Amended Final Application for New License for Major Water Power Project—Existing Dam

Bellows Falls Project (FERC No. 1855)

EXHIBIT B: PROJECT OPERATIONS AND RESOURCE UTILIZATION

June 2023 Revision

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TABLE OF CONTENTS

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LIST OF FIGURES

LIST OF TABLES

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EXHIBIT B: PROJECT OPERATIONS AND RESOURCE UTILIZATION

Section 5.18(a)(5)(iii) of Title 18 of the Code of Federal Regulations (CFR) refers to Section 4.51 (License for Major Project—Existing Dam) for a description of information that an applicant must include in Exhibit B of its license application. Exhibit B is a statement of Project operation and resource utilization.

B1 Existing and Proposed Project Operation

B1.1 Existing Project Operations

Project operations are automated and controlled from a consolidated hydro operations control center located in Wilder, Vermont. Great River Hydro, LLC (Great River Hydro), typically operates the Project in a coordinated manner with other Great River Hydro generating facilities on the Connecticut River, taking into consideration variations in electricity demand as well as natural flow to maximize the efficient use of available water.

When inflows are within the Project's generating capacity, Great River Hydro uses the limited impoundment storage at the Project to dispatch generation as required to meet the generation dispatch schedule managed by New England Independent System Operator (ISO-NE). During any day, generation can vary between the required minimum flow and full generating capacity, depending on inflow and impoundment storage. Over the day, the Project generally passes the average daily inflow.

Estimated and anticipated inflow forms the basis for bidding into the ISO-NE's day-ahead energy market. Day-ahead hourly bids reflect must-run generation periods associated with minimum flow periods, periods when sustained higher flows are anticipated, and opportunistic generation when inflow and available storage allows and electricity demand is anticipated to be high. Anticipated inflow calculations predict impoundment water surface elevations (WSEs) (all elevations are mean sea level (m.s.l.), NGVD 29) and determine whether spill gates must be operated to pass flow in excess of Project generating capacity. Estimated inflow is calculated using discharge from the Project plus/minus changes in impoundment elevation measured at the dam on an hourly basis, averaged over a rolling 6-hour period. Impoundment drawdown rates are typically less than 0.1 to 0.2 foot (ft) per hour and do not exceed 0.3 ft per hour and depend upon station turbine discharge capability and rate of inflow. Due to the length and [river] channel characteristics of the impoundment, changes in WSE and flow at the dam are not mirrored at upstream locations within the impoundment due to reduced influence and affect from operations at the dam and increased influence and contribution from inflow as distance from of the dam is increased. There is approximately 3,000 cubic feet per second (cfs) per hour per 0.1 ft of elevation, and 0.3 ft per hour represents a maximum station output with little to no inflow.

The maximum station discharge with all three units operating is approximately 11,400 cfs, although 98 percent of the time flows are less than 11,235 cfs. The Project itself has a maximum discharge (generation plus spill) capacity of 119,785 cfs, and the flood of record, occurred in March 1936, was 156,000 cfs. Since then, three upstream U.S. Army Corps of Engineers (USACE) flood control structures have been built (Union Village, Ompompanoosuc River; North Hartland, Ottauquechee River; and North Springfield, Black River) and Moore dam, which has some flood control capability, was constructed. These facilities have helped to decrease the peak flow during flood events. Since the Moore dam began operating in the late 1950s, the highest flow recorded at the Bellows Falls Project (as measured at the dam) was 103,397 cfs during Tropical Storm Irene on August 29, 2011.

The licensed minimum flow requirement at the Bellows Falls powerhouse is 1,083 cfs (or inflow if less) and is provided primarily through generation, typically at least 1,200 cfs. There is no minimum flow requirement through the dam into the bypassed reach, but leakage provides some flow in the bypassed reach (flows range between 125 to 300 cfs as calculated or estimated over the course of various studies. Additional non-generation flows are provided seasonally at the powerhouse on a schedule provided annually by the Connecticut River Atlantic Salmon Commission (CRASC) based on fish counts at downstream projects. If required, fish passage flows are provided in spring (May 15–July 15) and in fall (September 15–November 15) for upstream fish passage (25-cfs fishway flow and 55-cfs attraction flow) and for downstream fish passage (225 cfs). As of 2016, CRASC no longer requires downstream passage operations at Bellows Falls for Atlantic Salmon smolts in spring, and it only requires fall downstream passage operations if 50 or more adults are documented passing upstream (see Exhibit A1.6, *Fish Passage Facilities*). During the summer recreation season, beginning the Friday before Memorial Day and continuing through the last weekend in September, Great River Hydro maintains a self-imposed minimum impoundment WSE of elevation (El.) 289.6 as measured at the dam from Friday at 4:00 p.m. through Sunday at midnight and on holidays during this period, unless the Project is experiencing high flows above generating capacity.

B1.2 Operations during Adverse, Mean, and High Water Years and Emergency Conditions

High flows occur routinely throughout the year at the Project, most often during the spring freshet, the fall rainy season, and significant rainfall events affecting the Connecticut River watershed below the Moore dam. Annually, flows at the dam exceed station capacity approximately 28 percent of the time. During periods of sustained high flows, Great River Hydro dispatches Project generation in a must-run status to use available water for generation. Spring runoff on the Connecticut River typically occurs in phases based on latitude. The seasonal storage capability of the Fifteen Mile Falls Project (FMF), Moore dam primarily, is limited in comparison to the total amount of inflow it receives. However, the storage capacity at the FMF Project is used during spring runoff to "shave" the maximum anticipated peak flows downstream and refill the impoundments. This operation reduces downstream high

water conditions at the downstream dams including the Bellows Falls Project which is typically spilling at that time. During periods of ice movement, frequent upstream observations and river elevation checks are made within the impoundment. When an ice jam occurs immediately upstream of the dam, an increased or artificial inflow condition is created by a large swell of water in front of the jam as the water behind the jam pushes the ice and water in front of it. When this condition occurs, the station or roller gate discharge must be increased to pass water during this temporary situation and to keep the impoundment elevation within its operating limits because there is no impoundment storage capacity in this circumstance.

When anticipated inflows to the Project impoundment increase above Project generating capacity, Great River Hydro initiates "river profile" operations by lowering the impoundment elevation at the dam. When the calculated anticipated inflows exceed Project generating capacity, various combinations of spill gates (see Table A-1 in Exhibit A, *Project Description*) are operated and impoundment elevations are maintained at certain set-points until flows exceed the total spill capacity of the Project, when flows would surcharge WSE at the dam. Table B-1 lists maximum impoundment elevations that are maintained based on different anticipated inflow levels at the Project.

Table B-1. River profile and high flow operations, inflows, and impoundment elevations.

Anticipated Inflow (cfs)	Maximum WSE (ft) at the Dam (NGVD29)[a]
<11,000	291.6
11,000–20,000	291.1
20,000–50,000	290.1 (289.6 if ice is present)
50,000–90,000	289.6 and partial stanchion board removal @ 52,000 cfs
>90,000	All gates are opened, and all stanchion bays removed, impoundment elevation increases dependent upon inflow increases; impoundment WSE rises from 289.6 and is maintained at 290.6 as long as possible before WSE surcharges as inflow increases.

a. All vertical elevations in Exhibit B are stated in National Geodetic Vertical Datum of 1929 (NGVD29).

Typically, routine and periodic maintenance does not require impoundment drawdown outside the license-specified full operating impoundment range. Gate inspections and minor repairs are often performed during spill conditions when gates are out of water. Otherwise coffer dams are installed or other methods are employed to avoid deviating from normal operation or potentially restricting the ability to pass flows in emergencies. If the need arises for unanticipated reasons or emergencies, Great River Hydro would consult with state and federal regulatory agencies, seek authorization from the Federal Energy Regulatory Commission (FERC) if needed, and secure any necessary permits to conduct such work.

Requirements such as minimum flow are ensured through the use of alternative conveyance structures (other units or gates). Extreme high water emergencies requiring impoundment drawdowns beyond normal operating levels, as specified in Project operating procedures, are necessary for public safety, flood management, and dam safety purposes.

B1.3 Proposed Project Operations

Great River Hydro, with support from relevant state and federal resource agencies, and regional and national non-governmental organizations that have actively participated in scoping and study phases of relicensing, proposes a modified project operation that significantly reduces both the frequency, amplitude and rate of change in Project-related discharge and impoundment water surface fluctuation in comparison to existing project operation. See Attachment A, *Great River Hydro's Proposed Alternative Operation for the Projects*, and Attachment B, *Evidence of Support for Proposed Alternative Operation*, for further information.

The proposed operation focuses on creating more stable reservoir WSEs, reducing the magnitude of changes and the frequency of sub-daily changes in discharge from the project, increasing the amount of time that the project is operated as inflow equals outflow and at full reservoir. At the same time, the proposed operation maintains Great River Hydro's capability to be flexible and responsive to current wholesale energy, forward capacity, reserve and other ancillary services markets managed by the New England Independent System Operator (ISO-NE). The proposed operation will also remain responsive to ISO-NE system emergencies when ISO-NE requires operation for reserves, security, system stability (e.g., voltage-ampere-reactive [VAR] support), system over-supply conditions (ISO-NE minimum generation emergency or negative prices), and critical events or emergencies involving dam and public safety. The proposed operation ensures the Project's ability to address future regional energy demands and system needs as those evolve over time.

With the proposed Project operation, Great River Hydro will predominantly maintain a specified WSE (Target WSE) at the dam and as a result, maintain flow below the Project equal to the approximate inflow as measured or calculated at the dam (inflow equals outflow or IEO). Specifically, a Target WSE of 291.1ft m.s.l. (NVGD 29) will be maintained at the Bellows Falls dam by passing inflow within a Target WSE Bandwidth between 291.6 ft and 290.6 ft to account for potential differences between anticipated inflow and actual instantaneous inflow. A minimum of 300 cfs of the total flow below the Project will be continuously provided below the Bellows Falls dam in the bypassed reach associated with the Project. In addition to IEO Operation, the Project will have restricted discretionary Flexible Operation capability to respond to elevated energy prices as well as unrestricted capability to respond to emergencies and ISO-NE transmission and power system requirements. The proposed Project operation is described in detail in Attachment A, and evidence of stakeholder support is provided in Attachment B. Elements associated with the proposed Project operations, including modes of operation, capabilities, restrictions, requirements and allowances, are defined and described in the following section.

Great River Hydro proposes to construct and operate a new 680 kW turbine generator at the Dam for the purpose of providing the continuous 300 cfs minimum flow through generation. During maintenance or emergencies, when the unit is out of service, spilling over the dam crest or through gates will provide the required minimum flow into the bypassed reach. (See Exhibit A, Section A3 Proposed Modifications and Enhancements)

B1.3.1 Definitions and Terms used in Proposed Project Operations

The terms defined in this section are specific to the proposed Project operation. Terms are capitalized so that terms used before they are defined and after may be easily referenced.

Dwarf Wedgemussel Winter Habitat Protection Operation

Dwarf wedgemussel (DWM) winter habitat protection operation is intended to create overwintering habitat that is protected from potential water drawdown that could expose mussel beds to freezing air temperatures. Mussels reduce their mobility and settle into the substrate for the winter as water temperatures drop below 15°Celsius (°C). By lowering the WSE, the habitat they occupy will remain submerged over the winter, protecting largely immobile mussels from exposure and freezing air temperatures. To accomplish this, Great River Hydro will lower the WSE at the Bellows Falls dam to an elevation at or above the low limit of the Flexible Operating Impoundment Range and maintain that WSE for the limited period of time during which water temperatures consistently drop from 15°C to 10°C. This period is typically 10-21 days in length, occurring from late-October to early-November. Once water temperatures are consistently below 10°C within identified DWM habitats within the Bellows Falls Project impoundment, the WSE can be adjusted upward to the Target WSE to use the elevation range above the low limit for Flexible Operations. The WSE at the Bellows Falls dam will remain at or above this DWM habitat winter protection WSE throughout the subsequent period when water temperature is at or below 10°C and no earlier than March 1 unless inflow exceeds station capacity and inflow levels require flood profile operation WSE at the dam (see Section B1.2).

Emergency and System Operation Requirements

- Emergencies outside the control of Great River Hydro when dam safety, public safety or flood control require action or response.

- Emergency system operations, conditions, and emergencies when the ISO-NE requires Great River Hydro to be fully available and if necessary responsive. Examples include ISO-NE reserve deficiencies (a.k.a. reserve constraint penalty factors) when reserves are depleted on the power grid, for fuel security emergencies or scarcity events, for ISO-NE system (or system) stability (e.g., VAR support), and system over supply (negative prices).

- ISO-NE required audits, demonstrations, and tests necessary for participation in and to qualify resources for systems support and markets. Present audits

include claimed capacity audits (CCA) and reactive power demonstrations. A CCA demonstrates maximum capacity for the Project through a two-hour generation run and is used by the ISO-NE for calculating capacity related market participation. Reactive capacity demonstrations are ISO-NE audits currently required under both minimum and maximum generation conditions every five years, to verify capability of providing voltage reactive power or VAR to the regional power grid. Other future requisites are requirements specified by the ISO-NE, which are unknown and unanticipated at this time, to demonstrate and meet performance capability requirements, in accordance with ISO-NE market rules that may be changed from time to time.

Flexible Operation

When the Project is operated at the discretion of Great River Hydro and deviates from IEO Operation.

Flexible Operation Hours

The hours of Flexible Operation that will count towards the maximum number of hours of Flexible Operation allowed each month. Determination of the number of Flexible Operation Hours that have been used each month for comparison to the maximum number of Flexible Operation Hours allowed, will be as follows:

The minimum duration of a Flexible Operation event is one hour. Should an event be less than an hour for any reason, the event will be counted as one hour. ISO-NE is responsible for the dispatch of a unit or station and as such Great River Hydro is not able to precisely determine or dictate when a unit starts or stops. ISO-NE typically dispatches units at or near the top of the hour (e.g., 1:00, 2:00, etc.) under non-emergency situations. Should an event last more than 15 minutes past the top of the hour that event will be considered to have lasted and counted as if it were for that entire hour (e.g., if an event ends and Down-ramping Transition Operation is initiated within 15 minutes past the top of the hour, it will not be considered an additional hour; if after 15 minutes past the top of the hour, it will count as an additional Flexible Operation Hour. Examples are:

Approximate Time Flexible Operation Event Begins*	Time Flexible Operation Event Ends and Down-ramping Begins	Number of Flexible Operation Hours
2:00 pm	2:57 pm	1
2:00 pm	3:15pm	1
2:00 pm	3:16 pm	2

*ISO dispatches units near the top of the hour.

When up-ramping is implemented in accordance with Transition Operation, hours for Flexible Operation begin the hour immediately following the up-ramp hour. If up-ramping is not implemented in accordance with Transition Operation, due to

Real-Time pricing, hours for Flexible Operation begin as soon as Flexible Operation begins as described above. In all cases, the time that Flexible Operation ends for the purpose of determining the number of allowed hours that have been used each month is when down-ramping begins in accordance with Transition Operation.

If Great River Hydro needs to conduct more than two CCA tests per year at the Project (due to problems, changing conditions, or failure to reach expected levels), Great River Hydro will alert the relevant resource agencies that: 1) it must conduct additional tests, 2) each additional test will require maximum impoundment elevation of 291.63 ft (see Full Operating Impoundment Range) and no ramping, and 3) the number of Flexible Operation Hours for each additional test will be determined as described above and counted either in the current or in the next month's allocation if none were available in the current month (see Section B1.3.2).

Flexible Operation Maximum Discharge

The maximum discharge from the Project powerhouse during Flexible Operation, it is a function of Inflow and Maximum Station Generating Capacity.

Flexible Operating Impoundment Range

The WSE bounded limits, except during the DWM Winter Habitat Protection Operation, are as follows:

WSE Range (m.s.l. NGVD29)	Maximum Fluctuation During Any Flexible Operation Event (ft)
Oct 1 – May 31: 289.6 and 291.1 June 1-Sept 30: 290.1 and 291.1	Oct 1 – May 31: 1.5 June 1-Sept 30: 1.0

The Flexible Operating Impoundment Range is narrowed between June 1 and September 30 to reduce the potential for dewatering at-risk DWM habitat and individuals within portions of the Bellows Falls Project.

It is anticipated that the typical impoundment operating range as a function of Flexible Operation will be on average less than the Flexible Operating Impoundment Range measured at the dam and as specified in the table above. Great River Hydro may, at some future date and at its discretion, after gaining more operating experience with the Proposed Project Operation, request to meet with relevant resource agencies to discuss the potential for reducing the Target WSE Bandwidth and/or modifying the Flexible Operating Impoundment Range, by raising both the upper and lower limits of the range, but not increasing the difference between the upper and lower limits (i.e., the maximum fluctuation shown in the table above).

Full Operating Impoundment Range

The historic full operating range for the Bellows Falls Project that generally corresponds with the maximum height (top) of the flashboards or gates down to the low limit. This range is used for managing high flows and not for power generation. Water surface elevations must be lower if extreme high water or dam safety emergencies require stanchion flashboards and beams to be removed from the concrete dam crest. In order to rebuild the stanchion flashboards, the impoundment WSE must be lowered to the crest before rebuilding the structures can be accomplished. The Full Operating Impoundment Range for the Bellows Falls Project is top of boards - 291.63 ft; low limit to manage flood flows - 288.63 ft; and concrete stanchion flashboard crest - 278.63.0 ft (m.s.l. NGVD29).

High Water Operation

When anticipated Inflow at the dam exceeds Maximum Station Generating Capacity. In most cases this requires implementing high water procedures including management of the impoundment flood profile operating procedures, which require specific elevations be maintained at the dam for specific ranges of flow. These elevations fall within the Full Operating Impoundment Range of the Project.

Inflow

Flow to the Project estimated based on anticipated inflow arriving at the dam from upstream. In real-time it is calculated and monitored through actual change in WSE measured at the dam on an hourly basis and adjusted through actual discharge from the Project.

Inflow Equals Outflow (IEO) Operation

When the Project maintains discharge through the powerhouse equal to Inflow at the dam by maintaining a stable target WSE together with any required non-generation flow in the bypass reach flow, fish passage related flow or, when inflow exceeds Maximum Station Generating Capacity and all Inflow is passed via a combination of spillage and discharge through the powerhouse or, if the station were out of service, via spillage alone.

Maintenance Requirements

Either scheduled periodic maintenance or unscheduled maintenance due to an unanticipated situation or condition. Maintenance Requirements can, in some cases, be pre-planned and executed accordingly or unplanned and require various elements such as investigation and problem identification, engineering, planning, and execution.

Maximum Station Generating Capacity

The maximum flow that can be passed through the powerhouse as shown in the last column of the table below:

Number and Type of Turbines	Maximum Flow/ Turbine (cfs)	Minimum Flow/ Turbine (cfs)	Maximum Nameplate Rated Capacity* (cfs)	Maximum Station Generating Capacity** (cfs)
3- Vertical Francis	3670	700	11,010	11,400

* The maximum nameplate hydraulic capacity is based on design specifications of the turbine (or nameplate rating) and is the sum of the hydraulic capacities of all units in the powerhouse. It is not a realistic representation of what the Station can actually pass through the turbines at the same time, which is largely determined by net head.

** The maximum station generating capacity represents the maximum Station discharge based on operating data and represents the maximum discharge that can actually be passed through the turbines.

Minimum Base Flow

The minimum flow required to be maintained below the Project at all times. Flows are expected to be equal to Inflow and significantly higher than these base flows the vast majority of the time. The Minimum Base Flow includes a seasonal component. During the following periods, the requirement will be to provide, at a minimum, the approximate Inflow as measured at the dam.

- While operating in IEO Operation – discharging Inflow will require maintaining Target WSE within the Target WSE Bandwidth and hourly adjustments as necessary to maintain proximity to Target WSE.
- While operating in Flexible Operation and Transition Operation modes of Up-ramping and Down-ramping, flows will be maintained above or equal to Inflow.
- The economic minimum dispatch flow (Eco-Min) specified to the ISO-NE will be the estimated hourly inflow. When prices go negative, station discharge will be set to the specified Eco-Min (i.e., the estimated inflow). When a system minimum generation emergency is declared by the ISO-NE, a combined spill plus station discharge will equal the Eco-Min. Both of these situations will resemble IEO Operation and any discrepancy between estimated Eco-Min and real-time inflow would be captured within the Target WSE Bandwidth and adjusted once either the negative pricing situation or the system minimum generation emergency has ended.

While operating in the refill mode of Transition Operation, discharge will be approximately 70 percent of estimated inflow and adjusted as necessary through hourly real-time monitoring and calculation of Inflow. Discharge during refill will not fall below the seasonal Minimum Base Flow thresholds shown below.

- For the purpose of establishing a base flow below the dams for IEO/Flexible Operational planning purposes and deciding whether or not

to implement Flexible Operation by utilizing Flexible Operation Hour sin the Day-Ahead (DA) market or in responding to Real-Time (RT) price signals in the RT market, all flows associated with Transition Operation up-ramping, Flexible Operation, Transition Operation down-ramping, and Transition Operation refill will be maintained above the following Project and seasonal Minimum Base Flow thresholds. The only time Project flows prior to or following these periods may be less than these thresholds is when the calculated Inflow is less. It is anticipated that flows will be higher than the base flows the vast majority of the time.

Bellows Falls*
Oct 1 - March 31: 1,600 cfs
April1 - May 31: 3,000 cfs
June 1 - Sept 30: 1,400 cfs
Bypass Reach below dam: 300 cfs year round

* Minimum Base Flow is the combined flow below dam and station.

- Emergencies, facility outages, station trips that result in unanticipated reductions in station discharge will be considered unavoidable flow reductions, and Great River Hydro will restore flows below the Project to at least the estimated inflow as quickly as possible either through spill or station discharge or both.

Target Water Surface Elevation

A specified elevation at Bellows Falls dam to be maintained under IEO Operation by adjusting station discharge. The Target WSE would be monitored no less frequently than hourly, and station discharge would be adjusted as frequently as reasonably possible to ensure accurate WSE. Bellows Falls station discharge is calculated and adjusted based on unit discharge curves and formulas within the accuracy of the unit's control systems.

Target WSE Bandwidth

A range, 0.5 ft above and 0.5 ft below the Target WSE, available for use during IEO Operation, to absorb unanticipated changes in Inflow at the dam or slight deviations or imbalances between hourly Inflow and hourly discharge due to miscalculation of inflow or unit discharge. See Section B.1.3.2. for elevations associated with the bandwidth. Great River Hydro may, at some future date and at its discretion, after gaining more operating experience with the proposed operation, request to meet with relevant resource agencies to discuss the potential for reducing the Target WSE Bandwidth.

Transition Operation

Actions required to precede Flexible Operation in some cases and follow Flexible Operation in all cases. There are three modes associated with Transition Operation:

- Up-ramping: A flow increase for the hourly period that would precede most (exceptions specified below) initial Flexible Operation Hours at a specified flow so that the overall flow difference between the IEO Operation and the scheduled Flexible Operation flow is gradual and not instantaneous. Up-ramping rates only apply when Flexible Operation is scheduled in advance (i.e., in the Day-Ahead market) and not when Flexible Operation is initiated in Real-Time or for CCA and reactive capacity demonstrations audits. The up-ramp rate specific to Bellows Falls Project is the lesser of 5,414 cfs (representing 1 cfs/square mile of drainage area or cfsm) or the flow half-way between current IEO Operation flow and the Flexible Operation flow.

- Down-ramping: A flow decrease at a specified rate for the period following Flexible Operation until the flow is equal to Inflow at the dam. Decreases will occur on an hourly basis, as a percentage of the previous hourly flow. The first hour after the Flexible Operation Hour will be no greater than approximately 70 percent of the Flexible Operation flow and each successive hour will be approximately 70 percent of the previous hour.

- Refill: A maximum 48-hour period subsequent to post-Flexible Operation down-ramping when the impoundment WSE is restored to the Target WSE by passing a fraction of the Inflow at the dam and retaining the remaining fraction as impounded water above the dam. The hourly flow rate below the dam during refill will be the greater of approximately 70 percent of inflow or the Minimum Base Flow.

- The 48-hour maximum refill period begins immediately following down-ramping after a Flexible Operation event and ends no more than 48 hours later unless the reservoir is within 0.1 ft of the Target WSE. The 48-hour period includes any temporary interruptions during refill (e.g., purposely pausing refill and passing all inflow, or decisions to implement another Flexible Operation event prior to the impoundment reaching a WSE equal to the Target WSE minus 0.1 ft). Great River Hydro expects to only pause refill for extended periods as needed when participating in the Real-Time Market (see Transition Operation – up-ramping). Based on analysis of Flexible Operation simulations provided by Great River Hydro, it is expected that the number and duration of pauses will be minimal especially during the critical spawning months spanning from April through July 15.

B1.3.2 Description of Proposed Project Operation

The Project will comply with IEO Operation, applying Target WSE and associated Target WSE Bandwidths as described below, unless:

- Flexible Operation along with Transition Operation are applied as specified herein and implemented;
- IEO Operation is suspended due to either High Water Operation or Emergency and System Operation Requirements; or
- IEO Operation is suspended due to non-emergency Maintenance Requirements that mandate deviating from IEO Operation, but only after consultation with relevant state and federal resource agencies prior to initiating a necessary deviation and developing a suitable refill plan and schedule.

Target WSE for the Bellows Falls Project is 291.1 ft except during the DWM Winter Habitat Protection Operation. The corresponding Target WSE Bandwidth at the Bellows Falls Project is between 291.6 and 290.6 ft, representing 0.5 ft above and below the Target WSE.

Rates of change in station discharge to maintain a Target WSE (matching inflow with outflow) will be limited to reasonable changes necessary to continue or adjust the actual WSE to the Target WSE within the Target WSE Bandwidth, largely dependent upon rate of change in inflow, the degree of flow control using megawatt setpoints on the generator and the monitoring accuracy of WSE at the dam. Changes in station discharge necessary to match inflow should not occur more than once per hour (unless rate of change in inflow is rapidly accelerating or declining) and would not be greater than reasonably necessary to restore a balanced IEO Operation condition at the Target WSE. Specifics regarding how to distinguish between flow adjustments for IEO Operation and Flexible Operation for compliance purposes will be addressed in the operation compliance and monitoring plans (OCMPs) anticipated to be filed with the Commission.

Flexible Operations are limited, in part, by maximum allowable hours specified below, which are allocated on a monthly basis in order to reflect the seasonal criticality of instream aquatic resources as well as the criticality and fuel security concerns associated with winter peaking loads in New England:

- December, January, February, March: no more than 65 hours in each month
- April, May, June: no more than 10 hours in each month
- July: A total of 20 hours with no more than 10 hours from July 1 through July 15. Although a maximum of 10 hours is allowed from July 1 through July 15, in order to further enhance the potential for successful Sea Lamprey spawning, Great River Hydro will strive to minimize the hours of Flexible Operation during this period when conditions allow.
- August, September, October: a total of no more than 20 hours in each month.

- November: a total of 42 hours with no more than 10 hours from November 1 through 15.

Flexible Operations will comply with the Flexible Operating Impoundment Range. The duration (in hours) of each Flexible Operation event will be determined in accordance with Flexible Operation Hours. The minimum duration of a Flexible Operation event will be one hour in most cases.

Flexible Operation Maximum Discharge will be based upon the calculated inflow at the hour in which the Flexible Operation will occur as follows:

- When calculated inflow is approximately 1,800 cfs or less, Flexible Operation Maximum Discharge is 4,500 cfs.
- When calculated inflow is greater than approximately 1,800 cfs, the Flexible Operation Maximum Discharge is limited to 2.5 times the calculated inflow and will not exceed the maximum Bellows Falls station generating capacity of 11,400 cfs.

For the purpose of protecting DWM from freezing in the winter, the Bellows Falls Project impoundment will be temporarily lowered in the fall of each year as described for Dwarf Wedgemussel Winter Habitat Protection Operation. To reduce the potential for dewatering at-risk DWM habitat and individuals within portions of the Bellows Falls Project, the Flexible Operating Impoundment Range will be reduced by 0.5 ft and maintained between 291.1 and 290.6 between June 1 and September 30.

There are no limitations on the number of Flexible Operation events per day or the duration of Flexible Operation events other than those indirect limitations due to Inflow and Transition Operation requirements as specified herein.

Scheduled Flexible Operation will require one hour of Transition Operation up-ramping. Unscheduled (in response to Real-Time price signals) Flexible Operation and Emergency and System Operation Requirements will not require up-ramping.

All Flexible Operation events will require Transition Operation down-ramping and refill as defined. The Transition Operation modes will be applied as follows:

	Up-Ramping	**Down-Ramping**	**Refill**
IEO Operations	Not Applied	Not Applied	Not Applied
Flexible Operations, Scheduled	Applied during the hour prior	Applied as Defined	Applied as Defined
Flexible Operations, Un-Scheduled	Not Applied	Applied as Defined	Applied as Defined
High Water Operations	Not Applied	Not Applied	Not Applied
CCA and RPD Audits	Not Applied	Applied as Defined	Applied as Defined

	Up-Ramping	Down-Ramping	Refill
Emergencies and System Emergencies	Not Applied	Not Applied	Not Applied

B1.3.3 Compliance

Great River Hydro will determine specifics for compliance with the proposed Project operation in OCMPs developed in consultation with relevant resource agencies and filed with FERC. If review of information submitted to relevant resource agencies pursuant to the OCMPs indicates that operation of the Project is not complying with the proposed Project operation, Great River Hydro will consult with the state and federal resource agencies to discuss their concerns and, if necessary, will identify and implement appropriate corrective actions.

B1.3.4 Consultation

If after evaluating operation data pursuant to OCMPs, resource agencies observe instances where operations do not appear to adequately represent the proposed Project operation as described in Attachment A, specifically, a) the simulations discussed in the last paragraph of the Introduction, b) attain the five bulleted focus areas listed in the Introduction, or c) attain DWM management goals at levels suggested by Great River Hydro simulations, Great River Hydro will, if requested, meet with the agencies to discuss their concerns and possible corrective actions.

B2 Dependable Capacity and Annual Generation

B2.1 Estimate of Dependable Capacity and Average Annual Generation

At full load, with inflow equaling a maximum station discharge of approximately 11,400 cfs, the Project has the capability of producing 49.0 megawatts (MW). Current ten-year average annual generation is approximately 239,070 megawatt-hours (MWh). Generation is expected to remain close to this average under the proposed operations. The difference between generating continuously under inflow equals outflow and current operations would be negligible because the electricity would be produced continuously as opposed to in peaks.

B2.2 Annual Plant Factor

The average annual plant factor is calculated as the average annual generation / nameplate capacity x 8,760 hours per year. Nameplate capacity of the Project is 40.8 MW. Based on the 10-year average annual generation, the average annual plant factor = 239,070 MWh/(40.8 MW x 8,760 hours) = 66.8 percent.

B2.3 Project Flows and Flow Exceedance Curves

The Bellows Falls Project has a total drainage area (DA) of 5,414 square miles (sq. mi.). Inflow is from discharge from the Wilder Project and natural inflow from the 2,039 sq. mi. of intermediate DA downstream of the Wilder Project. More than 42 percent of the total enters as unmanaged flow downstream of the Wilder Project, except under flood flow conditions when the USACE dams on the Ottauquechee and Black rivers store water temporarily (see Exhibit E, Section 3.1.1, *Overview of the Basin*). Under normal generation conditions, it takes about 8 hours for flow from the Wilder Project to reach Bellows Falls dam.

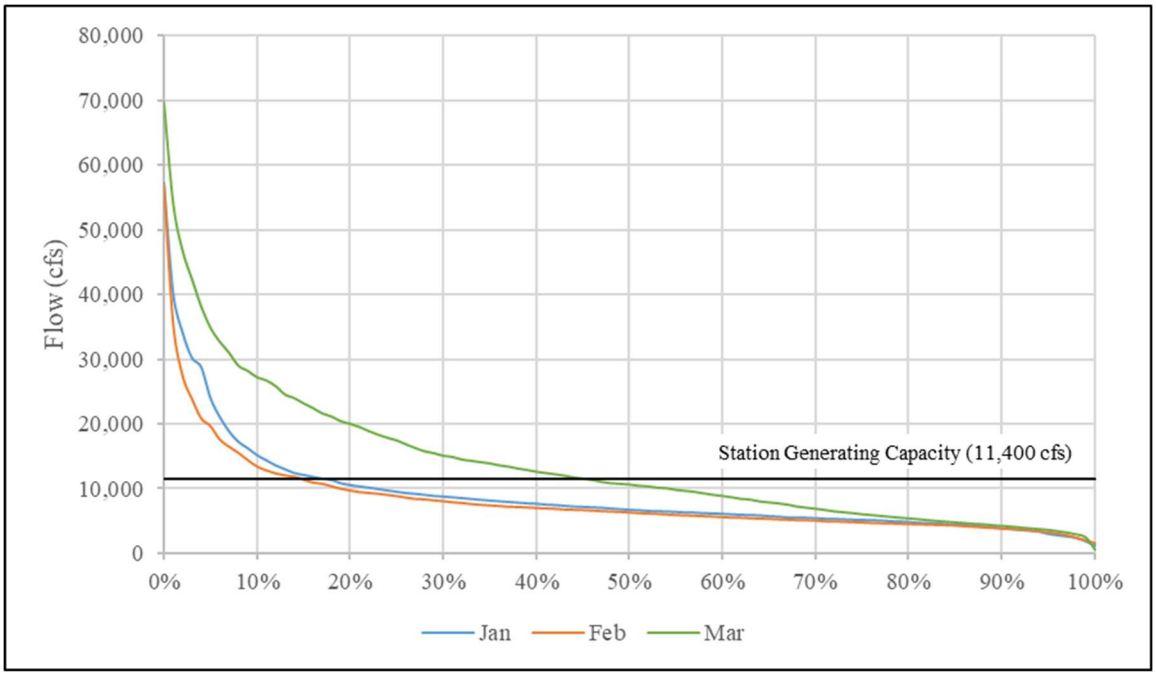
The impoundment is approximately 26 miles long and extends upstream to Chase Island at Windsor, Vermont, about 1 mile downstream of the Windsor Bridge. The impoundment is riverine in character and ranges in depths of several feet to about 30 ft near the dam. Bathymetry in the impoundment changes rapidly as a result of underlying bedrock, channel constriction, deposition, and scour primarily associated with high flows, such as those that occurred with Tropical Storm Irene in late August 2011. Because of the relatively flat terrain from the upper extent of the impoundment to the dam, the Project has limited storage capacity, which is primarily a function of impoundment length and operating range. Under normal generation conditions, regulated flow from the FMF Project reaches Wilder dam in about 8 hours on average and flows released at the Wilder Project generally reach the Bellows Falls dam in another 8 hours on average. Table B-2 summarizes the minimum, mean, and maximum values of average monthly flows from 1979 through 2019.

Table B-2. Bellows Falls estimated minimum, mean, and maximum average monthly flow values (cfs), January 1979—December 2019.

Month	Minimum	Year	Mean	Maximum	Year
January	2,589	1981	8,866	20,581	2006
February	2,698	1980	8,012	21,507	1981
March	4,407	2015	13,667	33,673	1979
April	7,693	1995	25,938	40,692	2008
May	7,139	1995	15,178	29,416	1996
June	3,039	1999	8,987	20,980	2006
July	1,897	1991	5,962	16,886	2013
August	1,632	2001	4,935	17,810	2008
September	1,534	1995	4,109	13,963	2011
October	1,811	2001	7,929	25,560	2005
November	2,772	2001	10,038	22,803	2005
December	3,559	2001	10,420	22,449	2003

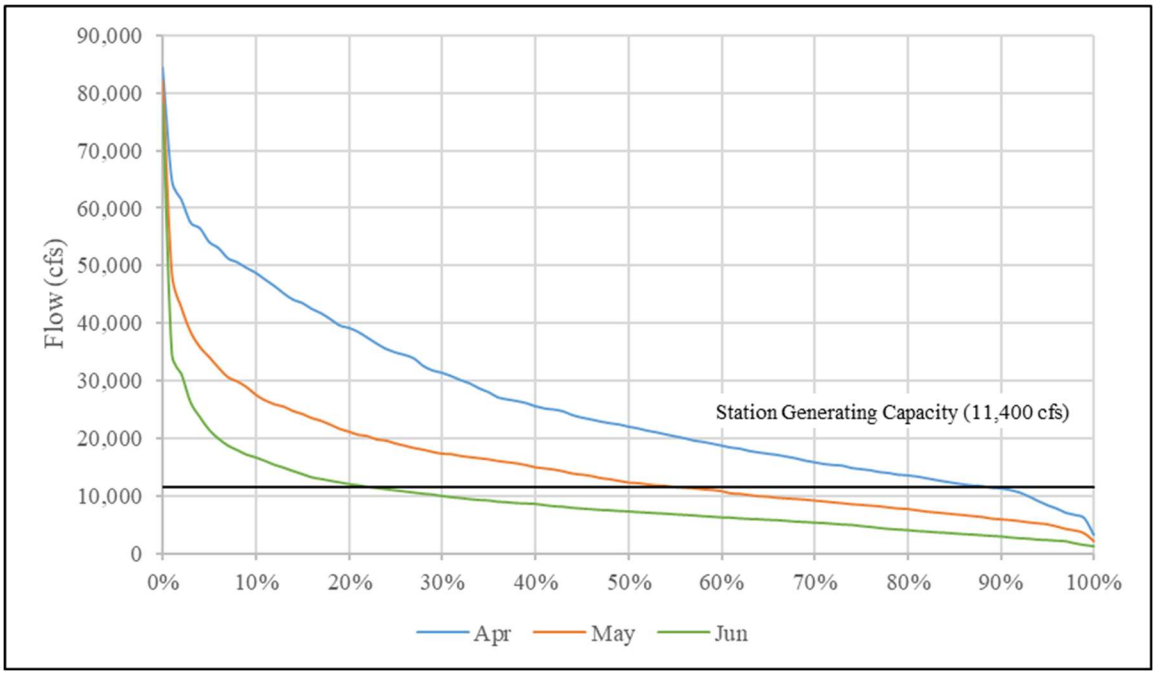
Source: USGS (2020, as modified by Great River Hydro)

Figures B-1 through B-4 provide monthly flow exceedance curves for the Bellows Falls Project from January 1, 1979, to December 31, 2019. Data are based on U.S. Geological Survey (USGS) gage no. 01154500, Connecticut River at North Walpole, New Hampshire (subsequently referred to as the North Walpole gage), located downstream of the confluence with Saxtons River (about 2 miles downstream from Bellows Falls dam). To estimate flow at only the Bellows Falls Project, the daily flow data from the North Walpole gage were prorated by 0.986 based on gaged DA to remove the small effect of inflow from the Saxtons River under most circumstances.



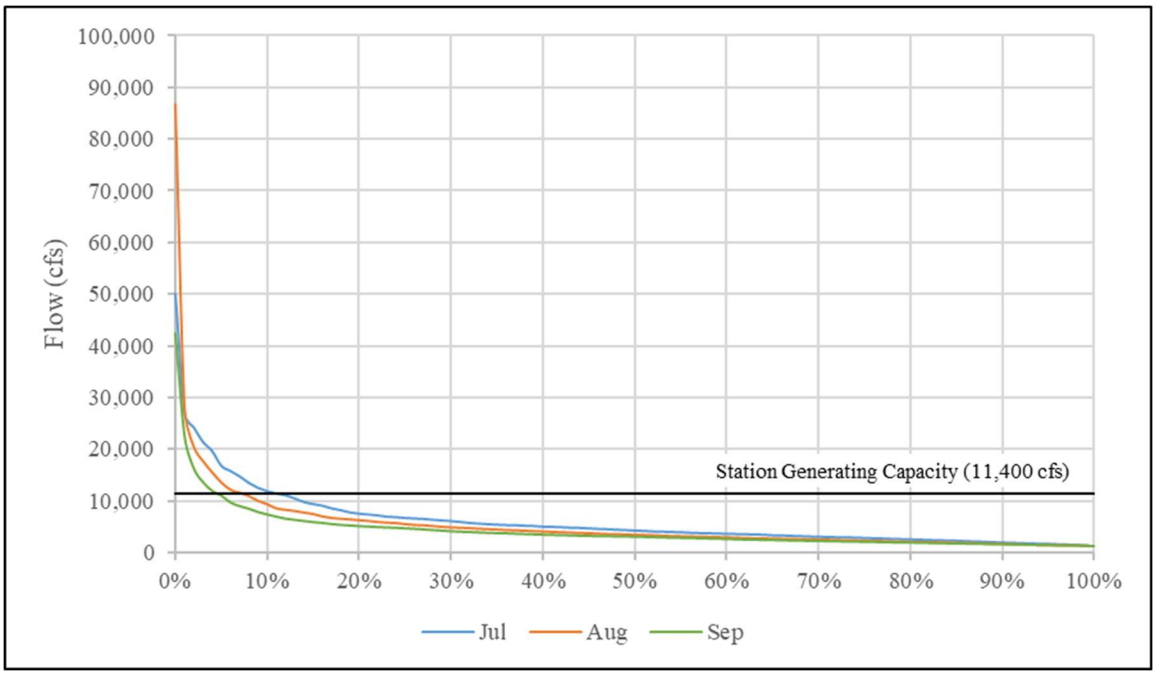
Source: USGS (2020, as modified by Great River Hydro)

Figure B-1. Flow exceedance curves, January–March (based on flow data from January 1, 1979 to December 31, 2019).



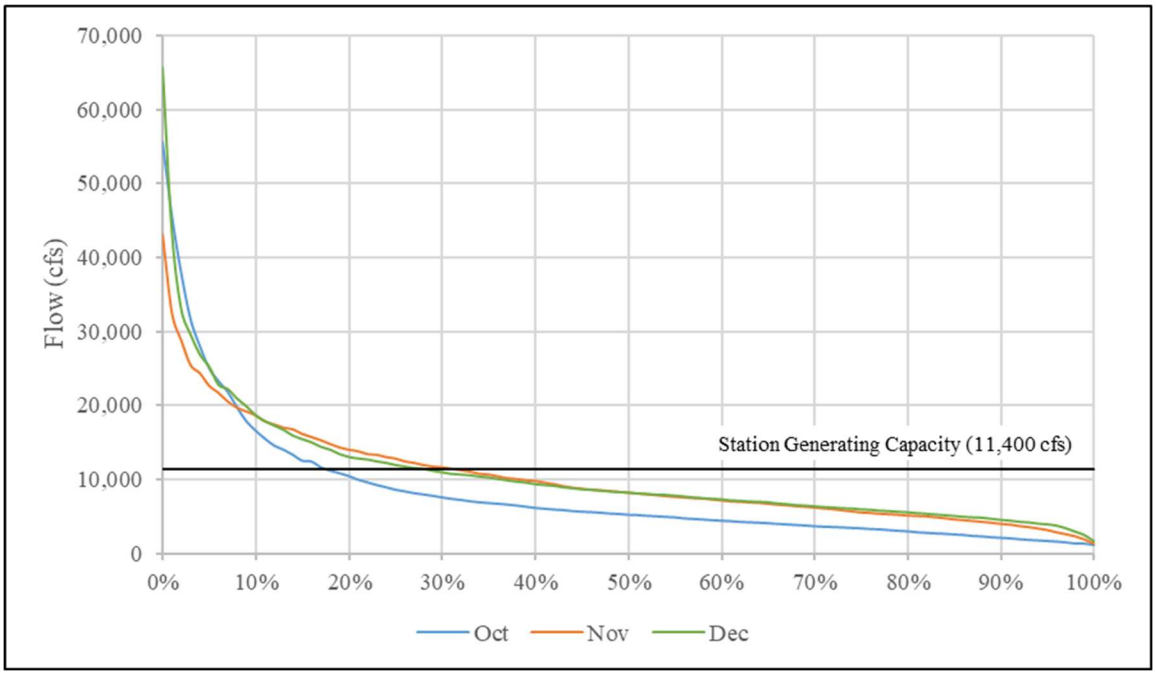
Source: USGS (2020, as modified by Great River Hydro)

Figure B-2. Flow exceedance curves, April–June (based on flow data from January 1, 1979 to December 31, 2019).



Source: USGS (2020, as modified by Great River Hydro)

Figure B-3. Flow exceedance curves, July–September (based on flow data from January 1, 1979 to December 31, 2019).



Source: USGS (2020, as modified by Great River Hydro)

Figure B-4. Flow exceedance curves, October–December (based on flow data from January 1, 1979 to December 31, 2019).

B2.4 Area-Capacity Curve

The impoundment has a surface area of 2,804 acres and a total maximum total volume of 26,900 acre-feet (acre-ft) at El. 291.63 ft (National Geodetic Vertical Datum of 1929 [NGVD29]) at the top of the stanchion boards. The overall operating range of the Project, accounting for both low inflow and most high inflow conditions, is typically between El. 288.63 ft and 291.63 ft, providing about 7,476 acre-ft of storage in the 3-ft range. The stage versus storage values are shown in Table B-3 and plotted in Figure B-5.

Table B-3. Stage versus storage curve.

Elevation (ft NGVD29)	Approximate Storage (acre-ft)
284	11,194
285	12,696
286	14,353
287	16,166
288	18,151
289	20,317
290	22,684
291	25,259
291.6	26,900

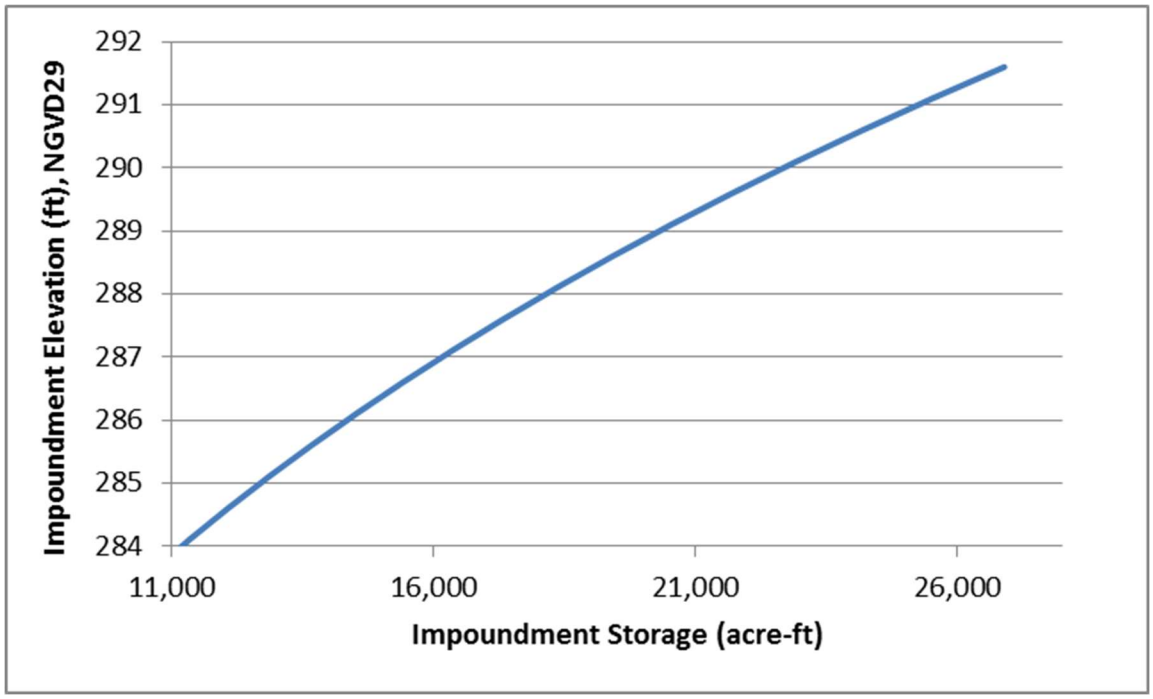


Figure B-5. Area-capacity curve.

B2.5 Hydraulic Capacity

The estimated maximum hydraulic capacity of Unit Nos. 1, 2, and 3 is 3,670 cfs each at 57 ft of head. The Project maximum hydraulic capacity (calculated as the sum of each individual unit's maximum discharge capacity) is therefore 11,010 cfs at 57 ft of head.

The estimated minimum hydraulic capacity of Unit Nos. 1, 2, and 3 is 700 cfs each for a total Project minimum hydraulic capacity of 2,100 cfs.

B2.6 Tailwater Rating Curve

The Project discharges directly into the Connecticut River. The normal tailwater elevation is El. 229.0 ft. The tailwater curve data represent the stage discharge relationship for discharge from the dam, spillway, and powerhouse at a location just downstream of the confluence of the bypassed reach with the powerhouse canal. The tailwater rating values are shown in Table B-4 and plotted in Figure B-6.

Table B-4. Tailwater rating curve.

Tailwater Elevation (ft NGVD29)	Flow (cfs)
211.4	0
229.3	10,000
232.9	20,000
235.9	30,000
238.6	40,000
240.9	50,000
243.1	60,000
245.0	70,000
246.9	80,000
248.7	90,000
250.4	100,000
263.6	200,000
274.2	300,000
283.9	400,000

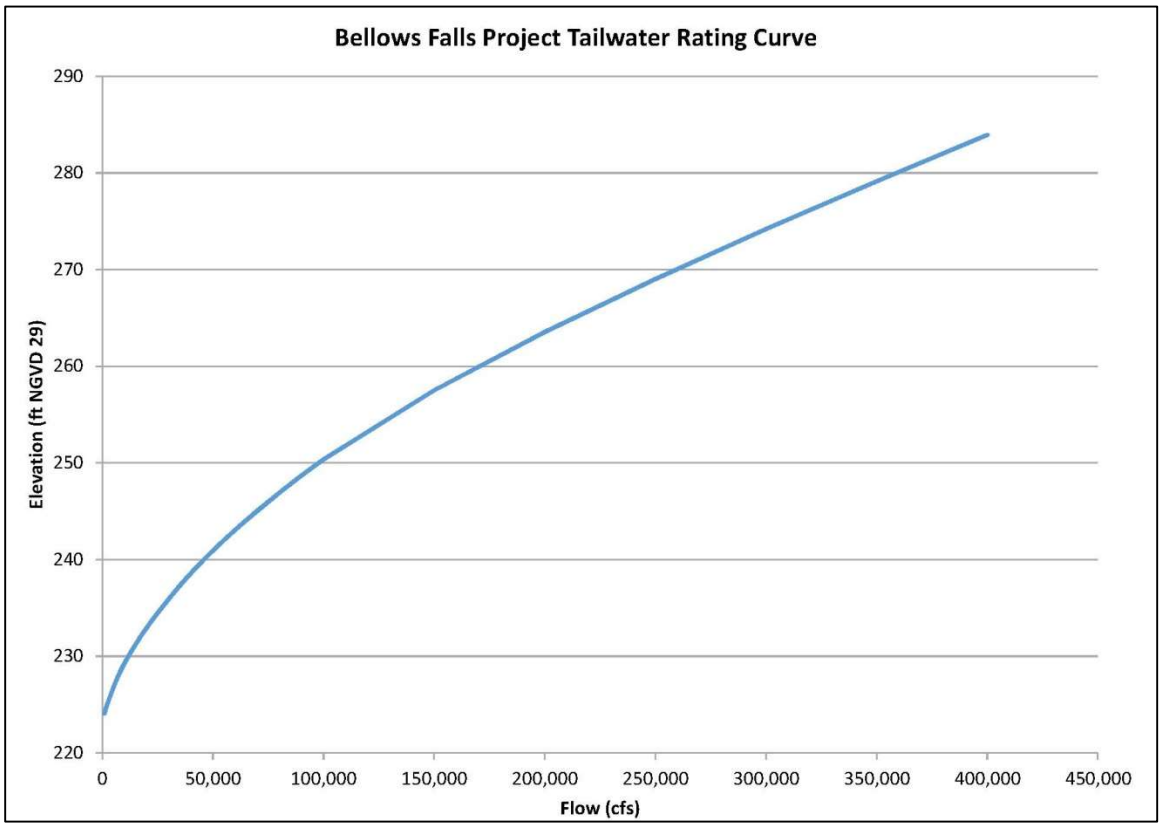


Figure B-6. Tailwater rating curve.

B2.7 Powerplant Capability

Powerplant capability is the Project's output in MW over a range of gross heads, depicted in Figure B-7.

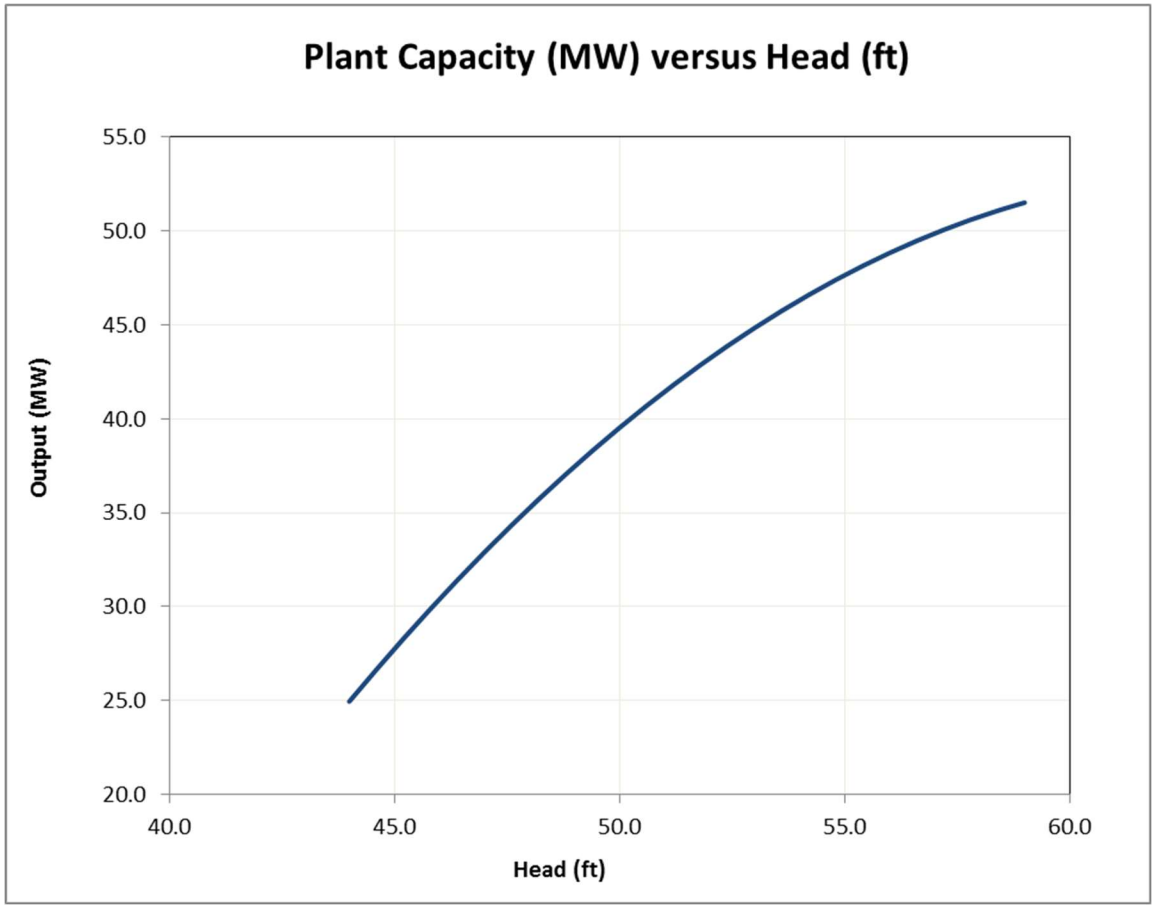


Figure B-7. Powerplant capability.

B3 Utilization of Project Power

The Project is located in the regional electric system that is operated by ISO-NE, which supplies electric power to the New England states. ISO-NE is responsible for regional grid operation, dispatch of generation, wholesale market administration, and power system analysis and planning to ensure that system reliability and adequate generation and transmission resources are available to meet regional needs. ISO-NE prepares both short- and long-term projections of electricity supply and demand. The 2020–2029 Forecast Report of Capacity, Energy, Loads, and Transmission projects the summer peak demand under typical summer peak weather conditions to rise annually at a rate of 0.9 percent and the winter peak demand under typical winter weather conditions to rise by an average of 1.1

percent, and 0.4 percent in annual overall electricity use from 2020 to 2029 (ISO-NE, April 30, 2020 reports).

As stated in Section B2.1, the Project has the capability of producing 49.0 MW and 239,070MWh annually, on average, to the regional power grid. The Project uses approximately 0.681 MWh annually for station service. In addition, the Island Corporation holds the rights to 300 kW of power from the Bellows Falls Project dating back to a 1914 lease indenture between the predecessor companies of Great River Hydro and Island Corporation.[1]

Over the term of the new license, the Project will continue to directly provide renewable power and can support and facilitate the further penetration of additional variable energy (wind and solar) resources into the region through reserve capacity and grid stability functionality. Project generation displaces fossil-fired generation, reduces power plant emissions, and provides substantial environmental benefit. The Project also provides forward capacity, real-time reserves, and VAR[2] support within the ISO-NE power pool.

B4 Plans for Future Development

Proposed new facilities include a new 680 kW minimum flow turbine generator, an affiliated control house at the dam and electrical interconnect equipment to local distribution utility in Vermont. The minimum flow unit will recover approximately 55% of the lost energy, resulting from the 300 cfs provided below the dam into the bypassed reach under the Proposed Project Operation described in Exhibit B, Section 1.3. Exhibit A Section A3 fully describes the proposed modifications and enhancement at the Project and Exhibit B, Appendix A, Figure A-9 shows the location of the new proposed minimum flow unit on the dam. The proposed 680 kW minimum flow unit will increase the nameplate capacity of the Project to 41,480 kW. The estimated maximum discharge capacity of the proposed unit is 340 cfs based on a net head of head of 34 feet.

~~Great River Hydro has no specific plans for future efficiency improvements, incremental development, or re-development of the Project.~~

[1] See Island Corp. Motion to Intervene dated December 29, 2016 (FERC accession number 20161229-5107).

[2] Voltage is regulated through reactive power production and consumption, and resources on the grid may be compensated for providing this reactive power capability. VAR is the unit of measurement for reactive power.

B5 Literature Cited

ISO-NE (New England Independent System Operator). 2020. ISO New England CELT report – 2020–2029 forecast report of capacity, energy loads and transmission. May 2, 2016. Available at: https://www.iso-ne.com/system-planning/system-plans-studies/celt/?document-type=CELT%20Reports&publish-date=[2016-01-01T00:00:00Z%20TO%20*. Accessed August 3, 2020.

USGS (U.S. Geological Survey). 2020. National Water Information System web page, Water data for the Nation. Available at: https://waterdata.usgs.gov/nwis/rt. Accessed February 18, 2020.

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Attachment A

Great River Hydro's Proposed Alternative Operation for the Projects

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Attachment B

Evidence of Support for Proposed Alternative Operation,

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