GSP SCHILLER

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By Electronic Mail/U.S. Mail

March 31, 2021

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U.S. Environmental Protection Agency
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Re: GSP Schiller Station NPDES Permit No. NH0001473
Permit Modification Request – Cooling Water Intake Structures (CWA § 316(b))

Dear Mr. Houlihan:

Pursuant to 40 C.F.R. § 122.62(a), please allow this correspondence and the enclosed alternative compliance proposal from Normandeau Associates, Inc. ("NAI"), to serve as GSP Schiller LLC's ("GSP Schiller" or the "company") request to modify the Clean Water Act § 316(b) requirements included in NPDES Permit No. NH0001473 (the "Permit"), issued by EPA Region 1 ("Region 1") on April 6, 2018 (and modified on March 25, 2020).

Background

Region 1's Permit for Schiller Station established best technology available ("BTA") conditions designed to minimize impingement and entrainment mortality stemming from the operation of the cooling water intake structures ("CWIS") at Schiller Station, in accordance with 40 C.F.R. Part 125, Subpart J. To address entrainment mortality, the Permit required GSP Schiller to install and operate a fine mesh wedgewire screen intake system ("WWS") with no greater than 0.8 mm slot or mesh sizes for the CWIS's of Units 4, 5, and 6, unless GSP Schiller could demonstrate

through a site-specific study that a larger slot or mesh size would be equally or more effective.[1] Because the Permit required GSP Schiller to install WWS to address entrainment mortality, the impingement mortality compliance method required the company to maintain a through-screen velocity at the WWS no greater than 0.5 feet per second.[2]

In reaching its BTA determination on entrainment, Region 1 reviewed an array of reports, data, and analyses submitted by the prior owner of Schiller Station, Public Service Company of New Hampshire, including information regarding the efficacy of WWS with different slot/mesh sizes. Region 1 ultimately determined in the Fact Sheet to the draft permit that 0.8 mm WWS constituted BTA for Schiller Station, in accordance with § 316(b) and 40 C.F.R. Part 125, Subpart J. In reaching this conclusion, the agency calculated that 0.8 mm screens reduced entrainment mortality of fish eggs and larvae by 37 percent[3] and reaffirmed this conclusion in its Response to Comments issued in conjunction with the final Permit.[4]

A multi-year schedule of compliance to satisfy the Permit's § 316(b) WWS requirements is included in the Permit, and the adjustment of certain dates in that schedule served as the basis for the permit modification in 2020.[5] To determine the optimal slot or mesh size, screen orientation, etc. for the WWS, the first portion of the Permit compliance schedule authorized GSP Schiller to conduct a 12-month study of various pilot wedgewire screens in the Piscataqua River. A study conducted in 2019 evaluated the entrainment reduction performance of a 0.8-mm cylindrical wedgewire screen concurrently with a 3.0-mm screen, using the Units 5 and 6 CWIS at Schiller Station as a representative control for the facility. Extensive data on entrainment reduction and equipment and materials performance were collected throughout the study and summarized in the following two reports provided to Region 1 in July 2020:

- Wedgewire Screen Site-Specific Study Engineering Evaluation, GSP Schiller LLC – Schiller Station, Portsmouth, New Hampshire; Enercon Services, Inc. (July 28, 2020); and
- Evaluation of the Entrainment Reduction Performance of 0.8-mm and 3.0-mm Cylindrical Wedgewire Screens at Schiller Station; Normandeau Associates, Inc. (July 2020).

As GSP Schiller previously explained in its July 30, 2020 correspondence to the agency, these reports provide a bleak outlook for the use of a full-scale WWS system to address entrainment at

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[1] *See* Permit at 11.

[2] *Id.* at 12.

[3] *See, e.g.*, 2015 Fact Sheet at 117-118.

[4] *See, e.g.*, Permit Response to Comments at 218. Region 1 also analyzed reductions in impingement and entrainment mortality for macrocrustaceans but provided in Response to Comments that the macrocrustacean reductions are not "'critical' to the BTA determination because the determination focused on the reductions in entrainment of early life stages of fish . . . ." *Id.* at 219; *see also id.* at 286.

[5] *See* Permit at 12-14. Installation of WWS at Schiller Station would have taken a minimum of five years from the effective date of the Permit. An exact date is not known because portions of the compliance schedule depend on or are tiered off of "obtaining all necessary permits and approvals" from other regulatory agencies. *See id.* at 13-14.

Schiller Station. During the pilot study, a host of operational/equipment issues arose, unanticipated screen degradation (*e.g.*, fouling, clogging, biogrowth, damage) occurred due to the uniquely harsh conditions in the Piscataqua River, and percent reductions in entrainment were significantly less than expected (including prior to the aforementioned equipment and screen degradation issues), meaning reductions in associated entrainment mortality were also not realized. These results have led GSP Schiller and its consultants to conclude that implementation of full-scale WWS at Schiller Station would be imprudent.

In addition, since the Permit was issued, GSP Schiller has assessed the prospective operational profile of the facility. Since June 1, 2020, all steam units at the facility have been in a long-term outage status with the Independent System Operator of New England (ISO-NE) and remain in this outage status as of the date of this correspondence.[6] GSP Schiller expects any operation of these steam units in the future to be intermittent and thus believes operational controls, in lieu of the installation and operation of physical equipment, can better address impingement and entrainment, in accordance with 40 C.F.R. Part 125, Subpart J.

The culmination of these factual circumstances has led to the need to timely modify the Permit's § 316(b) requirements.

Modification Request

For these reasons, GSP Schiller requests that Region 1 issue a modified permit for Schiller Station that removes the WWS entrainment requirements and associated 0.5 foot-per-second through screen velocity impingement requirement set out in Part I.A.11 of the current Permit. The company further requests that this modified permit include the following § 316(b) requirements:

Impingement: Require operation of a system of technologies, management practices, and operational measures optimized to minimize impingement mortality. Optimization will be determined based on an impingement technology performance optimization study, completed in accordance with 40 C.F.R. § 122.21(r)(6)(ii), and would include a minimum of two years of biological monitoring. The results of the optimization study will be timely submitted to EPA and NHDES after completion of the two years of biological monitoring.

Entrainment: Include appropriate permit provisions that limit the intake flow of the Schiller Station CWISs in accordance with the following monthly schedule:

[6] GSP Schiller continues to maintain its position that, due to the cessation of generation at the units, the alternative compliance schedule process set out in 40 C.F.R. §122.47(b) is applicable such that the additional milestones in the compliance schedule in the current Permit are not applicable.

Month	Existing CWIS				Proposed Flow Reductions		
	Mean Entrainment Density (N/100 m^3)	DIF (MGD)	DIF Volume (MG)	Entrainment Abundance	Intake Flow (MGD)	Estimated Entrainment Abundance	Entrainment Reduction Relative to DIF
Jan	14.74	125.8	3899.8	2,175,321	125.8	2,175,321	0.0%
Feb	115.97	125.8	3522.4	15,463,521	125.8	15,463,521	0.0%
Mar	84.24	125.8	3899.8	12,435,088	125.8	12,435,088	0.0%
Apr	36.53	125.8	3774.0	5,218,168	41.8	1,733,859	-66.8%
May	105.25	125.8	3899.8	15,536,819	41.8	5,162,472	-66.8%
Jun	630.82	125.8	3774.0	90,119,107	41.8	29,944,187	-66.8%
Jul	605.50	125.8	3899.8	89,385,625	41.8	29,700,470	-66.8%
Aug	235.28	125.8	3899.8	34,732,450	41.8	11,540,671	-66.8%
Sep	66.33	125.8	3774.0	9,475,828	41.8	3,148,566	-66.8%
Oct	4.78	125.8	3899.8	705,623	41.8	234,460	-66.8%
Nov	1.25	125.8	3774.0	179,115	125.8	179,115	0.0%
Dec	6.57	125.8	3899.8	970,170	125.8	970,170	0.0%
Annual Entrainment Abundance =				**276,396,833**		**112,687,899**	
Entrainment Reduction =							**-59.2%**

To estimate annual entrainment abundance reductions that would result from the proposed monthly intake flow reductions at Schiller Station, GSP Schiller contracted with NAI to develop a site-specific simulation model. The model compares reductions in flow and entrainment to the estimated entrainment by the existing CWISs at DIF utilizing monthly mean entrainment density estimates generated from the 2019 site-specific study at Schiller Station. EPA has repeatedly stated that it assumes reductions in intake flow result in a 1:1 ratio reduction in impingement and entrainment.[7] As shown above, GSP Schiller proposes a BTA alternative that annually reduces intake flow from 125.8 MGD to 41.8 MGD from April through October when the majority of entrainment takes place. This flow reduction scenario is estimated to reduce entrainment abundance by 59.2 percent compared to the estimated entrainment abundances at the currently permitted DIF for the CWISs at Schiller Station.

[7] *See, e.g.*, 79 Fed. Reg. 48,299, 48,331 (Aug. 15, 2014) ("Reduced volumes of cooling water produce a corresponding reduction in impingement and entrainment and, therefore, reduced impingement mortality and entrainment mortality."); see also id. n.48 ("Entrainment is generally considered to be proportional to flow and therefore a reduction in flow results in a proportional reduction in entrainment, as EPA assumes for purposes of national rulemaking that entrainable organisms are uniformly distributed throughout the source water. EPA has consistently applied this assumption throughout the 316(b) rulemaking process (for a discussion of proportional flow requirements in the Phase I and II rules *see, e.g.*, 66 FR 65276 and 69 FR 41599; *also see* EPA's 1977 draft guidance manual for 316(b), available at DCN 1-5045-PR from the Phase I docket) and continues to assume that it is broadly applicable on a national scale and is an appropriate assumption for a national rulemaking."); *see also* Response to Comments at 272 (explaining that Region 1 utilized this assumption in the Schiller and Merrimack Station NPDES permit renewal processes and acknowledging EPA's use of same in § 316(b) rulemakings).

As explained in the enclosed alternative compliance proposal prepared by NAI, this 59.2 percent reduction proposed by GSP Schiller exceeds the 37 percent Region 1 determined was necessary to satisfy § 316(b). GSP Schiller nevertheless has proposed these operational limitations because they represent the reasonable projection of the operation of the units for the foreseeable future. That said, GSP Schiller reserves the right to request adjustments to these percent reductions (including but not limited to changes in the overall percent reduction and adjustments in the monthly distributions of the percent reduction) in the future if circumstances change, and neither CWA § 402(o) nor 40 C.F.R. § 122.44(l) would prohibit any such adjustment.

This modification to the Permit will be beneficial to the environment for other reasons, as well. Although Schiller Station remains in a long-term outage—meaning no impingement or entrainment has occurred or is occurring—it would take more than 24 additional months to comply with the Permit's WWS requirements, as of the date of this correspondence. In all likelihood, compliance would not be required for 36 months or more, given the open-ended nature of several of the milestones. In contrast, the compliance option that GSP Shiller is requesting can be implemented on the effective date of the modified permit, meaning desired reductions in mortality will be assured earlier in time. This compliance option also eliminates the need for the "unavoidable loss of human life, personal injury, or severe property damage" exception associated with the WWS compliance provision in the current Permit.[8] This provision was added to the Permit because of the risk of significant damage, plugging, and/or clogging to the submerged WWS in the harsh Piscataqua River conditions rendering the screens temporarily inoperable—conditions that were confirmed in the pilot study. During any such periods, the impingement and entrainment reductions associated with WWS would not be realized. No such risks exist for the proposed compliance method. Furthermore, the lack of submerged WWS in a waterway with substantial commercial activity eliminates the risk of damages or other complications for GSP Schiller and/or third parties.

We believe this letter and the enclosed alternative compliance proposal provides Region 1 all of the information necessary to approve GSP Schiller's permit modification request. However, if you require additional information or have any questions, please do not hesitate to contact me. Thank you for your time and cooperation in this matter.

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I certify under penalty of law that this document and all enclosures were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

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[8] *See* Permit, Part I.A.11.a.4.

Sincerely,

Elizabeth H. Tillotson
Vice President
GSP Schiller LLC

Cc: Mark Stein, EPA
James Andrews, GSP Schiller LLC

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

A PROPOSED BTA ALTERNATIVE TO WEDGEWIRE SCREENS AT SCHILLER STATION

March 30, 2021

GSP Schiller LLC's ("GSP Schiller") Schiller Station, located along the western bank of the Piscataqua River estuary in Portsmouth, New Hampshire, provides up to 155 megawatts of electricity to the region. The Schiller Station units, Units 4, 5, and 6, are able to serve as baseload, intermediate and peaking resources for the electric grid; while Unit 5, a biomass unit, also provides on-demand renewable energy. The two cooling water intake structures ("CWISs") at Schiller Station have a combined total design intake flow ("DIF") of 125.8[1] million gallons per day ("MGD") and use more than 25 percent of the water the CWISs withdraw from the Piscataqua River exclusively for cooling Units 4, 5, and 6.

In accordance with 40 C.F.R. Part 125, Subpart J, United States Environmental Protection Agency Region 1 ("EPA") specified that GSP Schiller shall modify the Station's CWISs to "reflect the best technology available ("BTA") for minimizing adverse environmental impacts from the impingement and entrainment of various life stages of fish" in Schiller Station's renewed National Pollutant Discharge Elimination System Permit No. NH0001473, effective July 1, 2018 and modified on March 25, 2020 ("the NPDES Permit"; EPA 2018).Pursuant to the NPDES Permit, EPA determined that the BTA for reducing entrainment mortality at the facility is the installation of fine mesh wedgewire screens ("WWSs") with a slot or mesh size of no greater than 0.8-mm, "unless the permittee can demonstrate through a site-specific study that a larger slot size is equally or more effective for reducing entrainment mortality as a 0.8-mm slot or mesh size," as specified in Part I.A.11.a.1 of the NPDES Permit.

Schiller Station entered an outage period on June 1, 2020, that is expected to last until at least May 31, 2021.During this period and based upon results of the site-specific study ("the pilot study"), GSP Schiller is requesting an alternative BTA that is based on reduced operations and cooling water withdrawals at Schiller Station during biologically-critical periods. GSP Schiller contracted with Normandeau Associates, Inc. ("Normandeau") to develop a site-specific simulation model to estimate annual entrainment abundance reductions that would result from monthly intake flow reductions at Schiller Station. As discussed below, the results of that modeling show that the proposed flow reductions will produce entrainment and impingement mortality reductions beyond those produced by WWSs. Based on these results, GSP Schiller is requesting that EPA issue revised permit conditions based on these operational controls as BTA.

Overview of the Site-Specific Study

In accordance with the NPDES Permit, a site-specific study was conducted at Schiller Station in 2019 to evaluate the entrainment reduction performance of 0.8-mm and a 3.0-mm cylindrical wedgewire screens ("CWWSs") with results summarized by an "engineering report" (ENERCON 2020) and a "biological report" (Normandeau 2020) submitted by GSP Schiller to EPA in compliance with Part I.A.11.b.1 of the NPDES Permit. The primary objective of the site-specific study was to evaluate the performance of a WWS with a slot width of 3.0-mm versus a 0.8-mm slot width in reducing entrainment of ichthyoplankton at Schiller Station. The study was completed by comparing the total ichthyoplankton entrainment abundance estimates over a common, synchronized sampling period from March 11, 2019, to September 23, 2019, at each of the two test CWWSs to

[1] The DIF is 125 MGD as documented in ENERCON (2008) and in the Responses to Comments to the Draft NPDES Permit. This is slightly higher than the 124.4 MGD used by EPA to scale entrainment in the Fact Sheet.

the existing CWIS for Units 5 and 6 ("Control"), at both the actual intake flow ("AIF") and DIF. In addition, entrainment sampling at the Control began February 11, 2019 and ended February 3, 2020 to provide a complete yearlong sampling period.

In summary, both CWWSs under-performed the expected 72.9%[2] entrainment reduction of all ichthyoplankton which formed the basis of the BTA determination in the NPDES Permit (ENERCON 2008; EPA 2015; EPA 2018). The total entrainment abundance estimates of the 0.8-mm and 3.0-mm CWWSs from the site-specific study resulted in approximately 49% and 23% entrainment reductions, respectively, when compared to the entrainment abundance at the Control under DIF for the synchronized sampling period from March 11, 2019 to September 23, 2019. These entrainment reductions would have been even lower if synchronized sampling had continued beyond this period, due to the increasing rate of biofouling and damage of the test CWWSs.

Engineering Challenges and Environmental Factors Reduce Effectiveness of Wedgewire Screens as BTA

Several engineering, biological, and physical factors contributed to the lower-than-expected entrainment reduction performance observed for the 0.8-mm and 3.0-mm CWWSs tested in the site-specific study. The site-specific study identified engineering challenges to implement a full-scale WWS intake system and achieve the desired entrainment reduction performance. The CWWSs in the site-specific study experienced substantial biofouling and physical damage, which contributed to the substantially lower-than-expected entrainment reduction performance. The peak proportion of the clogged screen surface areas observed on the CWWSs was 36% and 21% for the 0.8-mm and 3.0-mm CWWS, respectively (ENERCON 2020). The effect of biofouling is higher through-slot velocities of the intake flow, which may reduce hydraulic bypass and behavioral avoidance of the CWWSs, and potentially increase extrusion of ichthyoplankton through the slots than may otherwise be observed.

In addition to biofouling, at the end of the site-specific study, the estimated damaged surface area of the 0.8-mm and 3.0-mm CWWSs was 19% and 16%, respectively, which reduced the entrainment reduction performance of the CWWSs due to the large openings in the screens on each CWWS (ENERCON 2020). Due to the physical damage of the CWWSs, a significant percentage of the withdrawn flow bypasses the screen through the large openings, estimated at 45% and 23% of the flow for the 0.8-mm and 3.0-mm CWWSs, respectively (ENERCON 2020). Based on the results of the site-specific study, it is highly likely that a full-scale installation of WWSs would experience similar issues with biofouling and physical damage.

Biological factors included periods during the site-specific study when the CWWSs entrained more ichthyoplankton than the Control. This highlights two issues that are site-specific to Schiller Station. First, entrainment reduction performance of fish larvae and juveniles at both CWWSs decreased during flood tidal conditions as the sweeping velocity increased. Second, tidal currents at Schiller Station are highly variable even within short distances in the vicinity of the Schiller Station intakes. The high sweeping velocities (3-6 ft/s) likely increased the rate of biofouling and entrainment (by increasing "contact density" of material and ichthyoplankton) and also increased the rate of extrusion, both which likely led to a reduced entrainment reduction performance of the CWWSs (Normandeau 2020; EPRI 2005). The high sweeping velocities also reduce the ability of fish larvae and juveniles to avoid the CWWSs, which may also contribute to the lower-than-expected performance of the CWWSs.

[2] In its Fact Sheet for the NPDES Permit (AR-259), EPA referred to 79.2% as the exclusion estimate from a 0.8-mm WWS, when citing prior studies at Schiller Station (e.g., Section 9.4.1, pg. 116 text and Table 9-B), which was incorrectly transcribed from 72.9% (ENERCON 2008, Tables 6-19, 6-20, and 6-21). However, the example reduction estimate calculations in Section 9.4.1 of the Fact Sheet correctly use 72.9% exclusion factor.

Physical factors included the extreme magnitude of the flood tidal current velocities at Schiller Station, as well as the location of the site with respect to the overall channel geometry, which created highly volatile currents during ebb tidal conditions; these factors likely impacted the site-specific study results. Multiple surveys were conducted prior to the site-specific study to find the optimal locations to install the CWWSs for the study, both outside of the hydraulic zone of influence of the current intakes, but also in the area of consistent currents that favor CWWS performance (Normandeau 2018). To meet these criteria, each CWWS was installed approximately 170 feet from the shoreline on the riverbed along the 40-foot MLLW depth contour (ENERCON 2020; Normandeau 2020). More specifically, the small headland with riprap shoreline just upriver from the site creates an eddy during ebb tidal conditions, resulting in turbulent currents at times nearshore at Schiller Station (Normandeau 2018). The asymmetrical tidal flow at Schiller Station, with flood currents more consistent or uniform closer to shore and ebb currents more consistent further offshore in the main channel and consistent eddies nearshore, creates complex physical conditions near the intakes at Schiller Station. Given the complex shoreline, bathymetry, and riverbed topography, the design of any full-scale WWS installation would have to account for the location and complex current velocities across a large footprint of WWSs due to the tidal dynamics in the area adjacent to Schiller Station (Normandeau 2018; Normandeau 2020).

BTA Performance Goals

The percent reduction in entrainment abundance observed in the site-specific study (49%) overestimates the effectiveness of the 0.8-mm CWWS for reducing entrainment mortality at Schiller Station because it does not account for mortality caused by the CWWS. Specifically, EPA used its projected reduction in entrainment abundance to generate "effective entrainment mortality reduction" estimates in the Fact Sheet by applying a survival of fish eggs (80%) and larvae (12%) excluded by WWSs (Section 9.4.1). This method accounts for survival of non-entrained ichthyoplankton that physically impact the CWWSs (EPA 2015). The site-specific study analyses assumed 100% mortality for entrained organisms, and applied no correction factor for mortality of organisms that may have been physically impacted or been impinged on the CWWSs but not subsequently entrained. While the former is a typical assumption in entrainment studies, the latter leads to a substantial overestimate in what would be the "effective entrainment mortality reduction".

Based on physical exclusion and limiting body dimensions, a 0.8-mm WWS was estimated to reduce entrainment abundance by 72.9% (ENERCON 2008; EPA 2015). The effective entrainment mortality reduction of ichthyoplankton for a 0.8 mm WWS was estimated by EPA in the Fact Sheet as 37.5%[3] after adjusting the 72.9% exclusion estimate to account for mortality caused by physical interactions with a WWS (Section 9.4.1 EPA 2015). Because the site-specific study was not designed to observe impingement or collision mortality of entrainable ichthyoplankton at the test CWWS, and no estimates of impact mortality/survival in the site-specific study were possible, EPA's concept of effective entrainment mortality reduction was applied using the observed entrainment reduction for the 0.8-mm CWWS in EPA's calculation (i.e., substituting 49% entrainment reduction for the 72.9% value used in the Fact Sheet).

This results in an updated effective entrainment mortality reduction of 25.2% for a 0.8-mm WWS based on the pilot study, as compared to the 37.5% calculated by EPA in the Fact Sheet. These observations have led to the consideration that other approaches to satisfying the BTA criteria in the permit may be not only more viable than WWSs, but also substantially more effective at reducing entrainment mortality.

[3] In the Fact Sheet AR-259, EPA refers to "37%" as the effective entrainment mortality reduction (e.g. Section 9.4.1 pg. 117-118). The actual calculations as presented yield 37.49% (e.g. Section 9.4.1 pg 118; EPA 2015).

Flow Reductions as a More Effective Alternative to BTA for Schiller Station

Based on the results from the site-specific study at Schiller Station (Normandeau 2020), several conclusions were drawn which indicate that a full-scale half-cylindrical WWS installation would present several significant challenges and undesirable features at Schiller Station and would be imprudent to install and unreliable for year-round implementation as BTA from an engineering perspective (ENERCON 2020). Chief among these is that the 0.8-mm CWWS substantially underperformed the expectations of the BTA performance goal. Specifically, the entrainment abundance reduction for the 0.8-mm CWWS relative to the existing CWIS (Control) was estimated to be 49%, or 32.8% lower-than-expected when compared to the 72.9% entrainment abundance reduction based on previous estimates used in the BTA determination (EPA 2015) and subsequently used to set the NPDES Permit requirements. When mortality from physical injury from encountering the WWSs is accounted for using EPA's calculation for effective entrainment mortality reduction, the adjusted effective entrainment mortality reduction for 0.8-mm WWSs at Schiller Station is 25.2%, based on the entrainment abundance reduction observed in the site-specific study, reduced from the 37.5% reduction calculated by EPA in the Fact Sheet.

Flow reductions are proposed by GSP Schiller that offer a more straightforward and objective BTA alternative to 0.8-mm WWSs for reducing entrainment mortality since EPA assumes that reductions in entrainment mortality are directly proportional to reductions in cooling water withdrawal at a 1:1 ratio[4]. In support of developing a flow reduction scenario that balances direct entrainment mortality reduction of fish and the needs for the region's electric grid reliability, GSP Schiller contracted Normandeau Associates, Inc. (Normandeau) to develop a site-specific simulation model to estimate annual entrainment abundance reductions that would result from monthly intake flow reductions at Schiller Station. The model was developed in Microsoft Excel software to allow GSP Schiller to evaluate the impact of monthly intake flow reductions on annual entrainment reduction compared to the estimated entrainment by the existing CWIS at DIF based on monthly mean entrainment density estimates from observations at the existing CWIS for Units 5 and 6 during the site-specific study from February 11, 2019 through February 3, 2020.

The goal of the model was to estimate annual entrainment reduction based on the selection of monthly AIF reductions, under EPA's assumption that entrainment is proportional to intake flow. With consideration of the seasonality of entrainment and the grid's power demands, GSP Schiller proposes a BTA alternative that reduces intake flow from 125.8 MGD to 41.8 MGD from April through October when the majority of entrainment takes place. This flow reduction scenario is estimated to reduce entrainment abundance by 59.2% compared to the estimated entrainment abundances at the permitted DIF (Figure 1, Table 1). The 59.2% reduction estimate for the proposed flow reduction alternative is substantially higher than the expected entrainment mortality reduction for 0.8-mm WWSs estimated for classifying WWS as BTA in the Fact Sheet (37.5%).

The performance of the BTA specified in the current version of the NPDES Permit compared to estimates from the flow reduction model show that it is possible to obtain effective entrainment mortality reductions greater with this proposed BTA alternative than the estimated effective entrainment mortality reductions from WWSs at Schiller Station. Moreover, the estimated performance of entrainment reduction using the proposed flow reduction alternative does not rely on assumptions related to the potential mortality of ichthyoplankton physically impacted by or impinged on a full-scale WWS installation. If approved by EPA as a BTA alternative and accepted as a modification to the NPDES Permit, flow reductions will be immediate, as the solution does

[4] *See, e.g.*, 79 Fed. Reg. 48,299, 48,331 (Aug. 15, 2014).

not impose construction impacts or delays to providing fish protection benefits, introduce potential navigational hazards to large vessels, or disturb the existing riverbed habitat.

When viewed in context with the observed performance of the test CWWSs during the site-specific study and the potential reduced effectiveness related to bypass modes, biofouling, or damage of a full-scale WWS installation, it is believed that the proposed intake flow reductions present the most effective and viable option for BTA for effective entrainment mortality reduction at Schiller Station.

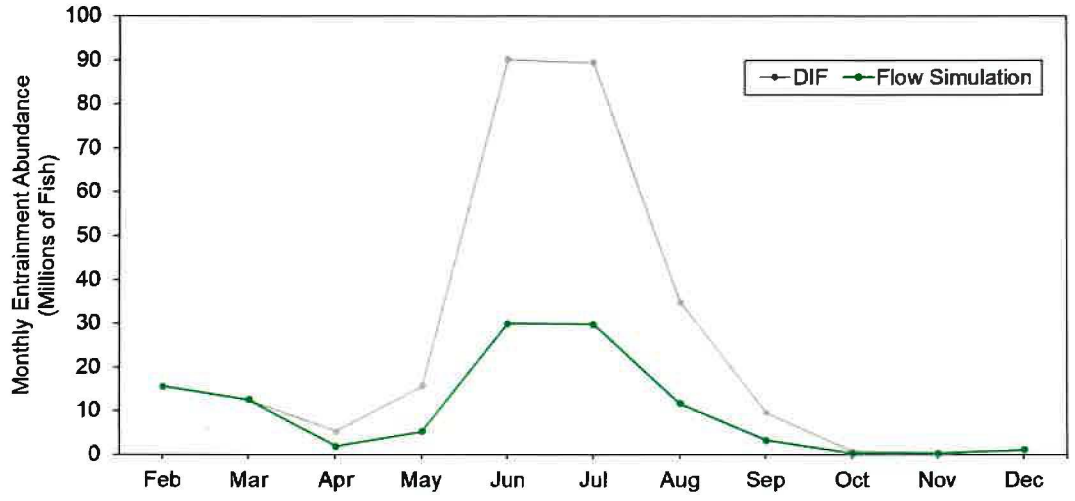

Figure 1. Estimated entrainment abundance based on the proposed flow reductions (in green) from design intake flow (DIF) (in gray) at the existing cooling water intake structure (CWIS) at Schiller Station.

Table 1. Estimated reduction in entrainment abundance with proposed monthly intake flows (million gallons per day, MGD) at Schiller Station based on entrainment abundance at the existing cooling water intake structure (CWIS) at design intake flow (DIF).

	Existing CWIS				Proposed Flow Reductions		
Month	Mean Entrainment Density (N/100 m^3)	DIF (MGD)	DIF Volume (MG)	Entrainment Abundance	Intake Flow (MGD)	Estimated Entrainment Abundance	Entrainment Reduction Relative to DIF
Jan	14.74	125.8	3899.8	2,175,321	125.8	2,175,321	0.0%
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Jul	605.50	125.8	3899.8	89,385,625	41.8	29,700,470	-66.8%
Aug	235.28	125.8	3899.8	34,732,450	41.8	11,540,671	-66.8%
Sep	66.33	125.8	3774.0	9,475,828	41.8	3,148,566	-66.8%
Oct	4.78	125.8	3899.8	705,623	41.8	234,460	-66.8%
Nov	1.25	125.8	3774.0	179,115	125.8	179,115	0.0%
Dec	6.57	125.8	3899.8	970,170	125.8	970,170	0.0%
Annual Entrainment Abundance =				**276,396,833**		**112,687,899**	
Entrainment Reduction =							**-59.2%**

Equation Definitions:

[D] = Mean Entrainment Density (N/100 m^3) is the monthly mean entrainment density of ichthyoplankton from the site-specific study at Schiller Station;

[V] = DIF Volume (million gallons, MG)= DIF x number of days;

[E] = Entrainment Abundance (number of individuals) = (V x 1,000,000 x 0.00378541) x (D/100)

[MGD] = Intake Flow (MGD) for all Units Combined = {entered by user in model}

[EEA] = Estimated Entrainment Abundance =MGD x Number of Days x 1,000,000 x 0.00378541) x (D/100)

[R] = Entrainment Reduction Relative to DIF = [(EEA - E)/E] x 100 (negative value = reduction)

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