Dahowa Falls Hydroelectric Project

Final License Application

Exhibit E – Environmental Report

Pursuant to 18 CFR §4.51

FERC Project No. 4644-NY

November 2024

GR Catalyst Two, LLC
c/o Gravity Renewables, Inc.
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Final License Application
Exhibit E – Environmental Report
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1.0 Consultation and Relicensing Timeline

GR Catalyst Two, LLC is utilizing the Traditional Licensing Process (TLP). **Error! Reference source not found.** below outlines timeframes consistent with a standard TLP.

Table 1. Preliminary Project Schedule

Activity		Estimated Date Range
Stage I		
	PAD & NOI	November 30, 2021
	Joint Agency Meeting	January 15, 2022
	End Stage I Comment Period	March 15, 2022
Stage II		
	Engineering & Environmental Studies	May 2022 – On-Going
Stage III		
	DLA	August, 2024
	FLA	November 30, 2024
	FERC NEPA Process	November 30, 2025
	License Order	November 30, 2026

2.0 Compliance with or Consultation Under the Following Laws

A license issued for the Dahowa Hydroelectric Project would be subject to several applicable statutes and requirements under the Federal Power Act (FPA). Relevant federal regulations are detailed in in sections 2.1 through 2.6.

2.1 Section 401 of the Clean Water Act

The Dahowa Hydroelectric Project is subject to Water Quality Certification from the New York Department of Environmental Conservation (NYDEC) and Section 401(a)(1) of the Federal Clean Water Act of 1977. Following submittal of the Pre-Application Document in 2021, the licensee received requests for several studies including a water quality study requested by U.S. Fish and Wildlife Service (USFWS) and NYDEC. A draft of the study plan was provided to agencies for review and comment, a final version was developed to incorporate feedback from NYDEC and USFWS. A report detailing the 2023 study effort is currently in progress. A brief summary of the results is provided In Section 5 (Water Resources) of this document. Additional environmental studies were completed, or are on-going, and are detailed in subsequent sections and supporting appendices.

2.2 Endangered Species Act

A variety of resources were utilized to evaluate potential Rare, Threatened and Endangered Species (RTE) in the project area. The USFWS Information Planning and Conservation System (IPAC) was used to evaluate Federally protected species and the NYDEC GIS data was used to review state protected species [72].

The requested IPAC official species report listed the following species as being potentially present in the project area: Northern Long-eared Bat (*Myotis septenrionalis*), and Monarch Butterfly (*Danaus plexippus*). The report also states there are no critical habitats within the project area (see appendix K for full IPAC report). A Review of the NYDEC GIS data indicated that there are no state listed animals in the immediate vicinity of the project area. See Appendix K for more details.

2.3 Magnuson-Stevens Fishery Conservation and Management Act

Based on a review of the National Marine Fisheries Service online database, the licensee has determined that there is no Essential Fish Habitat (EFH) or Habitat Areas of Particular Concern (HAPC) identified in the Battenkill River.

2.4 Coastal Zone Management Act (CZMA)

Under section 307(c)(3)(A) of the Coastal Zone Management Act (CZMA), the Commission cannot issue a license for a project within or affecting a state's coastal zone unless the state CZMA agency concurs with the license applicant's certification of consistency with the state's CZMA program, or the agency's concurrence is conclusively presumed by its failure to act within 180 days of its receipt of the applicant's certification.

The licensee inspected the information available from NOAA's Coastal Zone Management Office website to determine if the project area falls within the bounds of New York's Coastal Zone Boundary. A NOAA document titled *State Coastal Zone Boundaries* published February 9, 2012 states, "*New York's coastal zone varies from region to region while incorporating the following conditions: The inland boundary is* *approximately 1,000 feet from the shoreline of the mainland. In urbanized and developed coastal locations the landward boundary is approximately 500 feet from the mainland's shoreline, or less than 500 feet where a roadway or railroad line runs parallel to the shoreline at a distance of under 500 feet and defines the boundary. In locations where major state-owned lands and facilities or electric power generating facilities abut the shoreline, the boundary extends inland to include them. In some areas, such as Long Island Sound and the Hudson River Valley, the boundary may extend inland up to 10,000 feet to encompass significant coastal resources, such as areas of exceptional scenic value, agricultural or recreational lands, and major tributaries and headlands*." The Battenkill River enters the Hudson River greater than 30 miles upstream of the head of tide (located in Albany).

The Project is located outside of the Coastal Zone Area (CZA), see figure below. As a result, the licensee concluded that the project area does not fall within the CZA of the State of New York.

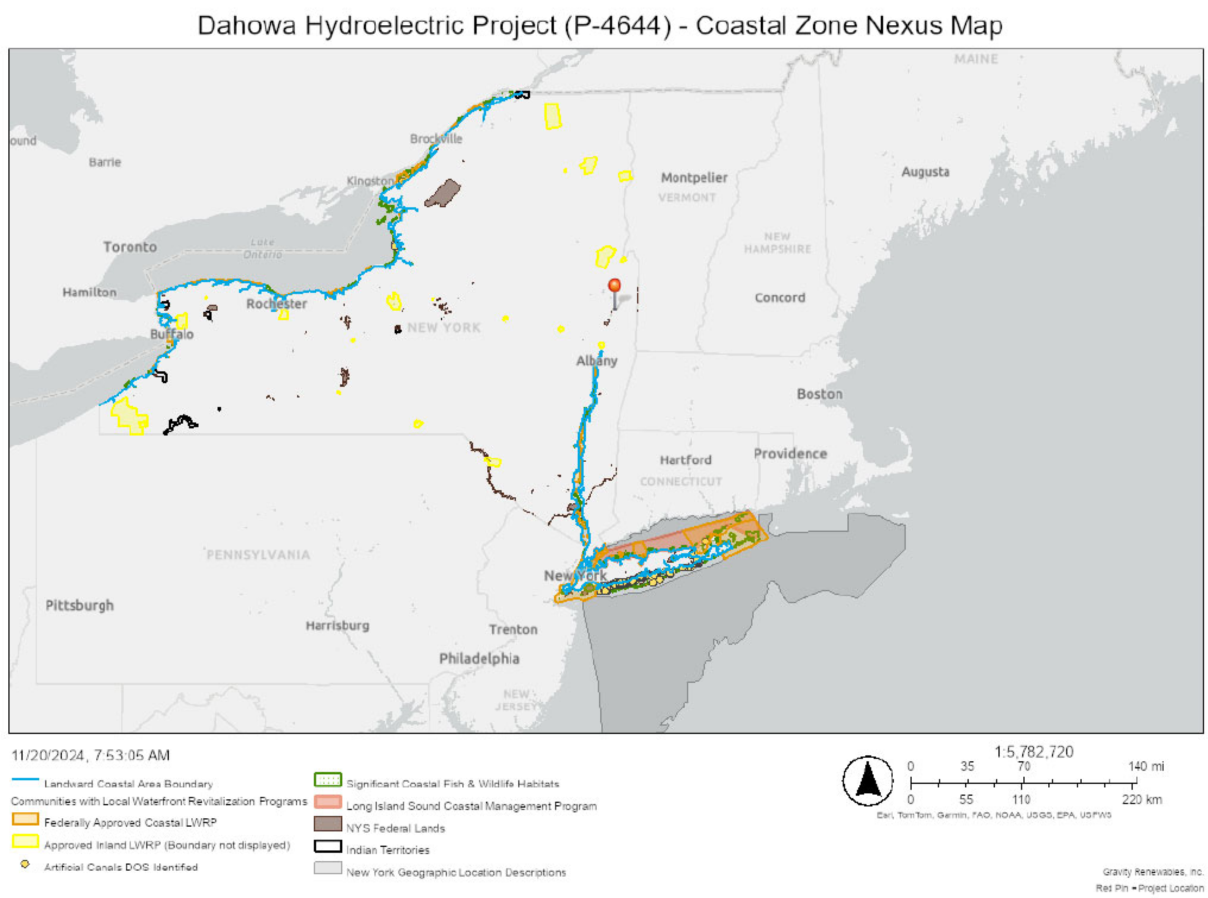


Figure 1. Project Location (red pin) in relation to New York Coastal Zone Area Map; the Project is outside of the Coastal Zone Area and not subject to review.

Guidance provided by the New York Department of State – Office of Coastal Zone Management regarding the applicability of federal consistency review requirements states:

If a proposed project would not be in the Coastal Area, no federal consistency review is required unless the proposed project is likely to affect the uses and resources of the Coastal Area.

There are no migratory species present in the Project area and the Project is operated in run-of-river mode, with no impact to downstream flows, as such there are no likely effects on the uses or resources of the CZA. Therefore, pursuant to the guidance provided by the NY Coastal Zone Management office regarding applicability of CZMA, consistency review is not applicable to the Dahowa Project.

2.5 National Historic Preservation Act Section 106

Section 106 of the National Historic Preservation Act (NHPA) requires that every federal agency consider that an undertaking could affect historic properties and to consult with the Advisory Council on Historic Preservation (ACHP) regarding such undertakings. Historic properties are defined as districts, sites, buildings, structures, traditional cultural properties, and objects significant in American history, architecture, engineering, and culture that are eligible for inclusion in the National Register of Historic Places (National Register).

Due to previous ground disturbing activities associated with the dam and hydropower Project, it is not anticipated that there will be any Project-related effects on cultural or historic resources. The Applicant will continue consultations with the State Historic Preservation Office (SHPO, CRIS Submission Token: 7FCV3PWU29U1) and tribal nations to ensure that any project related impacts are avoided and/or minimized. By continuing the operation of the hydroelectric facilities, the Dahowa Project is preserving the foundation of the previous industrial use of the waterway.

2.6 Wild and Scenic Rivers Act

Section 7(a) of the Wild and Scenic Rivers Act requires federal agencies to determine whether the operation of a project would affect the scenic, recreational, and/or fish and wildlife values present in a designated or study river corridor. The Battenkill River is not designated as a National Wild and Scenic Rivers System.

3.0 Summary of Recommended, Resource Specific Protection, Mitigation and Enhancement Measures

Exhibit E provides a description the existing conditions of specific environmental resources in the Project area as well as the anticipated project-related effects on these resources. The information contained in Exhibit E was obtained from public information, primary literature, studies and site-specific studies and analysis completed in support of this relicensing effort, as well as analyses and findings from comparable projects. Extensive formal consultations between the applicant, it's consultants and representatives of key State and Federal regulatory agencies further informed the data collection and analyses. A listing of reference materials and a record of consultation are provided herein.

Recommended protection, mitigation and enhancement (PM&E) measures are discussed on a resource specific basis and summarized in the table below.

Resource / Concern	Recommended PM&E Strategy
Water Resources	• Continue to operate in run-of-river mode. • No modifications to existing hydrograph or impoundment levels that would negatively impact resources.
Geology and Soils	• No proposed land disturbance activities.
Fish and Aquatic Resources	• Continue to operate in run-of-river mode. • No modifications to existing hydrograph or impoundment levels that would negatively impact resources. • Provide 40 cfs bypass aesthetic flows • Complete assessment of downstream passage conditions for resident species
Wildlife and Botanical Resources	• Continue to operate in run-of-river mode. • No modifications to existing hydrograph or impoundment levels that would negatively impact resources. • No proposed land disturbance or vegetation clearing activities.
Rare, Threatened and Endangered Species	• There are no known rare, threatened or endangered resources that would be affected by the continued operation of the Project. • Employ agency recommended avoidance and minimization strategies for northern long-eared bats, where appropriate.
Wetlands, Floodplains and Riparian Habitats	• No modifications to existing hydrograph or impoundment levels. • Continue to provide 40 cfs bypass aesthetic flows
Recreation	• Continue to operate Project to avoid conflicts with existing recreational uses.
Cultural and Historic Resources	• There are no known cultural, historic or archeological resources that would be affected by the continued operation of the Project.

4.0 General Description of the Project Locale

4.1 General Description of the Project

The Project is an existing hydropower development, which is located on the Battenkill (or Batten Kill) River in the towns of Greenwich and Easton in Washington County, New York. The Project is regulated by FERC under project number P-4644. The dam for the Project has a national dam inventory number of NY01429 and is classified by FERC as a low hazard dam.

The Dahowa Hydroelectric Project consists of an impoundment, dam, spillway, headrace wall, crest gate, intake structure, aesthetic flow outlet, powerhouse and tailrace (**Error! Reference source not found.**2). The Project is located on the Battenkill River approximately 3.8 miles (mi) upstream of its confluence with the Hudson River. The Project began operations in 1991.

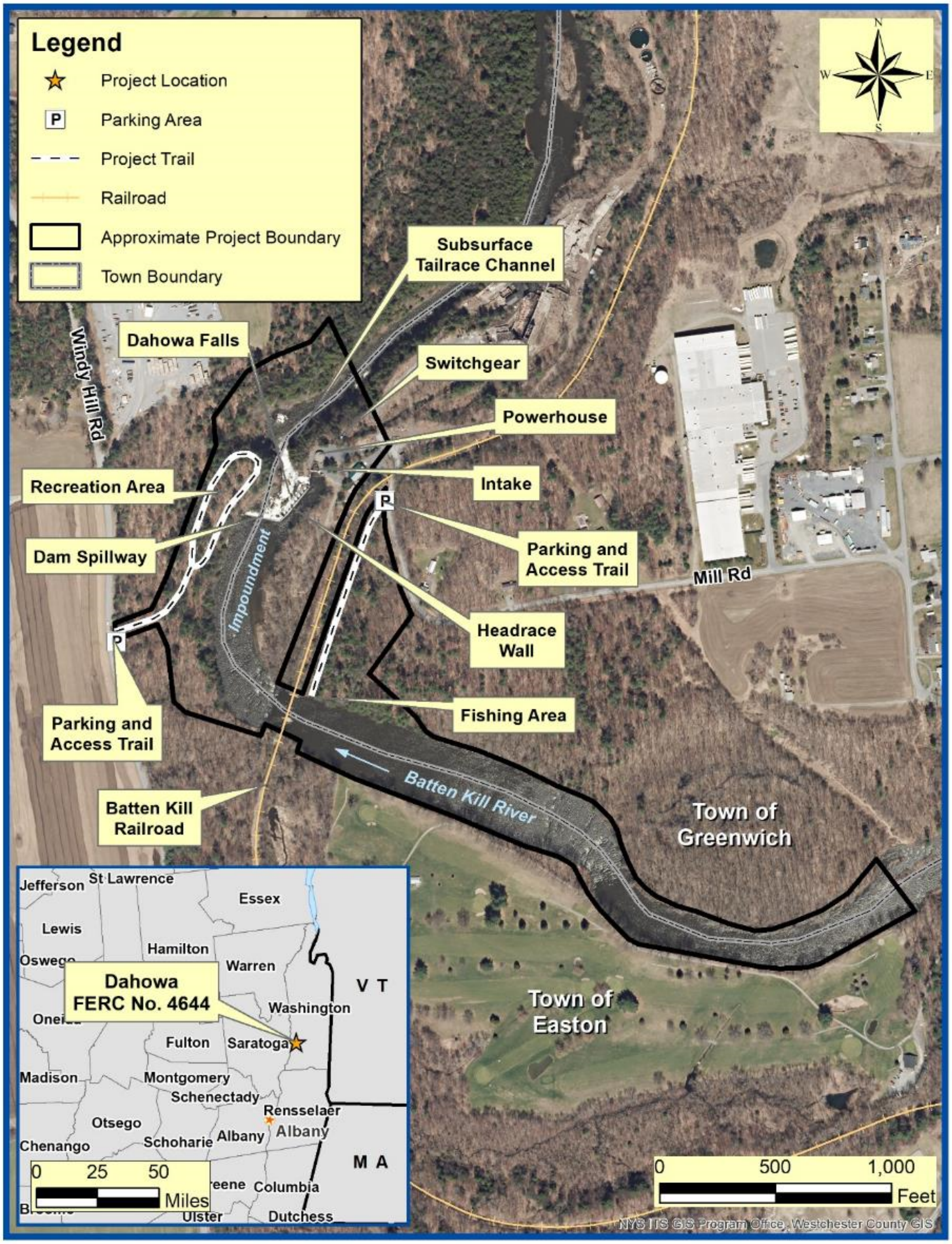


Figure 2. Dahowa Hydroelectric Project - General Configuration and Key Features

The Project is operated in run-of-river mode and does not have any provisions for storage. The normal, maximum, and minimum operating water surface elevation is 240.0 feet (ft) above National Geodetic Vertical Datum of 1929 (NGVD 29). The surface area of the reservoir is approximately 2.7 acres (ac) with an approximate reservoir volume of 12 acre-feet (ac-ft). The Project Dam is located at the top of Dionondahowa (Dahowa) Falls, a natural waterfall with an approximate height of 70 ft (**Error! Reference source not found.**) [79]. Flows that pass through the powerhouse are returned to the stream at the base of the falls via an underground tailrace tunnel.

The concrete dam is located immediately upstream from the falls. The dam is 163 ft long and varies from 3 to 15 ft in height, with a crest elevation of 235.0 ft (NGVD 29). It is fitted with 60-inch (in.) tall wooden flashboards. The headrace wall abuts the dam and is approximately 228 ft long and 8 ft high with a crest elevation of 237.0 ft (NGVD 29). The headrace wall is fitted with 36-in. timber (self-failing) tall wooden flashboards.

At the angled abutment between the spillway and headrace wall is a concrete block housing with an integrated pipe system which discharges water to the toe of the dam for aesthetic purposes; t

The Project utilizes the existing headwall to create a forebay in which headwater is conveyed to the intake structure. The intake structure conveys water to the powerhouse via a vertical drop pipe. The intake is located at the terminal (north end) of the canal. It consists of a trash rack spanning the forebay for the total intake and forebay width of 37 ft. The trash rack is approximately 36 feet wide with a wetted depth (at normal water surface elevation) of 27 ft. The top portion of the rack is plastic hydrothane type racks to reduce ice accumulation issues in the winter while the remaining bottom of the rack is steel bars. The clear spacing of all sections of the rack is 2.5 in. The trash rack is supported by a reinforced concrete pier constructed within the intake appended to the caisson walls of the forebay. This structure provides a deck for operations and maintenance of the trash rack.

At the terminus of the headwall and adjacent to the west side of the trashrack is a crest gate which is utilized to facilitate debris removal. The gate is approximately 12 feet long and 4 feet tall and is pneumatically operated.

Flows pass through the trash rack and then through a flared opening formed in reinforced concrete. Flows are directed downward through a bell mouth, travel vertically in an 18-ft diameter pipe formed from precast rings (drop pipe), and into the scroll case.

The caisson type powerhouse is constructed of concrete and is located below grade level, adjacent to the falls. The circular powerhouse has an outside diameter of 44 ft and a depth of 142 ft. The powerhouse houses a single turbine/generator and control equipment. The turbine equipment is fully automated with pond level control.

The tailrace tunnel was excavated between the powerhouse and the streambed at a depth below the river bottom and exits into the existing streambed below normal tailwater elevation. Due to the excavated nature of its construction and location below normal tailwater, the tailrace tunnel is not visible. Flows pass through the powerhouse and are returned to the stream at the base of the falls. The mean tailwater elevation with the turbine in operation is about 143.0 ft (NGVD 29).

4.2 General Description of the Watershed

The Project is located within the Upper Hudson River Drainage Basin, which extends across an area of approximately 4,620 square miles (sq. mi) in New York State and portions of southwestern Vermont and northwestern Massachusetts (Figure 3). The Battenkill River originates in southeastern Vermont and flows approximately 59 mi to the south and west before draining into the Hudson River approximately 3.8 miles downstream of the Project. With its tributaries, the Battenkill drains approximately 334 miles of streams over a drainage area of approximately 442 square mi [53].

The Project is one of eight dams located along the lower 11 mi of the Battenkill River (Figure 4, Table 6). Two additional FERC-licensed Projects, Middle Greenwich (FERC No. 6903) and Upper Greenwich (FERC No. 6904) are located approximately 4.0 miles and 4.5 miles upstream of the Dahowa Hydroelectric Project. Both are currently in the relicensing process as their licenses expire on January 31, 2026 and April, 30 2026, respectively. The remaining dams on the river are either FERC-exempt hydropower facilities or are used for other purposes. There are no dams or diversions on the Battenkill River located in Vermont [37].

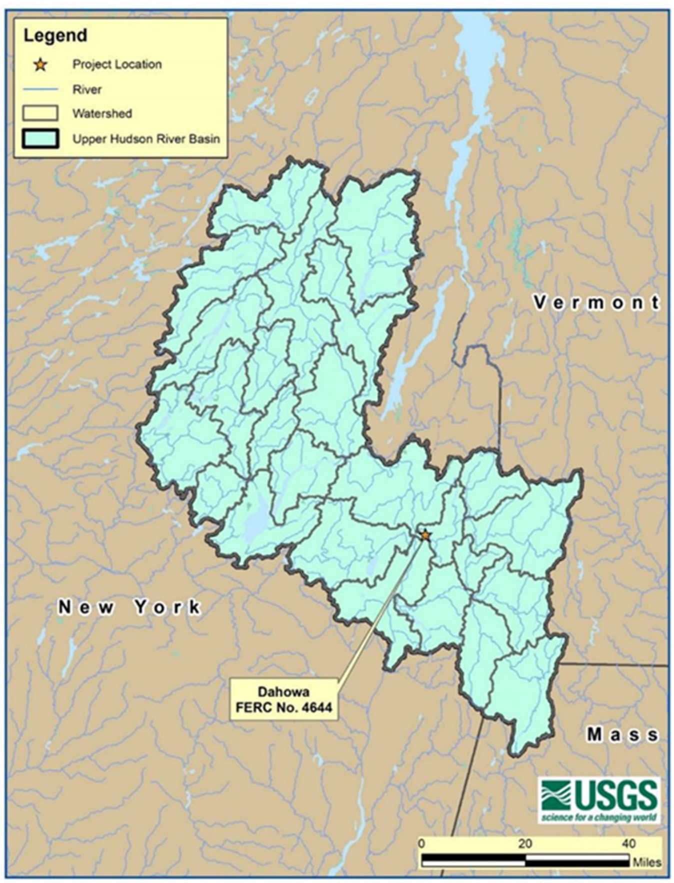


Figure 3. Upper Hudson River Drainage Basin and Watersheds [75]

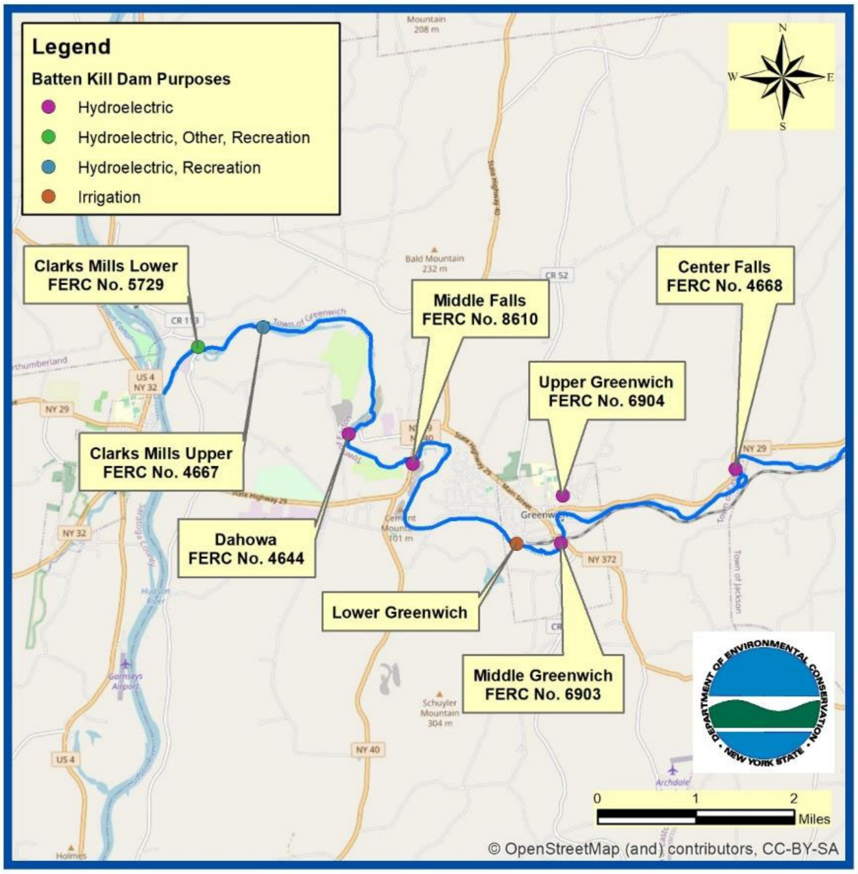


Figure 4. Battenkill Dams and Purposes [37]

Table 6 Battenkill Dams Summary

Project Name	FERC No.	FERC Status	Owner	Dam Height (ft)
Center Falls	4668	Exempt	Hollingworth & Vose Co.	28
Upper Greenwich	6904	Active Relicensing	Battenkill Hydro	11.5
Middle Greenwich	6903	Active Relicensing	Battenkill Hydro	10
Lower Greenwich	N/A	Non-FERC (Irrigation)	Marvin Ferris	7
Middle Falls	8610	Exempt	Adirondack Hydro Development Corp.	48
Dahowa	4644	Active Relicensing	GR Catalyst Two, LLC.	Average 6
Clarks Mills Upper	4667	Exempt	Hollingworth & Vose Co.	23
Clarks Mills Lower	5729	Exempt	Hollingworth & Vose Co.	20

4.3 Climate

The project region experiences warm summers and cold winters with snow. Temperature data from the National Weather Service Albany, NY monitoring station was reviewed for a period of January 1, 2021 through December 31, 2023. The highest maximum temperature recorded was in August 2022 and reached 99 degrees Fahrenheit. The lowest minimum temperature recorded over the three years was -13 in February 2023.

4.4 Topography

Greenwich, New York is located in the Hudson-Mohawk Lowlands Valley and Ridge physiographic province and Appalachian Highlands ecoregion. The immediate vicinity of the project is a mix of low density residential, agricultural and commercial development.

5.0 Geology and Soils

5.1 Affected Environment

The Project is located within the Valley and Ridge physiographic province of the United States (Figure 3**Error! Reference source not found.**), which forms a portion of the Appalachian Highlands and extends approximately 1,200 mi from east-central New York to the Coastal Plain of central Alabama. The province is characterized by long north-north easterly trending ridges separated by fertile valleys. This topography was formed by the erosion of alternating layers of hard and soft sedimentary rock that were folded and faulted during the building of the Appalachians. Ridges developed on resistant layers of sandstone or chert, which form thin acidic soils that support wooded areas, whereas valleys are underlain by shale or limestone that provide thicker, more fertile lowland soils [8].

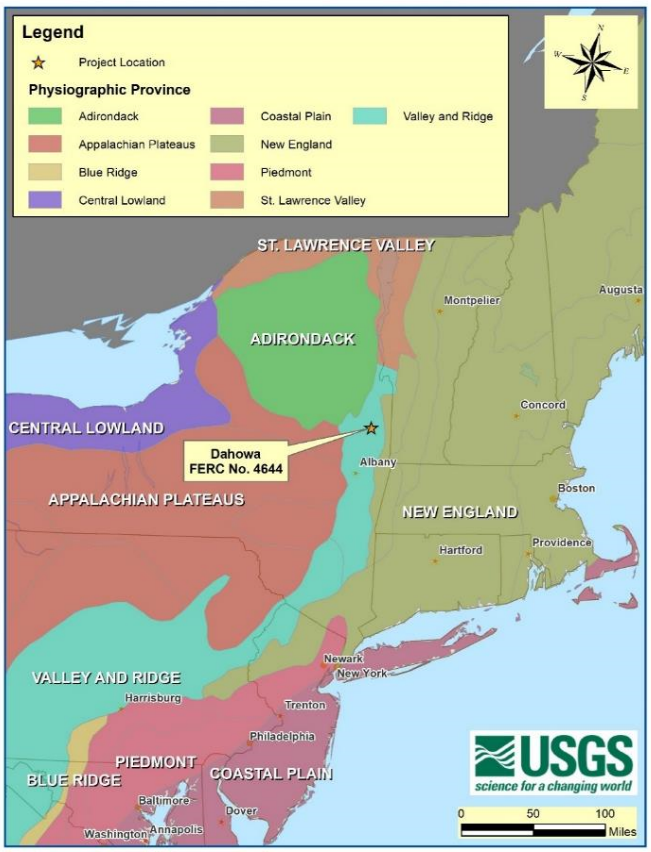


Figure 8. United States Physiographic Provinces – Dahowa Hydroelectric Project [16]

Among the 13 physiographic provinces of New York State, the Project is located within the Hudson-Mohawk Lowlands (Figure 4). Formed by glacial deposits, this lowland extends across much of the north-south length of eastern New York and is primarily bounded by uplands [54].

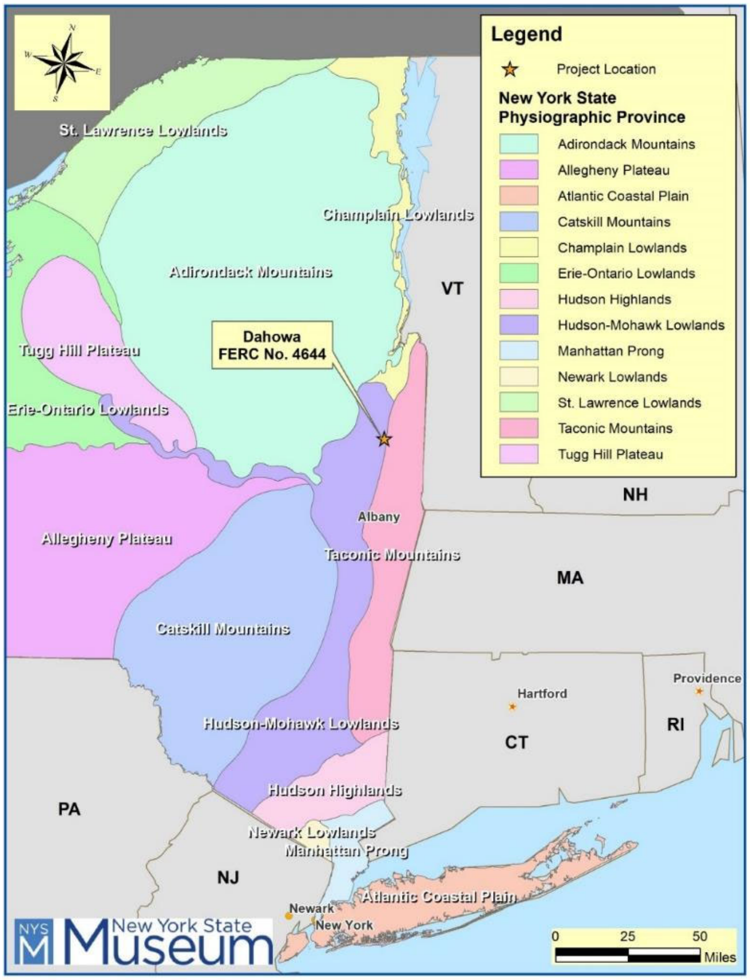


Figure 9. New York State Physiographic Provinces – Dahowa Hydroelectric Project [56]

Bedrock geology in the western portion of the Project area, including the dam and powerhouse, is underlain by Canajoharie Shale (Figure 5), a sedimentary black shale that is dark in color due to the presence of organic matter. Formed during the Middle Ordovician period, Canajoharie shale overlies Trenton limestone with Utica shale above it [61]. The bedrock in the eastern part of the Project area is Taconic Melange, a chaotic mixture of Early Cambrian thru Middle Ordovician pebble to block-size angular-to-rounded clasts in a pelitic matrix of Middle Ordovician (Barneveld) age [17].

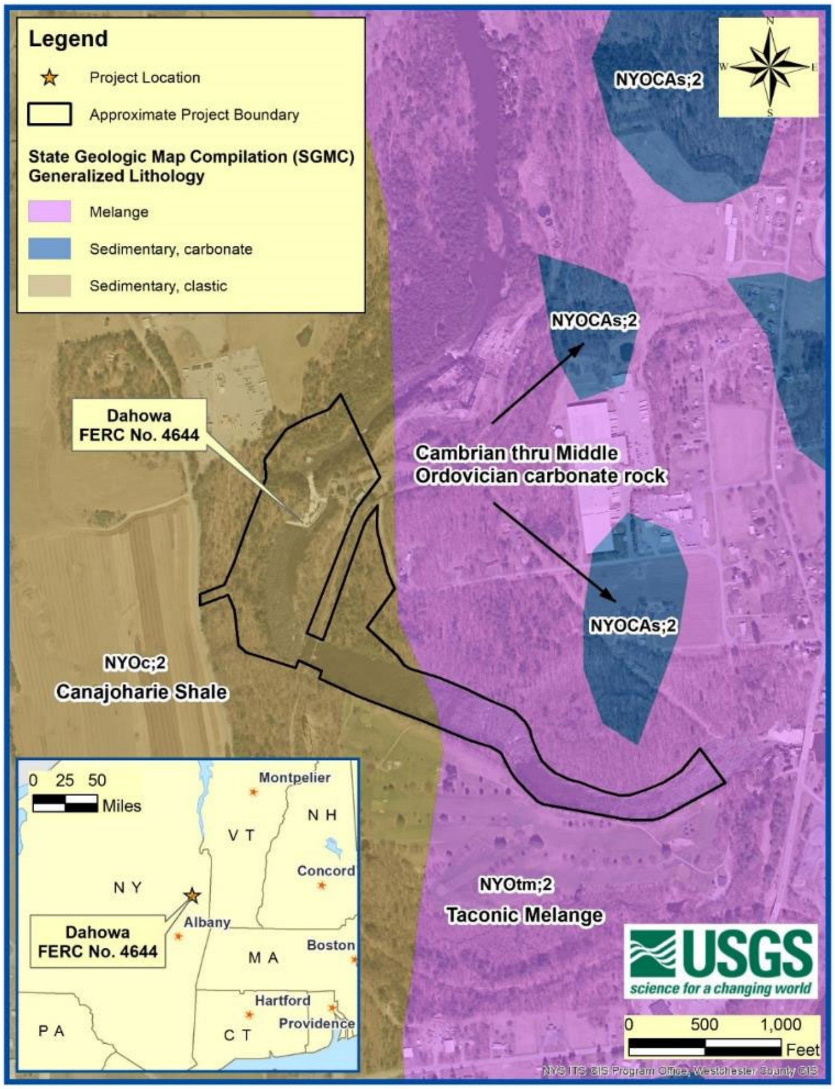


Figure 10. USGS Bedrock Map – Dahowa Hydroelectric Project [18]

Surficial geology across nearly the entire Project area consists of recent deposits of alluvium (Figure 6), which are typically oxidized fine sand to gravel confined to floodplains within a valley that may be overlain by silt in larger valleys. These deposits may vary in thickness from 3 to 33 ft. A small portion of the Project area upstream of the dam along the descending left bank consists of Lacustrine delta (Figure 6), which is coarse to fine gravel and sand that is stratified and generally well-sorted. It is frequently deposited at a lake shoreline with thicknesses ranging from approximately 10 to 50 ft [5].

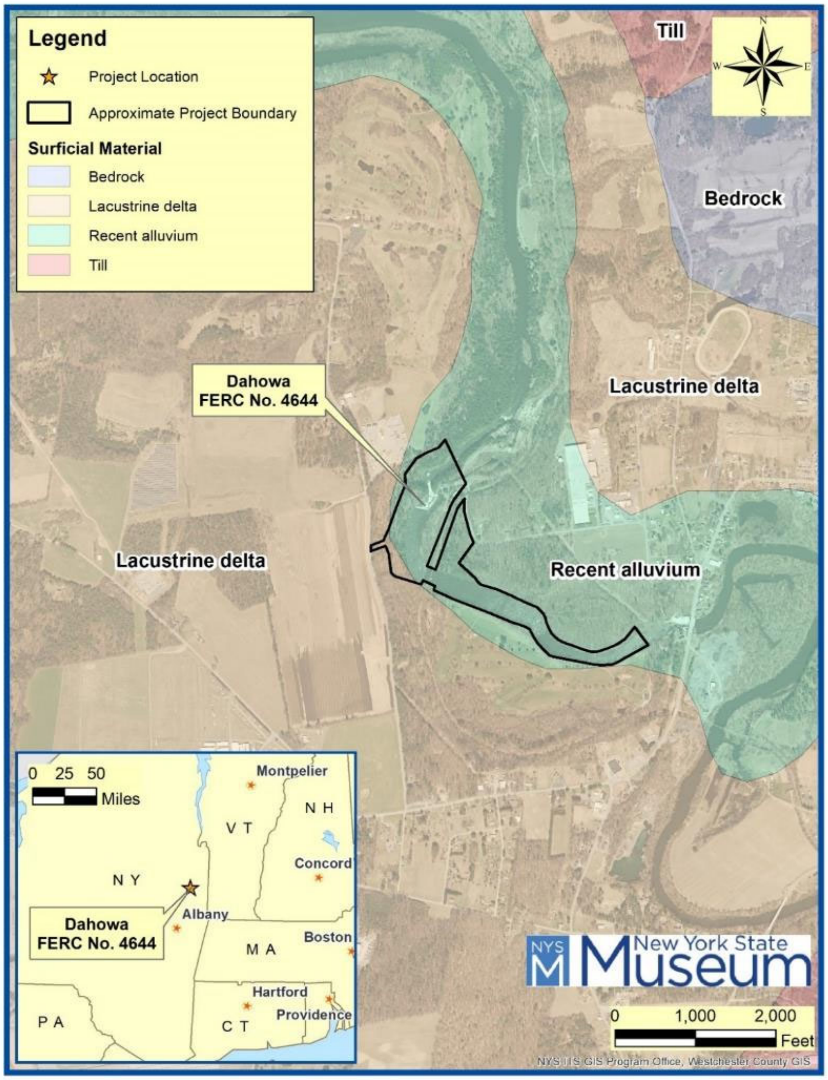


Figure 11. Surficial Geology – Dahowa Hydroelectric Project [57]

Soils within the Project area (Figure 7) are described using data obtained from the Web Soil Survey tool provided by the US Department of Agriculture Natural Resources Conservation Service (USDA NRCS). Excluding open water, soils in the Project area were found on steep slopes and primarily of the Oakville and Hoosic series (**Error! Reference source not found.**) [68].

The full USDA soils report can be found in Appendix C.

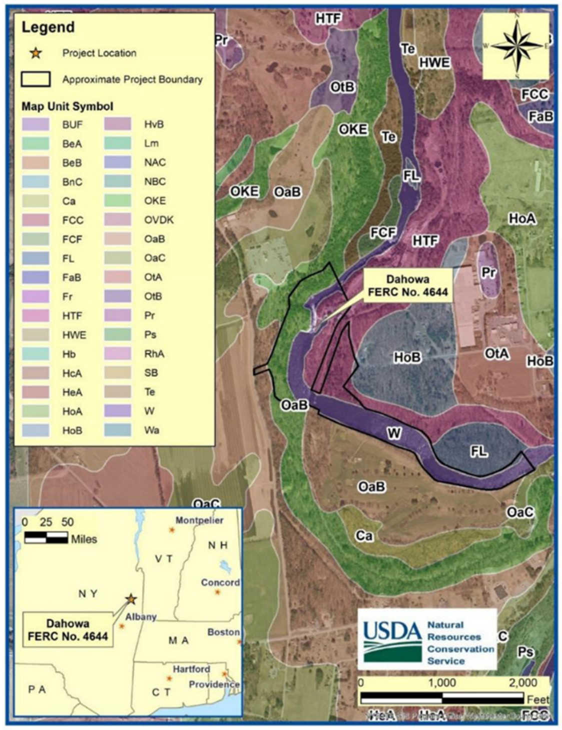


Figure 12. USDA Soils Map – Dahowa Hydroelectric Project

Table 13. Summary of USDA NRCS Soil Types [68]

Map Unit Symbol	Map Unit Name	Percent Area of Interest
FL	Fluvaquents	1.9
HoB	Hoosic Gravelly Sandy Loam, 3-8 percent slopes	0.3
HTF	Hoosic and Otisville soils, steep and very steep	26.8
OaB	Oakville loamy fine sand, 0 to 5 percent slopes	1.7
OaC	Oakville Loamy Fine Sand, 5-15 percent slopes	0.0
OKE	Oakville loamy fine sand, moderately steep and steep	22.2
W	Water	47.1

5.2 Project Impact on Geology and Soils

There currently are no proposed changes to Project operations or new land disturbing activities planned which would impact geologic or soil resources in the Project area. Continued operation of the Project as it has over the existing license term will maintain the existing hydrograph, limit impoundment fluctuations and maintain existing shoreline conditions.

5.3 Protection, Mitigation, and Enhancement Measures (PM&E)

Agency Recommended Mitigation

The licensee is not aware of any agency proposed PM&E measures related to Geology and Soils.

Applicant Proposed Mitigation

The licensee is not proposing any PM&E measures related to Geologic or Soil Resources.

6.0 Water Resources

6.1 Affected Environment

Drainage Area

The Project is located within the Upper Hudson River Drainage Basin, which extends across an area of approximately 4,620 square miles (sq. mi) in New York State and portions of southwestern Vermont and northwestern Massachusetts (**Error! Reference source not found.**). The Battenkill River originates in southeastern Vermont and flows approximately 59 mi to the south and west before draining into the Hudson River approximately 3.8 miles downstream of the Project. With its tributaries, the Battenkill drains approximately 334 miles of streams over a drainage area of approximately 442 square mi [53].

Streamflow – USGS Gage Data

There is a U.S. Geological Survey (USGS) gage located on the Battenkill River upstream of the Project at Battenville, NY (USGS Gage No. 01329490) with discharge data available from 1922 to present; however, there is a data gap until mid-1998 (Figure 8). A 21-year period of record (1999-2020) was available for evaluation to determine flows at the project [76].

The USGS gage at Battenville represents 396 sq. mi of drainage area [76]. According to USGS StreamStats, the Project has a drainage area of 436 sq. mi [77]. Given the US gage drainage area of 396 sq. mi, the drainage area ratio used to normalize discharge measurements to the Project is 1.10 (Figure 5). The StreamStats report can be found in Appendix D.

Using the data from the Battenville USGS gage (normalized to the Project location), the flow duration curve is shown in **Error! Reference source not found.**, and the flow data are shown in **Error! Reference source not found.** and **Error! Reference source not found.**. Monthly flow duration curves can be found in Appendix E.

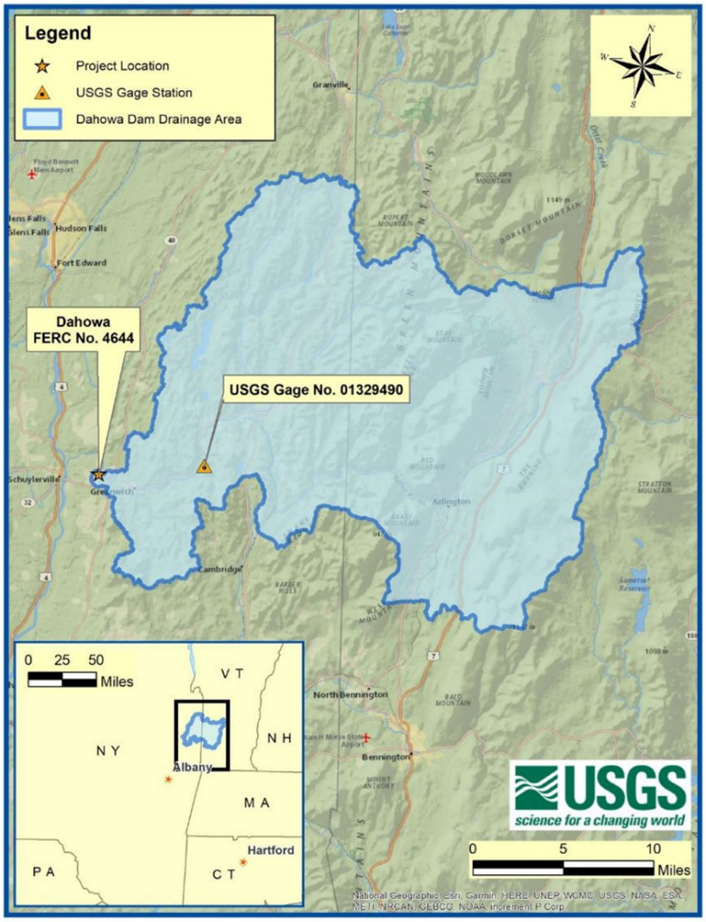


Figure 5. USGS StreamStats Delineation – Dahowa Hydroelectric Project [77]

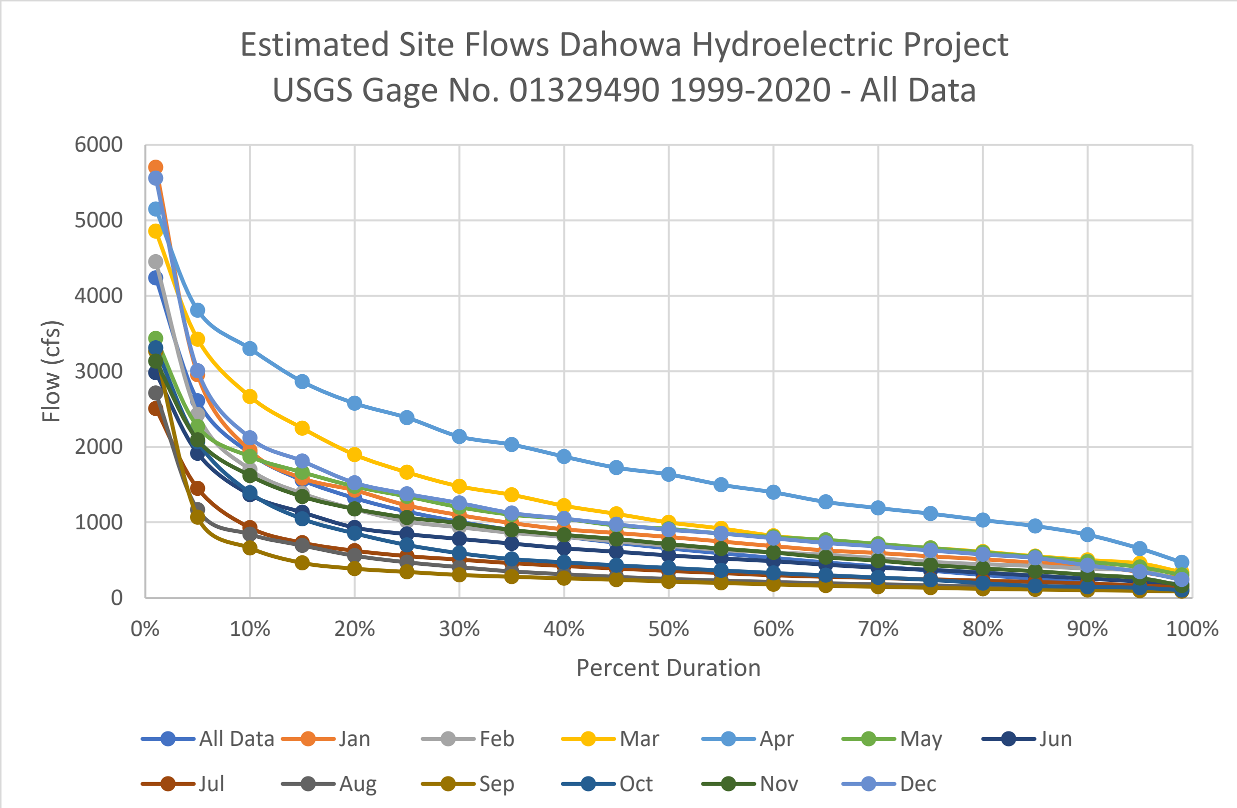


Figure 6. Flow Duration Curve, 1999-2020 – Dahowa Hydroelectric Project [76]

Table 7. Flow Duration Values by Month 1999-2020 – Dahowa Hydroelectric Project [76]

Percent Duration	Flow Rate (cfs)												
	ALL MONTHS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	4238	5702	4451	4856	5148	3435	2982	2508	2712	3267	3311	3134	5558
5	2609	2953	2428	3424	3808	2268	1914	1448	1167	1067	2067	2090	3007
10	1916	1951	1700	2666	3301	1872	1365	929	843	660	1392	1618	2118
15	1557	1585	1382	2246	2863	1664	1132	729	694	462	1046	1342	1812
20	1321	1425	1176	1896	2576	1475	931	624	558	387	854	1178	1524
25	1142	1225	1011	1663	2386	1343	844	553	471	343	701	1063	1376
30	1007	1096	935	1476	2136	1200	781	507	406	304	592	990	1256
35	900	991	861	1365	2029	1101	719	460	350	280	514	900	1123
40	813	908	808	1220	1872	1047	657	423	312	259	471	834	1051
45	730	860	749	1112	1724	958	611	389	278	240	432	780	973
50	655	806	689	999	1635	913	563	357	250	216	397	713	902
55	590	746	634	919	1497	852	523	328	230	197	363	652	853
60	528	685	602	822	1398	806	486	300	210	179	329	600	789
65	469	628	571	759	1270	767	440	280	193	161	298	536	727
70	415	594	525	706	1189	714	400	263	180	147	270	492	680
75	361	551	476	661	1115	659	371	246	165	133	238	435	628
80	303	512	446	610	1029	603	333	227	151	120	194	390	575
85	251	466	422	551	951	543	294	211	138	110	157	353	528
90	198	432	385	502	836	479	255	191	126	103	146	306	430
95	146	341	358	455	652	408	217	164	115	93	133	262	347
99	103	254	231	339	469	302	182	139	102	86	102	163	241

Table 8. Hydroelectric Project Flows - Minimum, Average and Maximum, 1999-2000 [76]

	Flow Rate (cfs)		
	Max	**Avg**	**Min**
All	15084	914	78
Jan	11891	1084	233
Feb	6001	925	209
Mar	8500	1340	275
Apr	8500	1866	416
May	4536	1074	253
Jun	4085	721	146
Jul	4459	506	130
Aug	15084	432	92
Sep	6980	362	78
Oct	5087	620	87
Nov	4294	861	148
Dec	10746	1181	209

Impoundment

There are no known existing water uses within the impoundment or Project boundary. Similarly, there are no known proposals for water use within the impoundment or Project boundary other than the continued operation of the Dahowa Hydroelectric Project.

Bypassed Reach

The Project bypass reach consists only of the shear rock waterfall. The dam is immediately upstream of the waterfall and the turbine discharges release directly into the pool at the toe of the waterfall. Habitat in this area is limited to rock pools and sporadic and opportunistic vegetative growth along the gorge walls.

According to the FERC license, a minimum 40 cfs aesthetic flow over the waterfall is required between 6:00 AM and 8:00 PM from the third Saturday in May through Labor Day weekend and from sunrise to sunset on weekends and holidays from Labor Day weekend through November 30. At all other times, a minimum flow of 25 cfs is required over the waterfall for water quality purposes and for the protection of flow-dependent resources. The 40 cfs is released from a combination of crest gate and siphon pipe discharge.

The minimum flow required for turbine operation is 250 cfs. During periods when the minimum flow requirements is 25 cfs the turbine does not operate until the river flow is 275 cfs. During periods when the minimum flow requirements is 40 cfs, the turbine does not operate until the river flow is 290 cfs. Due to the fluctuation of minimum flow release requirements, it is not uncommon for the licensee to simplify operations and maintain a steady 40 cfs minimum flow even when only 25 cfs is required.

When river flows exceed the minimum flow requirement plus the maximum turbine flow, all excess flow is passed over the flashboards. In high water conditions, the crest gate can be lowered to provide some additional water control, in some instances. The project is not operated for flood control and does not have provisions to do so.

The project is operated as run-of-river. The project has pressure transducers and a programmable logic controller (PLC) that automatically maintain the pond level

Water Quality Standards

The Project is located within the lowermost segment of the Battenkill River, which is identified under the Water Inventory/Priority Waterbodies List (WI/PWL) ID 1103-0010. This segment is designated as a Class C surface water according to Title 6 of the New York Codes, Rules, and Regulations (NYCRR) § 701 (Figure 7). Class C fresh surface waters are characterized in 6 NYCRR § 701.8 according to the following:

Currently there are no known use impairments to the Lower Battenkill segment [34]. The Middle (WI/PWL ID 1103-0011) and Upper (WI/PWL ID 1103-0012) segments are currently listed as impaired on the New York State List of Integrated Report (IR) Category 4a/b/c Waters, which lists waterbody segments exempted from the Clean Water Act (CWS) Section 303(d) List of Impaired Waters because a Total Maximum Daily Load (TMDL) is not necessary [40]. Both have use impacts to habitat/hydrology related to the systematic removal of stream cover that provides refuge for fish from predators [35], [36], [40]. According to its waterbody fact sheet, the Upper Battenkill segment is also impaired for fish consumption due to elevated levels of mercury in a crayfish sample likely resulting from atmospheric deposition [36].

Table 9. New York Water Quality Standards for Class C, Non-trout Surface Waters [31], [32]

Parameter	Numeric or Narrative Standard
pH	Shall not be less than 6.5 nor more than 8.5.
Dissolved oxygen (DO)	For non-trout waters, the minimum daily average shall not be less than 5.0 mg/L, and at no time shall the DO concentration be less than 4.0 mg/L.
Dissolved solids	Shall be kept as low as practicable to maintain the best usage of waters but in no case shall it exceed 500 mg/L.
Total coliforms (Number per 100 milliliters)	The monthly median value and more than 20 percent of the samples, from a minimum of five examinations, shall not exceed 2,400 and 5,000, respectively.
Fecal coliforms (Number per 100 milliliters)	The monthly geometric mean, from a minimum of five examinations, shall not exceed 200.
Taste-, color-, and odor-producing, toxic, and other deleterious substances	None in amounts that will adversely affect the taste, color, or odor thereof, or impair the waters for their best usages.
Turbidity	No increase that will cause a substantial visible contrast to natural conditions.
Suspended, colloidal, and settleable solids	None from sewage, industrial wastes, or other wastes that will cause deposition or impair the waters for their best usages.
Oil and floating substances	No residue attributable to sewage, industrial wastes, or other wastes, nor visible oil film nor globules of grease.
Phosphorus and nitrogen	None in amounts that will result in growths of algae, weeds, and slimes that will impair the waters for their best usages.
Thermal discharges	The following general criteria shall apply: • The natural seasonal cycle shall be retained; • Annual spring and fall temperature changes shall be gradual; • Large day-to-day temperature fluctuations due to heat of artificial origin shall be avoided; • Development or growth of nuisance organisms shall not occur in contravention of water quality standards; • Discharges which would lower receiving water temperature shall not cause a violation of water quality standards and section 704.3 of this Part; and • For the protection of the aquatic biota from severe temperature changes, routine shut down of an entire thermal discharge at any site shall not be scheduled during the period from Dec. through March.

Parameter	Numeric or Narrative Standard
Thermal discharges (Continued)	The following special criteria shall apply to non-trout waters: • The water temperature at the surface of a stream shall not be raised to more than 90 degrees Fahrenheit (°F) at any point. • At least 50 percent of the cross-sectional area and/or volume of flow of the stream, including a minimum of one-third of the surface as measured from shore to shore, shall not be raised to more than 5º F over the temperature that existed before the addition of heat of artificial origin or to a maximum of 86º F, whichever is less. • At least 50 percent of the cross-sectional area and/or volume of flow of the stream, including a minimum of one-third of the surface as measured from shore to shore, shall not be lowered more than 5°F degrees from the temperature that existed immediately prior to such lowering. From June through September no discharge shall be permitted that will lower the temperature of the stream more than two Fahrenheit degrees from that which existed immediately prior to such lowering.
Flow	No alteration that will impair the waters for their best usages.

Available Water Quality Data

Water quality in the Battenkill River has been monitored since the 1980s and it continues to be assessed approximately every five years as part of the NYSDEC's Rotating Integrated Basin Studies (RIBS) program [49]. A 2021 assessment of the Upper Hudson River under this program is currently in progress [50]. Water quality historically has been excellent throughout the river, although slightly impacted conditions were observed during 1999 and 2001 sampling with most of the apparent declines in water quality occurring in upstream reaches of the river [33], [34].

Results of field-based and water chemistry measurements collected from monitoring stations located in the Lower Battenkill River (Figure 7) are presented in Table 10, Table 11, and Table 12 [51].

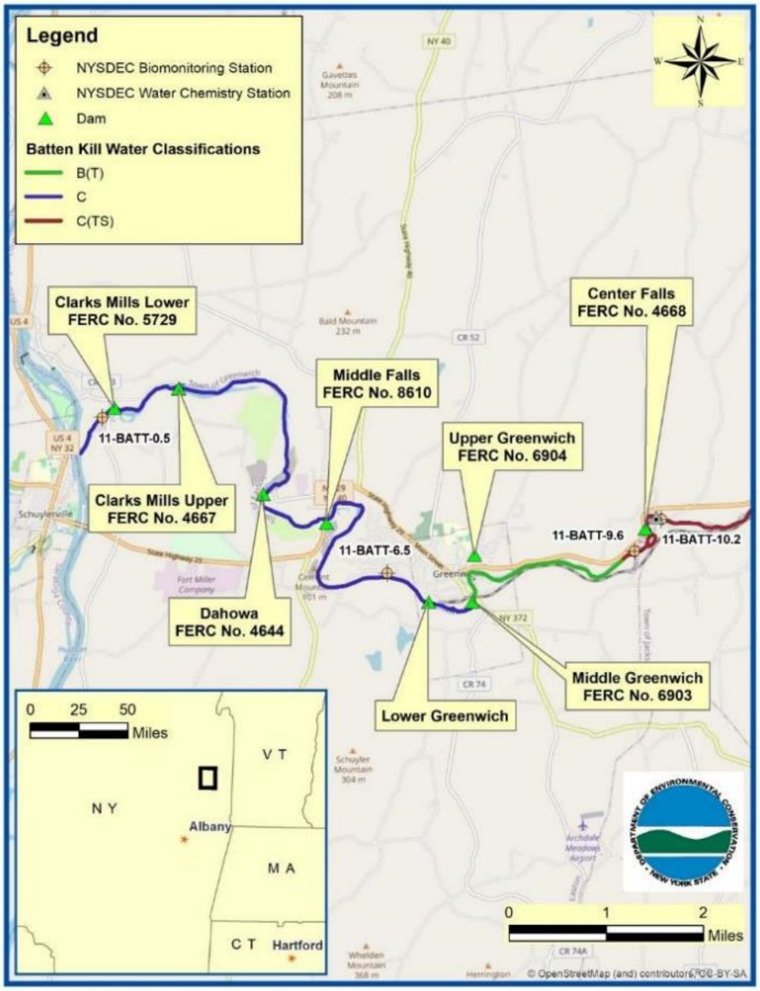


Figure 7. Lower Battenkill River Water Classifications and Monitoring Station [39], [41]

Table 10. Water Quality Field Measurements Collected in the Lower Battenkill River, 1984-2012 [51]

	Water Temperature (°C)				Conductivity (µS/cm)				Dissolved Oxygen (mg/l)				pH			
Month Year	RM 0.5	RM 6.5	RM 9.6	RM 10.2	RM 0.5	RM 6.5	RM 9.6	RM 10.2	RM 0.5	RM 6.5	RM 9.6	RM 10.2	RM 0.5	RM 6.5	RM 9.6	RM 10.2
October 1984	10.0	10.0	10.0	10.0	170	170	170	150	10.2	10.2	10.2	10.2	8.2	8.0	8.0	7.8
June 1986	17.5	16.0	16.0	16.0	155	160	145	150	9.4	9.8	10.2	9.8				
August 1987		21.0				225				9.3						
July 1993		20.1				280				8.9				8.0		
August 1999	24.2	24.1		22.3	261	280		264	7.0	8.8		8.1	7.9	8.3		8.1
September 2001	18.7		18.4		280		315		10.5		9.4		8.2		8.0	
September 2012			20.5				296				8.8				7.9	
Mean	17.6	18.2	16.2	16.1	217	223	232	188	9.3	9.4	9.6	9.4	8.1	8.1	8.0	8.0

Table 11. Water Chemistry Samples Collected in the Battenkill River, 2007 [51]

Parameter	**4/30**	**5/22**	**6/11**	**7/9**	**8/14**	**9/4**	**9/24**	**10/15**	**11/5**	**Mean**
Alkalinity, Total (As CaCO3) (total, mg/l)	52.0	54.4	91.2	103.0	114.0	123.0	122.0	92.0	84.0	**92.8**
Aluminum (dissolved, µg/l)	97.0	71.8								**84.4**
Aluminum (total, µg/l)	193.0	409.0	72.0	58.2			54.6	243.0	83.7	**159.1**
Calcium (total, mg/l)	16.9	16.3	44.0	28.5	33.8	34.1	32.1	29.0	24.4	**28.8**
Chloride (As Cl) (total, mg/l)	6.7	6.2	10.6	12.9	13.9	14.2	19.0	11.2	10.7	**11.7**
Coliform (total, cfu/100ml)	20	520	220	2600	1000	250	1500	760	150	**780**
Copper (dissolved, µg/l)	0.957	0.729	1.400	0.950	0.966	0.685	0.885	0.936	0.795	**0.923**
Copper (total, µg/l)	2.1	1.9	2.3	1.5	2.0	0.7	2.1	4.4	4.2	**2.4**
Fecal Coliform (total, cfu/100ml)	20	86	46	250	80	40	150	95	50	**91**
Hardness (As CaCO3) (total, mg/l)	54	54	93	107	125	135	125	105	90	**99**
Iron (total, µg/l)	280	469	963	101	61	54	113	337	157	**282**
Lead (dissolved, µg/l)	0.104	0.115	0.085				0.058	0.083	0.069	**0.086**
Lead (total, µg/l)	0.7	3.0	1.6	1.0	6.1	0.2	0.4	3.3	1.3	**2.0**
Magnesium (total,mg/l)	4.3	4.2	17.1	8.4	10.4	10.5	10.3	9.0	6.4	**9.0**
Manganese (total, µg/l)	28.3	31.1	65.4	19.7	20.3	21.6	20.1	52.2	18.3	**30.8**

Parameter	4/30	5/22	6/11	7/9	8/14	9/4	9/24	10/15	11/5	Mean
Nickel (dissolved, µg/l)	1.2	0.9	0.8	1.2	0.8	0.7	1.1	1.1	1.0	**1.0**
Nickel (total, µg/l)	1.3	1.2	1.5	1.3	1.6	0.7	1.1	1.7	1.1	**1.3**
Nitrogen, Ammonia (As N) (total, mg/l)	0.018			0.032		0.013	0.012		0.012	**0.017**
Nitrogen, Kjeldahl, Total (total, mg/l)	0.259	0.256	0.269	0.375	0.185	0.279	0.143	0.188	0.191	**0.238**
Nitrogen, Nitrate (As N) (total, mg/l)	0.875	0.577	0.642	0.703	0.575	0.601	0.487	0.368	0.742	**0.619**
Nitrogen, Nitrate-Nitrite (total, mg/l)	0.875	0.577	0.656	0.714	0.575	0.601	0.487	0.368	0.742	**0.622**
Nitrogen, Nitrite (total, mg/l)			0.0143	0.0107						**0.0125**
pH (total, ph units)	7.4	7.4	7.8	7.5	7.8	7.9	8.0	7.1	7.1	**7.5**
Phosphate Ion (total, mg/l)	0.003	0.004		0.003	0.003		0.003	0.004	0.005	**0.004**
Phosphorus (total, mg/l)	0.021	0.017	0.013	0.030	0.009	0.011	0.019	0.018	0.015	**0.017**
Potassium (total, mg/l)	0.586	0.675	0.760	0.846	0.912	0.929	0.952	1.180	1.030	**0.874**
Sodium (total, mg/l)	4.22	4.19	6.69	7.32	8.77	8.66	8.15	7.81	7.30	**7.01**
Specific Conductance (total, µmhos/cm)	135	144	225	258	278	302	284	237	222	**232**
Sulfate (As SO4) (total, mg/l)	5.4	5.2	6.5	6.8	7.0	7.3	9.1	7.6	8.0	**7.0**
Total Dissolved Solids (Residue, Filterable) (total, mg/l)	89	102	129	150	151	160	164	130	129	**134**
Total Organic Carbon (dissolved, mg/l)	2.93	2.66	1.91	1.92	1.66			3.84	2.10	**2.43**
Total Organic Carbon (total, mg/l)	2.7	3.1	2.2	2.1	1.2		1.2	4.2	2.3	**2.4**
Total Solids (total, mg/l)	76	75	114	133	151	166	152	132	123	**125**
Total Suspended Solids (total, mg/l)	11.8	14.4	2.9	3.4	2.3	1.7	1.9	3.0	3.2	**5.0**
Total Volatile Solids (total, mg/l)	19	31	15	32	30	28	32	39	19	**27**
Zinc (total, µg/l)	7.1	7.5	12.8		28.5	8.8	3.4	14.3		**11.8**

Table 12. Water Chemistry Samples Collected in the Battenkill River, 2012 [51]

Parameter	4/9	4/23	5/7	5/29	6/20	7/17	8/6	9/18	10/10	10/29	Mean
Alkalinity, Total (As CaCO3) (total, mg/l)	89.7	55.0	67.3	95.6	98.0	110.0	111.0	124.0	88.8	87.0	**92.6**
Aluminum (dissolved, µg/l)	16.2	134.0	26.1	17.6	5.4	8.0	9.6	6.6	30.1	24.7	**27.8**
Aluminum (total, µg/l)	49.5	1620.0	117.0	64.0	40.0	57.1	78.5	40.7	63.5	61.8	**219.2**
Cadmium (total, µg/l)	0.187	0.058									**0.123**
Calcium (total, mg/l)	26.8	17.2	21.2	28.9	28.7	30.3	30.6	32.9	24.1	28.9	**27.0**
Chloride (As Cl) (total, mg/l)	9.4	6.0	7.6	9.3	10.6	12.5	13.2	14.4	9.3	9.4	**10.2**
Copper (dissolved, µg/l)	0.625	0.913	0.704	0.829	1.2	0.846	0.814	0.666	0.678	0.523	**0.780**

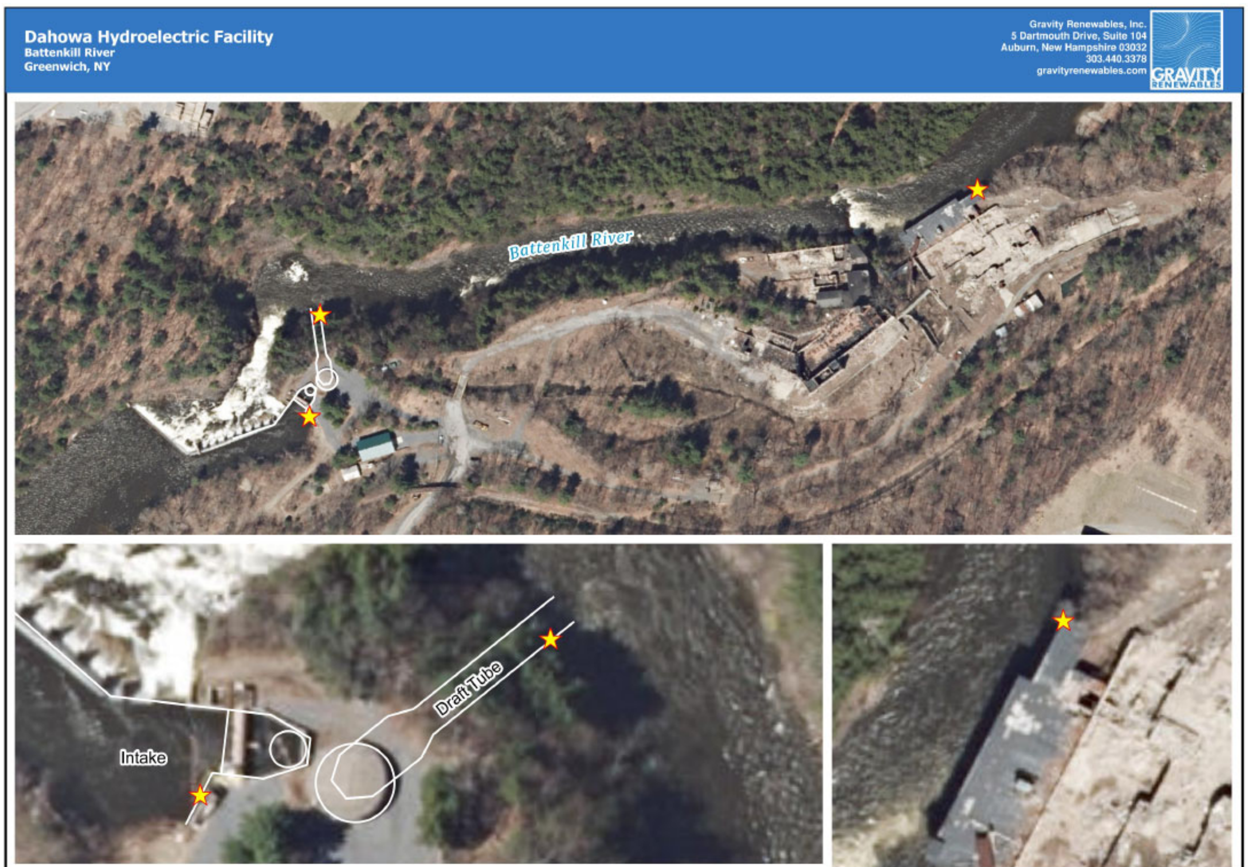
Parameter	4/9	4/23	5/7	5/29	6/20	7/17	8/6	9/18	10/10	10/29	Mean
Copper (total, µg/l)	0.7	2.6	0.9	1.0	0.9	0.9	0.9	0.7	0.7	0.5	**1.0**
Dissolved Organic Carbon (dissolved, mg/l)	1.4	3.7	2.2	2.0	1.9	2.0	2.2	1.6	3.3	2.5	**2.3**
Hardness (As CaCO3) (total, mg/l)	100	66	78	108	114	136	122	128	96	96	**104**
Iron (total, µg/l)	130	2560	200	133	99	95	136	79	131	127	**369**
Lead (dissolved, µg/l)		0.189	0.096	0.087	0.158		0.129	0.091			**0.125**
Lead (total, µg/l)	0.3	2.3	0.3	0.2	0.5	0.2	0.6	0.4	0.2	0.1	**0.5**
Magnesium (total, mg/l)	7.4	5.0	5.5	7.4	8.0	9.7	9.1	10.2	7.2	7.2	**7.7**
Manganese (total, µg/l)	19.7	179.0	28.3	23.2	14.2	23.0	30.4	18.9	16.0	22.0	**37.5**
Mercury (total, ng/l)	0.628	2.400	0.656	0.563	0.869	0.936	0.897	0.625	0.729	0.920	**0.922**
Nickel (dissolved, µg/l)	1.9	0.8	0.9	1.0	1.2	1.0	1.1	1.3	2.2	0.6	**1.2**
Nickel (total, µg/l)	0.8	2.1	0.9	1.0	0.9	1.0	1.1	1.6	0.8	0.7	**1.1**
Nitrogen, Ammonia (As N) (total, mg/l)	0.034	0.016						0.010		0.019	**0.020**
Nitrogen, Kjeldahl, Total (total, mg/l)		0.560	0.110	0.200	0.120	0.260	0.150	0.130		0.210	**0.218**
Nitrogen, Nitrate (As N) (total, mg/l)	0.514	0.377	0.377	0.499	0.571	0.531	0.466	0.386	0.284	0.421	**0.443**
Nitrogen, Nitrate-Nitrite (total, mg/l)	0.514	0.377	0.377	0.499	0.571	0.531	0.466	0.386	0.284	0.421	**0.443**
pH (total, ph units)	8.0	7.7	7.9	8.1	8.0	8.1	8.0	7.9	7.9	7.9	**8.0**
Phosphate Ion (dissolved, mg/l)		0.0054									
Phosphorus (total, mg/l)	0.006	0.081	0.011	0.013	0.011	0.010	0.015	0.008	0.008	0.012	**0.017**
Potassium (total, mg/l)	0.809	1.150	0.669	0.811	0.701	0.996	1.160	0.974	0.937	1.190	**0.940**
Silver (total, µg/l)							0.12				
Sodium (total, mg/l)	6.93	4.50	5.29	7.14	7.27	7.88	8.49	9.18	6.32	7.03	**7.00**
Specific Conductance (total, µmhos/cm)	218	140	173	228	251	277	281	300	217	226	**231**
Sulfate (As SO4) (total, mg/l)	6.4	4.8	5.8	6.1	6.1	6.2	6.4	5.8	5.1	6.5	**5.9**
Total Dissolved Solids (Residue, Filterable) (total, mg/l)	111	82	90	115	130	148	150	162	118	118	**122**
Total Organic Carbon (total, mg/l)	1.5	4.2	2.3	2.2	2.0	2.1	2.4	1.7	3.2	2.6	**2.4**
Total Solids (total, mg/l)	116	158	106	136	147	169	165	173	129	127	**143**
Total Suspended Solids (total, mg/l)	1.2	74.4	4.4	3.2	2.8	2.3	3.9	2.3	1.4	1.9	**9.8**
Total Volatile Solids (total, mg/l)	14	19	20	25	37	45	37	38	22	29	**29**
Turbidity (total, ntu)	0.75	5.69	0.89	1.42	1.30	1.25	1.24	1.09	1.18	1.21	**1.60**
Zinc (dissolved, µg/l)	8.2	2.7	3.1	3.3	5.4	5.3	1.9		1.7	2.6	**3.8**
Zinc (total, µg/l)	7.2	9.9	2.8	2.6	1.1	4.6	1.1		1.9	2.0	**3.7**

2023 Water Quality Study

An agency requested water quality study was conducted during 2023. The report of that study is still in process, but a brief summary is included below.

The goal of the 2023 study was to determine if operation of the Project causes or contributes to any potential detriment of water quality in the Battenkill River relative to the State of New York water quality standards. Water temperature and Dissolved Oxygen (DO) were collected at multiple locations in the Project area using both instantaneous measurements and continuous data collected via multi-parameter data loggers. Data were collected during low flow and high temperature conditions representative of typical summer conditions.

Three multi-parameter continuous data loggers were deployed. One in the impoundment, one in the reach downstream of the cascade where safe access is available, and one downstream of the cascade reach near the abandoned mill (see below). The loggers were deployed between April 19 and November 3, 2023.



Logger Locations
Water Quality Study 2023

Data collection from the two downstream loggers experienced interruptions associated with instrument losses resulting from high flow events. These periods are described below:

Tailwater – On July 17th, 2023, during a routinely scheduled maintenance and offload of the logger, it was discovered that during the preceding high flow event, the logger had become detached from its tether and was unlocatable. A new logger was calibrated and deployed at the same location on July 21st for the duration of the study. This resulted in a gap in data from June 23rd through July 21st.

Abandoned Mill – On August 4th, 2023, during a routinely scheduled maintenance and offload of the logger, the logger failed to communicate the recorded data to the data shuttle. On August 18th an offload of the logger was attempted again and failed. A new logger was calibrated and deployed at the same location on August 21st for the duration of the study. The originally deployed logger was sent to the manufacturer for investigation and possible data recovery. It was ultimately determined that the logger experienced a gasket failure within the instrument which allowed water to enter the device and led to complete corruption of the hardware and loss of the stored data. This resulted in a data gap from July 7th through August 21st.

There are no temperature standards to compare against, key metrics of dissolved oxygen data as part of the study are summarized below.

Summary of Key Dissolved Oxygen Data Metrics.

Metric (mg/L)	Headpond	Tailwater	Downstream Mill
Min. DO	3.32	7.66	8.18
Max. DO	12.71	14.13	12.98
Avg. DO	9.68	10.02	10.22

There were no observations which did not meet daily average DO standards for Class C waters in the headpond, tailrace or downstream reach of the Project. On September 8 and September 18, there were two brief periods when the instantaneous dissolved oxygen concentrations recorded by the headpond data logger fell below the state standard. There were two very brief (~0.016% of sample time) violations of instantaneous dissolved oxygen concentrations recorded by the headpond instrument. These occurrences were transient in nature; readings from both downstream loggers during the corresponding sample times recorded DO levels of 7.91 and 8.67 mg/L indicating that the conditions observed in the headpond did not transfer downstream.

Based on data collected during the study, Project operations were not found to impact water quality in the Battenkill River. Preliminary results were shared with resource agencies in Spring 2024 – a draft report is currently under review and is included as Appendix F.

6.2 Project Impact on Water Resources

Currently there are no known use impairments to the Lower Battenkill segment [34]. The Middle (WI/PWL ID 1103-0011) and Upper (WI/PWL ID 1103-0012) segments are currently listed as impaired on the New York State List of Integrated Report (IR) Category 4a/b/c Waters, which lists waterbody segments exempted from the Clean Water Act (CWS) Section 303(d) List of Impaired Waters because a Total Maximum Daily Load (TMDL) is not necessary [40]. Both have use impacts to habitat/hydrology related to the systematic removal of stream cover that provides refuge for fish from predators [35], [36],

[40]. According to its waterbody fact sheet, the Upper Battenkill segment is also impaired for fish consumption due to elevated levels of mercury in a crayfish sample likely resulting from atmospheric deposition [36].

The Project's use of river flows is limited to once-through non-contact energy harnessing. Chemicals are not introduced to water as it passes through the turbines, nor is it processed in any way. Continued operations of the Project will not result in any water contamination or exasperation of existing water quality issues. Continued operations of the Project will not result in any water contamination or exasperation of existing water quality issues. There are no anticipated Project-related impacts to the river basin characteristics, water quality or supply.

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6.3 Protection, Mitigation, and Enhancement Measures (PM&E)

Agency Recommended Mitigation

In their April 18, 2022 comment letter, the NY DEC recommends 40 cfs minimum flow to the bypass reach year-round.

Applicant Proposed Mitigation

The Licensee currently proposes to maintain the existing operational protocols that have been in place during the term of the existing license, including formalization of the voluntary 40 cfs year-round minimum flow release to the bypassed reach. Operation in an instantaneous run-of-river mode with minimal fluctuations will maintain the existing hydrograph and minimize Project-related fluctuations to water surface elevations in the impoundment. The existing bypass flow requirements will be continued for aesthetic value and provide stability of physical habitat conditions along the face of the natural falls.

7.0 Fish and Aquatic Resources

7.1 Affected Environment

Resident Fish

The NYSDEC conducted several fisheries surveys of the Battenkill River that included reaches in proximity to the Dahowa Hydroelectric Project during the 20th century. Surveys conducted in 1932 and 1975 used unknown sampling gears, whereas a 1988 survey deployed experimental gill nets as part of the Toxic Substance Monitoring Program.

The 1932 survey performed sampling above the Dahowa Dam from 0.25 to 0.5 mi downstream of the Middle Falls Dam. Sampling for the 1975 survey extended from the first dam on the river to above the Project at the factory at Middle Falls. The 1988 survey was conducted downstream of the Project within the second impoundment above the confluence with Hudson River [46].

Twenty-three species representing seven families were collected across the three surveys (Table 14). Among the 11 species collected during the 1988 survey, eight were collected during each of the three sampling efforts. The three remaining species collected during 1988 were also present in the 1975 survey, which had the greatest number of species collected (Species Richness=19) among the three studies. Yellow perch (*Perca flavescens*), pumpkinseed (*Lepomis gibbosus*), white sucker (*Catostomus commersonii*), and brown bullhead (*Ameiurus nebulosus*) were the most numerous species collected during 1988. Sunfishes in the family Centrarchidae, including bluegill (*Lepomis macrochirus*), smallmouth bass (*Micropterus dolomieui*), and rock bass (*Ambloplites rupestris*), were also moderately abundant. Brown trout (*Salmo trutta*) was only collected during the 1932 survey [46].

The upper reaches of the Battenkill River are known for its recreational trout fishery (see Figure 13), which is primarily supported by wild and stocked brown trout. During 2017, it was estimated that 7,066 anglers fished a total of 78,875 days on the Battenkill, which was the 32nd highest number of angler days among waterbodies in the state (Vermont). Brown trout was targeted during 85% of angler days with 61 % of anglers reporting that they were satisfied with the fishing offered by the river [38].

Fifteen species were reported among 37 verified naturalist observations of fish in Washington County, New York as reported to iNaturalist.org since 2015 (Table 15) [21]. Ten species previously had been collected from the Battenkill near the Project by the NYSDEC. None of the five remaining species observed in Washington County were found in the Battenkill River [21]. No additional historic fish assemblage data were found for the Battenkill River.

Table 14. NYSDEC Battenkill Historical Fish Survey Results –Dahowa Hydroelectric Project Vicinity [46]

Family	Scientific Name	Common Name	Presence (X) by Survey			1988 Survey Results		
			1932[1]	1975[2]	1988[3]	No.	Percent	Mean (Range) Length in mm
Catostomidae - Suckers	*Catostomus commersonii*	White sucker	X	X	X	19	9.8	12.6 (9.0-17.0)
	Hypentelium nigricrans	Northern hog sucker		X				
Centrarchidae - Sunfishes	*Ambloplites rupestris*	Rock bass	X	X	X	9	4.7	5.6 (3.7-8.4)
	Lepomis gibbosus	Pumpkinseed	X	X	X	50	25.9	6.6 (3.4-7.8)
	Lepomis macrochirus	Bluegill		X	X	11	5.7	7.0 (6.6-7.6)
	Micropterus dolomieui	Smallmouth bass	X	X	X	10	5.2	9.8 (6.1-12.2)
	Micropterus salmoides	Largemouth bass	X	X	X	2	1.0	9.8 (5.8-13.9)
	Pomoxis nigromaculatus	Black crappie		X	X	2	1.0	9.0 (6.7-11.3)
Cyprinidae - Carps and Minnows	*Crassius auratus*	Goldfish		X				
	Exoglossum maxilingua	Cutlips minnow		X				
	Notemigonus crysoleucas	Golden shiner	X	X	X	4	2.1	7.1 (6.6-7.5)
	Notropis bifrenatus	Bridle shiner	X					
	Rhinichthys atratulus	Blacknose dace	X	X				
	Rhinichthys cataractae	Longnose dace		X				
	Semotilus corporalis	Fallfish		X	X	1	0.5	10.4
Esocidae - Pikes and Mudminnows	*Esox lucius*	Northern pike	X	X				
	Esox niger	Chain pickerel	X					
Ictaluridae - North American Catfishes	*Ameiurus natalis*	Yellow bullhead		X				
	Ameiurus nebulosus	Brown bullhead	X	X	X	14	7.3	11.6 (9.0-15.4)
Percidae - Perches and Darters	*Etheostoma nigrum*	Johnny darter		X				
	Etheostoma olmestedi	Tesselated darter	X					
	Perca flavescens	Yellow perch	X	X	X	71	36.8	8.3 (5.4-11.1)

[1] *Survey conducted upstream of the Project area (0.25-0.5 mi downstream of Middle Falls).*
[2] *Survey conducted both upstream and downstream of the Project area (first dam to Middle Falls).*
[3] *Survey conducted downstream of the Project area (within impoundment of second dam).*

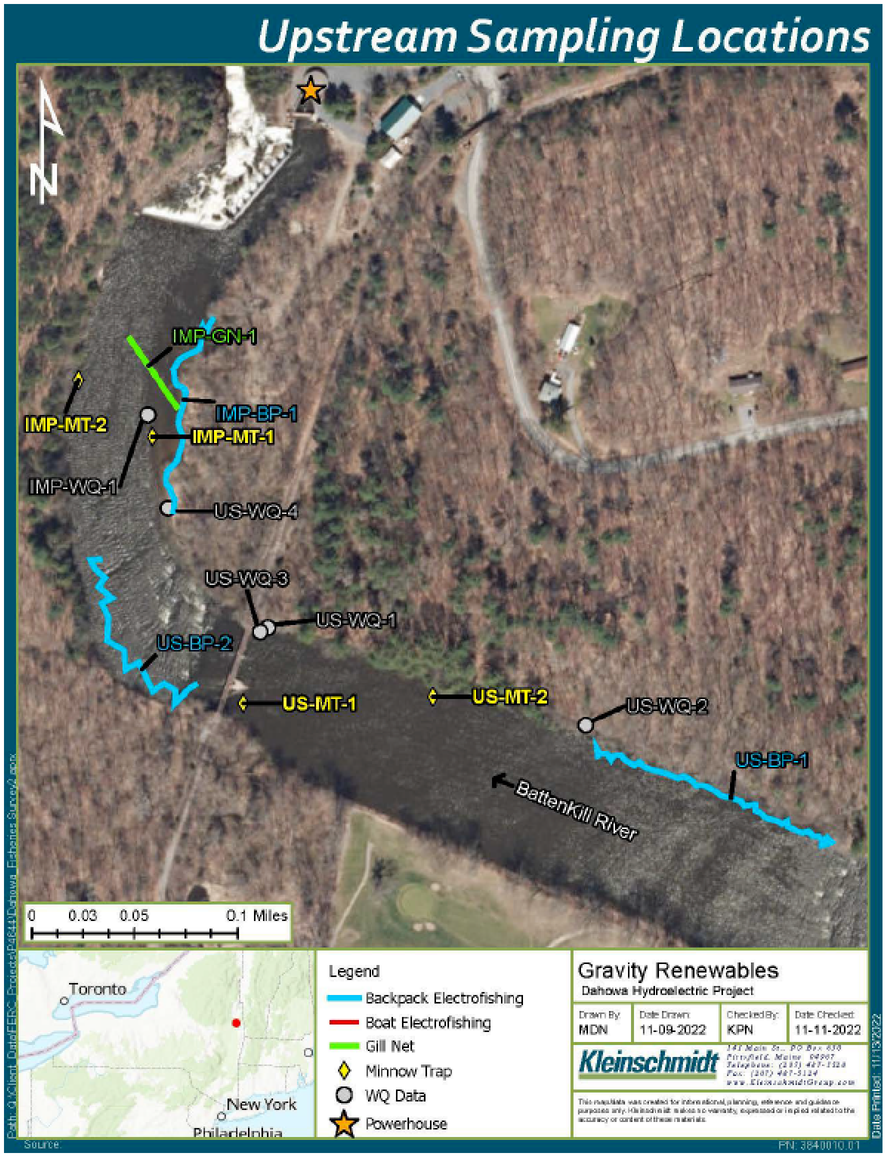
Family	Scientific Name	Common Name	Presence (X) by Survey			1988 Survey Results		
			1932[1]	1975[2]	1988[3]	No.	Percent	Mean (Range) Length in mm
Salmonidae - Trouts and Salmons	*Salmo trutta*	Brown trout	X					
		Total	**14**	**19**	**11**	**193**	**100.0**	

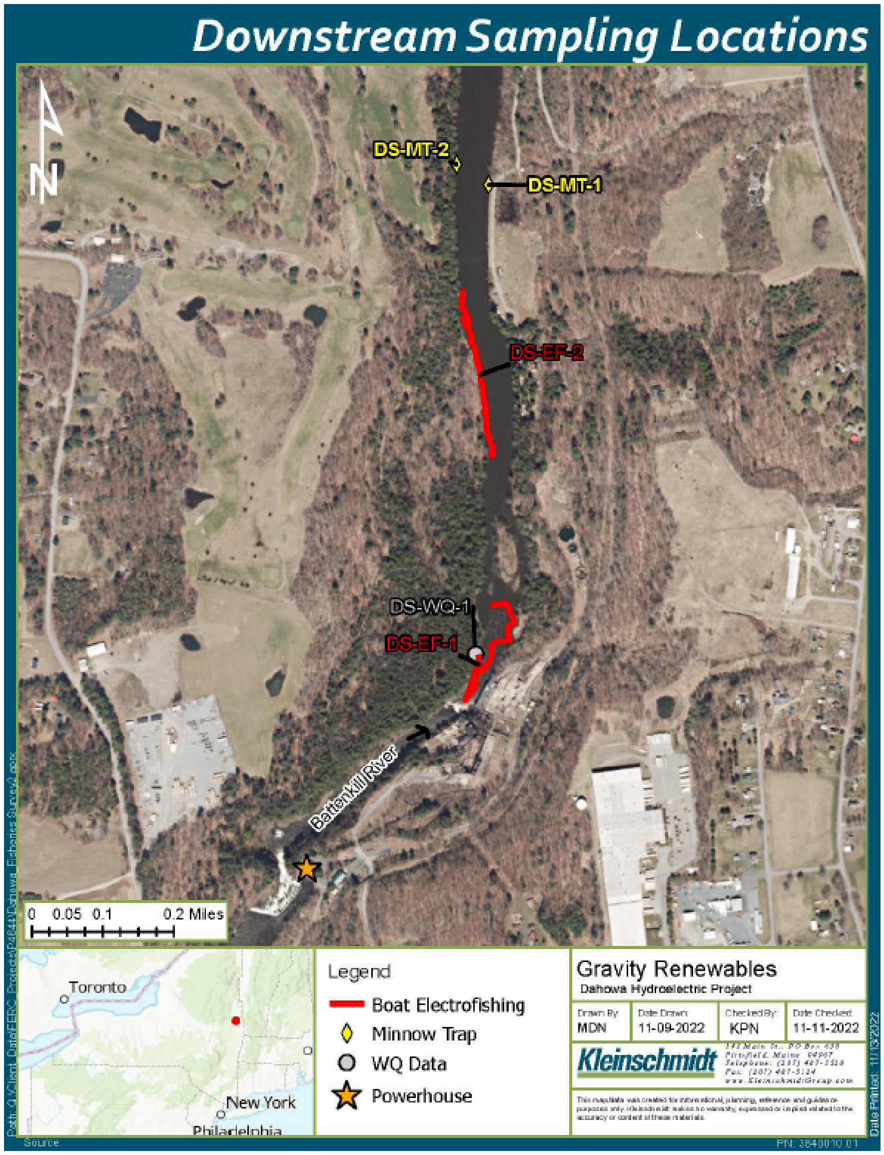
Table 15. Fish Species Reported in Washington County, New York [21]

Family	Scientific Name	Common Name
Centrarchidae - Sunfishes	*Lepomis gibbosus*	Pumpkinseed
	Lepomis macrochirus	Bluegill
	Micropterus dolomieui	Smallmouth bass
	Micropterus salmoides	Largemouth bass
	Pomoxis annularis	White crappie[1]
	Pomoxis nigromaculatus	Black crappie
Cyprinidae - Carps and Minnows	*Cyprinus carpio*	Common carp[1]
	Notropis atherinoides	Emerald shiner[1]
	Rhinichthys sp.	Riffle daces
Ictaluridae - North American Catfishes	*Ameiurus melas*	Black bullhead[1]
	Ameiurus nebulosus	Brown bullhead
Percidae - Perches and Darters	*Etheostoma olmestedi*	Tesselated darter
	Perca flavescens	Yellow perch
Salmonidae - Trouts and Salmons	*Salmo trutta*	Brown trout
	Salvelinus fontinalis	Brook trout[1]

2022/23 Fish Assemblage Study

A fish assemblage study was conducted in the Fall of 2022 and Spring of 2023 to collect empirical information on the existing fisheries resources occurring in the Project area and to inform on the relicensing proceedings. The study area included the Battenkill River immediately upstream of the Project impoundment, the Project impoundment, and the reach downstream of the dam that could be safely accessed by boat (see figures below).


Upstream Sampling Locations
N
IMP-GN-1
IMP-BP-1
IMP-MT-2
IMP-MT-1
IMP-WQ-1
US-WQ-4
US-WQ-3
US-WQ-1
US-BP-2
US-MT-1
US-MT-2
US-WQ-2
US-BP-1
BattenKill River
0 0.03 0.05 0.1 Miles
Toronto
New York
Philadelphia
Legend
Backpack Electrofishing
Boat Electrofishing
Gill Net
Minnow Trap
WQ Data
Powerhouse
Gravity Renewables
Dahowa Hydroelectric Project
Drawn By: MDN
Date Drawn: 11-09-2022
Checked By: KPN
Date Checked: 11-11-2022
Kleinschmidt



A total of five sites were sampled during both survey periods. Three sites upstream of the Project impoundment and the margins of the impoundment were surveyed using a backpack electro-shocker, and two sites two sites downstream of the dam were surveyed via boat electrofishing. A gill net was also set and allowed to fish for 24 hours at the upstream margin of the impoundment. Two minnow traps were deployed in the upstream reach, downstream reach and in the Project impoundment, for a total of six traps which were baited and allowed to fish for approximately 24 hours.

Captured fish were identified to species, enumerated and a subsample were measured for total length then released. Additional data collected included GPS location, sampling gear type, sampling effort (i.e., duration), average depth, various water quality parameters, predominate substrate, time, date, presence of cover and proportion of aquatic vegetation cover. Tabulated below is a summary of habitat conditions at each sample location.

Sample Site	Depth Range (ft)	Habitat and Substrate	Cover	Photo
Downstream 1 (DS_EF_1)	0-5	Site consisted of a mix of mesohabitats including riffle and run. Substrates were coarse in the upper part of the reach and included bedrock, cobble, and boulder. The lower reach was silty.	Sparse aquatic vegetation (<25%), additional cover provided by sparse boulders and in-water features of an old Project works.	1
Downstream 2 (DS_EF_2)	0-5	Included a small section of run mesohabitat before transitioning into the downstream impoundment. Substrates were generally fine consisting of silt and sand.	In-water cover was moderate (~50%) consisting mostly of aquatic vegetation with some wood debris.	2
Impoundment 1 (IMP_EF)	0-3	Transitioning from run to impoundment.	Cover was sparse (<25%) consisting of wood debris and aquatic vegetation.	3
Impoundment 2 (IMP_GILL)	1-5	Run mesohabitat transitioning into the relatively still water of the impoundment. Substrates included silt, sand, and gravel.	Cover was sparse (<25%) consisting of wood debris and aquatic vegetation.	4
Upstream 1 (US_EF_1)	0-3	Mix of riffle and run mesohabitats with moderately embedded cobble and areas of sand and gravel substrates, some bedrock.	Cover was generally sparse (<25%) consisting of woody debris and aquatic vegetation, additional cover provided by sparse boulders.	5
Upstream 2 (US_EF_2)	0-3	Riffle mesohabitat dominated by ledge with areas of mixed cobble and boulder substrates.	Cover was generally sparse with less than 25% aquatic vegetation.	6

Note: ft = foot/feet

Between the two studies, a total of 377 fish were collected representing 17 species. Spottail shiner was the most numerically dominate species, followed by tessellated darter, fallfish, and cutlips minnow. The spring sampling resulted in a lower quantity of fish caught, however the relative abundance of species was similar to that of the fall sample. Differences in fish size were also apparent during the spring survey compared to the fall. For example, the average total length of smallmouth bass in the fall survey was 102 millimeters compared to 376 millimeters during the spring survey. Results of each survey event are tabulated below; a completed copy of the study reports are provided in Appendix G.

Total by Site		
Species	**Quantity**	**Percent (%)**
Downstream (Total = 158)		
Bluntnose Minnow[G]	2	1.27
Common Carp[G]	1	0.63
Common Shiner	13	8.23
Creek Chub[G]	1	0.63
Fallfish[G]	25	15.82
Mimic Shiner[S]	5	3.16
Pumpkinseed[G]	11	6.96
Rock Bass[G]	1	0.63
Smallmouth Bass[G]	18	11.39
Spottail Shiner[G]	33	20.89
White Sucker[G]	17	10.76
Brown Trout	1	0.63
Yellow Perch[G]	30	18.99
Impoundment (Total = 10)		
Yellow Bullhead[G]	1	10.00
Common Shiner	8	80.00
White Sucker[G]	1	10.00
Upstream (Total = 131)		
Common Shiner	2	1.53
Creek Chub[G]	2	1.53
Cutlips Minnow	28	21.37
Longnose Dace[S]	15	11.45
Rock Bass[G]	1	0.76
Smallmouth Bass[G]	2	1.53
Spottail Shiner[G]	43	32.82
Tessellated Darter	28	21.37
White Sucker[G]	10	7.63
Grand Total	**299**	

[G] Fluvial generalist by Wells 2009.
[S] Fluvial specialist by Wells 2009.

Fall 2022 Fish Assemblage Data

Total by Site		
Species	Quantity	Percent (%)
Downstream (Total = 44)		
Common Shiner	5	11.36
Fallfish[G]	5	11.36
Pumpkinseed[G]	1	2.27
Rock Bass[G]	1	2.27
Smallmouth Bass[G]	4	9.09
Spottail Shiner[G]	2	4.55
White Sucker[G]	14	31.82
Yellow Perch[G]	12	27.27
Impoundment (Total = 1)		
White Sucker[G]	1	100.00
Upstream (Total = 33)		
Bluntnose Minnow[G]	3	9.09
Cutlips Minnow	8	24.24
Longnose Dace[S]	7	21.21
Smallmouth Bass[G]	1	3.03
Spottail Shiner[G]	1	3.03
Tessellated Darter	13	39.39
Grand Total	**78**	

[G] Fluvial generalist by Wells 2009.

[S] Fluvial specialist by Wells 2009.

Spring 2023 Fish Assemblage Data

Both the spring and fall surveys were dominated by warmwater species and habitat generalists; except for one fluvial habitat specialist (longnose dace) which was observed upstream of the Project's impoundment. A wild brown trout was captured downstream of the Project dam during the fall survey, suggesting that natural trout production may be occurring within the greater system. Project waters contain some suitable habitat for brown trout, which generally prefer a combination of slow-moving pool, riffle and run mesohabitats over rocky bottoms with abundant shoreline cover (VTFWS 2023). Warm water temperature in mainstem rivers may affect the distribution of cool or cold-water fishes such as trout, which often seek areas of thermal refuge during the warm months. In such cases, these fish often move into tributaries and other cold-water inflows. However, given that trout were in low abundance during a period when river temperatures were optimal (11.7 – 18.9°C) it is unlikely that trout utilize project waters substantially. A complete copy of the Fish Community Survey Study reports are provided as Appendix G.

NYSDEC stocks New York inland waters with approximately 900,000 pounds of fish on an annual basis to enhance recreational fishing opportunities and restore native species to formerly occupied waters [43].

The stocking program is supported by twelve state-run hatcheries that specialize in rearing one or more species, including brook trout (*Salvelinus fontinalis*), brown trout, rainbow trout (*Oncorhynchus mykiss*), lake trout (*Salvelinus namaycush*), steelhead trout (*Oncorhynchus mykiss*), chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*Oncorhynchus kisutch*), landlocked salmon (*Salmo salar* sebago), walleye (*Sander vitreus*), muskellunge (Esox masquinongy), and tiger muskellunge (*Esox lucius* × *masquinongy*) [43].

Several reaches of the Battenkill River are designated as trout waters, with three assigned to stocked trout management categories that are stocked with yearling and older brown trout starting in April (Figure 13). Each of the stocked reaches are located upstream of the Project, with the nearest located above the Center Falls Dam extending from 0.5 miles upstream and downstream of the Battenville Bridge [45].

NYSDEC fish stocking data from 2011-2021 indicate that stocking of the Battenkill occurs in the towns of Greenwich and Salem (Table 16). Over this period, an annual average of approximately 6,000 and 15,000 brown trout were stocked at Greenwich and Salem, respectively. Stocked fish typically range from 8 to 15 in. in total length [44].

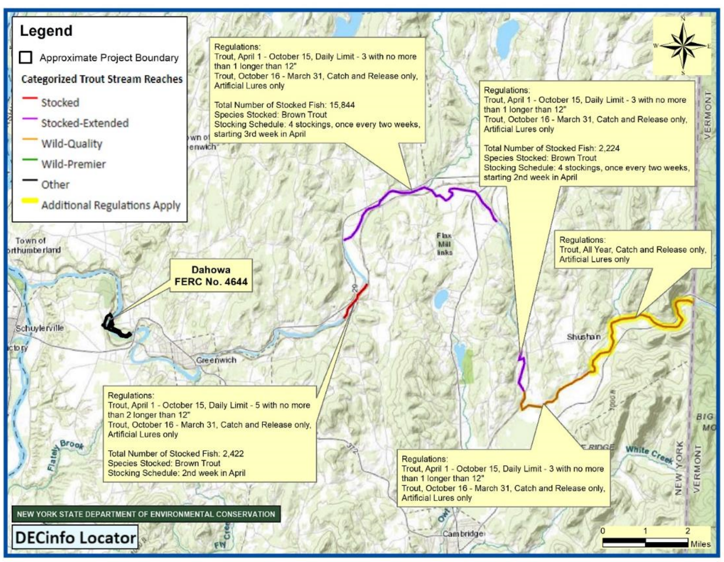


Figure 13. Trout Management Categories - Battenkill River Reaches [45]

Table 16. Brown Trout Stocked in the Battenkill River by Location, 2013-2021 [44]

Year	Greenwich	Salem
2011	6,390	15,220
2012	6,670	15,850
2013	5,550	13,380
2014	6,480	15,440
2015	6,450	12,080
2016	6,490	15,360
2017	6,250	14,790
2018	6,550	15,480
2019	6,960	9,680
2020	5,610	25,500
2021	6,882	13,608
Total	**70,282**	**166,388**
Average/yr (2011-2021)	**6,389**	**15,126**
Average/yr (2017-2021)	**6,450**	**15,812**
Length Range	**8-15 inches**	

Migratory Fish

American shad (*Alosa sapidissima*) historically were known to migrate upstream within the Hudson River and enter the lower Battenkill River [62]. However, the construction of dams, bridges, and culverts during the past century created numerous barriers to the migration of diadromous fish species [4]. Notably, the U.S. Army Corps of Engineers Green Island-Troy Lock and Dam at river mile (RM) 154 of the Hudson River represents the first major barrier to fish passage that currently limits the upstream migration of most diadromous fish in the mainstem of the river and its upstream tributaries, such as the Battenkill (Figure 14) [81]. In the absence of artificial barriers, the Dahowa waterfall is an established natural barrier to shad and other migrating species.

The American eel (*Anguilla rostrata*), which is a catadromous species, is more widely distributed across the state in comparison to the anadromous species (Figure 15) [81]. However, the American eel has not been reported in the Battenkill River in recent years (Figure 16) [6], nor was it collected during historical fisheries surveys conducted in the vicinity of the Project (see Table 14) [46]. In 2010, Dittman, et. al. completed an analysis of available data on eels for the USGS and concluded that this species likely had been extirpated from the subbasin where the Project is located (Figure 17) [13].

In total, there are five dams on the Hudson River below the confluence with the Battenkill River and two dams on the Battenkill below the Project that lack upstream fish passage (Figure 18) [37]. The 70-ft Dahowa Falls (AKA Diadahowa Falls) presents a natural barrier that would likely prevent upstream migration of fish to and above the Project Dam regardless of the presence of existing dams located downstream.

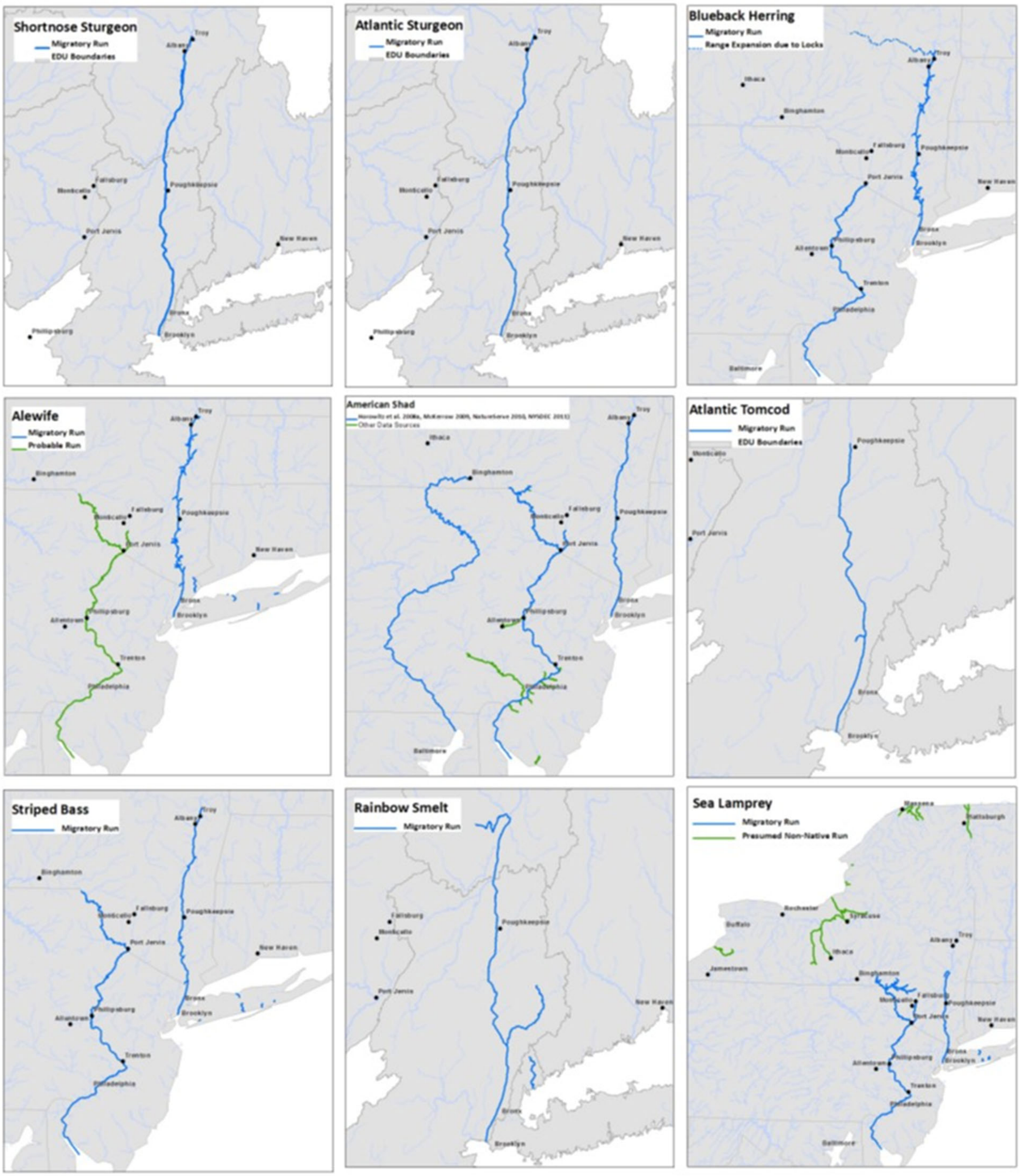


Figure 14. Current Migratory Fish Runs of Diadromous Fish in New York State as Developed by National Heritage Program and the Nature Conservancy [81]

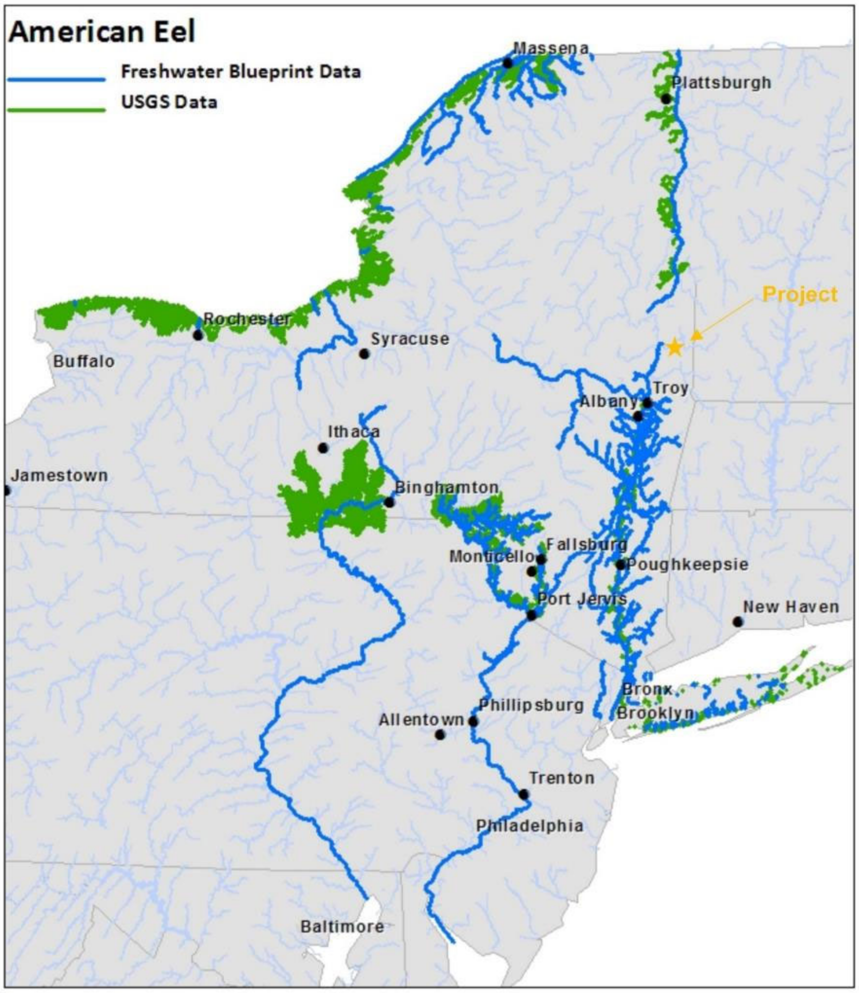


Figure 15. Current Migratory Run of American Eel in New York State as Developed by National Heritage Program and the Nature Conservancy [81]

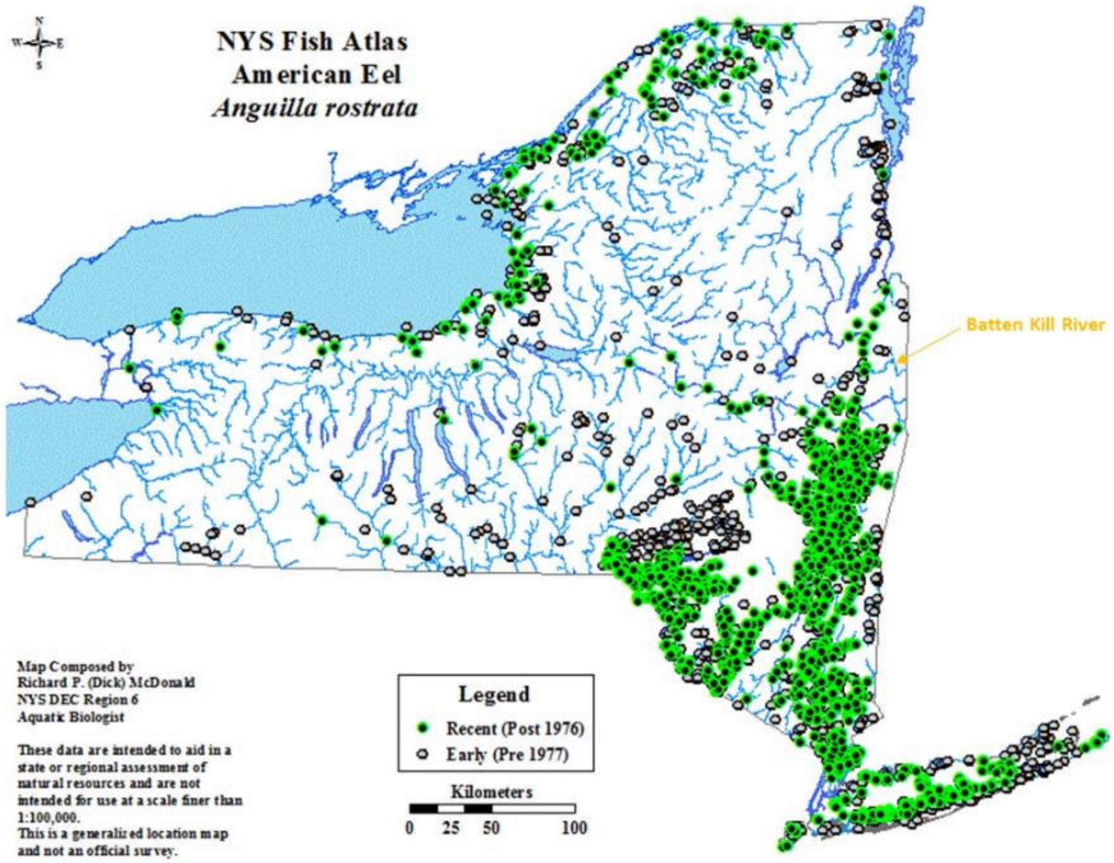


Figure 16. Reported Observations of American Eel in New York State as compiled by NYSDEC in 2016 [6]

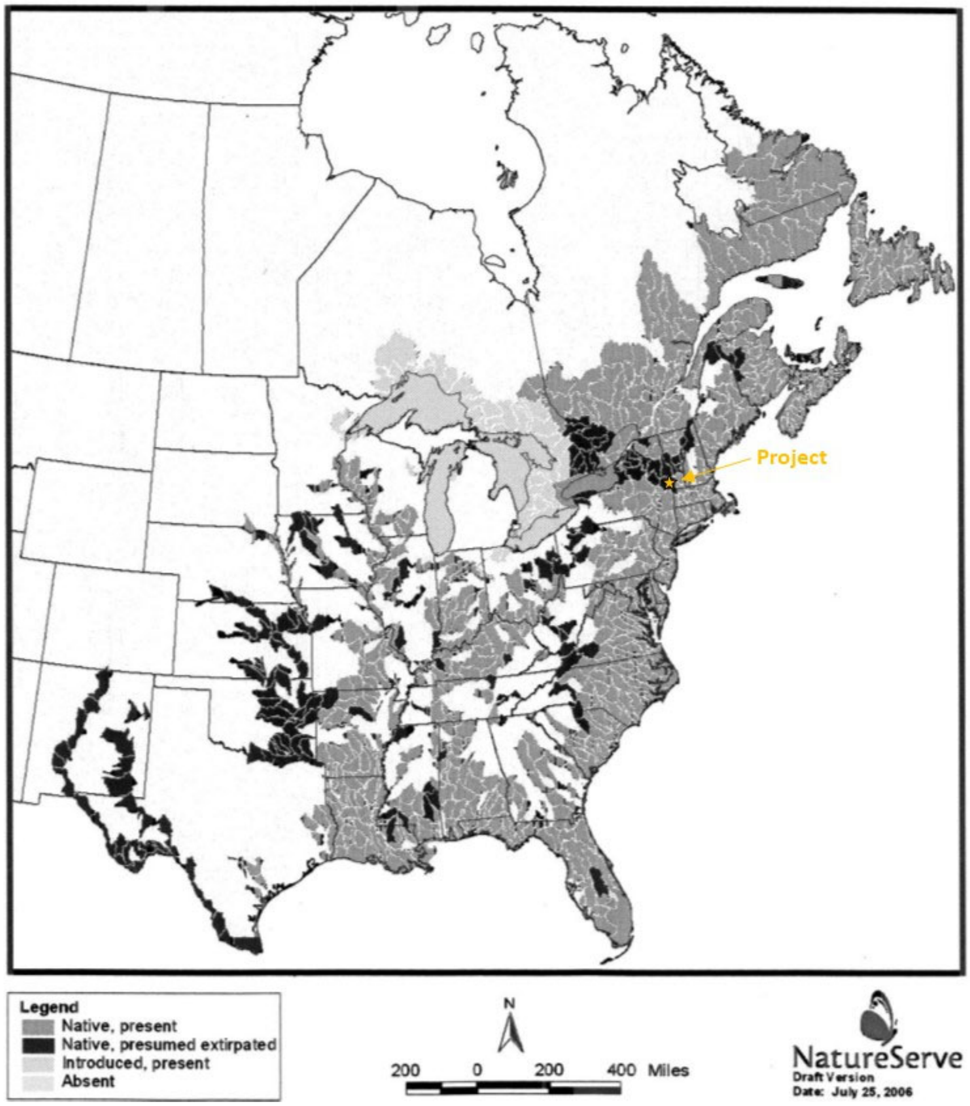


Figure 17. American eel Distribution - United States [13]

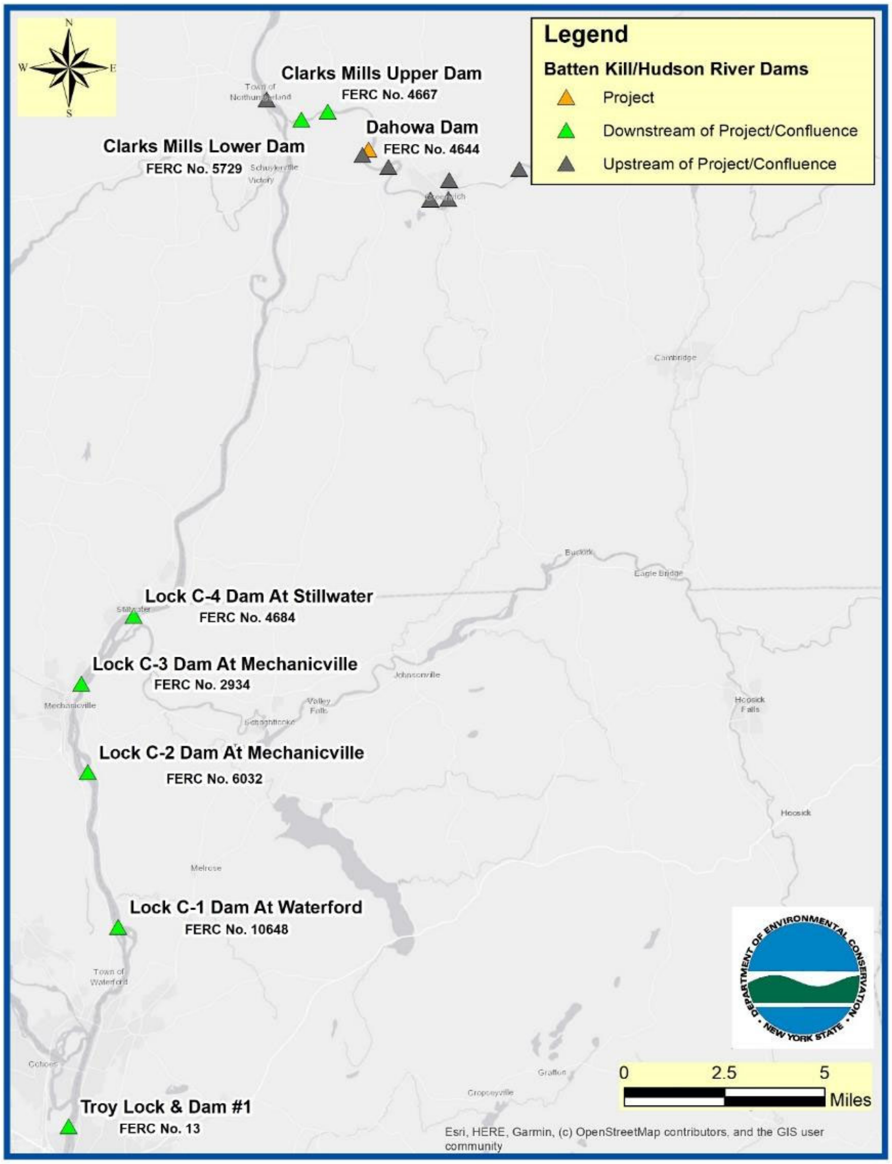


Figure 18. Battenkill and Hudson River Dams Downstream of the Dahowa Hydroelectric Project [37]

2022 American Eel eDNA Study

Among the study requests was a request to determine whether American eel (*Anguilla rostrata*) are present in the Project area through use of environmental DNA (eDNA) analysis. Gravity subsequently held a teleconference with the FWS and DEC to review the study requests and conceptual approaches to addressing the management concerns of the agencies. A draft eel eDNA study plan was subsequently provided to agencies; a final study plan was then developed and approved by the DEC and FWS prior to implementation. The goals and objectives of the study were to provide information on the existing fishery resources, specifically the presence, or absence, of American Eel, in the vicinity of the Project, including areas upstream and downstream of the Project.

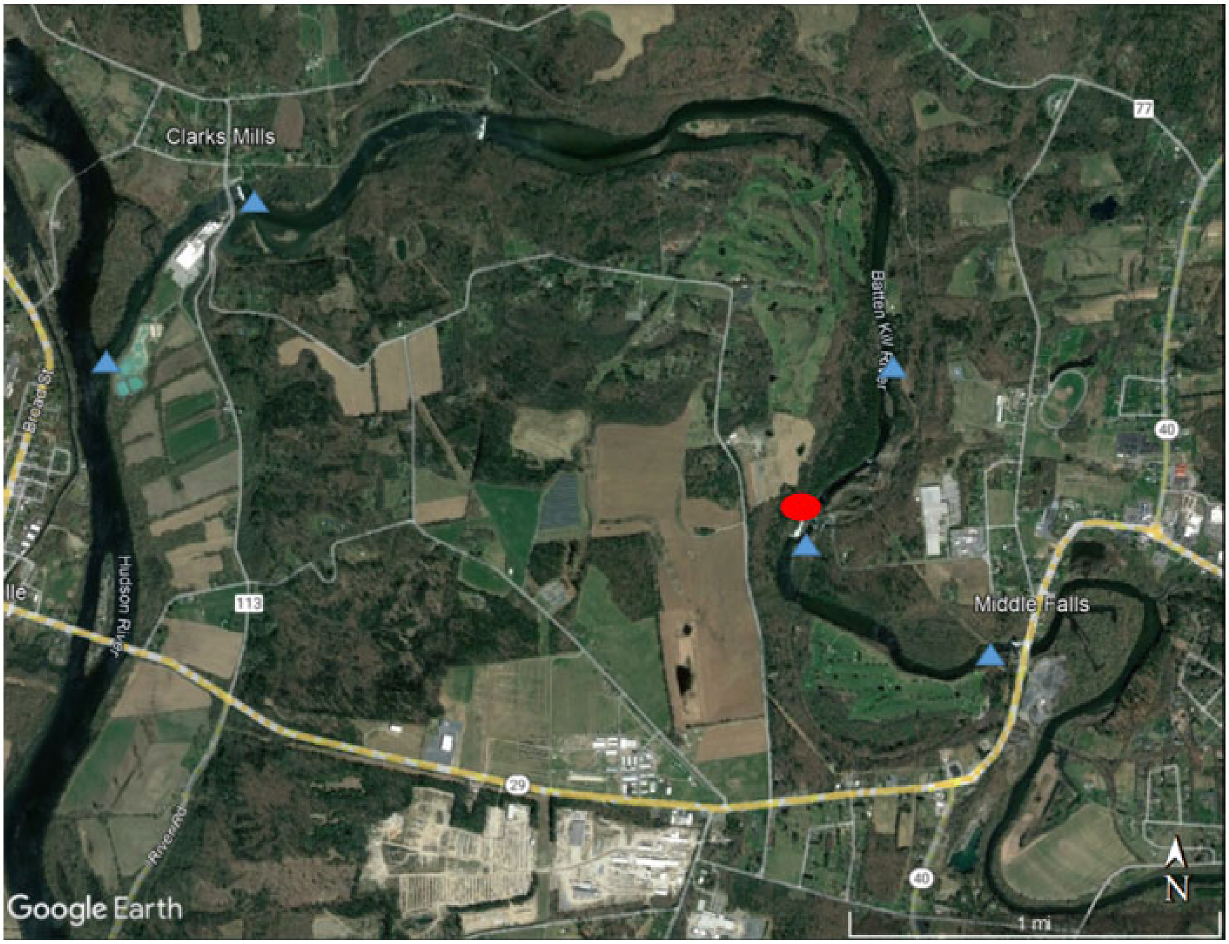
Sampling and analysis of environmental DNA (eDNA) from the Battenkill River was used to detect genetic material from American eels that may be present in the aquatic system. eDNA is organismal DNA that can be found in the environment which originates from cellular material shed by organisms (via skin, excrement, etc.) into aquatic or terrestrial environments that can be sampled and monitored using molecular methods.

The chemical structure of DNA is the same for all organisms, but differences exist in the order of the DNA building blocks, known as base pairs. Unique sequences of base pairs, particularly repeating patterns, provide a means to identify species, populations, and even individuals. This study utilized quantitative polymerase chain reaction (qPCR) to analyze water samples for DNA base pair markers for American eel. In qPCR, primers are used to amplify a region of DNA that is specific to a target organism, and a probe is used to provide additional specificity and quantitative information.

Two of the eDNA kits served as a true positive control units by filtering water where American eel presence was positively confirmed and five kits served as negative control units by filtering water from distilled bottled water, a source where American eel absence was positively confirmed. Five sampling sites were selected downstream and two upstream of the Project Dam. At each site, three replicates were collected, in addition to one control. Two replicates of the positive control were collected to verify the accuracy of the qPCR assay in positively identifying the presence of American eel using eDNA analysis.

Five sampling locations were selected (3 downstream and 2 upstream of the Project dam); at each sampling location three replicates were collected in addition to one negative control[4]. Two replicates of the positive control[5] samples were collected to verify the accuracy of the qPCR assay in positively identifying the presence of American eel using the eDNA analysis. Samples were collected in the areas shown in the figure below.

[4] *Negative controls sampled water from distilled bottled water.*
[5] *Positive controls sampled water from holding tanks containing American eels being used as part of a study associated with the Woonsocket Falls Project (P-2972).*



eDNA Sampling locations (blue triangles) and Project dam (red circle).

Analysis of samples collected from the positive control source confirmed that ability of the qPCR analysis to detect genetic material from a known source. Analysis of samples collected from the positive control source (Woonsocket Falls 1 & 2) detected over 1,000,000 copies of the genetic marker for American eel; these data confirm the ability of the qPCR analysis to detect genetic material from a known source. Analysis of samples collected from all locations of the Battenkill River detected no copies of the genetic marker for American eel; these data suggest an absence of American eel in the sampled reach of the Battenkill River. Results of the qPCR analysis are summarized in the table below.

Results of qPCR analysis by location.

SITE NAME	AMERICAN EEL DNA DETECTED	NOTES
Mouth 1	NO	Confluence of Battenkill & Hudson Rivers
Mouth 2	NO	
Mouth 3	NO	
Mouth C	NO	
Clarks Mill 1	NO	Upstream of Clarks Mill Dam
Clarks Mill 2	NO	
Clarks Mill 3	NO	
Clarks Mill C	NO	
Downstream 1	NO	Downstream of Dahowa Dam
Downstream 2	NO	
Downstream 3	NO	
Downstream C	NO	
Impoundment 1	NO	Adjacent to Project Intake
Impoundment 2	NO	
Impoundment 3	NO	
Impoundment C	NO	
Upstream 1	NO	Tailwater of Middle Falls Dam
Upstream 2	NO	
Upstream 3	NO	
Upstream C	NO	
Woonsocket Falls 2	YES	Eel Tank - Positive Control
Woonsocket Falls 1	YES	

Analysis of samples collected from all locations of the Battenkill River detected no copies of the genetic marker for American eel; thus, suggesting an absence of American eel in the sampled reach of the Battenkill River above and below the Dahowa Project.

The full Eel eDNA report is provided in Appendix H.

Downstream Fish Passage and Protection Assessment

As part of the FERC relicensing process, the applicant engaged BioPassage Scientific Consulting to conduct a desktop assessment of fish passage and protection at the Project. Impingement on the project's trash racks and turbine and total project survival were evaluated for freshwater species that are known to occur upstream of the project. Based on the results of these assessments, conclusions and recommendations regarding the need for protection, mitigation, and enhancement measures (PM&Es) to address potential impacts to affected fish populations are discussed below. The assessment was completed following the study plan outlined discussed with resource managers. A draft of the Downstream Fish Passage and Protection Assessment was provided to resource agencies on November 20, 2024; the report and its recommendations are subject to consultation and review. A complete copy of the draft report is provided in Appendix L.

Management Goals

The FWS and NYDEC consider the Battenkill to have a mixed cool and coldwater fishery. The following management goals were provided by the NYDEC in their PAD comment and study request letter submitted to the applicant and FERC:

"*The NYDEC's fishery management goals include sustaining and enhancing all existing viable fisheries resources of the Battenkill, especially for brook trout (<u>Salvelinus fontinalis</u>), brown trout (<u>Salmo trutta</u>), smallmouth bass (<u>Micropterus dolomieui</u>), and recreationally important panfish species. The Battenkill is classified as C throughout the hydroelectric project and should be treated as such as per 6 NYCRR 941.6 Item numbers 890.1. Additional goals include promoting the maintenance and propagation of all fish, shellfish, wildlife, macroinvertebrates and plant species in an ecological balance, and assuring designated water quality standards are achieved and maintained.*"

Assessment Summary Findings

The following are the primary findings of the downstream passage assessment conducted for the Dahowa Project:

- The species composition of the affected fish community upstream of the Dahowa Project is typical of Northeast streams and rivers of small to moderate in size and flow, with mainly cold and coolwater species. Diadromous species do not occur upstream or downstream in the vicinity of the project. Consequently, the potential need for any type of PM&E measures to address turbine entrainment and mortality is limited to freshwater fishes that are not obligatory migrants (i.e., do not need to access downstream habitats to complete their life cycle).

- Impingement on the trash racks is not expected to occur due to the large size of fish (about 15 inches and greater in length) that are physically excluded by the 2.5-inch clear bar spacing and the low approach velocities (< 2 ft/s). Therefore, injury and/or mortality due to impingement will not occur for any fish encountering the intake.

- Total project survival estimates for fish with lengths of 8 inches and less were high (> 92%) across the range of river flows that occur annually at the project. For fish with lengths greater than 8 inches, total survival estimates ranged from 78.2 to 98% across all river flows.

- The annual estimates of total survival (i.e., all river flows combined) ranged from 84.1% for fish with lengths of 15-22 inches to 97.4% for fish with lengths 4 inches and less. For all size groups combined, the annual total survival rate was estimated to be to be 96.2%.

Total survival may actually be higher than estimated for fish passing downstream at Dahowa because it was conservatively assumed that no behavioral or physical exclusion of fish less than 22 inches in length occurs at the turbine intake racks. Behavioral exclusion of fish small enough to pass through various bar spacings has been demonstrated during laboratory and field studies with freshwater and diadromous fish species. Also, some of the fish species that are present upstream of Dahowa will be physically excluded from passage through the 2.5 inch clear spacing of the trash rack bars before they reach a length of 22 inches (e.g., Brown Bullhead, White Sucker, and Smallmouth Bass). The maximum approach flow velocity at the intake racks was calculated to be 1.6 ft/s, for which all of the species upstream of Dahowa have sufficient swimming speeds to avoid. Consequently, behavioral avoidance of entrainment could be significant, particularly for larger fish (> 8 inches in length). Despite the conservative approach of not factoring in behavioral and physical exclusion, annual total project survival rates were estimated to be 84% for fish greater than 15 inches in length and 90% for fish 8 to 15 inches. Subsequently, any mitigation measures considered for application at Dahowa to reduce turbine entrainment will only provide marginal benefits for a few species that reach a relatively large size (primarily White Sucker and Smallmouth Bass).

Based on an analysis of data from field studies conducted at 43 hydropower projects (EPRI 1997; Winchell et al. 2000), notable peaks in turbine entrainment rates occur in the spring (April), summer (July), and fall (October). Fish less than 4 inches in length dominate entrainment in the spring and summer and fish with lengths of 4 to 8 inches comprise the greatest proportion of entrainment in the fall. Entrainment rates of larger fish (>8 inches in length) were reported to be significantly lower than for the smaller size groups (Winchell et al. 2000). The observed entrainment peaks are likely the result of juvenile fish displacement during spring freshets and dispersal in the summer and fall related to seasonal habitat preferences, water quality, and/or food availability. These types of downstream movements of small fish would be expected at Dahowa as well.

Entrainment of fish greater than 8 inches in length is assumed to be low due to the relatively small numbers of individuals of this size in the population upstream of the project and their ability to avoid entrainment (i.e., behavioral exclusion for fish between 8 and 15 inches and physical exclusion for many fish greater than 15 inches). Consequently, any loss of larger fish due to turbine entrainment over the course of a year will be inconsequential to the affected populations.

Overall, the estimated total project survival rates for fish passing downstream at Dahowa were high and indicate there are likely minimal or no impacts to the species comprising the local fish community due to downstream passage mortality. Furthermore, the sizes (> 15 inches in length) and species (White Sucker, Smallmouth Bass) that had the lowest survival rates (annual estimate of 84%) are only a small proportion of fish entrained at Dahowa. Therefore, the use of PM&E measures (e.g., narrow-spaced bar racks, angled guidance structures, and fish bypass systems) to reduce turbine entrainment and associated mortality would only provide marginal benefits, if any, to the affected fishery resources.

Target Species

Species and life stages considered in the assessment of downstream passage at Dahowa include all that were identified during surveys conducted upstream in the vicinity of the project (KA 2023a, 2023b), with the exception of Mimic Shiner and Common Carp.

Table 2. Fish species collected during surveys in the Project vicinity.

Species	1975 Downstream/Upstream Survey	1988 Downstream Survey	2022/2023 Surveys	
			Downstream	Upstream
Black Crappie	X	X	--	--
Blacknose Dace	X	--	--	--
Bluegill	X	X	--	--
Bluntnose Minnow	--	--	X	X
Brown Bullhead	X	X	--	--
Brown Trout	--	--	X	--
Common Carp	--	--	X	--
Common Shiner	--	--	X	X
Creek Chub	--	--	X	X
Cutlips Minnow	X	--	--	X
Fallfish	X	X	X	--
Goldfish	X	--	--	--
Golden Shiner	X	X	--	--
Johnny Darter	X	--	--	--
Largemouth Bass	X	X	--	--
Longnose Dace	X	--	--	X
Mimic Shiner	--	--	X	--
Northern Hog Sucker	X	--	--	--
Northern Pike	X	--	--	--
Pumpkinseed	X	X	X	--
Rock Bass	X	X	X	X
Smallmouth Bass	X	X	X	X
Spottail Shiner	--	--	X	X
Tessellated Darter	--	--	--	X
White Sucker	X	X	X	X
Yellow Bullhead	X	--	--	X
Yellow Perch	X	X	X	--

Juveniles and adults of each species occurring upstream of the project may be exposed to turbine entrainment at Dahowa if they attempt to move downstream past the project. However, none of the species occurring upstream have a biological need to move downstream of the project to complete their life cycle. The potential for fish to move downstream past the project likely varies by species, but probably is minimal for many of them assuming adequate resources exist upstream (e.g., preferred habitats, sufficient food resources, acceptable water quality conditions).

The primary factors that have potential to influence downstream passage at Dahowa include water quality, flow conditions, and biological motivation for fish move to downstream habitats (e.g., for spawning, feeding, reduced competition, and/or seasonal habitat preferences). The species comprising the fish community upstream of Dahowa do not include any obligatory migrants that require access to habitats downstream of the project in order to complete their life cycle. Therefore, downstream movements could be random events, displacement during high flow periods, or associated with searching for alternative food sources or for preferred habitats with better water quality conditions or less competition.

Data from field studies conducted at a large number of hydropower projects have demonstrated peaks in turbine entrainment in the spring and fall that appear to be driven by juvenile dispersal (FERC 1995). Downstream displacement due to high flow conditions can also occur during freshets and periods of significant precipitation that are more common during spring and fall. Lower numbers of entrained fish (i.e., less downstream movement) were observed in the entrainment data for summer (lowest flows and warmest temperatures) and winter (cold temperatures) months when fish are considerably less active.

Passage Route Characterization

Fish moving downstream at the Dahowa Project can either pass through the turbine when it is operating or over the spillway, below which they enter the natural falls and continue through the bypass reach and into mainstem river below the tailrace. Spillway survival is likely high (≥ 98%) at Dahowa due to the relatively short drop from the dam crest to the concrete sill below. Entrainment through hydro turbines is influenced by trash rack bar spacing, approach flow velocities, and fish size and swimming capabilities. Fish that reach a size at which their body width physically excludes them from entrainment through the bar racks at Dahowa (which have a clear spacing of 2.5 inches) will either remain upstream of the project or pass over the spillway. Additionally, some fish small enough to pass through the bar spacing will exhibit behavioral exclusion, particularly if they have sufficient swimming ability to avoid being swept through the racks. An assessment of impingement and entrainment risk and downstream passage survival is provided in a separate report section below.

Performance Expectations and FWS Fish Passage Design Criteria

USFWS design criteria for downstream passage facilities are generally focused on the needs of migratory fish populations and currently includes clear bar spacings of 0.75 inches for silver American Eels and 1.00 inch for anadromous species with approach flow velocities of 2 ft/s or less at the face of the trash racks. Alternative safe passage routes are also required and may include dedicated fish bypasses, existing spill or debris sluice gates, notches in a spillway crest, or a sufficient volume and depth of spill. The number and location of downstream bypasses is typically determined by the intake size and configuration, with a goal of maximizing the opportunity of discovery by downstream migrating fish. Performance expectations may vary by site and species, but total passage survival goals often exceed 90% for diadromous fish populations. Appropriate targets for total passage survival of freshwater species are more difficult to determine and generally have not been specified for most hydro dams regardless of whether diadromous fish are present.

Impingement and Entrainment Analysis

Impingement

Fish impingement was assessed by determining the size at which fish will be physically excluded by the Project's trash rack bar spacing (2.5-inch clear) and by comparing species and life stage swimming speeds to intake approach flow velocities. The risk of impingement was evaluated for species that may occur upstream of the project. The lengths at which the fish would be excluded by a 2.5-inch bar spacing were estimated using body width to total length ratios reported by Smith (1985).

The lengths above which the fish species found upstream the Dahowa Project would be physically excluded from entrainment through the project trash racks range from 14.5 inches for Yellow Bullhead to 32.1 inches for Northern Pike. The other species that fall within this length range include Brown Bullhead, Brown Trout, Largemouth and Smallmouth Bass, Norther Hog Sucker, and White Sucker.

The approach velocity immediately upstream of the intake trash racks was calculated using a cross-sectional area of 972 ft^2 (based on wetted rack dimensions of 36 ft wide and 27 ft high) and a turbine flow range of 250 to 1,600 cfs. Using these parameters and assuming a clean rack and uniform flow distribution, the estimated approach flow velocity to the intake will range from 0.26 ft/s at the minimum turbine flow to 1.6 ft/s at the maximum flow. These velocities are below prolonged and burst swimming capabilities of the species determined to be potentially at risk to impingement based on the lengths at which they would be physically excluded by the 2.5-inch clear bar spacing of the trash racks. Additionally, the estimated maximum approach velocity is also below the criterion established by FWS for protecting fish from entrainment through turbine intakes (2 ft/s) (USFWS 2019). Consequently, none of the fish species known to be upstream of the project would be at risk for impingement if they were to encounter the turbine intake trash racks

Turbine and Total Project Survival

Methods

Turbine and total project survival for fish passing downstream at the Dahowa Project were estimated using the FWS Turbine Blade Strike Analysis (TBSA) Excel spreadsheet application (Towler and Pica 2018). The TBSA application calculates turbine survival using a theoretical blade strike probability equation described by Franke et al. (1997). A mortality correlation coefficient (λ) of 0.2 was used for the TBSA calculations of turbine survival (i.e., proportion of fish struck by a blade that are killed). For the estimation of total project survival, spillway mortality and the proportion of fish passing downstream through each route are either based on site-specific studies or assigned by the TBSA application user based on professional judgment and/or studies conducted at other projects with similar species.

Field evaluations of downstream passage and survival have not been conducted at Dahowa or for the fish species that occur in the vicinity of the project. Therefore, it was assumed spillway survival is 98% based on the relatively small drop over the dam crest before fish enter the natural falls and continue downstream. The proportion of fish passing downstream through the turbines and over the spillway was assumed to be the same as the proportion of river flow passing at each route and, conservatively, it was assumed there was no behavioral or physical exclusion for fish less than 22 inches in length encountering the intake trash racks.

Downstream passage survival was evaluated for four size groups of fish: 1 to 4, 4 to 8, 8 to 15, and 15 to 22 inches in length. The midpoint length for each size group was used as a mean length for the TBSA calculations along with standard deviations that produced minimum and maximum lengths approximating the lower and upper bounds of each size group. Total survival estimates for each size group were generated for river flows corresponding to the 1, 15, 25, 50, 80, and 90% annual exceedance values. A sample of 10,000 fish was used for the analysis of each combination of fish size group and river flow. Weighted estimates of total project survival for each river flow were calculated for all size groups combined using entrainment data reported for studies conducted at sites with bar rack spacings of 2.50 and 2.75 inches and for fish lengths corresponding to those used for the Dahowa analysis (Winchell et al. 2000). Annual estimates of total project survival weighted by flow probabilities were calculated for each size group and all sizes combined by multiplying the probability of occurrence for specified flow intervals by the corresponding survival rates and summing the resulting proportional rates.

Results

Turbine survival estimates for the fish size groups evaluated ranged from 76.0 to 96.5% at the minimum turbine flow and 82.2 to 97.6% at the maximum flow (**Error! Reference source not found.**). Survival decreases at lower flows and for larger fish due to greater probability of strike (i.e., slower passage between blades at lower flows and longer fish increase strike exposure).

For the range of river flows that occur annually at the Dahowa Project, the results of the analysis conducted with the FWS TBSA application produced total project survival rates of 93 to 98% for fish with lengths of 8 inches and less and 78 to 98% for fish between 8 and 22 inches in length (this covers the range of fish sizes that can pass through the 2.5 inch bar spacing for species occurring upstream of the project, with the exception of Northern Pike).

The total survival of all size groups combined weighted by the proportion of each size group expected to comprise entrainment was estimated to be 95 to 98% for the flow range evaluated. The highest survival rate (98%) for all size groups occurred at the less than about 300 cfs, for which there is insufficient flow to operate the turbine.

Exceedance Probability (%)	Flow (cfs)			Total Passage Survival (%) by Fish Length (in)				Total Survival All Size Groups Combined
	River	Turbine	Spill	1-4	4-8	8-15	15-22	
99	103	0	103	98.0	98.0	98.0	98.0	98.0
80	303	268	35	96.7	93.5	86.0	78.2	95.2
50	655	620	35	96.9	92.9	85.8	78.3	95.2
25	1142	1107	35	97.4	93.9	87.3	79.8	95.9
15	1557	1522	35	97.6	93.9	88.9	82.4	96.1

1	4238	1600	2638	98.0	96.6	94.8	92.1	97.5

Average total survival rates weighted for the proportion of time that specified flow rates occur over the course of a year (as estimated using exceedance probabilities for the lower and upper flows of each interval) ranged from 84.1% for fish with lengths between 15 and 22 inches to 97.4% for fish 4 inches and less (**Error! Reference source not found.**). The average total survival for all size groups and flows combined was 96.2% (**Error! Reference source not found.**).

Identification Of Alternatives for Feasibility Analysis

Due to the high total survival rates estimated for fish passing downstream at Dahowa, implementing any type of operational changes or installing measures to reduce turbine entrainment and provide alternative downstream passage routes is not recommended because they would only provide marginal benefits, if any, to the local fish populations.

Recommendations for Downstream Fish Passage

The results of the impingement, entrainment, and survival assessment indicate the existing conditions for downstream passage at Dahowa are not negatively affecting the local fish populations and that any attempts to reduce entrainment and/or increase passage survival would not provide any meaningful benefits. Therefore, it is recommended that measures to reduce turbine entrainment and increase passage survival not be implemented at the project.

Benthic Macroinvertebrates

Benthic macroinvertebrates are invertebrate fauna that can be captured by a 500 µm sieve. Taxa can include anthropods (insects, mites, scuds, and crayfish), mollusks (snails, limpets, mussels, and clams), annelids (segmented worms), nematodes (roundworms), and platyhelminthes (flatworms). Some macroinvertebrates live their entire lives in the water and some only complete some of their life cycle in water [69].

Benthic macroinvertebrates are an indicator of river health and are a link between a system's primary productivity and its aquatic consumers through the conversion of plant biomass to consumable energy. Benthic macroinvertebrates are useful indicators of water quality because species vary in their range of tolerances to pollution [69]. Those belonging to the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), which are collectively referred to as EPT macroinvertebrates, are highly sensitive to pollution [33]. Furthermore, EPT species are high-quality forage for a variety of freshwater fish species.

Benthic macroinvertebrates have been sampled in the Lower Battenkill River on five occasions between 1984 and 2012 [51]. Collections were made from four different monitoring stations located at RM 0.5, RM 6.5, RM 9.6, and RM 10.2 (see Figure 7), however only the station at RM 9.6 was sampled on each occasion. Eighteen unique orders and at least 50 families were collected when combining samples across monitoring stations and years (Table 17). Ephemeroptera, Trichoptera, Diptera (true flies), Coleoptera (beetles), and Haplotaxida (clitellate annelid worms) represented most organisms collected.

Biological indices were calculated from the macroinvertebrate community data for the purposes of assessing water quality within the Battenkill River [33]. These measures included species richness, the Hilsenhoff Biotic Index, Percent Model Affinity, and EPT value. Means calculated across years for the four monitoring stations ranged from 27 to 36 for species richness, 3.90 to 4.83 for the Hilsenhoff Biotic Index, 66 to 75 for the Percent Affinity Model, and 13 to 17 for EPT value (Table 18) [51]. According to the descriptions outlined in the Battenkill Biological Stream Assessment report (Table 19) [33], these values are largely indicative of a non-impacted waterbody with very good water quality. The monitoring station at RM 0.5, which is located just upstream of the confluence with the Hudson River, consistently had the lowest mean biological index values among the four monitoring sites. In contrast, the station located at RM 6.5, which is closest in proximity to the Project, achieved the best mean biological index scores for three of the four indices.

Table 17. Percent Abundance of Benthic Macroinvertebrate -lower Battenkill River Samples [51]

Major Group	Order	Family	Taxon	Percent Abundance					
				1984[1]	1986[1]	1999[2]	2001[3]	2012[4]	Total
Annelids	Haplotaxida	Enchytraeidae - Potworms	Undetermined Enchytraeidae	0.0	0.3	0.0	0.0	0.0	0.1
		Naididae – Naidid Worms	*Aulodrilus pigueti*	0.0	0.3	0.0	0.0	0.0	0.1
			Nais behningi	0.0	2.3	0.0	0.0	0.0	0.6
			Nais bretscheri	9.3	10.3	0.0	0.0	0.0	5.6
			Nais pardalis	0.0	0.5	0.0	0.0	0.0	0.1
			Nais simplex	0.8	1.3	0.0	0.0	0.0	0.6
			Nais variabilis	0.0	1.5	0.0	0.0	0.0	0.4
			Quistadrilus multisetosus	0.0	0.8	0.0	0.0	0.0	0.2
			Slavina appendiculata	0.0	0.3	0.0	0.0	0.0	0.1
			Stylaria lacustris	0.5	0.0	0.0	0.0	0.0	0.1
			Undetermined Tubificidae	0.5	0.3	0.0	0.0	0.0	0.2
	Lumbriculida	Lumbriculidae – Freshwater Worms	Undetermined Lumbriculidae	0.0	0.0	2.3	0.0	5.0	0.9
	Opisthopora	Undetermined - Earthworms	Undetermined Lumbricina	0.3	0.0	0.0	0.0	0.0	0.1
Arthropods	Coleoptera - Beetles	Elmidae - Riffle Beetles	*Dubiraphia* sp.	0.5	0.3	0.0	0.0	0.0	0.2
			Dubiraphia vittata	0.0	1.0	0.0	0.0	0.0	0.3
			Optioservus fastiditus	0.0	0.0	0.0	4.5	0.0	0.6
			Optioservus sp.	5.8	0.8	5.0	0.0	0.0	2.9
			Optioservus trivittatus	0.0	0.0	4.0	7.0	7.0	2.4
			Promoresia elegans	0.0	0.0	1.7	0.0	0.0	0.4
			Promoresia sp.	0.0	0.0	0.0	0.0	1.0	0.1
			Stenelmis crenata	0.5	3.3	7.7	5.0	4.0	3.7
			Stenelmis sp.	2.0	0.0	0.0	1.0	0.0	0.7
		Gyrinidae - Whirligig Beetles	*Dineutus* sp.	0.0	0.3	0.0	0.0	0.0	0.1
		Hydrophilidae - Water Scavenger Beetles	Berosus sp.	0.0	0.3	0.0	0.0	0.0	0.1
		Psephenidae - Water Penny Beetle	Ectopria sp.	0.0	0.3	0.0	0.0	0.0	0.1

Major Group	Order	Family	Taxon	Percent Abundance					
				1984[1]	1986[1]	1999[2]	2001[3]	2012[4]	Total
Arthropods	Coleoptera - Beetles	Psephenidae - Water Penny Beetles	Psephenus herricki	0.0	0.0	0.0	0.0	5.0	0.4
			Psephenus sp.	1.0	1.3	0.7	0.0	0.0	0.8
	Diptera - True Flies	Athericidae - Watersnipe Flies	*Atherix* sp.	0.0	0.0	0.0	1.0	3.0	0.4
		Chironomidae - Nonbiting Midges	*Cardiocladius obscurus*	0.0	0.3	0.0	0.0	2.0	0.2
			Cladotanytarsus nr. *dispersopilosus*	0.3	0.0	0.0	0.0	0.0	0.1
			Corynoneura nr. *celeripes*	0.0	0.3	0.0	0.0	0.0	0.1
			Cricotopus bicinctus	0.3	2.3	1.3	0.0	0.0	1.0
			Cricotopus intersectus gr.	0.0	1.0	0.0	0.0	0.0	0.3
			Cricotopus tremulus gr.	0.3	0.0	0.0	0.5	1.0	0.2
			Cricotopus trifascia gr.	0.3	0.0	1.7	0.0	0.0	0.4
			Cricotopus vierriensis	0.0	2.8	0.7	0.0	0.0	0.9
			Cryptochironomus fulvus gr.	0.0	0.5	0.0	0.0	0.0	0.1
			Microtendipes pedellus gr.	10.8	3.5	0.3	0.0	1.0	4.2
			Nilothauma babiyi	0.0	0.3	0.0	0.0	0.0	0.1
			Orthocladius nr. *dentifer*	0.5	0.0	0.3	0.0	0.0	0.2
			Orthocladius obumbratus	0.8	0.0	0.0	0.0	0.0	0.2
			Orthocladius sp.	0.3	0.0	0.0	0.0	0.0	0.1
			Parametriocnemus lundbecki	0.0	0.3	0.0	0.0	0.0	0.1
			Paratanytarsus confusus	0.0	0.3	0.0	0.0	0.0	0.1
			Phaenopsectra sp.	0.3	0.0	0.0	0.0	0.0	0.1
			Polypedilum aviceps	0.0	0.3	0.0	0.0	0.0	0.1
			Polypedilum flavum	0.0	0.8	0.7	1.0	0.0	0.5
			Polypedilum illinoense	0.0	0.8	0.0	0.0	0.0	0.2
			Potthastia gaedii gr.	0.0	0.3	0.0	0.5	0.0	0.1
			Rheocricotopus robacki	0.0	0.3	0.0	0.0	0.0	0.1
			Rheotanytarsus exiguus gr.	1.3	0.0	0.7	0.0	0.0	0.5
			Stempellinella sp.	0.0	0.5	0.0	0.0	0.0	0.1
			Sublettea coffmani	0.0	0.3	0.0	0.0	1.0	0.1
			Tanytarsus glabrescens gr.	0.5	2.5	0.7	0.0	0.0	1.0
			Tanytarsus guerlus gr.	0.3	0.5	0.0	0.0	0.0	0.2

Major Group	Order	Family	Taxon	Percent Abundance					
				1984[1]	1986[1]	1999[2]	2001[3]	2012[4]	Total
Arthropods	Diptera - True Flies	Chironomidae - Nonbiting Midges	*Thienemannimyia* gr. spp.	0.5	1.5	1.0	1.0	0.0	0.9
			Tribelos jucundum	0.3	0.0	0.0	0.0	0.0	0.1
			Tvetenia vitracies	0.3	0.3	0.3	1.5	0.0	0.4
		Empididae - Dance Flies	*Hemerodromia* sp.	0.0	0.0	0.3	0.5	0.0	0.1
		Simuliidae - Blackflies, Black Gnats, Riffle Smuts	*Simulium jenningsi*	0.0	0.3	1.0	0.0	0.0	0.3
			Simulium sp.	0.0	0.0	0.0	1.0	0.0	0.1
			Simulium vittatum	0.3	0.0	0.0	0.0	0.0	0.1
		Tipulidae - Craneflies, Spikes, Mosquito Hawks	*Antocha* sp.	1.3	2.5	2.0	1.0	1.0	1.7
	Ephemeroptera - Mayflies	Baetidae - Small Minnow Mayflies	*Acentrella* sp.	1.3	5.5	0.7	2.0	0.0	2.4
			Acerpenna pygmaea	0.0	0.3	0.7	0.0	0.0	0.2
			Baetis flavistriga	0.8	1.5	1.0	1.5	0.0	1.1
			Baetis intercalaris	0.0	0.0	2.0	1.0	1.0	0.6
			Baetis sp.	0.0	0.3	0.0	0.0	0.0	0.1
			Centroptilum sp.	1.0	0.0	0.0	0.0	0.0	0.3
			Heterocloeon sp.	0.0	0.3	2.3	0.5	0.0	0.6
			Plauditus sp.	0.0	0.0	0.0	0.5	0.0	0.1
		Baetiscidae - Humpbacked Nymphs, Armored Mayflies	*Baetisca* sp.	0.3	0.0	0.0	0.0	0.0	0.1
		Caenidae - Tiny Graywinged Blue or Rusty Dun, Small Squaregills	*Caenis* sp.	1.3	4.3	1.0	0.0	1.0	1.9
		Ephemerellidae - Spiny Crawlers	*Drunella lata*	0.0	2.8	0.0	0.0	0.0	0.8
			Drunella walkeri	0.0	0.3	0.0	0.0	0.0	0.1
			Ephemerella sp.	1.8	4.5	0.0	0.0	0.0	1.8
			Eurylophella sp.	1.0	0.0	0.0	0.0	0.0	0.3
			Serratella deficiens	0.0	1.0	1.3	0.0	0.0	0.6
			Undetermined Ephemerellidae	0.0	5.0	0.0	1.0	3.0	1.8

Major Group	Order	Family	Taxon	Percent Abundance					
				1984[1]	1986[1]	1999[2]	2001[3]	2012[4]	Total
Arthropods	Ephemeroptera - Mayflies	Ephemeridae - Common Burrowers	*Ephemera* sp.	0.8	0.0	0.0	0.0	0.0	0.2
		Heptageniidae - Flatheaded Mayflies	*Epeorus* (iron) sp.	0.0	0.0	0.3	0.0	0.0	0.1
			Heptagenia sp.	0.0	1.3	0.0	0.0	0.0	0.4
			Leucrocuta sp.	0.0	0.0	0.7	1.5	2.0	0.5
			Maccaffertium luteum	0.0	0.0	0.0	0.0	2.0	0.1
			Maccaffertium mediopunctatum	0.0	3.3	0.0	0.0	0.0	0.9
			Maccaffertium modestum	1.5	0.0	0.0	3.5	0.0	0.9
			Maccaffertium sp.	0.0	0.0	0.0	0.0	3.0	0.2
			Maccaffertium terminatum	2.0	0.0	0.0	0.0	0.0	0.6
			Maccaffertium vicarium	21.0	0.0	0.0	0.5	0.0	6.1
			Stenacron interpunctatum	2.3	1.5	0.0	0.0	0.0	1.1
			Stenonema femoratum	0.3	0.3	0.0	0.0	0.0	0.1
			Stenonema sp.	0.0	0.3	6.7	4.0	0.0	2.1
		Isonychiidae - Brushlegged Mayflies; Mahogany or Slate Duns/Drakes	*Isonychia bicolor*	0.0	0.0	6.7	3.0	0.0	1.9
			Isonychia sp.	1.8	0.8	0.0	0.0	15.0	1.8
		Leptohyphidae - Little Stout Crawlers; Tiny Whitewinged Trico	*Tricorythodes* sp.	0.0	0.5	0.3	0.0	0.0	0.2
		Potamanthidae – Golden Drakes	*Anthopotamus* sp.	2.8	4.5	0.0	3.0	6.0	2.9
	Megaloptera - Dobsonflies and Alderflies	Corydalidae - Dobsonflies	*Corydalus cornutus*	0.0	0.0	1.3	0.5	3.0	0.6
			Nigronia serricornis	0.3	0.0	0.0	0.0	1.0	0.1
		Sialidae - Alderflies	*Sialis* sp.	0.5	0.3	0.0	0.0	0.0	0.2
	Odonata – Dragonflies and Damselflies	Coenagrionidae - Narrow-winged Damselflies, Pond Damsels	Undetermined Coenagrionidae	0.3	0.0	0.0	0.0	0.0	0.1
	Plecoptera – Stoneflies	Perlidae - Common Stoneflies	*Acroneuria abnormis*	0.0	0.0	0.0	0.0	1.0	0.1
			Neoperla sp.	0.0	0.0	0.0	0.0	1.0	0.1
			Paragnetina sp.	0.0	0.0	0.3	0.0	0.0	0.1

Major Group	Order	Family	Taxon	Percent Abundance					
				1984[1]	1986[1]	1999[2]	2001[3]	2012[4]	Total
Arthropods	Plecoptera – Stoneflies	Perlidae - Common Stoneflies	*Perlesta* sp.	0.0	1.8	0.0	0.0	0.0	0.5
	Trichoptera - Caddisflies	Thremmatidae	*Neophylax* sp.	0.0	0.0	0.3	0.0	0.0	0.1
		Apataniidae - Early Smoky Wing Sedges	*Apatania* sp.	1.3	1.5	0.0	3.0	0.0	1.2
		Brachycentridae - Humpless Casemakers	*Brachycentrus appalachia*	0.0	0.0	0.0	0.0	1.0	0.1
		Glossosomatidae - Saddlecase Makers	Undetermined Glossosomatidae	0.0	0.0	0.7	0.0	0.0	0.1
		Helicopsychidae - Snailcase Makers	*Helicopsyche borealis*	0.0	0.0	0.7	0.0	3.0	0.4
		Hydropsychidae - Netspinner Caddisflies	*Ceratopsyche bronta*	2.8	0.8	5.0	1.5	5.0	2.6
			Ceratopsyche morosa	2.0	3.3	2.0	1.5	2.0	2.3
			Ceratopsyche slossonae	0.0	0.0	0.0	2.0	0.0	0.3
			Ceratopsyche sp.	0.0	0.0	0.0	0.0	1.0	0.1
			Cheumatopsyche sp.	2.0	2.5	6.7	24.0	8.0	6.7
			Hydropsyche leonardi	0.0	0.0	4.3	0.5	0.0	1.0
			Hydropsyche scalaris	0.0	0.0	1.7	0.5	0.0	0.4
			Hydropsyche sp.	0.5	0.0	1.7	0.0	0.0	0.5
			Macrostemum carolina	0.0	0.0	9.0	0.5	3.0	2.2
		Hydroptilidae - Microcaddisflies, Pursecase Makers	*Agraylea* sp.	0.0	0.0	1.0	0.0	0.0	0.2
			Hydroptila consimilis	1.0	0.0	0.0	0.0	0.0	0.3
			Hydroptila nr. *albicornis*	0.0	0.3	0.0	0.0	0.0	0.1
			Hydroptila sp.	0.0	0.3	0.0	0.0	0.0	0.1
			Undetermined Hydroptilidae	0.0	0.0	0.3	0.0	0.0	0.1
		Leptoceridae - Longhorned Case Makers	*Ceraclea* sp.	0.0	0.0	0.3	0.0	0.0	0.1
			Oecetis avara	0.3	0.3	0.0	0.0	0.0	0.1
			Oecetis sp.	0.0	0.5	0.0	0.0	0.0	0.1
			Setodes sp.	0.0	0.3	0.0	0.0	0.0	0.1
			Triaenodes sp.	1.5	0.0	0.0	0.0	0.0	0.4
			Undetermined Leptoceridae	0.0	0.0	0.7	0.0	0.0	0.1
		Limnephilidae - Northern Case Makers	Undetermined Limnephilidae	0.0	0.3	0.0	0.0	0.0	0.1

Major Group	Order	Family	Taxon	Percent Abundance					
				1984[1]	1986[1]	1999[2]	2001[3]	2012[4]	Total
Arthropods	Trichoptera – Caddisflies	Philopotamidae - Fingernet Caddisflies	*Chimarra aterrima*	0.0	0.0	2.7	2.0	0.0	0.9
		Philopotamidae - Fingernet Caddisflies	*Chimarra obscura*	0.0	0.0	2.3	1.5	1.0	0.8
			Chimarra socia	0.0	0.0	0.0	0.0	6.0	0.4
			Chimarra sp.	0.0	0.3	0.3	0.0	0.0	0.1
		Polycentropodidae - Trumpetnet Caddisflies	*Neureclipsis* sp.	0.0	0.0	0.0	0.5	0.0	0.1
			Polycentropus sp.	0.3	0.3	0.0	0.0	0.0	0.1
		Psychomyiidae - Nettube Caddisflies	Undetermined Psychomyiidae	0.0	0.0	0.7	0.0	0.0	0.1
		Rhyacophilidae - Freeliving Caddisflies, Green caddisflies	*Rhyacophila formosa*	0.0	0.5	0.0	0.0	0.0	0.1
	Amphipoda - Scuds or Sideswimmers	Gammaridae - Scuds	*Gammarus* sp.	1.0	0.0	0.0	5.5	0.0	1.1
	Decapoda – Crabs, Shrimps, and Lobsters	Cambaridae - Crayfishes	Undetermined Cambaridae	0.3	0.0	0.0	0.0	0.0	0.1
	Isopoda - Pillbugs	Asellidae - Aquatic Sowbug, American Sowbug	*Caecidotea* sp.	0.0	0.3	0.0	0.0	0.0	0.1
Mollusks	Sphaeriida – Pea Clams	Sphaeriidae	*Sphaerium* sp.	0.0	0.5	1.3	0.0	0.0	0.4
	Venerida – Venus Clams	Pisidiidae	Undetermined Pisidiidae	3.0	0.0	0.0	1.0	0.0	1.0
	Basommatophora – Aquatic Snails	Ancylidae	*Ferrissia rivularis*	0.5	0.5	0.0	0.0	0.0	0.3
		Physidae	*Physella* sp.	0.0	1.0	0.0	0.0	0.0	0.3
		Planorbidae - Ramshorn Snails	*Gyraulus* sp.	0.0	0.5	0.0	0.0	0.0	0.1
			Undetermined Planorbidae	0.3	0.0	0.0	0.0	0.0	0.1
	Neotaenioglossa - Snails	Hydrobiidae	Undetermined Hydrobiidae	0.3	0.0	0.0	0.0	0.0	0.1
		Pleuroceridae	*Goniobasis virginica*	3.3	0.0	0.0	0.0	0.0	0.9

Major Group	Order	Family	Taxon	Percent Abundance					
				1984[1]	1986[1]	1999[2]	2001[3]	2012[4]	Total
Ribbon Worms	Hoplonemertea	Tetrastemmatidae	*Prostoma graecense*	0.3	0.0	0.3	0.0	0.0	0.1
Flatworms	Turbellaria - Planarians		Undetermined Turbellaria	0.3	0.3	0.3	8.0	0.0	1.4

[1] RM 0.5, RM 6.5, RM 9.6, and RM 10.2 monitoring stations sampled.
[2] RM 0.5, RM 6.5, and RM 9.6 monitoring stations sampled.
[3] RM 0.5 and RM 9.6 monitoring stations sampled.
[4] RM 9.6 monitoring station sampled.

Table 18. Biological Index Values in the Lower Battenkill River, 1984-2012 [51]

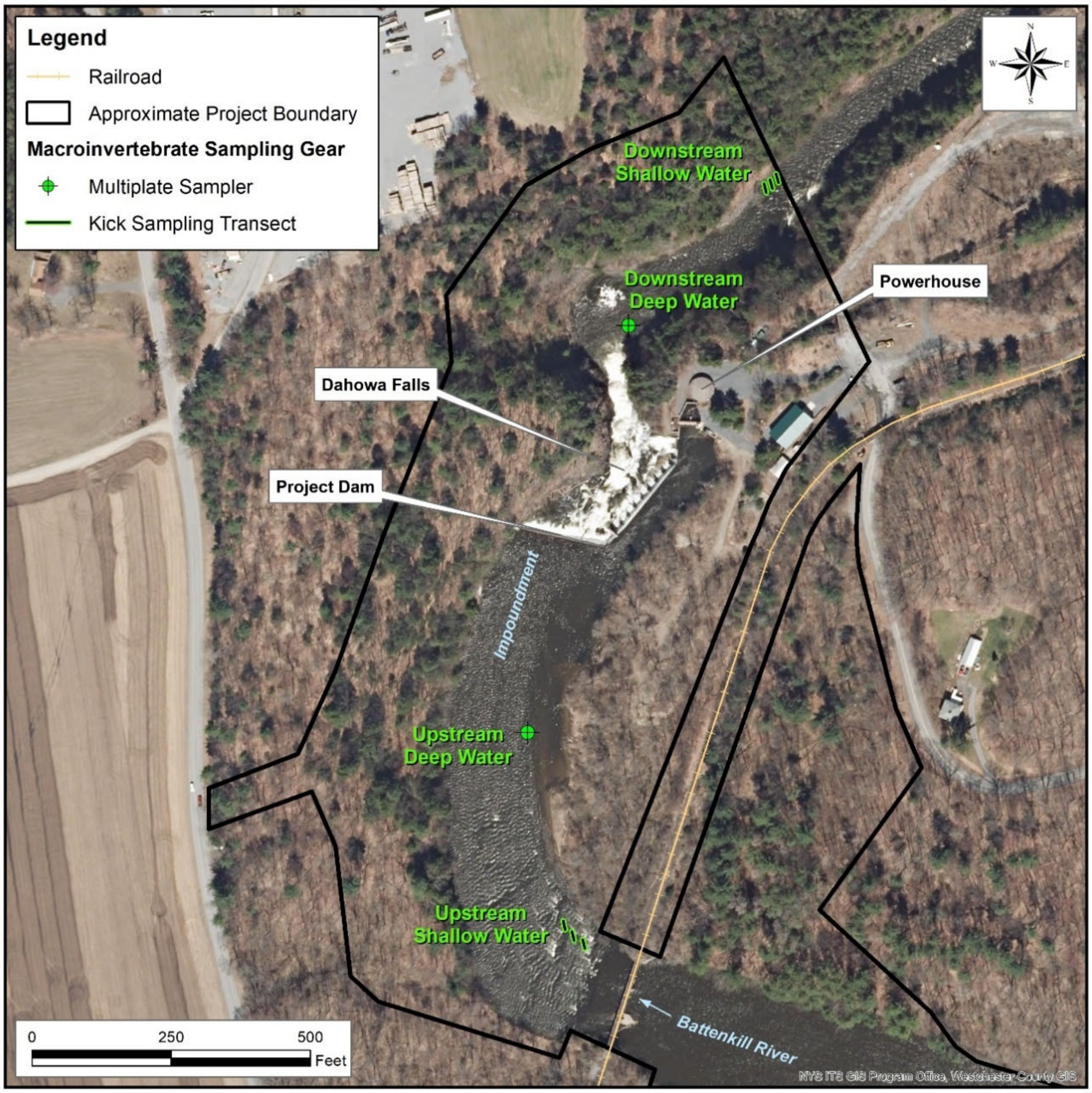
	Species Richness				Hilsenhoff Biotic Index				Percent Model Affinity				EPT Value			
Month Year	**RM 0.5**	**RM 6.5**	**RM 9.6**	**RM 10.2**	**RM 0.5**	**RM 6.5**	**RM 9.6**	**RM 10.2**	**RM 0.5**	**RM 6.5**	**RM 9.6**	**RM 10.2**	**RM 0.5**	**RM 6.5**	**RM 9.6**	**RM 10.2**
October 1984	26	35	28	28	4.48	4.49	4.21	4.67	74	84	80	72	10	15	18	16
June 1986	35	46	25	25	5.81	5.59	3.67	4.22	76	85	75	76	14	19	16	14
August 1999	30	28	26		4.22	3.59	3.91		59	56	62		15	18	16	
September 2001	22		22		4.79		3.99		54		56		13		12	
September 2012			32				3.72				73				19	
Mean	**28**	**36**	**27**	**27**	**4.83**	**4.56**	**3.90**	**4.45**	**66**	**75**	**69**	**74**	**13**	**17**	**16**	**15**

Table 19. Description of Water Quality Impact Assessments Based on Biological Index Values [33].

Water Quality Impact	Description	Species Richness	Hilsenhoff Biotic Index	Percent Model Affinity	EPT Value
Non-Impacted	Very good water quality. Macroinvertebrate community is diverse with mayflies, stoneflies, and caddisflies well-represented. Water quality should not be limiting to fish survival or propagation. This level of water quality includes pristine habitats and those receiving discharges which minimally alter the biota.	≥27	≤4.50	>64	>10
Slightly Impacted	Good water quality. Macroinvertebrate community is slightly but significantly altered from the pristine state. Mayflies and stoneflies may be restricted. Water quality is usually not limiting to fish survival, but may be limited to fish propagation.	19-26	4.51-6.50	50-64	6-10
Moderately Impacted	Poor water quality. Macroinvertebrate community is altered to a large degree from the pristine state. Mayflies and stoneflies are rare or absent, and caddisflies are often restricted. Water quality often is limiting to fish propagation, but usually not to fish survival.	11-18	6.51-8.50	35-49	2-5
Severely Impact	Very poor water quality. Macroinvertebrate community is limited to a few tolerant species. Mayflies, stoneflies, and caddisflies are rare or absent. The dominant species are almost all tolerant, and are usually midges and worms. Water quality is often limited to both fish propagation and fish survival.	≤10	>8.50	≤35	0-1

2022 Macroinvertebrate Study

Macroinvertebrate sampling was conducted during late summer and early fall of 2022 to provide information on the existing benthic macroinvertebrate communities upstream and downstream of the Project Dam that may be impacted by Project operations. Four sites located upstream and downstream of the Project Dam were chosen as representative of habitats found in shallow and deep waters. Sampling locations are depicted in the figure below.



Multiplate samplers were deployed at the deep-water habitat sampling sites for six weeks from August 17 to September 29, 2022. Two samplers were deployed at each location to increase the probability that at least one device was recovered. Travelling kick sampling was conducted at the shallow water habitat sites on September 29, 2022. Each sample was collected over five minutes along a 5-m transect oriented diagonal to streamflow.

During laboratory analysis, macroinvertebrate community indices often used to assess community health were calculated based on taxon counts in each sample with different sets of indices calculated for multiplate and kick samples. Following adjustment for subsampling, an estimated 2,804 macroinvertebrates representing 84 distinct taxa were present in three multiplate samples and six kick samples collected during the 2022 study. The most numerous insects belonged to the orders Diptera, Ephemoptera, Trichoptera and Colepotera. A large number of annelid worms, members of the Naididae family were also collected.

Community index values were relatively consistent between multiplate samples collected upstream and downstream of the Project Dam. The Biological Assessment Profile (BAP) water impact scale values for multiplate samples indicated that values at both the upstream and downstream locations were representative of non-impacted sites with very good water quality. Results are tabulated below.

Biological Assessment Profile (BAP) of index values for multiplate samples collected at the Dahowa Hydroelectric Project during 2022.

Index	Upstream			Downstream
	Plate 1	Plate 2	Mean	Plate 1
SPP	10.0	10.0	**10.0**	7.3
EPT	8.5	9.5	**9.0**	10.0
DIV	10.0	10.0	**10.0**	10.0
HBI	9.5	9.2	**9.4**	10.0
BAP Mean	**9.5**	**9.7**	**9.6**	**9.3**

BAP water impact scale values for kick samples at the upstream site were representative of a slightly impacted site with good water quality. The overall mean BAP value at the downstream site location was representative of a non-impacted site with very good water quality. Results are tabulated below.

Biological Assessment Profile (BAP) of index values for kick samples collected at the Dahowa Hydroelectric Project during 2022.

Index	Upstream				Downstream			
	Kick 1	Kick 2	Kick 3	Mean	Kick 1	Kick 2	Kick 3	Mean
SPP	4.0	7.4	8.1	**6.5**	9.2	9.4	8.6	**9.1**
EPT	5.5	10.0	8.5	**8.0**	10.0	10.0	10.0	**10.0**
PMA	0.2	8.3	8.4	**5.7**	9.3	9.2	9.0	**9.1**
HBI	5.4	7.3	7.0	**6.6**	7.8	7.7	8.6	**8.0**
NBI-P	4.4	4.6	4.4	**4.5**	6.0	7.6	7.4	**7.0**
BAP Mean	**3.9**	**7.5**	**7.3**	**6.2**	**8.4**	**8.8**	**8.7**	**8.6**

The mean BAP of index values observed both upstream and downstream of the Project Dam during this study were within the range of historical values recorded within the river.

Over the course of the study, eighty-four distinct taxa of benthic macroinvertebrates were identified in three multiplate samples and six kick samples that were collected from sampling areas located upstream and downstream of the Project Dam during the late summer and early fall of 2022. In multiplate samples, higher SPP values were observed at the upstream location, whereas the downstream location had higher values in kick samples. Using either sampling method, EPT values tended to be slightly higher and HBI values tended to be slightly lower at the downstream location. DIV values did not vary strongly between locations for multiplate samples. In kick samples, PMA values were higher and NBI-P values were lower at the downstream location with NBI-P values indicating oligotrophic to mesotrophic conditions at the downstream location and slightly eutrophic conditions at the upstream location.

BAP water impact scale values for multiplate samples collected in a navigable waterway consistently indicated non-impacted water quality conditions at the upstream location. Similar results were observed for the downstream multiplate sample, however the SPP value was indicative of a slightly impacted site. BAP mean values at both locations were representative of non-impacted sites with very good water quality.

BAP water impact scale values for kick samples collected in a riffle differed slightly by sampling location. One of the three upstream samples (Kick 1) was dominated by naidid worms and had impact scale values ranging from slightly impacted for the EPT and HBI indices to severely impacted for the PMA index. Some naidid worm species are tolerant of organic pollution and reduced dissolved oxygen concentrations, and dominance of these species can be indicators of such conditions (Learner et al.

1978, SWCSMH 2013). Naidid worms identified in the present study included *Nais behningi*, *Nais bretscheri*, an unidentified *Nais* species, and an unidentified *Pristina* species. Of these taxa, *Nais bretscheri* was the most numerous due to its dominant presence in the upstream Kick 1 sample. This species is known to be relatively intolerant of organic enrichment and none of the other taxa collected are considered indicators of pollution (Learner et al. 1978, SWCSMH 2013). Naidid worms were either absent (Kick 2) or much less abundant (Kick 3) in the remaining two upstream kick samples, which were collected in close proximity to the Kick 1 sample. Thus, the variation in naidid worm densities observed in upstream kick samples likely was due to small-scale habitat differences as pollution likely would have influenced the samples similarly to promote the dominance of pollution-tolerant taxa. The remaining two upstream samples had values ranging from slightly impacted to non-impacted for each of the indices other than NBI-P, which had moderately impacted values. In contrast, the downstream samples consistently had water impact scale values indicative of non-impacted water quality with the exception being the NBI-P index, which had slightly impacted values. Whether the naidid worm-dominated sample was included or excluded from analysis, the overall mean BAP value observed at the upstream location was representative of a slightly impacted site with good water quality, whereas the overall mean BAP value at the downstream location was representative of a non-impacted site with very good water quality.

The finding of BAP of index values representative of sites with good to very good water quality conditions closely agreed with past stream biomonitoring samples collected in the Battenkill River and indicates that resident benthic macroinvertebrate communities likely are not impacted by operations at the Project.

The full Macroinvertebrate Survey report is provided in Appendix I.

Freshwater Mussels

Freshwater mussels or clams of North America are aquatic bivalve mollusks (Phylum Mollusca, Class Bivalvia) of the order Unionida belonging to either the Margaritiferidae or Unionidae families. With over 300 species, North America has the highest diversity of freshwater mussels in the world. Most species belong to the Unionidae family and are found east of Mississippi River. As filter-feeders, freshwater mussels feed on phytoplankton, diatoms, and other microorganisms and help to improve water quality by removing suspended particles and pollutants. Populations have declined since the late 1800s due to a combination of overharvesting, water flow alterations, pollution and sedimentation, and the introduction of invasive species, such as the zebra mussel (*Dreissena polymorpha*). Nearly three-quarters of native species currently are considered endangered, threatened, or species of special concern, with as many as 35 species already extinct [66].

At least 49 species of freshwater mussels are known to have been present in the state of New York (Table 20). Of these, ten species have not been reported in the state since before 1970. The invasive zebra mussel has only been present following its introduction to the Great Lakes region in the 1980s. Based on the number of New York river reaches where species have been detected, the most widely distributed species include: the eastern elliptio (*Elliptio complanata*), squawfoot or creeper (*Strophitus undulatus*), eastern floater (*Pyganodon cataracta*), fat mucket (*Lampsilis siliquoidea*), triangle floater (*Alasmidonta undulata*), elktoe (*Alasmidonta marginata*), floater or giant floater (*Pyganodon grandis*), eastern lampmussel (*Lampsilis radiata*), yellow lampmussel (*Lampsilis cariosa*), flutedshell (*Lasmigona costata*), pocketbook (*Lampsilis ovata*), cylindrical papershell (*Anodontoides ferussacianus*), and the creek heelsplitter (*Lasmigona compressa*) [81].

Freshwater mussels found in Washington County, New York were determined by searching several public databases, including the Illinois Natural History Survey mollusk collections database [20], verified naturalist observations reported to iNaturalist.org [21], and results provided by NYSDEC's Nature Explorer application [47]. Based on these data, a total of 11 species are or were historically present in Washington County (Table 21). These included: the triangle floater, eastern elliptio, plain pocketbook (*Lampsilis cardium*), creek heelsplitter, flutedshell, fragile papershell (*Leptodea fragilis*), black sandshell (*Ligumia recta*), pink heelsplitter (*Potamilus alatus*), eastern floater, giant floater, and the squawfoot or creeper.

Table 20. New York State Freshwater Mussels and Number of Reaches Detected [81]

Family	Scientific Name	Common Name	No. of Reaches
Dreissenidae	*Dreissena polymorpha*[1]	Zebra mussel	3
Margaritiferidae	*Margaritifera margaritifera*	Eastern pearlshell	38
Unionidae	*Actinonaias ligamentina*	Mucket	55
	Alasmidonta heterodon	Dwarf wedgemussel	10
	Alasmidonta marginata	Elktoe	139
	Alasmidonta undulata	Triangle floater	148
	Alasmidonta varicosa	Brook floater	56
	Alasmidonta viridis	Slipper shell	5
	Amblema plicata	Three-ridge	21
	Anodonta implicata	Alewife floater	27
	Anodontoides ferussacianus	Cylindrical papershell	94
	Elliptio complanata	Eastern elliptio	399
	Elliptio dilatata	Spike	53
	Epioblasma triquetra[2]	Snuffbox	1
	Fusconaia flava	Wabash pigtoe	38
	Fusconaia subrotunda	Long-solid	1
	Lampsilis cardium	Plain pocketbook	29
	Lampsilis cariosa	Yellow lampmussel	122
	Lampsilis fasciola	Wavy-rayed lampmussel	27
	Lampsilis ovata	Pocketbook	108
	Lampsilis radiata	Eastern lampmussel	133
	Lampsilis siliquoidea	Fat mucket	149
	Lasmigona compressa	Creek heelsplitter	80
	Lasmigona costata	Flutedshell	115
	Lasmigona subviridis	Green floater	52
	Leptodea fragilis	Fragile papershell	33
	Leptodea ochracea	Tidewater mucket	21
	Ligumia nasuta	Eastern pondmussel	41
	Ligumia recta	Black sandshell	56
	Obovaria olivaria[2]	Hickory nut	2
	Obovaria subrotunda[2]	Round hickorynut	3
	Pleurobema clava	Clubshell	2
	Pleurobema sintoxia	Round pigtoe	44
	Potamilus alatus	Pink heelsplitter	29
	Potamilus capax[2]	Fat pocketbook	2
	Potamilus ohiensis[2]	Pink papershell	1

Family	Scientific Name	Common Name	No. of Reaches
	Ptychobranchus fasciolaris	Kidneyshell	19
	Pyganodon cataracta	Eastern floater	150
	Pyganodon grandis	Floater/Giant floater	135
	Quadrula pustulosa[2]	Pimpleback	1
	Quadrula quadrula[2]	Mapleleaf	2
	Simpsonaias ambigua[2]	Salamander mussel	1
	Strophitus undulatus	Squawfoot/Creeper	230
	Toxolasma parvus	Lilliput	4
	Truncilla truncata	Deer toe	4
	Uniomerus tetralasmus[2]	Pondhorn	1
	Utterbackia imbecillis[2]	Paper pondshell	7
	Villosa fabalis	Rayed bean	18
	Villosa iris	Rainbow	41

[1] Nonnative, invasive species introduced from Eurasia.
[2] Historically present (no reported observations since 1970)

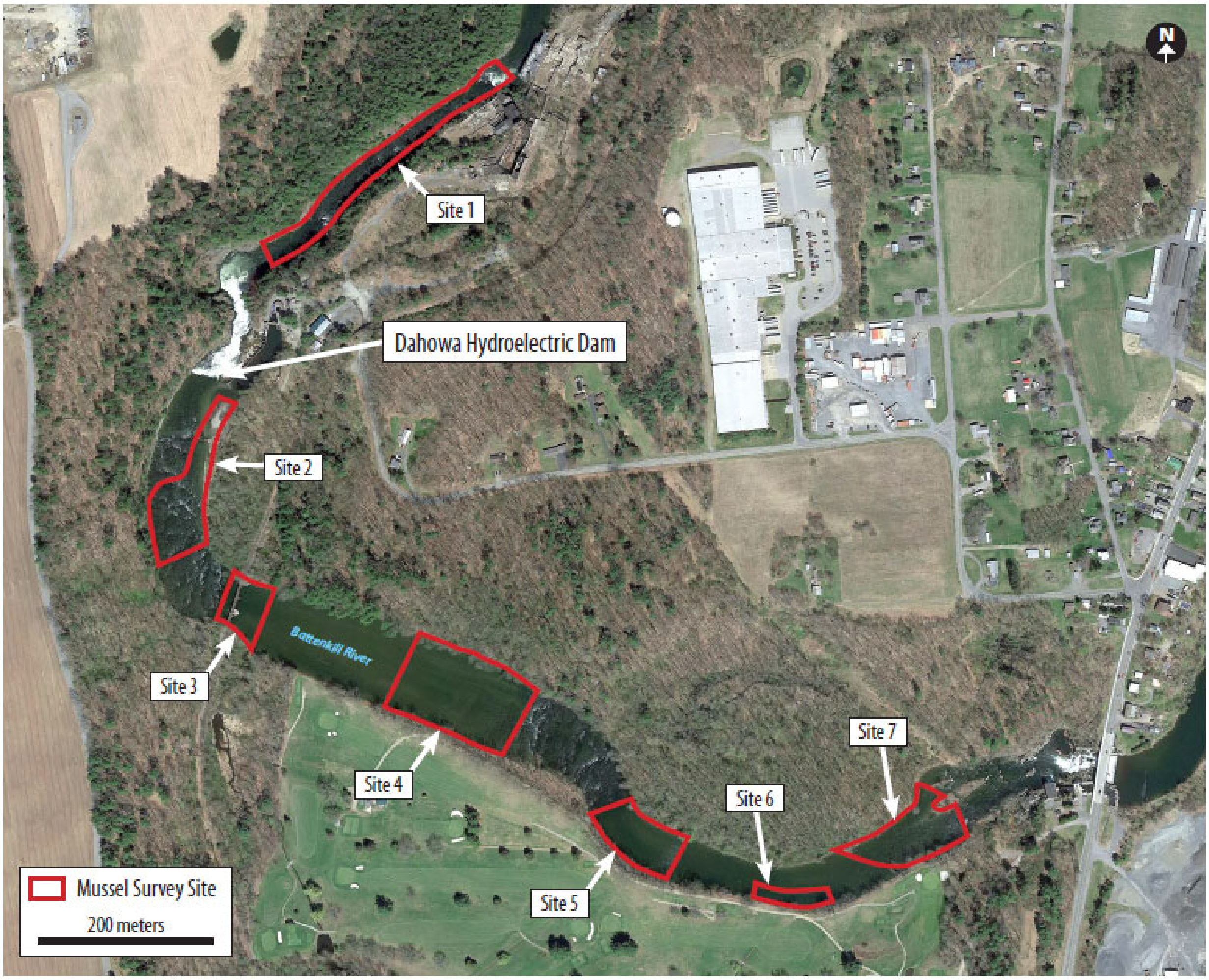
Table 21. Freshwater Mussels Reported in Washington County, New York [20], [21], [47]

Scientific Name	Common Name	Number of Observations		Presence (X)
		Illinois Natural History Survey (1978-1983)	iNaturalist (2019-2021)	NYSDEC Nature Explorer
Alasmidonta undulata	Triangle floater	7		
Elliptio complanata	Eastern elliptio	2	2	
Lampsilis cardium	Plain pocketbook	4		
Lasmigona compressa	Creek heelsplitter	10		
Lasmigona costata	Flutedshell	6		
Leptodea fragilis	Fragile papershell		1	X
Ligumia recta	Black sandshell			X
Potamilus alatus	Pink heelsplitter	1	1	X
Pyganodon cataracta	Eastern floater	3		
Pyganodon grandis	Floater/Giant floater	1	1	
Strophitus undulatus	Squawfoot/Creeper	2		
	Total	**40**	**5**	

2022 Freshwater Mussel Study

A freshwater mussel survey was conducted on August 3-4, 2022, in areas of the Battenkill River influenced by the Dahowa Hydroelectric Project. Survey objectives included characterizing species composition, distribution, relative abundance, and habitat of the mussel community in the study area. The study aimed to characterize the entire mussel community focusing on Endangered, Threatened, and high-ranking species.

The study area included the entire impoundment as well as an 0.8-mile upstream reach and a 0.2-mile reach downstream of the dam. Six sites were surveyed in the impoundment and one site was surveyed downstream of the dam. See figure below.



Freshwater mussel survey sites in the areas influenced by the Project.

Timed qualitative mussel surveys were conducted by snorkeling. A minimum of 2 hours were spent at each survey site with four hours in the reach downstream of the dam.

Data recorded included mussel species present, count for all species, location and shell lengths. Fish, fish nests and submerged aquatic vegetation were also noted at each site. No live mussels of any species were observed at any of the survey sites. One complete shell of creeper (*Strophitus undulatus*) was found at Site 2 in the lower impoundment. Creeper has a state rank of S4 ("Apparently Secure") in New York. Native fingernail clams were found at nearly all survey sites, but no non-native bivalves were observed.

While searching for mussels, biologists noted fish and vegetation species. Smallmouth bass and white sucker were observed at nearly all sites. Other species found at multiple (but not all) sites included largemouth bass, yellow perch, tessellated darter, bluegill, fallfish, rock bass, brown trout, and some unidentified juvenile fishes and cyprinids. A few fish nests were observed in quiet, shallow water. Biologists also noted the approximate abundance of submerged aquatic vegetation at each site. Generally, submerged aquatic vegetation was sparse throughout the entire study area. Species observed included Elodea (*nuttallii* or *canadensis*), *Vallisneria americana*, *Myriophyllum spicatum*, and one or two other species that were unidentified.

Survey results indicate that routine operations of the Dahowa Hydroelectric Project should have no effect on freshwater mussels.

The full Freshwater Mussel Survey report is provided in Appendix J.

7.2 Project Impact on Fish and Aquatic Resources

The 70-ft Dahowa Falls presents a natural barrier that would likely prevent upstream migration of fish to and above the Project Dam regardless of the presence of existing dams located downstream. The Project has no effect on migratory species as there is no evidence indicating that there are any migratory species present. Downstream dams lacking upstream fish passage located on the Battenkill River and the mainstem of the Hudson River, as well as the Dahowa Falls located below the Project, are barriers to any anadromous species. Surveys conducted in 2022 for American eel reveal no evidence for their presence in the Battenkill River, and it is presumed to be extirpated from the subbasin where the Project is located.

Based on the results of fish community survey data the resident fish assemblages upstream and downstream of the Project are highly comparable suggesting that the Project has a minimal effect on resident and game species of fish within this reach of the Battenkill River. The licensee is currently conducting a desktop fish passage assessment focused on downstream passage for resident species; results will be submitted to the licensing docket following completion of the analysis and associated consultations with resource managers. As noted, the presence of a natural cascade, coupled with comparable fish communities above and below this feature suggest that the Project has minimal effect on the fish community; no modifications to Project structures or operations are currently proposed, therefore it is anticipated that this minimal effect shall continue.

The results of the impingement, entrainment, and survival assessment indicate the existing conditions for downstream passage at Dahowa are not negatively affecting the local fish populations and that any attempts to reduce entrainment and/or increase passage survival would not provide any meaningful benefits. Therefore, it is recommended that measures to reduce turbine entrainment and increase passage survival not be implemented at the project.

Survey data indicate that the Project has a minimal effect on benthic macroinvertebrates and freshwater mussels. There currently are no anticipated changes in Project operations that would affect the extent and/or function of habitat or water quality required by macroinvertebrates and freshwater mussels. There currently are no anticipated Project-related impacts to river flows or Project operations.

7.3 Protection, Mitigation, and Enhancement Measures (PM&E)

Agency Recommended Mitigation

NYDEC has recommended 1-inch clear bar rack spacing for the protection of resident fish species. The applicant is in continuing consultations related to characterizing downstream passage conditions for the existing resident fish community.

Applicant Proposed Mitigation

The project is operated in run-of-river mode with no proposed changes to Project structures or operations.

8.0 Terrestrial Resources

8.1 Affected Environment

The Project is anticipated to have no or minimal effect on wildlife and botanical resources. The existing stream flow and reservoir regimes will be maintained, resulting in no modification to wildlife and botanical resources which provide habitat outside of the limited Project footprint. The Licensee will coordinate with resource agencies to develop appropriate protection mechanisms for both resident species and any listed species (if needed) to ensure appropriate avoidance measures are taken, to the extent practicable. Additional discussions of rare, threatened, and endangered species can be found in later sections.

Botanical Resources

The Project is located in the Lower New England – Northern Piedmont ecoregion, which extends across 12 states and the District of Columbia from southern Maine to northern Virginia (Figure 19) [29]. The Lower New England portion of the ecoregion was formerly glaciated and is comprised of low mountains and lakes with limestone valleys in western Massachusetts and Connecticut, Vermont, and eastern New York, whereas Rhode Island and eastern Massachusetts and Connecticut are characterized by broad plains with many ponds on glacially deposited sandy till that supports fire-adapted communities. The Northern Piedmont portion in Maryland, northern Virginia, and Pennsylvania was never glaciated and features gently rolling hills and valleys with remnant dry oak and mesophytic forests found along steep slopes and ridgelines [2].

Much of the ecoregion is comprised of northern hardwood and coniferous mixed forests. Within the Project area and the surrounding vicinity, forests are classified as Appalachian (Hemlock)-Northern Hardwood Forest habitat. These forests typically include sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), and yellow birch (*Betula alleghaniensis*) that is sometimes mixed with and potentially dominated by eastern hemlock (*Tsuga canadensis*). Northern red oak (*Quercus rubra*) and white oak (*Quercus alba*) are also common with black cherry (*Prunus serotina*), black birch (*Betula lenta*), eastern white pine (*Pinus strobus*), and tulip tree (*Liriodendron tulipifera*) also occurring at lower densities. Understory plants associated with this habitat type include broad beech fern (*Thelypteris hexagonoptera*), flowering dogwood (*Cornus florida*), four-leaved milkweed (*Asclepias quadrifolia*), perfoliate bellwort (*Uvularia perfoliata*), round-leaved tick trefoil (*Desmodium rotundifolium*), spicebush (*Lindera benzoin*), squawroot (*Conopholis americana*), and pinedrops (*Pterospora andromedea*) [1].

A visual inspection of trees within the Project area indicated that the canopy is dominated by species of maple and oak with eastern hemlock, white pine, and species of birch also present. Invasive honeysuckle (*Lonicera* spp.) was abundant within the understory, particularly along the shoreline.

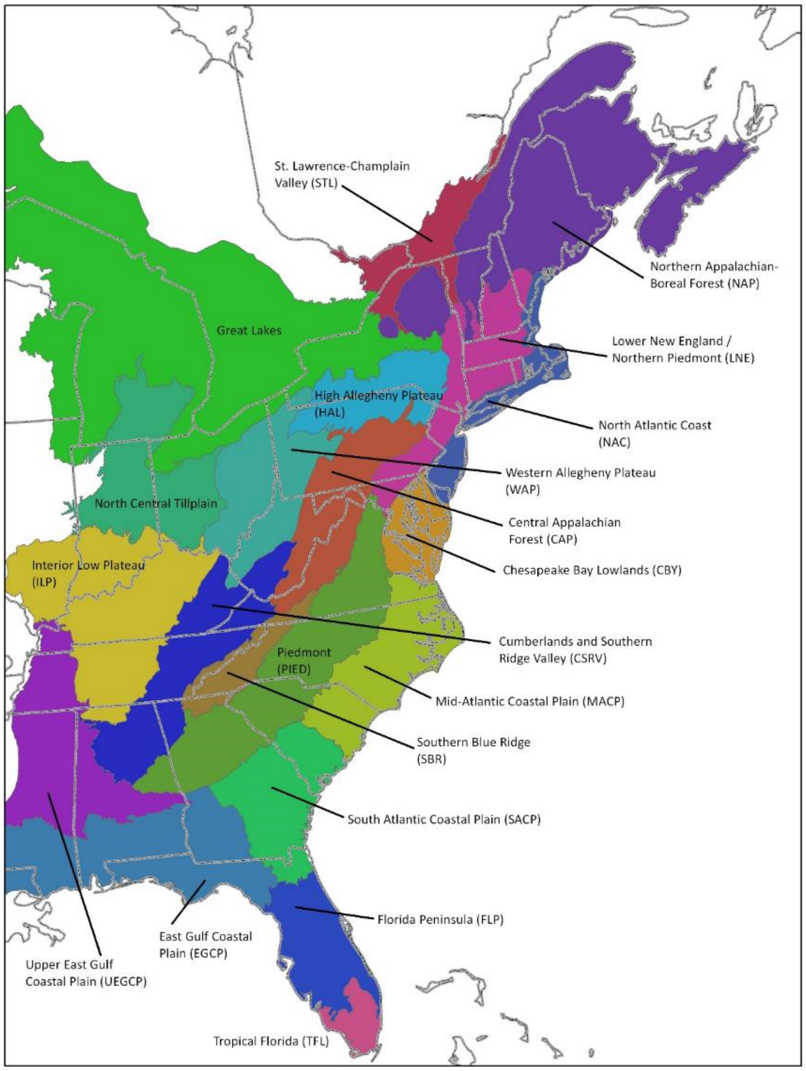


Figure 19. Ecoregions of the Northeast United States and Eastern Canada [29]

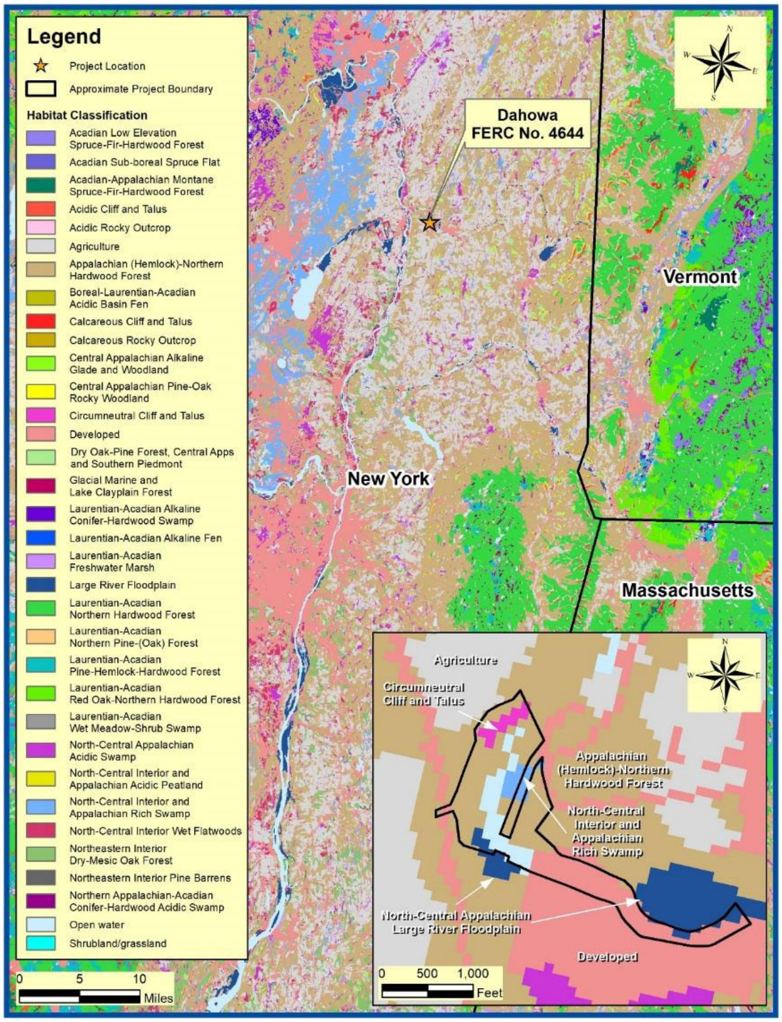


Figure 20. Northeast United States Habitats – Dahowa Hydroelectric Project Vicinity [28]

Wildlife Resources

Mammals present in Washington County, New York were determined by searching verified naturalist observations reported to iNaturalist.org [21]. Based on these data, at least 31 species are known to be present in Washington County and may potentially occur in the vicinity of the Project (**Error! Reference source not found.**).

Table 22. Mammals Potentially Present Dahowa Hydroelectric Project Vicinity [21]

Order	Family	Scientific Name	Common Name
Artiodactyla - Even-Toed Ungulates	Cervidae - Deer	*Alces alces*	Moose
		Odocoileus virginianus	White-tailed deer
Carnivora - Carnivores		*Canis latrans*	Coyote

Order	Family	Scientific Name	Common Name
	Canidae - Coyotes, Dogs, Foxes, Jackals, and Wolves	*Urocyon cinereoargenteus*	Gray fox
		Vulpes vulpes	Red fox
	Felidae - Cats	*Felis catus*	Domestic cat
		Lynx rufus	Bobcat
	Mephitidae - Skunks and Stink Badgers	*Mephitis mephitis*	Striped skunk
	Mustelidae - Badgers, Otters, Weasels, and Relatives	*Lontra canadensis*	North American river otter
		Mustela richardsonii	American ermine
		Neogale frenata	Long-tailed weasel
		Neogale vison	American mink
		Pekania pennanti	Fisher
	Procyonidae - Coatis, Raccoons, and Relatives	*Procyon lotor*	Common raccoon
	Ursidae - Bears	Ursinae subfamily	Typical bears
Chiroptera - Bats	Vespertilionidae - Evening Bats and Vesper Bats	Vespertilionidae family	Evening bats
Didelphimorphia - New World Opposums	Didelphidae - Opossums	*Didelphis virginiana*	Virginia opossum
Lagomorpha - Pikas, Rabbits, and Hares	Leporidae - Hares and Rabbits	*Sylvilagus floridanus*	Eastern cottontail
Rodentia - Rodents	Castoridae - Beavers	*Castor canadensis*	American beaver
	Cricetidae - New World Rats and Mice, Voles, Hamsters, and Relatives	*Microtus pennsylvanicus*	Meadow vole
		Ondatra zibethicus	Muskrat
		Peromyscus maniculatus	Deer mouse
	Erethizontidae - New World Porcupines	*Erethizon dorsatum*	North American porcupine
	Muridae - Old World Mice and Rats, Gerbils, Whistling Rats, etc.	*Rattus norvegicus*	Brown rat
Rodentia - Rodents	Sciuridae - Squirrels	*Marmota monax*	Groundhog
		Sciurus carolinensis	Eastern gray squirrel
		Tamias striatus	Eastern chipmunk
		Tamiasciurus hudsonicus	American red squirrel
Soricomorpha - Shrews and Moles	Soricidae - Shrews	*Blarina brevicauda*	Northern short-tailed shrew
	Talpidae - Desmans, Moles, and Relatives	*Condylura cristata*	Star-nosed mole
		Parascalops breweri	Hairy-tailed mole

Avifauna

Bird species present in Washington County, New York were determined by searching public databases, including species lists for three North American Breeding Bird Survey routes in the county [60], verified naturalist observations reported to iNaturalist.org [21], and results provided by NYSDEC's Nature Explorer application [47]. Based on these data, a total of 196 bird species and one hybrid are or were historically present in Washington County and may potentially occur in the vicinity of the Project (**Error! Reference source not found.**).

Table 23. Birds Potentially Present – Dahowa Hydroelectric Project Vicinity [21], [47], [60]

Family	Scientific Name	Common Name	BBS (1967-2019)	iNaturalist (1992-2021)	NYSDEC Nature Explorer
Accipitridae - Hawks, Eagles, and Kites	*Accipiter cooperii*	Cooper's hawk	X	X	X
	Accipiter gentilis	Northern goshawk	X		X
	Accipiter striatus	Sharp-shinned hawk	X		X
	Aquila chrysaetos	Golden eagle		X	
	Buteo jamaicensis	Red-tailed hawk	X	X	X
	Buteo lagopus	Rough-legged hawk		X	
	Buteo lineatus	Red-shouldered hawk	X	X	X
	Buteo platypterus	Broad-winged hawk	X	X	X
	Circus hudsonius	Northern harrier	X	X	X
	Haliaeetus leucocephalus	Bald eagle		X	X
Alaudidae - Larks	*Eremophila alpestris*	Horned lark	X	X	X
Alcedinidae - Kingfishers	*Megaceryle alcyon*	Belted kingfisher	X	X	X
Anatidae - Ducks, Geese, and Waterfowl	*Aix sponsa*	Wood duck	X	X	X
	Anas crecca	Green-winged teal		X	
	Anas platyrhynchos	Mallard	X	X	X
	Anas rubripes	American black duck	X	X	X
	Anas strepera	Gadwall			X
	Anser caerulescens	Snow goose		X	
	Aythya collaris	Ring-necked duck		X	
	Branta canadensis	Canada goose	X	X	X
	Bucephala albeola	Bufflehead		X	
	Bucephala clangula	Common goldeneye		X	
	Clangula hyemalis	Long-tailed duck		X	
	Cygnus olor	Mute swan		X	X
	Lophodytes cucullatus	Hooded merganser	X	X	X
	Mergus merganser	Common merganser	X	X	X
	Spatula clypeata	Northern shoveler		X	
	Spatula discors	Blue-winged teal	X		
Apodidae - Swifts	*Chaetura pelagica*	Chimney swift	X		X
Ardeidae - Herons, Egrets,	*Ardea alba*	Great egret		X	
Ardeidae - Herons, Egrets, and Bitterns	*Ardea herodias*	Great blue heron	X	X	X
	Botaurus lentiginosus	American bittern	X	X	X
	Butorides virescens	Green heron	X	X	X
	Ixobrychus exilis	Least bittern	X	X	X

Family	Scientific Name	Common Name	BBS (1967-2019)	iNaturalist (1992-2021)	NYSDEC Nature Explorer
	Nycticorax nycticorax	Black-crowned night-hero			X
Bombycillidae - Waxwings	*Bombycilla cedrorum*	Cedar waxwing	X	X	X
Calcariidae - Longspurs and Snow Buntings	*Calcarius lapponicus*	Lapland longspur		X	
	Plectrophenax nivalis	Snow bunting		X	
Caprimulgidae - Nightjars and Allies	*Chordeiles minor*	Common nighthawk	X		X
Cardinalidae - Cardinals and Allies	*Cardinalis cardinalis*	Northern cardinal	X	X	X
	Passerina cyanea	Indigo bunting	X	X	X
	Pheucticus ludovicianus	Rose-breasted grosbeak	X	X	X
	Piranga olivacea	Scarlet tanager	X	X	X
Cathartidae - New World Vultures	*Cathartes aura*	Turkey vulture	X	X	X
	Coragyps atratus	Black vulture		X	
Certhiidae - Treecreepers	*Certhia americana*	Brown creeper	X		X
Charadriidae - Plovers and Lapwings	*Charadrius vociferus*	Killdeer	X	X	X
Columbidae - Pigeons and Doves	*Columba livia*	Rock pigeon	X		X
	Zenaida macroura	Mourning dove	X	X	X
Corvidae - Crows, Jays, and Magpies	*Corvus brachyrhynchos*	American crow	X	X	X
	Corvus corax	Common raven	X	X	X
	Corvus ossifragus	Fish crow			X
	Cyanocitta cristata	Blue jay	X	X	X
Cuculidae - Cuckoos	*Coccyzus americanus*	Yellow-billed cuckoo	X	X	X
	Coccyzus erythropthalmus	Black-billed cuckoo	X	X	X
Falconidae - Falcons and Caracaras	*Falco columbarius*	Merlin	X	X	
	Falco peregrinus	Peregrine falcon		X	X
	Falco sparverius	American kestrel	X	X	X
Fringillidae - Finches, Euphonias, and Allies	*Acanthis flammea*	Common redpoll		X	
Fringillidae - Finches, Euphonias, and Allies	*Coccothraustes vespertinus*	Evening grosbeak	X	X	X
	Haemorhous mexicanus	House finch	X	X	X
	Haemorhous purpureus	Purple finch	X	X	X
	Loxia curvirostra	Red crossbill		X	
	Pinicola enucleator	Pine grosbeak		X	
	Spinus pinus	Pine siskin	X	X	X
	Spinus tristis	American goldfinch	X	X	X
Gaviidae - Loons	*Gavia immer*	Common loon		X	X
Hirundinidae - Swallows	*Hirundo rustica*	Barn swallow	X	X	X
	Petrochelidon pyrrhonota	Cliff swallow	X		X

Family	Scientific Name	Common Name	BBS (1967-2019)	iNaturalist (1992-2021)	NYSDEC Nature Explorer
	Progne subis	Purple martin	X		X
	Riparia riparia	Bank swallow	X	X	X
	Stelgidopteryx serripennis	Northern rough-winged swallow	X	X	X
	Tachycineta bicolor	Tree swallow	X	X	X
Icteridae - Troupials and Allies	*Agelaius phoeniceus*	Red-winged blackbird	X	X	X
	Dolichonyx oryzivorus	Bobolink	X	X	X
	Euphagus carolinus	Rusty blackbird		X	
	Icterus galbula	Baltimore oriole	X	X	X
	Icterus spurius	Orchard oriole	X	X	X
	Molothrus ater	Brown-headed cowbird	X	X	X
	Quiscalus quiscula	Common grackle	X	X	X
	Sturnella magna	Eastern meadowlark	X	X	X
	Xanthocephalus xanthocephalus	Yellow-headed blackbird		X	
Laniidae - Shrikes	*Lanius borealis*	Northern shrike		X	
Laridae - Gulls, Terns, and Skimmers	*Hydroprogne caspia*	Caspian tern		X	X
	Larus argentatus	Herring gull			X
	Larus delawarensis	Ring-billed gull	X	X	
	Larus marinus	Great black-billed gull			X
Mimidae - Mockingbirds and Thrashers	*Dumetella carolinensis*	Gray catbird	X	X	X
	Mimus polyglottos	Northern mockingbird	X	X	X
Mimidae - Mockingbirds and Thrashers	*Toxostoma rufum*	Brown thrasher	X	X	X
Numididae - Guineafowl	*Numida meleagris*	Domestic guineafowl		X	
Odontophoridae - New World Quail	*Colinus virginianus*	Northern bobwhite	X		
Pandionidae - Osprey	*Pandion haliaetus*	Osprey		X	X
Paridae - Tits, Chickadees, and Titmice	*Baeolophus bicolor*	Tufted titmouse	X	X	X
	Poecile atricapillus	Black-capped chickadee	X	X	X
Parulidae - New World Warblers	*Cardellina canadensis*	Canada warbler	X		X
	Geothlypis philadelphia	Mourning warbler	X		X
	Geothlypis trichas	Common yellowthroat	X	X	X
	Leiothlypis ruficapilla	Nashville warbler	X		X
	Mniotilta varia	Black-and-white warbler	X		2
	Parkesia motacilla	Louisiana waterthrush	X	X	X
	Parkesia noveboracensis	Northern waterthrush	X		X
	Seiurus aurocapilla	Ovenbird	X		X

Family	Scientific Name	Common Name	BBS (1967-2019)	iNaturalist (1992-2021)	NYSDEC Nature Explorer
	Setophaga caerulescens	Black-throated blue warbler	X	X	X
	Setophaga cerulea	Cerulean warbler			X
	Setophaga coronata	Yellow-rumped warbler	X	X	X
	Setophaga discolor	Prairie warbler	X	X	X
	Setophaga fusca	Blackburnian warbler	X	X	X
	Setophaga magnolia	Magnolia warbler	X	X	X
	Setophaga palmarum	Palm warbler		X	
	Setophaga pensylvanica	Chestnut-sided warbler	X	X	X
	Setophaga petechia	Yellow warbler	X	X	X
	Setophaga pinus	Pine warbler			X
	Setophaga ruticilla	American redstart	X		X
	Setophaga tigrina	Cape may warbler		X	
	Setophaga virens	Black-throated green warbler	X	X	X
	Vermivora chrysoptera	Golden-winged warbler	X		X
	Vermivora chrysoptera × cyanoptera	Golden-winged × blue-winged warbler		X	X
Parulidae - New World Warblers	*Vermivora cyanoptera*	Blue-winged warbler	X		X
	Ammodramus savannarum	Grasshopper sparrow	X		X
	Centronyx henslowii	Henslow's sparrow			X
	Junco hyemalis	Dark-eyed junco	X	X	X
	Melospiza georgiana	Swamp sparrow	X	X	X
	Melospiza lincolnii	Lincoln's sparrow		X	
	Melospiza melodia	Song sparrow	X	X	X
	Passerculus sandwichensis	Savannah sparrow	X		X
Passerellidae - New World Sparrows	*Pipilo erythrophthalmus*	Eastern towhee	X	X	X
	Pooecetes gramineus	Vesper sparrow	X		
	Spizella pallida	Clay-colored sparrow		X	
	Spizella passerina	Chipping sparrow	X	X	X
	Spizella pusilla	Field sparrow	X		X
	Spizelloides arborea	American tree sparrow		X	
	Zonotrichia albicollis	White-throated sparrow	X	X	X
	Zonotrichia leucophrys	White-crowned sparrow		X	
Passeridae - Old World Sparrows	*Passer domesticus*	House sparrow	X	X	X

Family	Scientific Name	Common Name	BBS (1967-2019)	iNaturalist (1992-2021)	NYSDEC Nature Explorer
Phalacrocoracidae - Cormorants and Shags	*Nannopterum auritum*	Double-crested cormorant	X	X	X
Phasianidae - Pheasants, Grouse, and Allies	*Bonasa umbellus*	Ruffed grouse	X	X	X
	Meleagris gallopavo	Wild turkey	X	X	X
	Phasianus colchicus	Ring-necked pheasant	X	X	X
Picidae - Woodpeckers	*Colaptes auratus*	Northern flicker	X	X	X
	Dryobates pubescens	Downy woodpecker	X	X	X
	Dryobates villosus	Hairy woodpecker	X	X	X
	Dryocopus pileatus	Pileated woodpecker	X	X	X
	Melanerpes carolinus	Red-bellied woodpecker	X	X	X
	Melanerpes erythrocephalus	Red-headed woodpecker	X		X
	Sphyrapicus varius	Yellow-bellied sapsucker	X	X	X
Podicipedidae - Grebes	*Podilymbus podiceps*	Pied-billed grebe	X	X	X
Polioptilidae - Gnatcatchers	*Polioptila caerulea*	Blue-gray gnatcatcher	X	X	X
Rallidae - Rails, Gallinules, and Coots	*Fulica americana*	American coot			X
	Gallinula galeata	Common gallinule	X	X	
	Gallinula galeata	Common gallinule			X
	Porzana carolina	Sora			X
	Rallus limicola	Virginia rail	X	X	X
Regulidae - Kinglets	*Regulus satrapa*	Golden-crowned kinglet		X	X
Scolopacidae - Sandpipers and Allies	*Actitis macularius*	Spotted sandpiper	X	X	X
	Bartramia longicauda	Upland sandpiper	X		X
	Gallinago delicata	Wilson's snipe	X	X	X
	Scolopax minor	American woodcock	X	X	X
	Tringa flavipes	Lesser yellowlegs		X	
	Tringa melanoleuca	Greater yellowlegs	X		
	Tringa solitaria	Solitary sandpiper	X	X	
Sittidae - Nuthatches	*Sitta canadensis*	Red-breasted nuthatch	X	X	X
	Sitta carolinensis	White-breasted nuthatch	X	X	X
Strigidae - Owls	*Asio flammeus*	Short-eared owl		X	X
	Asio otus	Long-eared owl		X	
	Bubo scandiacus	Snowy owl		X	
	Bubo virginianus	Great horned owl	X	X	X
	Megascops asio	Eastern screech-owl	X		X
	Strix varia	Barred owl	X	X	X
Sturnidae - Starlings	*Sturnus vulgaris*	European starling	X	X	X

Family	Scientific Name	Common Name	BBS (1967-2019)	iNaturalist (1992-2021)	NYSDEC Nature Explorer
Threskiornithidae - Ibises and Spoonbills	*Plegadis falcinellus*	Glossy ibis		X	
Trochilidae - Hummingbirds	*Archilochus colubris*	Ruby-throated hummingbird	X	X	X
Troglodytidae - Wrens	*Cistothorus palustris*	Marsh wren	X		X
	Cistothorus stellaris	Sedge wren	X		X
	Thryothorus ludovicianus	Carolina wren	X	X	X
	Troglodytes aedon	House wren	X	X	X
	Troglodytes hiemalis	Winter wren	X	X	X
Turdidae - Thrushes and Allies	*Catharus fuscescens*	Veery	X	X	X
	Catharus guttatus	Hermit thrush	X		X
	Catharus ustulatus	Swainson's thrush			X
	Hylocichla mustelina	Wood thrush	X	X	X
	Sialia sialis	Eastern bluebird	X	X	X
	Turdus migratorius	American robin	X	X	X
Tyrannidae - Tyrant Flycatchers	*Contopus cooperi*	Olive-sided flycatcher			X
	Contopus virens	Eastern wood-pewee	X	X	X
	Empidonax alnorum	Alder flycatcher	X		X
	Empidonax minimus	Least flycatcher	X		X
	Empidonax traillii	Willow flycatcher	X		X
	Myiarchus crinitus	Great crested flycatcher	X	X	X
	Sayornis phoebe	Eastern phoebe	X	X	X
	Tyrannus tyrannus	Eastern kingbird	X	X	X
Tytonidae - Barn-Owls	*Tyto alba*	Barn owl			X
Vireonidae - Vireos, Shrike-Babblers, and Erpornis	*Vireo flavifrons*	Yellow-throated vireo	X		X
	Vireo gilvus	Eastern warbling vireo		X	
	Vireo gilvus	Warbling vireo	X		X
	Vireo olivaceus	Red-eyed vireo	X	X	X
	Vireo solitarius	Blue-headed vireo	X	X	X
		Total	**143**	**148**	**159**

Herptiles

Amphibians and reptiles present in Washington County, New York were determined by searching verified naturalist observations reported to iNaturalist.org [21]. Based on these data, 15 amphibian species (**Error! Reference source not found.**) and 13 reptile species (**Error! Reference source not found.**) are known to be present in Washington County and may potentially occur in the vicinity of the Project.

Table 24. Amphibians Potentially Present - Dahowa Hydroelectric Project Vicinity [21]

Order	Family	Scientific Name	Common Name
Anura - Frogs	Bufonidae - True Toads	*Anaxyrus americanus*	American toad
	Hylidae - Tree Frogs and Allies	*Hyla versicolor*	Gray treefrog
		Pseudacris crucifer	Spring peeper
	Ranidae - True Frogs	*Lithobates catesbeianus*	American bullfrog
		Lithobates clamitans	Green frog
		Lithobates palustris	Pickerel frog
		Lithobates pipiens	Northern leopard frog
		Lithobates sylvaticus	Wood frog
Urodela - Salamanders	Ambystomatidae - Mole Salamanders	*Ambystoma maculatum*	Spotted salamander
	Plethodontidae - Lungless Salamanders	*Desmognathus ochrophaeus*	Allegheny mountain dusky salamander
		Eurycea bislineata	Northern two-lined salamander
		Gyrinophilus porphyriticus	Spring salamander
		Plethodon cinereus	Eastern red-backed salamander
	Proteidae - Mudpuppies	*Necturus maculosus*	Common mudpuppy
	Salamandridae - True Salamanders and Newts	*Notophthalmus viridescens*	Eastern newt

Table 25. Reptiles Potentially Present - Dahowa Hydroelectric Project Vicinity

Order	Family	Scientific Name	Common Name
Squamata - Scaled Reptiles	Colubridae – Colubrid Snakes	*Lampropeltis triangulum*	Eastern milksnake
		Nerodia sipedon	Common watersnake
		Pantherophis alleghaniensis	Eastern ratsnake
		Storeria dekayi	Brown snake/De kay's snake
		Storeria occipitomaculata	Redbelly snake
		Thamnophis sirtalis	Common garter snake
	Scincidae - Skinks	*Plestiodon fasciatus*	Five-lined skink
	Viperidae - Vipers	*Crotalus horridus*	Timber rattlesnake
Testudines - Turtles and Tortoises	Chelydridae – Snapping Turtles	*Chelydra serpentina*	Common snapping turtle
	Emydidae – Pond Turtles	*Chrysemys picta*	Painted turtle
		Glyptemys insculpta	Wood turtle
		Graptemys geographica	Northern map turtle
	Kinosternidae - American Mud And Musk Turtles	*Sternotherus odoratus*	Eastern musk turtle

8.2 Floodplains, Wetlands, Riparian, and Littoral Habitat

Floodplains

The Project area lies on the border of Federal Emergency Management Agency (FEMA) flood insurance rate maps (FIRM) prepared separately for the towns of Greenwich and Easton, New York (Figure 21). FEMA classifies the floodplain with various flooding conditions and outlines the border of the 1 percent (100-year flood) and 0.2 percent (50-year flood) annual chance floodplain [14], [15].

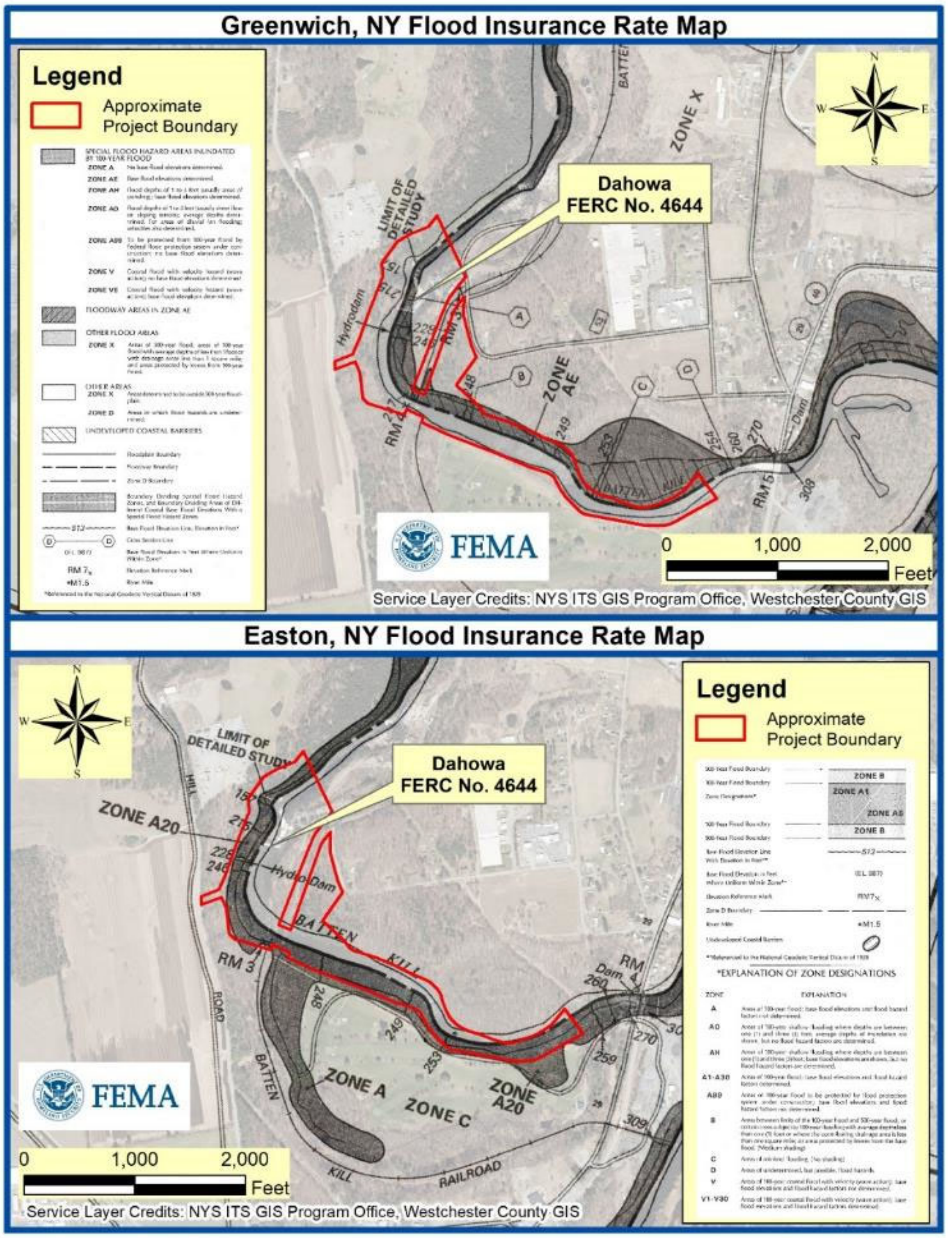


Figure 21. FEMA Flood Insurance Rate Maps- Dahowa Hydroelectric Project [54], [56]

Wetlands

The Battenkill River is the dominant wetland resource within the vicinity of the Project. According to US Fish and Wildlife (USFWS) National Wetlands Inventory (NWI) data [70], the Project area consists of freshwater pond, riverine, and lake wetland types (Figure 22). Most of the wetland area within the Project area consists of the Project impoundment and upstream portions of the river that are classified as freshwater pond. The falls are classified as riverine habitat, whereas the reach below the falls is classified as lake. Remnants of a former canal result in a narrow area being identified by NWI mapping as riverine channel to the north and east of the project. There is no direct open channel hydraulic connection between the impoundment and the former canal. The former canal is not located within the Project boundary, is not utilized for hydroelectric generation and is not owned by the licensee.

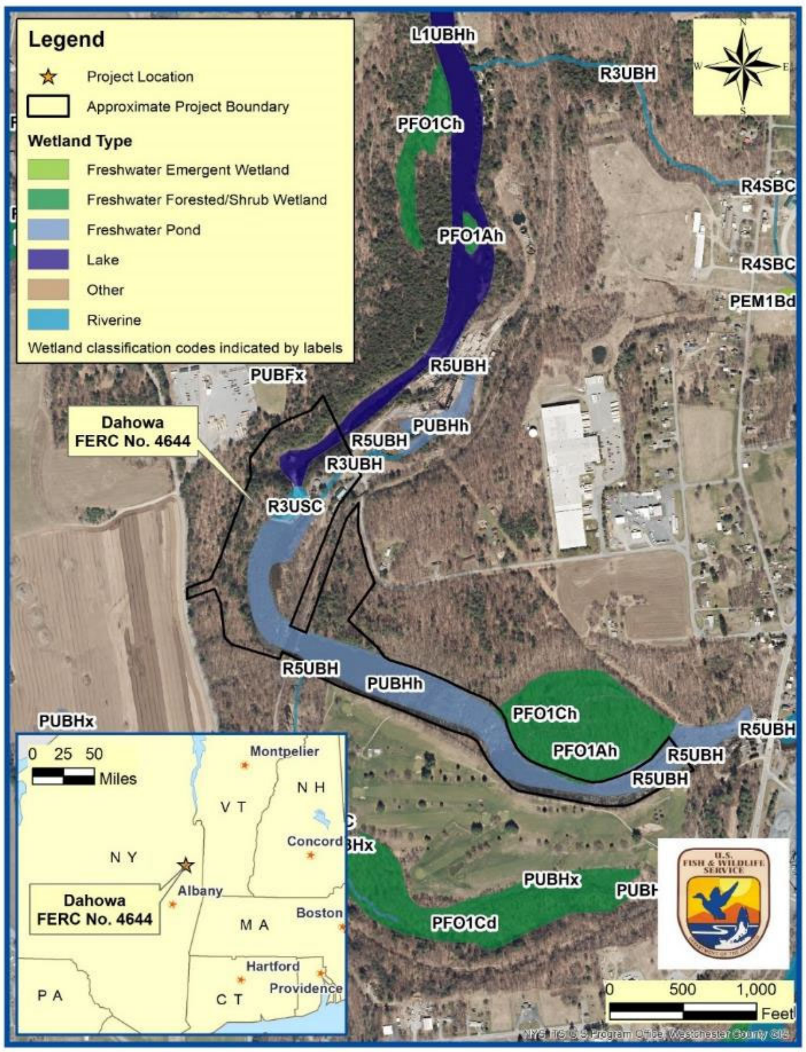


Figure 22. USFWS NWI – Dahowa Hydroelectric Project [70]

Table 26 is a summary of the NWI mapped wetland type(s) found within the immediate Project area.

Table 26. Summary of NWI Mapped Wetland Types Found within Immediate Project Area

Cover Type Code	Description	Area (AC)
PUBHh	Palustrine, Unconsolidated Bottom, Permanently Flooded, Diked/Impounded	1.4
R3UBH[4]	Riverine, Upper Perennial, Unconsolidated Bottom, Permanently Flooded	0.3
R3USC	Riverine, Upper Perennial, Unconsolidated Shore, Seasonally Flooded	0.1
L1UBHh	Lacustrine, Limnetic, Unconsolidated Bottom, Diked/Impounded	17.7
PFO1Ah	Palustrine, Forested, Broad-Leaved Deciduous, Temporary Flooded, Diked/Impounded	0.2
PFO1Ch	Palustrine, Forested, Broad-Leaved Deciduous, Seasonally Flooded, Diked/Impounded	0.7
R4SBC	Riverine, Intermittent, Streambed, Seasonally Flooded	<0.1
R5UBH	Riverine, Unknown Perennial, Unconsolidated Bottom, Permanently Flooded	0.1
	Total	**20.5**

[4]This wetland R3UBH no longer exists, but represents the former canal associated with the Stevens and Thompson Paper Company mill complex.

According to the NY DEC Environmental Resource Mapper, there are no New York State regulated wetlands within the Project area.

Riparian Zone Habitats

Riparian zones are transitional areas between aquatic and terrestrial habitats that occur as linear features along the shorelines of lakes, ponds, and rivers. Riparian zone soils consist of stratified sediments of different textures that are subject to periodic wetting and drying dependent on the water levels in the adjacent waterbody. Vegetation associated with these habitats often consists of emergent aquatic plants and hydrophilic herbs, shrubs, and trees. Riparian zones provide important ecological and societal benefits, including:

- Filtration of pollutants and retention of nutrients and sediment;
- Resources and habitat for wildlife, including important migration routes and stopping points;
- Streambank stabilization, erosion control, and flood flow attenuation;
- Temperature moderation, maintenance of base flows, and recharging of alluvial aquifers; and
- Recreational and scenic areas [65].

Loss of these benefits can occur when riparian areas are cleared and converted to other land uses, such as agriculture and urban development. Therefore, the NYSDEC Trees for Tribs Program promotes the restoration and maintenance of forested stream buffers along New York's tributaries to help decrease erosion, reduce flooding damage, improve wildlife and stream habitat, and protect water quality [52]. The program recognizes three zones that are characteristic of healthy riparian buffers, which combined have a total recommended width of at least 100 ft (Table 27) [48].

Table 27. Description of Healthy Stream Buffer Zones [48]

Zone	Description	Recommended Width (ft)
1	The area closest to the stream or waterbody should be planted with native species of water-tolerant trees and large shrubs with little or no harvesting. This zone provides streambank stabilization and provides leaf litter inputs to the stream. Leaf litter is eaten by macroinvertebrates in the stream, which are in turn eaten by fish. When trees grow in Zone 1, they shade the stream, which cools the water and provides better conditions for brook trout or other cold water-dependent fish species.	≥15
2	The zone upland from Zone 1 should be planted with native faster growing, smaller, shade-tolerant tree or shrub species. This zone allows water runoff to be absorbed and held in the soil. Nutrients and other pollutants are also filtered by the soil. Faster growing plants are able to uptake and store nutrients in their woody biomass.	20-60
3	The zone farthest from the stream and next to land use areas (for example, houses, crops or pastureland), should be planted with native grasses, wildflowers, or other herbaceous plants. These plants slow fast-moving water runoff and filter sediment.	15-60
	Total	**≥100**

NYSDEC sponsored a statewide riparian inventory and opportunity assessment to identify and prioritize sites for implementation of the Trees for Tribs Program that was conducted between 2016 and 2018. The assessment applied a suite of habitat indicators for relative ecological health and ecological stress to calculate scores at two spatial scales, the sub-watershed and catchment hydrologic units. Indicators were combined to determine overall scores for ecological health and ecological stress, as well as a comprehensive score that combines the two measures. Further details about the habitat indicators and the assessment methodology are provided in the *New York State Riparian Opportunity Assessment* report [11].

The catchment where the Project is located (202949766) had an ecological health score of 5.28, which placed it in the 92nd percentile for the Battenkill sub-watershed (HUC 020200030303) and above the 50th percentile for the Upper Hudson Watershed (020200) and all of New York State (**Error! Reference source not found.**) [58]. The ecological stress score for catchment 202949766 of 2.63 placed it between the 60th and 75th percentiles of catchments in the sub-watershed, watershed, and entire state. The comprehensive score of 0.23 ranked in the 75th percentile for the Battenkill sub-watershed and above the median for the watershed and state [58].

Within the Project area, forest covers most of the areas within 100 ft of the Battenkill River shoreline and beyond (**Error! Reference source not found.**) [78]. Exceptions include the powerhouse and the cleared and gravel access areas in its vicinity and the shoreline areas extending from below the Falls to the downstream limits of the Project area. In the latter case, the very steep slopes and cliffs associated with the Falls and gorge limit the establishment of vegetation (**Error! Reference source not found.**) [75]. Gentler slopes are present along both banks of the river upstream of the Project Dam. Excluding the immediate vicinity of the railroad bridge abutments, these areas support dense shoreline vegetation consisting of herbaceous and woody shrubs and large canopy trees (**Error! Reference source not found.**).

Table 28. Riparian Opportunity Assessment Indicator Scores - Catchment 202949766 [58]

Indicator Quality	Habitat Indicator	Zone Scored	Score	Percentile Within:		
			Catchment (202949766)	Battenkill Sub-watershed (020200030303)	Upper Hudson Watershed (020200)	New York State
Ecological Health	Canopy Cover	Entire Catchment	36	34	18	28
		Riparian Buffers	46	74	35	44
	Natural Cover	Entire Catchment	0.44	38	17	23
		Riparian Buffers	0.63	60	24	31
	Biological Assessment Profile	Riparian Buffers	7.70	70	85	88
	Brook Trout	Entire Catchment	0.00	92	59	60
	Floodplain Complexes	Entire Catchment	0.09	94	88	89
		Riparian Buffers	0.18	94	88	89
	Functional River Networks	Riparian Buffers	3073	94	97	97
	Matrix Forest Blocks	Entire Catchment	0.00	100	69	74
		Riparian Buffers	0.00	100	72	76
	Ecological Significance	Entire Catchment	0.62	89	60	61
		Riparian Buffers	1.85	94	77	76
	Native Fish Richness	Riparian Buffers	0.71	60	82	82
		Ecological Health Score	5.28	92	59	63
Ecological Stress	Dam Storage Ratio	Riparian Buffers	0	70	58	56
	Impervious Surface	Entire Catchment	10	96	95	95
		Riparian Buffers	4	81	90	92
	Landscape Condition Assessment	Entire Catchment	1116	89	89	91
		Riparian Buffers	942	83	84	87
	Known Water Impairments	Riparian Buffers	0.00	55	81	79
	Erosion Index	Riparian Buffers	19.98	68	65	71
	Topographic Wetness Index	Riparian Buffers	7.98	64	46	49
		Ecological Stress Score	2.63	60	75	73
		Comprehensive Score	0.23	75	53	55

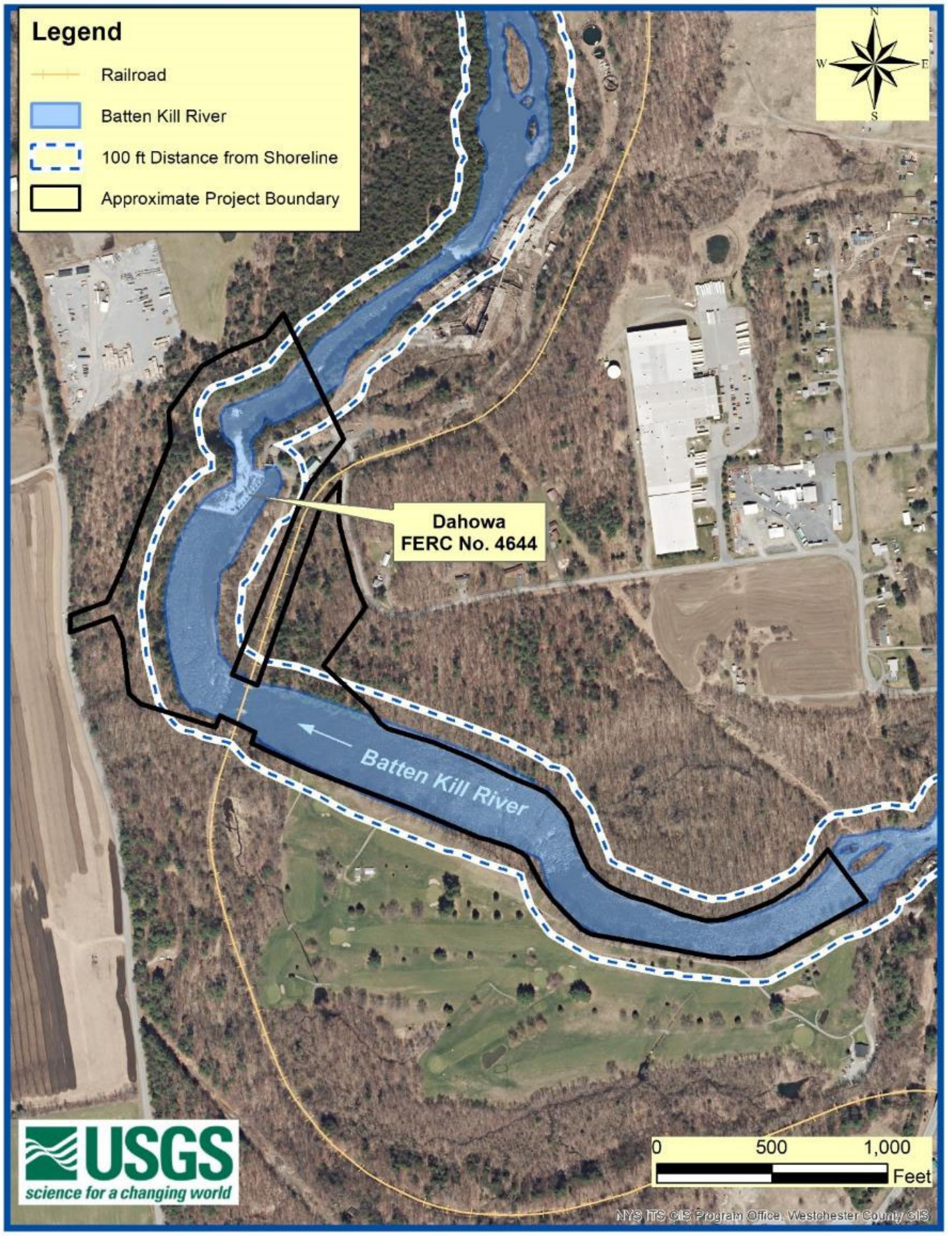


Figure 23. Shoreline Areas – Dahowa Hydroelectric Project [78]

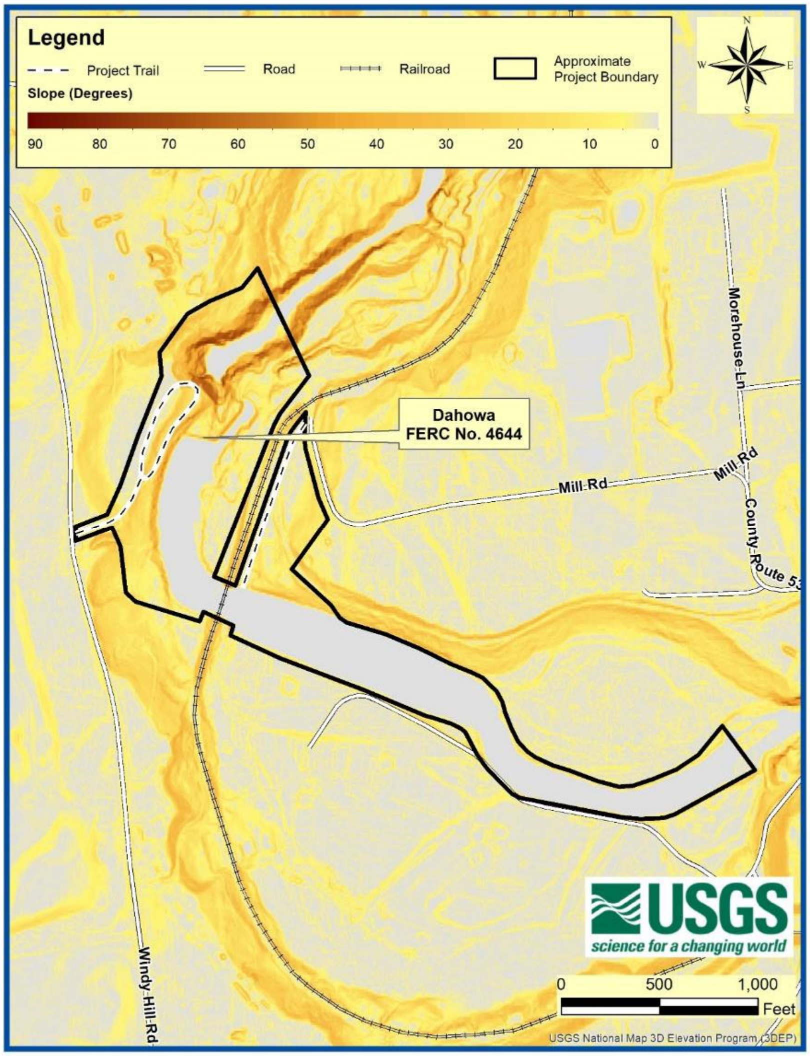


Figure 24. Slope-Dahowa Hydroelectric Project [79]

Photo 1. Upstream Riparian Vegetation and Riffle (immediately upstream of project impoundment)

Littoral Zone Resources

The littoral zone of a waterbody is the shallow transition zone extending from the water's edge to the depth that light penetrates where rooted aquatic vegetation occurs [25]. Light penetration varies based on physical, chemical, and biological factors affecting water clarity, and can reach depths exceeding 15 meters (m) or 50 ft in clear lakes and fewer than 5 m or 15 ft in turbid lakes [25]. The littoral zone can form a narrow or broad wetland with extensive area of aquatic plants sorted by their tolerance to the different water depths (Figure 25). These plants provide food and habitat to many aquatic organisms, including fish, frogs, birds, muskrats, turtles, insects, and snails. Therefore, a healthy littoral zone is often a signifier of a healthy lake or river [24].

Upstream of the Project Dam, the Battenkill River is classified as a palustrine system, which is defined as a wetland that is either dominated by trees, shrubs, and persistent emergent vegetation or has the following four characteristics:

1. Area less than 8 hectares (ha) or 20 ac;
2. A lack of active wave-formed or bedrock shoreline features;
3. Water depth in the deepest part of basin less than 2.5 m (8.2 ft) at low water; and
4. Salinity due to ocean-derived salts less than 0.5 parts per thousand (ppt)

According to NWI data, the reach of the river upstream of the Project Dam has unconsolidated bottom, which consists of at least 25 percent cover of particles smaller than stones (less than 6-7 cm) and a vegetative cover of less than 30 percent [70]. A visual inspection conducted from the fishing area (**Error! Reference source not found.**) confirmed that the river is shallow within the upstream limits of the Project area with little vegetation noted outside of the trees and shrubs growing within riparian areas along the shoreline (see **Error! Reference source not found.**). River flow in the main channel is relatively swift with a prominent riffle present approximately 60 ft downstream of the railroad bridge (see **Error! Reference source not found.**). These conditions may limit the growth of rooted aquatic vegetation outside of the immediate vicinity of the shoreline.

Downstream of the Project Dam are the Dahowa Falls and the lower reach, which begins at the base of the Falls. Both are characterized by steep slopes (see **Error! Reference source not found.**) and turbulent flows that likely provide limited littoral habitat.

8.3 Project Impact on Terrestrial Resources

The Project is anticipated to have minimal effect on wildlife and botanical resources. There currently are no plans to alter existing stream flow and reservoir regimes, resulting in no modification to wildlife and botanical resources which provide habitat outside of the limited Project footprint.

No impacts to the extent and/or function of existing floodplain, wetland, riparian or littoral zone resources within or in the vicinity of the Project are expected. There are no anticipated Project-related impacts to river flows or Project operations. Because these processes are the primary drivers of wetland formation and maintenance and riparian and littoral zone habitat dynamics, there are no anticipated Project-related impacts to these resources.

8.4 Protection, Mitigation, and Enhancement Measures (PM&E)

Agency Recommended Mitigation

The licensee is not aware of any agency proposed PM&E measures related to terrestrial resources.

Applicant Proposed Mitigation

No modifications to Project structures or operations are currently proposed.

9.0 Threatened and Endangered Species

9.1 Affected Environment

No critical habitats were identified within the Project area. An official species list was requested and resulted in the following species as potentially present in the general vicinity of the Project:

- Monarch Butterfly (*Danaus plexippus*)

The monarch butterfly is a candidate species and not yet listed or proposed for listing. There are generally no section 7 requirements for candidate species, but agencies are encouraged to take advantage of any opportunity they may have to conserve the species [73].

Adult monarch butterflies are large and conspicuous, with bright orange wings surrounded by a black border and covered with black veins. The black border has a double row of white spots, present on the upper side of the wings. Adult monarchs are sexually dimorphic, with males having narrower wing venation and scent patches. The bright coloring of a monarch serves as a warning to predators that eating them can be toxic [73].

During the breeding season, monarchs lay their eggs on their obligate milkweed host plant (primarily Asclepias spp.), and larvae emerge after two to five days. Larvae develop through five larval instars (intervals between molts) over a period of 9 to 18 days, feeding on milkweed and sequestering toxic chemicals (cardenolides) as a defense against predators. The larva then pupates into a chrysalis before emerging 6 to 14 days later as an adult butterfly. There are multiple generations of monarchs produced during the breeding season, with most adult butterflies living approximately two to five weeks; overwintering adults enter into reproductive diapause (suspended reproduction) and live six to nine months [73].

In many regions where monarchs are present, monarchs breed year-round. Individual monarchs in temperate climates, such as eastern and western North America, undergo long-distance migration, and live for an extended period of time. In the fall, in both eastern and western North America, monarchs begin migrating to their respective overwintering sites. This migration can take monarchs distances of over 3,000 km and last for over two months. In early spring (February-March), surviving monarchs break diapause and mate at the overwintering sites before dispersing. The same individuals that undertook the initial southward migration begin flying back through the breeding grounds and their offspring start the cycle of generational migration over again [73].

- Northern Long-Eared Bat (*Myotis septentrionalis*) and Indiana Bat (*Myotis sodalis*)

It is noted that the Northern Long Eared Bat and Indiana Bat were not identified as potentially present in the general vicinity of the Project. Although these species were not identified, the Licensee will work with USFWS and NYDEC to implement any protection measures for these protected species. This could include items such as limiting tree cutting activities to certain seasons.

The northern long-eared bat is a small bat, measuring an average of 8.6 cm (3.4 in) in total length, including a tail about 4 cm (1.6 in) long. Adults weigh between 5 and 8 g (0.18 and 0.28 oz). The fur and wing membranes are light brown in color, and the bat lacks the dark shoulder spots found in the closely related, and otherwise similar Keen's myotis (*Myotis keenii*). Compared to other *Myotis* species, these bats have long ears with a relatively long, pointed tragus; when folded forwards the ears extend well past the nose. They also have a longer tail and larger wing area than most comparably sized *Myotis* bats, giving them increased maneuverability during slow flight [74].

Northern long-eared bats are found through much of the eastern half of the United States and Canada from Manitoba and Newfoundland in the north to North Carolina and Alabama in the south. They are also rarely found in western parts of Canada, sometimes as far as the western borders of British Columbia and Yukon. They are found primarily in forested habitats, especially boreal forests, as they typically roost in hardwood trees during the summer [74].

The Indiana bat was listed as endangered in 1967 due to episodes of people disturbing hibernating bats in caves during winter, resulting in the death of large numbers of bats. Indiana bats are vulnerable to disturbance because they hibernate in large numbers in only a few caves (the largest hibernation caves support from 20,000 to 50,000 bats). Other threats that have contributed to the Indiana bat's decline include commercialization of caves, loss of summer habitat, pesticides and other contaminants, and most recently, the disease white-nose syndrome [71].

Indiana bats are quite small, weighing only one-quarter of an ounce (about the weight of three pennies) although in flight they have a wingspan of 9 to 11 inches. Their fur is dark-brown to black. They hibernate during winter in caves or, occasionally, in abandoned mines. During summer they roost under the peeling bark of dead and dying trees. Indiana bats eat a variety of flying insects found along rivers or lakes and in uplands [71].

The full IPAC output is provided in Appendix K.

In addition to federal species, the following GIS data layers were explored within the NYSDEC Environmental Resources Mapper looking at state species:

- Imperiled Mussels;
- Significant Natural Communities; and
- Rare Plants and Rare Animals [42].

A review of these layers indicated that there are no RTE species or Significant Natural Communities within the Project area or its immediate vicinity (**Error! Reference source not found.**).

Dahowa Hydroelectric Project - State RTE

Figure 26. NYSDEC Environmental Resources Mapper – Dahowa Hydroelectric Project Vicinity. Green Shows State Regulated Wetlands, Orange Shows Areas with Rare Plants or Animals [42]

9.2 Project Impact on Threatened and Endangered Species

There are no proposed Project changes; and it does not appear that the Project has any effect on state or federally listed species.

Agency Recommended Mitigation

The licensee is not aware of any agency proposed PM&E measures related to threatened and endangered species.

Applicant Proposed Mitigation

There is no proposed mitigation at this time, however the Licensee will coordinate with resource agencies as appropriate to avoid, minimize and mitigate any Project-related impacts to listed species. The licensee is amenable to developing and implementing measures design to reduce potential impacts to listed bat species (e.g., seasonal restrictions on vegetation clearing, etc.).

10.0 Recreation and Land Use Resources

10.1 Affected Environment

Recreation

Recreation sites within the vicinity of the Project can be found in Greenwich, Easton, and Schuylerville. These include parks, many of which are concentrated in the Village of Greenwich; natural areas that offer various recreational activities, including hiking, hunting, and swimming; boat/kayak launches; golf courses; and fairgrounds.

The Licensee maintains two recreation areas that are accessible to the public within the Project area per the existing license requirements. These include the fishing area located upstream of the Project Dam on the right descending bank and the recreation area located on the left descending bank (Figure 27). Both areas have access trails with parking pads that accommodate vehicles. The recreation area has two overlooks that offer views of the Dahowa Falls. See Figure 27.

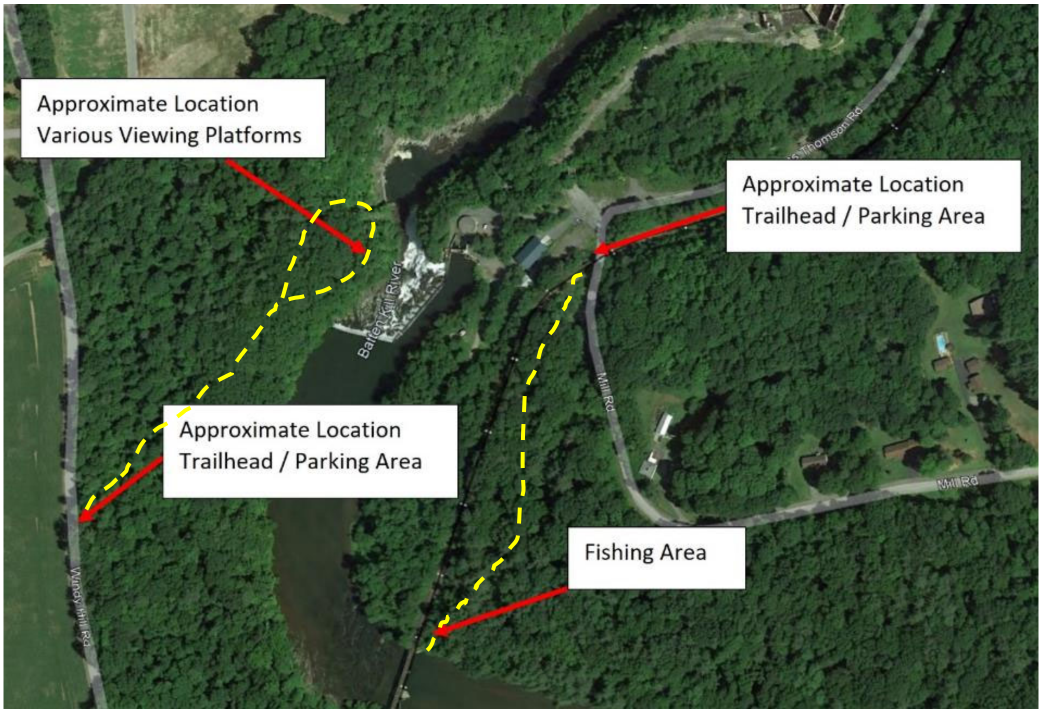


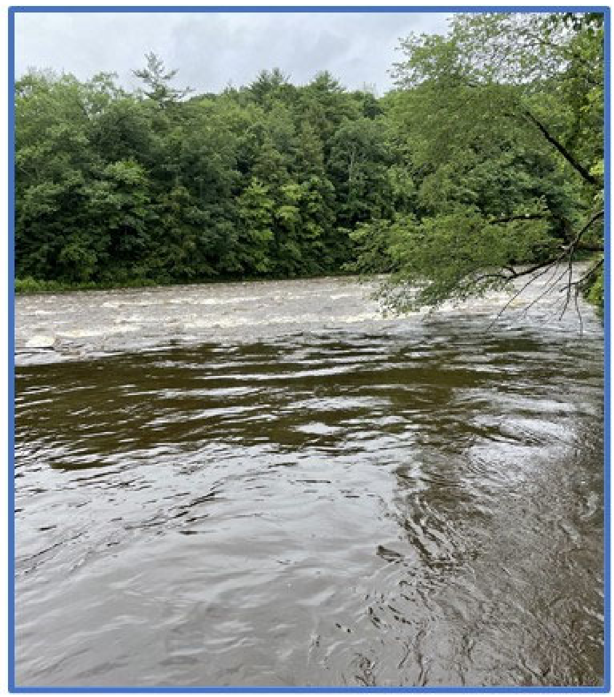
Figure 27. Recreation Facilities- Dahowa Hydroelectric Project, existing (approximate) trail alignments shown in yellow dashes.

As part of the consultations involved in the initial licensing of the Project, the existing recreation facilities were designed to encourage appropriate public use, while imposing limited burdens on recreational users. To accomplish this, the facilities provide access which purposely limits the number of users at any given time to the carrying capacity of the sites to accommodate users at a level which protects the sites and offers a high- quality user experience. The Project is exempt from data collection and reporting (formerly FERC Form 80) requirements, as such there are no quantitative data on recreational use of the facilities. Given the steep terrain and private land ownership in the area immediately surrounding the Project and in particular Dionodahowa Falls, there are limited non-project/informal recreational opportunities.

The fishing access area consists of the following elements:

- Parking for three cars accessible from the Mill Road access point
- Trail head with facility signage and kiosk
- ~700 ft natural surface long access trail

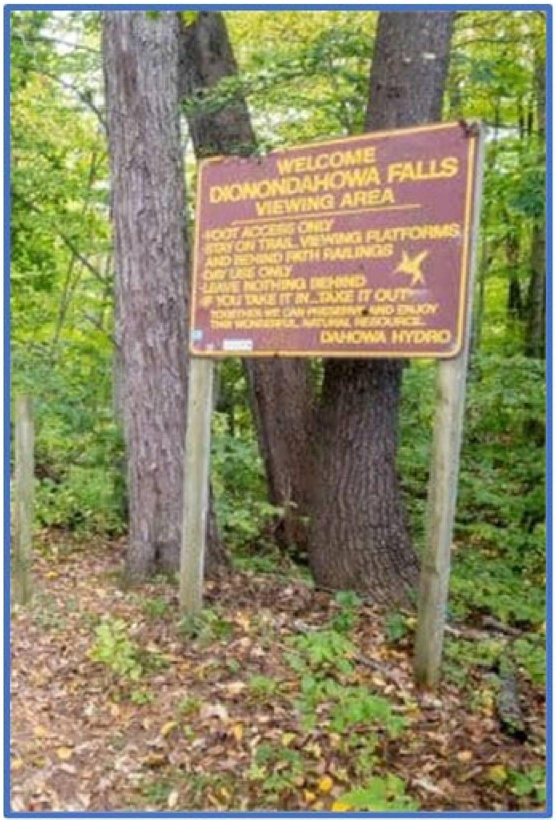
These facilities are regularly maintained by the licensee and include vegetation management, parking area surface maintenance, trash removal and upkeep of the trails and informational signage and kiosk. Representative photos of the fish access trail are provided below.

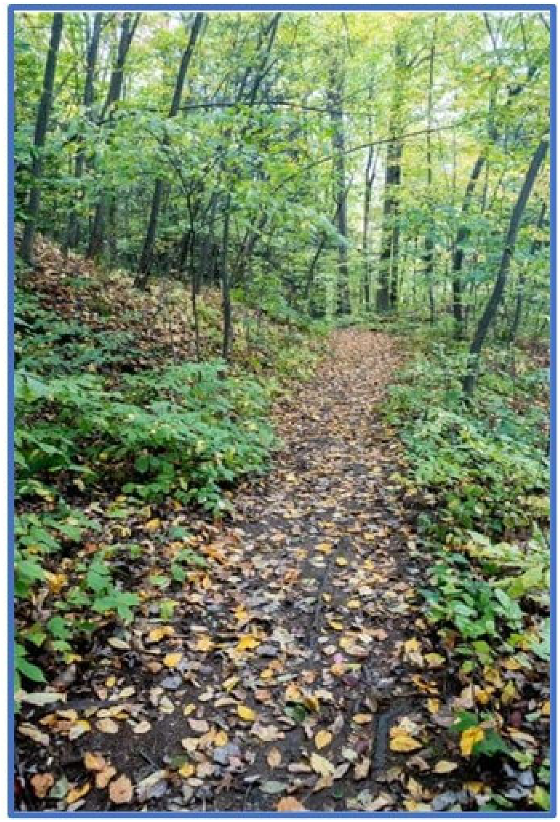


The nature appreciation and overlook trail consists of the following elements:

- Parking for three cars accessible from the Windy Hill Road access point
- Trail head with facility signage and kiosk
- ~1,300 ft natural surface long loop access trail
- Two wooden overlook structures situated for safe viewing of Dionodahowa Falls

These facilities are regularly maintained by the licensee and include vegetation management, parking area surface maintenance, trash removal and upkeep of the trails and viewing platforms. Representative photos of the overlook access trail are provided below (a photo from the perspective of the viewing platform is provided in the Aesthetic Resources section).





Land Use

According to National Landcover Database (NLCD) land use data from 2019, nearly 74 percent of the Upper Hudson River Basin is comprised of forest (Figure 28, Table 29). Farmland and wetlands each account for approximately 8 percent of the landcover in the basin, whereas developed land accounts for approximately 6 percent of the area. [12]

The area surrounding the Project (**Error! Reference source not found.**) is less dominated by forests as farmlands and developed land account for a greater share of the landcover (**Error! Reference source not found.**). Within the Project area (**Error! Reference source not found.**, **Error! Reference source not found.**), forests remain the dominant landcover type (62 percent), followed by open water (26 percent) [12].

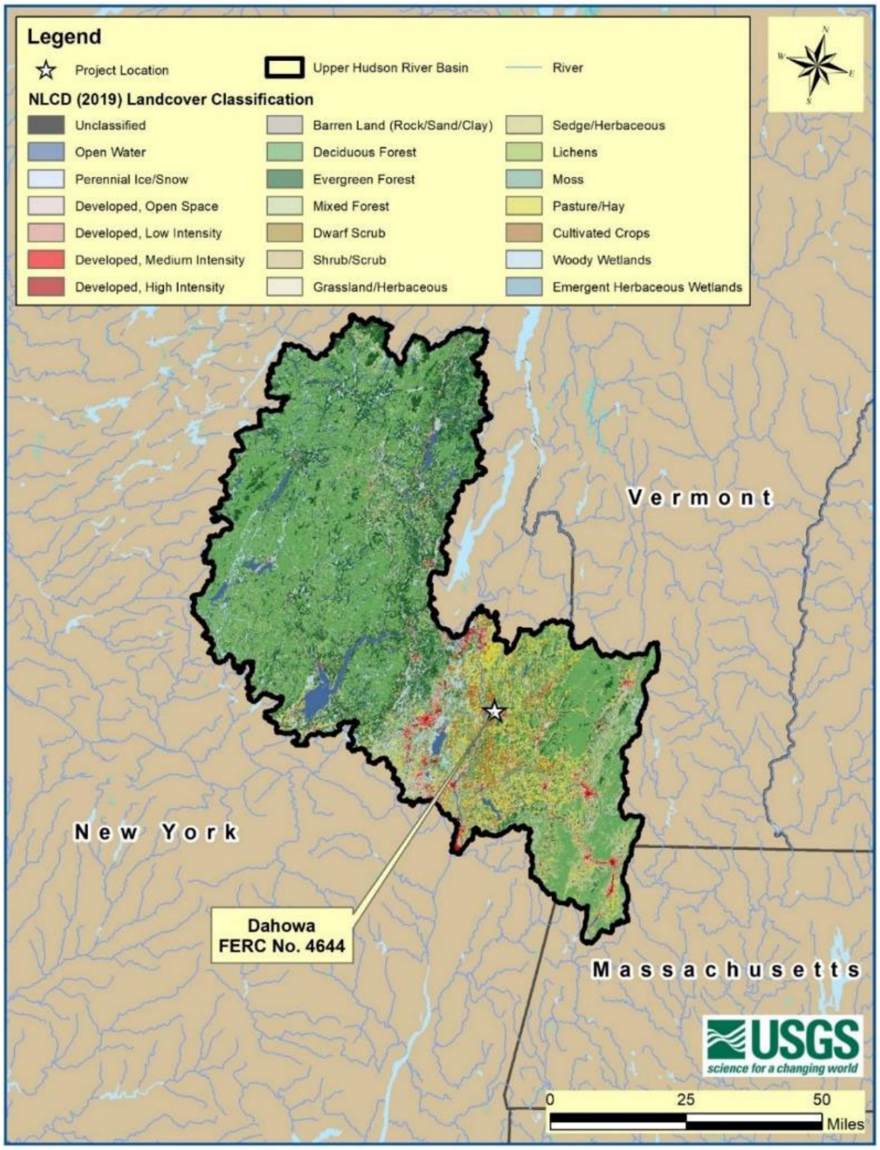


Figure 28. National Landcover Database Land Use Data – Upper Hudson River Basin [12]

The area surrounding the Project (**Error! Reference source not found.**) is less dominated by forests as farmlands and developed land account for a greater share of the landcover (**Error! Reference source not found.**). Within the Project area (**Error! Reference source not found.**, **Error! Reference source not found.**), forests remain the dominant landcover type (62 percent), followed by open water (26 percent) [12].

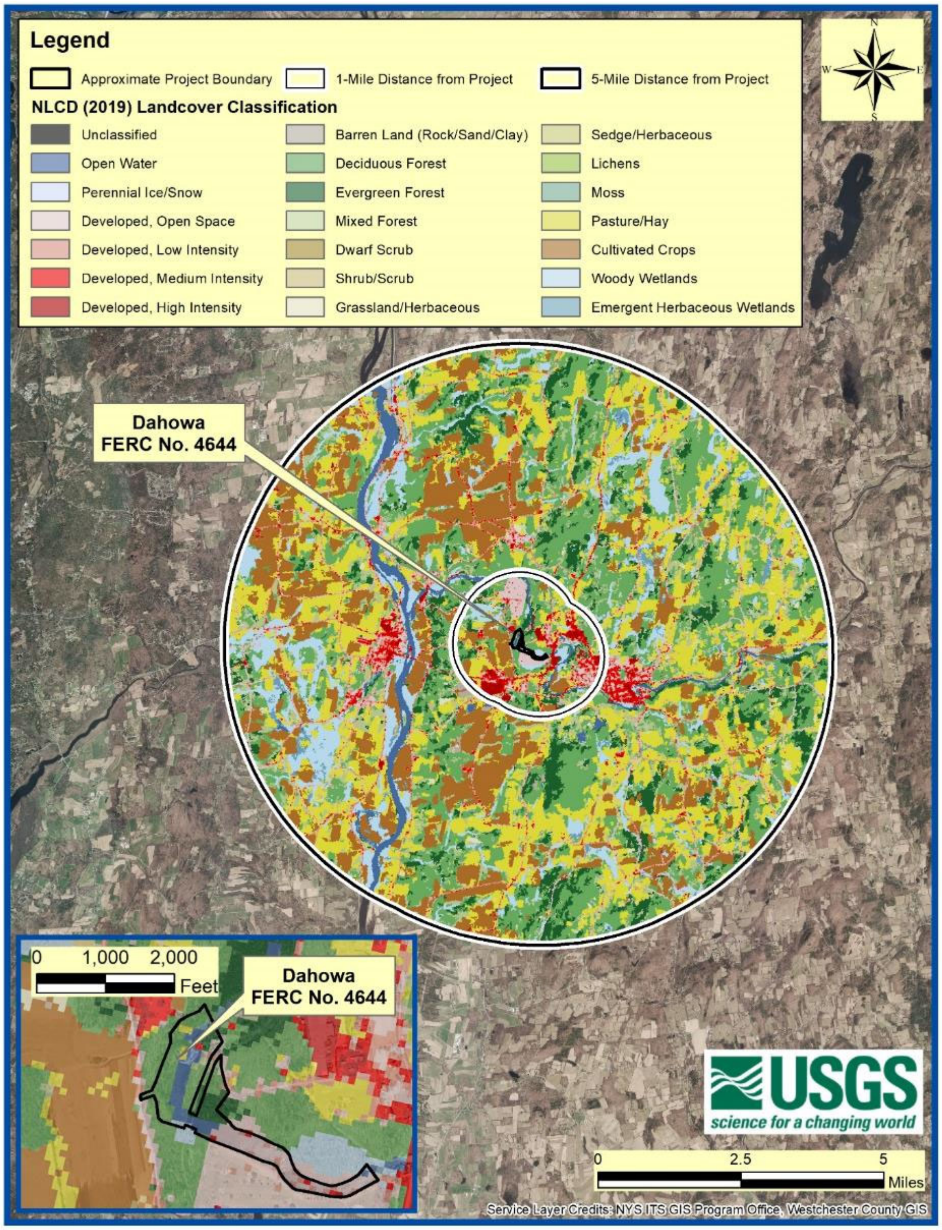


Figure 29. National Landcover Database Land Use Data - Dahowa Hydroelectric Project Vicinity [12]

Table 29. Summary of Landcover Types - Upper River Basin and Project Vicinity [12]

Landcover Type	Percent of Landcover			
	Upper Hudson River Basin	5-Miles of Project Area	1-Mile of Project Area	Project Area
Barren	0.2	0.3	1.2	1.5
Developed	5.9	9.8	29.4	33.5
Farmland	7.9	39.5	25.4	1.9
Forest	73.7	37.6	32.5	43.2
Grassland	0.6	0.6	0.7	0.0
Open Water	3.1	2.3	2.7	17.5
Shrub/Scrub	0.6	0.4	0.4	0.0
Wetlands	8	9.4	7.7	2.4
Total	**100.0**	**100.0**	**100.0**	**100.0**

The Village of Greenwich is undertaking efforts to improve the downtown area, located approximately 3 miles from the Project, and developed the Main Street Streetscape Plan in 2019. One of the key goals of the plan was to address waterfront access opportunities to connect downtown areas to the Battenkill waterfront. As part of this effort the Greenwich Waterfront Park Concept Plan was developed as shown in Figure 30.

Figure 30. Greenwich Waterfront Park Concept Plan (Upstream of Project)[6]

In addition, the Village of Greenwich has an ongoing Brownfield Opportunity Area Plan (BOA) that is currently being developed. As part of this effort, a waterfront focus group was formed to help formulate a waterfront concept plan that meets the goals of village residents.

[6] https://villageofgreenwich.org/government/projects/streetscapes-plan/

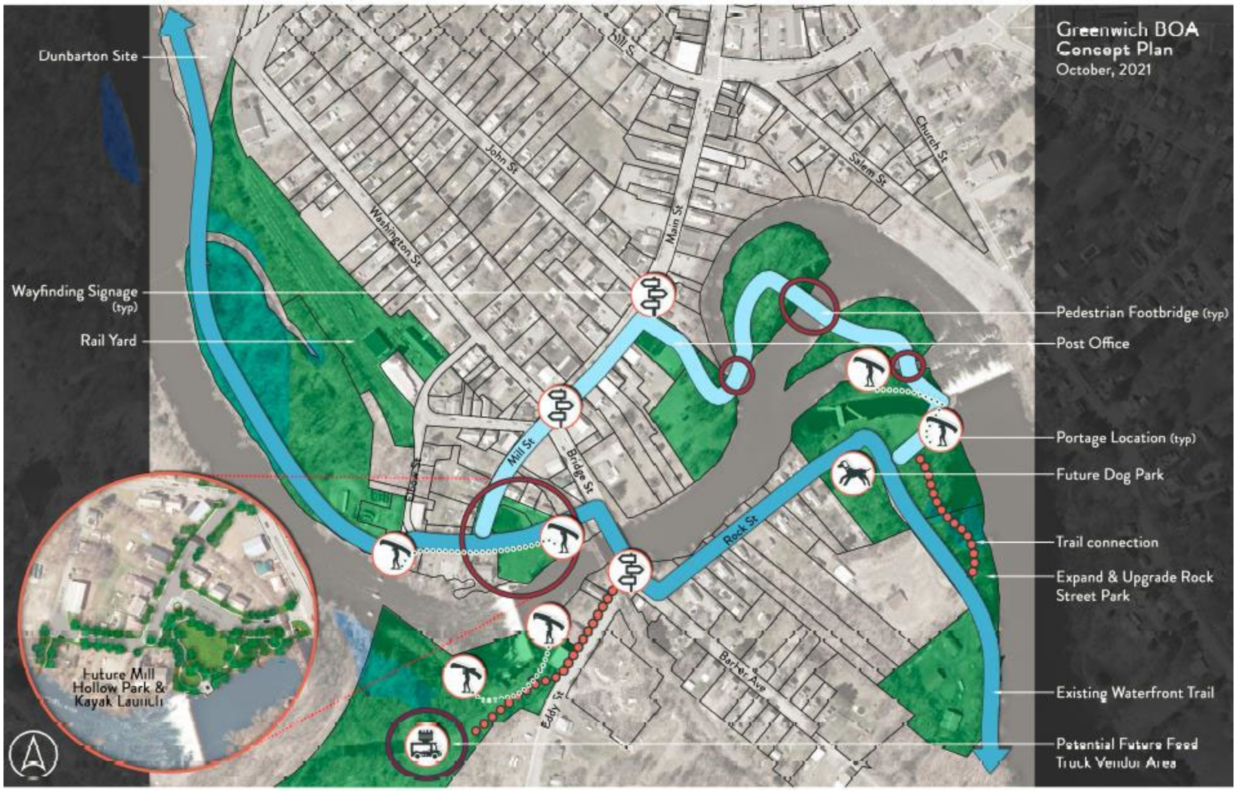


Figure 31. Greenwich BOA Concept Plan October 31, 2021. (Upstream of Project) [80]

These revitalization efforts are located several river miles upstream of the Dahowa Project.

10.2 Project Impact on Recreation and Land Use Resources

The proposed operation of the Project currently does not involve any modifications to the existing hydrograph or impoundment elevations and will therefore have no long-term effects on recreational opportunities associated with use of the impoundment or river. There currently are no proposed land disturbing activities which would impact the current land uses within the Project area or its vicinity. The Project operation will continue to support local recreational opportunities as it has since 1991.

10.3 Protection, Mitigation, and Enhancement Measures (PM&E)

Agency Recommended Mitigation

The licensee is not aware of any agency proposed PM&E measures related to recreation and land use resources.

Applicant Proposed Mitigation

The applicant is not proposing any PM&E measures related to new recreation features or land use resources. The licensee will coordinate with the Battenkill Conservancy to support their efforts to standardize signage for recreational facilities in the watershed, including signage at the Project's existing recreational facilities.

11.0 Aesthetic Resources

11.1 Affected Environment

The primary aesthetic resource within the Project area is the Dahowa Falls, located immediately downstream of the Project Dam, and can be viewed via the Project's overlook platforms located within recreation area on the left descending bank of the Battenkill River, which are maintained per the existing license requirements. Additionally, the existing license requires a minimum flow release of 40 cfs from the dam for aesthetic purposes between 6:00 AM and 8:00 PM from the third Saturday in May through Labor Day weekend and from sunrise to sunset on weekends and holidays from Labor Day weekend through November 30 (Photo 3). The licensee has voluntarily provided 40 cfs year-round and proposes to continue and formalize this practice under the new license.

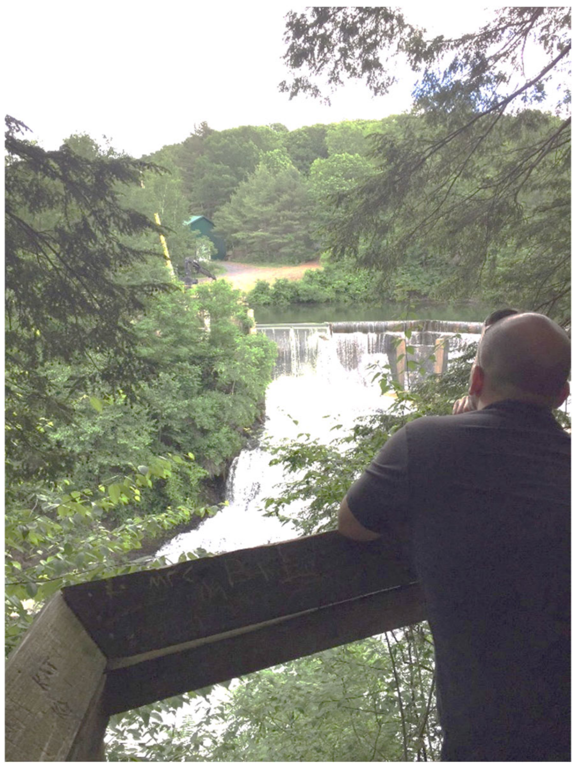


Photo 3. Dionodahowa Falls from the overlook recreation trail platform

Additional aesthetic resources include the woodlands within the Project area and its vicinity, as well as general views of the river upstream of the impoundment. These can be accessed or viewed from within the recreation areas maintained by the Project, which include the fishing area located upstream of the Project Dam on the right descending bank (**Error! Reference source not found.**) or the recreation overlook areas located on the left descending bank (**Error! Reference source not found.**).

Photo 4. Woodlands and Battenkill River Viewed from the Fishing Area

Photo 5. Woodlands Viewed from the Recreation Area [7]

11.2 Project Impact on Aesthetic Resources

It is not anticipated that Project relicensing will have any impacts to the aesthetic resources. Continuation of aesthetic flows and maintenance of features which create opportunities for safe public enjoyment of the falls and surrounding areas will provide on-going public benefits.

11.3 Protection, Mitigation, And Enhancement Measures (PM&E)

Agency Recommended Mitigation

The licensee is not aware of any agency proposed PM&E measures related to recreation and land use resources.

Applicant Proposed Mitigation

The Licensee currently proposes to maintain the existing operational protocols that have been in place during the term of the existing license. Operation in run-of-river mode or with minimal fluctuations will maintain the existing hydrograph and minimize Project-related fluctuations to water surface elevations in the impoundment. The voluntary practice of providing 40 cfs existing aesthetic flows year-round, as opposed to on the license specified holiday schedule, will be continued for aesthetic value and provide stability of physical habitat conditions along the face of the natural falls

12.0 Cultural Resources

12.1 Affected Environment

The applicant has reviewed information on pre-contact and archeological resource in the Project vicinity prepared in support of the relicensing of the Upper and Middle Greenwich Projects (P-6903 and P-6904). The passages below are adapted from the license application for these projects (KEI, 2024).

> *"The earliest evidence of human occupation in New York State dates to the retreat of continental glaciers at the end of the last Ice Age. Although the absolute chronology for the Paleoindian period in North America (and in New York State, specifically) remains in question, the period is generally considered to begin during the terminal stages of the late Wisconsin glaciation of the Pleistocene epoch (approximately 10,500 BC) (Adovasio and Carr 2002).*
>
> *There is a paucity of Paleoindian sites in New York State, and none have been identified within the vicinity of the Project. A number of factors contribute to the general lack of sites from the Paleoindian period (Heitert 2003, Johnson 1984). The age of Paleoindian deposits, subsequent landscape modifications, and associated ground-disturbing activities (e.g., agriculture and logging) make the likelihood of encountering intact Paleoindian sites relatively low. Other significant factors that affect the visibility of intact sites include the presumed low population densities during the Paleoindian period, the perishable nature of material culture types common to hunter-gatherer groups (e.g., cordage and fiber technologies), and the general environmental conditions in the region at the end of the Wisconsin glaciation. The paleoenvironmental landscape was significantly altered by natural environmental conditions precipitated by a host of post-glacial processes, including isostatic rebound, eustatic sea level rise, and concomitant changes in the characteristics of alluvial environments. These and other natural processes have further obscured the relationship between the paleotopography and the modern landscape.*
>
> *Warming and more arid climate following glacial retreat led to increased ecological diversity during the Archaic period (8,000 BC – 1,500 BC) (Quinn 1999, Ritchie 1965). The Early Archaic was characterized by the spread of boreal (coniferous) forests across the Northeast, followed by the establishment of essentially modern mixed deciduous forests and faunal assemblages by the Middle Archaic (Ritchie and Funk 1973). Relatively little is known about the Early and Middle Archaic in New York State and few sites have been extensively investigated (Nagel et al. 2001).*
>
> *The Late Archaic correlates with essentially modern climatic conditions and the stabilization of regional and local environments (Hartgen 2002, Mozzi and Clifford 2000). In New York State, forests were dominated by oak, hickory, and walnut, and the stabilization of sea levels led to the emergence of rich riverine habitats (Hartgen 2002). The Late Archaic in New York State is generally represented by diagnostic artifacts associated with the Laurentian tradition. Laurentian tradition subsistence patterns revolved around hunting and fishing, with a toolkit that included projectile points, gouges, adzes, ground slate knives, the ulu, barbed bone projectile points, and a variety of chipped stone tools (Ritchie 1965). The Laurentian tradition was widespread throughout the Northeast and can be subdivided into a number of regional and sequential phases.*

Within the vicinity of the Project, these include the Vergennes, Vosburg, Sylvan Lake, River, and Snook Kill phases (Majot 2008). Settlement patterns focused on seasonal resource availability, with population aggregation occurring in larger river valleys and along the shorelines of lakes during the warmer months and population dispersal of family groups into the uplands and smaller valleys during the winter.

The Woodland Period (1,500 BC – AD 1,550) was characterized by widespread and significant changes in cultural patterns across the eastern United States. The transition from the Late Archaic to the Early Woodland period is typically defined by the manufacture and use of ceramic vessels. This development occurred in areas of eastern North America during the Late Archaic period but became widespread in the Northeast and Mid-Atlantic by approximately 1,000 BC (Quinn 1999).

Early Woodland cultural traditions are evidence of the continuation, adaptation, and intensification of Archaic period cultural trends and broader interaction spheres of trade and communication across the entirety of the Eastern Woodlands (Nagel et al. 2001; Fagan 2000). Maize, bean, and squash agriculture became an important source of subsistence during the Late Woodland period. Major sociopolitical changes accompanied the widespread adoption of cultivation practices, including increased territorialization and changes in residence patterns. These changes led to the emergence of an identifiable Iroquoian Tradition within western, central, and northern New York State by AD 1300. In the Town of Greenwich, the Mohawk used the area as a hunting ground once known as the "Dense Forest" (NYGenWeb n.d.).

Ephemeral contact between Native Americans and Europeans along the Atlantic Coast of North America may have begun as early as the 1490s. Unverified archival accounts indicate that European fishing fleets may have made landfall along the coast of Newfoundland and the Gulf of St. Lawrence toward the end of the 15th century. In 1524, Italian explorer Giovanni da Varrazzano made the first documented contact with Native Americans along the Atlantic seaboard. Dutch explorer Henry Hudson navigated the river that now bears his name north to the present-day City of Albany in 1609. European settlers that soon followed these explorers encountered an indigenous population wracked by epidemic diseases brought from the Old World. Waves of epidemics killed thousands of Native Americans living in the Northeast during the early contact period. These epidemics were compounded by internecine hostilities fostered by competition for access to European trade goods. Warfare among indigenous populations would kill thousands of Native Americans and force others to flee the region during the 17th century (Grumet 1995).

By the early 17th century, the Dutch had established fortified trading posts along the Hudson River, including Fort Nassau and Fort Orange. The Dutch encouraged families and permanent settlers to relocate to these fortified trading posts as a means of providing a sustainable settlement along the Hudson River (Majot 2008). In 1675, New York had become an English colony and by the 18th century, farms dotted the Hudson River Valley, and cities such as Kingston and Albany had become important English strongholds in the New World (Grumet 1995).

Settlement north of Albany remained sparse and concentrated in areas that could be defended. English colonists in the Hudson River Valley faced pressure from the French in the north and Native American raids were common (Majot 2008). As the road network expanded north from Albany, scattered settlements appeared along "River Road" or the "King's Highway" that followed the Hudson River northward. By 1720 about 12 Dutch families from Albany established farms in the Greenwich area (Kirk et al. 2018), but Majot (2008) summarizes the dangerous conditions for settlers in the Hudson River Valley between the late 17th century and the American Revolution:

Prior to the American Revolution, very little settlement occurred in the outlying areas…This wilderness was the interface between the French occupations to the north along Lake Champlain and the British interests along the Hudson River and Lake George. As these main Euro-colonial powers vied for control of this northern area, a series of inter-colonial wars were waged from approximately 1689 until 1763, referred to as King William's, Queen Anne's, King George's and the French and Indian Wars.

The Town of Greenwich was involved in every war that has taken place in the United States. The Great War Trail ran along the Hudson River through the Towns of Greenwich and Easton, which was used by both Indians before the war period and later by the French and British during the French and Indian Wars and used again during the American Revolution (NPS 1995, Town of Greenwich 2012). While some settlers moved into the area during the inter-war period, the military action that took place in Saratoga and Washington County during the American Revolution kept the region unstable (Cardinal and Schmitt 2006). While no military engagements took place in the Town of Greenwich during the American Revolution, both American and British troops occupied the area (Kirk et al. 2018).

Early settlers were attracted to the Town of Greenwich and the advantages of waterpower on the Batten Kill. Grist mills and sawmills were the first to be developed followed by wool, cotton, flax, and plaster mills. Paper mills and agriculture later became the major industries in the region. The Village of Greenwich was first named as Whipple City after Job Whipple, a successful industrialist who established the first cotton mill in New York in 1804 (NPS 1995, Town of Greenwich 2012). It was renamed to Greenwich in 1867 (Town of Greenwich 2012). The Towns of Easton and Greenwich were also home to a famous station of the Underground Railroad by George Corliss (NYGenWeb n.d., Washington County n.d.)." (KEI, 2024).

European colonists began to establish communities near present-day Greenwich, New York during the late 18th century. Originally a part of five land patents, the town was formed in 1803 from a part of the Town of Argyle. The water resources offered by the Hudson and Battenkill Rivers attracted early settlers, who initially established grist and sawmills before building woolen, cotton, flax, and land plaster mills. Paper mills and agriculture later became major drivers of the town's economy [63].

The region held strategic importance during the French and Indian War and the American Revolutionary War, and the Town of Greenwich has been represented in every subsequent war fought by the United States. Prior to the American Civil War, Greenwich was a stopping point along the Underground Railroad as abolitionists aided former slaves in their escape to Canada [63].

Train service in Greenwich began with the construction of the Greenwich and Johnsonville Railroad in 1869. The line became the Battenkill Railroad after it was sold to Mohawk-Hudson Transportation in the early 1980s following the closure of the Georgia Pacific pulp and paper mill in Thomson, New York [9]. As of 2013, the Battenkill Railroad was classified by the New York State Department of Transportation (NYSDOT) as being active for shortline freight service [55]. The line includes a railroad bridge that crosses the Battenkill River at the upstream limit of the Project area (see Figure 1).

Trolley service was established in Greenwich in1895 with the construction of the Greenwich and Schuylerville Electric Railroad. This line was later incorporated into the Hudson Valley Railway, which provided a transportation network that extended from the Albany Capital District to Warrensburg, New York. Trolley service between Greenwich and Thomson continued until 1928, when flooding washed out tracks near Clarks Mills [9]. A trolley bridge that passed over the Dahowa Falls at the current Project Site was later removed following the discontinuation of service (Photo 2).

There are no sites listed in the National Register of Historic Places in the immediate vicinity of the Project (Figure 32). Several historic buildings are located approximately one mile to the west of the Project area in the towns of Easton and Schuylerville. These are found within the Champlain Canal Cultural District, which extends approximately 50 miles in a northeastern direction from Troy to Whitehall, New York. The Village of Greenwich Historic District is located approximately two miles to the east of the Project [27].

The Cultural Resource Information System (CRIS) online database maintained by the New York State Office of Parks, Recreation & Historic Preservation's State Historic Preservation Office (NY SHPO) does not indicate the presence of any known cultural resources within the Project area (Figure 33). Within one mile of the Project area, there are 4 buildings eligible for historic designation, 15 consultation projects, 8 archaeology surveys, and 1 building survey (Table 30). Many of the consultations, including the three that remain open, are related to solar or public infrastructure projects. Five of the solar projects are located directly adjacent to the Property Boundary along its western limit in the town of Easton [59].

The Project area is located within the western limit of an archaeologically sensitive area, which is a buffer area drawn around a recorded archaeological resource. It is noted that locations outside of buffer areas may also be archaeologically sensitive [59]. A Phase 1A Literature Review and Archaeological Sensitivity Assessment prepared in 2018 for the Village of Greenwich identified areas that are archaeologically sensitive due to the potential presence of "precontact" (i.e., Native American) or "historic" archaeological deposits. The central part of the Village and area paralleling Fly Creek were considered to have high sensitivity because of their proximity to waterways and nearby precontact quarry sites, whereas northern parts of the village were considered to have low to moderate sensitivity. Areas that were developed prior to the 20th century were also considered to have high sensitivity [80].

A cluster of homes built prior to 1900 is located along New York State Route 29 approximately 0.5 miles to the east of the Project area (Figure 34). Among these residences, four are eligible for historic designation [59].

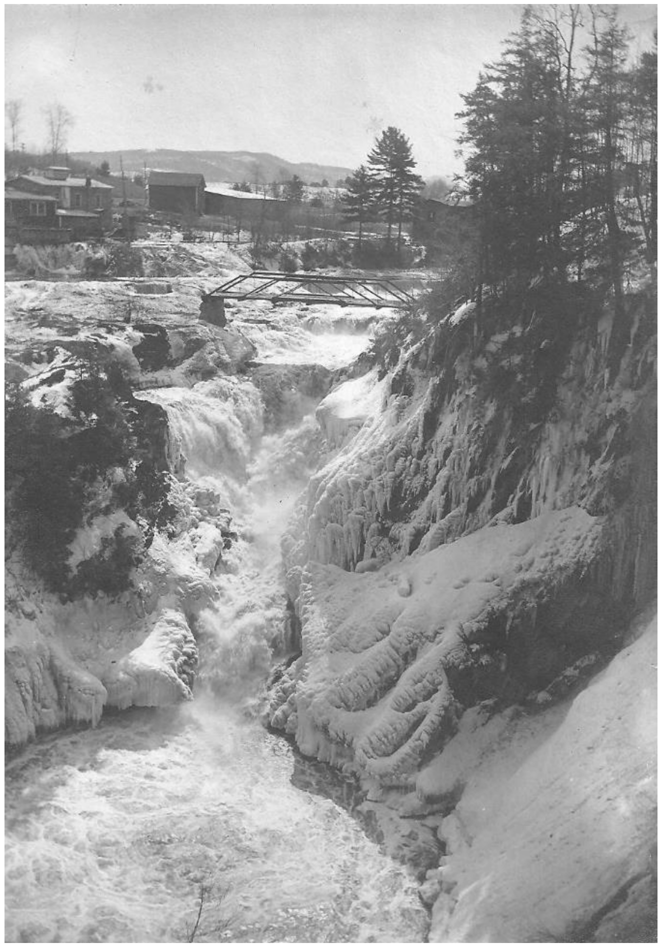


Photo 2. Historic Photograph of the Former Dionondahowa Trolley Bridge [10]

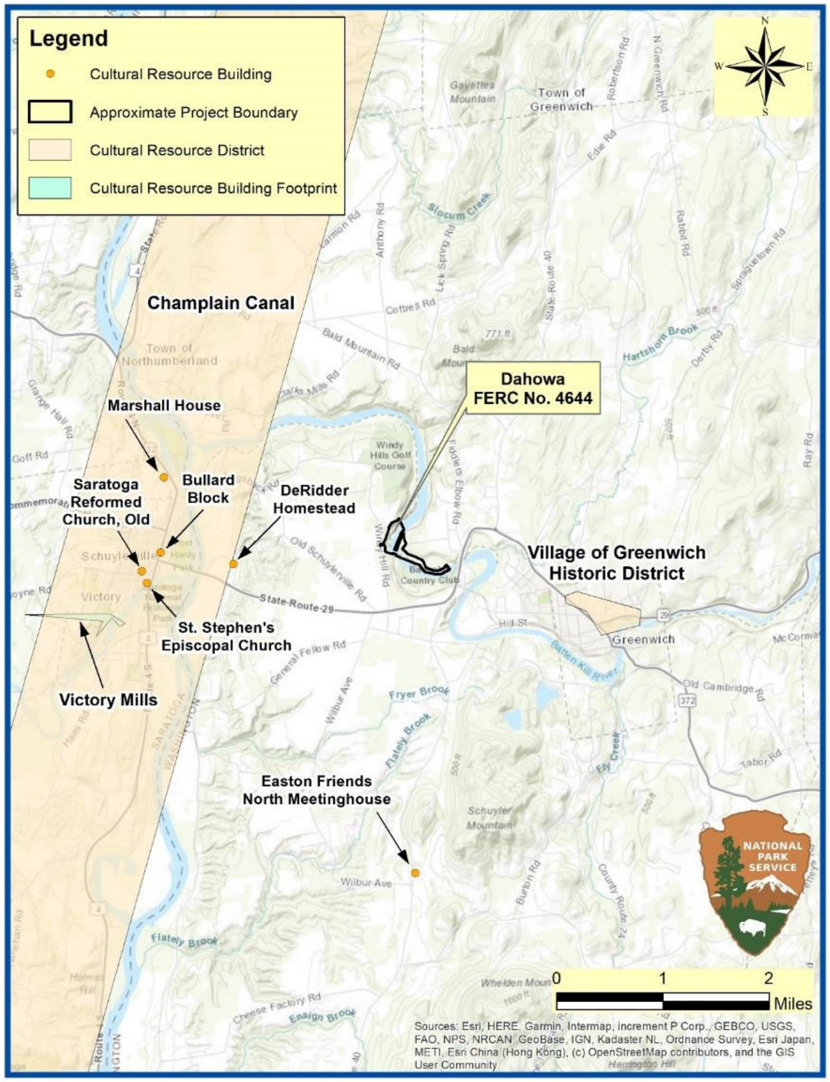


Figure 32. National Register of Historic Places – Dahowa Hydroelectric Project Vicinity [27]

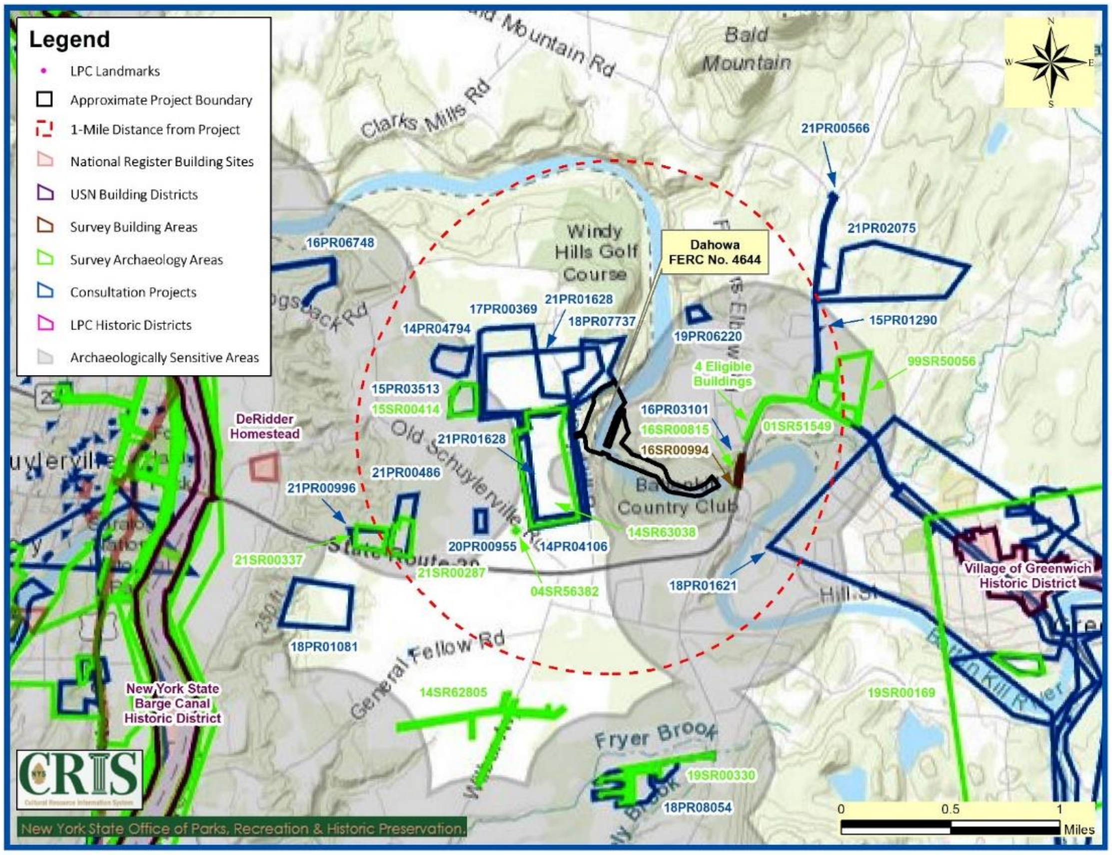


Figure 33. New York State Cultural Resources – Dahowa Hydroelectric Project Vicinity [59]

Table 303. NYSDHP CRIS Listings – Dahowa Hydroelectric Project Vicinity

Listing Type	USN/Project/Survey Number	Name
Eligible Buildings	11508.000620	1042 NY 29
	11508.000624	1054 NY 29
	11508.000627	1045 NY 29
	11508.000630	1051 NY 29
Consultation Projects	14PR04106[1]	Great Valley Solar
	14PR04794	Broke Materials Landfill Closure
	15PR01290	Greenwich Rehabilitation Program
	15PR03513	Easton Solar

Listing Type	USN/Project/Survey Number	Name
	16PR03101	1236.27.101 Route 29 over the Battenkill Bridge Replacement
	17PR00369	Windy Hill Solar Project
	18PR01621[1]	Village of Greenwich Waterlines
	18PR07737[1]	Great Valley Solar Project
	19PR06220	Ferrellgas Greenwich Proposed Propane Gas Facility
	20PR00955	Washington County Fair Central Sewer System Project
	21PR00486	United Ag & Turf Easton, NY
	21PR00566	Town of Greenwich Water Transmission Main
	21PR00996	NECB Properties LLC Commercial Development
	21PR01628	Boralex Easton Solar/20 MW/85 of 200 Acres
	21PR02075	Greenwich Solar Farm Project/±16.3 acres of 99.98-acres/5MW
Archaeology Surveys	99SR50056	Stage I Archaeological/Historical Sensitivity Evaluation and Archaeological Survey, Hannaford Brothers Development, New York State Routes 29 and 40, Town of Greenwich, Washington County, New York
	01SR51549	Cultural Resource Reconnaissance Survey Report of PIN 1236.22.121, Routes 29 and 40, Town of Greenwich, Washington County, New York
	04SR56382	Phase IB Investigation Report for the Proposed Telecommunications Facility at Old Schuylerville Road, Greenwich, Washington Co
	14SR63038	A Cultural Resource Management Survey of The Windy Hill Road Mining Area
	15SR00414	H&V Solar Project, Town of Easton, Phase I Archeological Investigation
	16SR00815	Cultural Resources Reconnaissance Survey Report 1236.27.101 Route 29 over the Battenkill Bridge Replacement Towns of Easton and Greenwich Washington County New York PR# 16PR03101
	21SR00287	Phase I Archeological Investigation, United Ag & Turf Easton, Town of Easton, Washington County, New York
	21SR00337	Phase I Archeological Investigation, NECB Properties Commercial Development, Town of Easton, Washington County, New York
Building Surveys	16SR00994	PIN 1236.27.101 NYS Route 29 over the Battenkill River, Replacement of BIN 1020720, Towns of Easton and Greenwhich, Washington County, NY

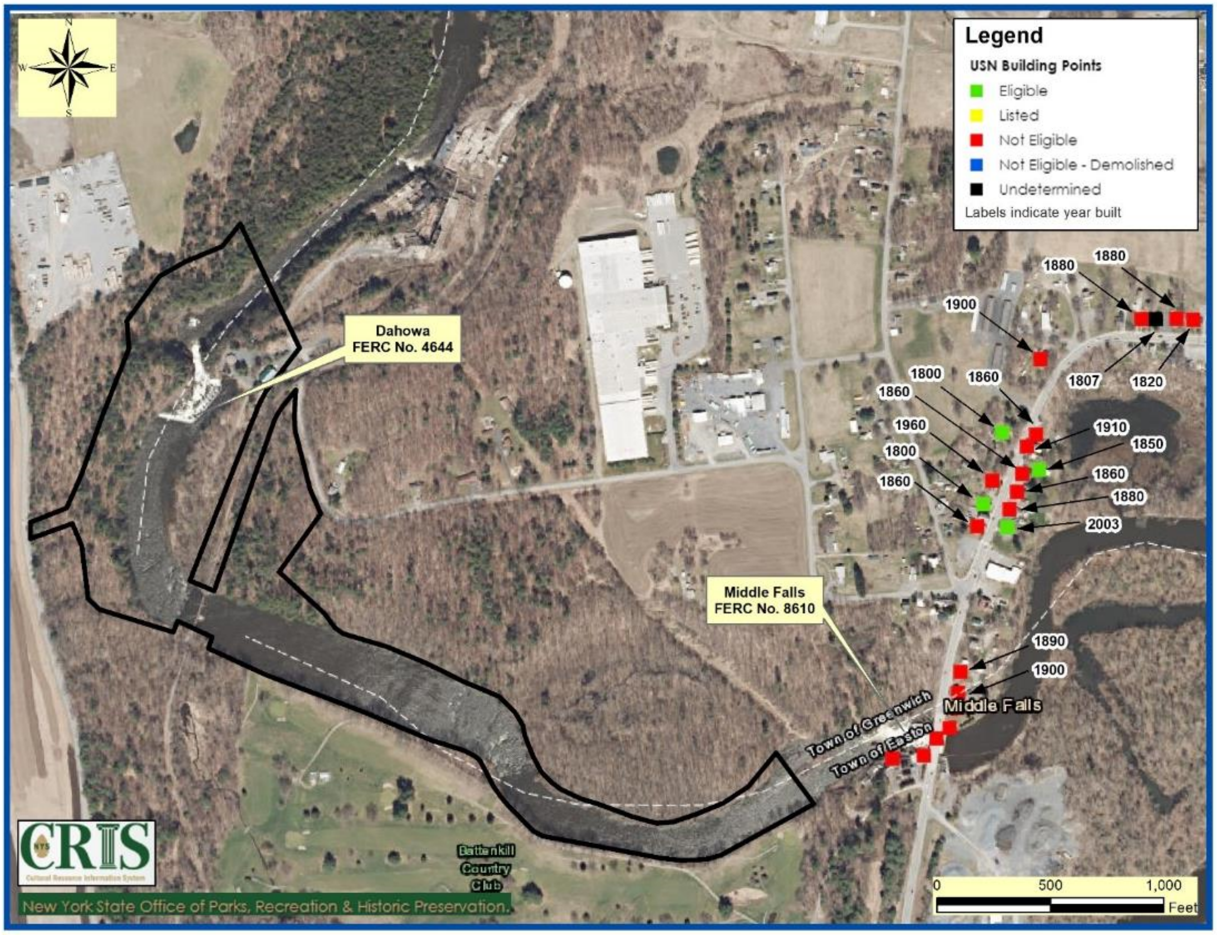


Figure 34. Dahowa Hydroelectric Facility Vicinity Residences – Years Built

Today, there are eight federally recognized tribes in the state of New York (**Error! Reference source not found.**), which include:

- Cayuga Nation,
- Oneida Nation of New York,
- Onondaga Nation,
- Saint Regis Mohawk Tribe (formerly the St. Regis Band of Mohawk Indians of New York),
- Seneca Nation of Indians,
- Shinnecock Indian Nation,
- Tonawanda Band of Seneca, and
- Tuscarora Nation of New York [26].

There are three state recognized tribes in the state of New York, which include:

- Tonawanda Band of Seneca,
- Tuscarora Nation of New York, and

- Unkechaug Nation [26].

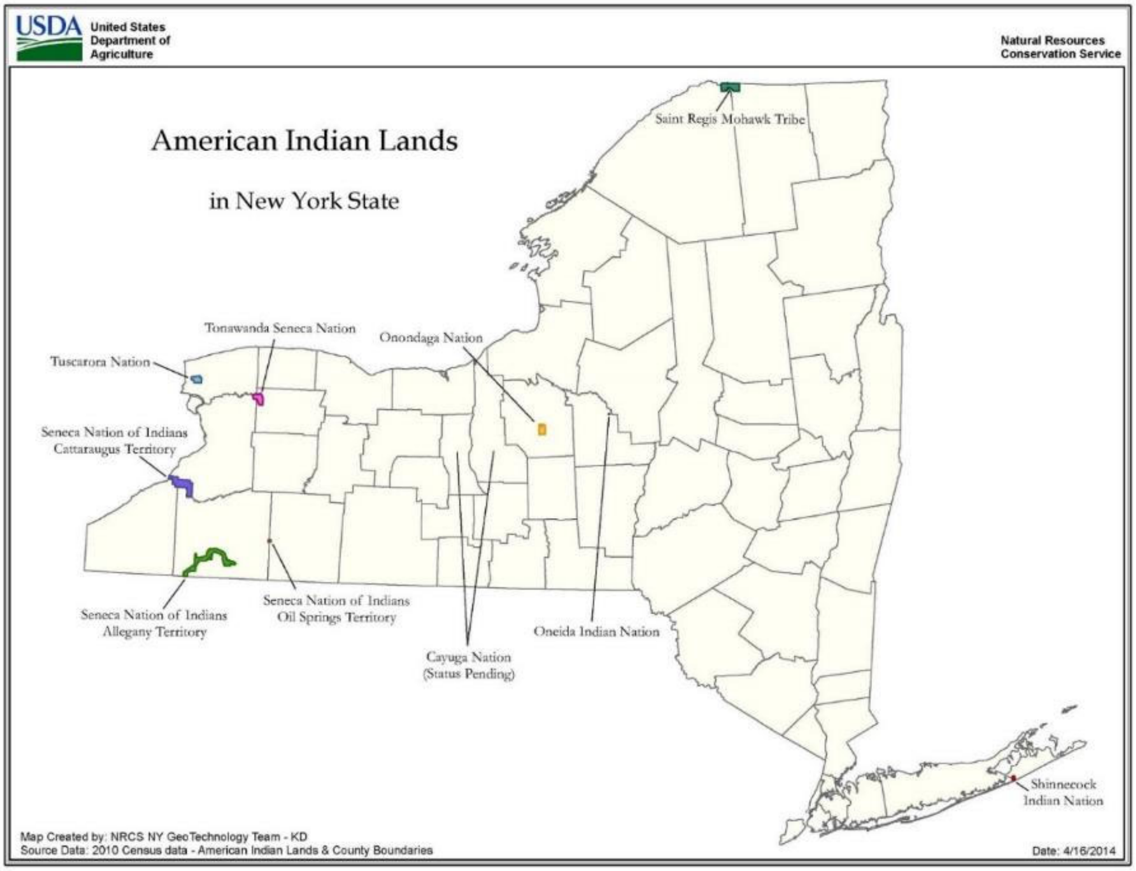


Figure 36. Federally Recognized Tribal Lands of New York State [67]

FERC and the Licensee completed outreach to the Saint Regis Mohawk Tribe. In addition, FERC received feedback from the Stockbridge Munsee Community Band of Mohican Indians. Copies of all tribal consultation is included in Appendix B.

12.2 Project Impact on Cultural Resources

Due to previous ground disturbing activities associated with the Project Dam and hydroelectric Project, as well as those associated with the former Stevens and Thompson Paper Company mill complex and the former hydroelectric facility, it is not anticipated that there will be any Project-related effects on cultural, historical or tribal resources. Consultation with the New York State Historic Preservation Office (NY SHPO) was initiated, including delineation of an Area of Potential Affect (APE); SHPO review is pending.

12.3 Protection, Mitigation, and Enhancement Measures (PM&E)

Agency Recommended Mitigation

The licensee is not aware of any agency proposed PM&E measures related to cultural resources.

Applicant Proposed Mitigation

The Applicant has initiated consultation with the NY SHPO and tribal nations to ensure that any Project-related impacts are avoided and/or minimized.

13.0 Socioeconomic Resources

13.1 Affected Environment

The Project is located within the towns of Greenwich and Easton, New York, which are small communities in southern Washington County that are approximately 15 mi to the east of Saratoga Springs and 30 mi to the north of Albany. Washington County occupies approximately 831 square mi in east-central New York, which is the 23rd largest county by land area in the state. The 2020 US Census reported a total population size of 61,302 people for Washington County, which was a three percent decrease compared to the 2010 Census [64].

The most recent American Community Survey 5-Year Estimates from 2022 estimated that the median age in Washington County was 44.6 years, which was approximately 5 years older than the New York statewide median age. Approximately 81 percent of the Washington County population was over 18 years of age with over 20 percent 65 years and older [64].

Median household income in Washington County was estimated as $68,703, which is approximately $11,000 less than the New York statewide median household income and $5,000 less than the median household income in the United States [64].

13.2 Project Impact on Socioeconomic Resources

The Applicant does not anticipate any Project-related impacts to socioeconomic resources. Operation and maintenance activities associated with the Project will continue to provide long-term benefits to local tax base, businesses and technical tradesmen.

It is anticipated that local contractors will be retained to complete any Project modifications if required in the new License. The Project has several full and part-time operators who perform routine operations and maintenance activities and will continue to do so post-licensing. In addition, local and regional specialty contractors are routinely engaged to assist in non-routine Project maintenance activities. The Project also contributes to the local tax base and will continue to do so under a subsequent license.

13.3 Protection, Mitigation, and Enhancement Measures (PM&E)

Agency Recommended Mitigation

The licensee is not aware of any agency proposed PM&E measures related to socioeconomic resources.

Applicant Proposed Mitigation

The licensee is not proposing any PM&E measures related to socioeconomic resources.

14.0 Compliance with FERC Recognized Comprehensive Plans

Section 10(a)(2) of the Federal Power Act (FPA) requires FERC to consider the extent to which a project is consistent with federal and state comprehensive plans for improving, developing, and conserving waterways affected by the project. In accordance with Section 10(a)(1) of the FPA, the list of Commission approved federal and state comprehensive plans was reviewed to determine applicability to the Dahowa Hydroelectric Project. The State of Vermont and federal resource agencies have prepared several comprehensive plans, which offer a general assessment of a variety of environmental conditions.

Based on a review of potentially relevant state and federal plans, it appears that the following are relevant to the Dahowa Project.

- Atlantic States Marine Fisheries Commission. 2000. Interstate Fishery Management Plan for American eel (Anguilla rostrata). (Report No. 36). April 2000.
- Atlantic States Marine Fisheries Commission. 2006. Addendum I to the interstate fishery management plan for American eel (Report No. 35b). February 2006.
- Atlantic States Marine Fisheries Commission. 2008. Amendment 2 to the Interstate Fishery Management Plan for American eel. Arlington, Virginia. October 2008.
- Atlantic States Marine Fisheries Commission. 2013. Amendment 3 to the Interstate Fishery Management Plan for American eel. Arlington, Virginia. August 2013.
- Atlantic States Marine Fisheries Commission. 2014. Amendment 4 to the Interstate Fishery Management Plan for American eel. Arlington, Virginia. October 2014.
- Atlantic States Marine Fisheries Commission. 2018. Addendum V to the interstate fishery management plan for American eel: commercial yellow and glass/elver eel allocation and management. August 2018.
- National Park Service. 1993. The Nationwide Rivers Inventory. Department of the Interior, Washington, D.C. 1993.
- New York State Office of Parks, Recreation, and Historic Preservation. New York Statewide Comprehensive Outdoor Recreation Plan (SCORP): 2003-2007. Albany, New York. January 2003.

14.1 FERC Approved State of New York Comprehensive Plans

New York State Office of Parks, Recreation, and Historic Preservation. New York Statewide Comprehensive Outdoor Recreation Plan (SCORP): 2003-2007. Albany, New York. January 2003.

The Statewide Comprehensive Outdoor Recreation Plan (SCORP) is prepared periodically by the New York State Office of Parks, Recreation and Historic Preservation (OPRHP) to provide statewide policy direction and to fulfill the agency's recreation and preservation mandate. The document is also used to guide the allocation of state and federal funds for recreation and open space projects. The direction for recreation in New York State is guided by several themes, with associated goals and recommended actions. As a road map for recreation decision-making, these themes provide structure and support for planning and inform administrative and legislative action. These themes are: 1. Keep the outdoor recreation system welcoming, safe, affordable, and accessible; 2. Improve the visitor experience; 3. Restore and enhance the State outdoor recreation system with an emphasis on conservation and resiliency; and 4. Celebrate and teach history while promoting historic preservation efforts across the State.

There is no specific reference to the Dahowa Project or the Battenkill River. However, as described in section 9, there are currently no proposed land disturbing activities which would impact the current land uses within the Project area or its vicinity. The Project operation will continue to support local recreational opportunities as it has since 1991.

Erie Canalway National Heritage Corridor Preservation and Management Plan, National Park Service, 2006

The Erie Canalway National Heritage Corridor, working through a wide range of partnerships, is preserving and interpreting our nation's past, providing world class recreational and educational opportunities, fostering economic revitalization, improving the quality of life in corridor communities, and guiding the reemergence of the Erie Canalway as a 21st century "River of Commerce and Culture."

In order to achieve this vision, the Erie Canalway National Heritage Corridor Commission has established the following goals and supporting objectives:

- The Corridor's historic and distinctive sense of place will be widely expressed and consistently protected
- The Corridor's natural resources will reflect the highest standards of environmental Quality
- The Corridor's recreation opportunities will achieve maximum scope and diversity, in harmony with the protection of heritage resources
- The Corridor's current and future generations of residents and visitors will value and support preservation of its heritage
- The Corridor's economic growth and heritage development will be balanced and self-sustaining
- The Corridor will be a 'must-do' travel experience for regional, national and international visitors

There is no specific reference to the Dahowa project. However, the Project's continued operation will support the objectives of the Erie Canalway National Heritage Corridor Preservation and Management Plan by: continuation of the harnessing of waterpower potential of Dionadahowa Falls, operating the Project in an environmentally sensitive manner, and providing public recreational opportunities.

14.2 FERC Approved Federal Comprehensive Plans

Atlantic States Marine Fisheries Commission. 2000. Interstate Fishery Management Plan for American eel (*Anguilla rostrata*). (Report No. 36). April 2000.

The goal of this FMP is to conserve and protect the American eel resource to ensure its continued role in the ecosystems while providing the opportunity for its commercial, recreational, scientific, and educational use. Specifically, the goal aims to: 1. Protect and enhance the abundance of American eel in inland and territorial waters of the Atlantic States and jurisdictions and contribute to the viability of the American eel spawning population; and 2. Provide for sustainable commercial, subsistence, and recreational fisheries by preventing overharvest of any eel life stage.

While it is possible that American eels could eventually move into the Dahowa Project area in the future, the licensee has conducted sampling documenting that American eels do not currently exist in the vicinity of the Project.

Atlantic States Marine Fisheries Commission. 2006. Addendum I to the interstate fishery management plan for American eel (Report No. 35b). February 2006.

The American Eel Management Board developed and subsequently approved this Addendum in order to establish a mandatory catch and effort monitoring program for American eel.

While it is possible that American eels could eventually move into the Dahowa Project area in the future, the licensee has conducted sampling documenting that American eels do not currently exist in the vicinity of the Project.

Atlantic States Marine Fisheries Commission. 2008. Amendment 2 to the Interstate Fishery Management Plan for American eel. Arlington, Virginia. October 2008.

Amendment II, placed increased emphasis on improving the upstream and downstream passage of American eel. No new management measures were implemented by Addendum II.

While it is possible that American eels could eventually move into the Dahowa Project area in the future, the licensee has conducted sampling documenting that American eels do not currently exist in the vicinity of the Project.

Atlantic States Marine Fisheries Commission. 2013. Amendment 3 to the Interstate Fishery Management Plan for American eel. Arlington, Virginia. August 2013.

Amendment 3 was implemented with the goal of reducing mortality on all life stages of American eel. The amendment was initiated in response to results of the 2012 Benchmark Stock Assessment, which found the American eel stock along the US East Coast was depleted. This amendment predominately focused on commercial yellow eel and recreational fishery management measures. Measures included implementation of new size and possession limits as well as new pot mesh size requirements and seasonal gear closures.

While it is possible that American eels could eventually move into the Dahowa Project area in the future, the licensee has conducted sampling documenting that American eels do not currently exist in the vicinity of the Project.

Atlantic States Marine Fisheries Commission. 2014. Amendment 4 to the Interstate Fishery Management Plan for American eel. Arlington, Virginia. October 2014.

As the second phase of management in response to the 2012 stock assessment, the goal of Amendment 4 is to continue to reduce overall mortality and increase overall conservation of American eel stocks. The amendment addresses concerns and issues in the commercial glass and silver eel fisheries, and domestic eel aquaculture. Amendment 4 established a coastwide catch cap and a mechanism for implementation of a state-by-state commercial yellow eel quota if the catch 1 cap is exceeded. Under Amendment 4, the coast wide catch cap was set at 907,671 pounds. Amendment 4 established two management triggers:
1) The coastwide catch cap is exceeded by more than 10 percent in a given year (998,438 pounds), and;
2) The coastwide catch cap is exceeded for two consecutive years, regardless of the percent overage.

While it is possible that American eels could eventually move into the Dahowa Project area in the future, the licensee has conducted sampling documenting that American eels do not currently exist in the vicinity of the Project.

Atlantic States Marine Fisheries Commission. 2018. Addendum V to the interstate fishery management plan for American eel: commercial yellow and glass/elver eel allocation and management. August 2018.

Addendum V was initiated in response to results of the 2017 stock assessment update and concerns that current management triggers do not account for annual fluctuations in landings. If a management trigger is exceeded immediate implementation of state-by-state quotas would pose significant administrative challenges. Addendum V increases the yellow eel coastwide cap beginning in 2019 to 916,473 pounds due to a correction in the historical harvest; adjusts the method (management trigger) to reduce total landings to the coastwide cap when the cap has been exceeded; and removes the implementation of state-by-state allocations if the management trigger is met. The addendum maintains Maine's glass eel quota of 9,688 pounds. Under Addendum V, management action is initiated if the yellow eel coastwide cap is exceeded by 10% or more in two consecutive years (10% of the coastwide cap = 91,647 pounds; coastwide cap + 10% = 1,008,120 pounds). If management is triggered, only those states accounting for more than 1% of the total yellow eel landings are responsible for adjusting their management measures.

While it is possible that American eels could eventually move into the Dahowa Project area in the future, the licensee has conducted sampling documenting that American eels do not currently exist in the vicinity of the Project.

National Park Service. 1993. The Nationwide Rivers Inventory. Department of the Interior, Washington, D.C. 1993.

The Nationwide Rivers Inventory (NRI) is a listing of more than 3,200 free-flowing river segments in the United States that are believed to possess one or more "outstandingly remarkable" natural or cultural values judged to be at least regionally significant. Hence, NRI river segments are potential candidates for inclusion in the National Wild and Scenic River System. Under the Wild and Scenic Rivers Act section 5(d)(1) and related guidance, all federal agencies must seek to avoid or mitigate actions that would adversely affect NRI river segments.

Although there are sections of the Battenkill River currently listed by the NRI as having "Outstandingly Remarkable Value", the Dahowa Project area is not currently included in those sections. The closest section included in the NRI stretches from Route 22 in New York to near Arlington Vermont for a total of 19 river miles.

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16.0 Appendices