and AR-1551). EPA's calculations, based on these two fisheries reports, indicate that during the period from 2010-2013, the relative abundance of warmwater species was 75.4% in Hooksett Pool and 74.1% in Garvins Pool. The relative abundance of coolwater species was 23.1% in Hooksett Pool and 25.3% in Garvins Pool. This information is consistent with the comment urging that, during this more recent time period, a comparison of the relative abundance of warmwater and coolwater species indicates that the Hooksett Pool fish community is in similar condition to the upstream Garvins Pool fish community.

LWB's comments related to the mix of warmwater and coolwater species in Hooksett and Garvins Pools during this recent time period are supported by the data referenced. EPA also wanted to know how this mix has changed over time in Hooksett Pool. While EPA could find no comparison in Normandeau's last two fisheries reports, the data were provided in the 2017 fisheries report (AR-1551, p. 33, 34). EPA compared mean relative abundance (RA) and catch per unit effort (CPUE) between warmwater and coolwater species for the 1970s (1972, 73, 74, 76) and 2000s (2010, 11, 12, 13). *See Table below*.

Differences between mean RA and CPUE of coolwater and warmwater fish species based on data from Tables 3-2 and 3-3 in AR-1551, pp. 33-34.

Time Period	Coolwater Species		Warmwater Species	
	CPUE	RA %	CPUE	RA %
1970s	33.4	15.6	157.9	82.4
2010s	16.7	19.6	68.9	77.0
Difference	-16.7	+4.0	-89.0	-5.4

This comparison indicates that the proportion of coolwater to warmwater species in Hooksett Pool has increased since the 1970s. Therefore, with the addition of new fisheries data (2010-2013) from a period when the plant was operating at reduced frequencies, this would support comments that the current Hooksett Pool fish community is similar to the Hooksett Pool BIP of the 1970s.

Another finding from this comparison that is more troubling is the notable decline in fish abundance from both temperature guilds between the 1970s and 2010s. Coolwater species declined by almost 17 (number of fish caught per 1,000 feet), a 50 percent decline from the 1970s. Warmwater species declined by even more at 56.4 percent.

Normandeau Comment (viii):

A review of generalist feeders and pollution tolerant species compared between Hooksett Pool and Garvins Pool indicates that there has been no appreciable harm to the BIP in the Hooksett Pool. As noted above, aquatic habitat that has been adversely impacted by a thermal discharge characteristically contains a higher percentage of both generalist feeders and pollution-tolerant individuals. Although the percentage of generalist and tolerant species were higher in Hooksett Pool than Garvins Pool during 2010 through 2013, (except for 2013 when pollution tolerant fish were higher in Garvins Pool), these differences were the result of increased relative abundance of both coolwater and warmwater species in Hooksett Pool. In 2011, 2012 and 2013, the coolwater Fallfish and coolwater White Sucker along with the warmwater Bluegill contributed to the higher percentage of generalist feeders in Hooksett Pool. The percentage of generalist feeders in all three pools in most years is dominated by warmwater fish and in 2013 Bluegill, Pumpkinseed and Redbreast Sunfish accounted for 96.9% of the generalist feeders in Garvins Pool, 92.7% in Amoskeag Pool and in Hooksett Pool the three sunfish species plus Fallfish and White Sucker (coolwater fish) accounted for more than 92% of the generalist feeders captured. The data demonstrates that the dominant generalist species in Hooksett Pool were similar to those present in Garvins Pool during each sampling year. The percentage of pollution tolerant fish species in most years is dominated by Bluegill in all three pools. The uniform dominance of Bluegill as a tolerant fish species within both Hooksett and the thermally uninfluenced Garvins Pool suggests factors other than thermal regime (e.g., habitat diversity, food resources) are likely contributing to the observed differences. If Merrimack Station's thermal discharge has adversely impacted the BIP in Hooksett Pool by increasing the percentage of generalist feeders or pollution-tolerant individuals, it would not be expected that coolwater species would have significantly contributed to these increases, as documented (Normandeau 2011a; 2017a).

EPA Response:

The commenter concludes that "a review of generalist feeders and pollution tolerant species compared between Hooksett Pool and Garvins Pool indicates that there has been no appreciable harm to the BIP in the Hooksett Pool," but EPA finds this conclusion is not supported by the commenter's own data and analyses. The commenter acknowledges that the percentage of generalists was higher in Hooksett Pool than in Garvins Pool each year from 2010 to 2013. Regardless of whether coolwater species contributed to the generalist category, this analysis does not support a finding of no appreciable harm.

Normandeau Comment (ix):

A review of length-weight-curve sampling data of fish compared between Hooksett Pool and Garvins Pool indicates that there has been no appreciable harm to the BIP in Hooksett Pool.

Where aquatic habitat has been adversely impacted by a thermal discharge, sampling data tend to show a decreasing slope to the length-weight curve, signifying progressively lower weight for a given length for a resident fish species over time or in comparison to the same species residing in a thermally uninfluenced habitat. Such a decreasing slope indicates a reduction in quality of body condition due to the thermal impact. Adequate length-weight data was available to compare within-year condition for four coolwater species in Garvins and Hooksett Pools for the time period 2008-2011 (Normandeau 2011a) and for three coolwater species between Garvins and Hooksett Pools for the time period 2012-2013 (Normandeau 2017a). Of the seven possible comparisons for the 2008-2011 time period, there were no significant differences observed in weight growth relative to a constant increase in length in three cases (2011 chain pickerel, 2009 white sucker, 2009 yellow perch). In three instances (2011 fallfish, 2011 white sucker, 2008 yellow perch), the length-weight curves showed coolwater species in Hooksett Pool grew significantly more rotund (or "fatter") with increasing length than in Garvins Pool. Only yellow perch during 2011 grew significantly more rotund with increasing length in Garvins Pool than was observed in Hooksett Pool. For the 2012-2013 time period, slope differences in the length-weight relations indicated that coolwater Fallfish and Yellow Perch grew significantly less rotund (or "fatter") with increasing length in Hooksett Pool than in Garvins Pool. Conversely, White Sucker grew significantly more rotund in Hooksett Pool than in Garvins Pool. Here, the observations of similar or increased growth among some coolwater species and age groups residing in Hooksett Pool compared to the same species residing in thermally uninfluenced Garvins Pool during years of comparable sampling (2008-2011 and 2012-2013) indicate that there has been no appreciable harm to the BIP in Hooksett Pool (Normandeau 2011a; Normandeau 2017a).

EPA Response:

While there is lack in consistency in the evidence indicating adverse impact, as demonstrated through these length-weight analyses, EPA does not agree that this evidence supports a finding of no appreciable harm. The data suggest white sucker, a coolwater species, did not show an adverse effect for the period studied, but yellow perch length-weight data for 2011-2013, as well as fallfish data for 2012-2013, appear to indicate these species grew significantly less rotund in Hooksett Pool compared to Garvins Pool.

According to the commenter's 2011 fisheries report (AR-871, p. 198), the length-weight relationship (condition) of yellow perch was significantly lower in 2011 than in 2005, which supports that the yellow perch in Hooksett Pool collected in 2011 were in worse condition compared to those collected during 2005. Also, the report (p. 198-199) states that the mean length at age of age-1, age-2, age-3 yellow perch was significantly larger in Garvins Pool than was observed in Hooksett Pool. Therefore, these results appear to meet the definition of "adversely impacted by a thermal discharge" for two of the three coolwater species studied, as defined in this comment.

Normandeau Comment (x):

Where aquatic habitat has been adversely impacted by a thermal discharge, sampling data tend to show lower mean length at age for resident fish species compared to the same species in a thermally uninfluenced area, due to a reduction in growth rates associated with thermal stress. Adequate age data for comparison of mean length at age for individual cohorts between Garvins and Hooksett Pools were collected for three coolwater species (White Sucker, Yellow Perch and Fallfish) and four warmwater species (Bluegill, Pumpkinseed, Largemouth Bass, and Smallmouth Bass) during 2008-2013 (Normandeau 2011a; Normandeau 2017a). Of the 15 available comparisons from the 2008-2013 time period for warmwater species, eleven showed no significant difference for mean length at age for individuals residing in Hooksett and Garvins Pools. Mean length at age was significantly greater in Hooksett Pool than in Garvins Pool for the remaining four comparisons. Of the 18 available comparisons from the 2008-2013 time period for coolwater species, ten showed no significant difference for mean length at age for individuals residing in Hooksett and Garvins Pools, six demonstrated greater mean length at age for individuals in Garvins Pool versus Hooksett Pool and two demonstrated greater mean length at age for individuals in Hooksett Pool versus Garvins Pool. Based on the assumption that warmer water conditions will enhance the growth of warmwater fish and inhibit growth of coolwater fish, these observations are not consistent with the hypothesis that the operation of Merrimack Station has caused appreciable harm to the balanced, indigenous fish population in the Merrimack River.

EPA Response:

The commenter's assumption that warmer water conditions will inhibit the growth of coolwater species also assumes that coolwater species will simply tolerate elevated temperatures, but these species (and all species) tend to abandon areas where temperatures reach stressful levels, if possible.

Normandeau Comment (xi):

Where aquatic habitat has been adversely impacted by a thermal discharge, sampling data typically show a greater total mortality (Z) for a resident fish species compared to the same species in a thermally uninfluenced area, due to increased stress associated with thermal impacts. Here, the mortality levels observed in Hooksett Pool are lower than or equal to those observed in Garvins Pool for five of the seven species examined (Normandeau 2017a). Mortality of the coolwater Fallfish and Yellow Perch was significantly higher in Hooksett Pool than in Garvins Pool, but mortality of the coolwater White Sucker was significantly lower in Hooksett Pool than in Garvins Pool. The increased mortality of Yellow Perch in Hooksett Pool compared to Garvins Pool is directly linked to the mortality of 777 Yellow Perch individuals that were harvested for the biocharacteristics study between 2008-2012 and cannot be conclusively attributed to thermal stress. When this analysis was conducted in 2011 (prior to the 2012 fish collections), the mortality of Yellow Perch was not significantly higher in Hooksett Pool compared to Garvins Pool (Normandeau 2012). No significant differences in mortality of warmwater species (Bluegill, Largemouth Bass, Pumpkinseed, and Smallmouth Bass) were detected between the pools. These observations are not consistent with the hypothesis that the operation of Merrimack

Station has caused appreciable harm to the balanced, indigenous fish population in the Merrimack River.

EPA Response:

EPA reviewed these data and analyses but does not find them compelling evidence as a predicter of appreciable harm. Additionally, for two coolwater species, yellow perch and fallfish, the commenter states that elevated mortality rates in Hooksett Pool are attributed to sampling mortality. This sampling issue makes any meaningful conclusions for those two important coolwater species impossible.

Normandeau Comment (xii):

Where aquatic habitat has been adversely impacted by a thermal discharge, sampling data tend to show lower fecundity for resident coolwater fish species compared to the same species in a thermally uninfluenced area, due to thermal stress. Fecundity of Yellow Perch and White Sucker was significantly higher in Hooksett Pool compared to Garvins Pool in 2012 (Normandeau 2017a). The observation of greater fecundity of two sensitive coolwater species in Hooksett Pool is not consistent with the hypothesis that the operation of Merrimack Station has caused appreciable harm to the balanced, indigenous fish population in Hooksett Pool.

EPA Response:

While this comparison suggests that yellow perch and white sucker had greater fecundity in 2012 in Hooksett Pool compared to Garvins Pool, which is encouraging, EPA is not convinced that fecundity would necessarily be lower in coolwater species due to thermal stress. Perhaps a better indicator of thermal effects on reproductive success, at least for yellow perch, would be egg viability at time of spawning.

There was another aspect of Normandeau's analysis on reproductive effects that is not mentioned in this comment. The commenter compared age and length of male and female yellow perch at 50% maturity between populations in Hooksett and Garvins pools. The results indicated a notable disparity between pools. According to the report (AR-871, p. 200), the age at maturity for both male and female yellow perch in Hooksett Pool was considerably younger than in Garvins. Similarly, the length at maturity was considerably smaller in Hooksett Pool versus Garvins Pool. (*See table below*). The report does not suggest these findings are inconsistent with the hypothesis that the operation of Merrimack Station has caused appreciable harm to the balanced, indigenous fish population in Hooksett Pool.

Age and length of male and female yellow perch collected by electrofishing within Garvins and Hooksett Pools during 2008 and 2009 from Table 4-15-18 in AR-871, p. 213.

Pool	Age at 50% Maturity		Length (mm) at 50% Maturity	
	Male	Female	Male	Female
Garvins	4.2	4.1	201	176
Hooksett	1.6	2.3	135	141

Although there may be other reasons for these dramatic differences, reductions in age and size at maturity have been identified as stress indicators for some commercial fish species (Trippel, 1995) (AR-1776). Normandeau does not offer an explanation for these data. These particular comparisons do not support a finding that Merrimack Station's thermal discharge has not caused appreciable harm to the BIP in Hooksett Pool relative to the thermally uninfluenced Garvins Pool.

Normandeau Comment (xiii):

A comparison of external and internal parasites on the same resident species in both Hooksett Pool and Garvins Pool indicates that there has been no appreciable harm to the BIP in Hooksett Pool. Resident fish species in aquatic habitat that has been adversely impacted by a thermal discharge characteristically manifest more frequent infestation of internal and external parasites compared to the same species resident in a thermally uninfluenced area, indicating a reduction in the overall health and conditions of the fish due to thermal impacts. Internal parasites were assessed for two coolwater fish, White Sucker and Yellow Perch and they were equal or in greater abundance in Garvins Pool for both species (Normandeau 2017a). Of the six warmwater species examined, the prevalence of external parasites was greater in Hooksett Pool compared to Garvins Pool for two species, Smallmouth Bass (2012, 2013) and Spottail Shiner (2012). External parasites were equal or in greater abundance in Garvins Pool for Bluegill (2012, 2013), Largemouth Bass (2012, 2013), Pumpkinseed (2012-2013) and Redbreast Sunfish (2013). Of the five coolwater fish species, the prevalence of external parasites was greater in Hooksett Pool for Black Crappie (2012), Fallfish (2012), White Sucker (Spring 2012, 2013) and Yellow Perch (2012). External parasites were equal or greater in Garvins Pool for Fallfish (2013), White Sucker (Fall 2012), and Yellow Perch (2013). Based on the assumption that warmer water conditions will enhance the frequency of parasitic infection of both warmwater and coolwater fish species, the inconsistent results do not provide support for the hypothesis that the operation of Merrimack Station has caused appreciable harm to the balanced, indigenous population in the Merrimack River.

EPA Response:

EPA has reviewed these comments and analyses but does not consider the absence or prevalence of parasites to be a major indicator of appreciable harm, or lack thereof, in this review. Parasites exist in most every temperature regime, and EPA agrees that stress caused by temperature or other sources can suppress a fish's immune system, increasing the potential for parasitic infestations. However, warmwater species are not likely to be stressed through exposure to the Facility's thermal plume in most sections of Hooksett Pool, and coolwater species exposed to elevated temperatures sufficient to cause a stress response are likely to abandon those areas, when possible.

Normandeau Comment (xiv):

In sum, observations on the 1972-2013 time series of abundance data for both coolwater and warmwater fish in Hooksett Pool demonstrated that there was no significant decrease in abundance observed for any of the five coolwater fish species resident in Hooksett Pool (Normandeau 2017). The abundance of one coolwater fish, Black Crappie, has increased significantly in Hooksett Pool since its introduction and first detection during 2004. The lack of significantly decreasing trends for the other native and resident coolwater fish species (Chain Pickerel, Fallfish, White Sucker and Yellow Perch) is not consistent with the hypothesis that Merrimack Station has caused appreciable harm to the balanced, indigenous population. There has been no appreciable harm to the BIP in Hooksett Pool based on increases in warmwater species. As estimated by the same standardized electrofish sampling efforts, there have not been significant increases in abundance for nine of the ten warmwater fish species resident in Hooksett Pool during the 1972-2013 time period. Abundance of the native Pumpkinseed has significantly decreased and abundance of Rock Bass has increased since its introduction and first detection during 1995 sampling. There were no significant differences in the abundance of Rock Bass within Garvins and Hooksett Pools during the period of comparable sampling in those locations (2010-2013) indicating Rock Bass in Hooksett Pool have not increased at a rate greater than that in the thermally uninfluenced Garvins Pool. The lack of a significant increase in the abundance of any warmwater fish species other than Rock Bass during the period of comparable sampling is not consistent with the hypothesis that Merrimack Station's thermal discharge has caused appreciable harm to the BIP in Hooksett Pool (Normandeau 2017a).

Finally, where aquatic habitat has been adversely impacted by a thermal discharge, fish sampling data typically show a reduction in quality of body condition, lower mean length at age, higher total instantaneous mortality rate, decreased reproductive potential and more frequent infestation of parasites when compared to an appropriate BIP. Here a review of biocharacteristics for thirteen fish species resident in both Hooksett Pool and Garvins Pool did not indicate a consistent pattern of impaired health and condition for either warmwater or coolwater individuals residing in Hooksett Pool (Normandeau 2011a; Normandeau 2017a) which is supportive of a finding of "no prior appreciable harm" due to Merrimack Station operations.
EPA Response:

EPA has carefully considered the comments and analyses provided by the commenters in regard to appreciable harm. As described in the responses to each comment above, EPA does not agree that many of the comments support a finding of "no appreciable harm" due to Merrimack Station's past operations under the terms of the 1992 Permit and the CWA § 316(a) variance underlying it. That said, there are three important areas where the more recent data is encouraging regarding the possible current state of the BIP:

1. The lack of a decreasing trend in abundance for coolwater species with the addition of sampling data from 2010-2013 suggests thermal conditions in Hooksett Pool may be improving for the resident species most sensitive to elevated temperatures from the Facility's thermal discharge. This could reflect a biological benefit from the reduction in operations at Merrimack Station, particularly during summer months.

2. The proportion (in relative abundance) of warmwater species to coolwater species in Garvins Pool and Hooksett Pool appear remarkably similar based on the most recent data. As explained in the beginning of this section (4-1), EPA concurred with comments received that the Garvins Pool fish community could serve as an acceptable representation of what the current Hooksett Pool BIP should be. As such, EPA finds the similarities in the fish communities of these adjacent impoundments to provide evidence on the side of supporting a finding of "no appreciable harm," as of 2013, to the Hooksett Pool BIP.

3. The proportion (in relative abundance) of coolwater species to warmwater species in Hooksett Pool increased in the 2010s when compared to the 1970s. EPA considers the Hooksett Pool fish community of the 1970s as an acceptable point of reference to assess the BIP. Therefore, from this perspective, in its evaluation of appreciable harm, EPA finds this evidence supports the view that, as of 2013, the condition of the Hooksett Pool BIP has improved, possibly associated with the Facility's reduction in operations and associated thermal discharges.

4.4.2 Adequate Fish Passage as Evidence of No Appreciable Harm

Comment II.4.4.2 (i)	**AR-1552, Normandeau, p. 22**
See also AR-846, PSNH, p. 51; AR-872, Normandeau, pp. 34-43	

Hooksett Pool is used by both resident and anadromous fish species. For the purposes of assessing the potential impact of Merrimack Station's thermal discharge on the BIP in Hooksett Pool, the entire length of Hooksett Pool should be considered a single water body, because fish residing in the pool are not limited in their ability to move about. The absence of any fish passage structure at Hooksett Dam prevents adult anadromous species from accessing Hooksett Pool unless directly stocked in or above Hooksett Pool. While several species of anadromous fish are occasionally present in Hooksett Pool due to stocking, the pool is not used as spawning or juvenile rearing habitat. With regards to anadromous species, the major role of Hooksett Pool is to serve as a downstream passage route and, once fish passage is installed, an upstream passage route. Concerns related to the interaction of migrating anadromous fish species and Merrimack Station's thermal discharge have been examined. Telemetry studies using Atlantic Salmon smolts (Normandeau 2006) and adult American Shad (Normandeau 1979c) indicated that the thermal plume did not act as a barrier to upstream or downstream migration.

In contrast to these comments, Normandeau disagrees with EPA's statement in the Determination Document (Section 5.3.1, p 34) that only juvenile Atlantic salmon, American shad, and alewife spend time in the pool during their downstream migration to the sea (AR-872, p. 55). According to Normandeau, adult Atlantic salmon have been captured in Hooksett Pool and are able to move past the thermal discharge without suffering mortality. Normandeau further comments that stocked American shad stocked use Hooksett Pool for more than just a migratory corridor, and successful spawning by stocked adult shad has been observed (p. 56-57).

EPA Response:

EPA's 2011 Draft Determinations Document, AR-618, p. 95, concluded that fish passage studies conducted for PSNH indicated that it was unlikely that Atlantic salmon out-migration would be impaired by the plant's thermal discharge, given the higher river flows and relatively cold ambient temperatures that commonly exist during the spring period when Atlantic salmon smolts migrate downstream through Hooksett Pool. In addition, the buoyant nature of Merrimack Station's thermal plume would leave room for Atlantic salmon smolts to travel beneath the plume to get downstream, if necessary. In any event, this is no longer a pertinent issue for this permit issuance because Atlantic salmon are no longer stocked in the Merrimack River, and upstream access to Hooksett Pool is currently impeded by the lack of a fish passage system at Hooksett Dam.

Regarding the comment that stocked American shad use Hooksett Pool for more than just a migratory corridor, EPA reviewed the locations of where American shad were captured in Hooksett Pool during electrofish sampling conducted by Normandeau in 2010 and 2011. Normandeau conducted fish sampling at 12 stations during the months of August and September; six stations were upstream from the plant's thermal discharge and six were downstream within the thermally-affected area of the pool. In 2010, a total of 69 American shad were caught on six dates at four stations from August 12 to September 23, according to catch data provided to EPA (AR-1778). Of these 69 American shad, all were captured upstream from Merrimack Station's thermal discharge. In 2011, the sampling effort resulted in only one American shad being caught. That fish was also located in waters upstream from Merrimack Station's thermal discharge. While it appears that there may be suitable habitat in Hooksett Pool for American shad, sampling conducted by Normandeau suggests that shad are using only the ambient waters upstream from the influence of Merrimack Station's thermal discharge, which represent roughly only 50 percent of the otherwise available habitat within Hooksett Pool.

American shad may also be present in Hooksett Pool in larval form due to the stocking of this early lifestage by USFWS in waters upstream from Hooksett Pool. Larval American shad could be present in Hooksett Pool from mid-June through the end of July based on the timing of stocking efforts (See discussion of temperature requirements of larval American shad on pages 90-93 in EPA's draft determination). EPA remains concerned that under reduced capacity plant operations, larval American shad drifting through Hooksett Pool could still be exposed to harmful, or potentially lethal, thermal conditions within Merrimack Station's thermal plume. Therefore, the Final Permit includes a temperature limit developed specifically for the protection of drifting American shad larvae. The acute limit (31.3ºC) is set 2ºC lower than the temperature identified in studies as causing lethality, and if this temperature is exceeded at Station S-4, the Facility must take measures necessary to ensure the temperature at S-4 is below the acute limit within 3 hours from the hour in which the exceedance occurs. Using the 2ºC buffer in this context is consistent with recommendations from the Gold Book and National Academy of Sciences (1973). *See* AR-175.

4.4.3 No Appreciable Harm to Hooksett Pool Shellfish and Macroinvertebrate Communities

Comment II.4.4.3 (i)	AR-1552, Normandeau, p. 24 AR-872, Normandeau, p. 45 AR-846, PSNH, pp. 26-28

Kick net macroinvertebrate sampling was conducted within Garvins Pool and at Monitoring Station N-10 in Hooksett Pool during late 2011 to validate the use of N-10 as a control site for the assessment of potential impacts to the macroinvertebrate community due to Merrimack Station's thermal discharge. Due to the limited mobility of benthic organisms in Hooksett Pool and the presence of ambient water temperatures at Station N-10, its use as such a control site is appropriate. Among the metrics examined for kick net data, no consistent pattern was detected to suggest that a significant difference in the macroinvertebrate communities within Garvins Pool and Hooksett Pool at Station N-10 exists. Kick net sampling provides the best representation of macroinvertebrate species available as a food source to fish residing within shallow water littoral habitats (Flotemersch et al. 2006). Even though the wadeable shore zone only accounts for a small proportion of the entire river channel, it may be the most productive and diverse zone for benthic macroinvertebrates (Wetzel 2001).

Macroinvertebrate sampling was conducted during October 2011 using the same sampling techniques and sampling locations as was performed during 1972. When compared to samples collected during 1972, kick net data collected in 2011 at Monitoring Stations N-10, S-0, S-4 and S-17 showed an increase in EPT richness of 150-300%. Taxa richness increased from 7-10 in 1972 to 21-23 in 2011. The 2011 EPT/chironomid abundance ratio was higher than that recorded during the 1970s, as would be expected from samples collected in a river with improved water quality and habitat tolerable for more pollution sensitive species (Normandeau 2012a). Degraded habitat conditions that might be caused by continued exposure to Merrimack Station's thermal discharge should result in a consistent pattern of reduced diversity and increased abundance of pollution-tolerant species for the Hooksett Pool macroinvertebrate population located downstream of Merrimack Station over time (1970s to present). That hypothesis is not supported by the data collected during 2011.

Normandeau further states (AR-872, p. 115) that macroinvertebrate communities are an excellent indicator of the health of an aquatic system. Due to their limited mobility, they are unable to avoid adverse environmental conditions, and are often eliminated (AR-872, p. 115). PSNH and Normandeau comment that continued exposure to Merrimack Station's thermal discharge should result in a consistent pattern of reduced diversity and increased abundance of pollution-tolerant macroinvertebrate species in Hooksett Pool over time, but data does not support this hypothesis (AR-846, p. 28).

Kick net data shows no difference between Garvins and Hooksett at N-10, but Ponar data shows increased richness and diversity at Garvins in relation to Hooksett N-10 (AR-846, p. 20); kick net is the best representation of macroinvertebrate species available as a food source to fish residing within shallow water littoral habitats (AR-846, p. 27).

EPA Response:

EPA agrees with the comment that macroinvertebrate communities are an excellent indicator of the health of an aquatic system given that, due to their limited mobility, they are unable to avoid adverse environmental conditions. EPA also agrees with PSNH's comment that continued exposure to Merrimack Station's thermal discharge should result in a consistent pattern of reduced diversity and increased abundance of pollution-tolerant macroinvertebrate species in Hooksett Pool over time if pollution intolerant species are being harmed by the thermal discharge, but EPA would argue that, in this case, "pollution-tolerant" means tolerant of elevated temperatures. Moreover, EPA does not agree with the comment that the data do not support this hypothesis.

Macroinvertebrate sampling within Garvins Pool and Hooksett Pool (at Station N-10) served to validate the use of N-10 as a control site for the assessment of potential impacts to the macroinvertebrate community due to the MS thermal discharge. "Ponar data revealed increased richness and diversity within Garvins Pool relative to Hooksett Pool (N-10)". (AR-872, p. 45)

A direct comparison of sampling data collected in Garvins Pool and Hookset Pool (downstream of Merrimack Station) was not done due to concerns over the effect of varied seasonal timing of the sampling (p. 46) Normandeau argues that degraded habitat conditions due to continued exposure to Merrimack Station's thermal discharge should result in a consistent pattern of reduced diversity and increased abundance of pollution-tolerant species for the macroinvertebrate population located downstream of Merrimack Station over time (1970's to present), but that this hypothesis is not supported by the data collected during 2011 (p.46).

The comment suggests that macroinvertebrate diversity has increased in the 2000's when compared to sampling conducted in the 1970's. During the public comment period, Normandeau submitted to EPA the report, "Comparison of Benthic Macroinvertebrate Data Collected from the Merrimack River near Merrimack Station during 1972, 1973, and 2011," dated January 2012, which serves to document changes in the benthic macroinvertebrate community composition from the 1970s to 2011, based on sampling conducted during 1972, 1973, and 2011 (p.1). Qualitative sampling appears to indicate improvements in the aquatic insect community with the most dramatic differences between the two decades seen in taxa richness, EPT richness, and EPT to Chironomidae abundance ratio. However, quantitative sampling of benthic macroinvertebrates revealed the presence of a highly invasive bivalve, the Asian clam (*Corbicula fluminea*), that had, at the time, never before been documented in this section of the Merrimack River, or anywhere else this far north in New England. Not only were they present, but they dominated sections of Hooksett Pool at and below the plant's thermal discharge canal, and were totally absent upstream from the thermal discharge.

EPA found the dominance of this highly invasive species in the thermally-influenced portion of Hooksett Pool, and its well-documented capacity to impact indigenous benthic invertebrate species elsewhere, to be disturbing new information. It provided evidence suggesting that the macroinvertebrate community in Hooksett Pool might have been negatively affected by Merrimack Station's thermal discharge. While the plant didn't introduce this species, its thermal discharge, especially during the winter months when Asian clam mortality is typically high under ambient conditions in northern climates, may have provided a thermal refuge for the clams to survive and thrive. *See* Section 5.0 for more information and discussion on Asian clams.

Comment II.4.4.3 (ii)	AR-870, Normandeau, pp. 1-14 AR-1300, LWB, pp. 4-5

Normandeau comments that it collected aquatic insects and benthic invertebrates during sampling conducted in 2011, and compared the results to similar sampling conducted in 1972. (AR-870, p.1). The sampling results and analyses are included in the report "Comparison of Benthic Macroinvertebrate Data Collected from the Merrimack River near Merrimack Station During 1972, 1973, and 2011," dated January 2012 (AR-870). According to this report, comparisons between sampling conducted in 1972 and 2011 show dramatic improvements in aquatic insect community composition, especially improvements in the ratio of pollution-sensitive species (EPT) to pollution-tolerant species (e.g., Chironomidae).

LWB Environmental Services, Inc. comments that information on the composition of benthic invertebrate communities is now routinely used to assess the extent of impairment of aquatic communities due to stressors such as habitat degradation and pollutant discharges (Barbour et al. 1999, Karr and Chu 1999). The objective of the Normandeau 2011 study was to determine whether changes in Merrimack River benthic invertebrate communities between these two time periods were consistent with improvements in water quality that have occurred since the 1960s.

Normandeau further comments that sampling of the benthic invertebrate communities also indicated that water quality improved slightly at all stations compared to 1972 data, although differences were not as large as the kick sample data (AR-870, p.14 Normandeau noted that the numerically-dominant taxon at the middle and western stations of S-0, S-4, and S-17 was the Asian clam, *Corbicula fluminea*, an invasive species that was introduced from Asia in the early 1900s.

LWB Environmental Services, Inc. also comments that data collected using both kick net and Ponar sampling were used to calculate five benthic community indices. These were (1) taxa richness, (2) Hilsenhoff Biotic Index, (3) Ratio of Ephemeroptera, Plecoptera, and Trichoptera (EPT) abundance to Chironomidae abundance, (4) Percent contribution of the dominant taxa to total number of organisms, and (5) EPT richness. All these metrics can be used to assess whether benthic invertebrate communities have been impaired due to environmental stress (Barbour et al. 1999).

Normandeau notes that several metrics, such as Hilsenhoff Biotic Index, total abundance, and percent contribution of the dominant taxon did not consistently indicate improved conditions for a specific year or station (AR-870, p.15). Normandeau also noted that Garvins Pool Stations DSR, USR, and Hooksett Pool Station N-10 showed little difference in metric values (AR-870, p.14).

Normandeau comments that the qualitative sampling conducted on aquatic insects along the shoreline provide the best data to compare benthic macroinvertebrate samples between the 1970s and 2011. It states that this is the case because organisms found in the littoral zones are typically more pollution sensitive than those found in the sand substrates invertebrate community, so that responses to changes in water quality would be more obvious (AR-870, p. 15). Normandeau also points out that kick net sampling provides the best representation of macroinvertebrates species available as a food source to fish residing within shallow water littoral habitats, even though the wadeable shore zone accounts for only a small portion of the river channel, perhaps being the most productive and diverse zone for benthic macroinvertebrates (AR-872, p. 45). LWB Environmental Services, Inc., comments that overall, the benthic invertebrate study provides some evidence that biological conditions in the Hooksett Pool have improved since the 1970s.

EPA Response:

Although only one sample was collected along each bank at the four stations sampled, EPA agrees that the qualitative aquatic insect data collected in 2011 suggests notable improvements compared to sampling conducted in 1972. However, a larger data set collected in 2011 during quantitative benthic sampling does not show similar improvements over data collected in 1972 and 1973. Therefore, these results are inconclusive.

EPA does not agree that the aquatic insect data collected along the shoreline should be considered better than benthic samples collected in deeper water. Both sets of sampling data are important for understanding the status of the entire macrobenthic community of Hooksett Pool.

EPA does agree with the comment that the shoreline shallows are important habitat for both aquatic invertebrates and vertebrates, including juvenile fish. This is precisely why Merrimack Station's surface-oriented thermal plume, which can hug the banks and extend down three-feet, has such a high capacity to affect fish that reside in these important habitats downstream from the plant's discharge canal. But the habitat "value" of a particular site sampled in a river can vary considerably over time as woody debris accumulates, then breaks down, or is washed downstream. Based on this limited sampling effort, it's unclear whether a substantial increase in abundance of aquatic insects at a particular location between 1972 and 2011 should be attributed solely to improved water quality, or to natural changes in available habitat at those sites over time that are unrelated to water quality, or both. Nevertheless, given that certain parameters of Hooksett Pool water quality have improved in that 40-year period, positive changes in the macrobenthic community within the shallow water littoral habitats would be expected, although similar improvements would be expected in the remaining benthic habitats, as well**.** This was not the case, however, as discussed below.

As Normandeau points out, deeper, unvegetated areas comprised of sand/silt/clay make up, by far, the largest habitat area in Hooksett Pool. According to Normandeau's March 2011 report, "Quantification of the Physical Habitat within Garvins, Hooksett, and Amoskeag Pools of the Merrimack River," sediments (sand/silt/clay) make up 90 percent of the total area of Hooksett Pool, with only 17 of the 382 acres being vegetated by SAV. Benthic organisms tend to be more sedentary in these unvegetated or sparsely vegetated, comparatively stable habitats, which exist below the depth typically scoured by ice movement. These organisms not only live on (or burrow into) the riverbed but can form habitats themselves by living in dense aggregations. For example, mollusks such as mussels can serve as habitat formers in these areas that otherwise lack substantial bottom structure. Additionally, benthic organisms' lack of mobility during most lifestages makes them useful for studying the effects of pollution above and within the influence of a point source discharge of pollutants.

Regarding Normandeau's comments on the documented presence of Asian clam (*Corbicula fluminea*) in Hooksett Pool, EPA considers the presence of this highly invasive species a troubling discovery. Asian clams are considered by some scientists to be one of the most invasive species in freshwater aquatic systems (Sousa et al. 2008). When EPA received this report in 2012, Hooksett Pool was the northern-most location in New Hampshire with a confirmed presence of Asian clams, and only the fourth known location within the state. According to NH DES, the other sites in New Hampshire include the Merrimack River downstream from Hooksett Pool, in Merrimack, and two ponds south of Hooksett Pool (Cobbetts Pond and Long Pond). Since 2012, however, other populations have been discovered in New Hampshire, including areas further upstream in the Merrimack River. *See Section 5.0 for a more complete discussion of Asian clams, included studies and analyses submitted by PSNH and CLF.*

According to the environmental fact sheet published by NH DES in 2012, Asian clams can form dense clusters of over 5,000 clams per square meter, dominating the benthic community and altering the benthic substrate. Large populations can severely alter lake or riverine food webs by competing directly with existing native fish and shellfish species for food and space. The clams release phosphorous into the water column through burrowing, feeding from the sediment, and their excreta, which can stimulate plant and algal growth, making potentially hazardous cyanobacteria blooms more likely to occur. In addition, according to NHDES's fact sheet, larval clams can be drawn into and damage boat engines. Similarly, they can be drawn into raw water intakes like those used at drinking water, electrical generation, and industrial facilities, impacting those systems. Asian clams are such a concern in New Hampshire that it is illegal to import, possess, or release them in the State. Additionally, NHDES's Watershed Report Cards for 2014, 2016, and 2018 identified the lower portion of Hooksett Pool as "likely impaired for non-native fish, shellfish, or zooplankton." EPA understands this to reflect the presence of Asian clams in the thermally-influenced section of Hooksett Pool. *See* https://www.des.nh.gov/organization/divisions/water/wmb/swqa/2018/index.htm.

While the presence of Asian clams in Hooksett Pool is, in itself, of great concern to EPA and NH DES, their distribution within Hooksett Pool is especially alarming. Sampling results provided in Normandeau's report (Normandeau 2012) presents compelling evidence that a relationship exists between the presence/abundance of Asian clams and Merrimack Station's thermal discharge. Normandeau collected two grab samples each at three locations upstream from the plant's discharge canal, for a total of six samples. From the data provided in the report (Normandeau 2012), it is unknown if any individual Asian clams were collected in these samples, but they were not listed as the dominant taxon. Of the 18 samples taken at or downstream of the plant's discharge canal, however, Asian clams were the dominant taxon in 14 of them, ranging in relative abundance from 58 to 94 percent, with a mean of 78.6 percent at the sites where they were dominant.

EPA reviewed published scientific literature to see if the relationship between Asian clams and thermal plumes from power plants had ever been studied. EPA found two studies that looked at this question and both found a strong relationship between the presence of Asian clams and the thermal plumes from power plants. One study was conducted near the Connecticut Yankee power plant, on the lower Connecticut River, and the other took place in a freshwater section of the St. Lawrence River, in Quebec. In the St. Lawrence River, which is considerably further north than Hooksett Pool, Asian clams were only present downstream of the power plant, and the clam's distribution appeared to be associated with the warm water plume (Simard et al. 2012, AR-1404). In the study conducted on the lower Connecticut River, the investigators concluded that high winter survival during most years was attributable to the power plant's thermal discharge, and that the key to *Corbicula*'s success in establishing a population in the Connecticut River was its ability to colonize refugia from winter temperature and spring freshet flow extremes that often cause high clam mortality (Morgan et al. 2003, AR-1405). Normandeau's findings regarding the location of Asian clams in Hooksett Pool appear consistent with the results from the studies at these other two power plants.

In response to concern over the presence of Asian clams in Hooksett Pool, EPA and NHDES collaborated on a study in 2013 and 2014 to look at the presence and abundance of Asian clams in Hooksett Pool and other known locations in New Hampshire. Sampling was conducted in July and November 2013, and in September 2014. Stations sampled by Normandeau in 2011 were revisited, as well as sites upstream from the plant's discharge canal, including stations in Garvins Pool, and downstream in Amoskeag Pool. During these sampling events, no Asian clams were collected at either the nine stations in Hooksett Pool upstream of Merrimack Station's discharge canal, or at any stations farther upstream in Garvins Pool. Asian clams were, however, found at, and downstream of, the plant's discharge canal, as well as in Amoskeag Pool, the impoundment immediately downstream from Hooksett Pool. During the sampling effort in September 2014, EPA divers collected samples and took video and photos of the river bottom in areas directly downstream of, at the mouth of, and directly upstream of the plant's discharge canal. This qualitative sampling revealed both high densities of clams near the mouth of the discharge canal and clam size that exceeded that of the clams collected further downstream in Hooksett Pool, and in Amoskeag Pool below the Hooksett Dam.

Normandeau and AST Environmental conducted additional Ponar sampling and diver transect sampling in 2014 and 2016. This sampling focused primarily on assessing the effects associated with Asian clams on native benthic invertebrates, especially mussels. *See Section 5 for more information on these sampling efforts, and related analyses.*

Comment 4.4.3 (iii)	**AR-872, Normandeau, pp. 45-46** **AR-870, Normandeau, p. 5**
See Also AR-1549, Enercon, pp. 25-35	

Normandeau comments that a direct comparison of kick net and Ponar data collected in Garvins Pool and Hooksett Pool *downstream* of Merrimack Station was not done due to concerns over the effect of varied seasonal timing of the sampling (AR-872, p. 46), but that macroinvertebrate sampling within Garvins Pool and Hooksett Pool served to validate the use of N-10 as a control site for the assessment of potential impacts to the macroinvertebrate community due to the Merrimack Station's thermal discharge. Due to the limited mobility of benthic organisms in Hooksett Pool, and the presence of ambient water temperatures at Station N-10, Normandeau comments that N-10's use as a control site is appropriate.

Normandeau argues that degraded habitat conditions due to continued exposure to Merrimack Station's thermal discharge should result in a consistent pattern of reduced diversity and increased abundance of pollution-tolerant species for the macroinvertebrate population located downstream of Merrimack Station over time (1970's to present), but that this hypothesis is not supported by the data collected during 2011. Normandeau also comments that the relatively high thermal tolerance of organisms found in the benthic macroinvertebrate community and the surface-orientation of the thermal plume were two factors ameliorating any discharge effects.

EPA Response:

Normandeau's expressed concern over the effect of "varied seasonal timing" to explain why it did not conduct direct comparisons between Garvins Pool and the thermally-influenced portions of Hooksett Pool appears to be related to a decrease in water temperature over the two-week period between sampling events in Hooksett Pool (Oct 25-26, 2011) and those in Garvins Pool (Nov 7-9, 2011). According to Normandeau's 2012 report, surface water temperatures dropped from approximately 11°C to 6°C (52° - 43°F) (AR-870, p. 5). Given that these benthic organisms have limited mobility, as Normandeau noted, changes in organism abundance during this two-week period may not have occurred unless there was a major die-off, or organisms buried themselves deeper into the sediments. Nevertheless, Normandeau's concern appears to underscore the strong influence temperature has on aquatic life, even macrobenthic organisms.

Normandeau's macrobenthic study found that taxa richness and diversity were both greater in Garvins Pool than in Hooksett Pool, upstream from the plant's thermal discharge (at Station N-10). It's unfortunate that Normandeau did not collect additional samples during the November sampling period at the Hooksett Pool stations within the influence of the thermal discharge.

Normandeau claims (at AR-872, p. 45) that the effects of the Merrimack Station's thermal discharge are ameliorated due to the relatively high thermal tolerance of organisms found in the macrobenthic community and the surface-oriented nature of Merrimack Station's thermal plume. If true, this may explain why Asian clams appear to be benefitting from the thermal refuge created by Merrimack Station's thermal discharge and the ice-free conditions that exist in the lower Hooksett Pool during winter months. But benefits to this introduced invasive species may come at a cost to indigenous benthic infauna, as demonstrated by the clam's dominance in areas of the lower Hooksett Pool, in 2011. While the size of the clams in close proximity to the plant's discharge canal suggest elevated temperatures enhance their growth rate and/or allow them to live longer, the presence and prevalence Asian clams further downstream in Hooksett Pool, and even within Amoskeag Pool, their absence upstream of the discharge, appears to indicate that the surface-oriented plume, which tends to keep the section of the Merrimack River around and downstream of the thermal discharge ice-free for multiple miles during the winter when the plant is operating, increases the clam's ability to survive. Their absence directly upstream from the plant's discharge canal and in Garvins Pool, along with the understanding that they benefit from warmer water during winter, provides compelling evidence suggesting that were it not for the plant's thermal discharge, this invasive species would not be the dominant species it has become in the lower Hooksett Pool. It should be noted that thermal modeling by Enercon Services, Inc. indicate that the effects of the Facility's thermal discharge are predicted to extend down from the surface to the river bottom along the west side of the river, at least to Station S-4, throughout the winter. (*See* AR-1549, p. 25-35).

Comment 4.4.3 (iv)	**AR-872, Normandeau, pp. 46-47** **AR-846, PSNH, pp. 17-18**
See Also AR-868, Normandeau, p. 21	

Diversity

Support for diversity at all trophic levels is provided in the numerous reports detailing the ecology of Hooksett Pool over the last four decades. Detailed studies of phytoplankton, zooplankton and meroplankton were last conducted during the late 1970s and no reduction or adverse changes were detected that could be attributed to Merrimack Station's thermal discharge (Normandeau 1979b). Submerged aquatic vegetation species that dominated during the 1970s were still the dominant species during a 2003 survey (Normandeau 2011b). Diversity in the number of macroinvertebrate species as sampled by kick net has increased in Hooksett Pool, and additional metrics indicate that the observed increase is due to an increase in pollution-sensitive species, which require improved water quality to survive (Normandeau 2012a). The submerged aquatic vegetation "habitat former" species that dominated in the 1970s was still dominant as of 2003 (AR-846, p. 17).

Similarly, diversity in the fish community has also been observed in Hooksett Pool. During the 1972-2013 time period, species diversity has increased as indicated by taxa richness and Shannon Diversity Index values (Normandeau 2011a, 2017a). Moreover, when Hooksett Pool fisheries sampling during comparable periods between 2010 and 2013 is compared to sampling in the thermally uninfluenced but otherwise comparable Garvins Pool, taxa richness is similar (22 and 19 fish species, respectively) (Normandeau 2011a; 2017a). (AR-1552, p. 25).

EPA Response:

PSNH's 316 (a) thermal variance request focused almost exclusively on the fish community since it was this biological community that had been studied most extensively, covering sampling periods in the 1960's, 1970's, 1990's, and 2000's. Accordingly, EPA focused its review primarily on the fish community in assessing the merits of PSNH's variance request, and based its conclusions largely on the plant's capacity to affect the fish community and evidence of changes in that community over time. As the commenters point out, other biological studies were conducted, as well, primarily in the 1970's. These included studies on plankton, macro-invertebrates, and SAV. Some additional studies were conducted in the 2000's and 2010's, and their results were submitted to EPA during the public comment period for the 2011 Draft Permit and thereafter.

The comment states (at AR-872, p.46) that submerged aquatic vegetation (SAV) that was dominant in the 1970s was still dominant as of 2003, but species dominance is not the same as diversity.

EPA maintains that changes in the fish community over time provide critical information on whether, or the extent to which, the thermal discharge from this plant (or any plant) has impacted the BIP of the Hooksett Pool. Furthermore, fish can be particularly sensitive to changes in water temperature and their behavior can be influenced by the sub-lethal effects of heat. Nevertheless, the intent of the CWA's § 316(a) variance is to protect all parts of the BIP. EPA described in the 2011 Draft Determinations Document (AR-618, p. 36) the reasons for evaluating primarily the fish community, given that studies directed at other biological communities had not been conducted since the 1970s. Now that PSNH has completed and provided more current studies on biological communities other than fish, EPA has evaluated these studies, as well. Moreover, EPA has not only evaluated PSNH's submissions in this area, but the Agency has also conducted its own research in this area.

EPA does not consider an increase in species diversity in Hooksett Pool an appropriate argument to support PSNH's contention that its thermal discharge has not caused appreciable harm to the pool's BIP. While increased species diversity is often considered a positive indicator of habitat health in environmental assessments, this may not be the correct conclusion for assessments concerning impacts from heat on native aquatic organisms in New England, as is the case under this CWA § 316(a) thermal variance request. As mentioned in the draft Determinations Document (AR-618, p. 66), there is a tendency for warmer environments to have greater species richness than colder environments (Wehrly et al. 2003), so increased species richness is not necessarily desirable when assessing changes to naturally cool or cold-water aquatic communities. Furthermore, the intent of CWA § 316(a) is to protect the balanced, indigenous community of fish and other aquatic organisms within a waterbody, so the presence of *new* species may not be desirable, particularly if they compete with, or prey upon, native species. Also, it should be noted that trap net sampling conducted by Normandeau in the 1970s resulted in the capture of 18 species, while only 17 species were caught in the 2000's (2004, 2005) (Normandeau 2007a), though these numbers could potentially reflect greater sampling effort conducted in the 1970s.

Normandeau's electrofish sampling effort increased dramatically during the 2010 and 2011 sampling period compared to sampling completed in the 1970s, 1990s, and 2000s. Whereas earlier electrofish sampling in Hooksett Pool by Normandeau was conducted at 10 stations once per month (20 samples pool-wide for August and September, combined), sampling in 2010 and 2011 was conducted 10 times at each of 12 stations (on average) during August and September, for a total of 120 samples pool-wide. Moreover, the recent sampling was only conducted at 6 stations in both Garvins and Amoskeag pools versus 12 in Hooksett Pool, so that Normandeau collected only half the number of samples (60 vs. 120) in these two other pools. In addition, Garvins Pool, which is four miles longer than Hooksett Pool (9.8 miles vs 5.8 miles), was only sampled within a two-mile stretch in the mid-section of the pool. As a consequence, high-value backwater (oxbow), cobble, and boulder habitats where other species might be expected to reside were missed. Despite being designed to "…provide a current assessment of the whole fish community in Garvins, Hooksett, and Amoskeag Pools…" (AR-871, p. 91), this inconsistent sampling strategy increases the chances of finding more species in Hooksett Pool than either Garvins or Amoskeag pools. Therefore, the fish diversity comparisons presented by Normandeau between the 1970s and 2000-2010s in Hooksett Pool, as well as between the three pools during 2010-2011, does not provide reliable information for understanding actual differences in fish diversity.

The comment also suggests that macroinvertebrate diversity increased in the 2000's when compared to sampling conducted in the 1970's. During the public comment period, Normandeau submitted to EPA a report, "Comparison of Benthic Macroinvertebrate Data Collected from the Merrimack River near Merrimack Station during 1972, 1973, and 2011," dated January 2012, that documents changes in the composition of the benthic macroinvertebrate community from the 1970s to 2011, based on sampling conducted during 1972, 1973, and 2011 (AR-870, p. 1). Qualitative sampling appears to indicate improvements in the aquatic insect community with the most dramatic differences between the two decades seen in taxa richness, EPT richness, and EPT to Chironomidae abundance ratio. However, quantitative sampling of benthic macroinvertebrates revealed the presence of the invasive bivalve, Asian clam (*Corbicula fluminea*), that had never before been documented in this section of the Merrimack River, or anywhere else this far north in New England. Not only were they present, they dominated sections of Hooksett Pool at and below the plant's thermal discharge canal and were totally absent upstream from the thermal discharge (AR-870).

The dominance of this invasive species in the thermally-influenced portion of Hooksett Pool, and its documented capacity to impact indigenous benthic invertebrate species elsewhere, was initially viewed as disturbing new information. This information provides evidence that the diversity of the macroinvertebrate community in Hooksett Pool may have been negatively affected by Merrimack Station's thermal discharge. While the Facility did not introduce this species to Hooksett Pool, its thermal discharge, especially during the winter months when Asian clam mortality is typically high under ambient conditions in northern climates, appears to have provided a thermal refuge for the clams to survive and thrive. Studies and additional sampling made on behalf of PSNH in 2014 and 2016 cast doubt on the significance of Asian clam's impact on benthic communities (*See Section 5.0*) in general, and on the Hooksett Pool community, in particular. EPA concurs with comments that it does not appear that Asian clam's have caused appreciable harm to the Hooksett Pool BIP at this time, but the Final Permit requires additional studies to assess this issue more thoroughly.

Comment II.4.4.3 (v)	**AR-1552, Normandeau, pp. 25-26**
See also AR-846, PSNH, pp. 30-32, 47; AR-1174, Normandeau, pp. 4-16	

Presence of Necessary Food Chain Species

Support for the continued presence of necessary food chain species is provided through an examination of recent macroinvertebrate and fisheries data within Hooksett Pool. Benthic macroinvertebrate data collected from littoral areas of Hooksett Pool, where numerous young of year and juvenile fish reside and forage, showed that total abundance, taxonomic richness, EPT richness, and the abundance of EPT taxa to chironomid taxa were all much higher in 2011 compared to 1972. A review of recent fisheries sampling indicates that forage species such as Spottail Shiner, Fallfish, Common Shiner and Golden Shiner are important components of the Hooksett Pool fish community as they were during the 1970s (Normandeau 2011a; 2017a). Abundance of these forage species are comparable to levels observed during sampling conducted during the same years in Garvins Pool.

EPA Response:

The most common forage species in Hooksett Pool today are not the same as those in the 1970s, according to the commenter's own sampling results. In the 1970s, a total of six spottail shiners were captured in the four years of electrofish sampling Normandeau used for its trends analysis (AR-3, p. 61).The four-year mean CPUE for spottail shiner was 0.08, and relative abundance was 0.15 percent (AR-3, p. 64); this species was not an important component of the Hooksett Pool forage base. By 1995, however, Normandeau identified spottail as being the most abundant species of all in Hooksett Pool at 43.6 percent (CPUE of 58.10) based on one year of electrofish sampling. More recently, the 4-year mean relative abundance is 15.7 percent (mean CPUE of 5.5) based on sampling from 2004, 2005, 2010, and 2011 (AR-871, p. 77-78). Spottail shiner now appears to be an important component of the Hooksett Pool fish community based on its abundance as a forage species.

The other forage species listed in the comment (fallfish, common shiner, and golden shiner) were present in Hooksett Pool in the 1970s, but not abundant, either. The relative abundance of common shiner and golden shiner was always below one percent during the four years of sampling used by Normandeau in its trends analyses (1972, 1973, 1974, and 1976), with a total of 22 fish captured during electrofishing in August and September of those years (AR-3, p. 61). The relative abundance of fallfish during the same four years sampled ranged from 2.7 percent in 1972 to 0.0 percent in 1976 (AR-3, p. 61).

In its Merrimack River Monitoring Program Summary Report, dated March 1979 (AR-364), Normandeau identifies two species as being important for forage, yellow perch and golden shiners. More specifically, the report identifies yellow perch *juveniles* as being important as forage for gamefish, while the adults were themselves considered important as an abundant gamefish. Yellow perch was, by far, the most abundant species identified as forage in the 1970s, but as Normandeau's statistical trends analysis has demonstrated, its abundance significantly declined between 1972 and 2011 (AR-871, p. 225). As yellow perch numbers dropped to a record low in 1995 (CPUE = 0.2), spottail shiner abundance soared to a CPUE of 58. Similarly, bluegill, which like spottail, had a CPUE of 0.0 in 1976, also dominated in 1995 with a CPUE of 55 (AR-3, p. 64).

Regarding comparisons with the forage base in Garvins Pool, EPA agrees the two pools have similarities, except for yellow perch abundance, if they are still considered forage as juveniles as they were in the 1970s. Juvenile yellow perch abundance was greater in Garvins Pool than Hooksett Pool for young-of-year (YOY) and immature perch sampled in 2010, according to Table 2-10 of Normandeau's 2011 fisheries analysis report (AR-871, p. 35).

PSNH provides no support for its generalization that aquatic habitats adversely impacted by a thermal discharge contain a higher percentage of generalist feeders and pollution-tolerant species. The company cites Barbour et al. (1999), but this reference speaks to pollution more generally, not conditions related specifically to elevated temperatures. A species such as white sucker, which is often identified as pollution-tolerant and generalist-feeder, is also temperature-sensitive. Therefore, simply counting species identified as pollution-tolerant or generalist feeders has little value when analyzing thermal effects and can misrepresent effects that are occurring from temperature alone, or in combination with other stressors. Nevertheless, Normandeau's analysis, presented in its Fisheries Survey Analysis Report (AR-871) concludes that there were more pollution-tolerant species in Hooksett Pool in 2011 than in 1972. Furthermore, comparisons by Normandeau of the Hooksett Pool and Garvins Pool fish communities indicate that Hooksett Pool contained more pollution-tolerant species, as well as a higher percentage of generalist feeders than in Garvins Pool. But, as the commenter points out, the temperature sensitivity of these species is not necessarily consistent with their feeding habits or their broader tolerance to pollution. Therefore, EPA finds this argument to have little relevance to temperature effects on the Hooksett Pool fish community.

4.4.4 No Appreciable Harm to the Hooksett Pool Phytoplankton, Zooplankton and Meroplankton Communities

Comment II.4.4.4	**AR-1552, Normandeau, pp. 22-23** **AR-846, PSNH, pp. 31-32**

Lower Hooksett Pool is a segment of the Merrimack River that is considered a low potential impact area for phytoplankton (USEPA 1977), because it is in a portion of the Merrimack River continuum where the annual carbon cycle is typically dominated by heterotrophic activities in a detrital food chain (Hynes 1970). Annual studies of the community composition and standing crop of phytoplankton and periphyton over a four-year study period (1975-1978), demonstrated that

- no endangered or threatened species were found,
- no shift towards nuisance species was observed in either the upstream or downstream portions of Hooksett Pool, and
- there were no long-term reductions or increases in autotrophic production of the periphyton or phytoplankton components of the algal community that could be attributed to Merrimack Station's thermal discharge (Normandeau 1979a).
- the same study looked at zooplankton and meroplankton communities and found there was no appreciable harm to these communities because no endangered or threatened species were found and no reduction or adverse change was observed in exhaustive studies performed upstream and downstream of Merrimack Station
- there was minimal entrainment mortality of net zooplankton and meroplankton due to passage through the condenser cooling system and cooling canal of Merrimack Station (Normandeau 1979a), indicating that the heated discharge did not alter the standing crop,

relative abundance, natural population fluctuations or free drift of these components of the BIP.

Also, PSNH states (at AR-846, p. 31-32), that annual studies of the community composition and standing crop of phytoplankton and periphyton from 1975 through 1978 in the portion of the Hooksett Pool upstream and downstream of Merrimack Station showed no endangered or threatened species were found, no shift towards nuisance species observed in either the upstream or downstream portions of the Hooksett Pool, and no long-term reductions or increases in autotrophic production of the periphyton or phytoplankton components of the algal community that could be attributed to Merrimack Station's thermal discharge (p. 31). According to PSNH (p. 31-32), transient episodes of low productivity resolved quickly due to the short generation time (up to two cell divisions per day) of the diatoms which were dominant in the algal community and replenished rapidly during the fall season. PSNH maintains that these findings support the current existence of a BIP in the Hooksett Pool.

EPA Response:

Normandeau's comments refer only to their plankton studies from the late 1970's, but the first ecological studies conducted by Normandeau in 1967 and 1968 included plankton, as well. The conclusions listed in this first report (Normandeau, undated) regarding plankton are the following (in the order they appear):

> (1) The rise in temperature of the cooling water does have a significant effect on the plankton suspended in it; (2) This effect is related to temperature, with excess of 100ºF causing significant changes in frequency of occurrence of various groups; (3) The total effect of the power plant on the plankton of the Merrimack River is related to temperature and flows and is limited to the water passing through the plant; (4) Some groups of plankton are more susceptible to the effects of increased temperature, this is particularly true of the zooplankton; (5) Although reduction in the plankton may occur as the result of passing through the condensers, the plankton is not completely destroyed when going through the plant; (6) There is substantial recovery in numbers of plankton prior to reaching the Hooksett Dam; (7) It appears that the only affected area is the warm stratified layer south of the discharge canal; (8) It has not been established as to whether the effects of the rise in temperature on the plankton has had or could have significant adverse effects on the ecology of the Merrimack River. The available results are much too inconclusive; and (9) All things considered, however, it would seem that under the worse conditions, adverse effects on the plankton would be limited to a relatively short period of time and to a relatively small portion of the river.

NHFGD reviewed the same data at that time, and incorporated its own interpretation into the report, "Merrimack Thermal Study" (Wightman, 1971). In its discussion of the plankton study, NHFGD states, "There appears to be a reduction in the frequency of occurrence of plankton in the surface waters south of the Bow Steam Plant." The report also states, "zooplankton such as ciliates, rotifers, flagellates and cladocera appear to be adversely affected by the heated effluent while desmids, diatoms, and blue green algae indicated similar effects among the phytoplankton." In the Wightman report, NHFGD referenced a study by Trembly in Pennsylvania (Trembly, not reviewed by EPA) which states, "As temperatures increase there is a decrease in the number of organisms. As temperature increases to 80-87ºF, the number decreases by 54 percent and when the temperature increases from 87-93ºF, there is a 24 percent loss." NHFGD concluded that although the Bow Steam Plant appears to have had some effect on the plankton of the area, the supplementary flows from the Suncook River provided a partial recovery effect in the lower section of the river, although this contribution slowed considerably during periods of low flows and high seasonal temperatures (Wightman, 1971). Phytoplankton also has an ability to re-establish populations rather quickly through primary production (Normandeau, 1979b), but obviously zooplankton lacks that ability. Furthermore, while NHFGD acknowledged that the data from this two-year study does not indicate that a critical level had been reached in the study area (lower Hooksett Pool), the report emphasized the importance of plankton to the survival of certain species of fish at some life stages, and recommends that future plants should have cooling facilities incorporated in their initial plans as a protective measure to maintain the ecological balance (Wightman, 1971).

The egg and larval lifestages of certain fish species are referred to as ichthyoplankton given their small size and drifting (or weakly swimming) behavior. While many of the fish species found in the Merrimack River do not have a drifting larval stage, some do, including yellow perch, American shad, golden shiner, and white sucker. These drifting larvae are part of the broader zooplankton community, but in studies of the thermal effects on the plankton community conducted in the 1960s and 1970s, ichthyoplankton is not discussed in the analysis. (Ichthyoplankton are, however, discussed relative to the potential to entrain these organisms into and through the plant.) Although these fish species are only in this planktonic life stage for a limited period, they are especially susceptible to heat exposure. Some fish larvae, such as American shad, are attracted to sunlight and try to stay close to the surface. This behavior could put them within Merrimack Station's surface-oriented thermal plume. In the 2011 Draft Determinations Document, EPA evaluated the potential effects of the thermal discharge on fish species found to be most vulnerable to the effects of elevated temperatures (*i.e.*, yellow perch and American shad) and proposed water quality-based temperature limits designed to be protective of these species during the period when they exist as larvae. EPA was particularly concerned about the possible presence of larval American shad which could drift down from upstream stocking areas during the months of June and July when temperatures within Merrimack Station's thermal plume could reach levels that could cause mortality to larval shad after 30 minutes of exposure. *See* page 203 of the 2011 Draft Determinations Document for a more detailed discussion.

Based on studies conducted in the 1970s Normandeau concluded that there is no evidence that the Hooksett "Pond" zooplankton community has suffered any adverse changes related to the operation of Merrimack Station (Normandeau 1979b). It does state, however, that zooplankton survival studies conducted elsewhere have established lethal temperatures for zooplankton entrained into power plant condenser cooling systems. The temperatures that resulted in 100 percent zooplankton mortality ranged from 30-35ºC (86-95ºF). The report also states that zooplankton entrained in the Merrimack Station cooling system would typically be exposed to temperatures <u>above</u> 35ºC (>95ºF)(*i.e.*, exceeding the lethal temperature limit) during the summer, but stressed that no permanent changes in the Hooksett Pond zooplankton community were documented in their study (Normandeau, 1979b).

Zooplankton communities are considered transient members of the river community, as Normandeau mentioned in its 1979 summary report (Normandeau, 1979b), and as such, population-level effects are difficult to identify. Merrimack Station clearly has the capacity to affect a sizable portion of the Hooksett Pool zooplankton community that drifts past the plant's thermal discharge, especially during summer periods of low flow and high ambient and discharge temperatures. Furthermore, planktonic organisms that are entrained into and through the plant's condenser cooling system are even more likely to succumb to thermal stress or the physical impacts of being pumped through the entire condenser cooling system. For example, as described in the 2011 Draft Determinations Document (p. 244), EPA calculated that the plant can withdraw approximately 23 percent of the available flow under average river flow conditions in the month of August, and over 60 percent under minimum flows, based on data collected from 1993 to 2007. Therefore, approximately one quarter to over one half of the river flow (and all the planktonic organisms in it) can be redirected through the plant while being heated rapidly to temperatures that average 91ºF (33ºC). (Temperatures are likely even higher within the cooling system as the 91ºF (33ºC) value is the temperature recorded at the mouth of the discharge canal (Station S-0) during the months of July and August, after some limited cooling has already occurred from use of the plant's power spray modules.) These organisms, as well as those that were not entrained into the plant but are exposed to elevated temperatures as they drift downstream into the plant's thermal plume, may possibly remain within the buoyant plume as they drift down towards the Hooksett Dam, especially if they lack the mobility to escape it, or are attempting to remain close to the surface because they are attracted to light. EPA is aware of no additional plankton studies that have been conducted in relation to the plant's thermal discharge since the last studies completed in 1978, 36 years ago.

Based on the available information, most of it 36 years old, or older, it's unclear to what extent the plant is impacting the present plankton community in Hooksett Pool, and whether it is affecting the broader river ecosystem. Nevertheless, reducing the critical forage base that the plankton community represents for juvenile fish and other aquatic organisms in the pool can only add to the adverse effects from other stressors on the Hooksett Pool fish community, including effects from the plant's thermal discharge.

4.4.5 No Appreciable Harm to Hooksett Pool Aquatic Vegetation

Comment II.4.4.5	**AR-1552, Normandeau, p. 23**
See Also AR-869, Normandeau, pp. 4-5; AR-868, Normandeau, p. 21	

Aquatic vascular plants (i.e., "macrophytes") are the primary habitat formers in the impounded freshwater riverine ecosystem found in lower Hooksett Pool. This segment of the Merrimack River is considered a low potential impact area (USEPA 1977) for aquatic macrophytes, because no endangered or threatened species were found, and because within-year comparison of similar habitats upstream and downstream from the cooling canal discharge revealed that Merrimack Station's thermal discharge has generally had no adverse effect on the distribution and abundance of aquatic macrophytes in Hooksett Pool (Normandeau 1979a). Within-year variability among stations sampled from 1970 through 1974 in both the upstream ambient and thermally influenced portions of the study area was lower in magnitude than inter-annual variation at each station, supporting classifying the study area as one of low potential impact for habitat formers.

Trends in the abundance of submerged aquatic vegetation can be linked to changes in nutrient loading associated with impaired water quality in the system prior to the 1972 enactment of the CWA (Normandeau 2011b). Increases in system production due to algal growth have been linked to the addition of sewage to a receiving water (Mackenthun 1965). Semi-quantitative submerged aquatic vegetation data were collected in Hooksett Pool by Normandeau in 2002 and 2010. Looking at presence-absence only, a decline in overall extent of submerged aquatic vegetation in Hooksett Pool is implied between the 1970s data and the 2002 and 2010 data. This apparent decrease in submerged aquatic vegetation is likely attributable to the reduction in nutrients in the Merrimack River. Such improvement has likely resulted in corresponding changes to the river's indigenous aquatic populations.

EPA Response:

Aquatic vegetation, also known as "macrophytes," is important habitat for many fish and invertebrate species, and submerged aquatic vegetation (SAV) can also serve as an important indicator of water quality. Normandeau did not specifically address the macrophyte community in PSNH's 316(a) variance request demonstration. Therefore, EPA did not evaluate potential effects to this community when reviewing impacts to the BIP.

SAV abundance was studied in 2002 and 2010, but species identification was not conducted, only overall abundance, primarily using side scan sonar (AR-868, p.21). According to Normandeau's 2011 report (AR-868, p. 21), SAV habitat declined between the 1970s and 2000s, and again between the 2000s and 2010s. The number of sites sampled that were vegetated with SAV dropped from 76 percent in the 1970s to 60 percent in the 2000s (2002), and further down to 50 percent in 2010. Based on the information provided by Normandeau, it is unclear whether SAV diversity in Hooksett Pool has changed since the 1970's, but overall abundance has declined, which the comment acknowledges, but attributes to reduced nutrient loadings from pollutant discharges.

The comment seems to suggest that increased algal growth associated with sewage discharges would somehow be indicative of greater abundance in SAV, or that increased nutrient loadings associated with sewage discharges would promote SAV abundance just as it promotes algal growth. Yet, this seems unlikely since SAVs typically rely on good water clarity for photosynthesis which would be degraded by high nutrient levels. Also, algal growth on SAV blades would further reduce the plants' capacity to engage in photosynthesis and would increase stress levels in the plants. *See also* Response to Comment 4.3.6.

4.4.6 Merrimack's Retrospective Analysis is Insufficient

Comment II.4.4.6	AR-1573, Sierra Club et al., pp. 8-10
See Also AR-1574, Nedeau; AR-1575, Hickey	

Eversource has failed to show, under a retrospective analysis, that "no appreciable harm has resulted from the normal component of the [past thermal] discharge" at the Merrimack Station. 40 C.F.R. § 125.75(c)(1)(i).

EPA has already determined that Eversource has failed to carry their burden in showing that, in the past, the Merrimack Station's thermal discharge had not harmed the Hooksett Pool BIP. Attachment D at 116. After reviewing each analytical index provided in Eversource's Fisheries Analysis Report, which included catch per unit effort, taxa richness, rank abundance, fish community similarity, length-weight relationships, and species guild biomass, EPA concluded that "Merrimack Station has failed to demonstrate that the plant's past and current thermal discharges have not resulted in prior appreciable harm to the [BIP]…in the Hooksett Pool." *Id*. To the contrary, EPA determined that the previous thermal discharges have "appreciably harmed" the BIP. *Id.* at 116, 121.

As detailed above, none of the new information provided by Eversource is relevant to, or should alter, EPA's determination that Eversource has failed to show that its previous thermal discharges did not harm the Hooksett Pool's BIP. Eversource's clarification of the daily maximum and minimum temperatures in Appendix A of the Normandeau Report does nothing to alter this conclusion. As the Hickey Report explains, "each year's statistical summaries do not represent useful or appropriate temperature data submittals in the 316(a) context." Hickey at 10.

In addition, the Hickey Report analyzed the reported temperatures in the Hooksett Pool and found that there is a good reason that the thermal plume's high summer temperatures have resulted in changes to the BIP – because of Merrimack's thermal discharge, temperatures in the Hooksett Pool in summer surpass important survival thresholds for native fish species. Hickey Report at 12-14. Specifically, the Report describes how often the temperatures in the thermal plume exceeds the applicable fish tolerance thresholds for American Shad and Yellow Perch. *Id.* The "exceedances of acute and average weekly fish tolerances for extended time periods at Merrimack River stations" suggest that the power station is altering the BIP of the Hooksett Pool. *Id.* at 14.

The Nedeau Report provides additional evidence that Merrimack Station's thermal discharges have harmed the Hooksett Pool BIP by supporting a strong population of Asian clams down stream of Merrimack Station. Nedeau Report at 3. The Asian Clam is an invasive species, not native to New Hampshire or New England. Even though biologists believed that the cold winter waters in northern New England would prevent the Asian Clam from spreading further north, the species have expanded throughout New England to a surprising extent. The Asian Clam has survived, and spread, by relying on thermal effluent in rivers that are otherwise too cool for over winter survival, and by acclimating and adapting to the cooler waters of southern New England. Nedeau Report at 1-2. Asian Clams were first reported within Merrimack Station's thermal plume in 2012 and it now appears that their population is widespread in the lower Merrimack River watershed. Nedeau Report at 2.

According to the Nedeau Report, “Merrimack Station provided a warm and stable thermal environment; ensured locally high Asian clam growth rate, abundance, and overwinter survival and therefore a more stable source population and provided an opportunity for Asian clams to acclimated and adapt to cooler waters.” Nedeau Report at 3. Sampling revealed high densities of Asian Clams and larger individuals near the mouth of the discharge canal and smaller but substantial populations downstream at Hooksett Pool and below the Hooksett Dam. No Asian Clams have been found upstream of Merrimack Station. Nedeau Report at 3. This suggests that “the strong source of population of Asian clams downstream from Merrimack Station *exists solely because of the thermal pollution*.” Nedeau Report at 3 (emphasis added). Thus, because a BIP “may not include species whose presence or abundance is attributable to alternative effluent limitations imposed pursuant to section 316(a),” 40 C.F.R. § 125.71(c), Merrimack’s role in sustaining a source population of Asian clams within its thermal plume shows that the past thermal discharge has not protected the Hooksett Pool’s BIP.

Moreover, in 2011, in its discussion of the fisheries analysis/retrospective EPA noted that “Merrimack Station does not assess impacts to aquatic communities other than fish in the Fisheries Analysis Report.” Attachment D at 36. While Merrimack claimed that the past and current operations have resulted in no appreciable harm to the balanced, indigenous populations of non-fish aquatic organisms in the segment of the Merrimack River receiving the Station’s thermal discharge, this assertion was based on studies from the 1970’s. *Id.* at 36-37. EPA correctly found that relying solely on data collected more than 30 years ago is insufficient to determine the current status of benthic and other non-fish species and whether these species have been protected since then. *Id.*

The Nedeau Report reinforces and highlights Eversource’s failure to show that there has been no appreciable harm to benthic species – specifically mussels. Based on available temperature data, the Nedeau Report found that the thermal effluent is warm enough to cause mortality or sublethal stress for some life stages of freshwater mussels living within the thermal plume, to cause sensitive fish species (some of which may be important hosts for native mussels) to avoid the thermal plume, and to alter the river’s thermal regime by eliminating the wintertime cold period and potentially disrupting natural cues for dormancy, breeding, and spawning. Significantly, Nedeau identifies temperature tolerance thresholds for various life stages of native mussels. When compared to the data interpretations in the Hickey Report, it is clear that these thresholds, like those for native fish species, are exceeded in the Hooksett Pool because of Merrimack. However, the magnitude of these effects remains unknown due to lack of data. Nedeau Report at p. 6.

Eversource has failed to carry its burden of providing adequate data to prove that there is no appreciable harm to the BIP. The available temperature data are inadequate for understanding (1) natural condition (upstream monitoring), (2) thermal regime (year-round continuous monitoring) within and outside (upstream and downstream) of the thermal plume, (3) the full spatial extent of the thermal plume under a variety of conditions (seasonal, at different river flows, etc), (4) how the spatial extent of the thermal plume relates to the distribution of mussels and mussel habitat, (5) data on other water quality parameters, such as dissolved oxygen, that could interact with temperature to affect mussels. Nedeau Report at 7.

In sum, Eversource has failed to carry its burden of showing that "no appreciable harm has resulted from the normal component of the [past thermal] discharge." 40 C.F.R. § 125.75(c)(1)(i). Nothing has changed since EPA first rejected Eversource's request for a 316(a) variance in 2011, and thus there is no reason that EPA renew a 316(a) variance now. In fact, the available data strongly support EPA's earlier determination that Merrimack Station has degraded the BIP of the Hooksett Pool.

EPA Response:

EPA has reviewed these comments and the reports they reference. EPA agrees with CLF's comment (AR-1573, CLF, et al., p. 8) that EPA has already determined that Eversource failed to carry its burden to show that, in the past, the Merrimack Station's thermal discharge did not cause appreciable harm to the Hooksett Pool BIP. EPA stands by its conclusions in this regard based on the data and analyses EPA had received prior to the release of the 2011 Draft Permit. EPA received additional information relevant to the thermal discharge evaluation both during and after the two public comment periods that EPA held related to the Facility's §316(a) thermal variance request, including four years of additional sampling in both Hooksett Pool and the pools immediately upstream and downstream. While this new information did not change our conclusions regarding the status of the BIP as of 2005, the last year standard fish sampling was conducted before the 2011 Draft Permit was released, it does suggest conditions have improved in Hooksett Pool, as reflected in fish community data. These improvements coincide with a period of reduced operations (and reduced thermal discharges) at Merrimack Station.

New evidence from recent fisheries data (2010-2013) suggests that the balance of warmwater and coolwater fish species that now (as of the 2013 data) comprise the Hooksett Pool fish community is comparable to the community that existed in the 1970s. It also compares closely to the fish community of Garvins Pool, the next adjacent, upstream impounded section of the Merrimack River, in terms of the proportions of coolwater and warmwater species. Given this evidence of improvement, which corresponds with the Facility's reduced operations, EPA concludes that the Hooksett Pool BIP will be protected now and in the future if the Final Permit includes a combination of operational and temperature limitations that ensure Facility operations maintain current operational levels and thermal discharges do not cause instream temperatures to exceed critical levels set to protect species that make up the BIP.

CLF comments (AR-1573, CLF, et al., p. 8) that the Hickey Report analyzed the reported temperatures in the Hooksett Pool and found that there is a good reason that the thermal plume's high summer temperatures have resulted in changes to the BIP – because of Merrimack's thermal discharge, temperatures in the Hooksett Pool in summer surpass important survival thresholds for native fish. EPA agrees that Merrimack Station's thermal plume has the capacity to cause temperatures downstream from the discharge to exceed the thermal tolerances of some fish species. EPA conducted additional analyses of actual temperature data, not 21-year averages, and determined that stressful thermal conditions can and do occur in the thermally-influenced portion of Hooksett Pool. *See* Section 3.4. In the 2011 Draft Determinations Document, EPA explained its concerns about thermal discharges from Merrimack Station operating as a baseload generator with open-cycle cooling. AR-618, Sections 5.0, 6.0 and 9.0.

Regarding comments related to impacts to the benthic invertebrate community (AR-1573, CLF, et al., pp. 9-10), EPA agrees that this is a segment of the BIP that was not closely evaluated before. The commenter raises concerns about the presence and abundance of Asian clams within the area of Hooksett Pool affected by Merrimack Station's thermal plume. EPA agrees with comments that there appears to be the potential for Asian clams to dominate the benthic community, possibly to the detriment of native mussels residing there. While the limited benthic sampling data that exists clearly shows the Asian clams' affinity to the elevated temperatures near the discharge canal and downstream, studies and analyses that addressed this issue appear to indicate that, at this time, mussels are not being adversely impacted by the Asian clam's presence. EPA concludes that the effects of Asian clams on the Hooksett Pool benthic community should continue to be evaluated over the next few years and has included study requirements in the Final Permit.

5.0 Asian Clam

5.1 The Presence of the Asian Clam in Hooksett Pool Should Have No Bearing on EPA's Variance Determination Because the Clam Is Not Causing Appreciable Harm to the BIP

Comment II.5.1.1	**AR-1548, PSNH, pp. 60-66; AR-1552, Normandeau, p. 24**
See Also AR- 1556, Robert F. McMahon; AR-1555, AST Environmental Inc., pp. 41-42, 163-173, and elsewhere; AR-1577, EPRI, pp. 4-1 to 4-11	

EPA seeks public comment concerning the presence and abundance of the Asian clam (*Corbicula fluminea*) in Hooksett Pool and its implications for Merrimack Station's NPDES Permit.[274] The Asian clam is a non-indigenous, invasive species that was first identified in Hooksett Pool in 2011 by PSNH and its consultant, Normandeau, as part of Normandeau's analysis of macroinvertebrate data and its ultimate determination that Merrimack Station's thermal discharge has not caused appreciable harm to the shellfish and macroinvertebrate communities in Hooksett Pool.[275] As EPA acknowledges in its Statement, it was PSNH that advised EPA of the clam's presence in Hooksett Pool in 2012, through Normandeau's submissions in response to the 2011 Draft Permit.[276]

In its Statement, EPA remarks that it found the discovery of the Asian clam "worthy of further research because of the possibility that Merrimack Station's thermal discharge was contributing to the *presence* and/or *prevalence* of the Asian clam in the Hooksett Pool and the potential relevance of such a finding to regulating the Facility's thermal discharges under CWA § 316(a) and New Hampshire water quality standards."[277] As an initial matter, the mere *presence* or *prevalence* of the Asian clam in Hooksett Pool is irrelevant to the thermal variance analysis unless it is causing appreciable harm to the BIP of the relevant waterbody (*i.e.*, Hooksett Pool). As EPA made clear in its Fact Sheet to the 2011 Draft Permit, non-indigenous species historically not present in Hooksett Pool but that appear later in time should not be included in analysis of the BIP, except to consider how their presence has affected, if at all, the balanced indigenous community.[278] Indeed, EPA has granted § 316(a) variances where Asian clams and other invasive species were present in the relevant waterbody. For example, in 2014, EPA issued its Draft NPDES Permit to the Mount Tom Generating Station located in Holyoke, Massachusetts, approximately 90 miles from Merrimack Station.[279] EPA granted Mount Tom's request for a § 316(a) variance, despite the presence of a number of invasive species, including Asian clams, in the watershed, whose effect on fish populations was identified as "currently unknown."[280]

The Asian clam is ubiquitous, as the Statement notes,[281] and found throughout the United States near power plants and elsewhere. Asian clams are prolific up major waterways in the west (e.g., Columbia River, Sacramento Delta region), up the Mississippi and Ohio Rivers and their watersheds, and along the east coast in major harbors, rivers, and their various tributaries. The figure below shows the extent of the Asian clam's presence in the United States:

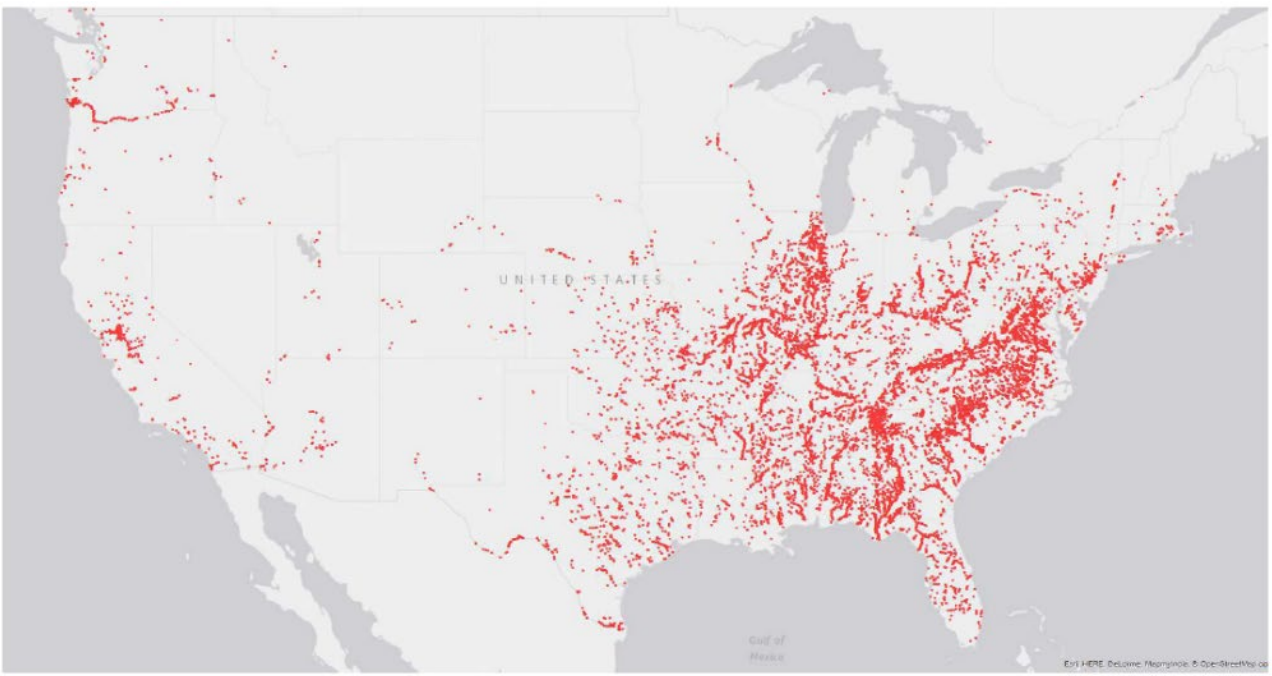

Figure - *Corbicula Fluminea* in the United States

The red dots shown on the map represent Asian clam locations reported in the United States Geological Survey (USGS) database.[282] Further, the Asian clam is extensively found near power plants (shown in green):

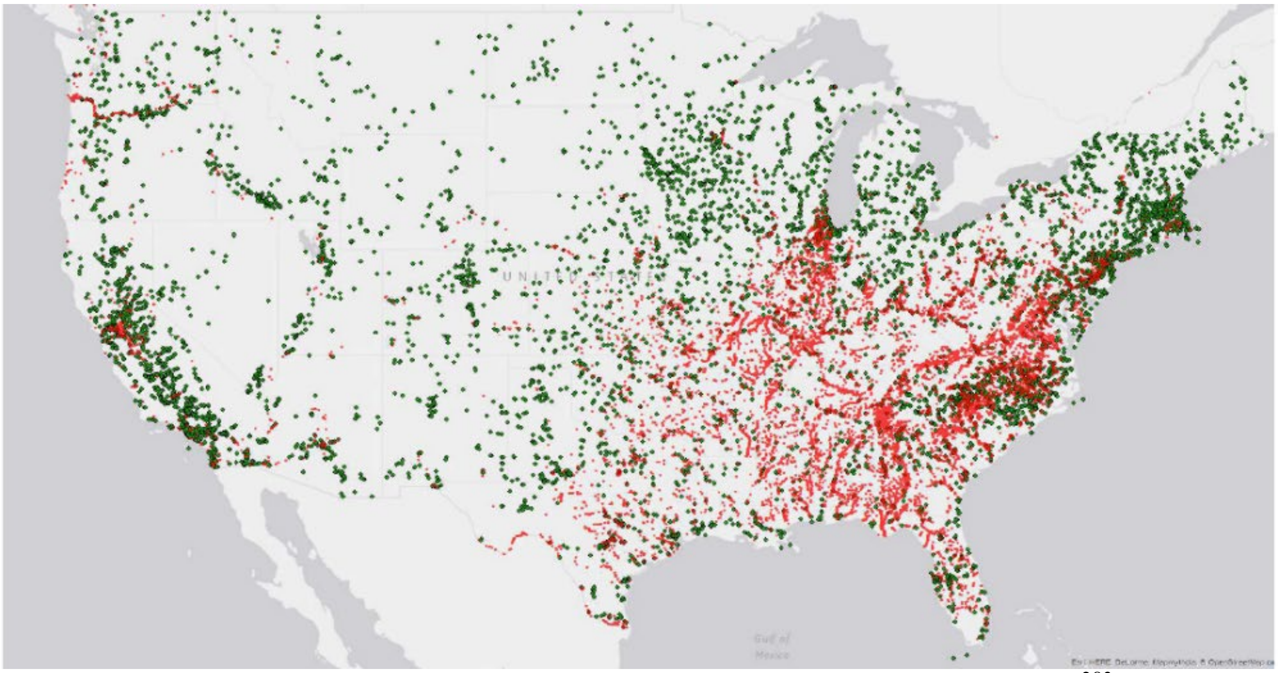

Figure - Overlay of Power Plants and Findings of *Corbicula Fluminea*[283]

Given EPA's silence concerning the Asian clam despite receiving the findings of Normandeau that Hooksett Pool hosts a healthy, BIP of fish and macroinvertebrates, PSNH did not anticipate EPA's interest in the Asian clam until learning of it by happenstance approximately three years ago. In 2014, PSNH observed EPA conducting dives, unannounced, with NHDES in the immediate vicinity of Merrimack Station. Near this same time period, EPA responded to several Freedom of Information Act ("FOIA") requests issued by PSNH concerning the Merrimack Station permit proceeding.[284] Although EPA never mentioned its interest in the Asian clam to PSNH, its permit holder, documents contained within EPA's FOIA production made clear EPA had fixed its focus on the Asian clam, almost to the exclusion of other species. As a mounting number of documents from EPA's FOIA production focused on the Asian clam, PSNH grew concerned EPA might be considering a new basis to attempt to shore up the fatally flawed Draft Permit and its denial of PSNH's § 316(a) variance request that were based on EPA's erroneous determination that the polluted Merrimack River of the 1960s hosted a BIP and was the appropriate baseline for comparison.[285] Indeed, documents included in one of EPA's FOIA productions revealed that, in September 2015, EPA had contemplated a dive study for the purpose of assessing the Asian clam's effect on the Hooksett Pool BIP.[286] As explained in this "Project Plan" document, EPA sought to improve its "understanding of the power plant's influence on this invasive species" and, in turn, to "evaluate the plant's ability to meet state and federal water quality standards, and its NPDES permit requirements, as they apply to protecting the resident biological communities."[287] Among its study objectives, EPA planned to "assess the abundance of *Corbicula* relative to native epifaunal and infaunal macroinvertebrates," in addition to "*Corbicula's* capacity to displace native invertebrates, including mussels."[288] However, EPA's study plan was abandoned and the evaluation was never undertaken.[289]

Given PSNH's concerns arising from EPA's apparent interest in the Asian clam and its undisclosed dive efforts near the Station, PSNH engaged AST Environmental, an environmental consulting firm staffed by freshwater biologists, scientists, and researchers with extensive knowledge and experience in marine ecologies, including those inhabited by non-native species such as the Asian clam. Dr. Terry Richardson, a leading expert malocologist with AST with extensive knowledge concerning the Asian clam, evaluated the Asian clam's presence in Hooksett Pool, and specifically, its relationship to the Pool's BIP. AST (in conjunction with Normandeau) conducted dive surveys in Hooksett Pool, upstream and downstream of the discharge in the Merrimack River, and in various other water bodies in New Hampshire, in accordance with strict dive protocols and scientifically accepted sampling methodologies (in contrast to EPA's limited informational dive activities in 2013 and 2014). In addition to analyzing the limited data from EPA's own dive efforts in 2013 and 2014, and conducting comprehensive research into the Asian clam's northward expansion in the United States and other parts of the world, Dr. Richardson specifically examined the effect of the clam in Hooksett Pool on other native invertebrates, and, in doing so, answered the question considered by EPA in its abandoned 2015 study plan. The results of this extensive study and investigation are contained in the attached report titled, "The Asian clam (*Corbicula fluminea*) and its relationship to the balanced indigenous population ("BIP") in Hooksett Pool, Merrimack River, New Hampshire"[290] As detailed in AST's report, a comparison of the Asian clam to native bivalve populations in Hooksett Pool and upstream of the discharge in the Merrimack River, using various EPA-approved metrics and indices, demonstrates the Asian clam has not caused appreciable harm to Hooksett Pool's BIP, and may, in fact, be positively benefitting the ecosystem of the Pool.[291]

In addition to Dr. Richardson's investigation and analyses, PSNH engaged Dr. Robert McMahon, one of the country's leading experts on Asian clams. EPA no doubt is familiar with Dr. McMahon, whose research concerning the Asian clam is referenced in EPA's abandoned 2015 study plan. Dr. McMahon peer reviewed the AST Report and confirmed its conclusions, in addition to reviewing the available literature concerning the Asian clam and its impact on native bivalve communities.[292] As discussed in these comments, Asian clams are gaining a foothold in numerous parts of New Hampshire and in northern latitudes at sites with no thermal influence, as they have done throughout the world, often introduced by boating and recreational fishing transporting clams from one waterbody to another.[293] Importantly, the Asian clam's northern expansion into areas not impacted by a thermal influence supports its ability to survive in colder climates than originally believed. Further, apart from some speculation and conjecture that has arisen from the frequently high population abundances achieved by Asian clams through its reproductive capacity, there is no credible evidence to support Asian clams causing harm to other native bi-valves and macroinvertebrates.[294] Dr. McMahon confirms the conclusions of AST that the Asian clam has not caused and is not likely to cause appreciable harm to the BIP in Hooksett Pool.[295]

Further, PSNH also is including with these comments the results of Computational Fluid Dynamics ("CFD") Modeling by Enercon Services,[296] which illustrate that thermal discharges from Merrimack Station do not materially influence the bottom of the Hooksett Pool, where the Asian clam population is located.[297] Given the demonstrated ability of Asian clams to survive throughout New Hampshire and northward in areas without thermal influence, the draconian requirement of CCC would not assure the Asian clam's removal from Hooksett Pool. In addition to substantial uncertainty concerning the effect CCC would have on the Asian clam's presence and abundance in Hooksett Pool, identification of the Asian clam in the Pool does not equate to harm to the Pool's BIP. To simply equate presence with harm absent evidence of any impact to native species would be arbitrary, capricious, and contrary to law.

[274] *See* AR-1534 at 43.

[275] *See* AR-1174.

[276] *See* AR-1534 at 41. As explained in Normandeau's Comparison of Benthic Macroinvertebrate Data Collected from the Merrimack River near Merrimack Station (AR-1174) and in Normandeau's 2012 Comments (AR-1170), Normandeau's evaluation of Hooksett Pool's macroinvertebrate community in 2012 revealed an absence of prior appreciable harm to the BIP.

[277] *Id.* (emphasis added).

[278] AR-618 at 47 ("These species, and others that appeared later, should not have been included in an analysis of the balanced, indigenous community, except to explain how their presence may have affected the indigenous community."); *id.* at 52 ("Data provided in the Fisheries Analysis Report for the 2000s included (warmer water-favoring) species not present in Hooksett Pool in the 1960s and, therefore, not considered part of the balanced, indigenous community.").

[279] *See* U.S. EPA, Region 1, Draft NPDES Permit No. MA0005339 for Mount Tom Generating Company, LLC (April 11, 2014) ("Mount Tom Permit"). This draft permit is attached hereto as Exhibit 11. After completing its analysis and finding that CCC would represent BAT for controlling thermal discharges at the Mount Tom facility, EPA "determined that it can grant a thermal discharge variance under CWA § 316(a) to authorize the thermal discharge limits proposed in the new Draft Permit for MTS" and that "thermal discharge limits based on technology and water quality standards would be 'more stringent than necessary to assure the protection and propagation of a [BIP] of shellfish, fish, and wildlife in and on the body of water into which the discharge is to be made . . . .'" *See id.*, Fact Sheet at 62 (quoting 33 U.S.C. § 1326(a)).

[280] *See id.*, Fact Sheet at 60. EPA specifically provided that "a number of invasive species are known to exist in the watershed," including, specifically, Asian clams, and further noted that "[t]he potential for these species to affect anadromous and resident fish populations is currently unknown." *Id.*

[281] *See* AR-1534 at 41.

[282] *See Nonindigenous Aquatic Species*, USGS, https://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=92 (last visited, October 31, 2017). ArcGIS was used here to plot their locations on a map of the United States.

[283] This figure overlays Asian clam locations (red dots) with power generating plants with a minimum output of 0.1 MW (green dots). Fuel sources include geothermal, hydro, solar (photo-voltaic residential installations not included), coal, nuclear, petroleum, natural gas, and bio-mass. The Energy Information Administration (EIA), a private organization funded by the Department of Energy to provide statistical data on the Energy Sector for public use, has compiled the location of every major power generating station in the U.S. This information is publicly available and can be overlaid on a map of the United States using ArcGIS. This figure shows the extent of energy generating infrastructure in the United States and Asian clam sitings reported in the USGS database.

[284] Despite the passage of time since the 2011 Draft Permit and the submission of substantial comments concerning the Draft Permit, EPA has not communicated with PSNH regarding the agency's position and has declined to have any substantive dialogue with PSNH concerning these permit proceedings. As a result, PSNH was forced to resort to FOIA requests for information on a periodic basis to determine EPA's consideration of the key issues in the Merrimack Station permit proceedings. Further, much of the information provided in response to these requests was heavily redacted or marked "deliberative process" or "attorney client privileged information." Aside from PSNH's suppositions about EPA's likely direction, PSNH had no definitive information regarding EPA's position until the Statement, which speaks to only some of the issues.

PSNH respectfully requests that the documents produced to PSNH in response to its numerous FOIA requests be added to the administrative record for this permit proceeding.

[285] These concerns are legitimized by EPA's Statement, which without citation or attribution, states "[t]he arrival of invasive Asian clams in NH represents a threat to the state's water quality." AR-1534 at 42. The suggestions and implications that arise from unsubstantiated assertions of that nature, or that are encouraged to arise from them, imperil reasoned policy-making or defensible rulemakings.

[286] *See* U.S. EPA, Draft Quality Assurance Project Plan-"Qualifying the density of Asian clams (*Corbicula fluminea*) within and beyond the influence of the thermal discharge of a power plant" (2015) ("Project Plan"). This document is attached hereto as Exhibit 12.

[287] *Id.* at 3.

[288] *Id.* at 4.

[289] *See* AST Report at 3, 33-34.

[290] *See generally* AST Report.

[291] *See, e.g., id.* at 2-3. All bivalves, including the Asian clam, are considered ecosystem engineers (i.e., organisms that can physically modify the environment in a positive way), improving substrate for epibionts, refuge from predation, reducing physical or physiological stress, and otherwise stabilizing the environment.

[292] *See* McMahon Review at 2, 8.

[293] *See, e.g.*, AST Report at 8-12; McMahon Review at 2-3.

[294] *See, e.g.*, AST Report at 36-41; McMahon Review at 3-8.

[295] McMahon Review at 8.

[296] *See* Enercon 2017 Comments, Attachment 5.

[297] *See* AST Report at 51-53.

EPA Response:

Regarding the comment (AR-1548, p 61) whether or not the mere presence or prevalence of Asian clams in Hooksett Pool represents evidence of appreciable harm to the BIP, EPA notes that 40 CFR § 125.71(c) states that a BIP is characterized by, among other things, "a lack of domination by pollution tolerant species … [and n]ormally … will not include species whose presence or abundance is attributable to the introduction of pollutants that will be eliminated by compliance by all sources with section 301(b)(2) of the Act; and may not include species whose presence or abundance is attributable to alternative effluent limitations imposed pursuant to section 316(a)." The regulation also provides that a BIP "may include historically non-native species introduced in connection with a program of wildlife management and species whose presence or abundance results from substantial, irreversible environmental modifications." *Id*. The presence of Asian clams in Hooksett Pool, is relevant to the question of appreciable harm if it is negatively impacting the BIP and the plant's variance-based thermal discharges have contributed to the clam's presence. Initial benthic survey data provided by PSNH's consultant, Normandeau Associates, Inc., in its 2012 report (AR 870, pp. 12-14), indicated that the clam's abundance was notably higher within the portion of Hooksett Pool affected by the plant's thermal discharge as compared to the unaffected portion upstream. In fact, of the 9 locations sampled within the area affected by the thermal discharge (each location sampled twice), 7 were dominated by Asian clams. Their percent composition relative to other species collected at those 7 sites ranged from 58-94 percent with a mean of 79 percent for the 14 samples collected. By contrast, Asian clams were not listed as the dominant taxa for any of the sampling locations upstream of the thermal discharge. The report did not specify whether any Asian clams were found upstream of the thermal discharge. This information suggested to EPA that the distribution of Asian clams, a highly invasive, non-native species, was influenced by Merrimack Station's thermal discharge, and that the species dominates in areas where it was found. Therefore, this new information was relevant to the question of appreciable harm to the Hooksett Pool BIP and worthy of further evaluation in EPA's §316(a) thermal variance request analysis.

The commenter remarks (at p. 62) that Asian clams are ubiquitous, occuring both near power plants and in other locations throughout the United States. In EPA's view, Asian clams are wide-spread across the country and now appear to be expanding further north in New England, but the species is clearly <u>not</u> ubiquitous within Hooksett Pool. Quantitative sampling conducted by Normandeau in 2011, and AST Environmental (AST) in 2014, and 2016, as well as semi-quantitative diver sampling in 2014 and 2016, found Asian clams throughout the lower, thermally-influenced portion of Hooksett Pool, from Station S-0 at the mouth of Merrimack Station's discharge canal down to Station S-24, just above the Hooksett Dam. They were also found in Amoskeag Pool, below the dam. Despite their wide-spread presence throughout the thermally-influenced portion of Hooksett Pool, no Asian clams were found at either the two ambient stations in Hooksett Pool upstream from the Station's discharge or in Garvins Pool, the impoundment just upstream of Hooksett Pool.

According to a report by AST Environmental referenced by the commenter and titled, "The Asian clam (*Corbicula fluminea*) and its relationship to the balanced indigenous population ("BIP") in Hooksett Pool, Merrimack River, New Hampshire" (AR-1555, pp. 41,42), states:

> Examining the results of semi-quantitative diver transect surveys (Appendix C1 and C2) indicated that Asian clams were located at survey sites S0, S4, S17, and S24. Numerous native mussels were also located at those same survey sites (and elsewhere in Hooksett Pool). From these 42 assessments, it is clear that native bivalves were as abundant and spatially distributed, i.e., near the shore, along transects without Asian clams (USR through N5) as they were along transects with Asian clams (S0-S24).

Similarly, quantitative benthic sampling conducted in 2014 and 2016 for all the sites sampled by Normandeau in 2011 revealed a total absence of Asian clams at all sites sampled upstream from Merrimack Station's discharge canal, including sites in Garvins Pool. The absence of Asian clams in the ambient portion of Hooksett Pool is barely discussed in the report, but Figure 9 (p. 45) shows where Asian clams were found in Hooksett Pool. Instead, the focus of much of the analyses presented is to look at differences in benthic species *other than* Asian clams in order to assess differences in species composition and richness. While these analyses have relevance to the question of appreciable harm, they are not the only considerations and do not provide a clear assessment of species dominance throughout Hooksett Pool *with Asian clams included* in the sampling results. These analyses are also inconsistent with Normandeau's standard approach to analyzing the potential for appreciable harm related to both invertebrates and fish. For example, Normandeau states (at AR-1552, p. 24):

> Degraded habitat conditions that might be caused by continued exposure to Merrimack Station's thermal discharge should result in a consistent pattern of

> reduced diversity and increased abundance of pollution-tolerant species for the Hooksett Pool macroinvertebrate population located downstream of Merrimack Station over time (1970s to present). That hypothesis is not supported by the data collected during 2011.

While the Asian clam has not been classified as "pollution-tolerant" per se, it is an invasive species with an affinity for warmer water temperatures than typically found in the Merrimack River under ambient conditions, and heat is a pollutant under the CWA. *See* 33 U.S.C. § 1362(9). To test the above-stated hypothesis, it would have made sense to compare the relative abundance of all species, including the Asian clam, upstream and downstream Facility's discharge canal.

Regarding the comment (at p. 64) that EPA had not mentioned its interest in the Asian clam to PSNH, EPA had no reason to do so. EPA was initially unaware of the presence of the species in Hooksett Pool and PSNH's CWA § 316(a) variance application provided no specific analysis of the species. EPA only noticed the presence of Asian clams when it was reviewing some of the biological sampling data submitted by the Facility. EPA's discovery of the Asian clam information in Normandeau's 2012 report came after the public comment period had closed during EPA's review of the comments. EPA then began its effort to assess the significance of the issue. EPA does not need to contact the Facility prior to reviewing data and evaluating its significance. Moreover, since the Facility submitted this data to EPA, it should have been aware of it, and given that the Asian clam has been the subject of multiple studies related to its presence within the influence of thermal discharges at other power plants (*See* AR-1404, 1405), it should not have been a surprise that EPA would be interested in its presence and abundance in Hooksett Pool.

The comment also twice appears to complain that EPA did not give it advanced notice of its dive survey work with the state – referring to the work as "unannounced" and "undisclosed" – to obtain direct information to inform its investigation and consideration of the Asian clam issue. EPA does not need to announce that it is considering or evaluating issues in a permit development. Moreover, as stated above, EPA's consideration of the Asian clam was prompted by data submitted by PSNH, itself. Furthermore, the Merrimack River is a public water body and EPA does not need permission from the Facility to conduct investigations in the water body. Finally, EPA's dive work was, of course, not "undisclosed." PSNH became aware of it because it was disclosed by EPA. Moreover, after EPA did enough work on the subject to decide it warranted further evaluation, the Agency specifically discussed the issue and invited public comment on it in the 2017 Statement. *See* AR 1534, p. 42.

The commenter notes that "EPA had fixed its focus on the Asian clam, almost to the exclusion of other species." This comment is plainly incorrect. The record plainly demonstrates EPA's concern about fish, SAV, and other macroinvertebrates besides Asian clam. That said, EPA *was* concerned about this new information as were state resource agencies. The discovery of Asian clams in New Hampshire prompted the development of state regulations making it illegal to import, possess or release Asian clams in the state (Administrative rules NHFG FIS 803.04, NHFG FIS 804.03, NHFG FIS 805.01). In 2012, NHDES issued the Environmental Fact Sheet, Asian Clams in New Hampshire" (AR-1408). In it, NHDES describes how large populations of

Asian clams can severely alter lake or riverine food webs by "directly competing with existing native fish and shellfish species for food and space." Thus, the Asian clam has the potential to adversely alter the BIP of Hooksett Pool and data from Normandeau's 2011 sampling that indicated not just the presence, but the *dominance,* in the lower half of Hooksett Pool, of the species prompted EPA to consider this a serious new issue potentially related to Merrimack Station's thermal discharge that warranted further evaluation.[31]

The commenter states (at AR-1548, pp. 80-81) that in 2014, EPA granted a CWA § 316(a) variance to the Mount Tom Generating Station, in Holyoke, MA, despite the presence of Asian clams. This is irrelevant, however, to the present assessment of the effect of the Asian clam on the Hooksett Pool BIP and the possible relationship of Merrimack Station's thermal discharge to that effect. With regard to the draft permit for Mount Tom Station, it is notable that EPA expressly considered the presence of Asian clams and other invasive species in the watershed in the context of its CWA § 316(a) variance analysis, but concluded that the effect of these species on the BIP was uncertain. *See* Fact Sheet for Mount Tom Station Draft NPDES Permit, p. 60 (https://www3.epa.gov/region1/npdes/permits/2015/finalma0005339permit.pdf). The abundance of Asian clams relative to other benthic organisms in the section of the river receiving the thermal discharge had not been assessed. In any event, before EPA issued the final permit to Mount Tom Station in 2015, the facility stopped generating electricity as a coal-fired power plant and terminated its associated thermal discharge *See* Final Permit for Mount Station (https://www3.epa.gov/region1/npdes/permits/2015/finalma0005339permit.pdf). The Mount Tom Station permit has no bearing on the Merrimack Station permit determination.(https://www3.epa.gov/region1/npdes/permits/2015/finalma0005339permit.pdf)..

The commenter also argues that a comparison of the Asian clam to native bivalve populations in Hooksett Pool and upstream of the discharge in the Merrimack River, using various EPA-approved metrics and indices, demonstrates the Asian clam has not caused appreciable harm to Hooksett Pool's BIP, and may, in fact, be positively benefitting the ecosystem of the Pool (*See* AR-1548, p. 82). The details of AST's report are discussed in various comments within this section, but EPA generally agrees that, based on the information provided to date, it appears that the effects associated with the Asian clams' presence and abundance has not caused appreciable harm to the Hooksett Pool BIP. (EPA does not agree, however, that the presence of this invasive species is benefiting the ecosystem. The reasons for this are discussed throughout these responses to comments.) AST's analyses looking at differences in the abundance and species richness in native invertebrates upstream and downstream of the Facility's thermal discharge suggests that impacts to the benthic community from Asian clams have not yet risen to the level that EPA would consider appreciable harm. Furthermore, temperature and operational limits in the final permit could reduce the extent to which the Facility's thermal discharge promotes Asian clam abundance in Hooksett Pool going forward.

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[31] NHDES's Environmental Fact Sheet identifies the risk Asian clams pose to the cooling water intake systems (CWIS) for power-generating plants like Merrimack Station. According to the Fact Sheet, such systems can become impaired or clogged by clam shells or by juveniles that are sucked into the intake and grow in the system. So, this documented risk should concern Merrimack Station, as well. It should be noted, however, that the plant's cooling water intake structure is located well upstream of the thermal discharge so perhaps the risk to the plant's CWIS is not great since no clams have been collected in the portion of Hooksett Pool that is not affected by the plant's thermal discharge.

That said, EPA is convinced by the data provided that the abundance of Asian clams in the thermally-influenced portion of Hooksett Pool, and it's total absence in the ambient area directly upstream, is directly related to Merrimack Station's thermal discharge. Under the definition of BIC (and BIP) in 40 CFR § 125.71(c), the Asian clam is not part of the BIP and its effects species that are part of the Hooksett Pool BIP will clearly be an ongoing subject of interest while the Facility continues to operate. As a result, it is a focus of monitoring required in the Final Permit.

PSNH comments (*at* pp. 71-73) that it is including with these comments the results of Computational Fluid Dynamics ("CFD") Modeling by Enercon Services[296] that illustrate that thermal discharges from Merrimack Station do not materially influence the bottom of the Hooksett Pool. EPA discusses the findings of this model in detail at II.5.1.4 and there describes why it does not agree with this comment.

Comment II.5.1.2	**AR-1548, PSNH, p. 64**

EPA had contemplated a dive study for the purpose of assessing the Asian clam's effect on the Hooksett Pool BIP.[286] As explained in this "Project Plan" document, EPA sought to improve its "understanding of the power plant's influence on this invasive species" and, in turn, to "evaluate the plant's ability to meet state and federal water quality standards, and its NPDES permit requirements, as they apply to protecting the resident biological communities."[287] Among its study objectives, EPA planned to "assess the abundance of *Corbicula* relative to native epifaunal and infaunal macroinvertebrates," in addition to "*Corbicula's* capacity to displace native invertebrates, including mussels."[288] However, EPA's study plan was abandoned and the evaluation was never undertaken.[289]

AST (in conjunction with Normandeau) conducted dive surveys in Hooksett Pool, upstream and downstream of the discharge in the Merrimack River, and in various other water bodies in New Hampshire, in accordance with strict dive protocols and scientifically accepted sampling methodologies (in contrast to EPA's limited informational dive activities in 2013 and 2014).

EPA Response:

Regarding the commenter's description of EPA's diving activities in 2013 and 2014, and its planned (but abandoned) Asian clam study, EPA acknowledges that it completed reconnaissance dives with assistance from NHDES in 2013 and 2014 to confirm the presence of Asian clams in proximity to Merrimack Station's thermal discharge. In some cases, and at some stages of investigation, a reduced or more qualitative level of research is appropriate. That research may, in some cases, then be followed up with more extensive, quantitative analysis. Indeed, certain of Merrimack Station's array of hired consultants also conducted qualitative research in some areas. With regard to the Asian clam, EPA at one point had intended to follow up with a more comprehensive study, but due to competing priorities and resource limitations, the Agency ultimately decided not to pursue that study. The dives that EPA conducted were not intended or designed to provide quantitative evidence by themselves, but rather to collect photo documentation of the presence of Asian clams in Hooksett Pool, to determine if further work was warranted, and, to inform the development of a potential, more comprehensive future study. Ultimately, as stated above, EPA decided not to conduct the additional study.

Comment II.5.1.3	**AR-1548, PSNH, pp. 65-67**

Dr. Richardson specifically examined the effect of the clam in Hooksett Pool on other native invertebrates, and, in doing so, answered the question considered by EPA in its abandoned 2015 study plan. The results of this extensive study and investigation are contained in the attached report titled, "The Asian clam (*Corbicula fluminea*) and its relationship to the balanced indigenous population ("BIP") in Hooksett Pool, Merrimack River, New Hampshire"[290] As detailed in AST's report, a comparison of the Asian clam to native bivalve populations in Hooksett Pool and upstream of the discharge in the Merrimack River, using various EPA-approved metrics and indices, demonstrates the Asian clam has not caused appreciable harm to Hooksett Pool's BIP, and may, in fact, be positively benefitting the ecosystem of the Pool.[29]

Dr. McMahon peer reviewed the AST Report and confirmed its conclusions, in addition to reviewing the available literature concerning the Asian clam and its impact on native bivalve communities.[292] As discussed in these comments, Asian clams are gaining a foothold in numerous parts of New Hampshire and in northern latitudes at sites with no thermal influence, as they have done throughout the world, often introduced by boating and recreational fishing transporting clams from one waterbody to another.[293] Importantly, the Asian clam's northern expansion into areas not impacted by a thermal influence supports its ability to survive in colder climates than originally believed. Further, apart from some speculation and conjecture that has arisen from the frequently high population abundances achieved by Asian clams through its reproductive capacity, there is no credible evidence to support Asian clams causing harm to other native bi-valves and macroinvertebrates.[294] Dr. McMahon confirms the conclusions of AST that the Asian clam has not caused and is not likely to cause appreciable harm to the BIP in Hooksett Pool.[295]

EPA Response:

EPA is pleased that Merrimack Station agreed that researching the Asian clam issue was important and that it endeavored to follow up on EPA's initial research to gather more information. EPA has reviewed the reports from the Facility's consultants, the details of which are discussed in comments below. Also, EPA is aware that, as the comment states, PSNH had one of its consultants, MacMahon, "peer review[]" the report by another of its consultants, AST.

Comment II.5.1.4	**AR-1548, PSNH, p. 67, 73**
See AR-1549, Enercon Services, Inc.; AR-1555, AST Environmental, pp. 12-13	

While Asian clams have expanded into areas in the Northeast where they once would not have been expected to survive the prolonged low temperatures thought to cause high mortality in this species, the reason that they exist in other locations without a thermal discharge is not determinative of the reasons for their presence and prevalence in Hooksett Pool. The focus of EPA's CWA § 316(a) review is to assess whether Merrimack Station's thermal discharge is influencing the clam's ability to survive typical winter conditions in Hooksett Pool and enhancing their ability to proliferate in Hooksett Pool then and throughout the year to the point where the clams, or the effects of their presence, are adversely affecting the resident biotic community to the degree that EPA concludes it cannot set alternative thermal discharge limits under CWA § 316(a) that will assure the protection and propagation of the pool's BIP**.** Computational Fluid Dynamics ("CFD") Modeling by Enercon Services,[296] which illustrate that thermal discharges from Merrimack Station do not materially influence the bottom of the Hooksett Pool, where the Asian clam population is located.[297] Given the demonstrated ability of Asian clams to survive throughout New Hampshire and northward in areas without thermal influence, the draconian requirement of CCC would not assure the Asian clam's removal from Hooksett Pool. In addition to substantial uncertainty concerning the effect CCC would have on the Asian clam's presence and abundance in Hooksett Pool, identification of the Asian clam in the Pool does not equate to harm to the Pool's BIP. To simply equate presence with harm absent evidence of any impact to native species would be arbitrary, capricious, and contrary to law.

EPA Response:

EPA has considered this comment but notes that it is off target in certain respects. First, it argues that for EPA "[t]o simply equate presence [of the invasive Asian clam] with harm [to the BIP] absent evidence of any impact to native species would be arbitrary, capricious, and contrary to law." Yet, EPA did no such thing. The burden is on the discharger to demonstrate to EPA that limits based on technology and water quality requirements are more stringent than needed to assure the protection and propagation of the BIP. For a "retrospective demonstration," the discharger has the burden to demonstrate that its past discharges under an existing CWA § 316(a) variance have not caused appreciable harm to the BIP. In this case, the Facility's initial variance application included, among other things, data that provided potentially troubling information about the presence and prevalence of the invasive Asian clam in the portion of the Hooksett Pool affected by Merrimack Station's thermal discharge, but the application provided little discussion of that data and did not offer any evaluation of its significance, one way or another. As a result, EPA quite properly began to pursue the questions raised by the data and, as stated above, we are pleased the Facility later assessed it as well.

Furthermore, the comment that "the draconian requirement of CCC would not assure the Asian clam's removal from Hooksett Pool …" suggests a basic misunderstanding of the CWA's requirements applicable to thermal discharges. The 2011 Draft Permit's thermal discharge limits based on closed-cycle cooling were set under the application of the BAT technology standard. These limits were not set to eradicate the Asian clam from the Hooksett Pool and that is not a criterion underlying the application of the BAT standard. In addition, the closed-cycle cooling-based requirements in the draft permit were not "draconian." They were not set as penalties and they were not overly strict requirements based on the facts and analysis discussed in the 2011 Draft Determinations Document. The requirements followed in this case from the proposed denial of PSNH's CWA § 316(a) variance renewal application and the resulting application of the CWA's longstanding BAT standard. Numerous power plants around the Nation and the world use, and have for many years, used closed-cycle cooling. In some cases, closed-cycle cooling has been retrofitted to existing facilities. The question here, of course, is whether those requirements should be applied at Merrimack Station, which has been an issue of close debate since the 1970s. See AR 618, pp. 8-16.

EPA disagrees with the comment that the Computational Fluid Dynamics ("CFD") Modeling by Enercon Services illustrates that thermal discharges from Merrimack Station do not materially influence the bottom of the Hooksett Pool, where the Asian clam population is located (*See* AR-1548, p. 67). On the contrary, the report shows that the section of river bottom from the point of the plant's thermal discharge down along the west bank of the river to Station S-4 is influenced by the plant's thermal discharge. PSNH identifies 2ºC as the minimum threshold for Asian clam survival (*See* AR-1548, p.73). According to the CFD modeling report, during the months from December to March, the percentage of river bottom at Station S-4 (approximately 2,000 feet downstream from the plant's thermal discharge) that is at or above 2ºC ranges from 40% in March to 48% in February (*See* AR-1549, Attachment 5, pp. 25-31). Moreover, maximum bottom temperatures at Station S-4 in those months (December-March) were predicted to be 4.85ºC, 4.85ºC, 4.43ºC, and 3.83ºC, respectively, according to the CFD modeling results. At the mouth of the plant's discharge canal, the bottom temperatures do not appear to ever drop below 9.14ºC during winter months (*See* AR-1549, Attachment 5, pp 25-31). There is no information for the rest of the discharge canal, which could also provide thermal refuge during winter months. *See* II.5.2 for additional comments on the CFD modeling results.

Bottom temperatures upstream of the discharge canal likely remain at or below 2ºC for extended periods during the winter months, as would portions of the lower section of the pool where the thermal plume does not reach the bottom. However, since Asian clams can reproduce twice a year and release up to 3,000 larvae per day (AR-1555, pp. 12-13), areas in the lower pool where Asian clams may have suffered mortality due to lethally cold conditions can be repopulated by the portion of the Asian clam population that is able to survive and reproduce in the thermally-influenced areas upstream. While the areas downstream of the discharge canal could be repopulated as larval Asian clams drift downstream and settle on the bottom, areas upstream would obviously not be reached by the drifting larvae. This may explain the Asian clam's prevalence in downstream sections of the Hooksett Pool, and its absence upstream of the discharge canal.

5.2 The Asian Clam Is Spreading Northward to Areas Unimpacted by Thermal Influence

Comment II.5.2	**AR-1548, PSNH, pp. 67-79**
See Also AR- 1555, AST; AR-1577, EPRI, pp. 4-1 to 4-11; AR-1549, Enercon, pp. 25-31.	

In its Statement, EPA invites comment concerning several articles pertaining to the Asian clam's distribution throughout the United States and suggestions that the thermal influence is necessary for Asian clams to survive in colder climates such as the Connecticut River (Connecticut) and St. Lawrence River (Canada).[298] However, a review of the literature and the known range expansion of the Asian clam northward into areas lacking thermal influence (including New Hampshire) call into question any conclusion that thermal influence is necessary for the clam's survival in the Merrimack River.

Originally native to Southeast Asia, the Asian clam has spread worldwide over the course of the last century and reached such new habitats as North and South America, Europe, Africa, and the Pacific Islands.[299] First reported in Western Europe in the 1980s, Asian clams are now fairly widespread throughout Europe. Current reports now show the Asian clam distribution as far north as 53.9426ºN in Ireland, 52.6261ºN in the Netherlands, 52.3828ºN in Germany, and at 53.3748ºN in Poland.[300] Although Asian clams have been found in waters associated with thermal discharges from power plants and other sources, studies in Europe reveal the clam's northward and westward expansion has occurred independent of thermal discharges in the Vistula River, Kraków, Poland, and in the Crisuri and Danube Rivers and associated tributaries in Hungary.[301]

Similarly, in the U.S. and Canada, northward range extension has occurred into areas with low water temperature lacking thermal discharge influence in Lake Pend Oreille, Idaho; St. Croix River, Minnesota; Michigan River, Michigan; Lake George, Lake Champlain and Erie Canal system, New York; Gildersleeve Island, Connecticut River, Connecticut; and Long, Wash, and Cobbetts Ponds, New Hampshire.[302] In North America, live Asian clams were first documented in 1938. By 1953, the clams had spread throughout much of the U.S., especially the Southeast.[303] The Asian clam now can be found in most of the lower 48 states of the U.S., including Hawaii, three of the Great Lakes (Erie, Michigan, and Superior), and the St. Clair River in Michigan.[304] Asian clams have spread north to areas of milder winters and water temperatures such as Lake Whatcom, Washington, and Vancouver Island, British Columbia, the Asian clam's northern-most North American locations, and have recently been found in northern latitudes in North America with low water temperatures and ice formation.[305]

In its Statement, EPA writes, "[w]hen PSNH submitted its report in 2012, the presence of Asian clams in New Hampshire had only been documented in the Merrimack River south of Bow, New Hampshire, and in Cobbetts Pond, in Windham, New Hampshire, according [to] NHDES' environmental fact sheet on Asian clams (NHDES, 2012)."[306] In fact, Asian clams were detected in the Merrimack River 25 miles downriver of Merrimack Station in 2007; four years later, in 2011, Asian clams were reported in Hooksett Pool.[307] Although there is no evidence of any one particular cause of the Asian clam's arrival at Hooksett Pool, it is likely that recreational boating or fishing, at a time when the clam was spreading throughout New England, is responsible for the clam's introduction to Hooksett Pool and other locations throughout New Hampshire.[308] In addition to Cobbetts Pond and Long Pond, Asian clams have been identified in New Hampshire's upper Merrimack River, above the city of Concord.[309] This location is well upstream of Merrimack Station and lacks thermal influences.[310] Additionally, Asian clams have been reported at two other sites in Hooksett Pool upstream of Merrimack Station, as well as in New Hampshire's Beaver Lake, Great Pond, Canobie Lake, and Little Island Pond.[311] None of these sites experience thermal influence – and yet they are home to Asian clam communities.[312] As explained by Dr. McMahon:

> These data strongly suggest that thermal effluents are not required to support sustainably reproducing Asian clam populations in

> New Hampshire water bodies. They also suggest that Asian clams do not require a thermal refuge to invade and thrive in New Hampshire water bodies as corroborated by a report that Asian clam populations have been found at 24 cold winter water sites in the Arkansas, Colorado, Platte, and San Juan River Basins of Colorado not receiving thermal effluents (Cordeiro et al. 2007). The Colorado water bodies and rivers supporting Asian clam infestations were at high altitudes (i.e., 1,200 to 3,200 m) where they were exposed to extremely low winter temperatures. Asian clams have also become established in Lake George, NY, which ices over every winter (Young and Wick 2017). A sustainably reproducing Asian clam population occurs in the Clinton River, Michigan, where ambient water temperatures range from 0-2°C for most of the winter (Janech and Hunter 1995). Further, an Asian clam population established in a section of the lower Connecticut River in 1990 impacted by thermal effluent discharge from the Connecticut Yankee Nuclear Power Station continued to thrive at similar densities after the Power Station was closed in 1997 and ceased to release thermal effluents (Morgan et al. 2004).
>
> Asian clams were first discovered in Europe in 1980 in the Bass Dordogone, France, and Tage Estuary, Portugal (Mouthon 1981). They have since spread throughout Europe extending west into Germany, Poland, Ukraine and Romania (DAISIE 2017) where they have invaded freshwater habitats with very low winter ambient temperatures (Müller and Baur 2011). In a laboratory study (Müller and Baur 2011), small and large winter-conditioned specimens of Asian clam were exposed to constant water temperatures of 0° and 2°C for a period of nine weeks while recording their mortality weekly. Clams had a high level of survival (>80%) during the first four weeks of exposure to ether 0° or 2°C after which mortality rapidly increased with further exposure time. However, some larger individuals (17.5%) survived the full 9 weeks of exposure. Overall, large individuals were more cold tolerant than small individuals (Müller and Baur 2011). Since water temperatures in northern temperate lotic systems do not remain at or below 2°C throughout the winter, including the Merrimack River, NH, this result explains the survival of Asian clam populations in areas of that river not receiving thermal effluents as noted in the AST Environmental report.[313]

A study conducted jointly by EPA and NHDES in 2013 that examined range extension by Asian clams in New Hampshire sheds further light on the Asian clam's relationship to (or lack of need of) thermal discharges. AST's correct interpretation of the data from the EPA-NHDES study found no significant difference in Asian clam densities among the four New Hampshire sites surveyed: two sites with no thermal effluent, Cobbetts Pond and Long Pond; and two sites receiving Merrimack Station cooling water release, Hooksett Pool and Amoskeag Pool.[314] In fact, while there was no statistical difference among locations, the pattern actually suggests lower Asian clam densities at Hooksett Pool (with its thermal input from the station) rather than at the sites without thermal input (Cobbetts and Long ponds).[315]

Surveys and studies such as the ones discussed above, coupled with the results of CFD modeling of Hooksett Pool, disprove that presence of the Asian clam in Hooksett Pool is attributable to Merrimack Station's thermal discharges. CFD modeling simulates complex scenarios involving fluid flow, heat transfer, and interaction with surfaces.[316] CFD simulation is able to incorporate turbulent flow conditions of the river and cooling water canal effluence along with heat transfer and the thermal and density properties of the ambient river and cooling water discharge to model the dynamics of the thermal plume as it interacts with the river bottom. To help assess the questions at hand, Enercon developed a CFD model using ambient river temperature upstream of Merrimack Station, temperature of the station's cooling water discharge canal, flow of the discharge canal, and flow of the river as input parameters.[317] The modeling shows the extent to which the cooling water discharge plume into Hooksett Pool provides for >2ºC water at the river bottom during winter operations of Merrimack Station.[318]

The resulting CFD models of the thermal plume from Merrimack Station into Hooksett Pool indicate the thermal influence of cooling water discharge: (1) minimally impacts the bottom where Asian clam and other invertebrates live, and (2) perhaps more importantly, does not elevate ambient river temperatures above the 2ºC minimum threshold for Asian clam survival at station S4 and further downstream.[319] These locations are relevant because S4 and further downstream S17 are the two sites with the highest Asian clam abundances in Hooksett Pool.[320]

Using monthly averages (2010-2017) of cooling water canal temperature at the mouth of the canal, cooling water canal discharge flow, and river flow with an assumed ambient river temperature input of 33ºF (0.6ºC) in the model, it was clear that, by 950 ft. downstream of the canal:

- In the month of December, the thermal influence at the river bottom was minimal, and river temperatures did not exceed 34ºF (1.1ºC) in December.

- In the month of January, bottom contact by the thermal plume was negligible and temperatures did not exceed 34ºC (1.1ºC).

- In February, bottom contact was practically non-existent and temperature did not exceed 33.5ºF (0.8ºC).

- In March, bottom contact was minimal and temperatures did not exceed 33.75ºF (1.0ºC).[321]

Thus, under average operation and river flow conditions, the thermal release from Merrimack Station does not elevate river temperatures above the 2ºC minimum tolerance limit of Asian clams, yet the two sites with greatest clam abundances in 2014, and 2016 occur 2,000 ft and 8,500 ft downstream of the canal at S4 and S17, respectively.[322]

Recent published findings, as discussed later in these comments, suggest the successful tolerance of Asian clams to cold water, as well as their northward spread, may also be due to the previously unrecognized genetic and physiological capacity of Asian clam to tolerate colder temperatures combined than previously thought.[323] Numerous scenarios exist—including in New Hampshire—where clam populations survive without relying on thermal discharges to provide an artificial heat influent to their habitat. And every such scenario negates EPA's insinuation that clams cannot survive in New Hampshire but for thermal discharges. A wide range of scientific studies and literature increasingly question the "conventional wisdom" of the clam being unable to survive the winters of northern latitudes without thermal discharges warming the otherwise cold waters.[324]

Indeed, as explained by Dr. McMahon:

> [D]ata and reports of thriving Asian clam populations in New Hampshire, Connecticut, Colorado and northern Europe (as described above) strongly suggest that even if the release of thermal effluents from the Merrimack Station into Hooksett Pool ceased, its Asian clam population would continue to exist because it appears to be tolerating ambient winter water temperatures below 2°C as are Asian clam populations upstream and downstream of the station's localized thermal effluent plume. Further, the Asian clam's extremely high reproductive and growth rates (McMahon 1999) would allow replenishment of any winter clam mortality during summer months by the indigenous population as well as by settlement of juvenile clams hydrologically transported (McMahon 1999) into Hooksett pool from populations upstream of the Merrimack Station. Moreover, if cooling tower basins are used to replace the existing once-though cooling system at Merrimack Station, the winter thermal refugia associated with the warm water in such cooling towers and blowdown discharge of warm water from cooling tower basins into Hooksett Pool would likely support Asian clam reproductive efforts (Post et al. 2000).[325]

"Taken as a whole, these studies and the data provided in the AST Environmental report strongly suggest that Asian clams are capable of sustaining populations under very cold conditions in the Northeastern United States, belying previous laboratory studies indicating that they could not survive continuous exposures to ambient water temperatures ≤ 2.0°C."[326]

EPA's Statement refers to two peer reviewed journal articles by Simard (2012) and Morgan (2003) for their study of the relationship between Asian clams and thermal discharges from power plants.[327] According to EPA, "[b]oth studies, one conducted in the Connecticut River (Connecticut) and the other in the St. Lawrence River (Canada), found that higher winter survival rates of Asian clams occurred within the influence of the power plants' thermal discharge than in ambient areas, and that the elevated temperatures appeared to affect the clam's reproductive success, growth, and abundance."[328] While EPA's statement about the contents of these articles is generally true, EPA failed to examine a third, important and relevant peer-reviewed journal article that studied the relationship between Asian clams and thermal discharges from a power plant. Morgan (2004)[329] produced a more extensive follow-up monograph to the Morgan (2003) paper, cited by EPA, expounding on its original conclusions. After providing a more thorough examination of the relationship between the Connecticut Yankee ("CY") power plant (Connecticut River) and the Asian clam's population dynamics as well as the Asian clam's interactions with other native bivalve species, Morgan (2004) states, "[t]he importance of CY thermal discharge as a refuge for [Asian clam] survival in the Connecticut River during cold winters appears minimal."[330] Morgan (2004) adds, "[a]dditional evidence that the CY discharge was not necessary for survival of [Asian clam] populations in the Connecticut River is apparent when [Asian clam] abundance during CY operation (1991- 1996) was compared to abundance following the plant closure (1997-2000). Following closure of the CY power plant in 1996, the abundance of [Asian clams] at all sites was not significantly different than during the operational period."[331] Finally, Morgan (2004) concluded that ". . . . annual densities during plant operation . . . were not significantly different from those following the plant closure . . . . This suggests that the CY thermal discharge did not serve as an important refuge area for [Asian clams] overwintering in the vicinity of the plant."[332]

These statements indicate that Morgan (2004) did not find the thermal discharge was necessary for Asian clam overwintering in the Connecticut River. The Lake George, New York, Asian clam population thriving in iced-over waters during winter is a better example that thermal discharge is not necessary for an Asian clam winter refuge,[333] as are the high altitude ice-covered sites in Colorado.[334] The relevance of the findings of such a thorough follow-up, peer-reviewed study and other similar studies and information undermine EPA's reliance on Simard et al. 2012[335] and Morgan et al., 2003[336] for the suggestion that Merrimack Station is responsible for the presence of the Asian clam in Hooksett Pool.[337] An examination of the Asian clam's physiology, as studied and articulated by various scientists and biologists, helps to explain the species' presence and abundance in colder habitats—and debunks overly-simplified linkages between thermal discharges and clam populations.

First, the Asian clam is a self-fertilizing, highly fecund, hermaphroditic species that typically reproduces twice a year.[338] During these reproduction events, as many as 3,000 juveniles can be released per clam per day and, as a result of the species' high feeding (filtration) rate and relatively high allocation of non-respired energy toward growth, the Asian clam matures relatively rapidly.[339] Such characteristics fuel the clam's ability to spread into new habitats,[340] and, as noted previously, such spread is occurring worldwide into habitats devoid of thermal discharges.

Second, adequate dissolved oxygen ("DO") levels are important for the Asian clam, and the Asian clam is among one of the least hypoxia (*i.e.*, low dissolved oxygen) tolerant freshwater bivalve mollusks.[341] This factor, rather than thermal influences, could partially account for prevalence of the clam in well-oxygenated shallow water habitats (such as Hooksett Pool).[342] Recalling EPA is of the stated opinion that "thermal discharges may substantially alter the structure of the aquatic community by . . . reducing levels of [dissolved oxygen],"[343] it seems incongruent that a DO-reducing thermal plume is essential to the Asian clam's survival.

Third, pH parameters can also impact Asian clams as evidenced by several studies. A study in North Carolina's Roanoke River established that a pH range of between 6.1 and 6.6 was important in explaining variation in Asian clam density and biomass among different sites, a study of the blackwater Ogeechee River in Georgia suggested that it was a stressful environment for Asian clams owing, in part, to the river's low pH, and a 2002 laboratory study demonstrated biomarker responses indicative of stress in Asian clams held briefly at pH's of 4.0-5.0 and 8.0-9.0.[344] The implication here is that acceptable pH levels in a waterbody, rather than a thermal influence thereon, may be a key factor in whether the Asian clam can or will continue to propagate in such waters.

Fourth, low calcium levels can also negatively affect Asian clam biomass and densities.[345] Conductivity and salinity are also important variables in determining *C. fluminea* abundance and biomass.[346] Again, the implication here is that acceptable calcium, conductivity, and salinity levels in a waterbody, rather than thermal influences, may, like dissolved oxygen and pH levels, be controlling factors in the Asian clam's establishment and survival in a given waterbody.

Fifth, "[f]ood availability is another very important environmental variable for the Asian clam. As filter feeders, Asian clams feed on a variety of suspended particles including bacterioplankton, phytoplankton and seston . . . ."[347] Food availability, therefore, could well be a controlling factor in a particular waterbody regardless of thermal influence.

The composition of the lake or river bottom, *i.e.*, the substrate, is yet another important habitat component for the Asian clam.[348] Although *Corbicula fluminea* inhabits nearly all substrate types where other habitat requirements are met (an adaptability that is likely a contributing factor in its global spread), the Asian clam displays a preference for certain substrate types and is found more abundantly in some substrates than in others—notably fine sand as preferred over coarse sand, sand without organic matter over sand containing organic matter, and any particulate substrate over a solid substrate.[349] As explained in the AST report:

> Newly released juvenile clams preferred course sand over mud or bare concrete (Sickel and Burbank 1974). Furthermore, clams grew best in sand rather than gravel, clay or solid substrata (Halbrook 1995). Similarly, field studies have shown clam abundances to be higher in fine sand over coarser material in the New River, VA, Roanoke River, VA, and Rhine River, Switzerland (Belanger *et al.* 1985; Cooper 2007; Schmidlin and Baur 2007). Although Asian clams are known to use pedal feeding in substrata containing some organic matter (Majdi *et al.* 2014), substrata relatively high in organic matter (*e.g.,* mud and "muck"), clays and detritus-rich sediment tend to have a negative effect on clam abundance, likely due to pore water hypoxia (Belanger 1991; Belanger *et al.* 1985; Cooper 2007). The importance of substratum type to Asian clam population

> dynamics and success is further emphasized by the clams displaying an increased stress response in the form of biomarkers and elevated metabolic rates when unable to burrow (Belanger 1991; Vidal. *et al,* 2002). [350]

In summary, there are a number of variables capable of contributing to the presence or absence of Asian clams in a given water body. As Dr. McMahon concluded in 2002, Asian clams have relatively low physiological resistance.[351] To link the Asian clam's presence in Hooksett Pool solely to the introduction of thermal discharges would be "scientifically unsound" and attribute a physiological fortitude to the clam that scientists do not recognize.[352] Many different abiotic requirements must be met to support the presence of Asian clams. The Asian clam's demonstrated ability to survive low winter temperatures in North America and northern Europe, the likelihood it may find warm water refuges even in a CCC system, the rapid growth rates of Asian clams after downstream settlement, and warming of ambient water temperatures in northeastern U.S. waterways have been identified as just a few of the reasons why it is unlikely that elimination of the thermal effluent from Merrimack Station would eliminate Asian clams from Hooksett Pool.[353] Such considerations are worth careful contemplation given the questions raised by the CFD modeling analysis.

[298] *See* AR-1534 at 42.

[299] AST Report at 8.

[300] *Id.*

[301] *Id.* at 10.

[302] *Id.* at 10-11.

[303] *Id.* at 8.

[304] *Id.*

[305] *Id.*

[306] AR-1534 at 41.

[307] AST Report at 22.

[308] *Id.*

[309] *Id.* at 11.

[310] *Id.* at 28, 30.

[311] *Id.* at 11.

[312] *Id.* at 49.

[313] McMahon Review at 2-3.

[314] AST Report at 26-29.

[315] *Id.* at 30.

[316] *See* Enercon 2017 Comments, Attachment 5 at 2-3.

[317] *See generally* Enercon 2017 Comments, Attachment 5.

[318] *See id.*; AST Report at 51-53. Asian clams are thought by many to have a 2ºC minimum thermal tolerance limit that excludes them from cold water habitats; although, as recognized by NHDES, recent research concerning Asian

clam presence in Lake George, New York, suggests clams may survive even lower temperatures for sustained periods of time. *See also* AR-1408.

[319] AST Report at 53. Survey points in Hooksett Pool and the Merrimack River are designated alpha- numerically. S0 is the reference point/survey location at Merrimack Station, the prefix "N" or "S" designates whether the survey point is, respectively, north (upriver) of the station or south (downriver) of the station, and the number indicates the number of 500-foot increments from S0. Thus, Site S4 is 2,000 feet south of the Station.

[320] *Id.* at 44.

[321] *See generally* Enercon 2017 Comments at 25-34.

[322] AST Report at 52-53.

[323] *See, e.g., id.* at 17.

[324] *See generally* AST Report at 18. "For example, in a study conducted in the northeastern United States, researchers concluded '[t]he importance of [Connecticut Yankee] thermal discharge as a refuge for *Corbicula* survival in the Connecticut River during cold winters appears minimal.'" Furthermore, another study cited human population density rather than temperature as being a more important factor than thermal discharge in Asian clam densities and establishment. Looking at Asian clams on the St. Lawrence River, it concluded that, "'[p]opulation densities [of Asian clam] did not differ between natural and artificially heated waterbodies in the Americas . . . '" and, "'[t]he probability of establishment in North American rivers was positively correlated with human population density in the basin…'" *Id.*

[325] McMahon Review at 3. [326] *Id.* (citation omitted). [327] AR-1534 at 42.

[328] *Id.* (citing AR-1404 and AR-1405).

[329] D.E. Morgan, M. Keser, J.T. Swenarton, & J.F. Foertch, *Effect of Connecticut Yankee Power Plant on Population Dynamics of Asiatic Clams and Their Interactions with Native Bivalves*, AMERICAN FISHERIES SOCIETY MONOGRAPH 9, 419-439 (2004). Hereinafter, references to this document will be cited as "Morgan (2004)." This journal article is attached hereto as Exhibit 13.

[330] *Id.* at 435 (emphasis added).

[331] *Id.*

[332] *Id.* at 436 (emphasis added). The findings at CY following removal of the thermal discharge call into substantial question the effect, if any, that CCC would have on the Asian clam's presence and abundance in the Merrimack River. Indeed, AST noted that the operation of wet evaporative cooling towers used in power stations, usually bring make-up water from a raw-water source to replace evaporated water lost to the evaporative cooling process and discharge (blow down) some water from their basins back to the raw water source to prevent excessive concentration of dissolved solids. *See* AST Report at 164, Appendix D. Juvenile clams can be drawn into the basins of such cooling towers with make-up water where they grow to adults producing juveniles that can be discharged back into source waters to become adults. *Id.* Thus, cooling towers become refuges for Asian clams from which juveniles are produced to be carried out on discharge water to re-infest the raw water source. *Id.* In fact, Asian clam fouling of wet cooling towers is well documented. *Id.*; *see also* McMahon Report at 3 (providing that "the winter thermal refugia associated with the warm water in . . . cooling towers and blowdown discharge of warm water from cooling tower basins into Hooksett Pool would likely support Asian clam reproductive efforts (Post et al. 2000)").

[333] *See* AR-1404.

[334] J.R. Cordeiro, A.P. Olivero, & J. Sovell, *Corbicula fluminea (Bivalvia: Sphaeriacea: Corbiculidae) in Colorado*, THE SOUTHWESTERN NATURALIST 52(3), 424-430 (2007). This journal article is attached hereto as Exhibit 14.

[335] AR-1404.

[336] AR-1405.

[337] Appendix D to AST's Report addresses the specific items in the administrative record EPA mentions in its Statement (*see* AR-1534 at 43-44) related to the Asian clam and added after closure of the public comment period for the 2011 Draft Permit. *See generally* AST Report, Appendix D.

[338] AST Report at 12.

[339] *See id.* at 12-14.

[340] *See id.* at 16-17.

[341] *Id.* at 18.

[342] *Id.*

[343] U.S. EPA, Environmental and Economic Benefits Analysis for Proposed Section 316(b) Existing Facilities Rule, EPA 821-R-11-002, at 2-12 (March 28, 2011).

[344] AST Report at 19.

[345] *Id.*

[346] *Id.*

[347] *Id.*

[348] *See id.* at 20-21.

[349] *Id.* at 20.

[350] *Id.* at 20-21.

[351] *Id.* at 21 (citing McMahon 2002).

[352] *Id.*

[353] McMahon Review at 8-9.

EPA Response:

EPA notes first that the comment's discussion of the concept of thermal refuges for Asian clams and its recognition that "Asian clams are thought by many to have a 2ºC minimum thermal tolerance limit that excludes them from cold water habitats," confirms the wisdom and appropriateness of EPA's decision to further explore the Asian clam issue after discovering the data in PSNH's submission that revealed the presence of species in the Hooksett Pool downstream of Merrimack Station's thermal discharge. As far as EPA has been informed, it was only after EPA began investigating the issue that PSNH undertook, and submitted to the Agency, its own evaluations.

The commenter again describes (AR-1548, pp. 67-71) how Asian clams have expanded in range throughout the country and in New Hampshire, and EPA recognizes this and again responds that this expansion is not determinative of this CWA § 316(a) review. *See response at Comment II.5.1.1.* The commenter repeatedly states that its research indicates that Asian clams can establish and survive without the presence of a power plant discharge of waste heat. EPA agrees and never stated otherwise. The question is what effect Merrimack Station's thermal discharge is having on Asian clams in the Hooksett Pool and how that relates to whether past thermal discharges have appreciably harmed the BIP and whether variance-based limits can assure the protection and propagation of the BIP in the future.

The commenter (at pp. 72-73) again refers to the findings of the CFD thermal modeling. Please see EPA's response to the same comment at Comment 5.1.4, above. The commenter states that:

- Using monthly averages (2010-2017) of cooling water canal temperature at the mouth of the canal, cooling water canal discharge flow, and river flow with an assumed ambient river temperature input of 33ºF (0.6ºC) in the model, it was clear that, by 950 ft. downstream of the canal:
  - In the month of December, the thermal influence at the river bottom was minimal, and river temperatures did not exceed 34ºF (1.1ºC) in December.
  - In the month of January, bottom contact by the thermal plume was negligible and temperatures did not exceed 34ºC (1.1ºC).
  - In February, bottom contact was practically non-existent, and temperature did not exceed 33.5ºF (0.8ºC).
  - In March, bottom contact was minimal and temperatures did not exceed 33.75ºF (1.0ºC).[321]
  - Thus, under average operation and river flow conditions, the thermal release from Merrimack Station does not elevate river temperatures above the 2ºC minimum tolerance limit of Asian clams, yet the two sites with greatest clam abundances in 2014, and 2016 occur 2,000 ft and 8,500 ft downstream of the canal at S4 and S17, respectively.[322]

The commenter has not established the relevance of its references to a location "950 ft downstream of the canal," as referenced in the comment above, since the model provides results for Station S4, which is 2,000 ft downstream. Beyond that, EPA's review of the same modeling report (AR-1549, Attachment 5, pp. 25-31) differs substantially from the commenter's. For example, the commenter states (at p. 72) that, "[i]n the month of December, the thermal influence at the river bottom was minimal, and river temperatures did not exceed 34ºF (1.1ºC) in December." However, the report (at p. 26) states for December, "The maximum water temperature at the riverbed is approximately 4.85ºC, and, as shown in the figure below, approximately 56% of the river bottom remains at a temperature below 2ºC." This would mean that 44% of the river bottom is at a temperature between 2-4.85ºC, which is not minimal.

Similarly, according to the comment (at p.72), "In the month of January, bottom contact by the thermal plume was negligible and temperatures did not exceed 34ºC (1.1ºC)." However, the modeling report states (AR-1549, p. 28) that for January, "The maximum water temperature at the riverbed is approximately 4.85ºC, and, as shown in the figure below, approximately 55% of the river bottom remains at a temperature below 2ºC." Therefore, approximately 45% of the river bottom is between 2-4.85ºC, which, again, is not minimal since almost half of the river width at S4 is at or above the critical 2ºC mortality threshold.

Once more, according to the comment (*at* p. 72), "In February, bottom contact was practically nonexistent and temperature did not exceed 33.5ºF (0.8ºC)." However, the modeling report states (at AR-1549, p. 28) that for February, "The maximum water temperature at the riverbed is approximately 4.34ºC, and, as shown in the figure below, approximately 52% of the river bottom remains at a temperature below 2ºC." Therefore, approximately 48% of the river bottom is between 2-4.34ºC, which is even closer to half of the river width at S4 being at or above the critical 2ºC mortality threshold.

Finally, according to the comment (at p. 72), "In March, bottom contact was minimal and temperatures did not exceed 33.75ºF (1.0ºC)." However, the modeling report states (at AR-1549, p. 32) that for January, "The maximum water temperature at the riverbed is approximately 3.83ºC, and, as shown in the figure below, approximately 60% of the river bottom remains at a temperature below 2ºC." Therefore, approximately 40% of the river bottom is between 2-4.34ºC, which again is not minimal since is 40% of the river width at S4 is at or above the critical 2ºC mortality threshold.

These comments appear to be at odds with the modeling report they reference. The modeling report seems to confirm that bottom temperatures on the west side of Hooksett Pool, where Asian clams have been found to be abundant (S-4), are sufficiently elevated throughout the winter months to provide a thermal refuge from water temperatures that drop below the critical minimum temperature of 2ºC.

The commenter concludes that surveys and studies completed, coupled with the results of thermal modeling of Hooksett Pool, disprove that presence of the Asian clam in Hooksett Pool is attributable to Merrimack Station's thermal discharge. (*See* AR-1548, p. 74). As stated in EPA's response at 5.1, EPA's analysis has not focused on the *mere presence* of Asian clams in Hooksett Pool, and EPA is not attempting to prove Merrimack Station's thermal discharge is the "sole" reason for the presence of Asian clams, as alleged (p. 79). What is important in this review is why Asian clams are not only present in the thermally-influenced portion of Hooksett Pool, but dominant there relative to other invertebrates, while at the same time being absent throughout the ambient portion of Hooksett Pool.

The commenter describes various physical and chemical parameters in addition to water temperature that can influence the presence and prevalence of Asian clams in any particular waterbody (*See* pp. 76-79), and also suggests (at p. 77) that sensitivity to low DO, rather than thermal influences, could partially account for the prevalence of the clam in well-oxygenated shallow water habitats, such as Hooksett Pool. The commenter recalls (at p. 77) that EPA is of the stated opinion that "thermal discharges may substantially alter the structure of the aquatic community by . . . reducing levels of [dissolved oxygen],"[343] and, therefore, suggests that it seems incongruent that a DO-reducing thermal plume would be essential to the Asian clam's survival. EPA disagrees, however, with the suggestion that Asian clams could not benefit from Merrimack Station's thermal plume without also suffering from hypoxic conditions. While Merrimack Station's thermal plume has the capacity to affect DO levels and has been identified as possibly causing or contributing to low DO events under low-flow summer conditions (*see II.4.2.2*) just above the Hooksett Dam, such conditions are likely temporary and limited to the area of the pool just upstream from Hooksett Dam. The thermal effects of the plume exist year-round when the Facility is operating and likely benefit the Asian clam mostly in the winter months when the plume's effects on DO are expected to be minimal. Clearly, DO levels or other physical or chemical parameters could explain why Asian clam exists in one location versus another, but it does not explain why it is present throughout the lower portion of Hooksett Pool, yet totally absent in the ambient area upstream from the Facility's discharge canal.

The commenter also suggests (at p. 78) that food availability could be a controlling factor that affects the presence of Asian clams in certain waterbodies. EPA agrees, and considers this to be another way in which Asian clam's presence and abundance in the thermally-influenced segment of Hooksett Pool should be considered when assessing appreciable harm. If food, which for Asian clams is largely plankton and suspended organic particles (*see* p. 78), is limited in the lower portion of Hooksett Pool, then the clams would be competing with native mussels, also filter feeders, for food. As noted in the comment at p. 76:

> First, the Asian clam is a self-fertilizing, highly fecund, hermaphroditic species that typically reproduces twice a year.[338] During these reproduction events, as many as 3,000 juveniles can be released per clam per day and, as a result of the species' high feeding (filtration) rate and relatively high allocation of non-respired energy toward growth, the Asian clam matures relatively rapidly.[339] Such characteristics fuel the clam's ability to spread into new habitats,[340] and, as noted previously, such spread is occurring worldwide into habitats devoid of thermal discharges.

Thus, the clam's ability to reproduce rapidly could give it a competitive advantage over native mussels and other bivalves. In addition to this potential competitive advantage, the waters downstream from the Facility's discharge canal have less live plankton than the waters upstream of the Facility's cooling water intake structure (located at N-5) due to the water withdrawal when the Facility is operating Unit 1 and/or Unit 2. While phytoplankton may be able to regenerate following that loss, zooplankton would not.

EPA understands that current information indicates that Asian clams exist in some northern locations that are not influenced by thermal discharges, and it agrees that the clam's presence in Hooksett Pool should not be attributed to Merrimack Station's operations alone. As stated, previously, the important question to EPA concerning this §316(a) thermal variance request review is not whether Merrimack Station's thermal discharge is the sole reason for the presence of Asian clams in Hooksett Pool, but rather whether the clam's presence and abundance in Hooksett Pool is negatively affecting native species such that EPA cannot set variance-based limits under CWA § 316(a) that will assure the protection and propagation of the BIP.

5.3 Careful Review of the Literature (and the Evidence) Reveals the Absence of Prior Appreciable Harm Resulting from Presence or Abundance of the Asian Clam in the Water Bodies They Inhabit

Comment II.5.3	AR-1548, PSNH, pp. 80-88
See Also AR-1555, AST; AR-1556, Robert F. McMahon, pp. 1-10; AR-1577, EPRI, pp. 4-1 to 4-11	

Although EPA's Statement seeks comment concerning whether Merrimack Station's thermal influence is causing or contributing to the presence or abundance of the Asian clam, even assuming some, unknown impact on the clam, the question for purposes of NPDES permitting is whether the Asian clam is causing appreciable harm to the Hooksett Pool BIP. It is not. Despite some speculation and conjecture associated with the frequently high population abundances achieved by Asian clams, there is no support for the supposition that Asian clams have impacted abundance and diversity of native bivalves in general, and unionids specifically, in North America.[354] As explained by Dr. Richardson:

> Despite the occurrence and recitations of such suppositions and misleading statements, the degree to which the Asian clam causes appreciable damage to the BIP, however, remains largely speculative, anecdotal, rarely quantitative, and largely scientifically unsubstantiated. Most touted negative impacts of Asian clams on the ecosystem they invade have simply not been scientifically confirmed or validated. When referring to effects on native bivalves, for example, Strayer (1999) subsequently states, "[u]nfortunately, the evidence for *Corbicula*'s impacts is weak, so its role…is <u>unresolved</u>," (emphasis added) and Vaughn and Hakenkamp (2001) point out, "[t]he invasion of *Corbicula* has been <u>speculated</u> to have negatively impacted native bivalve abundance and diversity in North America" (emphasis added). Still more recently, Ilarri and Sousa (2012) conclude for ecological impacts that, "[t]he majority of these effects remain <u>speculative</u> and <u>further research is needed</u> to clarify these interactions" (emphasis added).[355]

Indeed, as EPA itself recognized in granting Mount Tom's request for a § 316(a) thermal variance in 2014 for its Mount Tom Generating Station in Holyoke, Massachusetts, on the Connecticut River, only 90 miles away from Merrimack Station, the potential for Asian clams to affect other species is largely unknown:

> [A] number of invasive species are known to exist in the watershed. Some have been introduced to the Connecticut River watershed inadvertently by humans, while others have been purposefully introduced. These species include non-native fish, common reed, purple loosestrife, Eurasian milfoil, water chestnut, mute swans, <u>Asiatic clams</u>, and wooly adelgids. <u>The potential for these species to affect anadromous and resident fish populations is currently unknown</u>.[356]

Dr. McMahon also observed that the postulated impacts of Asian clams on unionids have not been supported by empirical studies:

Indeed, as indicated in the AST Environmental report and my own extensive literature search for this review, there appears to be scant published empirical evidence for negative impacts of Asian clams on native unionids and other freshwater bivalves. Thus, the main empirical reports of negative impacts of Asian clams on native unionid mussels have involved reported declines in unionid densities after Asian clam invasion of their habitats (Gardener et al. 1976, Sousa et al. 2005, Cordeiro et al. 2007). However, these reports are observational and did not ascertain the actual interaction with Asian clams that caused the observed native mussel density declines. Fuller and Richardson (1977) described Asian clams potentially dislodging native unionids from the substratum in the Savannah River (Georgia and South Carolina) but did not observe actual unionid dislodgement or unionid mortality resulting from it.

In contrast, most empirical studies have found no negative impacts of Asian clams on native unionid mussel or sphaeriid populations supporting the observation of no impact in the AST Environmental report. For example, Asian clams were first documented in the Connecticut River near the Connecticut Yankee Power Station in 1990. When sampled along with native unionid mussels and sphaeriid clams from 1991-2000, no significant trends in unionid, sphaeriid or Asian clam abundance occurred across the entire sampling period including when the plant was operational and generating a thermal effluent during 1991-1996 and after it was shut down from 1997-2000 suggesting that Asian clam invasion had not negatively impacted either the unionid or sphaeriid communities (Morgan et al. 2004). In a study of 30 stream reaches in eight rivers in the Ouachita Highlands of central and western Arkansas and eastern Oklahoma, Vaughn and Spooner (2006) found that, when measured at the entire site scale rather than as separate quadrates, Asian clam densities were not significantly correlated with mean unionid mussel densities ($p = 0.95$) or biomass ($p = 0.76$) indicative of no Asian clam impact. Similarly, Leff et al. (1990) in a study of bivalve distribution and abundance in 79 perpendicular transects separated by 100 m along a stretch of a backwater stream tributary to the Savannah River, found no significant correlation between the densities of Asian clams and the unionid, *Elliptio complanata*. Instead, their densities across sites appeared to vary independently from each other. These three empirical studies have all indicated that Asian clam infestations do not impact either sphaeriid or unionid density or biomass (BIP) including that of the unionid species, *E. complanata* that was also found not to be impacted by the

> presence of Asian clams in Hooksett Pool by the AST Environmental study.[357]

Similarly, based on his extensive review of the literature concerning the effects of the Asian clam on benthic macroinvertebrates, Dr. McMahon found the limited empirical studies performed "have overwhelmingly shown that Asian clams either have no impact or a positive impact on macroinvertebrate communities."[358] After analyzing these studies, Dr. McMahon concluded as follows:

> Thus, the available empirical studies all show that Asian clams either increase or do not impact benthic macroinvertebrate density, species richness or diversity. They increase habitat heterogeneity by deposition of hard shell substrata to soft sand/silt sediments, reworking sediments or transfering energy attained through their filter feeding on pelagic phytoplankton and bacterioplankton into benthic sediments with their feces and pseudofeces providing additional food resources to benthic macroinvertebrates. In contrast, my extensive literature search revealed no studies that showed the presence of Asian clams significantly negatively impacted benthic macroinvertebrate community species abundance, richness, or diversity.[359]

Accordingly, concerns and caveats regarding speculation and the need for further research on Asian clam impacts are well founded. A thorough review of the published literature and unpublished reports (where available) revealed no studies that provided a substantive or scientifically valid causative link for a negative impact of Asian clam presence on native bivalve abundance and diversity.[360] At best, studies were only suggestive of the causative links between Asian clams and any observed declines in native bivalves. As one scientist correctly recognized:

> [E]vidence for impacts of Asian clams on native bivalves is derived largely from examining non-overlapping, spatial distributions of bivalves or, less frequently, from changes in populations of native bivalves over time. Most of this evidence is anecdotal and not quantifiable with little or no experimental evidence, thus making it impossible to be precise about the impacts Asian clams may have on native bivalves.[361]

Negative correlations between Asian clams and native bivalves may be explained by the spatial scale at which the relationship is examined. A study by Vaughn and Spooner (2006)[362] that considered different spatial scales concluded that Asian clam densities varied widely in areas without native mussels or where native mussels were in low abundance, but Asian clam density was never high in areas where native mussels were dense.[363] As explained by Dr. Richardson, Vaughn and Spooner pooled patch-scale density and biomass information to represent entire stream reaches.[364] In doing so, the negative relationship between native mussels and Asian clams disappeared and there was no significant relationship between native mussels and Asian clams.[365] Rather than Asian clams impacting native bivalves, the Vaughn and Spooner study suggests native bivalves may impede Asian clam establishment.[366] Thus, the study hypothesized that the likelihood of successful Asian clam invasion may decrease with increasing abundance of native mussels.[367] As explained in the AST Report:

> Vaughn and Spooner (2006) suggested lack of space for Asian clams to colonize, physical displacement by actively burrowing native mussels, and locally reduced food resources in patches where native mussels feed as possible explanations for the likely impediment. Taken altogether, the results from Vaughn and Spooner (2006) suggest that the often observed negative correlations between native bivalves and Asian clams may exist simply because Asian clams do not successfully colonize where native bivalves are abundant.
>
> Similarly, Asian clams may only preferentially invade sites where native unionids have already been decimated (Kraemer 1979; McMahon 2001; Strayer 1999) or these nonnative clams take advantage of underutilized benthic habitat not preferred or utilized by native bivalves (Diaz 1994; McMahon, *pers. com*., Professor Emeritus, University of Texas-Arlington). Nonetheless, competition between native bivalves and Asian clams is still often, and perhaps erroneously, cited as contributing to the observed negative relationship between Asian clams and native unionid bivalves.[368]

Very few studies have actually examined competitive interactions between Asian clams and native mussels.[369] In one study that examined this competitive interaction, Belanger *et al.* (1990) concluded that Asian clam densities had no significant effect on growth or density of *Elliptio* sp, a native unionid. [370] Likewise, Karatayev *et al.* (2003) reported that native unionids and Asian clams were both abundant and observed to occupy the same areas with completely overlapping distributions.[371] Asian clams and native unionids have been observed to occur together in relatively high abundances.[372] Morgan *et al.* (2004) state that, "*Corbicula* has established a permanent population in the Connecticut River with little impact on native bivalves."[373] In fact, in northern, cold water populations like the Connecticut River, Asian clam abundances reached > 3,000 clams/m^2 over a nine year period.[374] Also, a study conducted in the Czech Republic—a colder, more northern location—concluded "there was no visible negative impact to original molluscan communities," although abundances of the Asian clams were comparatively low. [375] As explained by Dr. Richardson, "if Asian clams are detrimental to native bivalves, examples of overlapping distributions, especially when accompanied by relatively high abundances of both clams and native bivalves, should be rare when, in fact, they are common."[376]

Notably, the Morgan (2004) authors not only questioned the significance of thermal influence on Asian clam survival, they also went onto state that "[w]hile [the Asian clam] quickly established itself as the dominant bivalve in the Connecticut River, there was little change in native bivalve abundance found in the same sediments."[377] Further, "these [Asian] clams took advantage of underutilized benthic resources."[378] Morgan (2004) concluded that, "[t]he lack of correlation between presence of [Asian clam] and abundance of native clams and mussels suggest no detrimental effect of [Asian clam] on native species in the Connecticut River."[379] Morgan (2004) concludes that Asian clams were not harming the native bivalve fauna and certainly were not causing appreciable harm to the native mussels.[380]

EPA's Statement also refers to NHDES' Final 2014 Surface Water Quality Assessment (AR-1409) listing "non-native fish, shellfish or zooplankton" as a parameter that rated a "3- PNS," or "insufficient data/potentially not attaining standard," for the section of Hooksett Pool downstream from Merrimack Station (referencing NHIMP700060802-02).[381] EPA notes the same rating was applied to the Hooksett Pool bypass, just below the Hooksett Dam and in the Amoskeag Pool of the Merrimack River.[382] By comparison, EPA notes there is no such listing for the section of the Merrimack River immediately upstream of the Merrimack Station discharge canal or for the section upstream of Merrimack Station in the southern end of Garvins Pool.[383]

EPA's Statement omits NHDES' assessment from the water quality report card for the section of Hooksett Pool downstream from the Station (NHIMP700060802-02). As described below, NHDES explained its assessment as follows:

> The Asian clam, native to the freshwater of Southern and Eastern Asia, was documented at multiple locations within [the] Merrimack River from the Bow Power Plant to the Massachusetts border in 2011. While clams can form dense clusters of over 5,000 clams per square meter, dominating the benthic community and altering the benthic substrate[,] that has not yet been demonstrated here and have therefore been assessed as a potential problem.[384]

Notably, NHDES also recognized the ability of Asian clams to overwinter, surviving temperatures below 1ºC for months at Lake George in New York.[385] Furthermore, in 2016, NHDES noted, "[n]o control actions implemented, densities remain the same."[386]

Obviously, NHDES does not believe that Asian clams are currently causing appreciable harm to the BIP either through densities or through domination and only considers the Asian clam as a potential problem. As such, NHDES' assessment is comparable to EPA's assessment in its Fact Sheet granting Mount Tom's variance requests—that the potential of the Asian clams to affect other species is currently unknown. As discussed below, however, there is ample support that the Asian clams are not causing appreciable harm to Hooksett Pool's BIP based on the data collected since EPA and NHDES' initial sampling effort.

Thus, "the evidence for Asian clam impacts on BIPs in general, and native bivalves in particular, is, at best, weak and largely correlative."[387] There are "very few studies addressing the actual cause and effect of Asian clam establishment on the invaded ecosystem; furthermore, none support or report appreciable damage to the BIP," according to Dr. Richardson.[388] For that reason, an analysis of these very issues with respect to Hooksett Pool is particularly compelling—and such an analysis is described and recounted below.

[354] AST Report at 42.

[355] *Id.* at 37-38.

[356] Mount Tom Permit, Fact Sheet at 60 (emphasis added).

[357] McMahon Review at 4-5.

[358] *Id.* at 6.

[359] *Id.* at 7-8.

[360] AST Report at 38; McMahon Review at 4-5.

[361] AST Report at 38 (citation omitted). Dr. Richardson further provides:

More specifically to the point identified above, studies simply link or correlate declines in native bivalves; unionids and, more commonly, fingernail clams (Sphaeriidae); with the arrival of Asian clams in that area (Crumb 1977; Gardner *et al.* 1976). Further, numerous studies (*e.g*., Belanger *et al*. 1990; Clarke 1986, 1988; Kraemer 1979; Sickel 1973) have reported that Asian clams and native bivalves, especially unionids, have non-overlapping spatial distributions, so that unionids are abundant only where Asian clams are rare, and *vice versa*. However, most of these studies were conducted during a time of unprecedented decline in native bivalves across North America independent of Asian clams. It is likely that any such noted correlation would have been confounded with other more notable factors like habitat destruction, overutilization for commercial or other purposes, disease, predation, introduction of non-indigenous species other than Asian clams, pollution, hybridization, and restricted ranges (Williams *et al.* 1993). Any or all of these factors may have contributed to observed declines in native bivalves while allowing the spread of Asian clams (Strayer 1999).

Id. at 38-39.

[362] *Id.* at 39 (citing C.C. Vaughn & D.E. Spooner, *Scale-Dependent Associations between Native Freshwater Mussels and Invasive Corbicula,* HYDROBIOLOGIA 568(1), 331-339 (2006)).

[363] *Id.*

[364] *Id.*

[365] *Id.*

[366] *Id.*

[367] *Id.*

[368] *Id.* at 39-40.

[369] *Id.* at 40.

[370] *Id*.

[371] *Id.*

[372] *Id.*

[373] Morgan (2004) at 419.

[374] AST Report at 40.

[375] *Id.*

[376] *Id.*

[377] Morgan (2004) at 436.

[378] *Id*.

[379] *Id*.

[380] *Id*.

[381] AR-1534 at 42.

[382] *Id.* (citing AR-1409).

[383] *Id.* (citing AR-1409).

[384] Assessment from the 2014 Water Quality Report Card for NHIMP700060802-02, NHDES. This document was located through a search at the following interactive website http://nhdes.maps.arcgis.com/apps/webappviewer/index.html?id=aca7a13dced5426aa54°62b1ea10d0c by entering "Merrimack River-Hooksett Hydro Pond" as the location, clicking on the Merrimack River image, and referencing the "Waterbody Data (Aquatic Life and Swimming Uses)" pop-up hyperlink. The "Sum_Final_Table" tab of this document, attached hereto as Exhibit 15, includes NHDES' comments concerning the "3-PNS" designation.

[385] *See* AR-1408 at 1.

[386] Assessment from the 2016 Water Quality Report Card for NHIMP700060802-02, NHDES. *See* Exhibit 15

[387] AST Report at 41.

[388] *Id*.

EPA Response:

The commenter (at p. 80-85) cites various studies that question the actual versus perceived impacts from Asian clams on native mussels. While casting some doubt on why Asian clams have been broadly viewed as invasive species that negatively impacts native bivalves, these comments do not adequately address whether Asian clams are negatively impacting native mussels in Hooksett Pool, specifically.

The commenter suggests (at pp.80-81) that EPA itself recognized in granting Mount Tom's request for a § 316(a) thermal variance in 2014 for its Mount Tom Generating Station in Holyoke, Massachusetts, on the Connecticut River, only 90 miles away from Merrimack Station, the potential for Asian clams to affect other species is largely unknown. EPA disagrees that these assessments are comparable. First, it should be noted that the commenter cites to EPA's Fact Sheet supporting release of a Draft Permit for public review and comments; it was not a final permit or a final CWA § 316(a) variance determination. Second, for Mount Tom, while the presence of Asian clams in the watershed was known, there were no studies designed to assess the clam's presence and prevalence, or impacts to native bivalves, within the influence of the plant's thermal discharge. As it turned out, Mount Tom Station stopped generating electricity as a coal-fired power plant in 2014, and EPA did not grant a final CWA § 316(a) variance to the facility. CWA § 316(a).

The commenter points (at pp. 86-87) to EPA's reference to NHDES's 2014 Surface Water Quality Assessment that indicates the NHDES's concern about the presence of Asian clams in Hooksett Pool, but that NHDES concluded that the clam's prevalence had not reached densities (e.g., 5,000 clams per square meter) found at other locations in the country and that, therefore, according to the report, that Asian clam remains a "potential" problem. Apparently, Asian clam densities <u>did exceed</u> 5,000/m², according to comments at (AR 1548, p. 92) that state:

> *Following the 2013 population decline at Hooksett Pool, Asian clam densities rebounded to over 5,000/m^2 at S4, 4,100/m^2 at S17, and back to around 1,000/m^2 at S0 in 2014 only to precipitously crash again in 2016.*[406]

The commenter also suggests that NHDES's assessment of the presence of Asian clams in Hooksett Pool is comparable to EPA's assessment of invasive species (including Asian clams) for the Mount Tom thermal variance request. EPA disagrees with this comparison since it did not conduct a focused assessment on Asian clam's effects for Mount Tom. Like NHDES, however, EPA is concerned that the presence of Asian clams could become a problem in the future, but has concluded that the data provided to date suggest that despite the present prevalence in the thermally influenced section of Hooksett Pool of the Asian clam, the species is not significantly changing the macroinvertebrate community of the Pool.

That said, EPA remains concerned that Merrimack Station's continued operation could contribute to the Asian clam's ability to survive and flourish in Hooksett Pool to such a degree that it could possibly cause appreciable harm to the BIP in the future. Therefore, EPA has included in the Final Permit requirements for Granite Shore Power to develop a comprehensive multi-year study to continue to assess the status of the BIP. This study, the plan for which must be approved by EPA, will include a quantitative assessment of the distribution and abundance of Asian clams and other bivalves in Hooksett Pool. It will also assess potential impacts to the benthic community associated with the Asian clam's presence in Hooksett Pool and its impacts, if any, on the BIP. This study will be designed and undertaken in close coordination with EPA, NHDES, and NHFGD.

5.4 Analysis of the Effect, If Any, of the Asian Clam on Native Bivalves and the Hooksett Pool BIP Demonstrates the Lack of Prior Appreciable Harm

Comment II.5.4	**AR-1548, PSNH, pp. 88-90**
See Also AR-1555, AST; AR- 1556, Robert F. McMahon, pp. 1-10, AR-1577, EPRI, pp. 4-1 to 4-11	

Putting aside the question whether Merrimack Station's thermal discharges are contributing to the Asian clam's presence or numbers in Hooksett Pool, the pertinent question for purposes of EPA's § 316(a) "appreciable harm" analysis is whether the Asian clam is causing harm to the native species in Hooksett Pool (*i.e.*, the BIP). As recognized previously in these comments, § 316(a) authorizes EPA to grant variances for thermal discharges from "any point source otherwise subject to the provisions of section [301] . . . of [CWA]."[389] Specifically, § 316(a) permits EPA to grant a variance for thermal discharges whenever:

> [T]he owner or operator . . . can demonstrate . . . 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 <u>assure the protection and propagation of a [BIP]</u> of shellfish, fish, and wildlife in and on the body of water into which the discharge is to be made . . . .[390]

Although BIP is not defined by statute or regulation, the regulations state that "balanced, indigenous community" is synonymous with BIP.[391] Balanced, indigenous community is defined as:

> [A] biotic community typically characterized by diversity, the capacity to sustain itself through cyclic seasonal changes, presence of necessary food chain species and by a lack of domination by pollution tolerant species. Such a community may include historically non-native species introduced in connection with a program of wildlife management and species whose presence or abundance results from substantial, irreversible environmental modifications. Normally, however, such a community . . . may not include species whose presence or abundance is attributable to alternative effluent limitations imposed pursuant to section 316(a).[392]

For purposes of EPA's BIP analysis, the Asian clam, as a non-native species introduced to Hooksett Pool later in time should not be included in the analysis of Hooksett Pool's indigenous community, except to consider how its presence may have affected the BIP.[393] In other words, even assuming Merrimack Station's thermal influence is contributing to the presence or numbers of the Asian clam, the issue for purposes of PSNH's variance request is whether the Asian clam has caused appreciable harm to the balanced indigenous community.

To demonstrate that alternative limits "will assure the protection and propagation of a [BIP]," existing sources typically show there is an "absence of prior appreciable harm" to the BIP.[394] EPA guidance directs parties to study impacts to various plant and animal species, including: habitat formers, phytoplankton, zooplankton, macro invertebrates and shellfish, fish, and other vertebrate wildlife.[395] "[I]n attempting to judge whether the effects of a particular thermal discharge are causing the system to become imbalanced, it is necessary to focus on the magnitude of the changes <u>in the community as a whole and in individual species</u>; *i.e.*, whether the changes are 'appreciable.'"[396]

Here, a study of the community as a whole leads to only one conclusion—the Asian clam has not caused prior appreciable harm to the BIP of Hooksett Pool and may, in fact, be benefitting it. If anything, its presence has diminished in comparison to other species since Normandeau's macroinvertebrate analysis in 2011. Multiple EPA approved analyses applied to data concerning Asian clams and native bivalve populations in Hooksett Pool—collected by scientists held in high regard in their areas of expertise—demonstrate the Asian clam is simply co-existing with, and not displacing, native bivalves. The only evidence concerning the Asian clam in Hooksett Pool that is based on sound science and established scientific collection methods proves the Merrimack Station thermal discharge is not causing *any* harm, much less appreciable harm, to the BIP of Hooksett Pool.

[389] 33 U.S.C. § 1326(a).

[390] *Id.* (emphasis added).

[391] *See* 40 C.F.R. § 125.71(c).

[392] *Id.*

[393] AR-618 at 47 ("These species, and others that appeared later, should not have been included in an analysis of the balanced, indigenous community, except to explain how their presence may have affected the indigenous community."); *id.* at 52 ("Data provided in the Fisheries Analysis Report for the 2000s included (warmer water-favoring) species not present in Hooksett Pool in the 1960s and, therefore, not considered part of the balanced, indigenous community.").

[394] 40 C.F.R. § 125.73(a), (c)(1).

[395] *See generally* AR-444.

[396] *Wabash*, 1 E.A.D. at *7 (emphasis added).

EPA Response:

EPA agrees with the comment (at p. 88) that the pertinent question for purposes of EPA's CWA § 316(a) analysis is whether the Asian clam has harmed or will harm the Hooksett Pool BIP. More specifically, for a retrospective demonstration, the question is whether the applicant has demonstrated that the thermal discharge has not appreciably harmed the BIP despite the presence and prevalence of the invasive Asian clam, whereas for a prospective demonstration, the question is whether alternative thermal discharge limits will assure the protection and propagation of the BIP despite the presence and prevalence of the Asian clam. For the 2011 Draft Permit, EPA found that Merrimack Station's thermal discharge had caused appreciable harm to the BIP entirely apart from the Asian clam, because PSNH's variance application had not identified or discussed the Asian clam and EPA was not independently aware of its presence in Hooksett Pool. When EPA became aware of the species' presence in the Pool after reviewing data included in PSNH's comments on the 2011 Draft Permit, the Agency began to evaluate the issue so that it could be factored into the analysis. EPA also identified the issue and invited public comment on it in the Agency's 2017 Statement. AR 1534. Such comments were submitted by PSNH and others and EPA has considered these comments in its analysis for the Final Permit, as discussed above and below.

First, PSNH"s argument that the Asian clam is not part of the BIP and should not be considered in the CWA § 316(a) analysis except to consider how its presence may have affected the BIP in the past, or will affect the BIP going forward, appears to be inconsistent with some of Normandeau's analyses of the Hooksett Pool fish community. Asian clam was most likely included in comparisons of taxa richness in Normandeau's 2102 report (AR-870, pp. 8-11). If so, Normandeau's argument of improved richness and diversity in Hooksett compared to data from the 1970s would be based, in part, on the presence of Asian clams in 2011. In that sense, Normandeau would have included the Asian clam within the BIP by including its presence and abundance in the figures it uses to support arguments that the BIP's health has improved since the 1960s. While the introduction of new non-native species is often unavoidable, their presence should not necessarily be viewed in a positive way (*e.g.*, increase in species abundance), especially if their abundance can be attributed to elevated water temperatures associated with the alternative thermal discharge limits under a CWA § 316(a) variance.

The commenter (at p. 89) argues that, even if Merrimack Station's thermal discharge *is contributing* to the presence and abundance of Asian clams in Hooksett Pool, its studies demonstrate that the community "as a whole" does not reflect evidence of appreciable harm. To be clear, if EPA concluded that Merrimack Station's thermal discharge had contributed, or was contributing, to the presence and abundance of Asian clams in Hooksett Pool and that this invasive species had appreciably harmed, or was expected to harm in the future, the benthic portion of the Hooksett Pool BIP, then that finding would be sufficient to support denial of the Permittee's CWA §316(a) variance request, regardless of EPA's conclusions with regard to other biotic communities in the pool.

Even specific to the benthic community, attention needs to be given to how different groups of invertebrates occupy different habitats and how they are sampled. Two different sampling techniques were used to study the benthic invertebrate community in Hooksett Pool, which EPA agrees is appropriate for a large river system like the Merrimack. EPA also agrees that there appears to be no appreciable harm to the entire benthic invertebrate community based on both sampling techniques over the years sampled (*i.e.*, 2011, 2014, 2016). Had EPA found, instead, sufficient evidence to indicate that appreciable harm *had* occurred to either one of these rather distinct groups of organisms, but not the other, and that such harm was expected to continue in the future, then the Agency would have properly concluded that the benthic invertebrate community was not protected and, therefore, the Hooksett Pool BIP was not protected.

EPA notes that the commenter cites to a 1977 Draft guidance document on CWA § 316(a) reviews jointly issued by EPA and the Nuclear Regulatory Commission (NRC), AR 444, that has often been cited to by permittees and regulators alike in CWA § 316(a) variance demonstrations and determinations, respectively. EPA and the NRC never issued a final guidance document to replace the draft and, as a result, the draft guidance continued to be cited. Since issuance of the 2017 Statement, however, EPA's Office of Water has rescinded all draft guidances more than two years old. *See* AR-1739. Therefore, the draft guidance is no longer an appropriate reference. Nevertheless, EPA agrees with commenters points here, which is that the analysis should consider different components of the BIP (*e.g.*, fish, shellfish, macroinvertebrates, habitat formers, etc.), that the community as a whole and individual species should be considered, and that the magnitude of any harm should be evaluated.

5.5 The 2011 Normandeau benthic macroinvertebrate survey does not support an implication of appreciable harm.

Comment II.5.5	**AR-1548, PSNH, pp. 90-99**
See Also AR-870, Normandeau	

In the Statement, EPA remarked on the "notabl[e] concentrat[ion]" of Asian clams "in areas of Hooksett Pool with water temperatures directly affected by the plant's thermal discharge," noting Normandeau's survey conducted in 2011 (published in 2012) had revealed survey sites in Hooksett Pool where Asian clams were numerically dominant *vis a vis* native benthic macroinvertebrates.[397] In considering that information, EPA noted:

> Of the 18 samples taken at or downstream of the plant's discharge . . . Asian clams were the dominant taxon in 14 of them, ranging in relative abundance from 58 to 94 percent, with a mean of 78.6 percent at the sites where they were dominant. EPA found this

> discovery worthy of further research because of the possibility that Merrimack Station's thermal discharge was contributing to the presence and/or prevalence of the Asian clam in the Hooksett Pool and the potential relevance of such a finding to regulating [Merrimack Station's] thermal discharges . . . .[398]

As noted in the preceding subsection, EPA believes the "potential relevance" of such a finding is that "CWA § 316(a) variance-based temperature limits must assure the protection and propagation of the [BIP] of organisms" in Hooksett Pool.[399] EPA implies the Asian clam numbers from Normandeau's survey suggest continuation of PSNH's thermal variance from the 316(a) requirements may not assure the protection and propagation of the BIP in Hooksett Pool,[400] apparently notwithstanding that (1) Normandeau found no appreciable harm to the Hooksett Pool BIP based on its 2011 benthic macroinvertebrate analysis, (2) there is no evidence suggesting the Asian clam is displacing or impacting native species, and (3) Asian clam populations, as a rule, may fluctuate greatly from year-to-year before reaching an equilibrium.

In 2011, when Asian clams were first identified and sampled by Normandeau, their densities totaled around 1,100 clams/m^2 at Merrimack River Station S0, near 2,400/m^2 at S4, and just under 1,900/m^2 at S17.[401] Such numbers are not surprising considering Asian clam populations grow rapidly due, in part, to the clam's high allocation of energy to growth and reproduction that is typical of invasive species.[402] "This high allocation of energy to growth and reproduction is responsible for the relatively high fecundity (25,000-75,000 per lifetime of a hermaphroditic individual []) and, due to relatively low physiological tolerances, [Asian] clams depend on this elevated fecundity for invasive success and rapid population recovery."[403]

Within two years of the 2011 sampling, however, *C. fluminea* densities fell dramatically to less than 250, 113, and 54 clams/m^2 at S0, S4, and S17, respectively.[404] As recounted in the AST Report, such large fluctuations in population density are typical with Asian clams: "Asian clam populations may rapidly reach high abundances, but a low juvenile survivorship and a high mortality rate throughout adult life leads to considerable annual, seasonal, and site-to-site variability and fluctuations in abundances and frequent population mortality events."[405]

Following the 2013 population decline at Hooksett Pool, Asian clam densities rebounded to over 5,000/m^2 at S4, 4,100/m^2 at S17, and back to around 1,000/m^2 at S0 in 2014 only to precipitously crash again in 2016.[406] Eventually, Asian clam population abundances at Merrimack Station are expected to reach a quasi-equilibrium, as is typical with other Asian clam populations, with annual abundances commonly fluctuating as much as 2-3 orders of magnitude.[407]

These dramatic population fluctuations highlight the importance for multi-year surveys and assessments of clam populations in order to correctly ascertain numerical dominance and appreciable harm to the BIP. Dr. Richardson explains:

> For example, of the nine sites sampled in 2011 that had Asian clams, Normandeau (2012) assessed seven of those sites as having Asian clam percent composition >50%, *i.e.*, [Asian] clams were the numerically dominant benthic invertebrate (Table 3).

> Conversely, due to dramatic invertebrate population fluctuations and inherent variability in Asian clam population densities, by 2014 the percent composition of Asian clam had declined in seven of the nine sample locations and in six of the nine locations Asian clams were no longer numerically dominant (*i.e.*, <50%). By 2016, Asian clams were no longer numerically dominant at any of the nine sites including the sites directly within the cooling water plume.
>
> Clearly, therefore, whether or not the Asian clam is the numerically dominant benthic invertebrate of the BIP in Hooksett Pool depends entirely upon which year's data are examined. These data clearly point out that numerical dominance of the BIP by a nonindigenous species with a life history such as that of the Asian clam cannot be assessed based on 2011 data alone.[408]

And if such dominance cannot be accurately assessed, then one certainly should not use such population figures to assert the Asian clam is causing appreciable harm to Hooksett Pool's BIP.

Ironically, however, a thorough analysis of the results of Normandeau's 2011 survey (articulated in its 2012 report) provides insight as to the relationship of the Asian clam with Hooksett Pool's BIP.[409] While greater numbers of Asian clams existed at certain locations in Hooksett Pool compared to others, Normandeau concluded that mean taxa richness, mean EPT richness, and mean EPT/Chironomidae abundance ratio all increased in Hooksett Pool from 1973 to 2011. These EPA recommended indicators of BIP health all increased with the addition of the Asian clam.[410]

Further, the numerically dominant taxon collected during Normandeau's bankside kick sampling was a species that prefers unpolluted, clear cold waters (the freshwater arthropod *Gammarus fasciatus*) and, for that matter, "'kick sample data collected from the aquatic insect community . . . showed dramatic improvements in the aquatic insect community composition between 1972 and 2011.'"[411]

In conclusion, therefore, the Normandeau report, as based on the 2011 survey work, does not establish a scientific basis for concluding the Asian clam is the numerically dominant taxon in Hooksett Pool. In fact, if one did want to draw conclusions from the Normandeau report (for that particular time period), the more relevant conclusion would be that, despite the presence of large numbers of Asian clams at certain survey sites in Hooksett Pool, overall BIP health in Hooksett Pool is trending in a positive, rather than an adversely impacted, direction.

[397] AR-1534 at 41.

[398] *Id.*

[399] *Id.*

[400] *See id.* at 41-43.

[401] AST Report at 22.

[402] *Id.*

[403] *Id.* (citing McMahon 2002).

[404] *Id.* at 23.

[405] *Id.* (citations omitted).

[406] *See id.*

[407] *Id.*

[408] *Id.* at 23-24 (emphasis added and in original, respectively).

[409] *See* AR-1174.

[410] AST Report at 24-25.

[411] *Id.* at 25 (quoting AR-1174).

EPA Response:

EPA agrees with the comment (at p. 91) that the Agency's 2017 Statement indicated that the new information about the presence and prevalence of the newly discovered invasive Asian clam could factor into EPA's assessment of Merrimack Station's thermal variance request and the question of appreciable harm to the BIP from past discharges and/or whether the protection and propagation of the BIP would be assured going forward. The comment concurs with EPA's view that it is appropriate under CWA § 316(a) to consider other aspects of the BIP, such as macroinvertebrates, in addition to fish. While not conclusive, the new information about Asian clams raised questions about what impact this invasive species might be having on the BIP, if any, and whether the plant's thermal discharge was facilitating the species' survival, growth and reproductive success.

The commenter states that Normandeau found no appreciable harm to the Hooksett Pool BIP based on its 2011 benthic macroinvertebrate analysis, but EPAdoes not agree that the results of the 2011 sampling alone support a conclusion of no appreciable harm. The quantitative benthic invertebrate data clearly indicated that Asian clams were the dominant taxa in the thermally-influenced portion of Hooksett Pool, but were not dominant – or even present – in the upstream portion unaffected by the Facility's thermal discharge. That does not demonstrate a lack of appreciable harm, but instead raises the possibility that appreciable harm may be occuring. Still, as the text quoted by the commenter indicates, EPA had not reached final conclusions at the time of the 2017 Statement. *See* AR 1534, p. 41 ("EPA found this discovery worthy of further research because of the possibility that Merrimack Station's thermal discharge was contributing to the presence and/or prevalence of the Asian clam in the Hooksett Pool and the potential relevance of such a finding to regulating [Merrimack Station's] thermal discharges ….")

The commenter states (at p. 90) that there is no evidence suggesting the Asian clam is displacing or impacting native species, but in EPA's view, species dominance would evidences the potential for Asian clam to be displacing or otherwise adversely impacting native species. Moreover, species dominance, when evaluating relative abundance, is a commonly used metric for evaluating changes in biological communities. Thus, EPA defines "balanced indigenous population" as a community characterized by (1) diversity at all trophic levels, (2) the capacity to sustain itself through cyclic seasonal changes, (3) the presence of necessary food chain species, and (4) non-domination by pollution-tolerant species. 40 CFR § 125.71(c) (emphasis added).

At the same time, EPA agrees with the comment (at p. 92) that Asian clam populations may fluctuate greatly from year to year before reaching equilibrium, but also notes that maintenance of a thermal refuge due to the plant's thermal discharge could result in lower mortality rates during winter conditions compared to sections of the Hooksett Pool unaffected by the plant's thermal plume, if any Asian clams are present in the latter areas.

The commenter argues (at p. 93) that if dominance by the Asian clam cannot be accurately assessed because of varying abundance values from year to year, then one should not use population figures solely from 2011 to assert the Asian clam is causing appreciable harm to Hooksett Pool's BIP. EPA based its assessment on the status of the BIP as of the 2011 Draft Permit primarily on the data provided by the Permittee, which at the time did not include Asian clam information. Therefore, EPA's proposed determination under CWA § 316(a) for the 2011 Draft Permit did not consider the Asian clam. When Normandeau's comments on the 2011 Draft Permit included the 2012 macroinvertbrate report (AR-870) as evidence that Merrimack Station's thermal discharge was not causing appreciable harm to the Hooksett Pool BIP, EPA reviewed the report and became aware of the presence of the Asian clam. At that point, although Normandeau did not provide analysis of the significance of the Asian clam data, EPA began to consider the import of this invasive species. EPA notes that Normandeau did not describe its submission as an interim report or indicate that it would be collecting additional date to investigate possible population fluctuations. It also did not caution that the Asian clam data in the report should not be used in assessing the BIP because population figures could be variable. Nothing in the report suggested that the information provided would be insufficient for assessing the status of the Hooksett Pool invertebrate community. Therefore, EPA began to factor the information into its analysis. However, when PSNH/Normandeau became concerned that EPA was independently evaluating a finding evidenced in the report (*i.e.*, the presence and dominance of Asian clams in Hooksett Pool downstream of the Facility's thermal discharge), PSNH launched additional studies and now it and Normandeau argue that EPA should not rely the 2011 data results alone since sampling in later years revealed different results.

EPA notes, however, that decisions on the status of the BIP and permit limits need to be made in a timely way with the data available even if they may not represent as much information as the Agency might prefer. That said, EPA welcomes the additional data that PSNH later provided and agrees that all relevant data available for review should be considered and, as such, it has included the 2014 and 2016 data in its evaluation. EPA regards consideration and collection of additional data to be particularly important in this case because Merrimack Station's operations and attendant thermal discharges have been substantially reduced in more recent years and newer data may illustrate different or changing impacts. EPA also notes that fish abundance can also vary dramatically from one year to the next. Therefore, as is required for fish, the Final Permit requires continued sampling for Asian clams and the resident invertebrates they can impact (*e.g.*, mussels), to provide further information for assessing the status of the BIP going forward. Indeed, the comment suggests that multi-year surveys are important for the Asian clam (though none had been carried out at the time of PSNH's CWA § 316(a) variance application).

Normandeau's 2012 report (AR-870) does not explain why Asian clams dominate in the thermally-influenced portion of Hooksett Pool but are completely absent in ambient portions of the pool. The report suggests that the *qualitative* aquatic insect data that were collected are better than the *quantitative* benthic invertebrate samples (where Asian clams were collected) for purposes of comparing samples taken between the 1970s and 2011 because organisms along the littoral zones are typically more pollution sensitive than those found in sand substrates. While EPA agrees aquatic insects in the littoral zones are important for fish that forage there, both sets of sampling data are important for understanding the status of the entire macrobenthic community of Hooksett Pool.

The commenter stated (at p. 93) that Normandeau concluded that mean taxa richness, mean EPT richness, and mean EPT/Chironomidae abundance ratio all increased in Hooksett Pool from 1973 to 2011. It also notes (at p. 93) the numerically dominant taxon collected during Normandeau's bankside kick sampling was a species that prefers unpolluted, clear cold waters (the freshwater arthropod *Gammarus fasciatus*) and, for that matter, "'kick sample data collected from the aquatic insect community . . . showed dramatic improvements in the aquatic insect community composition between 1972 and 2011.'" EPA reviewed this analysis, but does not consider the EPT/Chironomidae abundance ratio to be particularly useful to the assessment of Asian clam impacts since these communities are not well-represented in Ponar sampling. This analysis seems more appropriate for the results from kick sampling along the wadeable riverbank.

The commenter also suggests (at pp. 93-94) that if one did want to draw conclusions from the Normandeau report (for that particular time period), the more relevant conclusion would be that, despite the presence of large numbers of Asian clams at certain survey sites in Hooksett Pool, overall BIP health in Hooksett Pool is trending in a positive direction. EPA needs to draw conclusions based on the data provided. While there do seem to be improvements in the aquatic insect community in comparisons between the 1970s and 2011 data, particularly with kick sampling results, the results are more mixed with the benthic community sampled with the Ponar grab. According to Normandeau's 2012 report (AR-870, p. 8-14), in 2011, taxa richness was higher on the east side of Hooksett Pool than in the 1970s, but about the same abundance in samples collected in the middle of the river (5.18 ('70s) vs. 5.74 ('11), and lower on the west side (8.07 ('70s) vs. 6.75 ('11)).Also, the 2011 taxa values most likely include the presence of Asian clams, which is not a resident species and did not exist in Hooksett Pool in the 1970s. EPA is wary of putting too much emphasis on one year of qualitative kick sampling data. This cautious approach is consistent with the commenter's recommendation not to rely on 2011 data alone for Ponar sampling results.

Additional Ponar sampling data were collected in 2014 and 2016. Analysis based on these new data are presented in AST's 2016 report (AR-1555), but unfortunately the actual data are not provided. Therefore, a comparison of the relative abundance of all benthic invertebrates sampled between all years and locations (1972, 1973, 2011, 2014, 2106) is not possible. Unfortunately, kick sampling was not conducted in 2014 or 2016. Additional kick sampling would have provided an opportunity to compare how representative the 2011 qualitative data were and increased the number of years sampled in the 2010s to the number used in the 1970s.

5.6 EPA's and NHDES' 2013 and 2014 Asian clam studies fail to demonstrate appreciable harm to Hooksett Pool's BIP or New Hampshire Water Quality.

Comment II.5.6	AR-1548, PSNH, pp. 94-99

EPA, in coordination with NHDES, conducted limited study and investigation of the Asian clam in certain New Hampshire waters in 2013 and 2014.[412] In the Statement, EPA observes, "[t]his qualitative sampling revealed both higher densities of clams and larger individuals near the mouth of the discharge canal, as compared to clams collected farther downstream in Hooksett Pool, and in Amoskeag Pool below the Hooksett Dam" and that "[n]either benthic sampling conducted by NHDES during 2013 (AR-1414), nor EPA dive investigations in 2014 (AR-1412), found evidence of Asian clams upstream from [Merrimack Station] in Hooksett Pool or Garvins Falls Pool."[413] Following these statements, EPA leaps to the (uncited and unsubstantiated) conclusion in the Statement that "[t]he arrival of invasive Asian clams in NH represents a threat to the state's water quality."[414]

As acknowledged by EPA, when required by the FOIA to do so, EPA provided PSNH with data derived from the 2013 and 2014 studies. As discussed below, EPA's and NHDES' collection and analysis of the relevant Asian clam data did not follow established scientific processes and, for that matter, suffered from other significant deficiencies (such as a failure to fully appreciate the expanding range of the Asian clam in the northern United States).[415]

First, EPA's 2013 study of Asian clams in New Hampshire, conducted in coordination with NHDES, erroneously reported the abundance of Asian clam at three New Hampshire sites. More than one-third of the samples collected in the Merrimack River during the study that did not contain any Asian clams were inappropriately excluded from density calculations and other analyses, skewing the entirety of the data.[416] Specifically, the elimination of this data incorrectly inflated densities to almost twice what they should have been based on actual EPA field data sheets.[417] Compounding the error, EPA took this faulty density data from the Merrimack River and compared it to Asian clam abundances in the nearby Cobbetts and Long Ponds. This led to the erroneous conclusion that clam abundances in the Merrimack River were greater than those found in the two other ponds, when, in actuality, a correct analysis reveals the Asian clam's presence in the Merrimack River is not significantly different than found elsewhere.[418]

EPA's second error in this 2013 study in the Merrimack River stems from its inclusion of samples containing only native unionid bivalves that were counted as Asian clams.[419] This too led to an improper inflation in the estimates of Asian clams within the waterbody.[420] Furthermore, EPA broke from accepted scientific protocol by utilizing replicate means instead of means calculated directly using sample replicates to generate and report its means for the study[421]—calling into question the agency's conclusions.

In contrast, when the analysis is performed correctly, the EPA data from the 2013 study supports the conclusion that the Asian clam's presence in the Merrimack River is not significantly different than found elsewhere and, in fact, demonstrates that the Asian clam's presence in these waters is part of the clam's naturally occurring, worldwide northern range extension often taking place in the absence of thermal discharges.[422]

EPA's 2014 study of Asian clams is similarly faulty. As explained in the AST report,

> A review of the sampling design that EPA utilized in 2014 indicates that it also was not based on acceptable scientific practices. As a result, the inappropriate sample design led to inaccurate and inappropriate conclusions about the significance of the Asian clam and native bivalve species. Specifically, EPA's 2014 study employed an inappropriate sample design for the Asian clam in Hooksett Pool. EPA excavated Asian clam samples and conducted video observations along a single transect at station S0. The sample design located the survey transect parallel to the shore and within and along a known, high-density Asian clam area. This approach was contrary to well-established scientific protocol for river sampling of bivalves that dictates that (1) multiple transects be used, (2) transects be located perpendicular to the shoreline, and
> (3) transects span the width of the river when possible. Utilizing its flawed sampling design, all EPA-excavated samples and video were taken from areas known to have high clam concentrations. Where EPA did employ multiple transects for ponar samples in 2014, the samples were limited to the west and middle of the transects, all locations of known high clam abundance and were not indicative of conditions in Hooksett Pool. Such an approach adversely affected the accuracy of any impact or assessment of Asian clam[s] on the [BIP] in Hooksett Pool.[423]

Both studies suffer from one additional flaw: neither attempted to gather data on the resident benthic invertebrate community of Hooksett Pool, meaning they fail to provide any basis for analysis on whether the Asian clam is causing appreciable harm to the BIP.[424] Based on AST's review, there was no data or information produced through PSNH's FOIA and New Hampshire Right-to-Know requests that attempted to assess the benthic invertebrate community Hooksett Pool beyond clams.[425]

The result of these errors is that EPA's 2013 and 2014 sampling artificially inflated the abundance and significance of Asian clams in Hooksett Pool. The data derived from these efforts is, therefore, invalid for assessing the abundance of clams in the Merrimack River or their impact (or lack of impact) to the BIP.[426] Further compounding these data collection issues, EPA's analysis of the results of the 2013 and 2014 surveys also omitted relevant range extension data and could lead to erroneous connections between the Asian clam and Merrimack Station.[427] Specifically,

> [O]f the 11 documented locations of Asian clam in New Hampshire (USGS 2017), only one, Hooksett Pool, Merrimack River, receives cooling water discharge. . . . EPA developed data

> on clam presence at several sites in New Hampshire. EPA's data, however, show no significant differences (ANOVA, P = 0.687) among sites in Asian clam numbers with and without thermal discharge (Figure 1). Unlike other EPA data sets and analyses, these data were collected using multiple sample replicates and, in the case of the Merrimack River, using shore-to-shore transects as is standard protocol; there is no indication that EPA's information using this sampling protocol is incorrect. Asian clam densities among all four New Hampshire sites surveyed by NHDES for EPA were similar when comparing two sites with no thermal effluent, Cobbetts Pond and Long Pond; and two sites receiving Merrimack Station cooling water, Hooksett Pool and Amoskeag Pool (Figure 1). The pattern suggests Asian clam densities may even be lower at Hooksett Pool receiving cooling water discharge from Merrimack Station compared to the two sites lacking any thermal input, *i.e.*, Cobbetts and Long ponds. Such a discernable pattern warrants recognition; however, such analysis was not provided.[428]

For that matter, EPA also omitted information on Asian clams from (1) Wash Pond, (2) the upper Merrimack River north of Concord, and (3) below Amoskeag Dam at the Pennichuck Water Works pipeline in the Merrimack River, all sites that also do not receive cooling water discharge.[429]

Although perhaps admittedly beyond the scope of EPA's and NHDES' immediate studies, had they conducted a broader geographic review of the Asian clam's range in the northern United States, they would have likely discerned the species' spread into bodies of water lacking thermal input is well-documented and "strongly supports the position that thermal discharge is not a requirement for spread and establishment of the Asian clam."[430] For example:

- There are at least 25 documented locations of established Asian clams at locations as far north, or nearly so, as is Hooksett Pool of the Merrimack River (Table 6).
- Twelve of these documented locations are in the New England area of the U.S.
- Eleven of these documented locations are in New Hampshire and one in Maine.
- Four of these New England locations are as far or farther north than Hooksett Pool of the Merrimack River.[431]

In light of the foregoing issues with data collection and analysis, EPA's and NHDES' work in 2013 and 2014 does little more than illustrate the Asian clam's presence in Hooksett Pool and certainly does not support the Asian clam in Hooksett Pool as "a threat" to the Pool's water quality.[432] AST's more comprehensive analysis of the issue, as detailed below, leads to a far different conclusion.

[412] AR-1534 at 42.

[413] *Id.*

[414] *Id.*

[415] *See* AST Report at 26-33.

[416] *Id.* at 26.

[417] *Id.*

[418] *See id.* at 26-29.

[419] *Id.* at 27.

[420] *Id.*

[421] *Id.*

[422] *Id.* at 27-28.

[423] *Id.* at 28.

[424] *Id.* at 29.

[425] *Id.* Dr. Richardson noted that there was some limited information in these agency materials regarding sampling for native mussels. *Id.* However, the sampling design provided was inappropriate for native unionid mussels and could only suffice for an analysis of native fingernail clams, which was not apparent within the four- corners of the materials. *Id.* The agency materials were clearly aimed at sampling Asian clams only, according to Dr. Richardson, and therefore do not allow for an assessment of appreciable harm—if any—to the BIP of Hooksett Pool. *Id.*

[426] *Id.*

[427] *Id.* at 30.

[428] *Id.*

[429] *Id.*

[430] *Id.*

[431] *Id.* at 31.

EPA Response:

In response to comments regarding studies conducted by EPA and NHDES in 2013 and 2014, these studies were designed primarily to evaluate differences in the abundance and size of Asian clams known to exist in the Merrimack River and two New Hampshire ponds, Cobbett's Pond and Long Pond. During these studies, NHDES took all benthic samples, processed the results, and conducted all the comparative analyses. EPA collected water quality sampling at the locations where benthic samples were taken. EPA was provided an opportunity to review a draft of the report but did not use the data to demonstrate appreciable harm, as the commenter alleges (p. 96). The Agency did, however, verify the data collected and presented by Normandeau in its 2012 invertebrate report (AR-1465), which indicated that Asian clams were indeed present in the river immediately downstream from the Facility, the area most affected by the thermal discharge. Indeed, the comment complains that EPA's data collection was focused in the areas most affected by the thermal discharge, which are "known high clam areas." EPA's initial data collection effort was also intended to provide the basis for EPA potentially to develop a more comprehensive study to evaluate the distribution of Asian clams in Hooksett Pool, as well as differences in their abundance and size at various locations upstream, downstream, and adjacent to the discharge canal. After working on development of such a study, EPA ultimately decided not to carry out the more detailed study in light of competing work priorities and resource limitations.

EPA disagrees with the comment's claim that EPA, in its 2017 Statement, AR 1534, p. 42, "leaps to the (uncited and unsubstantiated) conclusion in the Statement that '[t]he arrival of invasive Asian clams in NH represents a threat to the state's water quality.'" EPA's discussion of the issue in the 2017 Statement was reasonable and properly supported. Placed in fuller context, EPA's 2017 Statement explained that:

> [t]he arrival of invasive Asian clams in NH represents a threat to the state's water quality. Their presence is regulated in New Hampshire, and it is illegal to import, possess or release Asian clams in the state, according to NHDES (NHDES 2012) (AR-1408).

AR 1534, p. 42. Moreover, this statement was appropriately included within the context of a larger discussion of the Asian clam issue. *Id*. at 41-43.

5.7 AST's comprehensive investigation and analysis of Asian clams and native species in Hooksett Pool demonstrates an absence of prior appreciable harm to the BIP.

Comment II.5.7	AR-1548, PSNH, pp. 99-107

AST, in coordination with Normandeau, performed extensive investigation into the presence of the Asian clam and its relationship to the Hooksett Pool BIP, specifically the native benthic macroinvertebrates. The investigation included a two-year study of the Asian clam in Hooksett Pool to assess how, if at all, it has been impacted by Merrimack Station's thermal discharges and whether it is causing appreciable harm to the BIP of Hooksett Pool. Multiple dives were conducted excavating 0.25 m^2 samples and performing semi-quantitative assessments, and numerous ponar grab samples were taken along multiple transects in November/December 2014 and again in July 2016, leading to the collection of numerous clam and macroinvertebrate samples.[433] The samples were analyzed following scientifically accepted methods and led to the following overall conclusion by Dr. Richardson: "[T]he indigenous ecology of Hooksett Pool, supported by an apparently viable and self-sustaining food chain, is typical of what one would expect to find in a New Hampshire river system – and . . . represents a marked improvement over the river's pollution-impacted state in the first half of the 20th century."[434]

In addition to assessing the health and viability of Hooksett Pool's indigenous ecology, Dr. Richardson analyzed whether or not the indigenous populations or communities found in Hooksett Pool's ecology are threatened by harmful imbalance caused by the Asian clam's introduction to the water body. In order to derive actual data on the Asian clam in Hooksett Pool on which scientific conclusions regarding the clam and its ecological impact could be based, Dr. Richardson compared "abundances and size-frequency distributions of native bivalves at designated river sampling sites with Asian clams and those without clams . . . to see if Asian clams were in any way causing appreciable harm to the native mussel community."[435] Using SCUBA, dive assessments were performed in 2014 and 2016 that followed scientifically approved collection methods.[436] These studies revealed that native bivalve abundance was unaffected by the presence of Asian clams and an absence of appreciable harm. As explained in the AST Report:

> Analysis of the diver excavated 0.25 m^2 quadrates indicated a significant difference among native bivalve species (2-way ANOVA; P = 0.014), but did not reveal a significant difference among stations (P = 0.227), and there was no significant station by species interaction (P = 0.251) (Figure 3). ***No significant station by species interaction means that native bivalve abundance was unaffected by presence of Asian clams and certainly no appreciable harm was indicated.*** Notably, native bivalves, mostly *Elliptio complanata* and sphaeriids, had densities at Station N10, where no clams occurred, similar to those of Station S24, where clams were fairly abundant (Figure 3).
>
> Examining the results of semi-quantitative diver transect surveys (Appendix C1 and C2) indicated that Asian clams were located at survey sites S0, S4, S17, and S24. Numerous native mussels were also located at those same survey sites (and elsewhere in Hooksett Pool). From these assessments, it is clear that ***native bivalves were as abundant and spatially distributed, i.e., near the shore, along transects without Asian clams ([Upstream Reference Site] through N5) as they were along transects with Asian clams*** (S0-S24). Also, the native bivalves appear to avoid the mid-channel area of the river. As suggested by Vaughn and Spooner (2006), it is highly likely that Asian clams in Hooksett Pool are mostly exploiting the highly disturbed mid-channel shifty and loose sand substrate generally uninhabited by native bivalves. These areas are largely unsuitable and inappropriate for most native bivalve species, especially members of the Unionidae, but provide typical habitat for Asian clams (McMahon 2002 and *pers. comm.*).[437]

Recognizing this reality is important, because "ignorance of the spatial distribution of native bivalves and Asian clams . . . would lead one to a spurious negative correlation between native bivalve abundance and Asian clam density [and,] subsequently[,] to an incorrect conclusion of a negative impact of Asian clams on native bivalves . . . which is simply not the case."[438]

Furthermore, if Asian clams were causing appreciable harm to the native bivalves through competition, there would be differences in population size structure between stations with Asian clams versus those without Asian clams.[439] Specifically, if negative competitive interactions between native bivalves and Asian clams were occurring (with the subsequent appreciable harm), one would expect to see smaller native bivalves in those locations where Asian clams are present (as compared to those locations where they are absent).[440] But in Hooksett Pool, a comparison of the size-frequency distribution of native bivalves from stations with Asian clams to stations without Asian clams did not reveal significant differences.[441] This is indicative of no appreciable harm.[442] Further, if Asian clams were causing appreciable harm to native bivalve recruitment by impacting glochidia and settling juveniles, one would expect to see a corresponding lack of smaller individuals at stations with Asian clams compared to stations without Asian clams.[443] Again, however, no difference was detected between the two distributions. These findings show that Asian clams are not causing appreciable harm to native bivalves through negative impacts on recruitment.[444]

Dr. Richardson not only compared and analyzed Asian clams to native bivalve populations in the course of his work, but also utilized various EPA-approved metrics to fully analyze appreciable harm, or lack thereof, to the Hooksett Pool BIP. Such analysis further demonstrated the Asian clam is not causing appreciable harm to the BIP of Hooksett Pool, according to Dr. Richardson.[445] A summary of the key analyses that led to Dr. Richardson's ultimate conclusion are summarized below.

First, although Normandeau's 2012 study shows Asian clams were abundant in 2011, when this 2011 data is compared against data Normandeau collected in 1972 and 1973, taxa richness, EPT richness, and EPT to *Chironomidae* abundance ratio all increased in the Hooksett Pool despite the presence of the Asian clam.[446] This indicates an improvement in the BIP, not harm.[447] "If clam presence and abundance caused appreciable harm to the BIP, these metrics should have decreased from 1972 and 1973 compared to 2011 rather than increased," as they did.[448]

Second, the abundance of all other benthic invertebrates in the Hooksett Pool was the same or higher at sampling stations at which Asian clams were also present compared to sampling stations that did not include any Asian clams.[449] "Interestingly, there were even higher invertebrate abundances at S17, one of the sites with the highest Asian clam densities. For Asian clam presence and abundance to have caused appreciable harm to the benthic macroinvertebrate BIP, the abundance of other benthic invertebrates should have been reduced at stations without clams."[450] No such reductions were identified, according to Dr. Richardson.[451]

Third, BIP taxa richness—an assessment EPA has recognized is the best candidate benthic invertebrate community metric—was the same or higher among all sampling stations at which Asian clams were present compared to those at which they were not.[452] "For Asian clam presence and abundance to have caused appreciable harm, the taxa richness of other benthic invertebrates should have been significantly reduced at sites with clams."[453] There were, however, no such reductions.[454]

Fourth, the BIP Shannon Community Diversity Index, which focuses on quantifying the uncertainty in predicting the species identity of an individual that is taken at random from the dataset, was the same among many stations at which Asian clams were present compared to those at which they were not.[455] "For Asian clam presence and abundance to have caused appreciable harm, the Shannon Community Diversity of other benthic invertebrates should have been significantly reduced at sites with clams."[456] As explained by Dr. Richardson, that was not the case.[457]

Fifth, Dr. Richardson assessed Hooksett Pool in terms of the Hilsenhoff Biotic Index ("HBI"), another EPA-approved benthic macroinvertebrate BIP metric.[458] A lower HBI means the benthic community is healthier and comprised of invertebrates that are less tolerant to pollution.[459] The HBI's were the same or lower among stations with versus those without Asian clams. In particular, the HBI's "were the same or lower at the two stations with highest Asian clam abundance (S4 and S17) in 2011, 2014 and 2016 following Asian clam establishment compared to 1972 or 1973, prior to Asian clam establishment."[460] The HBI of the Hooksett Pool benthic invertebrate community should have significantly increased at site with Asian clams if the species have caused appreciable harm to the BIP. No such increases occurred.[461]

Sixth, recognizing EPA considers EPT taxa richness another of the best metrics for assessing the health of benthic invertebrate communities, Dr. Richardson utilized it in his analysis and found the richness in the Hooksett Pool to be "the same or higher among stations with *versus* those without Asian clams."[462] EPT "derives its name from its reliance on counting the presence of three benthic insect groups: *Ephemeroptera* (mayflies), *Plecoptera* (stoneflies), and *Trichoptera* (caddisflies)."[463] EPT taxa richness at S4 and S17 (again, the two sites with the highest abundance of Asian clams) was the same or higher in 2011, 2014 and 2016, compared to 1972 or 1973, prior to the time the clams became established in the waterbody.[464] "For Asian clam presence and abundance to have caused appreciable harm, the EPT taxa richness should have been significantly reduced at sites with clams."[465] But no such reduction was evident.[466]

Seventh, HBI, Shannon Diversity Index, taxa richness, and total invertebrate abundance (minus Asian clams) estimates per sample were each analyzed for correlation with Asian clam abundances using samples taken in 2011 and 2014.[467] As explained in the AST Report,

> There was no significant correlation between Asian clam abundance and HBI [], Shannon diversity [], taxa richness [], or total invertebrate abundance []. For Asian clam presence and abundance to have caused appreciable harm, the Shannon diversity index, taxa richness, and total invertebrate abundance (minus Asian clams) of benthic invertebrates would be expected to have significant negative correlations with Asian clam abundance; HBI would be expected to have a significant positive correlation.[468]

Those correlations, however, were not identified.[469]

Eighth, Dr. Richardson utilized the Bray-Curtis Community Similarity Index to assess the health of the benthic invertebrate community in the Hooksett Pool. The "cluster analysis clustered stations into three groups, each containing stations with and without Asian clams."[470]

This indicates the macroinvertebrate communities among the sampling stations with and without Asian clams were very similar.[471] "For Asian clam presence and abundance to have caused appreciable harm, the Bray-Curtis Community Similarity clusters of benthic invertebrates should have separated sites with clams from sites without clam. Such separation was not encountered," however.[472]

Finally, the MDS Community Ordination (utilizing analyses from the Bray-Curtis Similarity Index), "lumped stations into three groups, each containing stations with and those without Asian clams indicating similar macroinvertebrate BIPs among stations with and without Asian clams."[473] This too supports a finding that Asian clams are not causing appreciable harm to the Hooksett Pool BIP. For, if they were, the MDS Community Ordination would have "separated sites with clams from sites without clams. Such separation was not encountered," however.[474]

Dr. McMahon concurred with each of these conclusions by Dr. Richardson and further provided: "All of the above described results consistently suggest that benthic macroinvertebrate abundance and diversity in areas of Hooksett Pool with Asian clams have either remained unchanged or have significantly increased resulting in no change to or an increase in biotic integrity as measured by the [HBI]."[475]

In summary, over a dozen analytical exercises, relying on the application of EPA- approved metrics to data scientifically derived from Hooksett Pool, generated results that demonstrate the Asian clam is not causing harm to the BIP in Hooksett Pool. This undisputed evidence, coupled with the in-Pool evidence that the Asian clam is simply co-existing with, rather than replacing, native bivalves, demonstrates an absence of prior appreciable harm to the Hooksett Pool BIP.

[432] *See* AR-1534 at 42. In follow-up to its limited investigation in 2013 and 2014, EPA developed a plan to study the presence and abundance of the Asian clam in the Merrimack River in order to improve the agency's "understanding of the power plant's influence" on the Asian clam and, in turn, "to further evaluate the plant's ability to meet state and federal water quality standards, and its NPDES requirements, as they apply to protecting the resident biological communities." Project Plan at 3. EPA's planned 2015 study, however, was not undertaken. *See* AST Report at 3, 33.

[433] *See* AST Report at 34.

[434] *Id*. at 35.

[435] *Id.* at 41.

[436] *Id.*

[437] *Id.* at 41-42 (emphasis in bold and italics added).

[438] *Id.* at 42.

[439] *Id.*

[440] *Id.*

[441] *Id.* at 43.

[442] *Id.*

[443] *Id.*

[444] *Id.*

[445] *Id.*

[446] AR-1174 at 18.

[447] AST Report at 43.

[448] *Id.*

[449] *Id.* As explained in the AST Report, there was no statistically significant difference (P>0.05) among these sites. *Id.*

[450] *Id.* at 43-44.

[451] *See id.* at 44. At S4 and S17, the two stations with the highest Asian clam abundance, the abundance of all other benthic invertebrates were generally the same in 2011, 2014 or 2016, compared to 1972 or 1973. "For Asian clam presence and abundance to have caused appreciable harm, the abundance of other benthic invertebrates should have been significantly reduced in 2011, 2014 and 2016." *Id.* There were no such reductions.

[452] *Id.*

[453] *Id.*

[454] *See id.* BIP taxa richness was the same at S4 and S17 (the two stations with highest Asian clam abundance) in 2011, 2014 or 2016, compared to 1972 or 1973. "For Asian clam presence and abundance to have caused appreciable harm, the taxa richness of other benthic invertebrates should have been reduced in 2011, 2014 and 2016." *Id.* at 45. No such reductions occurred.

[455] *Id.*

[456] *Id.*

[457] *See id.* Dr. Richardson provides:

BIP Shannon Community Diversity Indices <u>were the same</u> (ANOVA, P = 0.157) at the two stations with highest Asian clam abundance (S4 and S17) in 2011, 2014 and 2016 following Asian clam establishment compared to 1972 or 1973, prior to Asian clam establishment (Figure 10). For Asian clam presence and abundance to have caused appreciable harm, the Shannon Community Diversity of other benthic invertebrates should have been significantly reduced in 2011, 2014 and 2016.

Id. However, no such reductions were revealed through Dr. Richardson's analyses.

[458] *Id.* at 46. "The HBI estimates the overall pollution tolerance of the community in a sampled area, weighted by the relative abundance of each taxonomic group." *Id.*

[459] *Id.*

[460] *Id.*

[461] *See id.*

[462] *Id.*

[463] *Id.* (emphasis added).

[464] *Id.* at 47.

[465] *Id.* at 46-47.

[466] *See id.*

[467] *Id.* at 47.

[468] *Id.*

[469] *See id.*

[470] *Id.* at 48.

[471] *See id.*

[472] *Id.*

[473] *Id.*

[474] *Id.*

[475] McMahon Review at 6 ("Thus, the data support AST Environmental's conclusions that Asian clams are not negatively impacting the BIP of the Hooksett Pool benthic macroinvertebrate community.").

EPA Response:

The commenter states (at AR-1548, p. 99) that AST, in coordination with Normandeau, performed extensive investigation into the presence of the Asian clam and its relationship to the Hooksett Pool BIP, specifically the native benthic macroinvertebrates. The commenter further states (at p. 99) that the Facility's contractors collected 0.25 m^2 samples, performed semi-quantitative assessments, and gathered numerous Ponar grab samples along multiple transects in November/December 2014 and again in July 2016, leading to the collection of numerous clam and macroinvertebrate samples. EPA finds it unusual for studies designed to make comparisons of abundance between years and locations to sample at different times of the year, especially for organisms whose abundance can fluctuate dramatically. Normandeau's benthic invertebrate sampling was conducted between October 25-November 9 in 2011, December 2-23 in 2014, and July 25-27 in 2016. This sampling approach is also at odds with concerns expressed by Normandeau about comparison sampling between Garvins Pool and the thermally-influenced portion of Hooksett Pool, in 2011. According to Normandeau's comments (at AR-872, p. 46):

> A direct comparison of kick net and Ponar sampling data collected in Garvins Pool and Hooksett Pool downstream of Merrimack Station was not conducted due to concerns over the effect of varied seasonal timing of the sampling.

The above-mentioned sampling in Garvins Pool that Normandeau expressed concerns about took place in November 2011, only one month after the sampling for Hooksett Pool (AR-870, p. 2). Yet, Normandeau expresses no similar concern about seasonal macro-invertebrate sampling conducted in 2014 and 2016 that varied by up to five months (summer versus winter). EPA is concerned that the results of these comparisons are or may be confounded by the effect on sampling results of such a large shift in the months of sampling.
The commenter also suggests (at p. 100) that the indigenous ecology of Hooksett Pool, supported by an apparently viable and self-sustaining food chain, is typical of what one would expect to find in a New Hampshire river system, and that it represents a marked improvement over the river's pollution-impacted state in the first half of the 20th century. EPA agrees that there is evidence of improvement in water quality from reduced pollution thanks to implementation of the Clean Water Act, but does not agree that the ecology of lower Hooksett Pool is typical of what one would expect to find in a like New Hampshire river system, or even typical for other sections of the Merrimack River, given that the dominant species, at least in some years, is an invasive, non-indigenous species. In addition, the fact that certain improvements in water quality may result from the removal of other pollution sources over time does not establish whether or not thermal discharges have appreciably harmed the BIP in the past or will allow for assurance of the protection and propagation of the BIP going forward. Analysis of the effects of the thermal discharge, in combination with other stresses on the BIP, is needed.

The commenter also states (at p. 100) that PSNH's consultants compared "abundances and size-frequency distributions of native bivalves at designated river sampling sites with Asian clams and those without clams . . . to see if Asian clams were in any way causing appreciable harm to the native mussel community."[435] The commenter further states that, using SCUBA, they performed dive assessments in 2014 and 2016 that followed scientifically approved collection methods.[436] The commenter describes that these studies revealed that native bivalve abundance was unaffected by the presence of Asian clams and there was no appreciable harm. EPA considers this analysis helpful in understanding general trends in where Asian clams are found relative to native invertebrates, especially bivalves. The commenter also points out (at p. 101) that a comparison of the size-frequency distribution of native bivalves from stations with Asian clams to stations without Asian clams did not reveal significant differences. This comparison also provides encouraging evidence that the Asian clam's presence is not adversely affecting native mussels, but there has not been a sufficiently long study of the mussel community in Hooksett Pool to know if its abundance is stable.

The commenter again (at p. 102) compares more recent data with data Normandeau collected in 1972 and 1973, and indicates that taxa richness, EPT richness, and EPT to *Chironomidae* abundance ratio, all increased in the Hooksett Pool despite the presence of the Asian clam. The commenter urges that this provides evidence of no appreciable harm from Merrimack Station's thermal discharge. *See* EPA's response at Comment 5.5. Yet, the commenter has not submitted its actual sampling data for this analysis. Having the actual data to see just what was caught in each sample taken in 2014 and 2016 might make this information more meaningful for EPA in its assessment of impacts of Asian clams on the benthic community.

The commenter also notes (at pp.102-03) that the abundance of all other benthic invertebrates in the Hooksett Pool was the same or higher at sampling stations at which Asian clams were also present, as compared to sampling stations that did not include any Asian clams. EPA agrees that this suggests a lack of adverse effect from Asian clams. EPA also notes, however, that the commenter's report also indicated that total abundance of all invertebrates was considerably lower in 2011, 2014, and 2016 than in 1973, at Stations S4 and S17, especially at Station S4 (AR-1555, Figure 6, p. 73). Total abundance in 1972 was lower than in 2014, comparable to 2016, and higher than in 2011. These findings do not seem consistent with what would be expected with improved water quality conditions over time.

According to the commenter (at pp. 103-06), analyses on BIP taxa richness, Shannon Community Diversity Index, Hilsenhoff Biotic Index, and Bray-Curtis Similarity Index all suggested a lack of appreciable harm when sampling data from 2011, 2014 and 2016 were compared to data from 1972 and 1973. EPA would agree these findings suggest an absence of appreciable harm, though it still questions how results may have been influenced by the significant timing disparity of samples taken in the 1970s (October) with those taken in 2014 (December) and 2016 (July). Further, the commenter points to comparisons of EPT taxa richness as additional supporting evidence, but other than as evidence suggesting that overall water quality is improving, EPA questions the utility of this comparison of mayflies, stoneflies, and caddisflies with Asian clams given their differing habitat preferences (See AR-1555, p. 20). This analysis too could be affected by the differences in when sampling occurred.

What was not included among the numerous analyses performed was a simple assessment of percent contribution of the dominant taxon with all species, including Asian clams, comparing the ambient section upstream of Merrimack Station's discharge to the thermally-influenced section downstream. As described by Normandeau (See AR-870, p. 3), "The percent contribution of the most abundant taxon to the total number of organisms found in a sample is a measure of balance in the benthic community. If the dominant taxon accounts for a large percentage of the individuals present, it is an indication of stress because the community is dominated by one taxon, whereas unstressed communities typically exhibit a more evenly balanced abundance among several taxa." EPA could not complete such an assessment itself from the data provided in the comments. The Agency expects to require data collection under the Final Permit that will permit such an assessment in the future.

5.8 Asian clams may even be positively impacting Hooksett Pool and its BIP.

Comment II.5.8	AR-1548, PSNH, pp. 107-108

"Despite the popular conclusions and suppositions to the contrary . . . Asian clams may actually have *positive*, rather than negative, effects on their ecosystems."[476] This is because all bivalves—even the Asian clam—are considered ecosystem engineers (*i.e.*, organisms that can physically modify the environment). This trait has been recognized as important in scientific journal articles.[477] As explained in the AST Report:

> Asian clam shells can be abundant, persistent, and ubiquitous, thereby improving the physical structure of the substratum of the aquatic habitat for other species. It is commonly accepted that Asian clam shells have positive effects through providing substrate for epibionts, refuge from predation, reducing physical or physiological stress, control transport of solutes and particles in the benthic environment, stabilization of sediment, and through bioturbation of sediments. For example, clam shells form a more stable, complex, sheltered, and heterogeneous habitat that is attractive for several species including other mollusks, algae, freshwater sponges, crustaceans, and insects.[478]

In fact, areas of the Tennessee River with silty sediments previously unsuitable for native bivalves have been transformed by Asian clams into suitable, more stable substrate increasing the presence of native unionid mussels, and other scientists have found that Asian clam shells provided valuable hard substrate for other benthic organisms.[479]

The presence of the Asian clam can be beneficial in other ways, as well:

> Asian clam movement within the top layer of sediments leads to bioturbation. Such bioturbation contributes to substantial changes in abiotic conditions like dissolved oxygen, redox potential, amount of organic matter, particle size, and the like, in a manner typically enhancing habitat conditions for other organisms. Furthermore, high filtration rates by Asian clams remove a wide range of suspended particles having important repercussions for water clarity and subsequent light penetration that apparently benefit submerged plants.[480]

In fact a team of researchers found "'[t]here was no evidence of a negative impact on the distribution of the native bivalve in spite of high measured rates of water clearance by *C. fluminea*'" in one of the few experimental studies examining Asian clam filter feeding effects on native bivalves.[481] Dr. Richardson concludes his analysis on this positive impact from the Asian clam as follows: "In general, consideration of studies on the ecosystem engineering of bivalves, including Asian clams, overwhelmingly suggest that they either have no effect on native benthic invertebrates, *i.e.*, the BIP, or they '. . . mainly have positive effects on the density of benthic invertebrates' and conclude that invasive bivalve species, in general, ' . . . have positive effects on invertebrate density, biomass and species richness.'"[482]

[476] AST Report at 49.

[477] *Id.* (citing three scientific articles).

[478] *Id.* at 49-50 (citation omitted).

[479] *Id.* at 50 (citations omitted).

[480] *Id.* (citations omitted).

[481] *Id.* (quoting L.G. Leff, J.L. Burch, & J. McArthur, *Spatial, Distribution, Seston Removal, and Potential Competitive Interactions of the Bivalves Corbicula fluminea and Elliptio complanata, in a Coastal Plain Stream*, FRESHWATER BIOLOGY 24(2), 409-416 (1990)).

[482] *Id.* at 50-51 (quoting R. Sousa, J.L. Gutiérrez, & D.C. Aldridge, *Non-Indigenous Invasive Bivalves as Ecosystem Engineers*, BIOLOGICAL INVASIONS 11(10), 2367-2385 (2009)).

EPA Response:

The comments suggesting Asian clams may have beneficial effects to Hooksett Pool have not been supported with any site-specific evidence. Benefits could result in some respects, but the only relevant questions are whether Merrimack Station's thermal discharges have contributed to the Asian clams presence and/or prevalence in Hooksett Pool, whether the clams have caused or contributed to appreciable harm to the Hooksett Pool BIP, and whether in light of the Asian clam's presence, variance-based thermal discharge limits will assure the protection and propagation of the BIP going forward. The question of what, if any, the Asian clam's impact on Hooksett Pool's BIP may be is one that will continue to be assessed during the next NPDES permit cycle, as required in the Final Permit.

5.9 Conclusion

Comment II.5.9.1	AR-1548, PSNH, pp. 109-110

There is no evidence that the Asian clam's presence in Hooksett Pool is causing harm to the BIP or negatively impacting New Hampshire water quality. First, based on its analysis of the benthic macroinvertebrate community as set forth in its 2012 report, Normandeau confirmed the absence of prior appreciable harm to the Hooksett Pool BIP. Subsequent investigation by EPA and NHDES did not result in a different conclusion. In addition to the flaws in the EPA and NHDES sampling effort and analyses in 2013 and 2014, this very limited investigation did not consider the impact of the Asian clam on native species in Hooksett Pool. The analyses, when performed correctly, reveal the significant fluctuations in Asian clam population from year to year.

While a study to consider the impact of the Asian clam in Hooksett Pool was contemplated by EPA in 2015, the study ultimately was abandoned. AST, in coordination with Normandeau, performed an extensive investigation of the Asian clam in Hooksett Pool to determine the effect of the Asian clam on the BIP of Hooksett Pool. Based on an extensive two-year study following scientifically approved methods and utilizing various EPA approved metrics, Dr. Richardson found a healthy benthic macroinvertebrate community that showed no signs of any harmful impact of the Asian clam on native species or otherwise. This undisputed evidence, coupled with the in-Pool evidence that the Asian clam is simply co-existing with, rather than replacing, native bivalves, demonstrates an absence of prior appreciable harm to the Hooksett Pool BIP or New Hampshire's water quality. As such, there is no lawful or legitimate basis to establish thermal discharge limits for Merrimack Station and/or under New Hampshire water quality standards based on the presence of the Asian clam in Hooksett Pool. The findings of no appreciable harm to the BIP, coupled with substantial questions concerning whether CCC would materially impact the clam's presence in Hooksett Pool, should require no action with respect to CWA § 316(a) except possibly the continued monitoring of the clam's presence in Hooksett Pool.

EPA Response:

EPA disagrees with the comment that there is "no evidence" that the Asian clam's presence in Hooksett Pool has caused harm to the BIP or negatively impacted New Hampshire water quality. Normandeau's 2012 report presents evidence suggesting that this invasive species dominates (or has dominated) Hooksett Pool's benthic habitat sampled by Ponar in the thermally-influenced portion downstream from the plant's discharge (AR-870, p. 14). In its 2016 Water Quality Assessments, NHDES identified this section of Hooksett Pool (Assessment Unit ID NHIMP700060802-02) as (3-PNS) which means "Insufficient information/Potentially Not Attaining Standard." So, while there may be insufficient information to conclude that Asian clams are negatively impacting water quality or the BIP, EPA and NHDES do not agree that there is "no evidence" of possible such effects and both agencies find the existing data sufficiently concerning to warrant additional monitoring.

EPA also disagrees with the comment (at AR-1548, p. 109) that Normandeau confirmed the absence of prior appreciable harm to the Hooksett Pool BIP based on its analysis of the benthic macroinvertebrate community, as set forth in its 2012 report. The quantitative analysis based on Ponar data collected in 2011 of the benthic invertebrate community upstream and downstream of the plant's thermal discharge clearly does not support an absence-of-appreciable-harm finding. Additional data collected in 2014 and 2016 suggest that the clam's dominance in the lower half of Hooksett Pool has diminished but also that their abundance has fluctuated dramatically in those years, so increases in dominance might or might not occur in the future. At the same time, as Asian clam abundance has fluctuated in recent years, Merrimack Station's thermal discharges have been substantially reduced as the Facility has evolved from a baseload generator to one more similar to a peaking facility. It is unclear whether the reduced thermal discharges have affected Asian clam abundance.

After reviewing the reports and comments received, including the report from AST Environmental (AR-1555), as well as other data, including the most recent data, related to Asian clams in Hooksett Pool, EPA has concluded that, on balance, the available evidence suggests Asian clams have not caused or contributed to appreciable harm to the Hooksett Pool BIP, and that concerns about the Asian clam do not prevent EPA from concluding that the Final Permit's thermal discharge limits based on a CWA § 316(a) variance will assure the protection and propagation of the BIP. EPA agrees, however, with the comment (at pp. 109, 110) that additional monitoring of Asian clams in Hooksett Pool is warranted, and as indicated in the comments above, the continued monitoring and assessment of Asian clam's presence, prevalence, and impacts on the BIP will be required to support any future request to renew the Facility's CWA § 316(a) thermal variance. Thus, the Final Permit includes monitoring requirements to address these issues.

Comment II.5.9.2	**AR-1573, CLF et al, p. 9-10**
See Also AR-1574, Nedeau, p. 1-9; AR-1555, AST; AR-1556, PSNH; AR-1548, PSNH; AR-1576, Mitchell et al. (1996)	

The Nedeau Report provides additional evidence that Merrimack Station's thermal discharges have harmed the Hooksett Pool BIP by supporting a strong population of Asian clams down stream of Merrimack Station. Nedeau Report at 3. The Asian Clam is an invasive species, not native to New Hampshire or New England. Even though biologists believed that the cold winter waters in northern New England would prevent the Asian Clam from spreading further north, the species have expanded throughout New England to a surprising extent. The Asian Clam has survived, and spread, by relying on thermal effluent in rivers that are otherwise too cool for over winter survival, and by acclimating and adapting to the cooler waters of southern New England. Nedeau Report at 1-2. Asian Clams were first reported within Merrimack Station's thermal plume in 2012 and it now appears that their population is widespread in the lower Merrimack River watershed. Nedeau Report at 2.

According to the Nedeau Report, "Merrimack Station provided a warm and stable thermal environment; ensured locally high Asian clam growth rate, abundance, and overwinter survival and therefore a more stable source population and provided an opportunity for Asian clams to acclimated and adapt to cooler waters." Nedeau Report at 3. Sampling revealed high densities of Asian Clams and larger individuals near the mouth of the discharge canal and smaller but substantial populations downstream at Hooksett Pool and below the Hooksett Dam. No Asian Clams have been found upstream of Merrimack Station. Nedeau Report at 3. This suggests that "the strong source of population of Asian clams downstream from Merrimack Station *exists solely because of the thermal pollution*." Nedeau Report at 3 (emphasis added). Thus, because a BIP "may not include species whose presence or abundance is attributable to alternative effluent limitations imposed pursuant to section 316(a)," 40 C.F.R. § 125.71(c), Merrimack's role in sustaining a source population of Asian clams within its thermal plume shows that the past thermal discharge has not protected the Hooksett Pool's BIP.

EPA Response:

EPA has reviewed the Nedeau report (AR-1574) agrees with many of CLF's comments. While it's unclear how Asian clams found their way into Hooksett Pool, the abundance of Asian clams downstream from Merrimack Station's thermal discharge appears to be directly related to the Facility's discharge.Despite this apparent relationship, however, studies and analyses submitted to EPA (*see* AR-1555, AR-1556, AR-1548) suggest that the Asian clam has not caused or contributed to appreciable harm to the BIP in Hooksett Pool. In addition, new temperature and operational limits established in the Final Permit should further reduce the potential beneficial influence of the Facility's thermal discharge on Asian clams going forward. That said, the Final Permit includes monitoring requirements to enable further evaluation of this issue in the future, as appropriate.

Comment II.5.9.3	**AR-1688, Super Law Group (on behalf of Sierra Club and CLF), p. 16**

Super Law Group comments that in its 2017 public notice EPA stated that the agency had become "aware of the presence of non-native organisms in Hooksett Pool; in particular, the Asian clam (*Corbicula fluminea*) . . . notably concentrated in areas of Hooksett Pool with water temperatures directly affected by the plant's thermal discharge."[37] EPA stated that it "found this discovery worthy of further research because of the possibility that Merrimack Station's thermal discharge was contributing to the presence and/or prevalence of the Asian clam in the Hooksett Pool and the potential relevance of such a finding to regulating the Facility's thermal discharges" under the Clean Water Act and the requirements in New Hampshire water quality standards for the protection of local aquatic life.[38]

EPA also noted that when the Station is operating, one of its most visible thermal effects can occur during periods in the winter when the river just upstream of the discharge canal is completely ice-covered, but the river is ice-free for miles downstream of the discharge canal, including in the waters of Amoskeag Pool below Hooksett Dam.[39] EPA reviewed scientific publications on the relationship between Asian clams and thermal discharges from power plants, which found that higher winter survival rates of Asian clams occurred within the influence of the power plants' thermal discharge than in ambient areas, and that the elevated temperatures appeared to affect the clam's reproductive success, growth, and abundance.[40]

EPA thus invited public comments addressing the presence of the Asian clam in the Hooksett Pool and the import of this information for setting thermal discharge limits for the Merrimack Station permit under the CWA and/or New Hampshire water quality standards.[41]

EPA Response:

EPA notes that this comment just summarizes EPA's 2017 public notice that addressed, among other things, new information related to the presence of Asian clams in Hooksett Pool, and invited the public to comment on this new information.

6.0 Additional Comments Submitted by Super Law Group LLC (on behalf of Sierra Club and Conservation Law Foundation) Regarding Thermal Discharges After the 2017 Comment Period (AR-1688)

6.1 Executive Summary

Merrimack Station's antiquated once-through cooling system withdraws extremely large volumes of water – nearly 200,000 gallons a minute at its peak – from the Merrimack River and discharges waste heat back to a shallow, confined section of the river, resulting in thermal plumes that harm its fish populations, habitat, and aquatic ecology.

In 2011, EPA issued a draft NPDES permit for the Station. Based on the agency's independent assessment of "compelling evidence of appreciable harm to the balanced, indigenous fish community of Hooksett Pool" caused by the Station's thermal discharge, EPA stated that it must deny the company's application for a variance under CWA section 316(a). The draft permit thus contains thermal discharge requirements commensurate with the Best Available Technology (BAT), closed-cycle cooling, that limit the amount of heat the Station may discharge to the river monthly and annually, as well as additional limitations on the thermal plume. EPA explained the extensive evidence, its decisonmaking process, and why the proposed requirements are necessary to protect water quality in the Hooksett Pool in an extremely detailed and comprehensive discussion spanning more than 200 pages of its permit determinations document.

In 2014, while making other changes to other aspects of the permit, EPA issued a new draft NPDES permit for the Station containing exactly the same thermal discharge provisions as the 2011 draft permit.

In 2017, without issuing a new draft permit, EPA sought public comment on a limited set of questions relating to the 2011 and 2014 draft permits. In particular, EPA stated that it was considering strengthening the permit to add shorter-term thermal conditions (in addition to the monthly and annual heat limits) in order to protect indigenous species that are especially sensitive to short-term temperature excursions. EPA also expressed concern that by heating the river during the winter the Station was increasing the reproductive success, growth, and abundance of an invasive species in the Hooksett Pool, the Asian clam.

In 2018, Granite Shore Power (GSP)[1] acquired the Station. Since then, rather than finalizing the NPDES permit, EPA has instead met with GSP frequently to discuss possible changes to the permit. Documents obtained through the Freedom of Information Act indicate that EPA and GSP have exchanged "discussion drafts" of new thermal discharge requirements for possible inclusion in a revised version of the Station's NPDES permit. Those "discussion draft" provisions differ dramatically from the thermal discharge requirements in the 2011 and 2014 draft permits.

EPA should proceed to issue a final NPDES permit for Merrimack Station with thermal discharge requirements matching those in EPA's 2011 and 2014 drafts. If, however, EPA proposes to depart from its previous drafts and issue a permit fundamentally different from what it proposed twice before, the agency must subject the new draft thermal discharge requirements –

as well as any new evidence, rationale, and conclusions – to public notice and comment. A permit resembling the "discussion draft" recently exchanged between EPA and GSP would plainly not be a "logical outgrowth" of the 2011 and 2014 draft permits. Sierra Club and Conservation Law Foundation hereby request, and are legally entitled to, a formal opportunity to review (with the assistance of their technical experts) and submit comments on any new draft permit provisions that are not a logical extension of the prior drafts.

Furthermore, one set of effluent limitations contained in the Station's existing, 1992, permit – *i.e.*, the limitations restricting the Station's thermal plume, which were continued (with one addition) in the 2011 and 2014 draft permits – must be included in any future draft or final permit for the Station, regardless of any other thermal requirements EPA decides to include. The CWA's anti- backsliding rule prohibits renewed, reissued, or modified NPDES permits from containing effluent limitations less stringent than those in the previous permit.

Accordingly, EPA is foreclosed from removing the thermal plume effluent limitations that have been in the Station's permit since at least 1992 (and which are also in all or virtually all other EPA-issued NPDES permits for power plants located on rivers in New England).

Finally, to avoid decisionmaking that is arbitrary and capricious and therefore impermissible under the APA, EPA must have supporting evidence in the record, make a reasoned determination, and provide an explanation that rationally connects the facts found to the choice made. These essential features of proper agency decisionmaking currently exist for the 2011 permit, but have not been provided for any substantially different permit.

[1] Granite Shore Power LLC and GSP Merrimack LLC are referred to collectively as "GSP."

[2] 40 C.F.R. § 125.84(b)(1).

EPA Response:

In part, this comment recounts some of the history of this permit proceeding's effort to develop thermal discharge limits for the new Merrimack Station permit. While EPA generally agrees with the comment's description of major steps in this history, a few points bear response. The comment focuses on the Facility's maximum rate of water withdrawal and thermal discharge. While EPA agrees that such maximum rates should be considered, and the Agency has done so, EPA also thinks it important to account for when a cooling system operates and when it does not, in addition to considering the rates at which it operates. A facility that operates at a maximum rate every day, as Merrimack Station frequently used to do as a baseload generator, is different from a facility that operates only intermittently, and not necessarily at maximum levels, as Merrimack Station now does and has for the last several years. In EPA's view, these facts should be taken into account in the analysis. Thus, EPA looked hard at the Facility's effects given its varied levels of operations during the year.

In addition, while the comment discusses EPA's analysis in support of the 2011 Draft Permit, the Agency has also explained in these responses to comments that it came to a better understanding of the thermal data *after* 2011. EPA also discussed its new understanding of the data, and invited public comment on the data and its import, in the 2017 Statement. AR 1534, pp. 4, 7, 37-41.

With regard to EPA's 2014 Revised Draft Permit, the Agency expressly stated that the Revised Draft Permit only addressed issues related to setting effluent limits for discharges of Flue Gas Desulfurization (FGD) wastewater. EPA explained that it was doing so because after it issued the 2011 Draft Permit, it learned in 2012 that Merrimack Station had installed a new evaporative treatment system for that wastewater. *See* AR 1135, p. 3. The Agency did not revisit or reissue draft thermal discharge limits at that time. With regard to the 2017 Statement, the comment incorrectly states that "EPA stated that it was considering strengthening the permit to add shorter-term thermal conditions (in addition to the monthly and annual heat limits)." While EPA indicated that it was reconsidering both short-term and long-term thermal effects and how those should be factored into setting permit limits, *see* AR 1534, pp. 39-40, it did not indicate that it had decided that limits on such shorter-term exposures would "strengthen" the permit. EPA simply indicated that it was considering whether such limits should be added to the permit. *Id.*

The commenter then states that after GSP acquired the Facility, EPA met with the company "rather than finalizing the NPDES permit …." While it is true that after GSP acquired Merrimack Station (and other power-generating facilities) from PSNH, EPA met with the company and until now did not issue the Final Permit, EPA disagrees with any implication in the comment that EPA could have defensibly issued the permit at that time if it had chosen to do so and had not met with GSP. The comment period for the Statement of Substantial New Questions did not close until December 18, 2017, *see* AR 1692 (Public Notice of Second Extension of Public Comment Period (Nov. 28, 2017)), and EPA then had to consider the voluminous public comments submitted, including comments submitted by the present commenter. EPA discussions with the company also were needed to clarify for EPA what the new owners' plans were for the Facility, as well as clarifying the record in a variety of respects to help EPA develop a technically sound, legally defensible permit. EPA also notes that while it had discussions and shared information with GSP, it also had discussions and shared information with the commenter. *See* AR-1619; AR-1635; AR-1637; AR-1680; AR-1773; AR-1735; AR-1818. Indeed, EPA also notes that EPA did not require the commenter to submit Freedom of Information Act (FOIA) requests to obtain information concerning EPA's discussions with GSP. Regarding the discussions with GSP, EPA had already created public records documenting these discussions and provided them to the commenter whenever requested, whether the requests were made under the auspices of the FOIA or not. Moreover, to be clear, the law does not prohibit EPA from having such discussions with GSP or the commenter under these circumstances.

As the Final Permit indicates, EPA does not agree with the comment stating that the Final Permit's thermal discharge limits should simply match the 2011 Permit's limits. As explained herein, the facts of Merrimack Station's operations changed, EPA has gathered and received new information and new comments, and the Agency has conducted new analysis in response to this information. To the extent that some of this information was collected or submitted after closure of the last public comment period, EPA could perhaps have chosen to ignore it, but EPA's decision under the facts of this case to consider this information into account was rational and not prohibited. Also, some late-breaking information plainly had to be considered and addressed by the Final Permit, such as the federal court decision that vacated certain of the national ELGs for pollutant discharges from steam-electric power plants. *See Southwestern Elec. Power Co. v. United States Env'l Prot. Agency*, 920 F.3d 999 (5^{th} Cir. 2019).

The commenter also argues that if the Final Permit is patterned after limits identified in "Discussion Drafts" exchanged by EPA and GSP, and reviewed by the commenter, then such limits are "fundamentally different" from the 2011 Draft and would "not be a logical outgrowth" of the 2011 Draft Permit. As a result, according to the commenter, EPA must again reopen the comment period so that it can further review and comment on the limits in the Final Permit and the facts and analysis underlying them. EPA disagrees. Regardless of what was in the Discussion Drafts, the Final Permit's thermal discharge limits are a logical outgrowth of the 2011 Draft Permit and the record developed over the course of this permit proceeding, including the 2017 Statement and the public comments submitted throughout the proceeding.

EPA previously discussed the "logical outgrowth" issue, in general, in the Statement of Substantial New Questions. AR 1534, pp. 10-12. The APA does not require that conditions in a final permit necessarily be subject to a new round of public comment whenever they vary from the conditions proposed in the earlier draft permit. If that was the rule, then agencies would be unable to change permit conditions in response to public comments without first holding a new round of public comment. Such a rule could discourage agencies from fairly considering public comments that might lead changed permit conditions for fear of repeatedly having to reopen the public comment period. *See Conn. Light & Power Co. v. Nuclear Regulatory Com.*, 673 F.2d 525, 533 (1982); *Weyerhaeuser Co. v. Costle*, 590 F.2d 1011, 1031 (1978). What the APA requires is that an agency's notice of a proposed rulemaking set forth "the terms or substance ... or a description of subjects and issues involved" in the proposed rule. *Chemical Manufacturers Ass'n v. U.S. Env'l Prot. Agency*, 80 F.2d 177, 200 (5th Cir. 1989). Put differently, the public notice must "adequately frame the issues for discussion." *Connecticut Light & Power Co. v. NRC*, 218 U.S. App. D.C. 134, 673 F.2d 525, 533 (D.C. Cir. 1982).

EPA's public notices regarding the thermal discharges at issue in this case easily meet this standard. For the 2011 Draft Permit, EPA evaluated the option of controlling thermal discharges by limiting power plant operations but rejected it because Merrimack Station was then a baseload generator and thermal discharges could be controlled technologically without curtailing generation. AR 618, pp. 144-45. EPA also rejected the Facility's request for renewal of its existing CWA § 316(a) variance-based thermal discharge limits reflecting baseload operations, *id.* at 118-21, and, instead, set limits based on the BAT technology standard. *Id.* at 210-16. EPA also determined protective instream temperatures based on the most sensitive fish species (at various life stages) present during the year to ensure satisfaction of New Hampshire water quality standards, *id.* at 212-14, and expressly indicated that it was still considering, and affirmatively invited public comment on the idea of, using these protective instream temperatures to craft water quality-based and/or CWA § 316(a) variance-based limits. *Id.* at 216-17. In addition, in the 2017 Statement, EPA expressly identified that it was considering the import of Merrimack Station's reduced operations for the permit limits, provided notice of data reflecting such reduced operations, and requested public comment on these subjects. AR 1534, pp. 5, 8, 34-36, 39-41, and 68-70. The 2017 Statement also provided notice of, and invited public comment about, new thermal data, EPA's revised understanding of existing thermal data, and additional thermal biological effects analysis addressed in prior public comments and submissions. *Id.* at 36-41.

The Final Permit limits are based on a combination of operational limitations designed to mirror the Facility's current operating profile, along with the critical temperatures to ensure the protection of fish in the river. The effectiveness of EPA's notice is at least partly evidenced by the fact that the commenter provided comments on these subjects in response to the 2017 Statement, which EPA has responded to above. *See* AR 1573. *See also, e.g.,* Comment/Response II.3.2.3 and II.3.4.4. Indeed, the commenter urged that limits could only be based on reduced operations if permit limits restricted the Facility to maintain such reduced operations, which is exactly what the Final Permit does. The commenter also, of course, has submitted the present comment which, although it was submitted outside of the comment period and EPA is not legally required to respond to it, the Agency *has* considered and responded to it here.

In addition, EPA regulations authorize EPA to reopen a comment period when permit changes or additions to the record result in "substantial new questions" that warrant seeking additional public comment. *See* 40 CFR § 124.14. Whether to reopen a comment period for substantial new questions is discretionary with the permitting agency and the EPA's Environmental Appeals Board (EAB) reviews such decisions under an "abuse of discretion" standard. Furthermore, the EAB has explained that it considers the following factors in such a review:

> [i]n exercising its discretion to reopen (or decline to reopen) a public comment period, factors that may inform a permitting authority's decision include: "whether permit conditions have changed, whether new information or new permit conditions were developed in response to comments received during prior proceedings for the permit, whether the record adequately explains the agency's reasoning so that a dissatisfied party can develop a permit appeal, and the significance of adding delay to the particular permit proceedings." *Dominion II*, 13 E.A.D. at 416 n.10 (citing *NE Hub*, 7 E.A.D. at 584-88; *Old Dominion*, 3 E.A.D. at 797-98).

In re City of Palmdale, 15 E.A.D. 700, 715 (2012). For the Merrimack Station permit, the Final Permit's thermal discharge limits are different from those proposed in the Draft Permit but many aspects of the limits have not changed. For the 2011 Draft Permit, EPA rejected a CWA § 316(a) variance request based on renewal of existing limits based on baseload operations. This has not changed. For the 2011 Draft Permit, EPA considered water quality-based limits based on critical temperatures for fish species but ultimately set thermal limits based on the BAT technology standard which led to more stringent requirements. Nevertheless, for the 2011 Draft Permit, EPA indicated that it was still considering the water quality-based limits based on critical temperatures and expressly invited public comment on that option. *See* AR 618, pp. 210-17. For the Final Permit limits, EPA has set thermal limits that are based partly on critical temperatures and partly on operational restrictions to match the Facility's currently limited operations. While the Final Permit limits are new, EPA specifically requested comment on critical temperature-based limits and on the significance of Merrimack Station's reduced operations for setting permit limits. In addition, the new permit limits are based on new information submitted in comments and supporting materials from the public and on information that EPA made available for public review and comment. Furthermore, EPA has well explained its reasoning so that a party can develop an appeal of this decision, if it so chooses. Finally, it is important to avoid any further delay to this permit. The comment itself complains about past delays, and the commenter (Sierra

Club) sued EPA in 2016 complaining of unreasonable delay in issuing the Merrimack Station permit. AR 1534, pp. 8-9. This case was ultimately dismissed by the First Circuit Court of Appeals, but EPA agreed that finalizing this permit was an important priority and the Agency is trying to do just that. Reopening the comment period at this time is neither necessary nor in the public interest.

The comment also states that EPA is barred by CWA "anti-backsliding" requirements from removing the permit's "thermal plume requirements" from the Final Permit. While the comment does not specify which permit provision it is referring to, EPA understands the comment to be referring to Part I.A.1.g of the 1992 Permit, *see* AR 236, p. 3, as well as Part I.A.23 of the 2011 Draft Permit. *See* AR 609, p. 24. EPA disagrees with the comment under the facts of this case. The CWA's anti-backsliding requirements are found in CWA § 402(o), 33 U.S.C. § 1342(o), and, as the comment indicates, these requirements do in many instances preclude new permit provisions less stringent than the corresponding conditions in the prior permit. (The anti-backsliding rule does not, of course, apply to changes between a draft and final permit.) EPA disagrees, however, with the suggestion that the Final Permit's thermal discharge limits are less stringent than the limits in the 1992 Permit. In both cases, the limits are based on a CWA § 316(a) variance but while the 1992 Permit allowed for open-cycle cooling with baseload power plant operations and did not have directly enforceable temperature limits on the discharge, the new Final Permit includes specific temperature and operational limits reflecting the Facility's current, much reduced operations.

In addition, even if the commenter was correct that the Final Permit's thermal discharge limits are less stringent than those in the 1992 Permit, the CWA specifies certain exceptions to the anti-backsliding requirements and one of those exceptions applies here. Specifically, CWA § 402(o)(2)(D), 33 U.S.C. § 1342(o)(2)(D), provides that a subsequent permit may be issued with less stringent conditions if "the permittee has received a permit modification under section … 316(a)." That is what has happened here. The Final Permit changes the thermal discharge limits from those included in the 1992 Permit, as well as from the limits proposed in the 2011 Draft Permit, and the new limits are based on a variance under CWA § 316(a). EPA has determined that the Final Permit's stringent numeric thermal discharge limits will assure the protection and propagation of the BIP and that the narrative thermal plume provisions are not needed and could create confusion over whether the Facility is in compliance with the permit. For example, in a case in which the Facility is meeting the permit's numeric limits and the BIP is protected, but data indicates that the thermal plume has reached the surrounding shoreline, there could be uncertainty over whether the permittee has violated the permit. EPA believes the central issue under CWA § 316(a) is to assure the protection and propagation of the BIP and EPA concludes that the Final Permit's stringent numeric permit limits will do so. EPA's decision is based on a careful, site-specific analysis for this permit under CWA § 316(a). Whether such narrative thermal plume provisions may be appropriate for other permits is a separate question to be addressed for each individual permit on a case-specific basis.

EPA's record provides a fully adequate, rational basis for the Final Permit.

6.2 EPA Should Issue a Final NPDES Permit Consistent with its 2011 Thermal Determinations and the 2011/2014 Drafts, Without Further Delay

For the following reasons, we ask that EPA proceed to finalize the thermal discharge permit requirements the agency first issued in draft form in 2011.

The Merrimack Station, built in the 1960s, utilizes an antiquated, once- through cooling system. Since 2001, virtually all new power plants have been required to have closed-cycle cooling systems.[2] But even before that requirement became law, the power industry was rapidly moving to closed-cycle cooling. Roughly three-quarters of the coal-fired power plants and all of the large combined- cycle power plants built in the 1980s and 1990s have closed-cycle cooling systems.[3] As we enter the third decade of the 21st century, the Merrimack Station still lacks cooling technology that became commonplace in the last quarter of the last century.

Once-through cooling systems like that at the Station withdraw massive volumes of water from natural waterbodies and discharge their waste heat back to the same waterbody, creating thermal plumes that cause adverse environmental effects. The once-through cooling system at Merrimack Station withdraws nearly 200,000 gallons per minute (287 million gallons per day) from the Merrimack River and returns that water, heated well above ambient temperatures, to the River's Hooksett Pool, where it causes extensive harm to aquatic life and its habitat.

[3] 66 Fed. Reg. 28853, 28855-56 (May 25, 2001).

EPA Response:

EPA agrees that once-through cooling system operations can potentially harm aquatic ecosystems and aquatic life, but the type and extent of the effects vary based on site-specific considerations. In addition, to be clear, EPA notes that the general requirement for closed-cycle cooling for new facilities cited by the comment, *see* 40 CFR Part 125, Subpart I, is related to cooling water intake structures, not thermal discharges, and does not apply to Merrimack Station, which is an existing facility. That said, retrofitting from open-cycle to closed-cycle cooling is possible and could be required on a case-by-case basis to address either cooling water intake structures, thermal discharges, or both. *See* 40 CFR § 125.3(c) (setting effluent limits on a BPJ basis) and 40 CFR § Part 125, Subpart J (cooling water intake structure regulations for existing facilities). Therefore, consistent with applicable legal requirements, EPA has considered on a site-specific basis setting NPDES permit requirements based on closed-cycle cooling for Merrimack Station's thermal discharges, cooling water intake structures, or both.

Indeed, for the 2011 Draft Permit, EPA proposed technology-based thermal discharge limits based on retrofitted closed-cycle cooling constituting the BAT for the Facility, while also indicating that it was still considering additional options. After considering public comments, changed circumstances since the 2011 Draft Permit, and additional data and analysis, EPA has now decided instead to set thermal discharge limits for the Final Permit based on a CWA §

316(a) variance with stringent limits that recognize and require Merrimack Station's operation like a peaking plant, rather than as a baseload plant, as it was at the time of the 2011 Draft Permit. EPA's variance decision for the Final Permit is explained in these Responses to Comments. EPA's decision under CWA § 316(b) is also discussed in these Responses to Comments.

6.2.1 The Hooksett Pool's Aquatic Habitat Is "Particularly Vulnerable" to the Effects of the Station's Thermal Discharges

The Merrimack River is an important public resource, prized by communities in New Hampshire and Massachusetts for its wildlife, aesthetic values, prominent role in the history of the region, and for the fishing, boating and other recreational opportunities it affords. The Hooksett Pool is a relatively shallow, short, and slow- moving river impoundment, extending approximately 5.8 miles downstream from Garvin's Falls Dam to Hooksett Dam. As EPA itself has explained: "These characteristics make the aquatic habitat in Hooksett Pool particularly vulnerable to the effects of Merrimack Station's thermal discharge."[4]

Because the river's flow in Hooksett Pond is sometimes less than the 200,000 gallons per minute withdrawn by the Station's cooling system, the Station has the capacity to utilize more than 100 percent of the river volume during coincident periods of low flow and maximum power generation.[5] While the Station has not reported an incident recently where 100 percent of the pool's available flow was required for cooling water purposes, EPA calculated that the plant may have withdrawn approximately 95 percent of the available river flow at times.[6] More typically, the Station redirects up to 62 percent of the available river flow under low-flow conditions. "EPA regards this to be a large fraction of the available river flow."[7] The enormous volumes of water withdrawn from the river by the Station are discharged back into Hooksett Pool at temperatures up to 104°F (40°C) under peak summer conditions.[8]

[4] EPA Region 1 - New England, 2011 Fact Sheet, Attachment D, *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* (hereinafter, "2011 Thermal Determinations") at 37.

[5] 2011 Thermal Determinations at 37. In such conditions, water from the Station's discharge canal may flow upstream. *Id*. at 37-38.

[6] 2011 Thermal Determinations at 38.

[7] 2011 Thermal Determinations at 38.

[8] 2011 Thermal Determinations at 38.

EPA Response:

EPA agrees with this comment's characterization of both the importance of the Merrimack River and the character of the Hooksett Pool as a relatively shallow, slow-moving impounded section of the river. With respect to Merrimack Station's potential to use for cooling a large portion of the Hooksett Pool's flow during low-water periods in the river, EPA agrees that when operating at full capacity the Facility could do that under low river flow conditions, but it must also be understood that the Facility is no longer a baseload power plant and such withdrawals would be unusual now. Discharge monitoring reports from 2012 through 2019 indicate that on a daily basis (*i.e.*, maximum daily flow), the Facility has on occasion withdrawn up to 257 MGD (398 cfs or 68% of the 7Q10 low flow) during April through September. The Facility's average monthly flow for this period is substantially less, however, and supports EPA's conclusion that withdrawals as high as 62% of the low flow are no longer at all typical. For the months of April through September from 2012 through 2019, Merrimack Station's average monthly withdrawal was typically less than 10% of the 7Q10 low flow. As a result, EPA does not expect this to be a problem for the Hooksett Pool going forward.

6.2.2 The Station's Existing Permit Is Based on a CWA § 316(a) Variance Granted by EPA in 1992 without Independent Evaluation and Lack Numeric Maximum Temperature Limits, but Includes Important Effluent Limitations on the Thermal Plume

GSP currently operates Merrimack Station under the terms of a 1992 NPDES permit (the "1992 Permit") that expired in 1997, but has been administratively continued for more than twenty-two years. The thermal discharge provisions in the 1992 Permit were based on a variance EPA granted in 1992 under CWA section 316(a), which permits the Station to operate without complying with numeric effluent limitations on thermal discharge based on the level of control achievable through use of the best available technology (BAT). The 1992 Permit also regulates thermal discharges under New Hampshire water quality standards.

EPA has frankly admitted that "EPA's previous 316(a) variance request determinations appear to have relied heavily on Merrimack Station's interpretation of its own data in assessing thermal impacts to Hooksett Pool" and that the agency had not, until 2011, "conducted a detailed independent evaluation."[9]

[9] 2011 Thermal Determinations at 28; *see also id*. at 27 (agency's prior CWA "§ 316(a) variance determinations seem to have relied predominantly on the plant's assessment of the thermal discharge's impacts to Hooksett Pool based on the facility's assessment of its own data").

EPA Response:

EPA agrees that the 1992 Permit's thermal discharge requirements were based on a CWA § 316(a) variance and state water quality standards. AR 618, p.14; AR 112, p. 10. Specifically, the 1992 Permit includes certain narrative provisions based on state water quality standards and that address thermal discharges, and other aspects of the facility's operations. *See, e.g.,* AR 618, p. 14 ("Among other limitations, the permit again specified that discharges should not violate any applicable water quality standards. See 1992 Permit, Part I.A.1.b.").

Finally, EPA agrees that it did a careful analysis of thermal discharges for the 2011 Draft Permit. The Agency has done so again for the Final Permit.

6.2.2 (i) The 1992 Permit lacks numeric maximum discharge temperature limits.

The 1992 Permit contains no numeric maximum discharge temperature limits. As EPA admits, the absence of numeric maximum discharge temperature limits is "unusual, perhaps even unique" as compared with the permits for other large power plants in New England.[10] EPA Region 1 has issued NPDES permits with numeric maximum discharge temperature limits for the Brayton Point station in Massachusetts, the Vermont Yankee station in Vermont, and the Seabrook Station and Newington Energy station in New Hampshire, among others.[11]

[10] 2011 Thermal Determinations at 27.

[11] 2011 Thermal Determinations at 27.

EPA Response:

EPA agrees with this comment, which simply recounts matters that EPA discussed in the record for the 2011 Draft Permit. *See* AR 618, p. 27. EPA also notes, however, that the new Final Permit contains stringent numeric thermal discharges limits.

6.2.2 (ii) The 1992 Permit's "power spray module" conditions are inadequate, do not prohibit excess temperatures, and have not been complied with.

Instead of numeric temperature limits above which discharges are prohibited, the 1992 Permit contains other temperature-related provisions. One such permit provision requires that when temperature criteria specified in the permit are reached, the plant must operate its "power spray module" (PSM) system designed to cool the heated water in the Station's discharge canal before it reaches the main stem of the river.[12] This condition was originally included in the Station's 1979 NPDES permit, retained in later permits, and "intended to protect cold water fisheries."[13]

However, the PSM condition does not prohibit thermal discharges when certain temperature thresholds are exceeded; it only requires operation of the PSMs under such circumstances. Moreover, as EPA has acknowledged, the PSM system has "limited cooling capacity"[14] and in-river temperature criteria in the PSM provision "have regularly been exceeded in the summer."[15]

EPA Response:

In response, EPA notes that the new Final Permit contains stringent numeric thermal discharges limits. *See* Response to Comment II.3.4 (and associated sub-comments). The temperatures limits are more stringent than the 1992 Permit's conditions on operation of the power spray module. The Permittee may operate the PSMs in order to meet the in-stream temperature limits but the Final Permit requires compliance with the numeric temperature limits.

6.2.2 (iii) The 1992 Permit contains important effluent limitations on the thermal plume designed to protect the Merrimack River and achieve compliance with water quality standards.

While it lacks numeric maximum temperature limits, the 1992 Permit does contain important effluent limitations restricting the thermal plume. Specifically, the permit requires that "[t]he combined thermal plumes for the station shall: (a) not block the zone of fish passage, (b) not change the balanced indigenous population of the receiving water, and (c) have minimal contact with the surrounding shorelines.[16]

These effluent limitations are a common – indeed, nearly ubiquitous – feature of EPA-issued power plant NPDES permits in New England, especially for power plants that discharge thermal plumes into rivers, whether or not those permits contain numeric maximum temperature limits. (See further discussion below.)

The 1992 Permit also specifies that discharges should not violate any applicable water quality standards. The permit states:

> The discharges shall not jeopardize any Class B use of the Merrimack River and shall not violate applicable water quality standards. Pollutants which are not limited by this permit, but which have been specifically disclosed in the permit application, may be discharged at the frequency and level disclosed in the application, provided that such discharge does not violate section 307 or 311 of the Act or applicable water quality standards.[17]

Permit provisions like this, prohibiting violations of state water quality standards, are also a standard feature of NPDES permits, not only for thermal discharges from power plants but also for pollutant discharges from facilities of all kinds. They serve an important function by explicitly incorporating state water quality standards into NPDES permits, especially where the balance of the permit's provisions does not otherwise assure compliance with those standards. In New Hampshire, applicable water quality standards for Class B waters like the Merrimack River include narrative protections for aquatic life, species diversity, habitat, and recreational uses like fishing, as well as numeric limits on dissolved oxygen.[18]

[12] 2011 Thermal Determinations at 27. Specifically, the 1992 Permit states: "The power spray module system (PSM) shall be operated, as necessary, to maintain either a mixing zone (Station S-4) river temperature not in excess of 69°F, or a station N-10 to S-4 change in temperature (Delta-T) of not more than 1°F when the N-10 ambient river temperature exceeds 68°F. All available PSM's shall be operated when the S-4 river temperature exceeds both of the above criteria." *Id*., 1992 Permit at 11.b.

[13] 2011 Thermal Determinations at 27.

[14] 2011 Thermal Determinations at 134 ("The limited cooling capacity of the PSM system is illustrated by the hypothetical permit conditions that PSNH says Merrimack Station could meet. According to PSNH, if a new permit were written with an enforceable limit on the ΔT between Stations N-10 and S-4, the allowed temperature differential would have to be *at least 19°F* in order for the plant to be able to comply with the permit at bounding low river flow conditions with the existing canal and PSM configuration. PSNH November 2007 CWA § 308 Response at ix.") (emphasis in original).

[15] 2011 Thermal Determinations at vii. *Id*. at 28 ("[T]he permit record does not indicate that any attempt was ever made to verify that the target temperatures were being achieved. EPA's present review of over 20 years of temperature monitoring data has demonstrated that, at least during summer months, the target temperatures have not been maintained.").

[16] 1992 Permit, Part I.A ("Effluent limitations and Monitoring Requirements") atI.A.1.g.

[17] 1992 Permit, Part I.A ("Effluent limitations and Monitoring Requirements") atI.A.1.b.

[18] *See, e.g.,* N.H. Rev. Stat. Ann. § 485-A:8(II); N.H. Code R. Env-Wq § 1703.01(b), 1703.07(b), 1703.19(a), (b).

EPA Response:

EPA agrees that the permit condition quoted in the comment, which requires compliance with applicable water quality standards and not jeopardizing designated uses of the receiving water, was in the 1992 Permit, the 2011 Draft Permit, and is frequently, if not always, included in NPDES Permits issued by EPA Region 1. *See* AR 609, p. 23 (Part I.A.14); AR 236, p. 2 (Part I.A.1.b). EPA received no written comments asking for this permit provision to be dropped from the 2011 Draft Permit and EPA has retained it for the Final Permit. GSP has verbally suggested to EPA, in discussions after the close of the comment period, that the narrative water quality-related provisions are not needed if EPA sets thermal discharge limits based on a CWA § 316(a) variance *from water quality standards*. EPA agrees with GSP's comment in this regard as far as it goes, but the permit provision in question, however, addresses compliance with water quality standards beyond those related to thermal conditions and effects. The permit provision pertains to New Hampshire's water quality standards other than thermal discharges, which includes requirements such as, for example, maintaining certain levels of dissolved oxygen in the water and not discharging pollutants that would cause odors. *See* N.H. Code R. Env-Wq 1703.7 and 1703.12. This broad narrative provision is also consistent with, though not mandated by, CWA § 301(b)(1)(C), 33 U.S.C. § 1311(b)(1)(C) and is commonly included in NPDES permits issued by Region 1. EPA has decided to retain it here (see Final Permit, I.A.12), with some small changes to the language to match the Region's current practice with its permits, generally.

The comment also refers to the additional, multi-part narrative provision specifically addressing the Facility's thermal discharge that was included in the 1992 Permit and, somewhat modified, in the 2011 Draft Permit. The 1992 Permit, AR 236, p. 3 (Part I.A.1.g), provides that:

> [t]he combined thermal plumes for the station shall; (a) not block zone of fish passage, (b) not change the balanced, indigenous population of the receiving water; and (c) have minimal contact with the surrounding shorelines.

Similarly, the 2011 Draft Permit, AR 609, p. 25 (Part I.A.23), provided that:

> [a]ny thermal plume from Outfall 004D (intake de-icing water) or 003 (Discharge Canal) at Merrimack Station shall (a) not block zone of fish passage, (b) not change the balanced, indigenous population of organisms utilizing the receiving water, (c) have minimal contact with the surrounding shorelines, and (d) not cause acute lethality to swimming or drifting organisms, including those entering the discharge canal at Outfall 003.

These narrative permit conditions provided additional requirements specifically for the Facility's thermal discharge and, in essence, "backstopped" the permits' other thermal requirements in certain ways. *See* AR 112, p. 10. Based on its CWA § 316(a) variance determination, however, EPA has decided that these narrative conditions are no longer needed for the Final Permit.

The additional backstopping provisions made some sense for the 1992 permit because a CWA § 316(a) variance was being granted in the absence of detailed thermal data and analysis, as the commenter has noted farther above. *See also* AR 112, p. 10. Indeed, due to the limited available information, the 1992 Permit clearly also required a great deal of information gathering to support developing an understanding of the thermal discharge and its effects. *See* AR 236, pp. 18-20 (Parts I.A.11.a, I.A.16-20). Under these circumstances, EPA and NHDES included the additional provisions to support the CWA § 316(a) variance determination.

The 2011 Draft Permit's proposed thermal discharge limits were not, however, based on a CWA § 316(a) variance. They were based on the application of BAT technology-based requirements and water quality requirements. More specifically, the 2011 Draft Permit included technology-based numeric thermal discharge limits, but also proposed the narrative provisions to ensure that state water quality thermal requirements would also be satisfied, as required under CWA § 301(b)(1)(C). *See* AR 608, pp. 50-51.

Now, for the Final Permit, EPA has set stringent, specific thermal discharge limits based on a CWA § 316(a) variance that recognizes and is premised on the Facility's much reduced operations over the last several years. EPA has also determined after an extensive, detailed analysis that these thermal discharge limits will assure the protection and propagation of the Hooksett Pool's BIP. As a result, EPA concludes that the additional narrative, water quality-based provisions are no longer needed. The Final Permit also requires significant thermal and biological monitoring. If it turns out that the Final Permit's thermal discharge limits are not adequately protective, they can be appropriately tightened in the future.

The commenter suggests that retaining the narrative provisions "… serve[s] an important function by explicitly incorporating state water quality standards into NPDES permits, especially where the balance of the permit's provisions does not otherwise assure compliance with those standards." As discussed above, with regard to satisfying state water quality standards generally, EPA agrees with the comment and has retained the general narrative provision requiring compliance with state water quality standards. With regard to the narrative provisions focused on thermal discharge, however, EPA has not retained those provisions for the reasons explained above. The Final Permit's thermal discharge limits are based on a CWA § 316(a), 33 U.S.C. § 1326(a), variance *from* technology-based and water quality-based requirements under CWA § 301, 33 U.S.C. § 1311. As a result, narrative provisions designed to ensure compliance with thermal impact-related state water quality standards are not needed. EPA notes that, as discussed in the 2011 Draft Determinations Document, AR 618, pp. 216-17, the standards of CWA § 316(a) and the biologically-oriented criteria in New Hampshire's water quality standards overlap considerably. Therefore, in deciding that the Final Permit's thermal discharge limits satisfy CWA § 316(a), EPA expects that these biologically-oriented water quality criteria will also be satisfied. Notably, New Hampshire's certification under CWA § 401(a), 33 U.S.C. § 1341(a), does not call for those provisions to be retained.

Finally, the comment suggests that the narrative provisions addressing thermal discharges should be retained because they are a "nearly ubiquitous" feature of EPA permits regulating thermal discharges. While EPA agrees that they have been a common provision, the Agency also notes that they have in the past not been included in other permits with thermal limits based on detailed analysis under CWA § 316(a), such as, for example, for the permit for Brayton Point Station. EPA's reasoning for the Brayton Point Station permit is similar to that provided above for the Merrimack Station permit. https://www3.epa.gov/region1/npdes/braytonpoint/pdfs/finalpermit/BraytonPointFinalPermit.pdf . *See also* Final Permits for Kendall Station (Cambridge, MA), https://www3.epa.gov/region1/npdes/permits/2010/finalmodma0004898permit.pdf, and General Electric Aviation (Lynn, MA), https://www3.epa.gov/region1/npdes/permits/2015/finalma0003905permitmod.pdf.

In sum, the narrative permit requirement calling for compliance with water quality standards generally is, indeed, a common feature of EPA Region 1 permits and is being retained in the Final Permit (*see* Final Permit I.A.12) to address non-thermal water quality considerations. With regard to thermal discharges, however, the Final Permit's limits are based on a CWA § 316(a) variance (from technology-based and water quality-based requirements) and, therefore, there is no need to retain the 2011 Draft Permit's thermally-oriented narrative provisions. Instead, the Facility will need to comply with the Final Permit's specific thermal variance-based requirements.

6.2.3 In 2011, EPA Rejected Merrimack Station's Request for a Thermal Discharge Variance and Issued a Draft NPDES Permit Setting Maximum Temperature Discharge Limits Based on the Best Available Technology, Closed-Cycle Cooling.

The Station's former owner, Public Service of New Hampshire ("PSNH"), now doing business as Eversource Energy, requested renewal of its thermal discharge variance under CWA section 316(a) and requested a new permit "with thermal discharge conditions matching those in the existing permit."[19] In reviewing the Station's renewal application and issuing a draft permit in 2011, EPA noted that, rather than merely relying on the company's interpretation of its own data in assessing thermal impacts to Hooksett Pool (as it had done in the past), the agency "considered the plant's data and analyses, but . . . also . . . conducted a detailed independent evaluation of existing and new information . . . [and] coordinated with both state and federal scientists and regulators."[20]

EPA's "detailed independent evaluation" yielded numerous important conclusions and findings of fact, including that:

- PSNH failed to demonstrate that Merrimack Station's thermal discharge has not caused appreciable harm to the Hooksett Pool's "balanced indigenous population" of shellfish, fish, and wildlife in and on the body of water into which the discharge is made (hereinafter, the "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 thermal discharge limits consistent with once-through (or open-cycle) cooling would reasonably assure the protection and propagation of the BIP.

- 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.[21]

EPA therefore "determined that it *must reject* Merrimack Station's request for a CWA § 316(a) thermal discharge variance."[22]

EPA's 2011 analysis was described at length over more than 200 pages in a permitting determination document for the Station's thermal discharges (and cooling water intake structures). In that assessment EPA found "*compelling evidence of appreciable harm to the balanced, indigenous fish community of Hooksett Pool*."[23] EPA elaborated on this "compelling evidence" as follows:

> EPA concludes that the capacity of the plant's thermal discharge to adversely impact the balanced, indigenous fish community of Hooksett Pool is significant. The weight of evidence provided in Merrimack Station's Fisheries Analysis Report and earlier reports points to a significant shift in the fish community away from what was the balanced, indigenous community of the 1960s and early 1970s, to the more heat-tolerant community that exists today. In addition, not only has the fish community composition changed substantially, but sampling data suggests that overall fish abundance has dropped significantly, as well. Such a shift in community and in overall abundance indicates a degraded habitat no longer able to support the fish community that existed in the 1960s, or early 1970s. Changes in the fish community exceed those expected from natural variation alone. Introductions of fish species since the 1970s, whether intentional or accidental, have no doubt affected the resident, indigenous fish community. However, since virtually all are warmwater species, their ability to compete successfully with temperature-sensitive indigenous species may also be a consequence of Merrimack Station's thermal discharge.[24]

EPA also summarized some of the more notable evidence of Merrimack Station's thermal effects on the balanced, indigenous community, including:

1. "During summer low-flow conditions, Merrimack Station's thermal plume can extend from the end of the Discharge Canal . . . approximately 2.9 miles to . . . just above Hooksett Dam. This represents approximately 50 percent of the surface area of Hooksett Pool. Elevated temperatures attributable to Merrimack Station's thermal discharge are also recorded . . . immediately downstream of Hooksett Dam."

2. "Given the relatively shallow depths of Hooksett Pool (generally 10 feet or less), the thermal plume can affect one- to two-thirds of the water column in the deepest areas during summer conditions. Most, if not all, of the shallower areas along the shorelines can be affected by the thermal plume downstream from the discharge. These shallow shoreline areas are important habitat for juvenile fish."

3. "Based on a 21-year data set . . . water temperature[s] reached or exceeded 100ºF (37.8ºC) . . . in July and August, with the highest temperature reaching 104ºF (40.0ºC)."

4. "The thermal plume extends across the entire width of Hooksett Pool during typical summer conditions. As a result, surface- oriented organisms, including larval yellow perch, white sucker, and American shad, which have limited or no ability to avoid stressful thermal conditions, are exposed to plume temperatures while drifting past the discharge canal that have been demonstrated in controlled studies to cause acute lethality to these species."

5. "Under extreme low-flow conditions, Merrimack Station presently redirects up to 83 percent of the Merrimack River flow through the plant . . . Under these conditions, the discharged water can be up to 23.8°F (13.1°C) warmer than ambient temperatures in the river."

6. "Following the start-up of Unit 2 in 1968, the plant's design withdrawal rate was 286 [million gallons per day] of river water. . . At that rate, and using the same [lowest average discharge], the plant would have been withdrawing 75 percent of the total river flow under low-flow conditions. Shorter periods of extreme low flows have resulted in the withdrawal of even a greater percentage of the river's available flow for cooling [which] has caused the heated water from the discharge canal to flow upstream in Hooksett Pool . . ."

7. "Dissolved oxygen ('DO') studies revealed low-DO conditions immediately above Hooksett Dam. The study, conducted by PSNH, stated that the thermal plume from Merrimack Station caused stratification that contributed to low-DO conditions."

8. "Once-abundant populations of coolwater species, such as yellow perch and white sucker, have significantly declined since the 1960s and 1970s. Heat-tolerant species such as bluegill, largemouth bass and smallmouth bass, now

dominate."

9. "Yellow perch and white sucker largely avoided areas of the Hooksett Pool experiencing elevated temperatures associated with Merrimack Station's thermal discharge during August and September."

10. "Thermal conditions created by Merrimack Station's plume are not protective of juvenile alewife during August and early September."

11. "A comparison between the fish communities in Hooksett Pool and Vernon Pool (Connecticut River) demonstrates that temperature-sensitive species such as yellow perch have been competing successfully with introduced heat-tolerant species such as bluegill in the Vernon Pool, but not in the Hooksett Pool. Similarly, data collected by [New Hampshire Fish and Game Department] in 2007 suggests that the yellow perch population just upstream of Hooksett Pool is robust relative to otherspecies, including bluegill."

12. "The attraction of yellow perch to the thermal plume during colder months has been documented, which has potential implications for the species' ability to successfully reproduce following prolonged exposure to the warmer water."

13. "In addition to affecting fish directly, the rise in temperature of the cooling water has a significant effect on the plankton suspended in it downstream from the discharge, according to studies conducted in the 1960s for Merrimack Station. Zooplankton . . . which are important forage for larval and juvenile fish, were among the most susceptible. A significant fraction of the zooplankton forage base is likely exposed to high temperatures (often exceeding 100 degrees during the summer) and physical stressors, particularly under low-flow conditions when up to 83 percent of the river water is drawn into the plant, heated, and discharged back into the river."[25]

After rejecting PSNH's request for a CWA section 316(a) variance, based on that "compelling evidence," EPA determined that "converting the current open-cycle cooling system to a closed-cycle cooling system using 'wet' cooling towers" is the Best Available Technology (BAT) for thermal discharges at Merrimack Station.[26] EPA noted that closed-cycle cooling technology "could reduce the thermal discharge from Merrimack Station into Hooksett Pool by approximately 99.5%."[27] Based on this determination, EPA developed a set of thermal discharge limits consistent with the use of closed-cycle cooling technology. In particular, EPA established heat limits, expressed as the maximum amount of BTUs (British Thermal Units) the Station may add to the river in each month of the year, as well as an annual limit. Those limits were included in the draft NPDES permit that EPA issued for public comment on September 30, 2011 (hereinafter, the "2011 Draft Permit").

In addition, Part I.A.23 of the 2011 Draft Permit includes the effluent limitations on the thermal plume that are in the 1992 Permit with one additional restriction in subsection (d):

> Any thermal plume from Outfall 004D (intake de-icing water) or 003 (Discharge Canal) at Merrimack Station shall (a) not block the zone of fish passage, (b) not change the balanced indigenous population of organisms utilizing the receiving water, (c) have minimal contact with the surrounding shorelines, and (d) *not cause acute lethality to swimming or drifting organisms, including those entering the discharge canal at Outfall 003*.[28]

Likewise, Part I.A.14 of the 2011 Draft Permit includes the effluent limitation prohibiting violations of state water quality standards, almost verbatim from the 1992 Permit, with the addition that neither discharges, *nor water withdrawals*, from the Station may impair designated uses or violate state standards:

> Discharges and water withdrawals from Merrimack Station shall not jeopardize or impair any Class B use of the Merrimack River and shall not cause a violation of the water quality standards of the receiving water. Pollutants which are not limited by this permit, but which have been specifically disclosed in the permit application, may be discharged at the frequency and level disclosed in the application, provided that such discharge does not violate Clean Water Act Sections 307 or 311, or applicable water quality standards.[29]

[19] 2011 Thermal Determinations at viii.

[20] 2011 Thermal Determinations at 28-29

[21] 2011 Thermal Determinations at viii.

[22] 2011 Thermal Determinations at ix (emphasis added).

[23] 2011 Thermal Determinations at 118 (emphasis added).

[24] 2011 Thermal Determinations at 118.

[25] 2011 Thermal Determinations at 118-120.

[26] 2011 Thermal Determinations at 122.

[27] 2011 Thermal Determinations at 122.

[28] 2011 Draft Permit (NPDES Permit No. NH0001465) at Part I.A.23, Page 25 of 29 (emphasis added)

[29] 2011 Draft Permit (NPDES Permit No. NH0001465) at Part I.A.14, Page 23 of 29.

EPA Response:

This comment points to specific concerns EPA outlined in its draft permit determination related to Merrimack Station's thermal discharge and related impacts to the Hooksett Pool BIP. EPA stands by its initial conclusions that, based on all the information provided to the agency in support of the plant's §316(a) variance request prior to the release the Draft Permit in September 2011, the company, then PSNH, had failed to demonstrate that its past thermal discharges under the 1992 Permit had not caused appreciable harm to the BIP. The examples identified in the comment above represented some of the more conspicuous evidence in support of that conclusion. The Final Permit does not change this because, although EPA is basing the Final Permit's limits on a CWA § 316(a) variance, this variance is based on the limited thermal discharges associated with the Facility's much reduced operations, rather than on the baseload operations that prevailed in the past.

Since issuance of the 2011 Draft Permit, EPA has considered a large volume of public comments and additional information and analysis on the thermal discharge issues. Moreover, the additional public comment period for the 2017 Statement also addresses these, as well as other, issues. The comments and new information prompted EPA to re-evaluate its initial analysis and the data upon which it was based. As mentioned above, since the 2011 Draft Permit was issued, Merrimack Station's frequency of operation has dropped steadily and dramatically, especially during the summer months when its capacity to affect the Hooksett Pool aquatic community is the greatest. This reduction in operations was one of the topics that EPA discussed and sought public comment on in the 2017 Statement.

EPA attempts to fully explain in this document how the comments and new information received, in combination with the reduction in plant operations, has informed its decision to modify the Final Permit's thermal discharge limits from those proposed in the Draft Permit. While the 2011 Draft Permit's limits were based on technology and water quality standards, and the rejection of the Facility's request for renewal of the existing CWA § 316(a) variance that, in effect, allowed baseload, open-cycle operations, the Final Permit's limits are based on a CWA § 316(a) variance to authorize the thermal discharges associated with the Facility's current, much reduced operations. The details of how the Final Permit's limits will protect the BIP are described elsewhere in this document. See Responses to Comments II.3.1.3, II.3.4, III.4.5, III.4.6, and III.4.7 (and associated sub-comments.

6.2.4 In 2014, EPA Re-Issued the Draft NPDES Permit with No Changes to any of the Thermal Discharge Requirements

Three years later, in 2014, EPA issued a second version of the Merrimack Station's draft permit for public comment (hereinafter, the "2014 Draft Permit"). In the 2014 Draft Permit, EPA revised its determination of Best Available Technology for discharges of a wastewater stream *other* than thermal discharges from the Station's cooling system. Specifically, EPA determined that, based on public comments received during the comment period on 2011 Draft Permit and additional information the agency had gathered since then, vapor compression evaporation (VCE) technology is BAT for the Station's discharges of wastewater from its wet flue-gas desulfurization (FGD) scrubber. EPA thus gave public notice that it was reconsidering and revising particular provisions of the 2011 Draft Permit, specifically the effluent limits and reporting requirements for Outfall 003C at Part I.A.4 and for Outfall 003A at Part I.A.2 of the draft permit.

Significantly, despite having also received substantial comments from PSNH in objection to the thermal discharge determinations EPA made in 2011, EPA did *not* state in its 2014 public notice, or in the 2014 Draft Permit, or in its fact sheet, that EPA was reconsidering, revising, or reopening any of its thermal discharges determinations or permit provisions.

Indeed, the 2014 Draft Permit issued for public comment retains all of the thermal discharge effluent limitations – those based on closed-cycle cooling, as well as the effluent limitations that restrict the thermal plume and the prohibition against violating state water quality standards – verbatim from the 2011 Draft Permit.

EPA Response:

The comment is correct that EPA's 2014 Revised Draft Permit only reopened, discussed, provided information about, and sought comment on, the permit's effluent limits for discharges of Flue Gas Desulfurization (FGD) wastewater. AR 1135, p. 3 of 57. As EPA explained, it prepared the 2014 Revised Draft Permit because, after issuing the 2011 Draft Permit, it learned that Merrimack Station installed a new vapor compression evaporation treatment system in 2012. *Id.* at pp. 5-6 of 57. This action was irrelevant to ongoing efforts to determine the permit's thermal discharge limits.

6.2.5 In 2017, EPA Sought Public Comment on "New Questions" Related to Temperature Data and an Invasive Species in the Merrimack River, But Did Not Change Its Thermal Discharge Determinations, Did Not Issue a New Draft NPDES Permit, and Limited the Public's Opportunity to Comment to Only Certain Issues.

In 2015, PSNH told EPA that it believed that the agency had misunderstood some of the company's temperature data and acknowledged that "[a]dmittedly, any misinterpretation of the data by the agency is due to a lack of clarity in [PSNH's] Report itself."[30] Specifically, PSNH stated that certain temperature data that the company presented as though they were averages of daily maximum temperatures for each day of the calendar year, actually represented the highest daily maximum temperatures for each of those days over a 21-year period.[31]

After requesting more information from PSNH, EPA issued a 2017 public notice in which it stated that "it did, indeed, appear that the agency had misunderstood the earlier temperature data because of confusing aspects of how it was presented."[32] As a result, in 2017, EPA stated that it was "now re-evaluating its conclusions presented in the 2011 Draft Permit Determinations (AR-618) that were based on the agency's original interpretation of the temperature data."[33] Further, EPA explained:

> PSNH's clarifications about the data have also led EPA to reconsider the ways in which the effects of elevated temperatures can be usefully evaluated to support the development of thermal discharge limits that are adequately protective of the biological community in the affected receiving water. Thus, EPA has reevaluated the use of these data in its assessment of PSNH's thermal variance request and presently concludes that the single-day data submitted by [PSNH's consultant] can, in fact, provide one useful metric for assessing the effects of Merrimack Station's thermal discharge. While considering long-term averages has utility for evaluating thermal discharge impacts, looking *only* at long-term averages would obscure more extreme conditions that fish and other aquatic life might be exposed to over shorter, but still biologically significant periods of time.

> For example, such shorter, but impactful periods could occur during the summer when the plant is in full operation during low river flow and high ambient temperature conditions. Such temperature and flow extremes would be masked by only considering the data averaged over the full 21-year period. Consequently, in response to PSNH's clarification of the data it had submitted, *EPA is now also reevaluating the effects of shorter-term thermal conditions, particularly on species that may be especially sensitive to such temperature excursions in relation to their ability to survive and compete with more thermally-tolerant species*.[34]

Thus, EPA "invite[d] additional public comment addressing the above- discussed issues and materials relevant both to EPA's decision on PSNH's CWA § 316(a) variance application and to EPA's application of New Hampshire water quality standards with regard to thermal effects."[35] In particular, EPA invited public comment on:

- the import of PSNH's new data submissions for EPA's application of CWA § 316(a) and New Hampshire's water quality standards in developing thermal discharge standards for the Merrimack Station permit;

- the question of how shorter-term and longer-term thermal data should be factored into the evaluation under CWA § 316(a) and New Hampshire's water quality standards of the effects of Merrimack Station's thermal discharges on the Hooksett Pool and the development of thermal discharge limits for the Merrimack Station permit; and

- Specific thermal data and related material submitted by PSNH and its consultants, *i.e.*, AR-1352 (Attachments 2 and 3), AR-1367, AR-1298, and AR- 1299 through AR-1307.[36]

In addition, in its 2017 public notice EPA stated that the agency had become "aware of the presence of non-native organisms in Hooksett Pool; in particular, the Asian clam (*Corbicula fluminea*) . . . notably concentrated in areas of Hooksett Pool with water temperatures directly affected by the plant's thermal discharge."[37] EPA stated that it "found this discovery worthy of further research because of the possibility that Merrimack Station's thermal discharge was contributing to the presence and/or prevalence of the Asian clam in the Hooksett Pool and the potential relevance of such a finding to regulating the Facility's thermal discharges" under the Clean Water Act and the requirements in New Hampshire water quality standards for the protection of local aquatic life.[38]

EPA also noted that when the Station is operating, one of its most visible thermal effects can occur during periods in the winter when the river just upstream of the discharge canal is completely ice-covered, but the river is ice-free for miles downstream of the discharge canal, including in the waters of Amoskeag Pool below Hooksett Dam.[39] EPA reviewed scientific publications on the relationship between Asian clams and thermal discharges from power plants, which found that higher winter survival rates of Asian clams occurred within the influence of the power plants' thermal discharge than in ambient areas, and that the elevated temperatures appeared to affect the clam's reproductive success, growth, and abundance.[40]

EPA thus invited public comments addressing the presence of the Asian clam in the Hooksett Pool and the import of this information for setting thermal discharge limits for the Merrimack Station permit under the CWA and/or New Hampshire water quality standards.[41]

Significantly, nothing in the 2017 Statement of New Questions alerted the public that EPA had undertaken or might consider undertaking a complete reexamination of the "compelling evidence of appreciable harm to the balanced, indigenous fish community of Hooksett Pool" that the agency had independently evaluated in developing the 2011 Draft Permit and had not revisited in the 2014 Draft Permit. Indeed, the overall thrust of the thermal discharge questions in EPA's 2017 Statement of New Questions suggested that the agency was considering *strengthening* the thermal discharge requirements in order to ensure compliance with New Hampshire water quality standards or that EPA might be developing additional reasons why a CWA section 316(a) variance was inappropriate for the Station. In particular, EPA's questions expressed concern that (i) looking only at long-term averages and ignoring single-day data would obscure more extreme conditions that especially sensitive fish and other aquatic life might be exposed to over shorter, but still biologically significant periods of time; and (ii) the Station's thermal plume was harboring the invasive Asian claim and thereby further altering the Hooksett Pool's indigenous aquatic communities.

While any draft determination remains open to change until finalized, EPA's 2017 Statement of New Questions raised only questions and did not provide any basis for or explanation of a change to EPA's 2011 and 2014 determinations to reject PSNH's variance application, did not propose any new approach to the thermal discharge permit provisions for the Station (other than potentially adding shorter- term limits), did not issue a new draft permit for public comment, and did not seek comment on the general content of or specific language for any new thermal discharge permit provisions. In contrast, the public notice expressly limited the scope of public comment. EPA's notice stated: "In accordance with 40 C.F.R. § 124.14(c), the comment period for the Draft Permit is *not* being reopened 'across the board.' It is, instead, only being reopened with respect to certain issues."[42]

Accordingly, EPA has built an extensive record in support of the 2011 Draft Permit and the 2014 Draft Permit, has made rational decisions, and supplied explanations that connect its decisions to the facts found. EPA should proceed to issue a final NPDES permit for the Station containing thermal discharge requirements matching those in the 2011 Draft Permit and the 2014 Draft Permit.

[30] AR-1367.

[31] AR-1367.

[32] EPA Region 1 – New England, Statement of Substantial New Questions for Public Comment, Merrimack Station (NPDES Permit No. NH0001465) (hereinafter "2017 Statement of New Questions") at 39.

[33] 2017 Statement of New Questions at 39.

[34] 2017 Statement of New Questions at 39-40 (emphasis added).

[35] 2017 Statement of New Questions at 40.

[36] 2017 Statement of New Questions at 40-41.

[37] 2017 Statement of New Questions at 41.

[38] 2017 Statement of New Questions at 41.

[39] 2017 Statement of New Questions at 41.

[40] 2017 Statement of New Questions at 42.

[41] 2017 Statement of New Questions at 43.

[42] Joint Public Notice of The Reopening of the Public Comment Period for the Draft National Pollutant Discharge Elimination System (NPDES) Permit for Merrimack Station in Bow, New Hampshire (Aug. 7, 2017) (emphasis added).

EPA Response:

The above comment recounts some of the history surrounding EPA's reopening of the public comment period on the draft permit in 2017 and its issuance of the 2017 Statement for public review and comment. EPA takes issue with certain of the comment's characterizations of the facts around these actions and their implications.

First, while the comment emphasizes that EPA only reopened the comment period for certain issues related to the development of thermal discharge limits, the reopening was quite broad as it pertained to thermal discharge issues. AR 1534, pp. 4-5, 37-44. In addition, EPA asked for comment regarding the extent, if any, to which Merrimack Station's reduced operations should affect its permit's limits. *Id.* at 5, 8, 68-69. EPA's public notice well-identified the issues that were in play and EPA received many comments on them, including from the present commenter. While the commenter is correct that EPA did not present new permit conditions for review at that time – it had not developed new permit conditions at that time – it described the range of issues in question and broadly invited comment about them. In addition, the commenter appears to complain that "nothing in the 2017 Statement of New Questions alerted the public that EPA had undertaken or might consider undertaking a complete reexamination of the 'compelling evidence of appreciable harm to the balanced, indigenous fish community of Hooksett Pool,'" but this misses the point. EPA had not undertaken, and did not undertake, a "complete reexamination" of the evidence of harm to the Hooksett Pool from the past baseload operation. Rather, EPA explained that it was reconsidering the data based on a corrected understanding of that data. In EPA's view, it would have been irrational not to do so. Furthermore, EPA made clear that it was considering whether, and in what way, the Facility's reduced operations should affect the permit limits. Finally, while the commenter states that "the overall thrust of the thermal discharge questions in EPA's 2017 Statement of New Questions suggested that the agency was considering *strengthening* the thermal discharge requirements," EPA did not limit how it would consider public comments and what adjustments might be appropriate for the final permit. Moreover, EPA submits that the Final Permit's limits are not weaker than the 2011 Draft Permit. The Final Permit's limits are different from the limits in the 2011 Draft Permit, but the Final Permit limits are stringent and appropriate based on the changed, reduced operations at the Facility.

For comments above related to the presence of Asian clams in Hooksett Pool, these have been included and addressed in Section 5.0 of this document.

6.3 If EPA Proposes Granting a Variance and/or Making Significant Changes to the Permit's Thermal Discharge Provisions, the Agency Must Comply with Mandatory Legal Requirements under the APA and CWA

As discussed above, EPA should proceed to issue a final NPDES permit for the Station, containing the thermal discharge provisions that are in the 2011 Draft Permit and the 2014 Draft Permit. However, if EPA proposes to take the permit in a different direction, the agency must: (i) subject the new permit provisions to public notice and public comment; (ii) comply with the CWA's anti-backsliding rule by not removing or weakening the thermal plume effluent limitations contained in the 1992 Permit; and (iii) avoid making any arbitrary and capricious decisions.

EPA Response:

EPA has responded to these comments farther above in its responses to the comments presented in the Executive Summary of this comment letter and will briefly reiterate here.

First, EPA disagrees that the Final Permit should include the same thermal limits as the 2011 Draft Permit. The facts have materially changed since the 2011 Draft Permit was published and EPA has appropriately revised its analysis and the limits for the Final Permit. Moreover, the 2014 Revised Draft Permit is not relevant here as it only addressed the modified proposed limits for FGD wastewater discharges.

Second, EPA does not agree that another – what would be the fourth – notice-and-comment period is necessary at this point because the Final Permit is a logical outgrowth of the 2011 Draft Permit and EPA appropriately exercised its discretion, as explained in more detail above in response to the Executive Summary of the comment letter, not to reopen the comment period under 40 CFR § 124.14.

Third, in the same response above, EPA also explained that it does not agree that the CWA's anti-backsliding requirements apply to the Final Permit. This is because the Final Permit's thermal discharge limits are not less stringent than those in the 1992 Permit. Furthermore, even if the anti-backsliding provisions did apply here, those provisions include several exceptions to the prohibition against making a new permit's conditions less stringent than the corresponding provisions in the prior permit and one of the exceptions applies here. Specifically, the anti-backsliding rule does not apply to new permit limits issued pursuant to a CWA § 316(a) variance, such as the thermal discharge limits in the Final Permit here. *See* 33 U.S.C. § 1342(o)(2)(D).

Finally, the Final Permit is consistent with applicable law and EPA has provided a rational basis for its decision. That decision is neither arbitrary nor capricious.

6.3.1 Since it Bought the Station in 2018, GSP and EPA Have Met Frequently, and Have Recently Exchanged Radically New "Discussion Draft" Provisions for Thermal Discharges.

Documents provided by EPA under the Freedom of Information Act ("FOIA") indicate that, since GSP acquired the Station in 2018, GSP and EPA have met frequently – at least five times in person over the past fifteen months, as well as in numerous phone calls – to discuss the thermal discharge requirements (and other issues) in the Merrimack NPDES permit. After that series of meetings, it appears that EPA may propose a radical departure from the 2011 Draft Permit, the 2014 Draft Permit, and all the attendant public comment solicitations from the past decade. In particular, materials obtained through FOIA suggest that EPA is contemplating reversing its findings concerning the Section 316(a) variance and the permit's thermal discharge requirements (among other issues not addressed here). In fact, EPA appears to have shared with GSP some "discussion drafts" embodying these departures from the 2011 and 2014 Draft Permits. The "discussion drafts" exchanged between EPA and GSP differ dramatically from the thermal discharge provisions in the draft permits EPA noticed for public comment in 2011 and 2014.[43] However, such approach to permitting thermal discharges would be unique and none of these discussion drafts have been subjected to public notice and comment.

These new developments implicate several mandatory requirements under the APA and CWA.

[43] For example, the "discussion drafts" suggest that EPA may propose granting a CWA section 316(a) variance, reversing its 2011 and 2014 determinations to require closed-cycle cooling as BAT for thermal discharges, and base entirely new permit requirements on the Station's "capacity factor" (CF) (*i.e.*, the Station's ratio of an actual electrical energy output over a given period of time to the maximum possible electrical energy output over that period).

EPA Response:

The comment above correctly states that, prior to issuance of the Final Permit, EPA had a number of meetings and phone calls with GSP regarding the permit since the company purchased the Facility in January 2018. There is nothing inappropriate or unlawful about that. The commenter states that it learned about these EPA communications with GSP through records obtained in response to FOIA requests. This is only partly correct and is potentially misleading. EPA voluntarily provided the commenter with most records documenting EPA's communications with GSP, rather than provided them only in response to FOIA requests as the comment might suggest. *See, e.g.,* AR-1814; AR-1816; AR-1820. EPA regards these documents recounting its communications with GSP to be part of the public permit record and readily provided them to the commenter upon its request. Regardless of whether the commenter had requested them directly, EPA was still going to include those records in the Administrative Record for the Merrimack Station permit. It also should be mentioned that EPA not only spoke with GSP about the Merrimack Station permit, but it also discussed the permit over the telephone on multiple occasions with the commenter who called EPA with issues or questions that it wanted to discuss. *See, e.g.,* AR-1635; AR-1637; AR-1773; AR-1818.

The commenter states that the materials it has obtained from EPA "suggest that EPA is contemplating reversing its findings concerning the Section 316(a) variance and the permit's thermal discharge requirements." EPA disagrees about what those materials "suggest" but, in any event, confirms that it has not "reversed" its conclusions about the CWA § 316(a) variance that were associated with the 2011 Draft Permit. At that time, EPA proposed rejecting the Facility's request for renewal of the 1992 Permit's thermal discharge conditions based on a CWA § 316(a) variance that essentially allowed thermal discharges associated with baseload operations using open-cycle cooling. The Final Permit does not reverse that proposed decision. Instead, for the Final Permit, EPA has confirmed its earlier proposal not to renew Merrimack Station's 1992 CWA § 316(a) variance, *see* Responses to Comments II.3.1.3, 3.3.1, and 4.4, but also has decided to set stringent thermal discharge limits under CWA § 316(a) that will maintain river temperatures to protect the BIP and set operational requirements that reflect the Facility's current reduced operations.

EPA agrees with the commenter that the thermal limits considered in the "discussion drafts" are different from those proposed in the 2011 Draft Permit but does not agree that "dramatic" changes or "unique" permit provisions have resulted. For the 2011 Draft Permit, EPA considered the Facility's request for renewal of the thermal limits from the 1992 Permit under a CWA § 316(a) variance, as well as limits that would be set under the federal BAT technology standard and state water quality standards. Ultimately, EPA rejected the Facility's variance request and set limits based on technology and water quality requirements. These proposed limits restricted thermal discharges to a far greater extent than the 1992 Permit based on the expectation that the Facility would continue its longstanding baseload operations but could reduce thermal discharges by adding closed-cycle cooling. At the same time, EPA specifically indicated that it was also considering, and requested comment on, whether it should set water quality-based limits that would maintain certain instream temperatures that would protect the BIP in light of critical temperatures for resident fish species. *See* AR 618, pp. 214-17. These limits also would have restricted the Facility's thermal discharges far more than the 1992 Permit. EPA also considered the option of controlling thermal discharges based on operational restrictions but rejected it because the Facility could maintain its baseload operations to serve the electrical grid and control thermal discharges with closed-cycle cooling technology.

EPA's 2011 Draft Permit Determinations Document, as well as the 2017 Statement, provided extensive discussion of a range of options, the different potential bases of legal authority (namely, CWA § 316(a), technology-based and/or water quality-based requirements), and provided relevant information and data for review and comment. Indeed, the 2017 Statement expressly discussed and asked for comment on the extent to which the Facility's reduced operations should affect the final permit limits. AR 1534, pp. 5, 8, 34-36, 39-41, and 68-70. EPA indicated that it was not expecting to set thermal discharge limits based on reduced operations because PSNH was still requesting limits based on baseload operations, which it suggested might resume in the future. AR 1534, pp. 68-69. Later, the Facility's new owners, GSP, indicated that it expected to continue operating in the current, reduced mode and did not object to the concept of permit limits reflecting such operations.

Ultimately, EPA set the Final Permit's thermal discharge limits based on a CWA § 316(a) variance, taking account of the Facility's reduced operations, and using the same critical temperature approach identified in the 2011 Determinations Documentation with respect to possible water quality standards-based limits. As with the limits in the 2011 Draft Permit, the Final Permit's limits are much more stringent than those in the 1992 Permit.

The record shows that through multiple comment periods, EPA well informed the public of the range of issues and options under consideration for permitting Merrimack Station's thermal discharges. The Final Permit's thermal discharge limits are not dramatically different from the limits that were in the 2011 Draft Permit or were otherwise under public review during this permit proceeding.

Finally, contrary to the comment, the Final Permit's thermal discharge limits are not "unique." EPA has written other NPDES permits that regulate thermal discharges based on maintaining particular instream temperature levels to protect resident fish, such as the NPDES permit for the GenOn Kendall Station power plant in Massachusetts. *See, e.g.,* Statement of Basis for Kendall Station permit, pp. 8, 45. EPA has also set many permits with flow limits that, in effect, limit generation. *See, e.g.,* Permit for Taunton Municipal Light, https://www3.epa.gov/region1/npdes/permits/2006/finalma0002241permit.pdf. In addition, not only did EPA consider setting thermal discharge limits based on operational restrictions for the 2011 Draft Permit, *see* AR 618, pp. 144-45, but EPA has considered the same approach for other permits. *See* AR 664, pp. 4-38 to 4-39. And, of course, EPA's regulations authorize setting effluent limits in many ways, including water quality-based limits and production-based limits. *See* 40 CFR §§ 122.44(d) and 124.45(b)(2). In addition, EPA's 2014 CWA § 316(b) regulations authorize less stringent requirements for facilities that have a low capacity factor. 40 CFR § 125.94(c)(12). In the case of the Final Permit for Merrimack Station, EPA has taken many of these considerations into effect to craft stringent thermal discharge limits that will assure the protection and propagation of the Hooksett Pool BIP while corresponding to the Facility's current and planned future reduced mode of operation.

6.3.2 A Final Permit Containing the "Discussion Draft" Provisions Exchanged Between EPA and GSP Would Not Be a Logical Outgrowth of the 2011 Draft Permit or the 2014 Draft Permit.

As EPA is well aware, the APA, EPA's regulations, the federal courts, and EPA's Environmental Appeals Board (EAB) all require that a final permit issued by EPA must be a "logical outgrowth" of the draft permit; otherwise, EPA would have failed to give proper notice and allow the public the legally required opportunity for public comment.[44]

Although EPA has issued two draft permits for public comment (in 2011 and 2014), and has sought comment on "significant new questions" (in 2017), the thermal discharge provisions in the "discussion drafts" represent a dramatic departure from the 2011 and 2014 drafts.[45] EPA did not describe such new approach in the 2017 notice, nor could it have been predicted from the limited set of questions on which EPA sought comment in 2017.

As discussed above, the 2011 and 2014 draft permits were based on EPA's decision to reject PSNH's request for a CWA section 316(a) thermal variance. EPA's decision to reject the variance was based on a detailed analysis of the "compelling evidence of appreciable harm to the balanced, indigenous fish community of Hooksett Pool" that the agency had independently evaluated and explained in more than 200 pages in the 2011 Thermal Determinations.

If EPA proposes to view this evidence differently or to arrive at a different conclusion from all of this evidence, it must subject its new interpretation to public notice and comment. Or, if EPA proposes to find, on the basis of new information, that reduced operations at the Station will assure that the Hooksett Pool's BIP has been, or will be, restored to complete health, the agency must give the public notice of any such opinion and an opportunity to comment. Indeed, while noting in 2017 that EPA was "considering whether [the] changed operating profile should trigger changes to the permit limits being developed for the Facility's NPDES permit," EPA also stated that "[a]t present, EPA has determined that the changing operating scenario does *not* provide a basis for altering what would otherwise be the permit limits [and] . . . given that the Facility still operates at high rates in hot summer and cold winter conditions, its extensive operations during those periods can still potentially have serious environmental effects."[46] Equally important, if EPA wants to propose a very different set of thermal discharge requirements in the Station's NPDES permit, based on the Station's operational profile or anything else, then those new proposed requirements must also be subjected to public comment.

If the public is given an opportunity to comment on a new draft permit, Sierra Club and Conservation Law Foundation intend to engage technical experts to review the permit provisions and EPA's supporting rationale for proposing them, and to submit comments based on their evaluation. If the new proposed permit were to include requirements similar to those in the EPA-GSP "discussion drafts," then the issues warranting public comment might include issues such as the following, among others:

- Whether the permit should be based on a Capacity Factor limit and, if so:
    - what the CF% should be,
    - over what time period should it be measured,
    - when should it apply, and
    - should compliance with that limit exempt the Station from any other limits?;
- Whether a Capacity Factor limit would allow the Station to run at high capacity for significant periods of time and discharge a similar amount of waste heat during those times as a baseload facility;
- Whether the periods of time in the summer when the Station is most likely to run at high capacity (despite a Capacity Factor limit) correspond with when ambient temperatures are at their highest;
- How the periods of time in the summer when the Station is most likely to run at high capacity despite a Capacity Factor correspond with times when fish or other aquatic organisms sensitive to high temperatures will be present in or near the Station's thermal discharges;

- Whether exempting the Station from "chronic" temperature limits when Capacity Factor limits are met in the summer would allow river temperatures to exceed fish threshold tolerances;

- Whether there should be downriver temperature limits, and, if so:
  - where should they be measured,
  - what times of year should they be applied, and
  - how should they be expressed and calculated)?

- Whether the Station's thermal discharges should be monitored at monitoring station S-0 (at the end of the Station's discharge canal), or monitoring station S-4 (approximately half a mile downstream), or both;

- Whether EPA has a sufficient basis to correlate temperatures at S-4 with temperatures at S-0 and other locations in Hooksett Pool;

- If there is a temperature limit imposed at the discharge point:
  - what should this temperature limit be,
  - how should be expressed and calculated,
  - and how often should the company monitor the temperature?;

- Whether ascertaining permit compliance based only on S-4 temperatures will prevent acute lethality/mortality to larvae or other drifting or swimming organisms, including the zooplankton forage base, that may come in contact with hot water leaving the discharge canal;

- Whether ascertaining permit compliance based only on S-4 temperatures will protect shallower areas along the shorelines that provide important habitat for juvenile fish;

- Whether ascertaining permit compliance based only on S-4 temperatures will protect other locations in the river where "suitable habitat is needed for various lifestage requirements, including gonadal development, spawning, egg and larva development, and foraging and refugia for juveniles and adults," as is necessary to protect the BIP;

- How compliance with the S4 temperature limits can be measured if the Station is allowed to remove the temperature monitoring probe from S-4 during winter months;

- Whether there should be a Delta-T limit, and, if so:
  - what the limit should be,

  - o when it would be effective,
  - o and what two points in the river would be compared?

- Whether "acute" temperature limits that apply only in certain months of the year would be sufficient to protect aquatic organisms from excessive heat;
- Whether the permit requirements would sufficiently address the problem of "cold shock" for fish that find refuge in the heated discharge during winter and are then harmed or killed when warm water suddenly disappears because the Station powers down;
- Whether the permit requirements would sufficiently prevent other impacts of elevated temperatures on indigenous fish populations and lifestages that are accustomed to cold water in winter;
- Whether the permit requirements would sufficiently address the problem of higher winter survival rates of Asian clams within the influence of the power plants' thermal discharge than in ambient areas, caused by elevated temperatures that affect the clam's reproductive success, growth, and abundance;
- Which temperature limits would apply in the winter months, when the Station has been operating at its highest capacity recently;
- Whether GSP has submitted, and EPA has analyzed, *all* of the 15-minute- interval temperature data that the company has for the years 2013-2017, or only such data for the warmer months of the year.

In 2016, when PSNH wanted EPA to change the thermal provisions in the draft NPDES permit, the company told the agency:

> Region 1 needs to revisit and substantially revise its analysis of the aquatic organisms in the Hooksett Pool and its evaluations of what impact, if any, thermal discharges from Merrimack Station have on the BIP. The revisions required for Region 1's thermal analyses and permit determinations to comply with the law cannot reasonably be considered a "logical outgrowth" of the 316(a) conclusions set out in the 2011 Draft Permit. [¶] For all of these reasons, PSNH requests that Region 1 issue a new draft permit for Merrimack Station for public notice and comment. A new draft is compelled by . . . the corrected temperature data analysis affecting Region 1's 316(a) determinations [and] the extensive new information considered by the agency specific to this permit. Allowing PSNH and the public the opportunity to comment on a revised draft that reflects and is fully responsive to these significant developments is not only legally required, it is especially appropriate here given the significant public interest in the Merrimack Station NPDES permit and the likelihood of litigation.[47]

EPA has two choices under the law – it can proceed to finalize a NPDES permit that is similar enough to the 2011 and 2014 draft permits that it is a "logical outgrowth," or, if EPA proposes to make dramatic changes like those being discussed with GSP, then the agency must subject that new permit to public notice and public comment as the company itself requested.

[44] 5 U.S.C. § 553(b), (c); 40 C.F.R. §§ 124.6(d), 124.10(a)(1)(ii). The first judicial decision using the "logical outgrowth" language was a First Circuit case involving an EPA air quality transportation control plan for the Boston area. *South Terminal Corp. v. EPA*, 504 F.2d 646, 659 (1st Cir. 1974). *See also, e.g.,* NRDC v. EPA, 279 F .3d 1180, 1186 (9th Cir.2002); *In re D. C. Water and Sewer Auth.*, NPDES Appeal Nos. 05-02, 07-10, 07-11, 07-12, 2008 EPA App. LEXIS 15, *112 (EAB March 19, 2008) (holding that "new language in the Final [NPDES] Permit was not a logical outgrowth of the language in the previous draft and, accordingly, [Friends of the Earth and Sierra Club] were denied the opportunity to provide meaningful comments," and remanding the permit to EPA Region 3).

[45] For example, the "discussion drafts" exchanged between EPA and GSP suggest that EPA may propose wholly new permit requirements such as: Capacity Factor (CF) limits averaged over a 45- day (or other) period; "chronic" in-river temperature limits measured downstream from the discharge point; "acute" in-river temperature limits; and/or a "Rise in Temperature" limit from ambient upstream temperature. Those potential requirements differ dramatically from the proposed thermal requirements that EPA noticed publicly and are obviously not a "logical outgrowth" of the prior draft permits.

[46] 2017 Statement of New Questions at 68-69 (emphasis added).

[47] Letter from Eversource Energy to U.S. Environmental Protection Agency – Region 1 (Dec. 22, 2016) (AR-1352) at 7-8.

EPA Response:

As EPA has already discussed above in response to the Executive Summary section of this comment letter, the Final Permit's thermal discharge limits are a logical outgrowth of the 2011 Draft Permit and the 2017 Statement. All the relevant issues and information were made available to the public for review and comment and another comment period is not needed because of the Final Permit's thermal discharge conditions. Beyond that, EPA also notes that it has shared records of EPA's more recent discussions with GSP as well as drafts of the permit conditions as they were under development. The commenter reviewed those drafts and now has submitted these comments and EPA has considered them and responds to them herein. To be clear, as stated above, the Final Permit is a logical outgrowth of the 2011 Draft Permit and the 2017 Statement (and the analysis and record material associated with those documents) – this would be the case even if EPA had not shared the "Discussion Draft" permit conditions with the commenter – and EPA is not legally required to consider and respond to these late submitted comments. EPA has decided, however, as a discretionary matter, to do so (*i.e.*, consider and respond to the comments).

The commenter complains that it could not have predicted the Final Permit conditions. EPA disagrees. Of course, a commenter can always say it could not have predicted the Final Permit conditions when those conditions are different from earlier proposed conditions. Based on the facts here, however, EPA thinks that conditions like those in the Final Permit could have been predicted based on the information EPA presented previously to the public. Again, as described above, in the 2011 Determinations Document issued with the 2011 Draft Permit, EPA specified that it was still considering the alternative of setting water quality-based thermal discharge limits designed to maintain various instream temperatures based on critical temperatures for various life stages of resident fish species. Different temperatures would apply during different times of year based on what the most sensitive organisms and life stages are at different times, and water temperatures would be measured either at the end of the discharge canal (Monitoring Station S0) or at a downstream monitoring location (Station S4). *See* AR 618, pp. 214-17. EPA expressly requested comment on whether it should set permit limits based on this approach. *Id.* at 217.

EPA also identified, in the 2017 Statement, that it was considering the import of Merrimack Station's much reduced capacity factor in setting the final permit limits and requested comment on the subject. AR 1534, pp. 5, 8, 34-36, 39-41, and 68-70. Indeed, the present commenter submitted comments on this subject, which EPA has responded to above. S*ee* Response to Comment II.3.2.3. Ultimately, for the Final Permit, EPA decided it *should* take account of this reduced capacity factor while setting limits based on the water quality approach detailed in the 2011 Determinations Document. Indeed, some of the Final Permit's parameters and monitoring locations are exactly the same as those specified in the discussion in EPA's 2011 Determinations Document. *Compare* Final Permit, Part I.A.11 *with* AR 618, p. 215.

The commenter urges that if EPA changes its decision on PSNH's initial variance application from that set forth in the 2011 Draft Permit, then the Agency must have an additional comment period. In response, EPA notes, first, that it has *not* changed its decision on PSNH's earlier application seeking renewal of the CWA § 316(a) variance underlying the 1992 Permit. EPA rejected that request before and has not changed its decision on that. At the same time, even if EPA had changed that earlier decision in response to public comment, it is not necessarily the case that an additional comment period would be needed. Additional comment would not be needed if the final decision is a logical outgrowth of the proposed decision. The administrative process does not require that proposed agency decisions be "carved in stone" so that reasonable changes cannot be made in response to comments and information in the record.

The commenter also states that "… if EPA proposes to find, on the basis of new information, that reduced operations at the Station will assure that the Hooksett Pool's BIP has been, or will be, restored to complete health, the agency must give the public notice of any such opinion and an opportunity to comment." EPA has not, however, concluded that reduced operations alone will assure the protection and propagation of the BIP. Instead, EPA has taken into account the Facility's reduced operations but has set specific instream temperature limits and associated conditions that will control water temperatures in a manner that will assure the protection and propagation of the Hooksett Pool's BIP. EPA has explained its analysis herein and, as discussed above, this analysis and the Final Permit conditions are a logical outgrowth of the 2011 Draft Permit and the 2017 Statement, and EPA has reasonably exercised its discretion not to reopen the comment period again under 40 CFR § 124.14.

The commenter notes that in the 2017 Statement, EPA indicated both that it was considering whether Merrimack Station's reduced capacity factor should affect the final permit limits, and that it had decided against it because the Facility could increase operations again in the future. (EPA also noted that, at the time, the Facility was still seeking limits allowing baseload operations despite its consistent, reduced capacity factor. AR 1534, pp. 68-69.) EPA expressly invited comment on this issue, *id.* at 69, and ultimately decided to make permit changes reflecting the Facility's reduced capacity factor in part because GSP agreed that it could potentially accept CWA § 316(a) variance-based limits reflecting the reality of its reduced capacity factor. *See* AR-1802. EPA's Final Permit includes limits that, unless modified in the future, are not compatible with a return to baseload operations. EPA has determined that the combination of reduced operations and protective instream temperature limits will assure the protection and propagation of the BIP. The issues related to these Final Permit limits and the Agency's assessment have been subject to public review and comment.

The commenter goes on to provide a long list of questions and possible concerns that it might address if another comment period was provided. In EPA's view, the commenter could have addressed all of these issues before in response to, and prompted by, the analysis and material that EPA previously made available to the public with the 2011 Draft Permit and/or the 2017 Statement. In addition, EPA has addressed many of these issues in Responses to Comments in Section II.3.1.3 and II.3.4 (and associated sub-comments).
Finally, the commenter quotes an argument by PSNH from 2016 that EPA should renotice a new draft permit after making all the changes to the 2011 Draft Permit that it deemed necessary and to allow public review of all the new information that had been brought to bear on the thermal issues. EPA did, of course, reopen the comment period in 2017 to allow public review and comment on all the new information, which included a variety of additional matters not mentioned in the paragraph quoted by the commenter. As explained above, reopening the comment period again is not necessary at this point.

6.3.3 The Clean Water Act's Anti-Backsliding Rule Prohibits Removal of The Thermal Plume Effluent Limitations That Have Been in the Station's Permit Since at Least 1992.

The Clean Water Act was enacted to reduce and eventually eliminate the discharge of pollutants.[48] Accordingly, the Act prohibits permit writers from relaxing effluent limitations in subsequent permits. Specifically, the CWA's anti- backsliding provisions, in section 402(o) of the Act and EPA's regulations, forbid NPDES permits from being "renewed, reissued, or modified to contain effluent limitations which are less stringent than the comparable effluent limitations in the previous permit."[49]

The 1992 Permit contains several effluent limitations[50] that restrict the thermal plume. As noted above, the three limitations that provide restrictions on the Station's thermal plumes are set forth in Part I.A.1.g. of the existing permit, which provides:

> The combined thermal plumes for the station shall … not block the zone of fish passage;
>
> The combined thermal plumes for the station shall … not change the balanced indigenous population of the receiving water; and
>
> The combined thermal plumes for the station shall … have minimal contact with the surrounding shorelines.

These thermal plume limitations serve important functions. For example, as EPA explained at length in the 2011 Thermal Determinations, diadromous fish that pass into and through the Hooksett Pool are an important component of the Hooksett Pool's BIP.[51] In addition, shallower areas along the shorelines that can be affected by the thermal plume are important habitat for juvenile fish.[52]

And these limitations are far from unique. Indeed, virtually all NPDES permits issued by EPA Region 1 for power plants located on rivers in New England contain thermal plume limitations that are identical or nearly identical to those contained in the Merrimack Station's 1992 Permit. For example, in the 1990 NPDES permit for the Schiller Station on the Piscataqua River in Portsmouth, New Hampshire (which is also now owned by a GSP affiliate), EPA included exactly the same three thermal plume effluent limitations, verbatim, that are in the 1992 Merrimack Permit.[53] When EPA renewed the Schiller Station's NPDES permit on April 6, 2018, it retained all three thermal plume limitations and added a fourth – that the "thermal plumes from the station shall . . . not interfere with spawning of indigenous populations.[54] Likewise, the NPDES permit for the Newington plant (also on the Piscataqua River and owned by a GSP affiliate) has the same three thermal plume effluent limitations as Merrimack, plus the fourth one that EPA added at Schiller.[55] Similarly, in Massachusetts, EPA included those four thermal effluent plume limitations in the NPDES permits for the Mirant Canal Station[56] (on Cape Cod Canal), the Mystic Station[57] (on the Mystic River), and the Pepperrell Power Plant[58] (on the Nashua River).

These standard permit conditions were included in the EPA-issued NPDES permits for those five other New England power plants (and possibly others) regardless of whether the permits include numeric maximum temperature limits. For example, the current Schiller permit requires that "The 95° F temperature limit shall not be exceeded at any time (instantaneous maximum)."[59] Likewise, the Mirant Canal Station's permit imposes a maximum instantaneous temperature limit on the non-contact condenser cooling water discharge.[60] Thus, the permits include effluent limitations on the thermal plume even if there are maximum temperature limitations at the discharge point or another specific location.

In 2011 and 2014, EPA proposed adding a fourth effluent limitation to the Merrimack Station's NPDES permit: "Any thermal plume from Outfall 004D (intake de-icing water) or 003 (Discharge Canal) at Merrimack Station shall . . . (d) not cause acute lethality to swimming or drifting organisms, including those entering the discharge canal at Outfall 003."[61] This is an important requirement given EPA's very valid concern that "[s]ince the highest water temperatures from the plant exist closest to the discharge point, the potential for the thermal plume to cause acute lethality or impairment to drifting organisms, such as fish larvae, is most likely to occur in the waters near the discharge."[62] In addition, the thermal plume effluent limitation that was added to the Schiller permit in 2018, and is in the other power plant permits discussed above, but is not in the Merrimack permit – "The thermal plumes from the station shall . . . not interfere with spawning of indigenous populations" – should also be added to the Station's permit given that EPA's recognition that suitable habitat for spawning is critical to protecting balanced, indigenous community of Merrimack River.[63]

Accordingly, the CWA's anti-backsliding rule forecloses EPA from removing the thermal plume effluent limitations from the Station's NPDES permit, and the additional thermal plume effluent limitation proposed for the Station in 2011 and 2014, as well as the one included in the permits for the Schiller, Newington, Cape Cod Canal, Mystic, and Pepperell plants should be added to the Station's permit.

The Station's 1992 Permit also includes standard language prohibiting violation of state water quality standards:

> The discharges shall not jeopardize any Class B use of the Merrimack River and shall not violate applicable water quality standards….[64]

A provision of this type is commonplace in EPA-issued NPDES permits for power plants (and other types of facilities). For example, the current Schiller permit states: "Discharges and water withdrawals shall not cause a violation of the water quality standards or jeopardize any Class B use of the Piscataqua River."[65] The Newington permit provides: "Discharges and water withdrawals shall not either cause a violation of the water quality standards or jeopardize any Class B use of the Piscataqua River."[66] And the NPDES permit for the Kendall Station states: "The discharges shall not cause a violation of any applicable water quality standards (WQS) or degrade the aquatic habitat quality."[67]

Accordingly, the water quality standards effluent limitation must be retained in the Station's NPDES permit to comply with the anti-backsliding rule and EPA's longstanding practice.

As noted above, EPA and GSP have exchanged "discussion drafts" of the thermal discharge provisions for possible inclusion in a renewed NPDES permit for the Merrimack Station. It is not clear from the public record whether EPA currently intends to keep, eliminate, or modify the effluent limitations restricting the thermal plume and prohibiting violations of water quality standards because the "discussion drafts" exchanged between EPA and GSP did not include the pages of the permit that would presumably contain those limitations. What is clear is that the law forbids EPA from eliminating or including any effluent limitations less stringent than those in the 1992 Permit.

[48] 33 U.S.C. §1251.

[49] 33 U.S.C. § 1342(o)(1); 40 C.F.R. § 122.44(l)(1); *see, e.g., Citizens for a Better Env't-California v. Union Oil Co. of California*, 861 F. Supp. 889, 900 & n.4 (N.D. Cal. 1994) *aff'd*, 83 F.3d 1111 (9th Cir. 1996); *New Jersey Public Interest Research Group v. New Jersey Expressway Auth.*, 822 F. Supp. 174, 185 (D.N.J. 1992). There are certain exceptions to the anti-backsliding rule, which are not applicable here. Nevertheless, even where an exception does apply, CWA section 402(o)(3) includes a safety clause that "acts as a floor" and provides an absolute limitation on backsliding, by "prohibit[ing] the relaxation of effluent limitations in all cases if the revised effluent limitation would result in a violation of applicable effluent guidelines or water quality standards, including antidegradation requirements." U.S. Envtl. Prot. Agency, NPDES Permit Writers' Manual, at 7-4 (Sept. 2010), https://www3.epa.gov/npdes/pubs/pwm_chapt_07.pdf.

[50] CWA section 502(11) defines "effluent limitation" to mean "any restriction established by . . . the Administrator on quantities, rates, and concentrations of chemical, physical, biological, and other constituents which are discharged from point sources into navigable waters . . . including schedules of compliance. Both that definition and EPA's regulatory definition of "effluent limitation" at 40 C.F.R. § 122.2, are broad and include

narrative limitations; neither requires an effluent limitation to be expressed as a numeric limit. *NRDC v. EPA*, 673 F.2d 400, 403 (DC Cir. 1982), *cert. denied sub nom. Chemical Mfrs. Ass'n v. EPA*, 459 U.S. 879 (1982) ("Section 502(11) defines 'effluent limitation' as '*any* restriction' on the amounts of pollutants, not just a numerical restriction.").

[51] *See, e.g.,* 2011 Thermal Determinations at 33 ("In addition to resident species, diadromous species that once migrated freely through this reach of the Merrimack River are also considered part of the [BIP]. Diadromy is the collective term used for fish species that spend part of their life cycle in fresh water and part in salt water. There are three forms of diadromy, two of which – anadromy and catadromy – are represented by fish species found in the Merrimack River. Anadromous species are born in fresh water, mature in salt water, and return to fresh water to spawn. Conversely, fish born in salt water, mature in fresh water, and return to salt water to spawn are called catadromous species. Anadromous species that commonly inhabit Hooksett Pool during part of their life cycle are Atlantic salmon, American shad, and alewife. Blueback herring and sea lamprey may occasionally be present, as well. Only one catadromous species, American eel, is at times present in the pool.")

[52] 2011 Thermal Determinations at 119; *see also id*. at 39 ("Near-shore shallows are widely recognized as important habitat for juvenile fish."

[53] See Schiller Station, NPDES Permit No. NH0001473 (issued Sept. 11, 1990) at I.A.h:

"The combined thermal plumes for the station shall: (a) not block zone of fish passage,
(b) not change the balanced indigenous population of the receiving water, and (c) have minimal contact with the surrounding shorelines."

[54] Schiller Station, NPDES Permit No. NH0001473 (issued April 6, 2018) at I.A.10.b:

"The thermal plumes from the station shall: (a) not block zones of fish passage, (b) not interfere with spawning of indigenous populations, (c) not change the balanced indigenous population of the receiving water, and (d) have minimal contact with surrounding shorelines."

[55] Newington Generating Station, NPDES Permit No. NH0023361 (issued Oct. 25, 2012) at I.A.5.b:

"The thermal plumes from the station shall: (a) not block zones of fish passage, (b) not interfere with spawning of indigenous populations, (c) not change the balanced indigenous population of the receiving water, and (d) have minimal contact with surrounding shorelines."

[56] Mirant Canal Station, NPDES Permit No. MA0004928 (issued August 1, 2008) at I.A.15.b:

"The thermal plumes from the station shall: (a) not block zones of fish passage, (b) not interfere with spawning of indigenous populations, (c) not change the balanced indigenous population of the receiving water, and (d) have minimal contact with surrounding shorelines."

[57] Mystic Station, NPDES Permit No. MA0004740 (issued Aug. 17, 2001) at I.A.15.b:

"The thermal plumes from the station shall: (a) not block zones of fish passage, (b) not interfere with spawning of indigenous populations, (c) not change the balanced indigenous population of the receiving water, and (d) have minimum contact with surrounding shorelines."

[58] Pepperell Power Plant, NPDES Permit No. MA0032034 (issued Sept. 8, 2006) at I.A.13:

"The thermal plumes from the station shall: (a) not block zones of fish passage, (b) not interfere with spawning of indigenous populations, (c) not change the balanced indigenous population of the receiving water, and (d) have minimum contact with surrounding shorelines."

[59] Schiller Station, NPDES Permit No. NH0001473 (issued April 6, 2018) at I.A.1, Note 3.

[60] Mirant Canal Station, NPDES Permit No. MA0004928 (issued August 1, 2008) atI.A.2.

[61] 2011 Draft Permit at Part I.A.23; 2014 Draft Permit at Part I.A.23.

[62] 2011 Thermal Determinations at 83.

[63] 2011 Thermal Determinations at 37 ("EPA believes that all resident fish species identified as being part of the balanced, indigenous community historically had sufficient suitable habitat in Hooksett Pool to support them throughout every life stage. Suitable habitat is needed for various lifestage requirements, including gonadal development, spawning, egg and larva development, and foraging and refugia for juveniles and adults.)

[64] 1992 Permit, Part I.A ("Effluent limitations and Monitoring Requirements") at I.A.1.b.

[65] Schiller Station, NPDES Permit No. NH0001473 (issued April 6, 2018) at I.A.10.a.

[66] Newington Generating Station, NPDES Permit No. NH0023361 (issued Oct. 25, 2012) at I.A.5.a.

[67] GenOn Kendall, LLC (formerly Mirant Kendall, LLC), NPDES Permit No. MA0004898 (issued Dec. 17, 2010) at I.A.5.

"The thermal plumes from the station shall: (a) not block zones of fish passage, (b) not interfere with spawning of indigenous populations, (c) not change the balanced indigenous population of the receiving water, and (d) have minimal contact with surrounding shorelines."

EPA Response:

This comment again urges that the Final Permit must retain provisions like the narrative water quality-oriented provisions of the 1992 Permit and the 2011 Draft Permit. One of the provisions in each focused on satisfying water quality standards generally (Part 1.A.1.b of the 1992 Permit and Part I.A.14 of the 2011 Draft Permit) and the other provision had multiple sub-parts pertaining specifically to thermal discharges (Part I.A.1.g of the 1992 Permit and Part I.A.23 of the 2011 Draft Permit). EPA has discussed these issues in responding to comments 6.1 and 6.2.2, above. The Agency incorporates those responses here by reference and will discuss these issues again further here.

First, with respect to the general water quality-related provision in the Draft Permit (Part I.A.14), EPA has retained that provision in the Final Permit. This provision speaks broadly to maintaining compliance with New Hampshire's water quality standards, including the protection of designated uses, and, in the context of this permit, these standards address many issues other than thermal conditions. The commenter is correct that this type of provision is common in EPA's permits and it is retained in the Final Permit but not to address thermal standards or issues.

Second, with respect to the narrative water quality-related provisions specific to thermal discharge (Part 1.A.23 of the 2011 Draft Permit), EPA has not retained those provisions for the Final Permit. As explained previously, the reason is that EPA believes the Final Permit's stringent CWA § 316(a) variance-based thermal limits will assure the protection and propagation of the BIP and the narrative water quality-related provisions specific to thermal discharge are no longer needed. Moreover, in this case, the Final Permit's thermal discharge limits are based on a *CWA § 316(a) variance from both technology-based and water quality-based standards*. Thus, the narrative provisions in question are not legally required to satisfy water quality standards and, although EPA could include them if needed within the context of setting limits that would satisfy CWA § 316(a), EPA has reached a contrary conclusion in this case. EPA has determined that the permit's stringent thermal discharge conditions will assure the protection propagation of the BIP. This includes providing adequate protection of habitat, zone of passage, and drifting organisms to satisfy CWA § 316(a).

The commenter also argues that EPA *must* retain the narrative water quality-oriented provisions in order to comply with the CWA's anti-backsliding requirements, which prevent new permit conditions from being made less stringent than the corresponding provisions in a facility's existing permit. *See* 33 U.S.C. § 1342(o). EPA has already responded to this anti-backsliding argument in its responses to comments 6.1 and 6.3, above, and incorporates those responses here by reference. EPA also provides additional response below.

As EPA has explained above, it does not agree that the Final Permit's thermal discharge limits are less stringent than the limits in the 1992 Permit, taking the latter permit's narrative provisions into account. In EPA's view, the Final Permit's thermal limits assure the protection and propagation of the Hooksett Pool's BIP and are *more* stringent than the requirements of the 1992 Permit. As a result, the CWA's anti-backsliding restrictions are not violated.

To be clear, EPA agrees with the commenter than the narrative provisions are not barred simply because the Final Permit has numeric thermal discharge limits. In a particular case, EPA could conclude that both numeric and narrative thermal discharge conditions are needed. In this case, however, EPA concludes, based on its detailed assessment under CWA § 316(a), that the thermal discharge limits in the Final Permit are sufficient without the addition of the narrative conditions. EPA disagrees with the commenter's statement that these sorts of narrative provisions related to thermal plumes and water quality standards are included in "virtually all NPDES permits issued by EPA Region 1 for power plants located on rivers in New England." While they have been included in some such permits, they have not been included in other permits on the basis of detailed CWA § 316(a) variance determinations. For example, such narrative provisions were not included in the permits for Brayton Point Station, Kendall Station or General Electric Aviation. *See*
https://www3.epa.gov/region1/npdes/braytonpoint/pdfs/finalpermit/BraytonPointFinalPermit.pdf
; https://www3.epa.gov/region1/npdes/permits/2010/finalmodma0004898permit.pdf; and
https://www3.epa.gov/region1/npdes/permits/2015/finalma0003905permitmod.pdf.

Finally, as also explained farther above, even if one regarded the Final Permit as being less stringent than the 1992 Permit to the extent that the narrative water quality limits are not retained, this would not be barred by the statute's anti-backsliding requirements because one of the statutory exceptions to those requirements apply. Specifically, CWA § 402(o)(2)(D), 33 U.S.C. § 1342(o)(2)(D), provides that a subsequent permit may be issued with less stringent conditions if "the permittee has received a permit modification under section … 316(a)." That is what has happened here. The Final Permit changes the thermal discharge limits from those included in the 1992 Permit and the new limits are based on a variance under CWA § 316(a). EPA has determined that the Final Permit's stringent numeric thermal discharge limits will assure the protection and propagation of the BIP and that the narrative thermal plume provisions are not needed.

6.3.4 Any New Thermal Discharge Decisions to Be Made by EPA Must Be Supported by Record Evidence, a Rational Basis, and an Explanation that Logically Connects the New Decisions Made to the Facts Found.

The Clean Water Act prohibits the discharge of heat or any other pollutant from a point source to a water of the United States unless authorized by an NPDES permit.[68] The permit limits EPA establishes for thermal discharges must satisfy federal technology-based requirements and any more stringent requirements based on applicable state water quality standards.[69] CWA section 316(a) allows EPA to grant a variance and impose less stringent thermal discharge limits *only* if the permittee demonstrates that "any effluent limitation proposed for the control of the thermal component of any discharges . . . will require effluent limitations more stringent than necessary to assure the protection and propagation of a balanced, indigenous population ['BIP'] of shellfish, fish, and wildlife."[70] Nevertheless, permit conditions based on a section 316(a) variance must "assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the body of water."[71]

The permittee has the burden of proof in persuading the permitting authority both that the non-variance limits are more stringent than is needed and that an alternative set of limitations will be sufficient to protect the BIP.[72] "[T]he burden of proof in a 316(a) case is a stringent one."[73] Alternative thermal discharge limitations must "assure" the protection and propagation of the BIP.[74] As EPA has acknowledged, when considering a section 316(a) variance application, the Agency "may not speculate as to matters for which evidence is lacking,"[75] and that if "deficiencies in information are so critical as to preclude reasonable assurance, then alternative effluent limitations should be denied."[76]

An existing discharger may base its thermal demonstration on a showing that there has been no "appreciable harm" to the BIP from "the thermal component of the discharge taking into account the interaction of such thermal component [of the discharge] with other pollutants and the additive effect of other thermal sources."[77] Alternatively, an existing discharger can attempt to show that "despite the occurrence of such previous harm, the desired alternative effluent limitations (or appropriate modifications thereof) will nevertheless assure the protection and propagation of . . . [the BIP]."[78] Here, GSP has taken the former approach, arguing that there has been no appreciable harm to the Hooksett Pool, an argument that EPA soundly rejected in an extensive, independent analysis documented in more than 200 pages in the 2011 Thermal Determinations.

As with any administrative decisionmaking by a federal agency, EPA's section 316(a) and thermal permitting determinations must conform to the APA and be based on "reasoned decisionmaking."[79] "Not only must an agency's decreed result be within the scope of its lawful authority, but the process by which it reaches that result must be logical and rational."[80] A court must reject an agency decision that, inter alia, is based on explanation "that runs counter to the evidence before the agency" or lacks "a satisfactory explanation . . . including a rational connection between the facts found and the choice made."[81]

When EPA preliminarily determined, in 2011, that PSNH failed to demonstrate that the Station's thermal discharge has not caused appreciable harm to the BIP, that the "evidence as a whole indicates that [the] Station's thermal discharge has caused, or contributed to, appreciable harm to [the] BIP," and that PSNH did not demonstrate that thermal discharge limits based on technology-based and water quality-based requirements would be more stringent than necessary to assure the protection and propagation of the BIP, the agency did so based on an extensive record, its own independent analysis of data supplied by the applicant, and coordination with state and federal scientists and regulators. EPA supplied a detailed explanation of its process and its reasoning, including a rational connection between the facts found and the choice made. And the agency described in detail the extensive "compelling evidence of appreciable harm to the balanced, indigenous fish community of Hooksett Pool."

In 2014 and in 2017, EPA issued new public notices relating to aspects of the Station's NPDES permit, but did not change its conclusions that the Station's thermal discharges have harmed the BIP and that the technology-based and water quality-based requirements set forth in the 2011 and 2014 draft permits are necessary to assure protection of the BIP compliance with New Hampshire water quality standards.

If EPA plans to reconsider its 2011 decision to deny a section 316(a) variance, or if EPA is considering new thermal discharge requirements for the Station, the APA requires the agency to explain how the extensive record that supported its 2011 conclusions will support any new conclusions. In the absence of supporting record evidence, a rational basis, and an explanation logically connecting the decisions to the facts, agency action will be held unlawful and set aside as arbitrary and capricious under the APA.[82]

[68] 33 U.S.C. § 1311(a), 1362(6).

[69] *See* 33 U.S.C. § 1311(b)(1)(C), (b)(2)(A).

[70] 33 U.S.C. § 1326(a).

[71] 33 U.S.C. § 1326(a); 40 C.F.R. § 125.70.

[72] 33 U.S.C. § 1326(a); 40 C.F.R. § 125.73(a).

[73] *In the Matter of Public Serv. Co.* ("*Seabrook")*, 1 E.A.D. 332, 346 (E.P.A. June 10, 1977), 1977 EPA App. LEXIS 16, at *31.

[74] 2011 Permitting Determinations at 24.

[75] *Seabrook,* 1977 EPA App. LEXIS 16, at *31.

[76] *Seabrook,* 1977 EPA App. LEXIS 16, at *33 (quoting 1974 Draft EPA § 316(a) Guidance). *See also In the Matter of: Public Service Company of Indiana, Inc., Wabash River Generating Station, Cayuga Generating Station*, 1 E.A.D. 590 E.P.A. Nov. 19 10, 1979), 1979 EPA App. LEXIS 4, *34-40 (permit remanded to where variance-based thermal discharge limitations were issued despite lack of data regarding thermal effects under worst case, low-flow conditions).

[77] 40 C.F.R. § 125.73(c)(1)(i).

[78] 40 C.F.R. § 125.73(c)(1)(ii).

[79] *See Allentown Mack Sales & Serv. v. NLRB*, 522 U.S. 359, 374 (1998) (quoting *Motor Vehicle Mfrs. Ass'n of the United States, Inc. v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 52 (1983)).

[80] *Id.*

[81] *Grosso v. Surface Transp. Bd.*, 804 F.3d 110, 116 (1st Cir. 2015) (quoting *State Farm*, 463 U.S. at

43); *see also Southcoast Hosps. Grp., Inc. v. NLRB*, 846 F.3d 448, 453 (1st Cir. 2017).

[82] 5 U.S.C. § 706(2)(a).

EPA Response:

EPA largely agrees with the commenter's background discussion about various requirements under CWA § 316(a). EPA provided its own discussion of these matters in the 2011 Draft Permit Determinations Document. *See* AR 618, pp. 17-26. EPA does not agree with the comment, however, when it states that the Facility attempted only to make a retrospective demonstration that it qualifies for alternative thermal discharge limits under a CWA § 316(a) variance. Merrimack Station, rather, attempted to make both retrospective and prospective demonstrations. *See, e.g.,* AR 618, p. 78. *See also id.* at 27; 40 CFR § 125.73(c)(1)(ii). EPA's review and analysis of the Facility's demonstration and the available data and scientific information led to the Agency's conclusion that the Facility did not demonstrate either that its past thermal discharges had not appreciably harmed the BIP of the Hooksett Pool or that its requested thermal limits (based on discharges from baseload operations with open-cycle cooling technology) would assure the protection and propagation of the BIP in the future. *See* AR 618, pp. 120-21. Thus, EPA developed thermal discharge limits for the 2011 Draft Permit based on technology standards and water quality standards.

At the same time, EPA indicated that it was considering whether it could and should set limits based on seasonal critical temperatures for resident fish species. Such limits would have been based on water quality standards and a CWA § 316(a) variance from technology standards during some parts of the year. *See id.* at 212-17. EPA expressly invited public comment on this approach. This approach obviously involved a forward-looking assessment based on whether future limits would protect the BIP and was not based on a retrospective analysis, since EPA had found that the retrospective analysis did not establish that past discharges had not caused appreciable harm to the BIP.

Moving forward, and after considering public comment, EPA has not changed its view of PSNH's retrospective demonstration. If the Agency *had* changed its view, it could simply have renewed the existing variance-based limits secure in the knowledge that the Facility discharged far less waste heat now than it did before. Since the Agency maintained its conclusions about the retrospective demonstration, however, it has focused instead on the questions raised by the alternative approach identified in the 2011 Draft Permit determination document, as well as the questions discussed in the 2017 Statement: namely, whether in light of the Facility's much-reduced operations, new thermal discharge limits could be set that would assure the protection and propagation of the BIP going forward based on a prospective or predictive analysis considering critical temperatures for resident fish species. *See id*. at 212-17; AR 1534, pp. 39-41, 68. This is rational and reasonable given that the Facility's operational profile and the scope of its thermal discharges has changed so significantly since issuance of the 2011 Draft Permit for public review. Indeed, EPA finds that it would have been irrational and unreasonable to ignore the facts regarding the Facility's altered operations and thermal discharges.

In addition, the following discussion further responds to the comment's allusions to EPA's proposed determination for the 2011 Draft Permit based on appreciable harm to the Hooksett

Pool's BIP and the Agency's rationale for that determination. EPA received substantial comments and information after the 2011 Draft Permit was released questioning whether designating a fish community from the 1960s as the BIP was appropriate given that it likely reflected the poor water quality of that time. EPA had based its §316(a) variance request determination on analysis of fish community information originally provided largely by the plant. Prior to release of the 2011 Draft Permit, no reports or written concerns were received that questioned using fish data from the 1960s. EPA used this information because it reflected the earliest data that existed prior to the start-up of the plant's Unit II and, therefore, EPA considered it the best information to reflect the fish community prior to the Facility's full thermal discharge. In EPA's view at the time, this provided the closest approximation possible of the *indigenous* community of organisms in the Hooksett Pool and the best point of comparison for evaluating the Facility's thermal effects. While EPA questions or refutes some of PSNH's arguments made concerning the extent to which Hooksett Pool's water quality was impaired in the 1960s (*See* Section 4.2.1), it agrees that some of the fish species common in the 1960s in the Hooksett Pool are more tolerant of depressed dissolved oxygen levels, which is an important metric for characterizing water quality, and that some of the common species are identified as "pollution tolerant." However, since most of the Facility's initial analyses, prior to the release of the 2011 Draft Permit, focused on comparisons between the fish community of the 1970s with that of the 2000s (2004, 2005), much of EPA's original analyses did not change appreciably by shifting focus more to the 1970s fish community and less to the 1960s community.

EPA also received from PSNH's consultant Normandeau two reports describing results of fisheries studies conducted in 2010 and 2011 (AR-871,) and additional studies conducted in 2012 and 2013 (AR-1551). These reports included updated trends analyses for representative important species of the Hooksett Pool fish community. They also included comparisons of the Hooksett fish community with the Garvins Pool community, immediately upstream. While there are aspects to these studies that EPA has concerns about, which are discussed in this document (*See* II.4.3.3(ii)), they nevertheless represent the first comprehensive comparisons of these two adjacent fish communities. As such, EPA has considered the Garvins Pool fish community comparison information to provide additional useful information for assessing the current status of Hooksett Pool's BIP. Therefore, in response to comments, EPA has looked at both changes in historical trends and comparisons with an adjacent fish community not influenced by a thermal discharge because, in the Agency's view, it provides a more comprehensive approach to EPA's evaluation of the BIP. This approach is similar to a "Before-After-Control-Impact" study design often used in assessing impacts to biological communities. *See* Larson et al. 2018 (AR-1774).

Taking into consideration all the information received to date,[32] EPA concludes that the evidence still indicates that appreciable harm to the Hooksett Pool fish community occurred in the past, based on comparisons of the fish community from the 1970s with that of the early 2000s (2004, 2005). Declines in abundance in Hooksett Pool's most temperature sensitive resident species, yellow perch, were still evident through 2011, according to catch data and trends analyses presented in Normandeau's 2011 fisheries report (*See* AR-871 at 79, 220). That said, EPA also

[32] EPA received this additional information during the comment period on the 2011 Draft Permit, additional information submissions prior to the 2017 reopened comment period, in response to EPA information requests, and, finally, in comments submitted during the 2017 public comment period.

has found that additional fish data collected in 2012 and 2013, and related analyses, provide some evidence that the negative trend in yellow perch abundance had improved to the extent that a negative trend was no longer detectable (*See* AR-1551 at 27). In addition, increases in fallfish abundance – another coolwater species – in the thermally-influenced section of Hooksett Pool during 2012 and 2013 also suggest that temperature-sensitive fish species are inhabiting the lower section of Hooksett Pool more during the months of August and September (*See* AR-1551 at 16 and 19). These increases in habitat use correspond with substantial decreases in Merrimack Station's operation (and thermal discharge) during warmer months, which could be an influencing factor (*See* II.3.5.1, above).

In addition to these encouraging changes to trends within the Hooksett Pool fish community that could be indicative of a recovering BIP, comparisons of the present Hooksett Pool community to that of Garvins Pool suggests notable similarities in the mix of coolwater and warmwater species in these adjacent communities. *See* AR-871 at 217-219. These similarities would also be consistent with an improving balance to the resident community of fish. The introduction of new fish species over time is inevitable in a waterbody like the Merrimack River, and the Hooksett Pool community reflects such changes. These introductions can add to existing stress on indigenous species, especially if elevated temperatures provide the new arrivals with a competitive advantage. However, one notable introduction that did not appear in fish sampling catch results until 2004 was black crappie (*Pomoxis nigromaculatus*). This coolwater member of the sunfish family was newly present in Hooksett Pool in low abundance during the last four years of sampling (2010-2013). *See* AR-1551 at 34. While this species would not be considered part of the BIP for historical comparisons, its presence nevertheless demonstrates that other coolwater species are able to exist in Hooksett Pool under current thermal conditions.

Merrimack Station's "capacity" to adversely impact the Hooksett Pool's fish community remains relatively unchanged since EPA released its 2011 draft permit, but the plant's precipitous and steady reduction in operation over the past 10 years, particularly during the critical summer months, has allowed Hooksett Pool to return to a more natural habitat, far less influenced by the plant's thermal effects. While there is no indication that market forces will reverse the plant's decreased operations, the temperature and operational limits established in this final permit are designed to ensure that plant's future operation does not cause excessive and prolonged thermal conditions in the pool that would cause appreciable harm to the BIP. Therefore, EPA expects Hooksett Pool's BIP to be protected going forward, but the Final Permit requires fish studies to be continued to ensure the BIP remains protected.

Regarding the comment's reference to the 2011 Draft Permit and the 2017 public comment period, EPA reiterates two points already made in these Responses to Comments. First, the 2014 Revised Draft Permit addressed new limits for proposed FGD wastewater discharges and was not relevant to the thermal discharge issues. Second, the 2017 Statement identified a number of issues and a variety of new information that EPA was considering and inviting comment on that pertained to setting thermal discharge limits. AR 1534, pp. 4-5, 7-8, 36-44, 68-69.

EPA agrees with the comment that the Agency must articulate a rational basis for the Final Permit's thermal discharge limits. EPA has done so.

6.4 Conclusion

EPA should proceed, without further delay, to: (i) finalize its proposed denial of the Station's request for a CWA section 316(a) variance; (ii) issue a final NPDES permit containing thermal discharge requirements based on closed-cycle cooling, as it proposed in 2011; and (iii) retain the 1992 Permit's effluent limitations restricting the thermal plume and prohibiting violations of water quality standards.

If, however, EPA proposes to grant a variance and/or include substantially different requirements in the permit, then EPA must: (i) subject those new decisions to public notice and public comment; (ii) retain the 1992 Permit's effluent limitations restricting the thermal plume and prohibiting violations of water quality standards; and (iii) support any new conclusions with an evidentiary basis in the record, reasoned decision making, and a rational explanation connecting the decisions made to the facts found.

The permitting process for Merrimack Station has taken far too long already. EPA should not, at the behest of a new owner of the Station, further delay issuance of the permit and disregard years of work and analysis by the agency. Changing course now, as the "discussion drafts" suggest, would amount to an unwarranted windfall to the company, which acquired the Station knowing full well that EPA had made a proposed determination that BAT and state water quality standards required converting the Station's cooling system to closed-cycle cooling (and whose bid and purchase price for the Station must have factored in that risk). EPA should not delay any further and should not allow Station's "appreciable harm" to the Merrimack River to continue any longer.

EPA Response:

The commenter reiterates its view that EPA must reaffirm its denial of Merrimack Station's CWA § 316(a) variance request, set thermal discharge limits based on closed-cycle cooling technology, and retain the narrative water quality-oriented conditions in the 2011 Draft Permit. EPA has already responded to each of these points in responses to other comments above. EPA has not changed its decision not to grant a CWA § 316(a) variance that would authorize discharges consistent with baseload operations using open-cycle cooling. At the same time, EPA has not decided to set the Final Permit's limits based on closed-cycle cooling technology – though the Facility is free to meet the limits using that technology if it so chooses – and has instead decided to set the limits based on CWA § 316(a) and state water quality standards taking into account the Facility's reduced discharges and critical temperatures for resident and anadromous fish species. For the Final Permit, EPA has retained one of the narrative provisions mentioned in the comment, Part I.A.14 from the 2011 Draft Permit, but dropped the other, Part I.A.23 of the 2011 Draft Permit, because it is no longer needed and would be a potential source of confusion.

EPA has also already responded to comments insisting that if EPA changes the limits from the 2011 Draft Permit, the Agency must reopen the comment period again, and stating that the Agency must articulate a rational basis for the Final Permit's limits. With respect to the former point, EPA has explained its disagreement pointing out that the Final Permit is a logical outgrowth of the 2011 Draft Permit and the 2017 Statement, and that it has reasonably exercised its discretion under 40 CFR § 124.14 not to reopen the comment period again in this case. With respect to the latter comment, EPA agrees that it must provide a rational basis for the Final Permit and it has done so.

The commenter urges that "[t]he permitting process for Merrimack Station has taken far too long already" and EPA has properly taken this concern into account in its decision not to reopen the comment period again under 40 CFR § 124.14. Contrary to the comment's suggestion, EPA is not, "at the behest of a new owner of the Station," further delaying issuance of the permit or disregarding years of work and analysis by EPA. Instead, the Agency is moving forward to issue the Final Permit building on its past work and taking account of the facts and science. EPA's Final Permit will not, the Agency has concluded, allow continued "appreciable harm" to the Hooksett Pool's BIP, but it also requires continued monitoring so that conditions can continue to be assessed going forward. With regard to the commenter's suggestion that changing the Final Permit will provide "an unwarranted windfall to the company," economic considerations are not a valid factor to consider under CWA § 316(a), which focuses on the protection and propagation of the BIP, or under state water quality standards.