LOW IMPACT HYDROPOWER INSTITUTE CERTIFICATION APPLICATION

WEYBRIDGE HYDROELECTRIC PROJECT
(FERC NO. 2731)

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LOW-IMPACT HYDROPOWER POWER INSTITUTE CERTIFICATION APPLICATION

WEYBRIDGE HYDROELECTRIC PROJECT
(FERC EXEMPTION NO. 2731)

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1.0 FACILITY DESCRIPTION

The Weybridge Hydroelectric Project, Federal Energy Regulatory Commission (FERC or Commission) No. 2731 (Project), is owned and operated by the Green Mountain Power Corporation (GMP), formerly Central Vermont Public Service Corporation (CVPS). The Project is located in the towns of Weybridge and New Haven, Vermont and is situated at the head of a rock-walled gorge where the Otter Creek cascades around a small island. Otter Creek, a tributary to Lake Champlain, is a navigable waterway of the United States to a point upstream from the Center Rutland Project (FERC Project No. 2445), located in Rutland County. The Center Rutland Project is located upstream of the Weybridge Project.

1.1 PROJECT DESCRIPTION

The Weybridge Project consists of a concrete gravity dam with an integral powerhouse, a 62-acre impoundment, transmission facilities, and appurtenant facilities. Project works consist of: (1) a 30-foot-high, 302.6-foot-long concrete gravity dam consisting of two spillway sections, a 150-foot-long west spillway section, topped with a 6-foot-high hinged steel flashboard, and abutted by a 20-foot-wide and 10-foot-high Taintor gate, and a 116-foot-long east spillway section topped with an automatically-inflated rubber weir; (2) a 1.5-mile-long, 62-acre impoundment with a normal water surface elevation of 174.3 feet above mean sea level (msl); (3) a powerhouse integral with the dam containing a single vertical Kaplan turbine generator with an installed capacity of 3.0 MW, and an intake containing steel trashracks with a 3-inch clear spacing; (4) a diversion wall at the south end of Rock Island to better apportion flows between the downstream east and west channels; (5) appropriate generator leads and transformers to connect the Project to the interconnected transmission/distribution system at the Project switchyard about 100 feet from the powerhouse; and (6) appurtenant facilities.

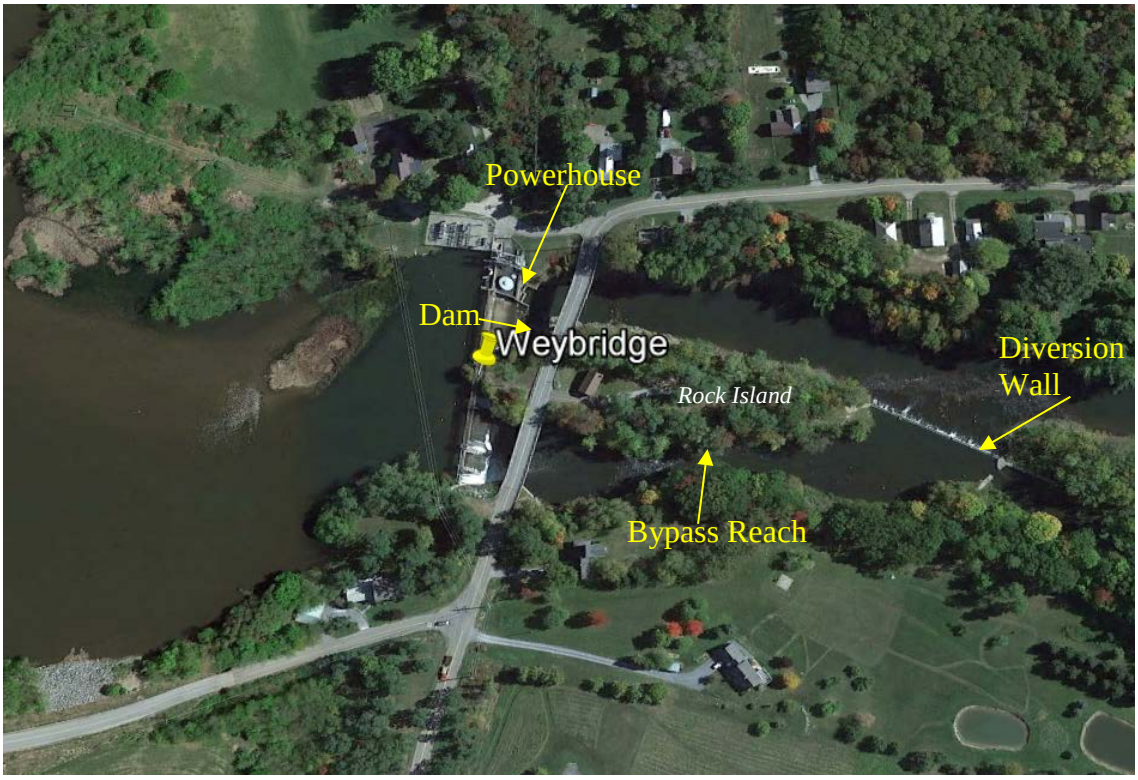

PHOTO 1 OVERVIEW OF PROJECT FEATURES

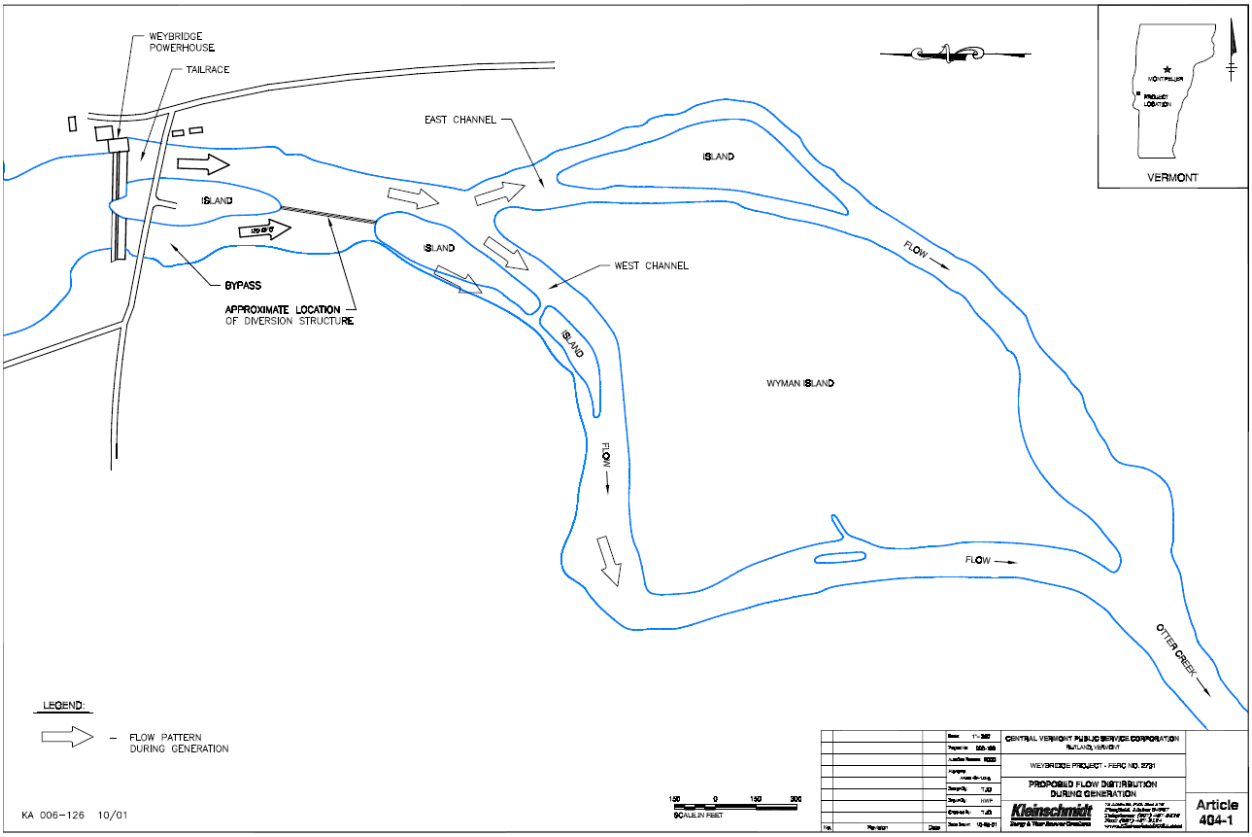

FIGURE 1 PROJECT LAYOUT

1.2 PROJECT OPERATIONS

Although the Weybridge Project is licensed to operate as a daily cycling facility during normal and low flow conditions where drawdowns are limited to 2 feet or less, GMP voluntarily operates in more of a run-of-river mode during these conditions. From April 1 – June 15 cycling is suspended and the Project is operated with a stable impoundment and in a true run-of-river mode. Run-of-river operations additionally occur when flows exceed the Project's hydraulic capacity of 1,600 cfs.

The Project provides a constant minimum flow of 125 cfs into the Project's bypassed reach for the protection and enhancement of water quality and aquatic resources. The minimum flow is released through the bypass gate located on the West spillway when the Project is generating. When the Project is not generating, a total conservation flow of 250 cfs is maintained using the West spillway gate release into the bypass. If notified by the Vermont Department of Environmental Conservation (Vermont DEC) that walleye have been introduced into this reach of the Otter Creek, GMP will raise the generating minimum flow to 250 cfs during April and May to accommodate for walleye spawning.

A diversion structure is located downstream of the Weybridge dam and situated between the downstream end of Rock Island and the upstream end of Wyman Island. The structure was constructed by the Licensee so to properly channel flows east and west around Wyman Island. GMP ensures a 125 cfs flow is met within the east channel and 100 cfs flow is met within the west channel.

1.3 REGULATORY AND COMPLIANCE HISTORY

On May 27, 1998, CVPS filed an application to the Federal Energy Regulatory Commission (FERC or Commission) for a subsequent license to continue to operate and maintain the Weybridge Hydroelectric Project[1]. Vermont Agency for Natural Resources (VANR) and the U.S. Fish and Wildlife Service (USFWS) issued comments and terms and conditions to the license. A Water Quality Certificate (WQC) from the Vermont DEC was issued for the Weybridge Project on May 7, 2001 (Appendix C) and all 17 WQC conditions were incorporated into the FERC license. The FERC license was issued on August 1, 2001 for a 30-year term[2].

Since issuance of the 2012 LIHI Certification for the Weybridge Project, the following notable actions have occurred as documented within FERC e-library:

- On July 28, 2012, CVPS and GMP filed a joint application to FERC for approval to transfer licenses for thirteen hydroelectric projects and one transmission line project from CVPS to GMP, including the Weybridge Project. On September 13, 2012, FERC issued an Order approving the transfer of the Weybridge Project license to GMP[3]. On November 9, 2012, GMP submitted its acknowledgement of acceptance of the Commission's September 13, 2012 Order[4].
- On December 31, 2013, GMP submitted the Annual HPMP Report for the Weybridge Project[5].
- On February 24, 2014, GMP submitted the bypass minimum flow verification study[6].
- On May 5, 2014, FERC acknowledged that the minimum flow verification study met the filing requirements set forth by the August 7, 2008 Order[7].
- On August 01, 2014, GMP submitted the Annual Weybridge HPMP Report for the Weybridge Project[8].
- On December 8, 2014, GMP filed the Dam Safety Inspection Report by New York Regional Office (NYRO) for the Weybridge Project for the period between May 15, 2012 to October 29, 2014. The dams, intake structure, powerhouse and downstream diversion structure were inspected.
- On April 1, 2015, GMP filed the Form 80 for the Weybridge Project[9].

[1] http://elibrary.ferc.gov/IDMWS/search/intermediate.asp?link_file=yes&doclist=1854619
[2] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=6006239
[3] http://elibrary.ferc.gov/IDMWS/common/OpenNat.asp?fileID=13064046
[4] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=13106693
[5] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=13385163
[6] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=13469087
[7] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=13536509
[8] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=13606881
[9] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=13826474

- On August 18, 2015, FERC filed the July 9, 2015 Environmental Inspection Report conducted to observe Weybridge Project recreational facilities, public safety signage and devices and compliance with the environmental license requirements. There were no items of non-compliance identified during the inspection.
- On September 18, 2015, GMP responded to the Environmental Inspection Report. GMP confirmed that they had regraded the Weybridge recreation area access road, repaired the Weybridge picnic tables and replaced tables that were identified as too warped[10].
- On July 29, 2016, GMP submitted the Annual Weybridge HPMP Report for the Weybridge Project[11].
- On August 1, 2017, GMP submitted the Annual Weybridge HPMP Report for the Weybridge Project[12].

[10] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=13990601
[11] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=14319721
[12] https://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=14650722

1.4 WEYBRIDGE FACILITY DESCRIPTION INFORMATION (LIHI CERTIFICATE #98)

TABLE 1 FACILITY DESCRIPTION INFORMATION

Information Type	*Variable Description*	*Response (and reference to further details)*
Name of the Facility	Facility name (FERC Project Name)	Weybridge Hydroelectric Project (FERC No. 2731) referred to as the Project throughout this application.
Location	River name (U.S. Geologic Survey (USGS) proper name)	Otter Creek
	River basin name	Lake Champlain-Richelieu Basin (See Appendix B)
	Nearest town, county, and state	Weybridge and New Haven, Addison County, Vermont
	River mile of dam above next major river	The Project is located at RM 19.5 on the Otter Creek.
	Geographic latitude	44.0665
	Geographic longitude	-73.2162
Facility Owner	Application contact names:	Jason Lisai – Green Mountain Power Corporation John Greenan – Green Mountain Power Corporation Andy Qua – Kleinschmidt Associates Katie Sellers – Kleinschmidt Associates Please see Section 4.0 for the Facility Contacts Form.
	Facility owner (individual and company names):	Green Mountain Power Corporation (GMP)
	Representative in LIHI certification	John Greenan, GMP
Regulatory Status	FERC Project Number and Issuance and expiration dates	Project No. 2731-020 Issued: 08/01/2001 Expires: 07/31/2031
	FERC license type or special classification (e.g., "qualified conduit")	Major
	Water Quality Certificate identifier and issuance date, plus source agency name	Issued by: Vermont Department of Environmental Conservation (Vermont DEC), Water Quality Division Issued on: May 7, 2001
	Hyperlinks to key electronic records on FERC e-library website (e.g., most recent Commission Orders, WQC, ESA documents, etc.)	• Order Issuing New License (08/01/2001) • Water Quality Certification (WQC) (08/01/2001): 2001 FERC License Appendix A, pages A-1 through A-7 & Appendix C. • Order Approving Dissolved Oxygen Monitoring Plan Under Article 406 (01/29/2002)

Information Type	*Variable Description*	*Response (and reference to further details)*
		• Final Environmental Assessment (11/01/2000) • Order Amending Minimum Flow Under Articles 401 and 401 License Amendment (August 7, 2008)
Power Plant Characteristics	Date of initial operation (past or future for operational applications)	The Hortonia Power Company originally constructed the hydroelectric generating station at Weybridge in 1922. The west timber crib dam was replaced by a concrete dam completed in 1944/1945. The Project later assumed its present day-form in 1950/1951, when the east timber crib dam was replaced by a concrete dam, the west dam crest was raised, and the second powerhouse was constructed. The original powerhouse constructed in 1922 has not been used since the 1951 powerhouse was constructed.
	Total name-plate capacity (MW)	3.0 MW
	Average annual generation (MWh)	13,846 MWH (5-year average (2011/2012 - 2015/2016))
	Number, type, and size of turbines, including maximum and minimum hydraulic capacity of each unit	Type: Single Vertical Shaft Kaplan Turbine Manufacturer: S. Morgan Smith Size of Turbine: 3.0 MW Maximum Hydraulic Capacity: 1600 cfs Minimum Hydraulic Capacity: 450 cfs Horsepower: 4900
	Modes of operation (run-of-river, peaking, pulsing, seasonal storage, etc.)	Daily cycling in normal and low flows;[13] Run-of-river in high flows
	Dates and types of major equipment upgrades	No major equipment upgrades have occurred at the Project.
	Dates, purpose, and type of any recent operational changes	No major operational changes have occurred at the Project.
	Plans, authorization, and regulatory activities for any facility upgrades	Due to deterioration of the wooden sluice gate, GMP received approval from the Vermont DEC for an emergency in-kind replacement with a steel sluice gate. Sluicegate replacement occurred at the end of October 2016.
Characteristics of Dam, Diversion, or Conduit	Date of construction	West dam built in: 1944-1945, then raised in 1950-1951 East dam built in: 1950-1951 Powerhouse built in: 1951

[13] Although licensed to operate as a daily cycling facility, GMP voluntarily operates in more of a run-of-river mode during normal and low flows.

Information Type	*Variable Description*	*Response (and reference to further details)*
		Additional Information available on Vermont Division for Historic Preservation Online Resource Center[14].
	Dam height	30 feet, concrete gravity
	Dam length	302.6 feet total length (Western spillway is 150-feet-long and Eastern spillway is 116-feet-long)
	Spillway elevation and hydraulic capacity	The crest of the dam is located at an elevation 168.3 feet NGVD while the flashboard systems raises the effective height of the dam crest to an elevation of 174.3 feet NGVD. Western spillway: 150-foot long spillway section, topped with a 6-foot high hinged steel flashboard, and abutted by a 20-foot wide and 10-foot high Taintor gate. Eastern spillway: 116-foot long east spillway section topped with an automatically-inflated rubber weir. The spillway's hydraulic capacity number is not readily available.
	Tailwater (downstream water surface) elevation	143.3 feet NGVD; A corresponding tailwater flow is not readily available and cannot be supplied at this time.
	Length and type of all penstocks and water conveyance structures between reservoir and powerhouse	No penstocks or water conveyance structures between the reservoir and the powerhouse. The Project contains a powerhouse that is integral with the dam.
	Dates and types of major, generation-related infrastructure improvements	No major generation-related infrastructure improvements have occurred at the Project.
	Designated facility purposes	The purpose of this facility is to generate power to be supplied to the local grid.
	Water source	Source: Head of Otter Creek, Peru, Vermont in Green Mountain National Forest Elevation: 2500 ft (762 m) 43.28024, -72.97545
	Water discharge location or facility	Water utilized by the Project discharges directly into the waters of Otter Creek.
	Gross volume	600 acre-feet of gross storage capacity; useable storage capacity of 115 acre-feet with a 2-foot drawdown.

[14] http://orc.vermont.gov/Documents/Weybridge_EnvironmentalReview_AD-95-0015_ApplicantSubmittal_00000144.pdf

Information Type	*Variable Description*	*Response (and reference to further details)*
Characteristics of Reservoir and Watershed	Surface area at full pool	62-acre impoundment at normal water surface elevation of 174.3 feet msl.
	Maximum water surface elevation (ft. MSL)	174.3 feet msl at full pond. Model output from a dam breach analysis conducted for the upstream Huntington Falls Dam indicates that the Weybridge impoundment level would be approximately 180 feet msl under the 100-year flood conditions with a river flow of 13,675 cfs.
	Maximum and minimum volume and water surface elevations for designated power pool, if available	The full pool elevation is 174.3 feet msl and the normal minimum operating elevation is 172.3 feet msl. The Project's 2-foot drawdown capacity creates a 51-acre reservoir with a useable storage capacity of about 115 acre-feet.
	Upstream dam(s) by name, ownership, FERC number (if applicable), and river mile	Upstream Dam: Huntington Falls Development (part of the Otter Creek Hydroelectric Project)[15] Ownership: Green Mountain Power Corporation FERC No. P-2558 River Mile (RM): 21.0 Four additional hydroelectric facilities operate upstream of the Huntington Falls Development: Center Rutland Project (FERC No. 2445) owned by GMP is located at RM 71; Proctor Development (part of the Otter Creek Hydroelectric Project (FERC No. 2558) owned by GMP is located at RM 64.2; Middlebury Lower Hydroelectric Project (FERC No. 2737) owned by GMP is located at RM 24.7; and Beldens Development (part of the Otter Creek Hydroelectric Project (FERC No.2558) owned by GMP is located at RM 23.0. Additionally, above these GMP facilities are the non-FERC Ripley Mills Dam at RM 72 and the Emerald Lake Dam located at RM 100. See Appendix B for a map of Otter Creek dam locations.
	Downstream dam(s) by name, ownership, FERC number (if applicable), and river mile	Downstream Dam Name: Vergennes Hydroelectric Project Ownership: Green Mountain Power Corporation FERC No. 2674 RM: 7.4 See Appendix B for a map of Otter Creek dam locations.
	Operating agreements with upstream or downstream reservoirs that affect water availability, if any, and facility operation	There are no operating agreements between the Project and surrounding projects.

[15] http://www.hydroreform.org/projects/otter-creek-p-2558

<table>
<tr><th>Information Type</th><th>Variable Description</th><th>Response (and reference to further details)</th></tr>
<tr><td></td><td>Area inside FERC project boundary, where appropriate</td><td>140 acres, approximately</td></tr>
<tr><td rowspan="4">Hydrologic Setting</td><td>Average annual flow at the dam</td><td>Average annual flow at the Weybridge Dam from 2007-2017 is 1,468 cfs.

Flow data for the Weybridge Project was prorated from UGSG Gage No. 04282500 – Otter Creek at Middlebury, VT and USGS Gage No. 04282525 – New Haven River at Brooksville, Near Middlebury, VT (both gages located upstream of the Project). The New Haven River enters Otter Creek between Middlebury, VT, and the Weybridge Project. The calculation was performed using the drainage areas at the Otter Creek gage (628 square miles (sq mi)), upstream of the confluence of the New Haven River with Otter Creek (636.1 sq mi), downstream of the confluence (752.5 sq mi), and at Weybridge Dam (755.8 sq mi) and using a precipitation factor of 0.8.

First, the river flow at the Otter Creek Gage was prorated to just upstream of the confluence of the New Haven River ((proration factor = 636.1/628)*0.8 = 1.01); the flow from the New Haven River gage was then added to this.

Next, the river flow calculated in the previous step was prorated from just downstream of the confluence of the New Haven River to Weybridge Dam ((proration factor = (755.8/752.5)*0.8 = 1.003). The result of this step is the river flow at the Weybridge Project.</td></tr>
<tr><td>Average monthly flows</td><td>Weybridge Dam Average Monthly Flows 2013-2017<table><tr><td>Jan. – 1,309 cfs</td><td>Feb. – 1,137 cfs</td><td>Mar. – 1,491 cfs</td><td>Apr. – 2,902 cfs</td></tr><tr><td>May. – 1,654 cfs</td><td>Jun. – 1,668 cfs</td><td>Jul. – 1,431 cfs</td><td>Aug. – 509 cfs</td></tr><tr><td>Sep. – 400 cfs</td><td>Oct. – 553 cfs</td><td>Nov. – 827 cfs</td><td>Dec. – 1,200 cfs</td></tr></table></td></tr>
<tr><td>Location and name of relevant stream gauging stations above and below the facility</td><td>Flow data for the Weybridge Project was prorated from UGSG Gage No. 04282500 – Otter Creek at Middlebury, VT and USGS Gage No. 040282525 – New Haven River at Brooksville, Near Middlebury, VT (both gages located upstream of the Project).</td></tr>
<tr><td>Watershed area at the dam</td><td>755.8 square miles</td></tr>
<tr><td></td><td>Number of zones of effect</td><td>Three (3) Zones</td></tr>
</table>

Information Type	*Variable Description*	*Response (and reference to further details)*
Designated Zones of Effect	Upstream and downstream locations by river miles	Zone 1 Impoundment: RM 21.0 (Huntington Falls Dam) to RM 19.5 (Weybridge Dam) Zone 2 Bypass Reach: RM 19.5 (Weybridge Dam) to RM 19.8 (downstream end of Rock Island) Zone 3 Downstream: RM 19.5 (downstream end of Weybridge powerhouse) to RM 7.4 (Vergennes Dam)
	Type of waterbody (river, impoundment, by-passed reach, etc.)	Zone 1: Impoundment Zone 2: Bypass Reach – Regulated waters around the western side of Rock Island. Zone 3: Downstream -Regulated riverine reach below the dam.
	Delimiting structures	Impoundment ZOE: Weybridge Dam to Huntington Falls Dam Bypass Reach ZOE: Weybridge Dam to downstream end of Rock Island Downstream ZOE: Weybridge Dam, around Wyman Island, down to Vergennes Dam.
	Designated uses by state water quality agency	Otter Creek is classified as Class B waters. Class B stream reaches are managed to achieve and maintain a high level of quality compatible with certain beneficial values and uses. Values are high quality habitat for aquatic biota, fish and wildlife and water quality that consistently exhibits good aesthetic value; uses are public water supply with filtration and disinfection, irrigation and other agricultural uses, swimming, and recreation.
Additional Contact Information	Names, addresses, phone numbers, and e-mail for local state and federal resource agencies	See Section 4.0 for the Project Contacts Form.
	Names, addresses, phone numbers, and e-mail for local non-governmental stakeholders	See Section 4.0 for the Project Contacts Form.
Photographs and Maps	Photographs of key features of the facility and each of the designated zones of effect	Please see Appendix A for photographs of key features of the facility and identification of each designated zone of effect (ZOE).

Information Type	*Variable Description*	*Response (and reference to further details)*
	Maps, aerial photos, and/or plan view diagrams of facility area and river basin	Please see Appendix B for figures depicting the facility area and river basin.

2.0 STANDARDS MATRICES

2.1 IMPOUNDMENT ZOE

Criterion		Alternative Standards				
		1	2	3	4	Plus
A.	**Ecological Flow Regimes**		X			
B.	**Water Quality**		X			
C.	**Upstream Fish Passage**	X				
D.	**Downstream Fish Passage**	X				
E.	**Watershed and Shoreline Protection**	X				
F.	**Threatened and Endangered Species Protection**		X			
G.	**Cultural and Historic Resources Protection**		X			
H.	**Recreational Resources**		X			

2.2 BYPASS REACH ZOE

Criterion		Alternative Standards				
		1	2	3	4	Plus
A.	**Ecological Flow Regimes**		X			
B.	**Water Quality**		X			
C.	**Upstream Fish Passage**	X				
D.	**Downstream Fish Passage**	X				
E.	**Watershed and Shoreline Protection**	X				
F.	**Threatened and Endangered Species Protection**		X			
G.	**Cultural and Historic Resources Protection**		X			
H.	**Recreational Resources**		X			

2.3 DOWNSTREAM ZOE

Criterion		Alternative Standards				
		1	2	3	4	Plus
A.	**Ecological Flow Regimes**		X			
B.	**Water Quality**		X			
C.	**Upstream Fish Passage**	X				
D.	**Downstream Fish Passage**	X				
E.	**Watershed and Shoreline Protection**	X				
F.	**Threatened and Endangered Species Protection**		X			
G.	**Cultural and Historic Resources Protection**		X			
H.	**Recreational Resources**		X			

3.0 SUPPORTING INFORMATION

3.1 ECOLOGICAL FLOWS STANDARDS: IMPOUNDMENT ZOE

Criterion	*Standard*	*Instructions*
A	2	Agency Recommendation: • Identify the proceeding and source, date, and specifics of the agency recommendation applied (NOTE: there may be more than one; identify and explain which is most environmentally stringent). • Explain the scientific or technical basis for the agency recommendation, including methods and data used. This is required regardless of whether the recommendation is or is not part of a Settlement Agreement. • Explain how the recommendation relates to agency management goals and objectives for fish and wildlife. • Explain how the recommendation provides fish and wildlife protection, mitigation and enhancement (including in-stream flows, ramping and peaking rate conditions, and seasonal and episodic instream flow variations).

- Per License Article 403 and WQC Conditions B and C, the Weybridge Project is operated as a daily cycling facility during normal and low flow conditions where drawdowns are limited to 2 feet or less[16]. From April 1 – June 15 or when flows exceed the Project's hydraulic capacity of 1,600 cfs, cycling is suspended and the Project is operated with a stable impoundment and in a true run-of-river mode. During the spring run-of-river period, the impoundment is maintained no more than three inches below the flashboard crest (three inches below 174.3 feet msl), unless the flashboard section needs to be manually tripped, in which case it is reset within 24 hours of the river stabilizing. During the remainder of the year the impoundment is not drawn down more than 2.0 feet below the flashboard crest, unless necessary for dam maintenance or operator safety, or due to a non-power emergency beyond the control of GMP. Recommendations included within License Article 403 and WQC Conditions B and C are derived from the Vermont DEC letter dated May 25, 1999[17] and the USFWS letter dated May 24, 1999[18].
- As detailed within the Vermont DEC May 25, 1999 commentary letter, Vermont DEC staff inspected the Project impoundment by canoe on October 22, 1998. The impoundment had been drawn down by 2 feet for the inspection. Areas with submerged or emergent aquatic vegetation with water depth less than one foot and in some cases only a few inches were observed. The species observed were those that tend to be more tolerant of water level fluctuations. At the upper end of the impoundment, drawdowns would affect the extent of backwatering the riverine reach below the Huntington Falls dam, and therefore the habitat conditions. Vermont DEC evaluation of the impoundment

[16] Although licensed to operate as a daily cycling facility, GMP voluntarily operates in more of a run-of-river mode during normal and low flows.
[17] http://elibrary.ferc.gov:0/idmws/file_list.asp?document_id=1950223
[18] http://elibrary.ferc.gov:0/idmws/file_list.asp?document_id=1953093

concluded that drawdowns in excess of two feet will affect plant communities and aquatic organisms that may utilize them.

- As stated within the Vermont DEC May 25, 1999 commentary letter, Vermont DEC's overriding management objective for the Otter Creek under Vermont Water Quality Standards is the provision of high quality aquatic habitat in the waters affected by the Project.
- By limiting impoundment drawdowns to 2 feet during normal operations, wetlands and other shoreline aquatic resources are still provided within healthy river flows. Additionally, eliminating reservoir drawdowns between April 1 – June 15 enhances fish spawning opportunities in the impoundment area.
- Project operations data was provided to Vermont DEC on June 5, 2018 for verification of Project run-of-river and Water Quality Certificate compliance (see Appendix C for email exchange).

3.2 ECOLOGICAL FLOWS STANDARDS: BYPASS REACH ZOE

Criterion	*Standard*	*Instructions*
A	2	Agency Recommendation (see Appendix A for definitions): • Identify the proceeding and source, date, and specifics of the agency recommendation applied (NOTE: there may be more than one; identify and explain which is most environmentally stringent). • Explain the scientific or technical basis for the agency recommendation, including methods and data used. This is required regardless of whether the recommendation is or is not part of a Settlement Agreement. • Explain how the recommendation relates to agency management goals and objectives for fish and wildlife. • Explain how the recommendation provides fish and wildlife protection, mitigation and enhancement (including in-stream flows, ramping and peaking rate conditions, and seasonal and episodic instream flow variations).

- In accordance with License Article 401 and WQC Condition B, a continuous minimum flow of 125 cfs is released into the Bypass Reach ZOE through the bypass gate located on the West spillway when the Project is generating. When the Project is not generating, a total conservation flow of 250 cfs is released into the Bypass Reach ZOE with the use of the West spillway gate. If notified by the Vermont DEC that walleye have been introduced into this reach of the Otter Creek, GMP, in accordance with License Article 401, will raise the minimum flow (when generating) to 250 cfs during April and May to accommodate for walleye spawning. Recommendations included within License Article 403 and WQC Conditions B and C are derived from the Vermont DEC letter dated May 25, 1999[19] and the USFWS letter dated May 24, 1999.[20]
- As detailed within the Vermont DEC May 25, 1999 commentary letter, an instream flow study was used to determine the habitat/flow relationship at a number of the locations downstream of the Weybridge dam including the bypass reach. Within the bypass reach, habitat for walleye spawning and incubation peaked at about 300 cfs and decreased at higher flows. A flow of 250 cfs provided nearly the same amount of habitat at 450 cfs. Habitat for adult rainbow trout was maximized at 175 cfs, but the habitat/flow curve was relatively flat from 125-250 cfs. It was determined within the study and by agencies that a release of 250 cfs, or inflow, if less, when the Project is not generating and 125 cfs during generation would provide acceptable habitat conditions in the bypass reach.
- As stated within the Vermont DEC May 25, 1999 commentary letter, the management objective for the riverine reaches downstream of the dam is to provide aquatic habitat conditions that support a diversity of species including fish, mussels and invertebrates, and their life cycle requirements, similar to that which would exist without the Project.
- Providing flows within the bypass reach allow for refugia and enhancement of habitat for local riverine species including rainbow trout.

[19] http://elibrary.ferc.gov:0/idmws/file_list.asp?document_id=1950223
[20] http://elibrary.ferc.gov:0/idmws/file_list.asp?document_id=1953093

- Project operations data was provided to Vermont DEC on June 5, 2018 for verification of Project run-of-river and Water Quality Certificate compliance (see Appendix C for email exchange).

3.3 ECOLOGICAL FLOWS STANDARDS: DOWNSTREAM ZOE

Criterion	*Standard*	*Instructions*
A	2	Agency Recommendation (see Appendix A for definitions): • Identify the proceeding and source, date, and specifics of the agency recommendation applied (NOTE: there may be more than one; identify and explain which is most environmentally stringent). • Explain the scientific or technical basis for the agency recommendation, including methods and data used. This is required regardless of whether the recommendation is or is not part of a Settlement Agreement. • Explain how the recommendation relates to agency management goals and objectives for fish and wildlife. • Explain how the recommendation provides fish and wildlife protection, mitigation and enhancement (including in-stream flows, ramping and peaking rate conditions, and seasonal and episodic instream flow variations).

- In accordance with License Article 403, Weybridge has imposed peaking constraints, which under normal operations are no greater than 4.5:1 ratio between maximum and minimum flow in a 24-hour period. All reservoir drawdowns are limited between April 1 and June 15 to enhance fish spawning opportunities, and all 4 foot drawdowns are eliminated between October 15 and April 1. Reservoir drawdowns of 2 feet or less are restricted to enhance wetland development and protect other shoreline aquatic resources; and existing down ramping and up ramping procedures are maintained to 250 cfs when reducing flows or increasing flows. As detailed in Condition G of the WQC, following approval for maintenance drawdowns and assuming refills cannot otherwise be reasonably accomplished, up to 10% of instantaneous project inflow may be placed in storage in order to refill the impoundment without significantly reducing downstream flows.
- Additionally, immediately downstream from the Project dam are Rock Island and Wyman Island that partition river flows. As required under License Article 402 and WQC Condition D, a flow diversion structure has been constructed below the Project and extends from the downstream end of Rock Island to the next small island located at the entrance to the West Channel around Wyman Island. The diversion structure was built so to properly reapportion flows from the bypassed (west) and tailrace (east) channels. The diversion structure includes a control weir with stop log slots at the diversion structure's downstream end. A 15 foot wide by 3.5 foot high notch in the control weir passes water from the pool formed by the control weir and the diversion structure downstream into the west channel around Wyman Island[21]. As incorporated within License Article 401 and amended within the August 7, 2008 FERC Order Amending Minimum Flow Under Articles 401 and 402, the Weybridge Project maintains a minimum flow of 100 cfs in the West Channel around Wyman Island and 125 cfs in the East Channel around Wyman Island. Recommendations included within License Articles 401, 402 and WQC

[21] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=11770877

Condition D are derived from the Vermont DEC letter dated May 25, 1999[22] and the USFWS letter dated May 24, 1999.[23]

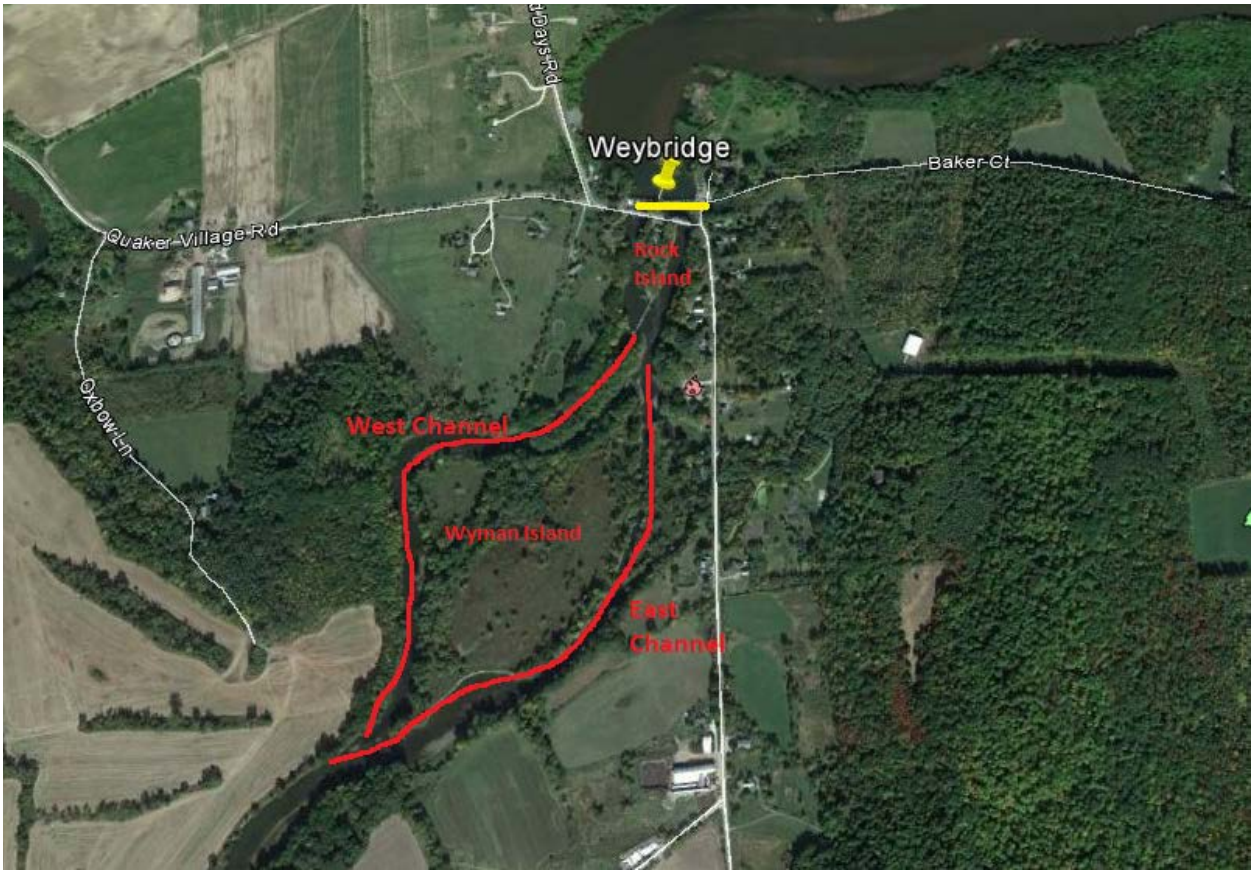

PHOTO 2 DOWNSTREAM RIVER FLOWS

- The Licensee worked with resource agencies and others to develop and design, test, permit and construct a diversion structure at the entrance to the Wyman Island West Channel. The reason for the diversion came about as channel configurations before its implementation offered very little or no water flows into the Wyman Island West Channel to continuously support aquatic habitat. A 1997 Instream Flow Incremental Methodology (IFIM) study showed that there was a considerable amount of potential aquatic habitat in this reach.

  The 1997 study[24] showed that no flow entered the Wyman Island West Channel until total inflow exceeded 200 cfs. Even at higher flows, a relatively small portion of the total inflow entered the West Channel. Based on the flow study conducted by the licensee, flow partitioning between the channels found that the majority of water went into the Wyman Island East Channel. Based on this study, it was determined that a diversion structure between Rock Island and Wyman Island would properly apportion flows downstream of the Project.

[22] http://elibrary.ferc.gov:0/idmws/file_list.asp?document_id=1950223
[23] http://elibrary.ferc.gov:0/idmws/file_list.asp?document_id=1953093
[24] http://elibrary.ferc.gov:0/idmws/file_list.asp?document_id=1950223

The diversion structure was completed in August of 2002 to maintain the necessary flow in the downstream area during both generation and non-generation periods. After initial calibration work in 2002, and subsequent calibration work and site meetings held in 2004, resource agencies and the Licensee agreed that the diversion structure was working as intended, but due to channel hydraulics below the Project, it was only providing 80% of the required minimum flow into the Wyman Island West Channel. Meeting participants agreed that the flow in the West Channel, though not the amount originally intended, was suitable for fishery habitat and acceptable to all parties for potential inclusion within the Project License at the end of a 5-year monitoring period. Accordingly, the February 1, 2005 FERC Order[25], outlined and approved the agreement reached at the meeting. Paragraph B of the Order required the Licensee to perform annual calibration and flow verification measurements of the diversion structure for the first five years of operation, and annually file with the Commission in 2006, 2007, and 2008, the results of the latter three years of its annual calibration measurements. Provided that the 2004 flow conditions in the river channels downstream from the Project dam have continued, Paragraph C of the February 1, 2005 Order required that at the end of the initial five years of diversion structure operation, the Licensee file for Commission approval a request to amend License Article 402. The Amendment request would reflect the lesser minimum flows agreed upon with resource agencies.

As discussed in a letter filed with FERC on July 29, 2008[26], the Licensee visually monitored the diversion structure throughout 2007, and monitoring indicated that the structure was operating as intended with flow levels and splits around Wyman Island during non-generation times remaining unchanged. This was confirmed by field measurements taken in September 2007. In the 2008 letter the Licensee formally requested that License Article 402 for the Weybridge Project be modified to reflect a new flow target of 100 cfs and that downstream flow monitoring proceed at five year intervals through the life of the license[27]. FERC approved the request and amended the Project License in the August 27, 2008 Order.[28]

In 2013, GMP contracted with Multiple Resource Management, Inc. (MRM) to conduct a flow verification study in the Wyman Island West Channel. Field measurements were taken on October 16, 2013. Discharge measured at USGS Gage 04282500 on the Otter Creek at Middlebury, VT was approximately 340 cfs. Flow measured in the West Channel was calculated to be 95.4 cfs. Results were found to be slightly lower than the 100 cfs target.

On May 5, 2014, a Bypass Minimum Flow Report pursuant to Paragraph B of the August 2008 Order was filed with FERC[29]. Per letter dated May 5, 2014[30] FERC acknowledged that the Bypass Minimum Flow Report met the requirements of the August 2008 Order and did not request additional information. The next Bypass Minimum Flow Report is due April 30, 2019.

- As stated within the Vermont DEC May 25, 1999 commentary letter, the management objective for the riverine reaches downstream of the dam is to provide aquatic habitat

[25] http://elibrary.ferc.gov:1/idmws/file_list.asp?document_id=4272493
[26] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=11762225
[27] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=11306449
[28] Order Amending Minimum Flow Under Articles 401 and 401 License Amendment (August 7, 2008)
[29] http://elibrary.ferc.gov:1/idmws/file_list.asp?document_id=14189118
[30] http://elibrary.ferc.gov:1/idmws/file_list.asp?document_id=14212762

conditions that support a diversity of species including fish, mussels and invertebrates, and their life cycle requirements, similar to that which would exist without the Project.

- Providing flows within the downstream reach allow for refugia and enhancement of habitat for local riverine species including rainbow trout.
- Project operations data was provided to Vermont DEC on June 5, 2018 for verification of Project run-of-river and Water Quality Certificate compliance (see Appendix C for email exchange).

3.4 WATER QUALITY STANDARDS: IMPOUNDMENT & BYPASS REACH ZOE

CRITERION	STANDARD	INSTRUCTIONS
B	2	Agency Recommendation: • If facility is located on a Water Quality Limited river reach, provide an agency letter stating that the facility is not a cause of such limitation. • Provide a copy of the most recent Water Quality Certificate, including the date of issuance. • Identify any other agency recommendations related to water quality and explain their scientific or technical basis. • Describe all compliance activities related to the water quality related agency recommendations for the facility, including on-going monitoring, and how those are integrated into facility operations.

- Otter Creek, in general, has been designated by the Vermont Water Resources Board as Class B waters. The Water Resources Board has also designated the reach from the upstream Proctor wastewater plant outfall to the river's mouth as warmwater fish habitat. Class B stream reaches are managed to achieve and maintain a high level of quality compatible with certain beneficial values and uses.[31] Values are high quality habitat for aquatic biota, fish and wildlife and water quality that consistently exhibits good aesthetic value; uses are public water supply with filtration and disinfection, irrigation and other agricultural uses, swimming, and recreation.

  On September 7, 2016, the Vermont DEC issued, under Section 303(d) of the Federal Clean Water Act, a list[32] of waters considered to be impaired based on water quality monitoring efforts. Otter Creek was listed as "impaired" with specific portions of Otter Creek having different pollutants:

  - Lower Otter Creek, Below Vergennes Waste Water Treatment Facility for e. Coli (downstream of Project);
  - Otter Creek in vicinity of Rutland Waste Water Treatment Facility for e. Coli (upstream of Project);
  - Little Otter Creek RM 15.4 to RM 16.4 for Agricultural nutrients and sediments (downstream of Project);
  - Lake Champlain (Ferrisburg) for elevated levels of PCBs in Lake Trout (downstream of Project).

  In an email dated January 27, 2017, the Vermont DEC concurred that Project operations continue to not be a contributing cause to impairment in the river (Appendix C). Project operations data was additionally provided to Vermont DEC on June 5, 2018 for verification of Project Water Quality Certificate compliance (see Appendix C for email exchange).

[31] http://dec.vermont.gov/sites/dec/files/documents/WSMD_WaterQualityStandards_2014.pdf
[32] http://dec.vermont.gov/sites/dec/files/documents/WSMD_mapp_303d_Part_A_2016_final_complete.pdf

- The May 7, 2001 Project WQC is included in Appendix C.

3.5 WATER QUALITY STANDARDS: DOWNSTREAM ZOE

Criterion	*Standard*	*Instructions*
B	2	Agency Recommendation: • If facility is located on a Water Quality Limited river reach, provide an agency letter stating that the facility is not a cause of such limitation. • Provide a copy of the most recent Water Quality Certificate, including the date of issuance. • Identify any other agency recommendations related to water quality and explain their scientific or technical basis. • Describe all compliance activities related to the water quality related agency recommendations for the facility, including on-going monitoring, and how those are integrated into facility operations.

- Otter Creek has been designated by the Vermont Water Resources Board as Class B waters. The Water Resources Board has also designated the reach from the upstream Proctor wastewater plant outfall to the river's mouth as warm water fish habitat. Class B stream reaches are managed to achieve and maintain a high level of quality compatible with certain beneficial values and uses[33]. Values are high quality habitat for aquatic biota, fish and wildlife and water quality that consistently exhibits good aesthetic value; uses are public water supply with filtration and disinfection, irrigation and other agricultural uses, swimming, and recreation.

  On September 7, 2016, the Vermont DEC issued, under Section 303(d) of the Federal Clean Water Act, a list[34] of waters considered to be impaired based on water quality monitoring efforts. Otter Creek was listed as "impaired" with specific portions of Otter Creek having different pollutants:

  - Lower Otter Creek, Below Vergennes Waste Water Treatment Facility for e. Coli (downstream of Project);
  - Otter Creek in vicinity of Rutland Waste Water Treatment Facility for e. Coli (upstream of Project);
  - Little Otter Creek RM 15.4 to RM 16.4 for Agricultural nutrients and sediments (downstream of Project);
  - Lake Champlain (Ferrisburg) for elevated levels of PCBs in Lake Trout (downstream of Project).

  In an email dated January 27, 2017, the Vermont DEC concurred that Project operations continue to not be a contributing cause to impairment in the river (Appendix C). Project operations data was additionally provided to Vermont DEC on June 5, 2018 for verification of Project Water Quality Certificate compliance (see Appendix C for email exchange).

- The May 7, 2001 Project WQC is included in Appendix C.

[33] http://dec.vermont.gov/sites/dec/files/documents/WSMD_WaterQualityStandards_2014.pdf
[34] http://dec.vermont.gov/sites/dec/files/documents/WSMD_mapp_303d_Part_A_2016_final_complete.pdf

- Per 2001 WQC Condition I and License Article 406, GMP is to file for Commission approval, a plan to conduct dissolved oxygen (DO) monitoring in the Weybridge Project tailrace during the months of July, August, and September, whenever Project shutdowns exceed two consecutive days, with the requirement to release flows to the tailrace to maintain state water quality standards, if the monitoring indicates a violation of state standards. The plan must outline a two-year sampling protocol with the objective of identifying when and under what river and operational conditions reduced DO levels occur in the tailrace, and what level of "freshening" flows are required to maintain state standards.

  As analyzed by the Vermont DEC within the 2001 WQC text, there are protracted periods during which the Project is shut down and no releases, except unquantified leakage, are made into the tailrace reach. The lack of flows in this reach may result in substandard conditions of low DO and high temperatures in the tailrace pool. The WQC was therefore conditioned to require monitoring of the tailrace to determine if special operations measures are necessary to assure there are no violations of water quality standards.

  On December 6, 2001, CVPS filed a Dissolved Oxygen Monitoring Plan under Article 406 of the license. On January 29, 2002, FERC approved the DO Monitoring Plan.[35] In March 2003, CVPS submitted its DO Monitoring report, and concurred with agencies that data collected in 2001 and 2002 showed that DO standards were being met in the project tailrace and no additional monitoring was necessary.[36] CVPS requested to discontinue filing the DO monitoring reports. On April 17, 2003, FERC approved the request to discontinue DO monitoring.[37]

[35] https://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=6000941
[36] https://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=10509636
[37] https://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=9680460

3.6 UPSTREAM FISH PASSAGE STANDARDS: ALL ZOE

No natural populations of anadromous or catadromous fish presently occur within the Project's reaches of the Otter Creek. The VANR manages the section of Otter Creek that extends from the Weybridge Project upstream to the Huntington Falls dam primarily as a warmwater fishery. The reach below the Project is managed as a mixed warmwater and coolwater fishery. The principle gamefish species found in the Project impoundment are northern pike and smallmouth bass; other gamefish that are present include largemouth bass, brown trout and rainbow trout[38]. Other species that occur upstream of the Project include rock bass, bluegill, pumpkin seed, yellow perch, brown bullhead, white sucker, and fall fish. Fish species found downstream are similar to those occurring upstream, with the exception of mirror carp, which is only found downstream of the Weybridge dam.

VANR stocks Atlantic salmon and Walleye downstream of the Vergennes Project, the most downstream facility on Otter Creek. Walleye is a non-native species specifically stocked for recreational angling (USGS 2015).

Criterion	***Standard***	***Instructions***
C	1	Not Applicable/De Minimis Effect: • The facility does not create a barrier to upstream passage, or • There are no migratory fish in the vicinity of the facility and the facility is nor the cause of extirpation of such species if they had been present historically

- There is no federal mandatory prescription for the passage of riverine fish upstream of Weybridge dam for ALL Zones of Effect, however License Article 405 reserves future FERC authority to order such fishways as prescribed by the Secretary of Interior.
- Historically, migratory fish from Lake Champlain ascended many of its tributaries to access spawning waters. Atlantic salmon are naturally occurring potamodromous species that historically existed within the Lake Champlain Basin. Natural populations of Atlantic salmon were extirpated from Lake Champlain Basin approximately 150 years ago (USFWS 2015). Today landlocked Atlantic salmon are stocked in the lower Otter Creek below the downstream Vergennes Project by the VANR and USFWS.

  Lake sturgeon in Vermont are classified as an endangered species and the extent to which lake sturgeon enter Otter Creek from Lake Champlain and occur below the downstream Vergennes Project (FERC No. 2674) is unclear, though, the Otter Creek is classified as a historic spawning area for the species (FERC 1998; Fisheries Technical Committee 2009).

[38] https://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=8033634

- To meet the goals of the bistate plan for the development of the Lake's salmonid fishery (a Strategic Plan for Development of Salmonid Fisheries in Lake Champlain, NYS Department of Environmental Conservation, October 4, 1977), upstream and downstream passage provisions are being sought at dams on certain Lake tributaries. In Vermont, the Winooski River and the Lamoille River are included in this effort; however, this initiative has not been extended to Otter Creek as the other tributaries present a better opportunity for cold water fish spawning.

3.7 DOWNSTREAM FISH PASSAGE AND PROTECTION STANDARDS: ALL ZOE

No natural populations of anadromous or catadromous fish presently occur within the Project's reaches of the Otter Creek. The VANR manages the section of Otter Creek that extends from the Weybridge Project upstream to the Huntington Falls dam primarily as a warmwater fishery. The reach below the Project is managed as a mixed warmwater and coolwater fishery. The principle gamefish species found in the Project impoundment are northern pike and smallmouth bass; other gamefish that are present include largemouth bass, brown trout and rainbow trout[39]. Other species that occur upstream of the Project include rock bass, bluegill, pumpkin seed, yellow perch, brown bullhead, white sucker, and fall fish. Fish species found downstream are similar to those occurring upstream, with the exception of mirror carp, which is only found downstream of the Weybridge dam.

VANR stocks Atlantic salmon and Walleye downstream of the Vergennes Project, the most downstream facility on Otter Creek. Walleye is a non-native species specifically stocked for recreational angling (USGS 2015).

Criterion	***Standard***	***Instructions***
D	1	Not Applicable / De Minimis Effect: • Explain why the facility does not impose a barrier to downstream fish passage in the designated zone, considering both physical obstruction and increased mortality relative to natural downstream movement (e.g., entrainment into hydropower turbines). • For riverine fish populations that are known to move downstream, explain why the facility does not contribute adversely to the sustainability of these populations or to their access to habitat necessary for successful completion of their life cycles. • Document available fish distribution data and the lack of migratory fish species in the vicinity. • If migratory fish species have been extirpated from the area, explain why the facility is or was not the cause of this.

- There are no migratory species in Otter Creek above the most downstream dam (Vergennes Project) and agencies have no active plans to introduce such species. License Article 405 reserves future FERC authority to order fishways as prescribed by the Secretary of Interior. No downstream passage requirements have been identified for migratory or riverine species at this time, therefore, the facility does not impose a barrier to downstream fish passage in any Zones of Effect.
- Existing riverine species appear to be abundant upstream and downstream of the Project.

[39] https://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=8033634

Downstream dispersal is facilitated by the Project spillway, Taintor gate, or turbine passage. Dispersal is also allowed over the downstream diversion structure and through the flow control weir. WQC Condition J requires that the Licensee consult the Vermont Department of Fish and Wildlife prior to replacement of Project trashracks. Such consultation will aid in the prevention of fish entrainment at the trashracks.

- The VANR manages the section of Otter Creek that extends from the Weybridge Project upstream to the Huntington Falls dam primarily as a warmwater fishery. The reach below the Project is managed as a mixed warmwater and coolwater fishery. The principle gamefish species found in the Project impoundment are northern pike and smallmouth bass; other gamefish that are present include largemouth bass, brown trout and rainbow trout. Other species that occur upstream of the Project include rock bass, bluegill, pumpkin seed, yellow perch, brown bullhead, white sucker, and fall fish. Fish species found downstream are similar to those occurring upstream, with the exception of mirror carp, which is only found downstream of the Weybridge dam.

  As recently depicted in the 2013 FERC Environmental Assessment for the upstream Otter Creek Project (FERC No. 2558), approximately 25 fish species are known to occur in the Otter Creek[40]. Table 2 lists the fish species known to occur within the Otter Creek watershed.

TABLE 2 FISH SPECIES KNOWN TO OCCUR IN THE OTTER CREEK WATERSHED

COMMON NAME	SCIENTIFIC NAME
Banded killifish	*Fundulus diaphanus*
Bluegill	*Lepomis macrochirus*
Bluntnosed minnow	*Pimephales notatus*
Brook trout	*Salvelinus fontinalis*
Brown trout	*Salmo trutta*
Brown bullhead	*Ameiurus nebulosus*
Burbot	*Lota*
Common shiner	*Luxilus cornutus*
Creek chub	*Semotilus atromaculatus*
Cutlips minnow	*Exoglossum maxillingua*
Fallfish	*Semotilus corporalis*
Golden shiner	*Notemigonus crysoleucas*
Largemouth bass	*Micropterus salmoides*
Longnosed dace	*Rhinichthys cataractae*
Northern pike	*Exos lucius*
Pumpkinseed	*Lepomis gibbosus*

[40] https://elibrary-backup.ferc.gov/idmws/common/opennat.asp?fileID=13315251

COMMON NAME	SCIENTIFIC NAME
Rock bass	*Ambloplites rupestris*
Slimy sculpin	*Cottus asper*
Smallmouth bass	*Micrpterus dolomieu*
Spottail shiner	*Notropis hudsonius*
Tesselated darter	*Etheostoma olmstedi*
Yellow perch	*Perca flavescens*
White sucker	*Catostomus commersoni*
Carp	*Cyprinus carpio*
Rainbow trout	*Oncorhynchus mykiss*

- Historically, migratory fish from Lake Champlain ascended many of its tributaries to access spawning waters. Atlantic salmon are naturally occurring potamodromous species that historically existed within the Lake Champlain Basin. Natural populations of Atlantic salmon were extirpated from Lake Champlain Basin approximately 150 years ago (USFWS 2015). Today landlocked Atlantic salmon are stocked in the lower Otter Creek below the downstream Vergennes Project by the VANR and USFWS.
- Lake sturgeon in Vermont are classified as an endangered species and the extent to which lake sturgeon enter Otter Creek from Lake Champlain and occur below the downstream Vergennes Project (FERC No. 2674) is unclear, though, the Otter Creek is classified as a historic spawning area for the species (FERC 1998; Fisheries Technical Committee 2009).
- To meet the goals of the bistate plan for the development of the Lake's salmonid fishery (a Strategic Plan for Development of Salmonid Fisheries in Lake Champlain, NYS Department of Environmental Conservation, October 4, 1977), upstream and downstream passage provisions were being sought at dams on certain Lake tributaries. In Vermont, the Winooski River and the Lamoille River are included in this effort; however, this initiative has not been extended to Otter Creek as the other tributaries present a better opportunity for cold water fish spawning.

3.8 SHORELINE AND WATERSHED PROTECTION STANDARDS: ALL ZOE

Criterion	*Standard*	*Instructions*
E	1	Not Applicable / De Minimis Effect: • If there are no lands with significant ecological value associated with the facility, document and justify this (e.g., describe the land use and land cover within the project boundary). • Document that there have been no Shoreline Management Plans or similar protection requirements for the facility.

- No Shoreline Management Plan, buffer zone or enhancement fund is required for the Weybridge Project.
- Shoreline erosion is common for valley-bottom rivers like Otter Creek as they change their channel form through meander processes that erode the alluvial floodplain soils.[41] An erosion study was completed by Knight Consulting Services in 1997, including both the Project impoundment and the downstream reaches to the Lemon Fair River in Vermont. For the downstream reach, the observer concluded that, although there are some banks experiencing severe erosion, Project operation is not a significant influence. In reaching that conclusion, the observer noted that peaking to total plant capacity (1,600 cfs) rarely occurs. The observer concluded that the impoundment shoreline erosion was relatively minor compared to downstream erosion and that the predominant factors are related to natural high flows and perhaps ice action, but not operational cycling of the impoundment. [42]
- The Impoundment ZOE shoreline is primarily bordered by forested upland areas and pasture/hay areas. Closer to the dam, the shoreline is more open with low intensity housing nearby. Throughout the Downstream ZOE, the shoreline primarily contains pasture/hay and crop lands and high intensity development near the town of Vergennes. Land cover units, with non-significant ecological value, identified in the vicinity of the Project can be found in Table 3 (based on National Land Cover Database 2011: http://www.mrlc.gov/nlcd11_leg.php).

[41] https://outside.vermont.gov/agency/ANR/HydroCompliance/Shared%20Documents/Weybridge401.pdf
[42] *Weybridge Project – Application for New License from Major Project (5 MW or Less),* May 1998, vol. III, Appendix B, Erosion Study Report, October 30, 1997.

TABLE 3 PROJECT LAND COVER CLASSIFICATION

CLASS/VALUE	CLASSIFICATION DESCRIPTION
11	Open Water- areas of open water, generally with less than 25% cover of vegetation or soil.
21	Developed, Open Space- areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.
22	Developed, Low Intensity- areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units.
23	Developed, Medium Intensity -areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.
24	Developed High Intensity-highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover.
41	Deciduous Forest- areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change.
42	Evergreen Forest- areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.
43	Mixed Forest- areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover.
52	Shrub/Scrub- areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.
81	Pasture/Hay -areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation.
82	Cultivated Crops -areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled.
90	Woody Wetlands- areas where forest or shrubland vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

CLASS/VALUE	CLASSIFICATION DESCRIPTION
95	Emergent Herbaceous Wetlands- Areas where perennial herbaceous vegetation accounts for greater than 80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

3.9 THREATENED AND ENDANGERED SPECIES STANDARDS: IMPOUNDMENT ZOE

Criterion	*Standard*	*Instructions*
F	2	Finding of No Negative Effects: • Identify all listed species in the facility area based on current data from the appropriate state and federal natural resource management agencies. • Provide documentation of a finding of no negative effect of the facility on any listed species in the area from an appropriate natural resource management agency.

- A U.S. Fish and Wildlife Service Information for Planning and Conservation (IPaC) Trust Resources report was generated on January 17, 2017 for the Weybridge Project area and impoundment ZOE (Appendix D). The IPaC report identified one federally endangered bat species, the Indiana Bat (*Myotis sodalist),* and one federally threatened species, the Northern Long-eared Bat *(Myotis septentrionalis)* that may occur within the Project area. Both bat species are additionally listed as endangered with the Vermont Fish & Wildlife Department Natural Heritage Inventory, which is a species list covering state-threatened or state-endangered animals in Vermont according to Vermont's Endangered Species Law (10 V.S.A. Chap. 123).[43] Given no critical habitat has been identified in the area and the transient nature of the identified species, continued Weybridge facility operations are not expected to impact these species.

  The October 17, 2016 IPAC Report additionally identified 14 migratory birds that may occur within the Project area. All of the bird species listed are considered birds of federal "conservation concern." The following bird species may be found within the Project area: American Bittern (*Botaurus lentiginosus*), Bald Eagle (*Haliaeetus leucocephalus*), Black Tern (*Chlidonias niger*), Black-billed Cuckoo (*Coccyzus erythropthalmus*), Black-crowned Night-heron (*Nycticorax nycticorax*), Canada Warbler (*Wilsonia Canadensis*), Common Tern (*Sterna hirundo*), Olive-sided Flycatcher (*Contopus cooperi*), Peregrine Falcon (*Falco peregrinus*), Pied-billed Grebe (*Podilymbus podiceps*), Prairie Warbler (*Dendroica discolor*), Short-eared Owl (*Asio flammeus*), Willow Flycatcher (*Empidonax traillii*), and Wood Thrush (*Hylocichla mustelina*). The only year-round bird found in the Project area is the Bald Eagle. All of the other 13 species are found exclusively during breeding season.

  As identified under the Vermont Endangered Species Law (10 V.S.A. Section 5401 and 5403) the following state endangered and threatened migratory bird species may occur within the Project area:

  - Osprey (*Pandion haliaetus),* a state-threatened species, are known to use this reach of the river on a transitory basis, but no known nesting attempts exist.
  - Bald Eagle (*Haliaeetus leucocephalus*), a state-endangered species, may also be found within the Project area.

- A February 15, 2017 email from VANR additionally identified the hybrid thread-leaved pondweed (*Stuckenia x fennica*) and the Riverweed (*Podostemum ceratophyllum*) to be

[43] http://www.vtfishandwildlife.com/common/pages/DisplayFile.aspx?itemId=268519

two state-listed rare species that may occur upstream of the Weybridge dam (Appendix D). Per VANR email dated May 30, 2017, it was identified that continued Project operations will not have a negative impact on rare plants (Appendix D). Within the February 15, 2017 email, the VANR also identified two other species that occur immediately upstream of the Middlebury dam and are likely to also occur between that structure and the Weybridge dam: fluted-shell *(Lasmigona costata)* and the Creek heelsplitter *(Lasmigona compressa)*, state threatened and rare species, respectively.

- The USFWS drafted a Recovery Plan in 2007 for the Indiana Bat[44] and the Vermont Fish and Wildlife published an October 2010 recovery plan for the bald eagle[45].
- Per Vermont DEC email dated June 20, 2017, it is stated that given the water quality certification was conditioned to ensure compliance with all applicable provisions of the Vermont Water Quality Standards and other appropriate requirements of state law, Vermont DEC can confirm that if operated with its certification, the Project does not negatively impact the above noted species (Appendix D).

[44] https://www.fws.gov/midwest/endangered/mammals/inba/pdf/inba_fnldrftrecpln_apr07.pdf
[45] http://www.vtfishandwildlife.com/common/pages/DisplayFile.aspx?itemId=111337

3.10 THREATENED AND ENDANGERED SPECIES STANDARDS: BYPASS REACH & DOWNSTREAM ZOE

Criterion	*Standard*	*Instructions*
F	2	Finding of No Negative Effects: • Identify all listed species in the facility area based on current data from the appropriate state and federal natural resource management agencies. • Provide documentation of a finding of no negative effect of the facility on any listed species in the area from an appropriate natural resource management agency.

- A second USFWS IPaC Trust Resources report was generated on January 17, 2017 for the Weybridge Project area and downstream ZOE to Lake Champlain (Appendix D). The IPaC report found that the bypass reach ZOE and downstream ZOE contained all of the same species as identified in the Impoundment ZOE, with the exception of one additional listed Migratory bird:
  - The Golden-winged Warbler (*Vermivora chrysoptera*) - The Golden-winged Warbler is a species identified as a federal "conservation concern."[46]
- A hackberry stand (*Celtis occidentalis*), which is considered to be a significant community in Vermont, exists in the upper floodplain of Otter Creek below the dam. Within the Project's WQC, it was determined to be unaffected by continued Project operations. A state threatened plant species, green dragon (*Arisaema dracontium*), also exists approximately 2.5 miles below the Weybridge dam.[47] Because the green dragon population is elevated above the river by over 8 feet, the population exists above the Project's influence.

  A February 15, 2017 email from VANR additionally identified the Giant floater (*Pyganodon grandis*) a state threatened species and the creeping lovegrass (*Eragrostis hypnoides*) a rare species to occur downstream of the Weybridge dam (Appendix D). Per VANR email dated May 30, 2017 (Appendix D), it was identified that continued Project operations will not have a negative impact on rare plants.

[46] The Golden-winged Warbler is listed as "Uncommon (Vulnerable)" with moderate risk of extinction\extirpation due to restricted range, relatively few populations or occurrences (often 80 or fewer), recent and widespread declines, or other factors.
[47] http://www.vtfishandwildlife.com/common/pages/DisplayFile.aspx?itemId=229829

3.11 CULTURAL AND HISTORIC RESOURCES STANDARDS

3.11.1 CULTURAL AND HISTORIC RESOURCES STANDARDS: ALL ZOE

Criterion	*Standard*	*Instructions*
G	2	Approved Plan: • Provide documentation of all approved state, provincial, federal, and recognized tribal plans for the protection, enhancement, and mitigation of impacts to cultural and historic resources affected by the facility. • Document that the facility is in compliance with all such plans.

- Per License Article 407, GMP implements the "Programmatic Agreement Among the Federal Energy Regulatory Commission, the Advisory Council on Historic Preservation, and the Vermont State Historic Preservation Office (SHPO) for Managing Historic Properties that May be Affected by a License Issuing to Central Vermont Public Service Corporation, for the Continued Operation of the Weybridge Hydroelectric Project in Vermont" executed on February 21, 2001. As included within the Programmatic Agreement, the licensee monitors and manages the Project and any archaeological and historic structures within the Project's area of potential effect in a responsible manner and in accordance with the HPMP filed on November 22, 2002 by CVPS.[48] GMP is aware of the consultation requirements with the SHPO prior to any construction or land disturbing activities set forth in Article 407.
- Since 2012, GMP has maintained compliance of the HPMP.
  - On August 3, 2012, CVPS filed the 2012 Annual HPMP Report.[49]
  - On October 31, 2013, GMP submitted the 2013 Annual HPMP Report.[50]
  - On August 1, 2014, GMP submitted the 2014 Annual HPMP Report.[51]
  - An Archaeological Phase II Testing of Native American Site VT-AD-44 within the Weybridge Hydroelectric Project report was prepared and filed with the Vermont SHPO in 2015 (Appendix E).
  - On July 29, 2016, GMP submitted the Annual 2016 HPMP Report.[52]
  - On August 1, 2017, GMP submitted the Annual 2017 HPMP Report.[53]
  - Monitoring of the Project shoreline will continue in 2018.

[48] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=10615741
[49] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=13040102
[50] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=13385163
[51] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=13606881
[52] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=14319721
[53] https://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=14650722

3.12 RECREATIONAL RESOURCES STANDARD: IMPOUNDMENT ZOE

Criterion	*Standard*	*Instructions*
H	2	Agency Recommendation: • Document any comprehensive resource agency recommendations and enforceable recreation plan that is in place for recreational access or accommodations. • Document that the facility is in compliance with all such recommendations and plans.

- The licensee filed a Recreation Plan with the Commission on February 14, 2002, in compliance with License Article 408 and WQC Condition O.[54] The Recreation Plan was approved by the Commission on July 30, 2002.[55] As-built recreation facility drawings were filed with the Commission on May 29, 2003[56] and approved by the Commission on July 18, 2003[57]. The licensee allows free access to the Project area for public recreation. Recreational facilities within the Impoundment ZOE include a canoe take-out and portage trail.
- On July 9, 2015, a FERC Environmental Inspection was completed at the Project site, including an assessment of recreation activities[58]. The recreational facilities and landscaping surrounding the facilities were documented to be in good condition with the exception of the picnic tables at the recreation site on Rock Island. The inspector found that the tables were warped and not considered usable. The inspector recommended that in order to provide a safe and enjoyable user experience at the picnic sites, the licensee to either repair or replace the worn out tables. Also, the condition of the access road to the picnic area was noted as a follow up item. The access road had been heavily rutted and contained numerous potholes from road use following wet conditions. In order to reduce the potential for erosion and runoff to adjacent land, GMP was requested to regrade and restore this access road.

  On September 18, 2015, GMP responded to the Environmental Inspection Report[59]. GMP confirmed that they had regraded the Weybridge recreation area access road, repaired the Weybridge picnic tables and replaced tables that were identified as too warped.
- The Weybridge Form 80 was submitted on April 1, 2015, and it not due again for another 6 years (April 1, 2021).[60]

[54] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=10145895
[55] http://elibrary.ferc.gov:1/idmws/file_list.asp?document_id=2302521
[56] http://elibrary.ferc.gov:1/idmws/file_list.asp?document_id=4107955
[57] http://elibrary.ferc.gov:1/idmws/file_list.asp?document_id=4120447
[58] http://elibrary.ferc.gov:1/idmws/file_list.asp?document_id=14367084
[59] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=13990601
[60] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=13826474

3.13 RECREATIONAL RESOURCES STANDARDS: BYPASS REACH & DOWNSTREAM ZOE

Criterion	*Standard*	*Instructions*
H	2	Agency Recommendation: • Document any comprehensive resource agency recommendations and enforceable recreation plan that is in place for recreational access or accommodations. • Document that the facility is in compliance with all such recommendations and plans.

- The licensee filed a Recreation Plan with the Commission on February 14, 2002, in compliance with License Article 408 and WQC Condition O.[61] The Recreation Plan was approved by the Commission on July 30, 2002.[62] As-built recreation facility drawings were filed with the Commission on May 29, 2003[63] and approved by the Commission on July 18, 2003[64]. The licensee allows free access to the Project area for public recreation. Recreational facilities within the Bypass Reach and Downstream ZOE include a canoe portage trail and portage put-in, a parking area, and picnic tables.
- On July 9, 2015, a FERC Environmental Inspection was completed at the Project site, including an assessment of recreation activities[65]. The recreational facilities and landscaping surrounding the facilities were documented to be in good condition with the exception of the picnic tables at the recreation site on Rock Island. The inspector found that the tables were warped and not considered usable. The inspector recommended that in order to provide a safe and enjoyable user experience at the picnic sites, the licensee to either repair or replace the worn out tables. Also, the condition of the access road to the picnic area was noted as a follow up item. The access road had been heavily rutted and contained numerous potholes from road use following wet conditions. In order to reduce the potential for erosion and runoff to adjacent land, GMP was requested to regrade and restore this access road.

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- The Weybridge Form 80 was submitted on April 1, 2015, and it not due again for another 6 years (April 1, 2021).[67]

[61] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=10145895
[62] http://elibrary.ferc.gov:1/idmws/file_list.asp?document_id=2302521
[63] http://elibrary.ferc.gov:1/idmws/file_list.asp?document_id=4107955
[64] http://elibrary.ferc.gov:1/idmws/file_list.asp?document_id=4120447
[65] http://elibrary.ferc.gov:1/idmws/file_list.asp?document_id=14367084
[66] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=13990601
[67] http://elibrary.ferc.gov/IDMWS/common/opennat.asp?fileID=13826474

4.0 CONTACTS FORMS

Project Owner:	
Name and Title	Jason Lisai, Generation Manager
Company	Green Mountain Power Corporation
Phone	(802) 655-8723
Email Address	Jason.Lisai@greenmountainpower.com
Mailing Address	163 Acorn Lane, Colchester, Vermont 05446
Consulting Firm / Agent for LIHI Program (if different from above):	
Name and Title	Andy Qua, Katie Sellers
Company	Kleinschmidt Associates
Phone	207-416-1246; 207-416-1218
Email Address	Andy.Qua@KleinschmidtGroup.com, Katie.Sellers@KleinschmidtGroup.com
Mailing Address	P.O. Box 650, Pittsfield, Maine 04967
Compliance Contact (responsible for LIHI Program requirements):	
Name and Title	John Greenan, Environmental Engineer
Company	Green Mountain Power Corporation
Phone	(802) 770-3213
Email Address	John.Greenan@greenmountainpower.com
Mailing Address	2152 Post Road, Rutland, Vermont 05701
Party responsible for accounts payable:	
Name and Title	John Greenan, Environmental Engineer
Company	Green Mountain Power Company
Phone	(802) 770-3213
Email Address	John.Greenan@greenmountainpower.com ; invoices@greenmountainpower.com
Mailing Address	Accounts Payable Processor, 2152 Post Road, Rutland, Vermont 05701
Agency Contact (Check area of responsibility: Flows☒, Water Quality ☒, Fish/Wildlife Resources ☐, Watersheds ☒, T/E Spp. ☒, Cultural/Historic Resources ☐, Recreation ☒):	
Agency Name	Vermont Department of Environmental Conservation
Name and Title	Jeff Crocker, Streamflow Protection Coordinator
Phone	802-490-6151
Email address	jeff.crocker@vermont.gov
Mailing Address	Watershed Management Division, Main Building - 2nd Floor, One National Life Drive, Montpelier, VT 05620

Agency Contact (Check area of responsibility: Flows☒, Water Quality ☒, Fish/Wildlife Resources ☐, Watersheds ☒, T/E Spp. ☒, Cultural/Historic Resources ☐, Recreation ☒):	
Agency Name	Vermont Department of Environmental Conservation
Name and Title	Eric Davis, River Ecologist
Phone	802-490-6180
Email address	eric.davis@vermont.gov
Mailing Address	Watershed Management Division, Main Building - 2nd Floor, One National Life Drive, Montpelier, VT 05620

Agency Contact (Check area of responsibility: Flows☐, Water Quality ☐, Fish/Wildlife Resources ☒, Watersheds ☐, T/E Spp. ☒, Cultural/Historic Resources ☐, Recreation ☐):	
Agency Name	U.S. Fish and Wildlife Service
Name and Title	Melissa Grader, Wildlife Biologist
Phone	413-548-8002
Email address	Melissa_Grader@fws.gov
Mailing Address	New England Field Office**,** 70 Commercial Street, Suite 300**,** Concord, NH 03301

Agency Contact (Check area of responsibility: Flows☐, Water Quality ☐, Fish/Wildlife Resources ☒, Watersheds ☐, T/E Spp. ☒, Cultural/Historic Resources ☐, Recreation ☐):	
Agency Name	Vermont Department of Fish and Wildlife
Name and Title	Mark Ferguson, Natural Heritage Zoologist
Phone	802-279-3422
Email address	mark.ferguson@vermont.gov
Mailing Address	1 National Life Drive, Davis 2, Montpelier, VT 05620

Agency Contact (Check area of responsibility: Flows☐, Water Quality ☐, Fish/Wildlife Resources ☒, Watersheds ☐, T/E Spp. ☒, Cultural/Historic Resources ☐, Recreation ☐):	
Agency Name	Vermont Department of Fish and Wildlife
Name and Title	Bob Popp, Botanist
Phone	802-476-0127
Email address	bob.popp@vermont.gov
Mailing Address	5 Perry Street, Suite 40, Barre, VT 05641

5.0 SWORN STATEMENT

Sworn Statement and Waiver Form

All applications for LIHI Certification must include the following sworn statement before they can be reviewed by LIHI:

SWORN STATEMENT

As an Authorized Representative of Green Mounatin Power Corp., the Undersigned attests that the material presented in the Weybridge application is true and complete.

The Undersigned acknowledges that the primary goal of the Low Impact Hydropower Institute's Certification Program is public benefit, and that the LIHI Governing Board and its agents are not responsible for financial or other private consequences of its certification decisions.

The undersigned further acknowledges that if certification of the applying facility is issued, the LIHI Certification Mark License Agreement must be executed prior to marketing the electricity product as LIHI Certified.

The undersigned Applicant further agrees to hold the Low Impact Hydropower Institute, the Governing Board and its agents harmless for any decision rendered on this or other applications, from any consequences of disclosing or publishing any submitted certification application materials to the public, or on any other action pursuant to the Low Impact Hydropower Institute's Certification Program.

Company Name: Green Mountain Power Corp.

Authorize Representative Name: John C. Greenan Title: Engineer

John C. Greenan

State of Vermont

County of Rutland

On this, the 13th day of November, 2017, before me a notary public, the undersigned officer, personally appeared John C. Greenan, known to me to be the person whose name is subscribed to the within instrument, and acknowledged that he executed the same for the purposes therein contained. In witness hereof, I hereunto set my hand and official seal.

Notary Public Colleen A. Kelly

LIHI Handbook 2nd Edition – Sworn Statement and Waiver Form

6.0 REFERENCES

Federal Energy Regulatory Commission (FERC). 1998. Environmental Assessment for Hydropower Licensing: Vergennes Hydroelectric Project FERC Project No. 2674. October 1998. Washington, D.C.

Fisheries Technical Committee. 1977. A strategic plan for development of salmonid fisheries in Lake Champlain. Lake Champlain Fish and Wildlife Management Cooperative. U.S. Fish Wildlife Serv., Essex Junction, VT.

U.S. Fish and Wildlife Service (USFWS). 2015. Fisheries Research. Restoring River-Run Landlocked Atlantic Salmon to Lake Champlain. July 8, 2015. [Online] URL: http://www.fws.gov/lcfwro/projects/research-salmon.html [Accessed October 12, 2015].

U.S. Geological Survey (USGS). 2015. NAS – Nonindigenous Aquatic Species: Walleye. May 26, 2015. [Online] URL: http://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=831 [Accessed October 9, 2015].

APPENDIX A

PROJECT ZOES AND PHOTOS

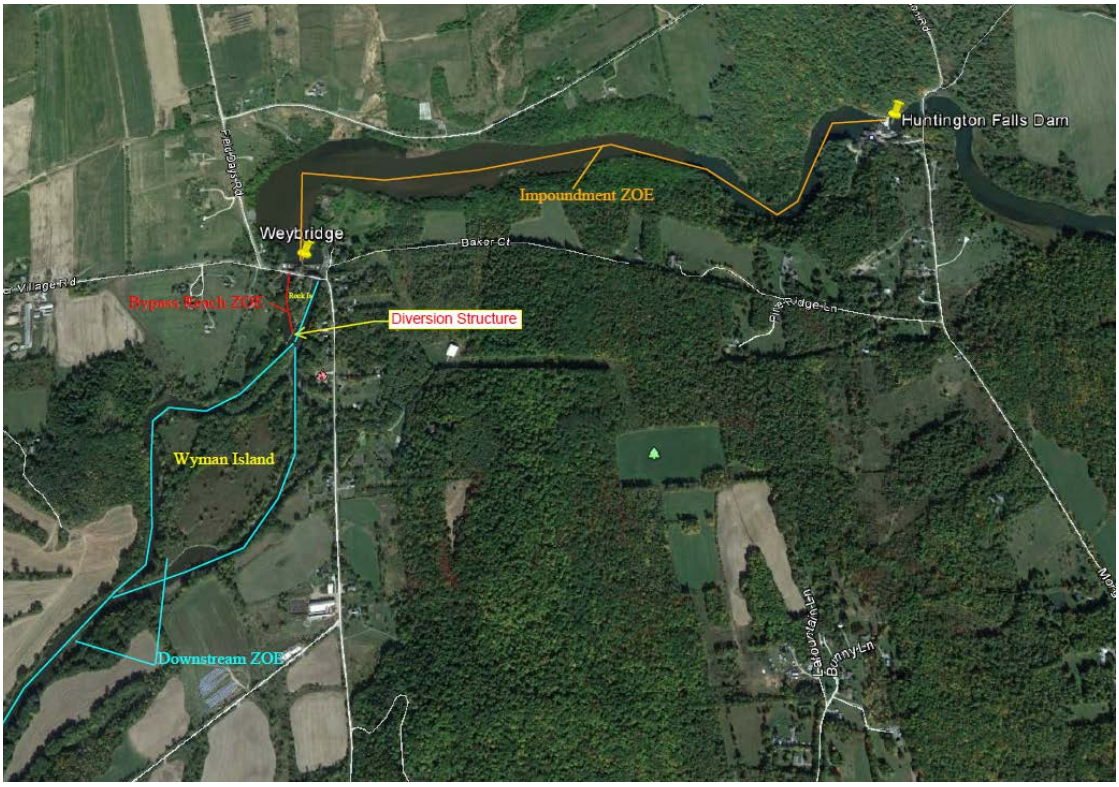


PHOTO 3 WEYBRIDGE HYDROELECTRIC PROJECT ZOES

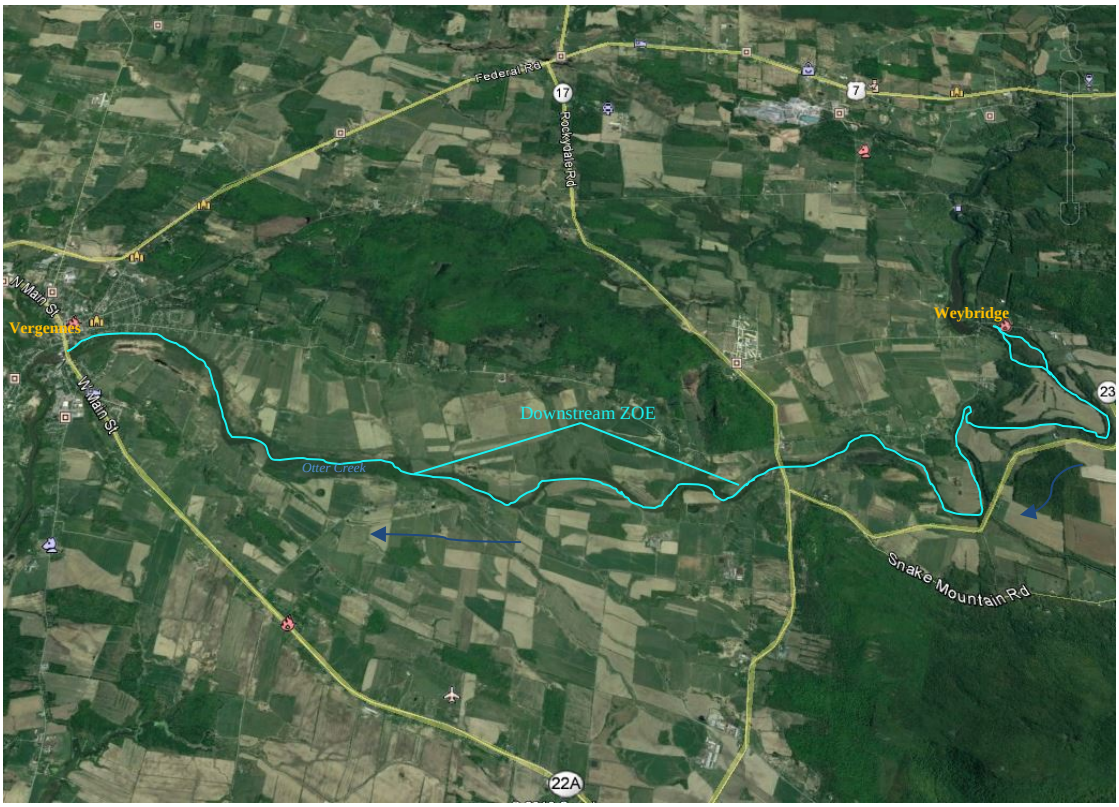


PHOTO 4 WEYBRIDGE HYDROELECTRIC PROJECT DOWNSTREAM ZOE CONTINUED

PHOTO 5 AERIAL PHOTO OF PROJECT FEATURES

PHOTO 6 CANOE PORTAGE TAKE-OUT SIGNAGE

PHOTO 7 CANOE TAKE-OUT GRANITE STAIRS

PHOTO 8 BOAT BARRIER

PHOTO 9 WEST SPILLWAY SECTION

PHOTO 10 MINIMUM FLOW RELEASE FROM WEST SPILLWAY

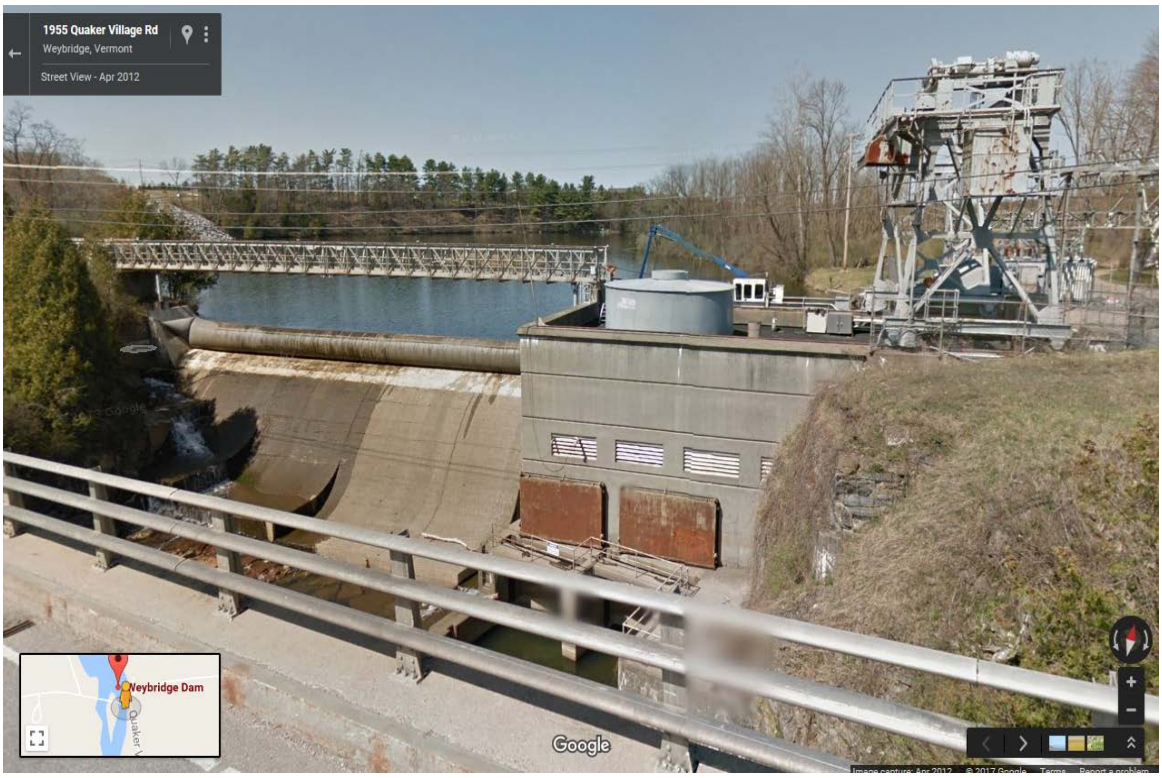


PHOTO 11 EAST SPILLWAY SECTION AND POWERHOUSE

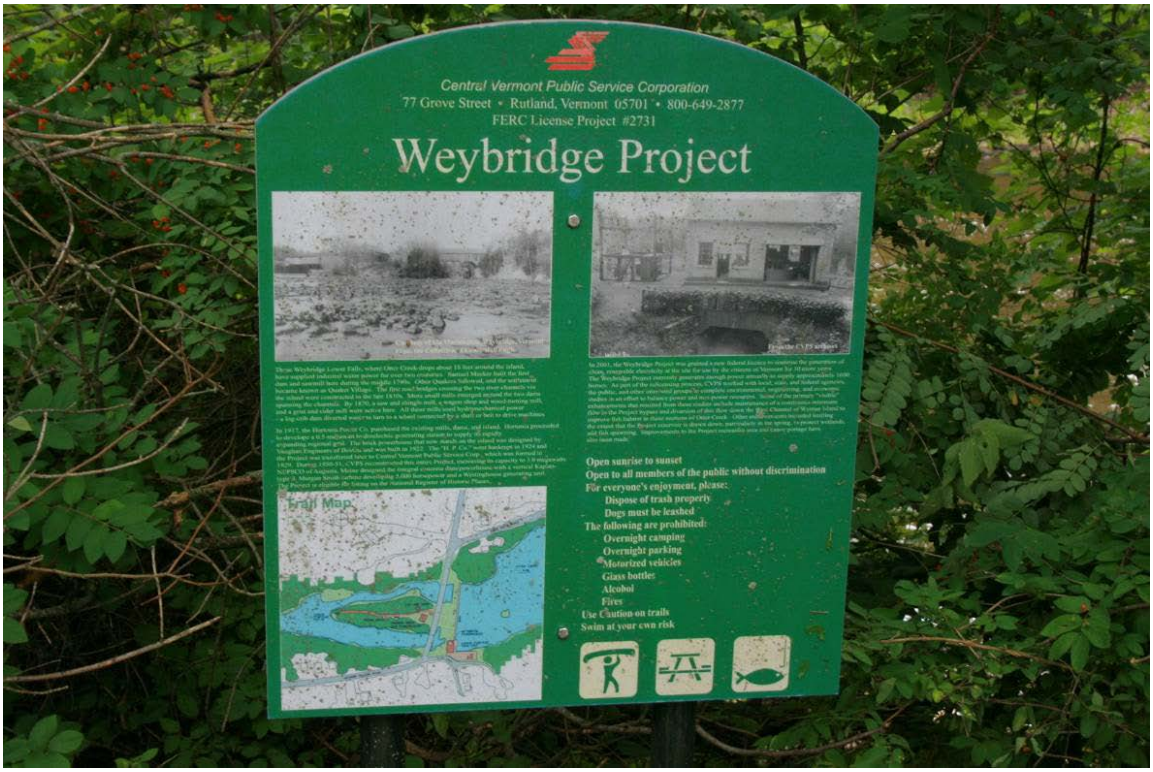


PHOTO 12 INTERPRETIVE SIGN WITH PART 8 INFORMATION

PHOTO 13 DIVERSION DAM AND FLOW CONTROL WEIR AT DOWNSTREAM END OF ROCK ISLAND

PHOTO 14 FLOW CONTROL WEIR (LOOKING UPSTREAM)

PHOTO 15 ROCK ISLAND PICNIC AREA

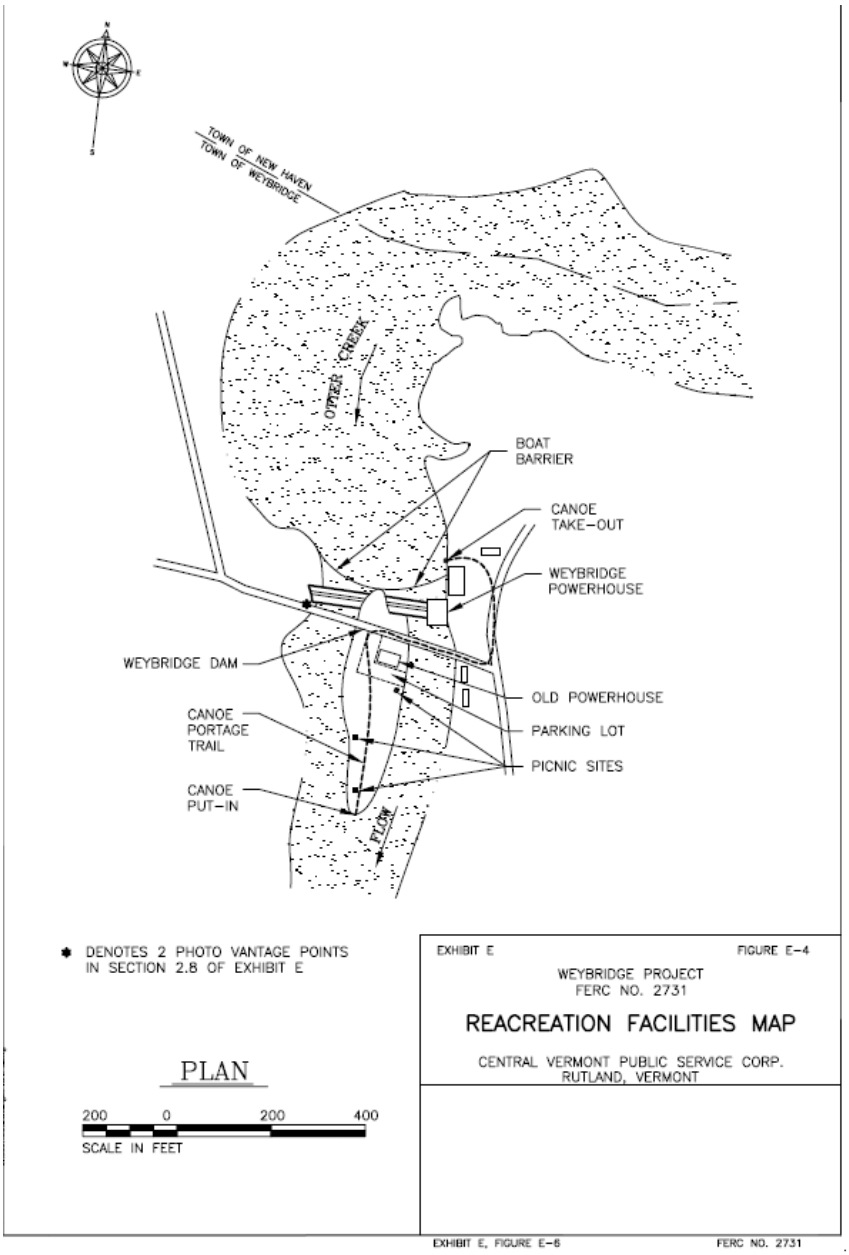
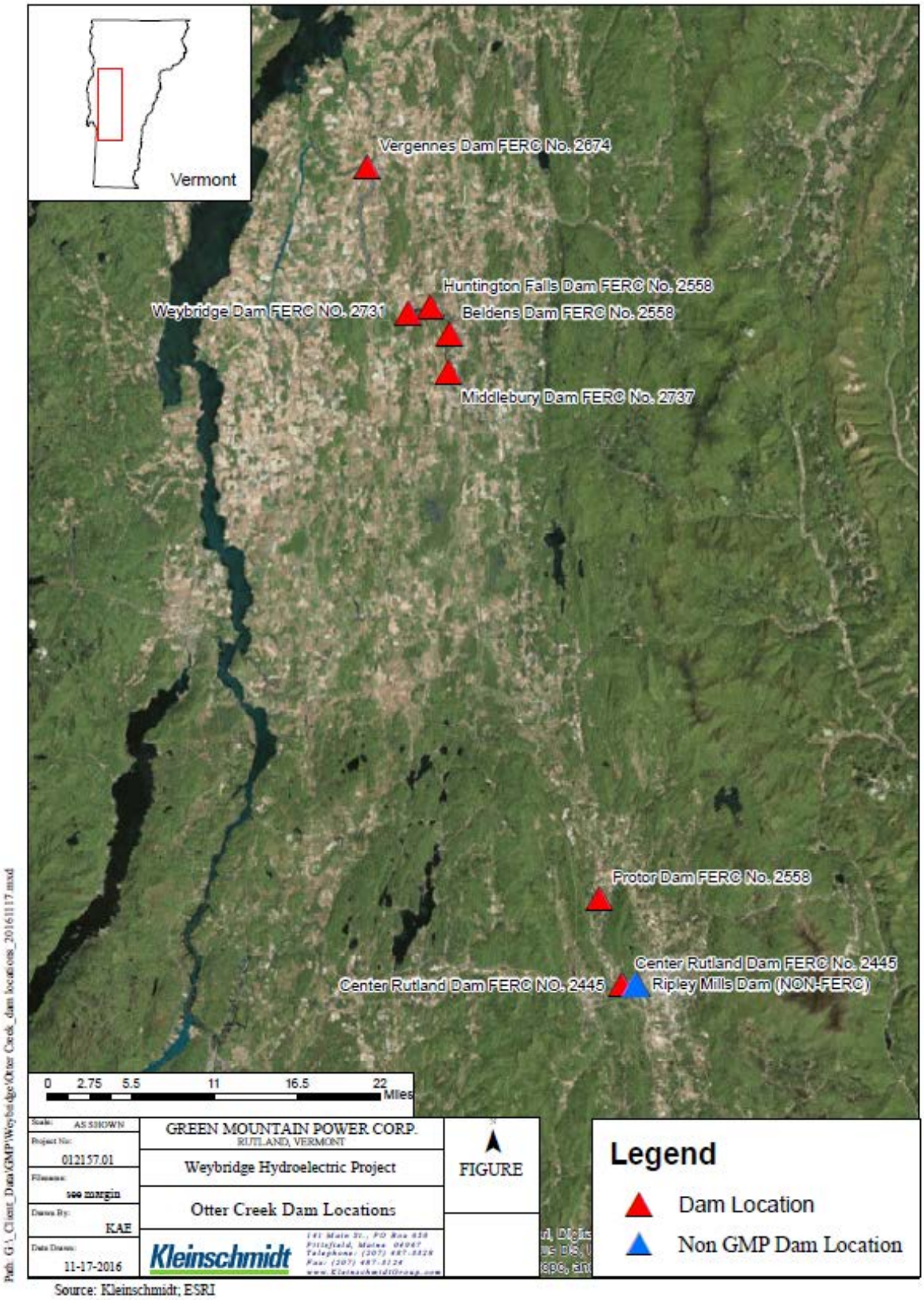


FIGURE 2 PROJECT RECREATION FACILITIES

APPENDIX B

FACILITY AREA AND RIVER BASIN



Source: Kleinschmidt; ESRI

FIGURE 3 OTTER CREEK DAM LOCATIONS

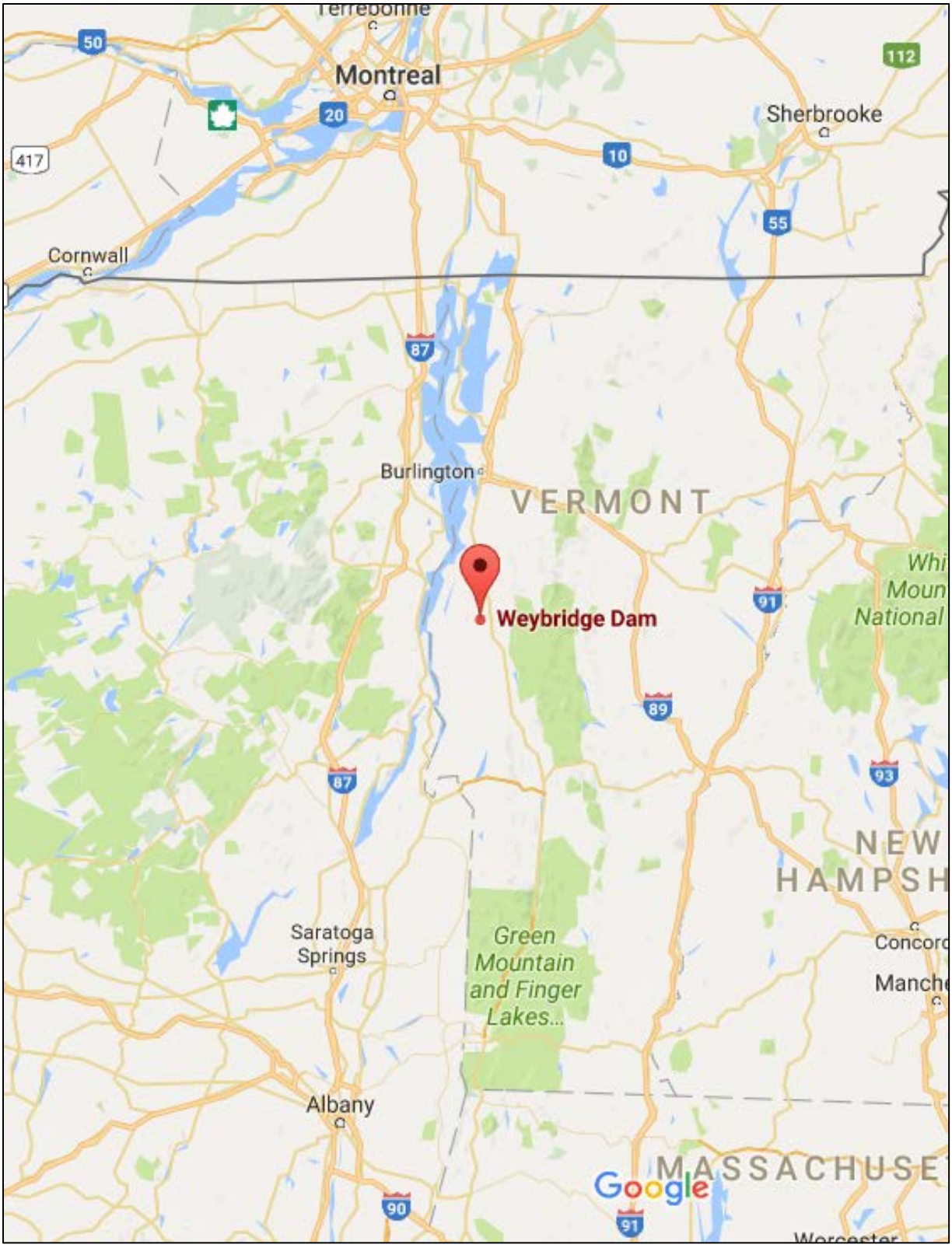


FIGURE 4 GEOGRAPHIC OVERVIEW OF WEYBRIDGE PROJECT LOCATION

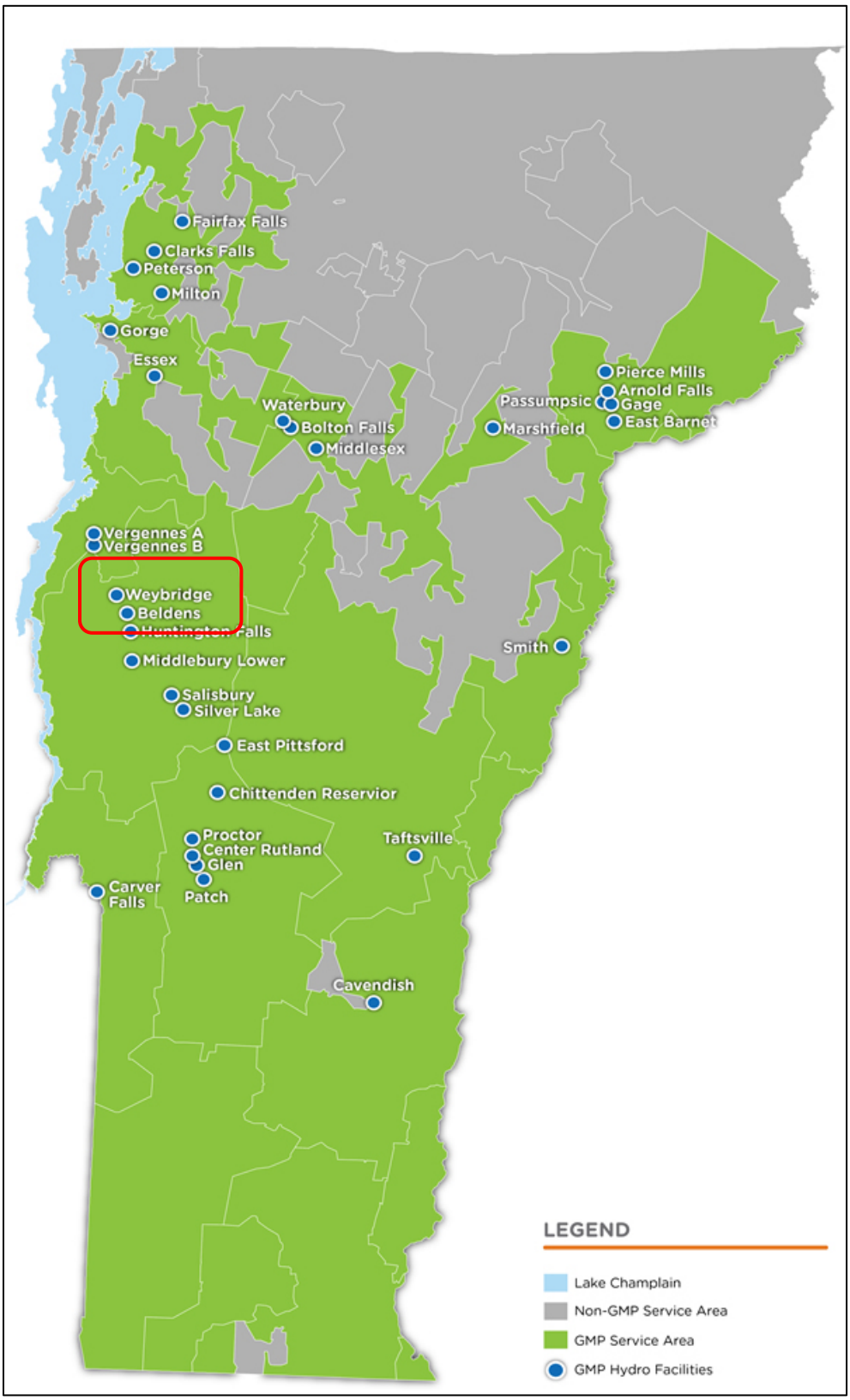


FIGURE 5 WEYBRIDGE HYDROELECTRIC RELATION TO GMP HYDRO FACILITIES

FIGURE 6 LAKE CHAMPLAIN-RICHELIEU BASIN

APPENDIX C

WATER QUALITY

Water Quality Certification
(33 U.S.C. §1341)

In the matter of: Central Vermont Public Service Corporation
77 Grove Street
Rutland, Vermont 05701

APPLICATION FOR WEYBRIDGE
HYDROELECTRIC PROJECT

The Water Quality Division of the Vermont Department of Environmental Conservation (the Department) has reviewed a water quality certification application filed by Central Vermont Public Service Corporation (the applicant) for the Weybridge Hydroelectric Project. The application was filed by letter dated June 29, 2000. The application was reviewed under the Vermont Water Quality Standards (Standards) adopted by the Water Resources Board on April 2, 1997, in accordance with Section 1-01(A) *Applicability*. The application includes the applicant's Federal Energy Regulatory Commission (FERC) license application, filed with FERC under a cover letter dated May 26, 1998. Project changes subsequent to the date of the license application were summarized in a letter dated April 22, 1999 from the applicant to the Department.

The Department placed a draft certification decision on notice February 9, 2001 under the rules governing certification and received written comments through March 14, 2001.

The Department, based on the application and record before it, makes the following findings and conclusions:

I. Background/General Setting

1. Otter Creek, Vermont's longest river, flows about one hundred miles from its source at Emerald Lake in Dorset north to its mouth at Lake Champlain in Ferrisburgh. The river has been heavily developed for hydroelectric power generation, hosting seven active dams on the mainstem. The applicant operates hydroelectric facilities at Middlebury Lower Dam and Weybridge Dam, the fifth and second dams, respectively, above the river's mouth. The other dams are owned by Green Mountain Power Corporation (GMP) and OMYA, Inc.

2. Weybridge Dam is located in Weybridge village at River Mile 19.5. Here the river opposes its northerly route by returning to a southerly flow orientation. The dam is at the head of a rock gorge where the river splits around a small island. That island also splits the dam structure into a west (river right) and an east (river left) section. The project impounds a reach of river about 1.5 miles in length, extending up river to Huntington Falls.

3. Of Otter Creek's 936 square mile watershed, the project utilizes runoff from an area of 750 square miles.

4. The Federal Energy Regulatory Commission licensed the project on May 12, 1980, with the term of the license running for a period of twenty years through May 31, 2000. Federal jurisdiction over the project was determined based on the Commission having found in 1965 that Otter Creek is a navigable waterway.

II. Project and Civil Works

5. The site was originally developed through the construction of a timber crib dam in about 1870. That dam was succeeded by another crib dam in 1910. The Hortonia Power Company, formed in 1912, undertook the development of hydroelectric generation at Weybridge and three other projects in the Otter Creek basin--the Middlebury Lower, Salisbury and Silver Lake projects. Hortonia Power Company constructed the hydroelectric generating station at Weybridge in 1922. The station housed a 750 hp waterwheel driven by a head of 18 feet. Later, the timber crib dam connecting the island with the west shore was replaced by a concrete dam substantially completed in 1944. The project assumed its present form when, in 1951, the east timber crib dam was replaced by a concrete dam, an integral powerhouse, and an adjacent wasteway. At that time, the project capacity was increased from 500 kW to 3,000 kW.

6. The powerhouse houses a single Kaplan-type turbine unit manufactured by S. Morgan Smith Co. and operating under a design head of 31 feet. (Redevelopment in 1951 resulted in an increase in the head on the order of 13 feet.) The turbine drives a Westinghouse generator.

7. The dam is a concrete gravity structure about 30 feet high and founded on bedrock. The crest elevation is 168.3 feet NGVD. The right (west) spillway is 150 feet long and incorporates a single Taintor gate, 20 feet x 10 feet high, and six foot high hinged steel flashboards, which are manually tripped. The gate can be operated on-site or remotely from the applicant's dispatch center. The left spillway, 116 feet long, is surmounted by automatic inflatable rubber flashboards six feet high. The flashboard systems raise the effective crest of the dam to elevation 174.3 feet NGVD. A stoplog sluice, three feet wide, is located adjacent to the intake.

8. A set of trashracks with a 3.0-inch clear spacing is located at the headworks. The trashracks are cleaned by a blower system and a

mechanical rake. The license application does not indicate how disposal of debris removed from the trashracks is handled.

9. The increase in operating head achieved in the 1951 redevelopment was partially gained through extensive channelization of the tailrace reach for 2,200 feet below the project. Approximately 20,000 cubic yards of material, including 5,000 cubic yards of bedrock, were removed. (*Weybridge Project - Application for New License for Major Project (5 MW or Less)*, May 1998, vol. III, *National Register of Historic Places Registration Form*, Section 8, p. 28)

10. The impoundment has a surface area of approximately 62 acres and a gross storage capacity of approximately 600 acre-feet. Useable storage has been estimated at 115 acre-feet with a two-foot drawdown.

11. The normal tailwater elevation is 143.3 feet NGVD. The tailwater elevation was reduced through the channelization project during the 1951 redevelopment.

12. The plant produces an average annual output of 14,000,000 kWh.

III. River Hydrology and Streamflow Regulation

13. The flow of Otter Creek is regulated by several of the hydroelectric facilities in the basin. Five hydroelectric dams are located on the river mainstem between the river's mouth and Middlebury. Starting at the mouth and going upstream, the five are Vergennes (River Mile 7.4), Weybridge (River Mile 19.5), Huntington Falls (River Mile 21.0), Beldens (River Mile 23.0), and Middlebury Lower (River Mile 24.7). GMP's Vergennes Hydroelectric Project was relicensed on July 30, 1999 for a 30-year term effective June 1, 1999. The Middlebury Lower Project, owned by the applicant, is also in relicensing and received a water quality certification from the Department on June 2, 1999. The Huntington Falls and Beldens facilities are owned by OMYA, Inc. and were redeveloped under a license amendment issued in 1986 to increase the installed capacity at both facilities. OMYA, Inc. also owns two upstream facilities on the mainstem of the river, Proctor Station at Sutherland Falls and the Center Rutland Hydroelectric Project in Rutland. The applicant owns several facilities in the Leicester River and East Creek watersheds.

14. The Beldens and Huntington Falls plants are operated as strict run-of-the-river facilities. As such, they no longer regulate flows to preferentially generate on peak. The applicant proposes to operate the Middlebury Lower facility in a strict run-of-the-river mode under

the new license. The utility, however, proposes to maintain a daily cycle operation at the Weybridge facility except during the spring period, April 1 - June 15, when the station would be operated run-of-river. As licensed, the Vergennes Hydroelectric Project is being operated as a strict run-of-the-river station. The Center Rutland and Proctor facilities are also operated as run-of-the-river stations. Inflows to the Weybridge Project can be considered as almost unaffected by artificial flow regulation. Lower Otter Creek from Weybridge to Lake Champlain is influenced by the project's peaking operation, with the most pronounced effect being in the reach directly below Weybridge dam. The Vergennes Project, by tracking instantaneous inflows, passes the Weybridge Project's flow impacts downstream, but channel storage attenuates the artificial flow fluctuations.

15. From Middlebury to Vergennes, about two-thirds of the river has been impounded by hydroelectric dams.

16. The Weybridge Project is remotely operated as a daily peaking plant through the applicant's Rutland dispatch center. When inflows exceed a flow of 1,600 cfs, the maximum turbine capacity, the project is no longer able to regulate flow and, therefore, operates run-of-river, spilling excess flows at the dam. Under normal operations, the impoundment is cycled two feet as many as three times a day depending on inflows and the ability to replenish storage for the next peak electrical demand period. Occasionally drawdowns of up to four feet occur for special generational circumstances and up to six feet for maintenance and inspection work. Under the current license, the applicant maintains a minimum flow of 140 cfs below the dam. Normally flows are only in the channel below the west spillway when the station has been taken off line and the Taintor gate opened to provide the 140 cfs downstream flow requirement. (The channel is referred to as the "Bypass".) The minimum hydraulic capacity for the turbine is 450 cfs.

17. At the beginning and end of each generation cycle, the applicant ramps flows to reduce the impact of the flow fluctuations on fish and other aquatic organisms downstream.

18. Otter Creek is free flowing for three miles below Weybridge Dam before the river enters the impoundment of the Vergennes Project about one half mile upstream of the Lemon Fair confluence.

19. Since 1903, the U.S. Geological Survey has operated a surface water gaging station (No. 04282500) on Otter Creek in Middlebury village. The intervening watershed between the gage and the project dam is about 122 square miles. The following hydrologic statistics are

available based on a direct proration of statistics from the gage data through water year 1999:

Mean annual flow	1,200 cfs
Annual runoff	21.67 inches
10% exceeds	2,770 cfs
50% exceeds	750 cfs
90% exceeds	310 cfs
7Q10	188 cfs (p.o.r. through 1981)

Applicant proposal for relicensing:

20. The applicant proposes to continue to operate the Weybridge Project as a peaking project using a two-foot operating cycle in the impoundment. Cycling would be suspended in the spring, from April 1 through June 15, to protect fish spawning use in the impoundment and downstream.

21. In the Bypass, the applicant would provide a continuous minimum flow of 125 cfs, increasing that flow to 250 cfs when the station is not operating. The minimum bypass flow during operation would be increased to 250 cfs during April and May should walleye be introduced to the Weybridge-Vergennes reach of Otter Creek in the future.

22. The proposal would result in a below-project conservation flow of 250 cfs, except for the spring run-of-river period. Directly below the project is a large island named Wyman Island. To restore habitat in the channel on the west side of Wyman Island, the applicant would construct a diversion weir at the lower end of the Bypass to shunt at least 125 cfs to the west channel.

23. To reduce the impact of peaking-related flow fluctuations on downstream habitat, the applicant would manage releases such that the ratio of each 24-hour-period's high flow to low flow does not exceed 4.5:1. Ramping would also continue to be used during the transition between generation and non-generation.

IV. Standards Designation

24. Otter Creek has been designated by the Vermont Water Resources Board as Class B waters. The Water Resources Board has also designated the reach from the Proctor wastewater treatment plant outfall to the river's mouth, with the exception of the segment between the Beldens and Huntington Falls dams, as warmwater fish habitat.

25. Class B stream reaches are managed to achieve and maintain a high level of quality compatible with certain beneficial values and uses. Values are high quality habitat for aquatic biota, fish and wildlife and water quality that consistently exhibits good aesthetic value; uses are public water supply with filtration and disinfection, irrigation and other agricultural uses, swimming, and recreation. (Standards, Section 3-03(A) *Class B Waters: Management Objectives*)

26. The dissolved oxygen standard for warmwater fish habitat streams is 5 mg/l and 60 percent saturation at all times. Depending on ambient stream temperature conditions, the temperature standard limits increases to values between 1.0 and 5.0°F from background. (Standards, Section 3-01(B)(2) *Temperature*) The turbidity standard is 25 NTU. (Standards, Section 3-03(B)(1) *Turbidity*)

27. Under the general water quality criteria, all waters, except mixing zones, are managed to achieve, as in-stream conditions, aquatic habitat with "[n]o change from background conditions that would have an undue adverse effect on the composition of the aquatic biota, the physical or chemical nature of the substrate or the species composition or propagation of fishes." (Standards, Section 3-01(B)(5) *Aquatic Habitat*)

28. Standards Section 2-02(B) *Hydrology: Artificial Flow Conditions* requires that "[t]he flow of waters shall not be controlled or substantially influenced by man-made structures or devices in a manner that would result in an undue adverse effect on any existing use, beneficial value or use or result in a level of water quality that does not comply with these rules." The project dam is a man-made structure that artificially regulates water levels and streamflows.

Present status:

29. On July 11, 2000, the Department issued, under Section 303(d) of the Federal Clean Water Act, a list of waters considered to be impaired based on water quality monitoring efforts. The project reach is not listed as impaired.

30. The Department also issued a four-part list, *List of Priority Surface Waters* (July 13, 2000). Part F lists those surface waters where water quality or habitat are being altered by flow regulation. The 2.5 mile segment of Otter Creek directly below Weybridge Dam is listed as having aquatic life support impacted by artificial flow regulation caused by this project.

V. Water Chemistry

31. During July and August 1982, the Department of Environmental Conservation completed limited summer sampling of dissolved oxygen and temperature at the project. Sampling was also done on July 27, 1982 by Aquatec, a consulting firm retained by the applicant. Downstream water temperatures mostly were in the range of 24 to 30°C. Many of the samples exhibited supersaturated dissolved oxygen concentrations, indicating substantial algal activity. The study lacked early morning sampling needed to disclose how much of a diurnal swing in dissolved oxygen occurs and what worse-case predawn conditions are. One early morning sample collected at 0638 below the project measured only 60% saturation, probably due to algal respiration. All daytime samples exceeded the minimum standards for warmwater fish habitat.

32. The applicant collected dissolved oxygen and temperature data more or less weekly from July 15 to September 2, 1997 at four stations: the head of the impoundment, in the headrace just upstream of the trashracks, the tailrace, and the Bypass. Flows were relatively low at estimated generation flows of 80-400 cfs. About 0.1 foot of spillage was maintained. All dissolved oxygen concentrations measured in excess of 7 mg/l and 80% saturation, well above the minimum standards for dissolved oxygen.

VI. Aquatic Biota and Habitat

33. Class B waters are managed for high quality habitat for aquatic biota (Standards, Section 3-03(A) *Class B Waters: Management Objectives*). Aquatic biota are defined in Standards, Section 1-01(B) *Definitions* as "organisms that spend all or part of their life cycle in or on the water." Included, for example, are fish, aquatic insects, amphibians, and some reptiles, such as turtles.

34. Otter Creek is managed to support both coldwater and warmwater fish. Fish species found below the dam include largemouth and smallmouth bass, brown and rainbow trout, yellow perch, northern pike, fallfish, some panfish species, white sucker, brown bullhead and a number of minnow species. The impoundment has a similar compliment of fishes, although trout are found primarily below the project or above the upstream Huntington Falls dam. The river reach below the project dam is managed as a mixed warmwater/coolwater fishery, while the impoundment us managed primarily as a warmwater fishery.

35. The Department of Fish and Wildlife has indicated an interest in introducing walleye into the downstream Vergennes impoundment

as a future management option. Should this introduction be undertaken and walleye become established, adult walleye would be expected to migrate upstream to the vicinity of the Weybridge dam where there is suitable habitat within the project area downstream of the dam for spawning and incubation.

36. Lower Otter Creek supports a rich diversity of freshwater mussels species. The giant floater mussel, observed about four miles below the Weybridge project, is currently state listed as threatened. The fluted-shell mussel, which is a state endangered species, has been found both upstream and downstream of the project and can be expected to occur at the project. No recent mussel surveys have been completed in the project area, although numerous mussels were observed in a portion of the channel west of Wyman Island during fisheries studies.

Flow needs for protection of aquatic habitat

37. In order to provide a base of information on the flow needs of aquatic life downstream, the applicant conducted an instream flow study in 1997 in cooperation with the Agency (*Weybridge Instream Flow Study, Otter Creek, FERC Project No. 2731*, Gomez and Sullivan Engineers, P.C., August 1997). Habitat availability under different flow regimes was modeled using the Instream Flow Incremental Methodology, a commonly used modeling technique originally developed by the U.S. Fish and Wildlife Service. The model uses field data related to river depths, velocities, and substrate characteristics.

38. Three islands downstream of the dam and the channelization work completed in 1951 provide for a complex flow distribution. For study purposes, critical habitat reaches were defined as the **Main Channel** (500 feet long), the **Bypass** (600 feet long), the **West Channel** (the natural channel on the west side of Wyman Island, about 2,900 feet long), and the **East Channel** (about 2,600 feet long). The Main Channel extends from where the Bypass and tailrace join off the south end of the dam island to where the East and West channels form at the north tip of Wyman Island. The East Channel is the channelized reach on the east side of Wyman Island. It is uniformly trapezoidal with steep sides and a smooth bed. A third, relatively small island flanks the East Channel, creating another channel further to the east. That island extends for about one third the length of the East Channel near the upper end of that channel.

39. Based on the 1997 habitat study, it was determined that no flows enter the West Channel until total project discharge exceeded 200

cfs, and only a small proportion of project releases were found to enter the West Channel at higher flows. It is believed that, prior to the channelization work, flows were almost evenly split between the East and West channels. Based on the 1997 study, the flow distribution was determined to be as shown in the following table.

Table 1. Flow Distribution at Wyman Island, 1997.

Total Flow (cfs)	Percentage of Flow in Each Channel	
	East Channel	West Channel
100	100	0
250	95	5
300	93	7
500	90	10
1,000	80	20
2,000	76	24

The habitat/flow study also indicated that, where the East Channel splits around the small island, about 43 percent of the flow stays in the channel next to Wyman Island and the remainder goes into the channel to the far east. (Except for a determination of the flow split, this latter channel was not studied further, and its habitat availability was assumed to equivalent to the other channel.) The split flows rejoin and travel another 1,400 feet down the East Channel before joining the West Channel flows.

The flow distribution is not stable. A 1998 flood substantially modified the hydraulics of the inlet conditions to the West Channel.

40. Most of the river reach between the dam and the downstream end of Wyman Island is characterized by gravel and cobble substrate. The Bypass contains ledge features and some boulders, with generally coarser substrate than is found elsewhere in the study area. Ledge also occurs in the tailrace area and off the upper tip of Wyman Island. These areas and the upper half of the East Channel are fairly armored and do not contain much small gravel (less than one inch diameter). These areas appear to be relatively stable. In contrast, the lower East Channel exhibits areas of bank erosion and sections of river bottom with exposed silts and clays that were likely exposed during channelization work.

41. Natural channel substrates appear to be intact in the West Channel and unaffected by the channelization work. The substrate is characterized as gravels, cobbles, and a few boulders. Since the channel historically carried a significant portion of the river flows, its channel width is relatively large compared to the amount of flow it now carries. The lower half of the West Channel has fairly uniform depth, substrate and flow conditions and lacks a well defined thalweg.

42. Issues considered in the habitat study and the consultation process, which involved the applicant, the Agency, and the U.S. Fish and Wildlife Service, included 1) bypass flow needs, 2) base flow needs in the East and West channels, 3) hydropeaking impacts, and 4) the effects of the 1951 channelization work, which both modified the East Channel's habitat quality and resulted in drastically reduced flows in the West Channel. Flows in the tailrace reach were not considered to be an issue; the 600-foot reach, which was altered during the channelization work, remains flooded even when the plant is shut down.

43. For management of a warmwater and coldwater fish community below the dam, data was collected in each of the channels, except for the tailrace. The evaluation species and life stages varied according the habitat types in each of the channel reaches; all of the targeted species and life stages studied are provided in the following table.

Table 2. Evaluation Species and Life Stages

Species	Life Stage
Rainbow Trout	adult, juvenile
Smallmouth Bass	all stages
Fallfish	all stages
Walleye (future mgmt.)	spawning and incubation
Macroinvertebrates	

Data was collected at eight transects, representing 7,230 feet of riverine habitat.

44. Habitat was modeled over a range of flows from a total river flow of about 100 cfs to 4,100 cfs. In the Bypass, the modeled range was 13 to 445 cfs. (*Weybridge Instream Flow Study, Otter Creek, FERC Project No. 2731*, Gomez and Sullivan Engineers, P.C., August 1997, Table 5.1-1)

45. *Main Channel.* The main channel reach of 500 feet is the only reach receiving the total flow of the river. Historically, under highwater conditions, some flows entering the Bypass would jump the bank into a high-flow channel and enter the West Channel before reaching the Main Channel. This high-flow channel is planned to be used as the route for diverting conservation flows to the West Channel using the diversion weir. The diversion weir will affect the hydrology of the Main Channel. The Main Channel is a riffle reach of cobbles and boulders that provides fish cover and habitat superior to the East Channel.

    In the Main Channel, habitat for walleye spawning and incubation was found to be maximized at 870 cfs, remaining within 85 percent of maximum value from 750 to 1,000 cfs. Habitat for rainbow trout adults was maximized at 375 cfs, remaining high from 250 to 600 cfs. A flow range of 200 to 400 cfs provided the most habitat for fallfish juveniles, while adult habitat was highest over the range 85 to 250 cfs. Macroinvertebrate habitat was maximized in the flow range of 250 to 900 cfs. Lower flows lacked suitable water depths, and higher flows exhibited excessive velocities. The general lack of overlap of suitable flow ranges makes optimization of a single conservation flow for all target species and life stages impossible.

46. *Bypass.* For the range of flows modeled, habitat for walleye spawning and incubation was maximized at about 300 cfs and decreased at higher flows. A flow of 250 cfs was found to provide nearly the same amount of habitat as a flow of 450 cfs. Habitat for adult rainbow trout was maximized at 175 cfs, but the amount of habitat changed little between 125 to 250 cfs. Macroinvertebrate habitat was greatest at about 250 cfs and declined about 35 percent with flows reduced to 125 cfs.

47. *East Channel.* There are two distinct reaches in the East Channel–the upstream reach adjacent to the small island and the downstream reach. The upstream reach receives only a portion of the East Channel flow because of the island split, and it was more altered by the channelization work in 1951. In the downstream reach, more habitat was found for all target life stages of smallmouth bass and fallfish at flows less than 200 cfs. For macroinvertebrates, habitat increased rapidly with flow, up to a maximum at a flow of 375 cfs. The habitat/flow relationship for the upper reach was found to be similar.

    Habitat availability for fallfish fry and for smallmouth bass young-of-year was maximized at flows of 100 to140 cfs. For fallfish fry, flows in the range of 140 to 200 cfs provided similar habitat conditions without locational shifts in suitability. (A habitat

mapping function of the model was used to assess the specific location of stream cells where habitat of differing qualities was located over the range of flows.) At 375 cfs, much of the channel became unsuitable, and this trend continued until only a small amount of habitat remained at the channel margins. For bass young-of-year, the locations of suitable cells began shifting as flow increased to 172 cfs. Continued increases in flow resulted in further declines in habitat and a shift of suitable cells to the channel margins.

For the lower reach, most of the channel contained suitable habitat for macroinvertebrates at 200 cfs. As flows declined below 172 cfs, all suitable habitat was lost. Similarly, at 1,000 cfs there were almost no suitable cells.

48. *West Channel.* A riffle reach about midway down the West Channel was considered separately in the assessment of West Channel habitat. Outside of this riffle reach, the proposed conservation flow, 125 cfs, was found to provide close to the maximum habitat for most target species and life stages over the range of flows modeled. Spawning and incubation habitat for fallfish, however, was low at all flows, and habitat for adult smallmouth bass peaked at 300 cfs, with only about half as much habitat available at 125 cfs. Similarly, macroinvertebrate habitat was maximized at about 400 cfs and declined by 40 percent at 125 cfs.

At the riffle, a flow of 125 cfs was found to generally provide lower percentages of maximum habitat, although these results seemed to conflict somewhat with a visual assessment of habitat made during a joint flow demonstration completed on October 6, 1998. During the demonstration, a flow of 120 cfs was observed in the West Channel, and the representative from the Department of Fish and Wildlife judged it as adequate.

The amount of adult bass habitat was found to be relatively low throughout the West Channel at all flows modeled. Adult bass habitat quality was not high until depths exceed three feet, but velocities may be unsuitable at the flows necessary to reach that depth. The Department of Fish and Wildlife biologist concluded that adult bass are likely to utilize the West Channel for feeding, but may seek deeper, slower water downstream for resting, and that juvenile bass can better utilize the shallower water. The amount of juvenile habitat available in the West Channel was judged to be much greater.

The modeling indicated that a flow of about 600 cfs or greater would accommodate future walleye spawning and incubation in the riffle reach.

West Channel diversion weir

49. The existing entrance to the West Channel is just below the Bypass and off the Main Channel. If sufficient flows are released from the power station, some water flows into the West Channel. The control at the channel entrance is a gravel bed, and the proportion of flow entering the West Channel was found to have changed significantly between the 1997 habitat study and the 1998 flow demonstration. This change was attributed to a large-magnitude flood which occurred in June 1998[1] and apparently caused the control to shift.

50. To restore base flows to the West Channel, the applicant proposes to construct a diversion weir in the Bypass upstream of the main inlet of the West Channel. A second inlet to the West Channel would carry the diverted flows. That inlet channel was judged to occasionally carry high flows and, under the proposal, the entrance to that channel would be lowered and widened to provide, with the weir, the correct hydraulic split of the 250 cfs Bypass flow between the East and West channels. The applicant, the Agency, and the U.S. Fish and Wildlife Service agreed that, in addition to providing the target flow distribution, the following design criteria would be used for the diversion weir:

    a. It will include an upstream fish passage device, enabling fish to move up into the Bypass.

    b. It will have a high degree of permanence and require little or no maintenance.

    c. Its design will include a means of adjusting the distribution of flow diverted and passing over the structure, to assure that flow targets will be met.

    d. It will not result in unplanned channel or bank erosion.

    e. The natural appearance of the site will be retained inasmuch as possible.

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[1]The New Haven River basin was particularly hard hit during the June 27, 1998 flood. The New Haven River enters Otter Creek about one mile upstream of Huntington Falls. A gage (drainage area of 115 square miles) located near the mouth of the New Haven River recorded a peak flow of 21,700 cfs on that date, and a mean daily flow of 6,680 cfs. That river apparently caused a transitory high flow at Weybridge. It is noteworthy that the Otter Creek mainstem at the upstream Middlebury gage only experienced a mean daily flow of 3,270 cfs on that date and flows receded in the days following. (*Water Resources Data, New Hampshire and Vermont, Water Year 1998*, U.S. Geological Survey, 1999)

f. It will not create a safety hazard.

51. For the October 1998 demonstration, granular substrate material at the proposed inlet channel was removed and jersey barriers were installed across the Bypass to test the feasibility of the proposal and allow flow observations to occur in the critical habitat areas.

52. Three test flows were observed: 1) a bypass release of 246 cfs without project generation, 2) a bypass release of 170 cfs with project generation at about 536 cfs, and 3) a bypass release of 170 cfs with project generation at about 1,280 cfs. Some leakage of bypass flows through the temporary weir occurred.

Bypass 246 cfs/Generation None: About 155 cfs entered the West Channel via the excavated diversion channel. The diversion channel appeared as a high gradient riffle at this flow and was judged as providing very good habitat. Under the project proposal, the proposed flow regime would result in new, sustained habitat in this section of channel. Below the riffle reach, a crossover channel carried a portion of the flow to the West Channel's main entrance channel, and some of this flow, estimated at 35 cfs, actually moved back out into the East Channel. A net flow of about 120 cfs, slightly less than the proposed conservation flow, flowed downstream through the West Channel. Because there was no generation flow during this particular test and because the weir discharge distribution was not controlled (principally leakage through the structure and around the right end), there was some habitat dewatering at the head of the Main Channel directly below the diversion weir. The test diversion weir was also noted to have flooded a portion of the Bypass. At the weir, the water surface dropped about 2.3 feet across the structure.

Bypass 170 cfs/Generation 536 cfs: About 121 cfs was diverted by the weir and an additional 46 cfs entered the West Channel via its main entrance channel. The resulting total West Channel flow was about 167 cfs. Because the project was operating, Main Channel substrate was not dewatered unlike the conditions observed during the first test flow.

Bypass 170 cfs/Generation 1,280 cfs: The pool in the upper section of the West Channel gained sufficient flow to become more of a run. In the shallower portions of the West Channel further downstream, the conditions did not appear markedly different from the earlier two tests, and a conclusion was reached that peaking would not be significantly detrimental to habitat quality in the reach. At the weir, the water surface dropped about 9-12 inches across the structure.

53. The flow demonstration included removal of a pair of concrete blocks to provide openings in the crest of the diversion weir, so as to emulate a fish passage device. The openings that were created passed an estimated 18 cfs in total. The Taintor gate was opened to provide a bypass flow of about 250 cfs. As noted earlier in the test, the downstream area was substantially dewatered. Design of fish passage will necessitate providing sufficient flow to accommodate fish movement, physically and behaviorally.

Artificial flow fluctuations

54. The project is not operated to cycle to its maximum turbine capacity. Under the applicant's proposal, it would limit the peaking ratio between the peak flow and the conservation flow to 4.5:1 during any 24-hour period. Existing upramping and downramping procedures would continue to be utilized. In addition, because the impoundment will be held stable between April 1 and June 15 each year, no peaking will occur during this period.

55. The West Channel experiences relatively minor peaking since a larger proportion of the generation discharge flows down the East Channel. During the flow demonstration work, the West Channel experienced a total flow of about 440 cfs with the project generating at maximum capacity (about 1,600 cfs).

Fish passage/movement

56. Historically, migratory fish from Lake Champlain ascended many of its tributaries to access spawning waters. To meet the goals of the bistate plan for the development of the Lake's salmonid fishery (*A Strategic Plan for Development of Salmonid Fisheries in Lake Champlain*, NYS Department of Environmental Conservation, October 4, 1977), upstream and downstream passage provisions are being sought at dams on certain Lake tributaries. In Vermont, the Winooski River and the Lamoille River are included in this effort; however, this initiative has not been extended to Otter Creek as the other tributaries present a better opportunity for coldwater fish spawning.

57. The U.S. Fish and Wildlife Service requested a reservation of authority under Section 18 of the Federal Power Act to prescribe fishways at Weybridge Dam should future management plans warrant such measures. (Letter from Andrew L. Raddant, Regional Environmental Officer, U.S. Department of Interior Office of Environmental Policy and Compliance, to David Boergers, Secretary, FERC, May 24, 1999)

58. Fish injury and mortality due to intake entrainment and trashrack impingement may occur. Fish entering the headrace may not be able to exit and may pass through the 3.0-inch spaces between the trashrack bars and become subject to turbine mortality.

VII. Wildlife and Wetlands

59. In July 1996, William D. Countryman, a wetlands consultant, observed three wetland complexes associated with the project impoundment. Only one of the wetlands, Wetland C, is subject to protection under the Vermont Wetland Rules as a Class Two wetland. Wetland C is located near the head of the impoundment on riparian terraces elevated above the impoundment; it was judged not to be hydrologically dependent on the impoundment. According to the consultant, the "largest and best developed" wetland complex (Wetland A) is located on the inside of the river bend directly upstream of the dam. The third wetland (Wetland B) is on the outside of the bend opposite. (*Weybridge Project - Application for New License for Major Project (5 MW or Less)*, May 1998, vol. III, Appendix B, memorandum from William Countryman to Bruce Peacock, CVPS, September 3, 1996)

60. Wetland A is a shallow to deep marsh on alluvium deposited on the inside of the river bend. It is dominated by cattails, bur-reed, rice cutgrass, and arrowhead. These plant species tend to be drawdown tolerant, especially rice cutgrass, an annual which would be expected to compete favorably against other plant species that are less tolerant. Functionally, the wetland provides habitat for fish and wildlife, including migratory birds, and has aesthetic value.

61. Wetland B is a shallow marsh dominated by narrow-leaved cattail and bulrushes. Functionally, the wetland provides water quality value by filtering sediment and nutrients from runoff coming from an upgradient pasture.

62. The applicant measured the change in impoundment surface area when the impoundment is drawn two feet and four feet. It dropped from 62 acres (full) to 51 acres and 41 acres, respectively. (*Weybridge Project - Application for New License for Major Project (5 MW or Less)*, May 1998, vol. III, Appendix B, Impoundment Wetted Area Study, undated) The impoundment maps produced in this study were compared to the wetlands map to determine the extent of dewatering of wetlands A and B during drawdowns of two and four feet. The two wetlands become about 66 percent and 15 percent dewatered, respectively, during a two-foot drawdown. During a four-foot drawdown, the wetlands are dewatered 78 percent and 96 percent, respectively.

63. Much of the reduced surface area acreages recorded in the Impoundment Wetted Area Study stem from the backwater limits moving downstream as the impoundment is lowered. The backwater is reduced by about 1,500 feet when the impoundment is drawn four feet. This represents about 8 acres of the 21-acre surface area reduction. Therefore, about 13 acres of aquatic habitat is dewatered by a four-foot drawdown. For a two-foot drawdown, there is significantly less dewatering of habitat, about 6 acres. In addition to wetlands A and B, the dewatered habitat includes a relatively narrow band of shoreline along both banks of the river.

VIII. Rare and Endangered Plants and Animals; Outstanding Natural Communities

The Vermont Endangered Species Law (10 V.S.A. § 5401 to 5403) governs activities related to the protection of endangered and threatened species.

64. The project reach is likely to support mussel species, including ones that are state listing as endangered or threatened, although no recent surveys have been completed to confirm use.

65. Osprey, a state-threatened species, are known to use this reach of the river on a transitory basis, with no known nesting attempts.

66. A hackberry stand, which is considered to be a significant community in Vermont, exists in the upper floodplain of Otter Creek below the dam, but is unaffected by normal project operations. A state-listed threatened plant species, green dragon, also exists below the dam, but elevated above the river by over eight feet.

67. No other protected species have been listed for the project reach.

IX. Shoreline Erosion

68. Shoreline erosion is common for valley-bottom rivers like Otter Creek as they change their channel form through meander processes that erode the alluvial floodplain soils. An erosion survey was completed by Knight Consulting Engineers, Inc. on October 15, 1997, including both the impoundment and the downstream reach to the Lemon Fair. For the downstream reach, the observer concluded that, although there are some banks experiencing severe erosion, project operation is not a significant influence. In reaching that conclusion, he noted that peaking to total plant capacity (1,600 cfs) rarely occurs. The observer concluded that the impoundment shoreline erosion was relatively minor compared to downstream erosion and that the predominant factors related to natural high flows and perhaps ice action, and not operational cycling of the

impoundment. (*Weybridge Project - Application for New License for Major Project (5 MW or Less)*, May 1998, vol. III, Appendix B, Erosion Study Report, October 30, 1997)

X. Recreational Use

69. Recreational uses at the project include angling, boating, sightseeing, and picnicking. The applicant estimated that approximately 182 people visited the project and participated in some form of recreation in 1996 (*Weybridge Project - Application for New License for Major Project (5 MW or Less)*, May 1998, vol. I, p. E-25). The applicant estimated that 10 percent of the project shoreline is accessible to the public via the applicant's lands. Otter Creek is particularly popular for canoeing as it is boatable for much of the year.

70. A day use area with a picnic tables and parking currently exists on the island below the old powerhouse. The applicant also provides a canoe portage with a take-out located on the east bank just upstream of the dam and a put-in at the south tip of the island. The applicant proposes several recreational improvements, including replacement of the information sign, installation of an interpretive sign, directional signs, and modifying one of the picnic tables for handicapped use.

71. The portage take-out is located at a very steep bank, making it very difficult to use, especially when the impoundment is drawn down. The Department recommended, in a letter to FERC dated May 25, 1999, that the applicant consider, when drafting the final recreation plan, whether the canoe take-out can be relocated a short distance upstream to allow canoes to be put in or taken out over a less steep bank. This area may involve land outside of the project boundary.

XI. Aesthetics

72. The impoundment shoreline is primarily bordered by forested upland areas. Closer to the dam, the shoreline is more open; near the right bank are Field Days Road and Twitchell Hill Road. The dam itself is in a village setting. Below the dam, the river courses through a bedrock gorge split by a forested island. The old powerhouse (c. 1922) on the island adds interest to the setting, which otherwise is largely dominated by the dam, highway bridges, powerhouse, and substation. Except for the Taintor gate discharge, the dam rarely spills, and no special spillage for aesthetics is proposed as part of this relicensing.

XII. State Comprehensive River Plans

The Agency, pursuant to 10 V.S.A. Chapter 49, is mandated to create plans and policies under which Vermont's water resources are managed and uses of these resources are defined. The Agency must, under Chapter 49 and general principles of administrative law, act consistently with these plans and policies, whenever possible.

Hydropower in Vermont, An Assessment of Environmental Problems and Opportunities (May 1988)

73. The Department publication *Hydropower in Vermont, An Assessment of Environmental Problems and Opportunities* is a state comprehensive river plan. The hydropower study, which was initiated in 1982, indicated that hydroelectric development has a tremendous impact on Vermont streams. Artificial regulation of natural stream flows and the lack of adequate minimum flows at the sites were found to have reduced to a large extent the success of the state's initiatives to restore the beneficial values and uses for which the affected waters are managed.

74. With respect to the Weybridge Project, the plan included recommendations that the Department continue to attempt to resolve flow issues related to the current project license and the 1975 water quality certification. These issues have been considered in the Department's current review.

1993 Vermont Recreation Plan

75. The *1993 Vermont Recreation Plan* (Department of Forests, Parks and Recreation), through extensive public involvement, identified water resources and access as top priority issues. The planning process disclosed that recreational use of surface waters is increasing, resulting in greater concern about water quality, public access to Vermont's waters, and shoreland development.

76. The Water Resources and Access Policy is:

> It is the policy of the State of Vermont to protect the quality of the rivers, streams, lakes, and ponds with scenic, recreational, cultural and natural values and to increase efforts and programs that strive to balance competing uses. It is also the policy of the State of Vermont to provide improved public access through the acquisition and development of sites that meet the needs for a variety of water-based recreational opportunities.

77. The applicant proposes to provide continued access to the river in the project area with shoreline access only limited in the immediate area of the powerhouse where an area has been fenced. This access

and improved flow management would be compatible with this policy and balance the competing uses of recreation and hydropower. Failure to provide access would exacerbate a critical state recreational problem.

78. Another priority issue identified in the Recreation Plan is the loss or mismanagement of scenic resources. The plan notes "[t]he protection of the scenic and visual resources in Vermont is paramount if Vermont is to maintain its renowned charm and character."

79. The Scenic Resources Protection and Enhancement Policy is:

> It is the policy of the State of Vermont to initiate and support programs that identify, enhance, plan for, and protect the scenic character and rural traditions of Vermont.

XIII. Analysis

Water Chemistry

80. Available water quality sampling by the Department of Environmental Conservation and by the applicant does not disclose any critical water quality issues at the project. The dissolved oxygen concentrations met the concentration and saturation standards set forth in Standards. The project, as proposed, will spill a minimum of 125 cfs at all times via the Taintor gate. This flow is somewhat less than the river's 7Q10 value, which has been estimated at 188 cfs. Discharge of this flow through the gate will provide a high level of oxygen entrainment.

    Since the below-project conservation flow would be 250 cfs, the project will not be capable of operating when inflows recede below 250 cfs. Under those conditions, all flows would spill and benefit from this point source of reaeration during critical low flow periods. Based on the U.S. Geological Survey gage data, spillage of all inflows will occur, on the average, about 3 percent of the time in June, 8 percent of the time in July, 17 percent of the time in August, and 15 percent of the time in September.

81. There are protracted periods during which the plant is shut down and no releases, except unquantified leakage, are made into the tailrace reach. The lack of flows in this reach may result in substandard conditions of low dissolved oxygen and high temperatures in the tailrace pool. Low dissolved oxygen levels could cause a fish kill for fish residing in the pool. It could also create a condition where a plug of water with a dissolved oxygen deficit could be flushed downstream when the station starts back up, causing impacts downstream until the water becomes sufficiently mixed and aerated.

This certification is being conditioned to require the applicant to monitor the tailrace water quality during such periods to determine if special operational measures will be necessary to assure there are no violations of water quality standards. For the purpose of determining whether there may be a problem, the dissolved oxygen monitoring will cover the period July - September in order to target worse-case conditions, although significant dissolved oxygen deficits, if they occur, may extend to June and October as well.

Flow Needs in Stream Reaches for Habitat Protection

82. Channelization of the river in 1951 and operation of the project in a peaking mode has degraded downstream aquatic habitat in a river where unimpounded habitat is relatively scarce. As a result of the channelization project, the East Channel lacks natural channel characteristics favorable to providing high quality aquatic habitat. It is deficient in shallow, low velocity habitat over a wide range of flows, typically found along the stream margins in natural channels. It also lacks large bed elements (such as boulders and cobbles), which would provide velocity refuges for fish. The habitat modeling done by the applicant indicated that even under natural moderate-to-high flows the reach becomes unsuitable due to excessive velocities. The East Channel is particularly poor habitat for the younger fish life stages. Large and more mobile fish capable of coping with higher velocities and changing habitat conditions are more likely to utilize the East Channel. There is no feasible way to ameliorate this situation. Extensive channel modifications to restore historic conditions would be prohibitively expensive and would be likely to unacceptably raise the tailwater elevation.

83. The West Channel contains higher quality physical habitat and offers the greatest opportunity for improvement through the establishment of a suitable flow regime. The proposed diversion structure, if successful, will restore flow, and hence habitat conditions, to the West Channel. The influence of hydropeaking in this channel is not significant. Although the pool at the upstream end of the West Channel does not receive as much flow as would be desirable, the lack of habitat in that section is offset by the creation of new habitat in the proposed diversion channel. The diversion channel will provide high gradient, fast water habitat, a type of habitat that is less common in Lower Otter Creek.

84. The diversion structure must provide for the target flow distribution and include a fish passage device that will allow fish to safely and effectively move upstream to the Bypass. The agreed-upon criteria listed in Finding 50 should be applied in the design. The design should also consider the need to avoid dewatering of habitat in the

Main Channel when the project is not operating and the need to use a low-profile structure to avoid flooding a significant amount of the Bypass habitat.

85. Into the Bypass, the licensee proposes to release 250 cfs, or inflow if less, when the project is not generating, and 125 cfs during generation. This flow regime will provide acceptable habitat conditions in the Bypass.

86. Walleye spawning and incubation occurs during April and May. Potential spawning and incubation habitat exists in the Main Channel, in the Bypass, and in the West Channel. The project will be operating in a run-of-river mode during this period and providing at least 250 cfs should the Department of Fish and Wildlife begin to manage for walleye in the downstream reach. Under the proposed operating regime and diversion configuration, walleye spawning and incubation habitat will be protected in the Main Channel and the Bypass. A lower level of support will be provided in the West Channel, since that channel was found to require on the order of 600 cfs to support walleye use, and operation of the project at full capacity (1,600 cfs) through most of the spring will result in substantially less than 600 cfs in the West Channel.

Impoundment Habitat

87. Impoundment aquatic habitat, including the wetland habitats, are currently impacted by drawdowns of up to six feet. Under the original licensing proposal, the applicant indicated that the normal peaking operation would use a two-foot cycle, but that additional less frequent operational drawdowns of four feet and six feet would occur 20-30 times annually and 10 times annually, respectively. The applicant's wetland and impoundment wetted area studies indicate that extensive dewatering of aquatic habitat occurs when drawdowns exceed two feet in magnitude. Impoundment water level fluctuations adversely affect fish, wildlife and plant life. Due to freezing effects, winter drawdowns are believed to be more problematic than those during warmer periods. Effects can include freezing of plant tubers, freezing of hibernating reptiles and amphibians, and ice scour. Summer drawdowns, especially on hot days, can cause plant dessication and mortality and stranding and loss of fish.

88. The applicant revised its drawdown proposal on April 22, 1999, limiting the operational drawdown to no greater than two feet and eliminating drawdowns between April 1 and June 15. The applicant indicated that drawdowns in excess of two feet may occasionally be needed for dam maintenance or operator safety, and agreed to consult with the Agency of Natural Resources before undertaking

such drawdown, unless necessary due to an emergency. Drawdowns in excess of two feet would not relate to system demand and line stabilization, however. (Letter from Michael J. Scarzello, P.E., applicant to Jeffrey R. Cueto, P.E., Department, April 22, 1999)

89. The elimination of spring drawdowns would benefit spring spawning of warmwater fish species as dewatering of eggs would be avoided. The six-foot-high steel flashboards may occasionally be manually tripped during spring highwater events, but the frequency of such events is low due to the control provided by the Taintor gate and the rubber flashboard system. The applicant indicated that, if the boards were tripped, they would be reset within 24 hours of the river stabilizing.

90. Even with optimal timing and minimization of the drawdown duration, some mortality of fish and benthic organisms is expected. Drawdowns several days in duration may be sufficient to cause substantial plant mortality. To the extent feasible, drawdowns in excess of two feet should be avoided. Where the drawdowns are unavoidable, the magnitude and duration of the drawdown should be minimized. Any planned drawdowns should be scheduled to take place at the end of the growing season but before herptile hibernation (about October 15) or freezing conditions begin. The next best option is timing for the latter half of June, preferably on a cool, overcast day. Limiting the duration of such drawdowns is also very important. One drawdown per year that is poorly timed or lasts long enough to cause significant plant or benthos mortality will have lasting effects, negating the benefits of drawdown limitations.

Screening

91. The 3.0-inch bar spacing on the trashracks may promote fish entrainment. Consideration should be given to using racks with a one-inch clear spacing at such time as the racks need replacement. By condition of this certification, the applicant shall be required to consult the Department of Fish and Wildlife at the time the trashracks for the plant are scheduled for replacement, and to obtain Department approval for the design.

Recreation and Aesthetics

92. Vermont Water Quality Standards require the protection of existing water uses, including the use of water for recreation. Standards also requires the management of the waters of the State to improve and protect water quality in such a manner that the beneficial uses and values associated with a water's classification are attained. (Standards, Section 1-03 *Anti-degradation Policy*)

93. Beneficial values and uses of Class B waters include water that exhibits good aesthetic value and swimming and recreation. (Standards, Section 3-03(A) *Class B Waters: Management Objectives*) Standards, Section 2-02(B) *Hydrology: Artificial Flow Conditions* prohibits regulation of river flows in a manner that would result in an undue adverse effect on any existing use or beneficial value or use.

94. The applicant has proposed certain minor recreational improvements and will provide continued public access to the project area. The portage will accommodate through boating as well as a starting point to boat the impoundment of the downstream reach as far as Lake Champlain. By condition of this certification, the applicant shall be required to investigate relocation of the take-out to a more suitable location and consult with the Department on future recreational improvements.

95. The forested natural condition of the island, gorge, and impoundment should be preserved as the forested shoreline adds visual interest, as well as adding to wildlife habitat. This certification is being conditioned to require the applicant to maintain the forested riparian zone to the extent feasible.

Erosion

96. Erosion, if severe, can impair recreational use and cause turbidity and the discharge of suspended solids, potentially violating the standards for those parameters (Turbidity: Standards, Section 3-03(B)(1); Total Suspended Solids: Standards, Section 3-01(B)(7)). No unusual shoreline erosion problems potentially attributable to project operation have been documented at the project.

97. Recreational use of project lands may cause some localized erosion. Proper recreation planning limits the risk of significant erosion; however, the Department will maintain continuing jurisdiction over this issue and require modifications where found necessary to abate erosion.

Debris

98. The applicant does not provide information on the handling and disposal of trashrack debris and other project related debris. The depositing or emission of debris and other solids to state waters violates the state solid waste laws and Standards, Section 3-01(B)(7) *Settleable solids, floating solids, oil, grease, scum, or total suspended solids*. Debris may also impair aesthetics and boating. A plan is being required as a condition of this certification.

General Conclusions

99. The project, if operated consistent with the conditions of this certification, will support the designated uses for Class B waters (Standards, Section 3-03(A) *Class B Waters: Management Objectives*); will not have a significant impact on aquatic biota, fish or wildlife such that the existing populations would have their viability impaired (Standards, Section 1-03(B)(2)(a) *Anti-degradation Policy: Protection of Existing Uses*); and will not significantly degrade the use of the water body for recreation, fishing, water supply or commercial purposes (Standards, Section 1-03(B)(2)(a) *Anti-degradation Policy: Protection of Existing Uses*).

100. As required under Standards, Section 2-02 *Hydrology*, the applicant's artificial regulation of flows, if consistent with the conditions of this certification, will not result in an undue adverse effect on any existing or designated use, including high quality habitat for aquatic biota, fish and wildlife. In making this determination, the Water Quality Policy (10 V.S.A. § 1250) has been considered, including the need to allow beneficial and environmentally sound development.

101. All of the restrictions and conditions set forth herein, in conjunction with the applicant's proposal, are necessary to ensure compliance with all applicable provisions of the Vermont Water Quality Standards and other appropriate requirements of state law.

ACTION OF THE DEPARTMENT

Based on its review of the applicant's proposal and the above findings, the Department concludes that there is reasonable assurance that operation and maintenance of the Weybridge Hydroelectric Project as proposed by the applicant and in accordance with the following conditions will not cause a violation of Vermont Water Quality Standards and will be in compliance with sections 301, 302, 303, 306, and 307 of the Federal Clean Water Act, P.L. 92-500, as amended, and other appropriate requirements of state law:

A. The applicant shall operate and maintain this project consistent with the findings and conditions of this certification, where those findings and conditions relate to protection of water quality and support of designated and existing uses under Vermont Water Quality Standards and other appropriate requirements of state law.

B. **Flow Management.** Except as allowed in Condition C below, the project shall be operated to provide conservation flows of 125 cfs in the Bypass and the West Channel and 125 cfs in the East Channel. When the project is not operating, the total conservation flow of 250 cfs shall be maintained using a Taintor gate release into the Bypass. During the period April 1 - June 15, the project shall be operated with a stable impoundment in a true run-of-river mode (outflow equal to impoundment inflow on an instantaneous basis). Upon a written request by the Department, the applicant shall increase the April - May conservation flow for the Bypass to 250 cfs. The request shall follow the Department's receipt of a written notification from the Department of Fish and Wildlife that walleye management has been instituted for the Vergennes impoundment. The Department of Fish and Wildlife shall provide the applicant with a copy of the notification, which shall include a walleye management plan with a stocking schedule. The Department may suspend this spring flow requirement upon a determination that walleye management has been abandoned or discontinued. Minimum flows shall be released on a continuous basis and not interrupted. Operations shall utilize the proposed ramping protocols and the maximum 24-hour generating release cycling ratio of 4.5:1.

C. **Impoundment Management.** During the spring run-of-river period, the impoundment shall be maintained no more than three inches below the flashboard crest (three inches below 174.3 feet NGVD), unless the flashboard section needs to be manually tripped, in which case it would be reset within 24 hours of the river stabilizing. During the remainder of the year, the impoundment shall not be drawn more than 2.0 feet below the flashboard crest, unless necessary for dam maintenance or operator safety, or due to a non-power emergency beyond the control of the applicant. Planned, non-emergency drawdowns shall be subject to prior consultation with and approval by the Department, with the intent that drawdowns in excess of 2.0 feet are to be avoided to the extent feasible, and if not avoidable, timed to minimize adverse impacts.

D. **Flow Distribution Structure.** The applicant shall construct a flow distribution structure at the lower end of the Bypass to provide for compliance with the conservation flows required in this certification. The structure shall be designed in accordance with the criteria set forth in Finding 50 above and shall use a low profile to minimize flooding of the Bypass. The design shall be filed with the Department within 120 days of issuance of this certification and shall be subject to Department approval. The design shall include a rating that shows the expected apportionment of flows between the West and East channels, including apportionment when total project releases decline below 250 cfs. The structure shall be designed to

limit dewatering of habitat in the Main Channel when the station is off line. The design shall include provisions for one or more devices to accommodate upstream and downstream fish movement between the Main Channel and the Bypass. The design shall also include the proposed implementation schedule and an erosion control plan. The erosion control plan shall include a description of how flows are to be managed during the construction period. No construction shall commence until Department approval is received.

E. **Flow Management Plan.** The applicant shall develop and file with the Department a flow management plan detailing how the project will be operated to comply with the conservation flow and impoundment fluctuation limitations set forth in this certification. The plan shall include information on how the project will be managed to control lag times and avoid related non-compliance with the conservation flow requirements. The plan shall also incorporate information on ramping, complying with the 4.5:1 cycling ratio, and managing run-of-river spring operations. After Department approval of the plan, the plan shall be filed with FERC no later than 120 days from the date of license issuance. FERC shall either approve the plan or return the plan to the applicant for revision to incorporate FERC-recommended changes. After revision, the applicant shall submit the plan to the Department for approval of the changes. The plan shall then be filed with FERC for final approval. The Department reserves the right of review and approval of any material changes made to the plan.

F. **Flow Distribution Structure Performance Reports.** For the first five years of use, the applicant shall file annual reports with the Department detailing the performance of the flow distribution structure. The reports shall be filed within 60 days of the end of the calendar year and shall include information on the stability of the flow rating, the reliability of the fish movement devices, and structural damage, if any. Visual observations shall be made at least monthly between December and March and at least once every two weeks between April and November, and the observations shall be documented in the annual reports. The annual reports shall include any recommendations on structural modifications and any opinions on expected long-term effectiveness of the structure. Should it be determined after the fifth year that the structure does not reliably maintain conservation flows and cannot reasonably be adapted to perform as intended, the applicant shall propose an alternate method for compliance. Should it be determined that the structure will no longer be used for maintenance of conservation flows, the applicant shall remove the structure and restore the river channel.

G. **Flow Management during Impoundment Refill.** Following an approved maintenance drawdown and assuming that refill cannot otherwise be reasonably accomplished, up to 10 percent of instantaneous project inflow may be placed in storage in order to refill the impoundment without significantly reducing downstream flows.

H. **Monitoring Plan for Impoundment and Flow Management.** The applicant shall develop a plan for continuous monitoring of flow releases at the project (Taintor gate releases into the Bypass, discharges from the powerhouse, and spillage, if any), impoundment levels, and inflows. The plan shall provide for an initial field verification of the design flow distribution at the flow distribution structure and periodic field measurements thereafter to assure that the distribution has not changed; the point of compliance in the West Channel shall be located below the two islands at the channel entrance (about 1,000 feet below the proposed flow distribution structure). The applicant shall maintain continuous records of flows and impoundment levels and provide such records on a regular basis as per specifications of the Department. The plan shall be developed in consultation with the Department and the U.S. Fish and Wildlife Service. After Department approval of the plan, the plan shall be filed with FERC no later than 120 days from the date of license issuance. FERC shall either approve the plan or return the plan to the applicant for revision to incorporate FERC-recommended changes. After revision, the plan shall be filed for Department approval. The plan shall then be filed with FERC for final approval. The Department reserves the right of review and approval of any material changes made to the plan.

I. **Tailrace Dissolved Oxygen Monitoring.** The applicant shall monitor tailrace dissolved oxygen concentrations at the dam during the period July - September when generation has been suspended for at least 48 hours. The purpose of the monitoring is to determine if special freshening flows are needed to assure that substandard dissolved oxygen conditions are not produced by plant shutdowns. The applicant shall file a plan of study within 90 days of issuance of this certification for Department approval, with sampling to be initiated during the first season following license issuance. Should the monitoring disclose a problem, the applicant shall propose a remedial measure, subject to Department approval. Monitoring results shall be filed on or before December 31 of the sampling year. The applicant may cease monitoring when the Department determines that adequate representative data has been collected consistent with the study plan.

J. **Prevention of Fish Entrainment at Intake.** Prior to the next replacement of the intake trashrack, the applicant shall consult with the Department of Fish and Wildlife with respect to trashrack design to determine the appropriate bar clear spacing and shall file the trashrack design information with the Department of Environmental Conservation for approval prior to commencement of work.

K. **Turbine Rating Curves.** The applicant shall provide the Department with a copy of the turbine rating curves, accurately depicting the flow/production relationship, for the record within one year of the issuance of the license.

L. **Debris Disposal Plan.** The applicant shall develop a plan for proper disposal of debris associated with project operation, including trashrack debris. The plan shall be developed in consultation with the Department. After Department approval of the plan, the plan shall be filed with FERC no later than 120 days from the date of license issuance. FERC shall either approve the plan or return the plan to the applicant for revision to incorporate FERC-recommended changes. After revision, the applicant shall submit the plan to the Department for approval of the changes. The plan shall then be filed with FERC for final approval. The Department reserves the right of review and approval of any material changes made to the plan at any time.

M. **Maintenance and Repair Work.** Any proposals for project maintenance or repair work, including desilting, drawdowns in excess of 2.0 feet below the crest of the flashboards to facilitate repair/maintenance work, and tailrace dredging, shall be filed with the Department for prior review and approval, if said work may have a material adverse effect on water quality or cause less-than-full support of an existing use or a beneficial value or use of State waters.

N. **Public Access.** The applicant shall allow public access to the project lands for utilization of public resources, subject to reasonable safety and liability limitations. Such access should be prominently and permanently posted so that its availability is made known to the public. Any proposed limitations of access to State waters to be imposed by the applicant shall first be subject to written approval by the Department. In cases where an immediate threat to public safety exists, access may be restricted without prior approval; the applicant shall so notify the Department and shall file a request for approval, if the restriction is to be permanent or long term, within 14 days of the restriction of access.

O. **Recreational Facilities.** Recreational facilities shall be constructed and maintained consistent with a recreation plan approved by the Department. The plan shall be filed with the Department within 60 days of license issuance and shall include an updated implementation schedule. If changes to current plan are contemplated, the applicant is advised to consult with the Department in the development of revised plans. The applicant shall investigate and propose, if feasible, improvement of the existing canoe access or relocation to a riverbank location that is less steep and provides for safer use. Where appropriate, the recreation plans shall include details on erosion control. Modifications to the recreation plan shall also be subject to Department approval over the term of the license.

P. **Erosion Control.** Upon a written request by the Department, the applicant shall design and implement erosion control measures as necessary to address erosion occurring as a result of use of the project lands for recreation. Any work that exceeds minor maintenance shall be subject to prior approval by the Department and FERC.

Q. **Compliance Inspection by Department.** The applicant shall allow the Department to inspect the project area at any time to monitor compliance with certification conditions.

R. **Posting of Certification.** A copy of this certification shall be prominently posted within the project powerhouse.

S. **Approval of Project Changes.** Any change to the project that would have a significant or material effect on the findings, conclusions, or conditions of this certification, including project operation, must be submitted to the Department for prior review and written approval where appropriate and authorized by law and only as related to the change proposed.

T. **Reopening of License.** The Department may request, at any time, that FERC reopen the license to consider modifications to the license as necessary to assure compliance with Vermont Water Quality Standards.

U. **Continuing Jurisdiction.** The Department reserves the right to add and alter the terms and conditions of this certification, when authorized by law and as appropriate to carry out its responsibilities with respect to water quality during the life of the project.

Canute E. Dalmasse
Commissioner

By /s/
Wallace McLean, Director
Water Quality Division

Department of Environmental Conservation

Dated at Waterbury, Vermont
this 7th day of May, 2001

c Distribution List

From:	Katie Sellers
To:	"Davis, Eric"
Cc:	Andy Qua; "Greenan, John"
Subject:	Weybridge Project - Operations Data Submission for LIHI Application
Date:	Tuesday, June 05, 2018 3:26:00 PM
Attachments:	Weybridge Theoretical Turbine Curve_2018.pdf

This message contains attachments delivered via ShareFile.

- 2016-2017 Weybridge Operations Data_FINAL.xlsx (21.8 MB)

Download the attachments by clicking here.

Hi Eric,

Kleinschmidt, on behalf of GMP, herein provides one-year (2016-2017) of Weybridge Hydroelectric Project (FERC No. 2731) operations data via ShareFile for review. This operations data is being supplied to the Vermont Department of Environmental Conservation (VDEC) for verification of Project compliance with the VDEC Water Quality Certificate conditions, as requested for Low Impact Hydropower Institute certification application review.

The attached 2016-2017 data depicts project generation, headpond level, river flow, and flashboard data to display operations occurring at the Weybridge Project. As depicted in the spreadsheet cover page, flow data was prorated from USGS gage 04282500 – Otter Creek at Middlebury, VT and USGS gage 040282525 – New Haven River at Brooksville, Near Middlebury, VT. Compliant operations are represented well across the dataset. As displayed in the data, the headpond was drawn down at the end of October 2016 for a sluice gate replacement and a short drawdown occurred again at the end of March 2017 to allow for flashboard work. Additional fluctuations in headpond levels correlate to the following identified occurrences:

- Weather events
- River forecast considerations
- Faulty transducer data
- Temporary maintenance activities
- Generator trips

In addition, please find a theoretical turbine rating curve for the Weybridge Project attached. This theoretical curve was developed using a combination of the attached operations data and standard factory information on the individual turbine. This curve has an accuracy range of approximately +5% to -10%.

Please note that the attached operational data is considered provisional by GMP, but has been vetted with operations staff to identify likely causes of anomalies, identified above. Should you have any questions upon review, please do not hesitate to make contact with John or myself as GMP staff are available to provide background information or further explanation as needed.

Thank you,
Katie

*To access ShareFile documents, select the “clicking here” link, fill in your name, email, and organization name when prompted (no passwords required). You will then be allowed to download the documents.

Katie E. Sellers, M.S.
Regulatory Coordinator
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*Providing **practical** solutions for **complex** problems affecting energy, water, and the environment*

From:	Davis, Eric
To:	Katie Sellers
Cc:	Nuria Claudio
Subject:	RE: Weybridge Hydroelectric Project - Review for LIHI Re-Certification
Date:	Friday, January 27, 2017 10:01:10 AM
Attachments:	image002.png

Good morning Katie,

I can confirm that waters listed below are on Vermont's 303 (d) List of Impaired Waters: Part A – Impaired Surface Waters in need of a TMDL. For each reach, I can describe the cause of impairment and the potential impact of project operations.

- Lower Otter Creek, BELOW Vergennes Waste Water Treatment Facility
  - This reach is listed as impaired for e. Coli due to periodic and recurring combined sewer overflows of the wastewater pump station. The projects current operations continue to not be a contributing cause to impairment of this reach.
- Otter Creek in vicinity of Rutland Waste Water Treatment Facility
  - This reach is listed as impaired for e. Coli due to the Rutland City WWTF collection system passing combined sewer overflows. The projects current operations continue to not be a contributing cause to impairment of this reach.
- Little Otter Creek RM 15.4 to RM 16.4 for Agricultural nutrients and sediments.
  - This reach is on a tributary to Otter Creek. It is listed as impaired for nutrients and sediment. The projects current operations continue to not be a contributing cause to impairment of this reach.
- Lake Champlain (Ferrisburg) for elevated levels of PCBs in Lake Trout
  - This segment is listed as impaired for PCBs. The projects current operations continue to not be a contributing cause to impairment of this segment.

Eric

Eric Davis, *River Ecologist*

1 National Life Drive, Main 2
Montpelier, VT 05620-3522
802-490-6180 / eric.davis@vermont.gov
http://www.watershedmanagement.vt.gov/rivers
(Please note my new e-mail address, effective July 27, 2015)

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION
RIVERS PROGRAM

See what we're up to on our Blog, Flow.

From: Katie Sellers [mailto:Katie.Sellers@KleinschmidtGroup.com]
Sent: Tuesday, January 17, 2017 5:06 PM
To: Davis, Eric <Eric.Davis@vermont.gov>
Cc: Nuria Claudio <Nuria.Claudio@Kleinschmidtgroup.com>
Subject: Weybridge Hydroelectric Project - Review for LIHI Re-Certification

Hi Eric, I am working on another LIHI re-certification application for Green Mountain Power: Weybridge Hydroelectric Project (FERC No. 2731) located on Otter Creek.

The LIHI application asks that we gain your feedback on the following water quality information:

Otter Creek, in general, has been designated by the Vermont Water Resources Board as Class B waters. On September 7, 2016, the Vermont DEC issued, under Section 303(d) of the Federal Clean Water Act, a list of waters considered to be impaired based on water quality monitoring efforts. Otter Creek was listed as "impaired" with specific portions of Otter Creek having different pollutants:

- Lower Otter Creek, BELOW Vergennes Waste Water Treatment Facility for e. Coli (downstream of Project);
- Otter Creek in vicinity of Rutland Waste Water Treatment Facility for e. Coli (upstream of Project);
- Little Otter Creek RM 15.4 to RM 16.4 for Agricultural nutrients and sediments (downstream of Project);
- Lake Champlain (Ferrisburg) for elevated levels of PCBs in Lake Trout (downstream of Project).

Could you please confirm, to your best abilities, that the Project's current operations continue to not be a contributing cause to the river's water quality limitations?

Do let me know if you have any questions upon review.

Thank you!
Katie

Katie Sellers
Regulatory Coordinator
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APPENDIX D

THREATENED AND ENDANGERED SPECIES

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Ecological Services Field Office
70 COMMERCIAL STREET, SUITE 300
CONCORD, NH 03301
PHONE: (603)223-2541 FAX: (603)223-0104
URL: www.fws.gov/newengland

Consultation Code: 05E1NE00-2017-SLI-0674 January 17, 2017
Event Code: 05E1NE00-2017-E-01106
Project Name: Weybridge - Bypass Reach and Upstream ZOE

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment

United States Department of Interior
Fish and Wildlife Service

Project name: Weybridge - Bypass Reach and Upstream ZOE

Official Species List

Provided by:

New England Ecological Services Field Office
70 COMMERCIAL STREET, SUITE 300
CONCORD, NH 03301
(603) 223-2541
http://www.fws.gov/newengland

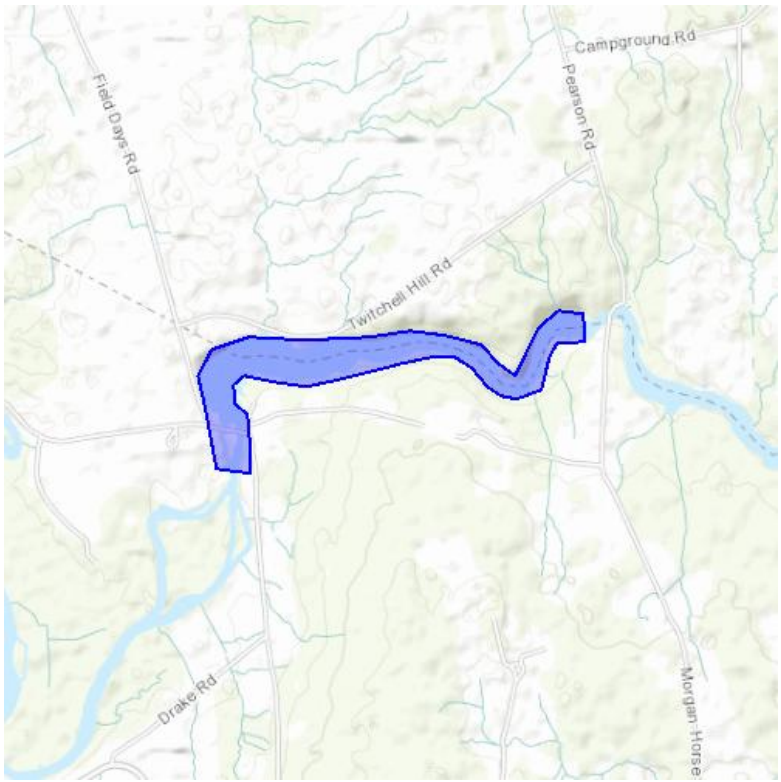
Consultation Code: 05E1NE00-2017-SLI-0674
Event Code: 05E1NE00-2017-E-01106

Project Type: DAM

Project Name: Weybridge - Bypass Reach and Upstream ZOE
Project Description: LIHI Review

Please Note: The FWS office may have modified the Project Name and/or Project Description, so it may be different from what was submitted in your previous request. If the Consultation Code matches, the FWS considers this to be the same project. Contact the office in the 'Provided by' section of your previous Official Species list if you have any questions or concerns.

Project Location Map:



Project Coordinates: The coordinates are too numerous to display here.

Project Counties: Addison, VT

Endangered Species Act Species List

There are a total of 2 threatened or endangered species on your species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Critical habitats listed under the **Has Critical Habitat** column may or may not lie within your project area. See the **Critical habitats within your project area** section further below for critical habitat that lies within your project. Please contact the designated FWS office if you have questions.

Mammals	Status	Has Critical Habitat	Condition(s)
Indiana bat *(Myotis sodalis)* Population: Wherever found	Endangered		
Northern long-eared Bat *(Myotis septentrionalis)* Population: Wherever found	Threatened		

Critical habitats that lie within your project area

There are no critical habitats within your project area.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Ecological Services Field Office
70 COMMERCIAL STREET, SUITE 300
CONCORD, NH 03301
PHONE: (603)223-2541 FAX: (603)223-0104
URL: www.fws.gov/newengland

Consultation Code: 05E1NE00-2017-SLI-0675 January 17, 2017
Event Code: 05E1NE00-2017-E-01108
Project Name: Weybridge Dam - Downstream ZOE

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment

United States Department of Interior
Fish and Wildlife Service

Project name: Weybridge Dam - Downstream ZOE

Official Species List

Provided by:

New England Ecological Services Field Office
70 COMMERCIAL STREET, SUITE 300
CONCORD, NH 03301
(603) 223-2541
http://www.fws.gov/newengland

Consultation Code: 05E1NE00-2017-SLI-0675
Event Code: 05E1NE00-2017-E-01108

Project Type: DAM

Project Name: Weybridge Dam - Downstream ZOE
Project Description: LIHI Review

Please Note: The FWS office may have modified the Project Name and/or Project Description, so it may be different from what was submitted in your previous request. If the Consultation Code matches, the FWS considers this to be the same project. Contact the office in the 'Provided by' section of your previous Official Species list if you have any questions or concerns.

Project Location Map:

Project Coordinates: The coordinates are too numerous to display here.

Project Counties: Addison, VT

Endangered Species Act Species List

There are a total of 2 threatened or endangered species on your species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Critical habitats listed under the **Has Critical Habitat** column may or may not lie within your project area. See the **Critical habitats within your project area** section further below for critical habitat that lies within your project. Please contact the designated FWS office if you have questions.

Mammals	**Status**	**Has Critical Habitat**	**Condition(s)**
Indiana bat *(Myotis sodalis)* Population: Wherever found	Endangered		
Northern long-eared Bat *(Myotis septentrionalis)* Population: Wherever found	Threatened		

Critical habitats that lie within your project area

There are no critical habitats within your project area.

From:	Davis, Eric
To:	Katie Sellers
Subject:	RE: Weybridge Hydroelectric Project - Review for LIHI Re-Certification
Date:	Thursday, February 23, 2017 4:28:08 PM
Attachments:	image003.png

Hi Katie,

I'll check regarding whether project operations continue to not negatively impact the identified listed species.

Thanks,
Eric

Eric Davis, *River Ecologist*

1 National Life Drive, Main 2
Montpelier, VT 05620-3522
802-490-6180 / eric.davis@vermont.gov
http://www.watershedmanagement.vt.gov/rivers
(Please note my new e-mail address, effective July 27, 2015)

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION
RIVERS PROGRAM

See what we're up to on our Blog, Flow.

From: Katie Sellers [mailto:Katie.Sellers@KleinschmidtGroup.com]
Sent: Tuesday, February 21, 2017 3:10 PM
To: Davis, Eric <Eric.Davis@vermont.gov>
Cc: Nuria Claudio <Nuria.Claudio@Kleinschmidtgroup.com>
Subject: RE: Weybridge Hydroelectric Project - Review for LIHI Re-Certification

Hi Eric – Thanks for passing this information along.

Can Chet (or others) possibly confirm that the Project, as it currently operates and with no plans for tree removal, continues to not negatively impact any of the currently listed species as identified in the finalized species list below?:

Giant floater – state-threatened
Creeping lovegrass – rare
Hybrid thread-leaved pondweed – rare
Riverweed – rare
Fluted-shell – state-threatened
Creek heelsplitter – rare
Indiana Bat - Endangered
Northern Long-eared Bat - Endangered

Osprey - SGCN
Bald Eagle - Endangered

Thank you,
Katie

Katie Sellers
Regulatory Coordinator
Kleinschmidt
Office: 207-416-1218
www.KleinschmidtGroup.com

From: Davis, Eric [mailto:Eric.Davis@vermont.gov]
Sent: Wednesday, February 15, 2017 3:22 PM
To: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>
Cc: Nuria Claudio <Nuria.Claudio@Kleinschmidtgroup.com>
Subject: RE: Weybridge Hydroelectric Project - Review for LIHI Re-Certification

Hi Katie,

I have some additional feedback on the Weybridge application. I've gotten some feedback from the Department of Fish and Wildlife regarding additional listed species in the vicinity of the project. Please see list included below:

Eric

Eric Davis, *River Ecologist*

1 National Life Drive, Main 2
Montpelier, VT 05620-3522
802-490-6180 / eric.davis@vermont.gov
http://www.watershedmanagement.vt.gov/rivers
(Please note my new e-mail address, effective July 27, 2015)

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION
RIVERS PROGRAM

See what we're up to on our Blog, Flow.

Downstream of dam:
Giant floater (Pyganodon grandis) – state-threatened
Creeping lovegrass (Eragrostis hypnoides) – rare

Upstream of dam:
Hybrid thread-leaved pondweed (Stuckenia x fennica) – rare
Riverweed (Podostemum ceratophyllum) – rare

Two other species occur immediately upstream of the Middlebury dam and are likely to also occur between that structure and the Weybridge dam:
Fluted-shell (Lasmigona costata) – state-threatened
Creek heelsplitter (Lasmigona compressa) – rare

Mark Ferguson
Natural Heritage Zoologist
Vermont Department of Fish & Wildlife
802-279-3422
New email address: mark.ferguson@vermont.gov

From: Katie Sellers [mailto:Katie.Sellers@KleinschmidtGroup.com]
Sent: Friday, January 27, 2017 1:26 PM
To: Davis, Eric <Eric.Davis@vermont.gov>
Cc: Nuria Claudio <Nuria.Claudio@Kleinschmidtgroup.com>
Subject: RE: Weybridge Hydroelectric Project - Review for LIHI Re-Certification

Thank you Eric for the review. Much appreciated.

Best!
Katie

Katie Sellers
Regulatory Coordinator
Kleinschmidt
Office: 207-416-1218
www.KleinschmidtGroup.com

From: Davis, Eric [mailto:Eric.Davis@vermont.gov]
Sent: Friday, January 27, 2017 10:01 AM
To: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>
Cc: Nuria Claudio <Nuria.Claudio@Kleinschmidtgroup.com>
Subject: RE: Weybridge Hydroelectric Project - Review for LIHI Re-Certification

Good morning Katie,

I can confirm that waters listed below are on Vermont's 303 (d) List of Impaired Waters: Part A – Impaired Surface Waters in need of a TMDL. For each reach, I can describe the cause of impairment and the potential impact of project operations.

- Lower Otter Creek, BELOW Vergennes Waste Water Treatment Facility
  - This reach is listed as impaired for e. Coli due to periodic and recurring combined sewer overflows of the wastewater pump station. The projects current operations continue to not be a contributing cause to impairment of this reach.

- Otter Creek in vicinity of Rutland Waste Water Treatment Facility
  - This reach is listed as impaired for e. Coli due to the Rutland City WWTF collection system passing combined sewer overflows. The projects current operations continue to not be a contributing cause to impairment of this reach.

- Little Otter Creek RM 15.4 to RM 16.4 for Agricultural nutrients and sediments.
  - This reach is on a tributary to Otter Creek. It is listed as impaired for nutrients and sediment. The projects current operations continue to not be a contributing cause to impairment of this reach.

- Lake Champlain (Ferrisburg) for elevated levels of PCBs in Lake Trout
  - This segment is listed as impaired for PCBs. The projects current operations continue to not be a contributing cause to impairment of this segment.

Eric

Eric Davis, *River Ecologist*

1 National Life Drive, Main 2
Montpelier, VT 05620-3522
802-490-6180 / eric.davis@vermont.gov
http://www.watershedmanagement.vt.gov/rivers
(Please note my new e-mail address, effective July 27, 2015)

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION
RIVERS PROGRAM

See what we're up to on our Blog, Flow.

From: Katie Sellers [mailto:Katie.Sellers@KleinschmidtGroup.com]
Sent: Tuesday, January 17, 2017 5:06 PM
To: Davis, Eric <Eric.Davis@vermont.gov>
Cc: Nuria Claudio <Nuria.Claudio@Kleinschmidtgroup.com>
Subject: Weybridge Hydroelectric Project - Review for LIHI Re-Certification

Hi Eric, I am working on another LIHI re-certification application for Green Mountain Power: Weybridge Hydroelectric Project (FERC No. 2731) located on Otter Creek.

The LIHI application asks that we gain your feedback on the following water quality information:

Otter Creek, in general, has been designated by the Vermont Water Resources Board as Class B waters. On September 7, 2016, the Vermont DEC issued, under Section 303(d) of the Federal Clean Water Act, a list of waters considered to be impaired based on water quality monitoring efforts. Otter Creek was listed as "impaired" with specific portions of Otter Creek having different pollutants:

- Lower Otter Creek, BELOW Vergennes Waste Water Treatment Facility for e. Coli (downstream of Project);
- Otter Creek in vicinity of Rutland Waste Water Treatment Facility for e. Coli (upstream of Project);
- Little Otter Creek RM 15.4 to RM 16.4 for Agricultural nutrients and sediments (downstream of Project);
- Lake Champlain (Ferrisburg) for elevated levels of PCBs in Lake Trout (downstream of Project).

Could you please confirm, to your best abilities, that the Project's current operations continue to not be a contributing cause to the river's water quality limitations?

Do let me know if you have any questions upon review.

Thank you!
Katie

Katie Sellers
Regulatory Coordinator
Kleinschmidt
Office: 207-416-1218
www.KleinschmidtGroup.com

From: Popp, Bob
To: Katie Sellers
Subject: RE: Weybridge Hydroelectric Project - LIHI Review
Date: Tuesday, May 30, 2017 11:52:52 AM

Hi Katie, I have no plants to add to the list. If nothing is changing in the operating protocol, then there should be no impact to the rare plants.

Thanks for checking with us.

Bob

Bob Popp
Department Botanist
VT. Dept of Fish & Wildlife
5 Perry St. Suite 40
Barre, VT. 05641

(802) 476-0127
bob.popp@vermont.gov

From: Katie Sellers [mailto:Katie.Sellers@KleinschmidtGroup.com]
Sent: Friday, May 26, 2017 9:25 AM
To: Popp, Bob <Bob.Popp@vermont.gov>
Subject: Weybridge Hydroelectric Project - LIHI Review

Hi Bob,
I have another Low Impact Hydropower Institute application in need of threatened and endangered plant species review. This is for the Weybridge Hydroelectric Project (FERC No. 2731) located on Otter Creek.

Upon reviewing pertinent environmental documents for this Project, a list of potential threatened and endangered species that may occur within this project area has been developed. Could you a) review the below species list to make sure it is accurate and/or suggest updates as appropriate; and b) review this list to confirm that the Project continues to not negatively affect any of the currently listed species that may occur within the Project area?

Species List:
-hybrid thread-leaved pondweed (*Stuckenia x fennica*)
-Riverweed (*Podostemum ceratophyllum*)
-hackberry stand (*Celtis occidentalis*)
-green dragon *(Arisaema dracontium)*
-creeping lovegrass (*Eragrostis hypnoides*)

No changes to the project or tree cutting are planned at this time. A map depicting the Weybridge Project area in need of review is attached (red highlighted area stretching from Huntington Falls

Dam to Vergennes Dam). Do let me know if you have any follow-up questions.

Thank you,
Katie

Katie E. Sellers, M.S.
Regulatory Coordinator
Kleinschmidt
Office: 207-416-1218
www.KleinschmidtGroup.com
*Providing **practical** solutions for **complex** problems affecting energy, water, and the environment*

From:	Davis, Eric
To:	Katie Sellers
Cc:	Nuria Claudio
Subject:	RE: Weybridge Hydroelectric Project - Review for LIHI Re-Certification
Date:	Tuesday, June 20, 2017 2:40:54 PM
Attachments:	image005.png

Hi Katie,

The Agency has reviewed our records for the Weybridge project and provides the following information regarding rare, threatened, and endangered species requested by Kleinschmidt to aid in the development of a complete LIHI application.

Rare, Threatened and Endangered Species

I can confirm that the Project, as it currently operates and with no plans for tree removal, does not have the potential to negatively affect listed bat, bird, and plant species.

In regards to the three mussel species, while there are no records of rare or state-listed freshwater mussels immediately upstream of the Weybridge dam, listed species do occur upstream of the Middlebury dam, where one rare (Creek Heelsplitter) and one state-endangered species (Fluted-shell) occur not far upstream. Since these two species haven't been reported in Otter Creek anywhere downstream of the Middlebury dam, it is difficult to know whether they might occur within the section affected by Weybridge hydroelectric operations. One state-listed freshwater mussel occurs downstream of the dam, Giant Floater. It has been reported in Otter Creek in New Haven as well as the Lemon Fair River. It is, therefore, likely that it occurs or did occur in Otter Creek upstream of the Lemon Fair Confluence as well, though no survey data for that section. If this species does occur in the downstream portion of Otter Creek that is affected by hydroelectric operations, regular fluctuation of water level would prevent Giant Floater from using the dewatered areas (primarily along the shores), thus potentially reducing overall available habitat.

However, the presence of mussel species, including ones that are state listed as endangered or threatened, were explicitly considered in the water quality certification for the project (Finding 64). Given the certification was conditioned to ensure compliance with all applicable provisions of the Vermont Water Quality Standards and other appropriate requirements of state law, I can confirm that if operated in compliance with its certification, the project would not negatively impact these species

Formal Application Review

The Agency hopes the input above assists you in developing a complete LIHI application. As you may know the Agency's review of LIHI applications has evolved, and the Agency has now developed a practice of requesting one year of project operations records to review for compliance with certification conditions in order to provide meaningful input into the LIHI review process. While we could request these when the application is noticed, we thought it may beneficial to the review process to flag this as an information need as early as possible.

Thank you,
Eric

Eric Davis, *River Ecologist*

1 National Life Drive, Main 2
Montpelier, VT 05620-3522
802-490-6180 / eric.davis@vermont.gov
http://www.watershedmanagement.vt.gov/rivers
(Please note my new e-mail address, effective July 27, 2015)

See what we're up to on our Blog, Flow.

From: Katie Sellers [mailto:Katie.Sellers@KleinschmidtGroup.com]
Sent: Tuesday, February 21, 2017 3:10 PM
To: Davis, Eric <Eric.Davis@vermont.gov>
Cc: Nuria Claudio <Nuria.Claudio@Kleinschmidtgroup.com>
Subject: RE: Weybridge Hydroelectric Project - Review for LIHI Re-Certification

Hi Eric – Thanks for passing this information along.

Can Chet (or others) possibly confirm that the Project, as it currently operates and with no plans for tree removal, continues to not negatively impact any of the currently listed species as identified in the finalized species list below?:

Giant floater – state-threatened
Creeping lovegrass – rare
Hybrid thread-leaved pondweed – rare
Riverweed – rare
Fluted-shell – state-threatened
Creek heelsplitter – rare
Indiana Bat - Endangered
Northern Long-eared Bat - Endangered
Osprey - SGCN
Bald Eagle - Endangered

Thank you,
Katie

Katie Sellers
Regulatory Coordinator
Kleinschmidt
Office: 207-416-1218

www.KleinschmidtGroup.com

From: Davis, Eric [mailto:Eric.Davis@vermont.gov]
Sent: Wednesday, February 15, 2017 3:22 PM
To: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>
Cc: Nuria Claudio <Nuria.Claudio@Kleinschmidtgroup.com>
Subject: RE: Weybridge Hydroelectric Project - Review for LIHI Re-Certification

Hi Katie,

I have some additional feedback on the Weybridge application. I've gotten some feedback from the Department of Fish and Wildlife regarding additional listed species in the vicinity of the project. Please see list included below:

Eric

Eric Davis, *River Ecologist*

1 National Life Drive, Main 2
Montpelier, VT 05620-3522
802-490-6180 / eric.davis@vermont.gov
http://www.watershedmanagement.vt.gov/rivers
(Please note my new e-mail address, effective July 27, 2015)

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION
RIVERS PROGRAM

Downstream of dam:
Giant floater (Pyganodon grandis) – state-threatened
Creeping lovegrass (Eragrostis hypnoides) – rare

Upstream of dam:
Hybrid thread-leaved pondweed (Stuckenia x fennica) – rare
Riverweed (Podostemum ceratophyllum) – rare

Two other species occur immediately upstream of the Middlebury dam and are likely to also occur between that structure and the Weybridge dam:
Fluted-shell (Lasmigona costata) – state-threatened
Creek heelsplitter (Lasmigona compressa) – rare

Mark Ferguson
Natural Heritage Zoologist
Vermont Department of Fish & Wildlife
802-279-3422
New email address: mark.ferguson@vermont.gov

From: Katie Sellers [mailto:Katie.Sellers@KleinschmidtGroup.com]
Sent: Friday, January 27, 2017 1:26 PM
To: Davis, Eric <Eric.Davis@vermont.gov>
Cc: Nuria Claudio <Nuria.Claudio@Kleinschmidtgroup.com>
Subject: RE: Weybridge Hydroelectric Project - Review for LIHI Re-Certification

Thank you Eric for the review. Much appreciated.

Best!
Katie

Katie Sellers
Regulatory Coordinator
Kleinschmidt
Office: 207-416-1218
www.KleinschmidtGroup.com

From: Davis, Eric [mailto:Eric.Davis@vermont.gov]
Sent: Friday, January 27, 2017 10:01 AM
To: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>
Cc: Nuria Claudio <Nuria.Claudio@Kleinschmidtgroup.com>
Subject: RE: Weybridge Hydroelectric Project - Review for LIHI Re-Certification

Good morning Katie,

I can confirm that waters listed below are on Vermont's 303 (d) List of Impaired Waters: Part A – Impaired Surface Waters in need of a TMDL. For each reach, I can describe the cause of impairment and the potential impact of project operations.

- Lower Otter Creek, BELOW Vergennes Waste Water Treatment Facility
  - This reach is listed as impaired for e. Coli due to periodic and recurring combined sewer overflows of the wastewater pump station. The projects current operations continue to not be a contributing cause to impairment of this reach.

- Otter Creek in vicinity of Rutland Waste Water Treatment Facility
  - This reach is listed as impaired for e. Coli due to the Rutland City WWTF collection system passing combined sewer overflows. The projects current operations continue to not be a contributing cause to impairment of this reach.

- Little Otter Creek RM 15.4 to RM 16.4 for Agricultural nutrients and sediments.
  - This reach is on a tributary to Otter Creek. It is listed as impaired for nutrients and sediment. The projects current operations continue to not be a contributing cause to impairment of this reach.

- Lake Champlain (Ferrisburg) for elevated levels of PCBs in Lake Trout
  - This segment is listed as impaired for PCBs. The projects current operations continue to not be a contributing cause to impairment of this segment.

Eric

Eric Davis, *River Ecologist*

1 National Life Drive, Main 2
Montpelier, VT 05620-3522
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http://www.watershedmanagement.vt.gov/rivers
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VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION
RIVERS PROGRAM

See what we're up to on our Blog, Flow.

From: Katie Sellers [mailto:Katie.Sellers@KleinschmidtGroup.com]
Sent: Tuesday, January 17, 2017 5:06 PM
To: Davis, Eric <Eric.Davis@vermont.gov>
Cc: Nuria Claudio <Nuria.Claudio@Kleinschmidtgroup.com>
Subject: Weybridge Hydroelectric Project - Review for LIHI Re-Certification

Hi Eric, I am working on another LIHI re-certification application for Green Mountain Power: Weybridge Hydroelectric Project (FERC No. 2731) located on Otter Creek.

The LIHI application asks that we gain your feedback on the following water quality information:

Otter Creek, in general, has been designated by the Vermont Water Resources Board as Class B waters. On September 7, 2016, the Vermont DEC issued, under Section 303(d) of the Federal Clean Water Act, a list of waters considered to be impaired based on water quality monitoring efforts. Otter Creek was listed as "impaired" with specific portions of Otter Creek having different pollutants:

- Lower Otter Creek, BELOW Vergennes Waste Water Treatment Facility for e. Coli (downstream of Project);
- Otter Creek in vicinity of Rutland Waste Water Treatment Facility for e. Coli (upstream of Project);
- Little Otter Creek RM 15.4 to RM 16.4 for Agricultural nutrients and sediments (downstream of Project);
- Lake Champlain (Ferrisburg) for elevated levels of PCBs in Lake Trout (downstream of Project).

Could you please confirm, to your best abilities, that the Project's current operations continue to not be a contributing cause to the river's water quality limitations?

Do let me know if you have any questions upon review.

Thank you!
Katie

Katie Sellers
Regulatory Coordinator
Kleinschmidt
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APPENDIX E

CULTURAL RESOURCES

Archaeological Phase II Testing of Native American Site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont

prepared for:

Green Mountain Power Corporation
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April 2, 2015
Revised
April 28, 2015

Archaeological Phase II Testing of Native American Site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont

ABSTRACT

The Northeast Archaeology Research Center, Inc. conducted archaeological phase II testing of Native American archaeological site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont, from November 4-6 and November 11-15, 2014. The work was conducted on behalf of the Green Mountain Power Corporation, under Section 106 of the National Historic Preservation Act. The site is located on a level terrace landform on Wyman Island, within the Otter Creek drainage basin. The site possesses at least two separate occupations, and overall represents a medium-sized, possibly seasonal encampment focused on various resource processing tasks, likely associated with riverine resources. Maize is documented at the site but the extent of horticultural practices are not yet defined. During phase II testing, artifacts including temporally diagnostic projectile point fragments, other lithic tools and debitage were recovered from intact subsurface contexts, including a remnant hearth feature/activity area. The data and artifacts recovered from the site, including decorated Native American ceramics and a direct radiocarbon date on the maize, indicate that the site is attributable minimally to the later Middle Woodland to Late Woodland period of Native American history for the region, ca. A.D. 800-1400. The site is eligible for listing in the National Register of Historic Places under *Criterion D*. Given a significant rate of erosion within the site area, a plan for mitigation of adverse effect through archaeological phase III data recovery is being developed, and is scheduled for 2015.

Archaeological Phase II Testing of Native American Site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont

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Archaeological Phase II Testing of Native American Site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont

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Archaeological Phase II Testing of Native American Site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont

I. INTRODUCTION

Archaeological phase II testing of Native American site VT-AD-44, located within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont, has been completed by the Northeast Archaeology Research Center, Inc. (NE ARC). The work was conducted on behalf of Green Mountain Power Corporation (GMP) from November 4-6 and November 11-15, 2014.

The overall Weybridge Hydroelectric Project includes an impoundment upstream of the Project dam, measuring approximately 2.5 km (1.5) mi, as well as a tailwater component, which extends 3.3 km (2.0 mi) downstream, for a total Project length of 5.6 km (3.5 mi). Various cultural resource management studies have been completed for the Project as part of the FERC hydroelectric relicensing process, resulting in the identification or confirmation of 17 archaeological sites, including 15 Native American sites and two Euroamerican sites. Potential adverse effects to those sites related to the presence and operation of the Project has been determined. While the majority of the Project shorelines remain stable and healthy, and thus adverse effects to archaeological sites are minimal, significant erosion continues to affect the landform containing site VT-AD-44 (Baker 2013).

Site VT-AD-44 is located on a terrace landform at the southeastern extent of Wyman Island on the Otter Creek, approximately 750 m downstream of the Weybridge Dam (Figures 1 and 2). The phase II archaeological work was conducted as part of the Historic Properties Management Plan (HPMP) for the Project as part of ongoing protection and maintenance of historic properties within the Project boundary (Baker 2013). Previous archaeological work at VT-AD-44 included surface inspection conducted as part of annual monitoring of the Project, as well as a phase IB archaeological survey completed in 2011 by Central Vermont Power Service (CVPS), the previous owners, in order to mitigate the effects of erosion on site VT-AD-44 (Tetra Tech, Inc. 2011). Given continued erosion within the defined site area, the phase II archaeological work reported herein was conducted in order to more precisely determine the extent of site VT-AD-44, to confirm National Register of Historic Places (NHRP) eligibility status of the site and to better understand the potential effects of erosion on the archaeological deposits.

Archaeological phase II testing included the excavation of 15 0.5 m x 0.5 m test pits, six 1.5 m x 0.5 m test units, five 2.0 m x 1.0 m units, and one 1.0 m x 1.0 m unit, for a total excavated area of 19.25 square meters. All of the excavation units and seven of the test pits were positive for Native American cultural material. Cultural material was also noted along the eroding embankment. A sample of such material recovered prior to phase II testing is also included in this report. In total, 539 Native American artifacts and 47 fragments of calcined bone were recovered during the phase II archaeological work, while an additional 146 surface collected artifacts are included in the analysis. Recovered specimens include lithic debitage, fire-cracked rock, lithic tools including scrapers, utilized flakes, a hammerstone, and projectile point fragments, and Native American ceramics. One cultural feature, a hearth remnant/activity area and associated post mold, was identified.

Temporally diagnostic artifacts recovered from the site including a Levanna-type point fragment and decorated ceramics demonstrate that the site dates minimally to the later Middle Woodland period to Late Woodland period of Native American history for the region, ca. A.D. 800-1400. Of

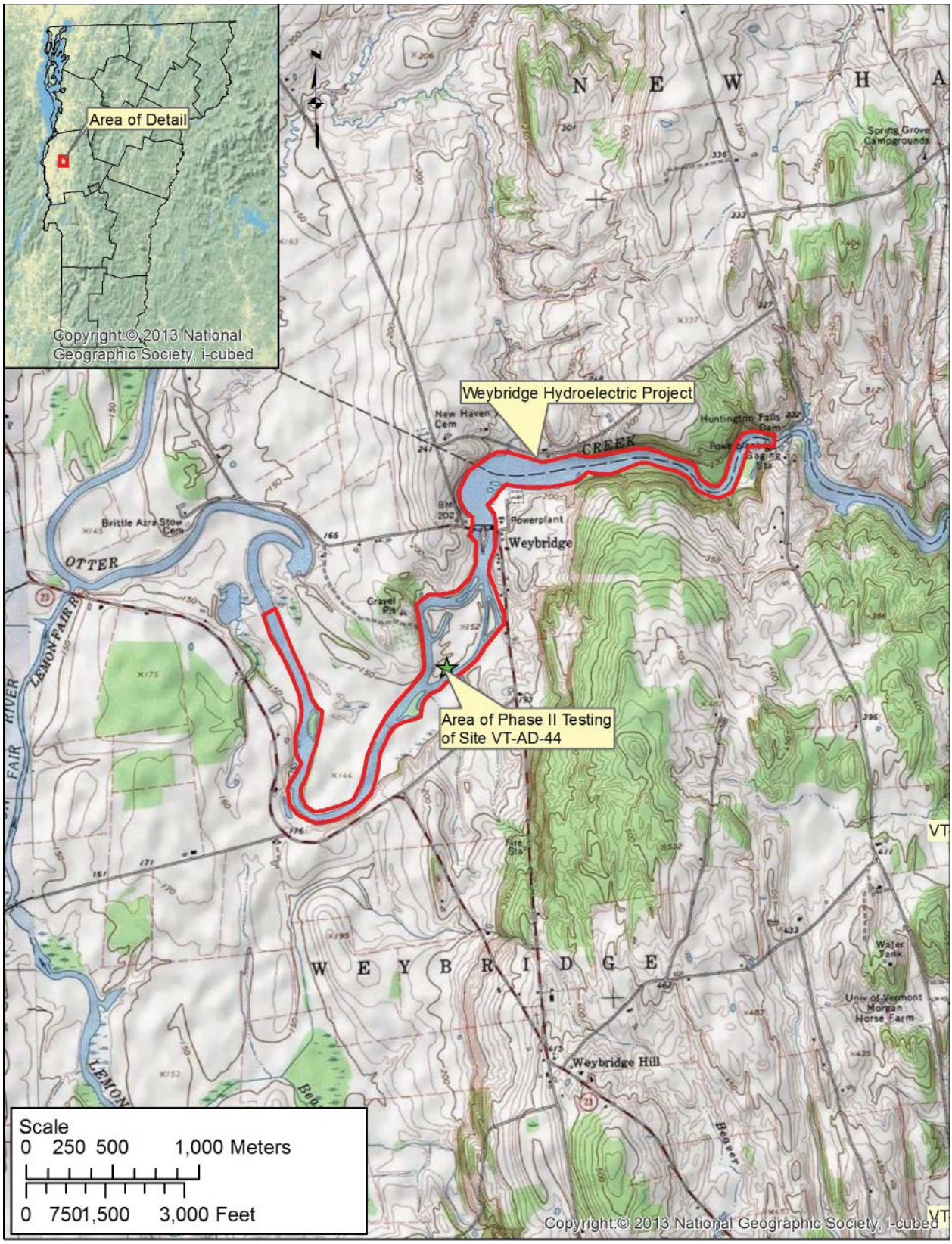

Figure 1. Topographic map showing the location of site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont.

Figure 2. Aerial photograph showing the location of site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont.

particular note, carbonized maize was identified from the cultural feature and was subsequently sent for radiocarbon dating, returning a conventional radiocarbon age of 550±30 B.P., ca. A.D. 1400 and placing this feature within the middle of the Late Woodland period. Sediments at the site are characterized as a complex of seasonal alluvial depositional events with evidence of at least two buried developed 'A' soil horizons or paleosols. These paleosols yielded the highest density of cultural material, and likely demonstrate separate occupations. The focus of occupation appears to have occurred at the western extent of the defined site area, which may originally have been a point of land. Site density also decreases moving back away from the eroding landform. Overall, the site is estimated to measure a minimum of 6,000 m^2 (0.6 hectares, 1.48 acres) in extent with at least 130 m of river frontage. Site VT-AD-44 represents a medium sized, possibly task-specific encampment located on a fairly significant drainage and likely occupied by a small group on a seasonal basis. While maize is documented at the site, it is not known if horticulture was practiced at this location or whether cultigens were brought in. The site is significant in both local and regional contexts, and is considered eligible for listing in the National Register of Historic Places under *Criterion D.*

Mapping data indicate that up to 5.0 m (perpendicular to the riverbank) have eroded since 2009 and up to 15 m have eroded since 2006. Over the 130 m distance of the site, this constitutes about 650 m^2 since 2009 and 1560 m^2 since 2006. Given this significant rate of erosion and thus site loss, it is recommended that GMP in consultation with the Vermont Division for Historic Preservation develop a mitigation plan for this historic property before much of the site is lost.

The archaeological work reported herein was conducted under Section 106 of the National Historic Preservation Act (P.L.89-665), as amended. All work was performed in accordance with the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation (48 FR 44716), supplemented by the Vermont Division for Historic Preservation (VT DHP) Guidelines for Archaeological Studies (Peebles 1989). Ellen R. Cowie, Ph.D., RPA and Robert N. Bartone, M.A., RPA served as co-principal investigators, and exceed the minimum federal standards for conducting archaeology as set forth in 36 CFR Part 61.

II. ENVIRONMENTAL SETTING

Local and regional environmental conditions are briefly summarized here since human lifeways, past and present, are better understood in relation to the ecological settings in which they occur. Additional geographic and environmental information is also included for the individual developments in subsequent sections below. This overview is also relevant in that it supplies information bearing on the presence or absence of archaeological sites in a given area, as well as the conditions of preservation there.

Site VT-AD-44 is located on a river terrace landform near the downstream extremity of Wyman Island. In total, Wyman Island comprises approximately 1,600 m of shoreline within the Otter Creek. Wyman Island is thus located within the Otter Creek drainage basin, approximately 23 km (14 mi) upriver, and 15 m (50 ft) in elevation above the Otter Creek's confluence with Lake Champlain in the Town of Ferrisburg; and 135 km (84 mi) downriver, and 168 m (550 ft) in elevation below the Otter Creek's headwaters in the Town of Dorset (Figure 3). Lake Champlain lies at an elevation of approximately 28 m (93 ft) a.m.s.l., and the headwaters of the Otter Creek in Dorsett at just over 213 m (700 ft). Wyman Island lies at roughly 43-46 m (140-152 ft) a.m.s.l., with site VT-AD-44 lying at approximately 43 m a.m.s.l. and three to four meters above Otter Creek. It is not known if Wyman Island has been an island throughout the time of human occupation of the region, however the presence of multiple river channels in this portion of the Otter Creek suggests that it has likely been an island for a long period. While that extent of time is not known, 18th and 19th century maps of the area do show the location as an island (see Tetra Tech 2011).

Portions of Otter Creek, including the Weybridge Hydroelectric Project, flow through the Champlain Lowlands Physiographic zone of Vermont (Figure 4). Although the climate of the broad region is typified by relatively long, cold winters and mild summers, within the Champlain Lowlands the climate is more moderate, and is the warmest area of Vermont with 140-150 frost free days annually (Meeks 1975). The annual precipitation is approximately 78.8 cm (31 in) and the average temperature is 7.8°C (46°F), with January and July averaging 5.6°C (22°F) and 21.1°C (70°F), respectively. Snowfall averages 152-178 cm (60-70 in) (Griggs 1971; Meeks 1975).

The Weybridge Hydroelectric Project and site VT-AD-44 lie within the Transition Hardwoods-White Pine-Hemlock vegetation zone, reflecting the relatively mild setting of the area compared to more upland settings. Oak and hickory, typical of more southern climates, are present, along with birches, beech and maples typical of more northern areas. Pines, hemlock, poplar, basswood and other species are also present (Westveld et al. 1956). This forest zone has more potential native food resources for humans than any other of the locally relevant forest zones in the broader Vermont region.

The surficial geology of the Champlain Lowlands resulted largely from glaciation. The last major southward expansion of the Laurentian ice sheet began ca. 25,000 B.P., with a retreat sometime between 17,000 and 15,000 B. P., passing north of the St. Lawrence River valley by 12,500 B.P. (Stewart and MacClintock 1969). Substantial changes have occurred within the Otter Creek drainage and the broader region as a result of the advancing and retreating ice from several episodes of glaciation.

The Weybridge Hydroelectric Project falls within the maximum extent of Late Pleistocene glacial Lake Vermont (Doll 1970). As the major ice mass in the Champlain Lowland retreated northward, Lake Vermont was formed in the depression south of the ice margin. This lake was constantly fed by ice calving off the glacial front and by the rivers draining from the Adirondack Mountains on the west and by the Otter Creek and the Missisquoi, Lamoille and Winooski rivers flowing out of the Green Mountains on the east (Stewart and MacClintock 1969). These rivers dumped large

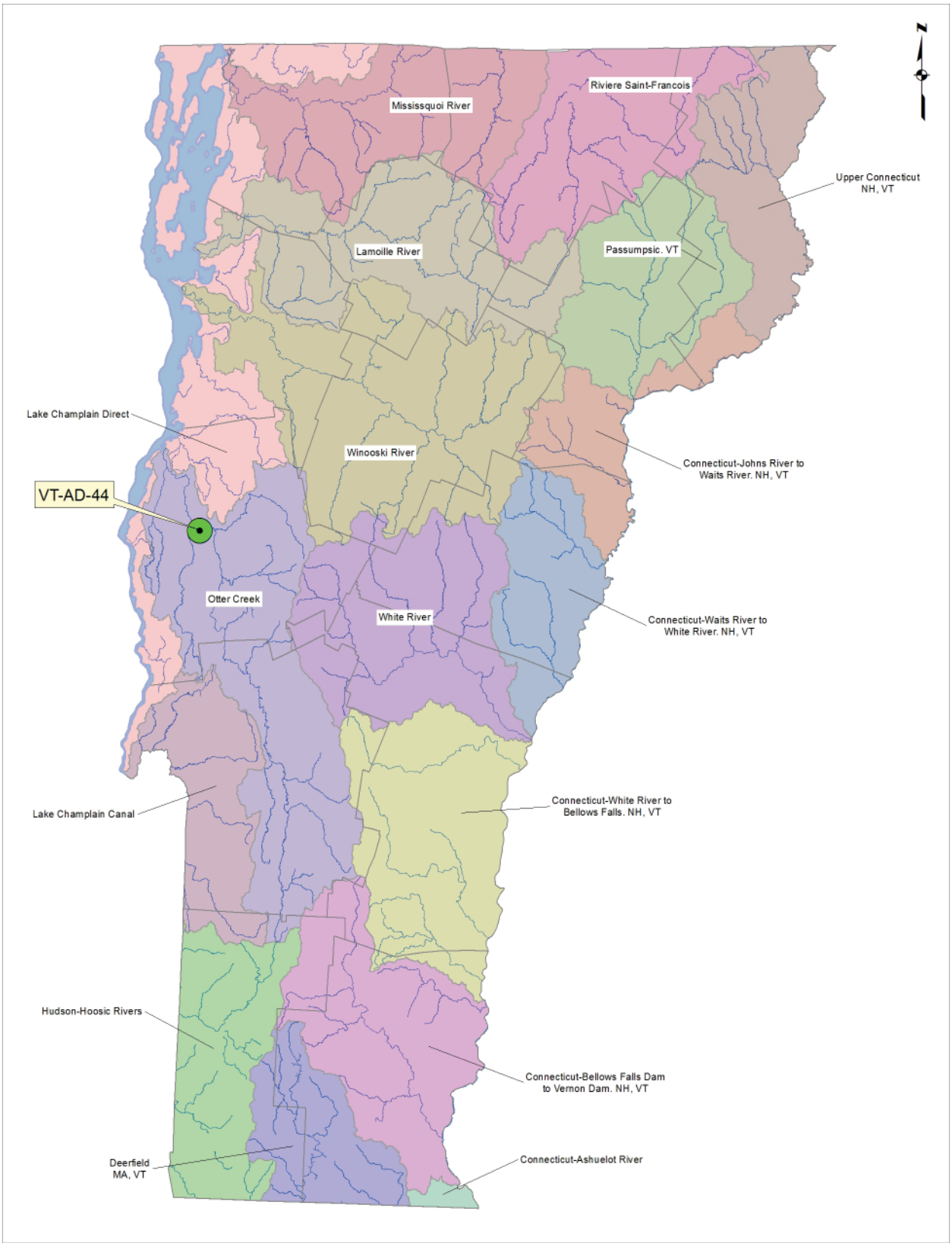

Figure 3. Drainage map depicting the location of site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont.

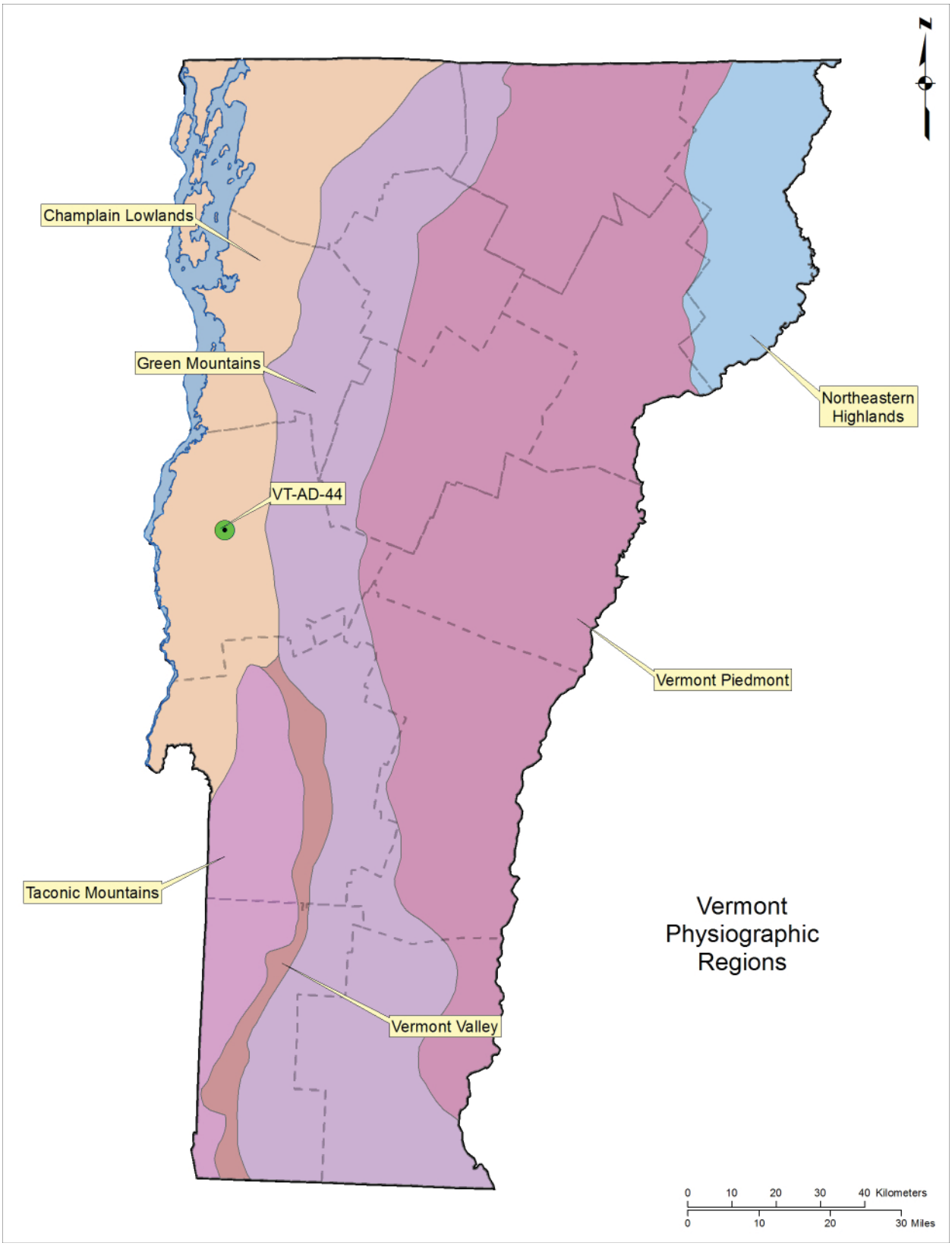

Figure 4. Map showing the physiographic regions of Vermont and the location of site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont.

volumes of outwash sediments into Lake Vermont as well as in the lower reaches of their own courses. Several stages of Lake Vermont occurred until the glacier moved to the north of the St. Lawrence River Valley, allowing the rising ocean waters of the Gulf of St. Lawrence to penetrate the Champlain Lowland, creating a new salt-water aquatic environment, the Champlain Sea. This was not as extensive as Lake Vermont, however, and did not reach along the valley of the Otter Creek.

Sediments associated with glacial outwash and with Lake Vermont itself form much of the basic surficial geology of the project area, with glaciolacustrine sediments from Lake Vermont (namely, Vergennes clay) and glaciofluvial sediments (sandy loams) and till (predominantly rocky and coarse loams). However, areas immediately adjacent to the Otter Creek also possess more recent Holocene sediments in the form of alluvium, which form silty and sandy loam soils. The area of site VT-AD-44 includes Hadley series soils, consisting of very fine sandy loam which is frequently flooded. These well-drained soils develop from a parent material of coarse-silty alluvium and are associated with floodplain settings with slopes of less than 3% (USDA 2014).

In the vicinity of site VT-AD-44, various surficial deposits are present which affect sediment stability and erosion potential. These include glaciolacustrine lake bottom deposits of silt and clay containing ice rafted boulders, which border Wyman Island to the north, east, and south. Such deposits exhibit lower erosion potential compared to the alluvial deposits present within the Otter Creek river channel. The oxbow located to the south of Wyman Island most likely developed as the river channel has migrated to the south, cutting through the alluvial deposits. A surficial deposit of beach gravel is present to the immediate west of Wyman Island, and beach gravels can also be seen along the southern margin of the island. Marine sand deposits representing remnants of the Champlain Sea drainage event are also present to the south and west of Wyman Island. As a result of the high erosion potential of the alluvial deposits which form much of Wyman Island, the shoreline fronting VT-AD-44 is heavily eroded, and portions of the bank ae slumped and denuded.

The Champlain Lowland lies sandwiched between Lake Champlain and the faulted Cambrian-Ordovician sequence bordering the Green Mountain Anticlinorum (Welby 1961). Folded and partly metamorphosed beds of sedimentary rock break up the landscape with north-south oriented bedrock outcrops that structure drainage patterns. The underlying bedrock at the site is the Bascom formation, which includes limestones, dolomites, and marbles (Doll 1961). In addition to structuring the landscape, bedrock provided lithic sources for Native American tool manufacturing. Limestone and dolomites occasionally contain reasonably high quality chert, and a black variety is known from Mount Independence, to the west of the project area. Chert nodules are common in various local limestone and dolomite formations as well, including the Clarendon Springs dolomite formation. In addition, outcrops of Cheshire formation quartzite are located east of the project area along the western foothills of the Green Mountains. Both chert and quartzite lithic artifacts have been recovered from the sites within the Otter Creek drainage.

The evolutionary development of local and regional biota was undoubtedly of importance to human populations during the Holocene epoch. Conditions have varied from tundra and spruce-fir parkland soon after de-glaciation in the Late Pleistocene until about 8,000-7,500 B.C. when more substantial forests returned. During the postglacial climatic optimum, ca. 5,500 B.C. to 2,500-2,000 B.C., mixed hardwood forests with some conifers would have been locally present. Near modern conditions were established thereafter, with an increase in conifers since about A.D. 1, as cooler conditions prevailed (Davis et al.1980; Davis and Jacobson 1985).

Generally, animal species which were likely important to Native American inhabitants include a variety of large mammals such as white tail deer, moose and black bear, and a variety of small species were also significant, including such furbearing species as muskrat, otter, mink, raccoon and beaver. Cold water fish species utilized include lake and brook trout, salmon, perch, and sucker,

among others, and birds would have also played their part, including lake or wetland varieties such as loons, grebes, ducks, and geese, and terrestrial game birds such as turkey, partridge, and passenger pigeon (Godin 1977; Howland 1974).

III. CULTURAL SETTING

Regional Native American History

Professional archaeological research in the Northeast is a relatively recent endeavor and many areas, particularly interior settings, have been little studied. Throughout the Northeast in general and New England in particular, the record of Native American occupation is variably known. Therefore, archaeological data from the broad New England area and eastern New York State are necessary to outline the local culture history. The human occupational sequence of New England certainly has been long and varied. The first human entrants into the region likely followed close behind the southern edge of the retreating glacier after ca. 10,000-9,000 B.C. Native American populations continued to live in New England from that time until historic times, and descendants of these people are still present today. The pre-contact past can be divided into three major temporal periods: the Paleoindian period, ca. 9,000-7,000 B.C.; the Archaic period, ca. 7,000-1,000 B.C.; and the Woodland period, ca. 1,000 B.C.-A.D. 1600 (Haviland and Power 1994). Subsequent developments occurred during the historic period. Of particular interest, the early portion of historic times is known as the Contact period, ca. A.D. 1600-1750, when local Native American populations first came into contact with Europeans and experienced the near collapse of their traditional lifeways under the pressures of European settlement and expansion.

The regional culture history is summarized below to provide an outline of the Native American occupation of the region (Figure 5), beginning with generalizations for each time period, followed by a specific discussion of sites in close proximity to VT-AD-44 and a brief consideration of documented Native American history of the immediate area of Weybridge and the Otter Creek drainage.

Paleoindian Period

Following deglaciation, the first human entrants into the region were undoubtedly small, semi-nomadic groups of hunters and gatherers who were adapted to residence and subsistence in tundra and tundra-woodland environments during the Paleoindian period. In Vermont and the northeast, the Paleoindian period is generally dated to ca. 11,000-9,000 B.P. (9,000-7,000 B.C.) (Bourque 2001; Haviland and Power 1994; Cox and Petersen 1995; Starbuck 2006).

The Paleoindian period is variably represented throughout Vermont and New Hampshire, with the best known sites occurring in the Champlain Valley of Vermont and in southern New Hampshire. Known Paleoindian sites in the region demonstrate what is typically known of Native lifeways in this period, and archaeologists have gained a picture of a small and mobile population, exhibiting a foraging settlement/procurement pattern focused on megafauna and/or gregarious herd animals. Palaeoindian mobility and/or social networks are attested to by a preference for high-grade lithic materials including fine-grained cherts and rhyolites obtained from sources as much as 500 miles distant (Curran and Grimes 1989; Custer and Stewart 1990; Ellis 1989). Most known Paleoindian sites are small, contain relatively few artifacts, and tend to be associated with well-drained and often sandy sediments on high ground overlooking broad, flat lands along watercourses. Within Vermont, a strong correlation exists between Paleoindian sites and the changing marine limits of the receding Champlain Sea (Loring 1980; Robinson IV 2012). Larger aggregation sites are known, and likely represent activities such as communal hunting and associated processing and ritual activities, such as at Bull Brook in Massachusetts (Robinson et al. 2009).

The Paleoindian period can be split into two portions, the Early and Late periods, which each have their diagnostic artifacts. The diagnostic artifact type of the earlier part of the Paleoindian period (9,000-8,000 B.C.) is the fluted point, while the Late Paleoindian period (8,000-7,000 B.C.) is identified by non-fluted, parallel-flaked lanceolate points (Bourque 2001; Bradley et al. 2008;

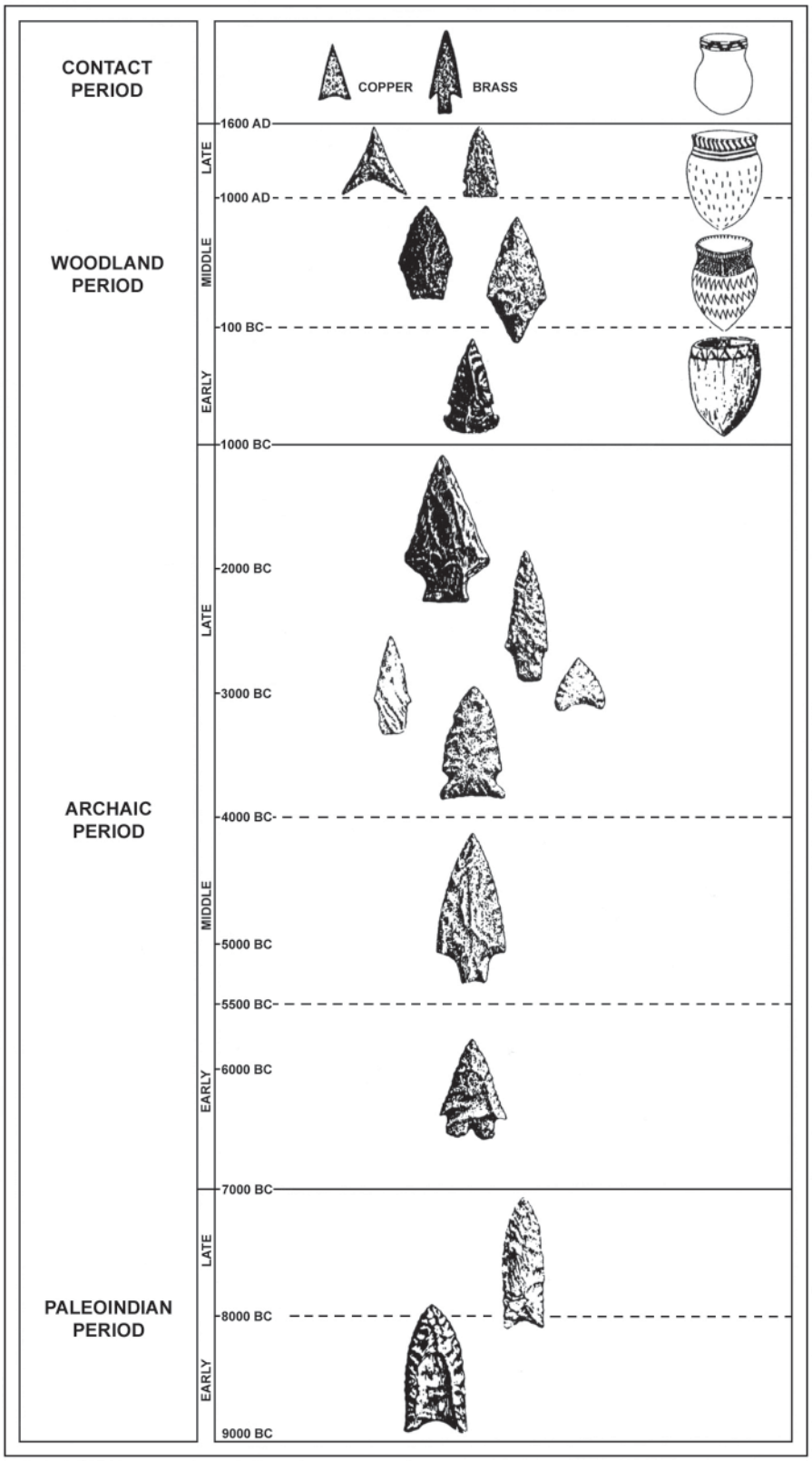

Figure 5. Cultural time line for Native American prehistory and early history for Vermont and the broader Northeast.

Chapdelaine 1994; Doyle et al. 1985; Ellis and Deller 1990; Mason 1981). This shift from the Early to Late Paleoindian periods relates to a paleo-environmental change from the mosaic environment of tundra, shrubs, and trees to the forested environment in the region following deglaciation - the transition from the Late Pleistocene to the Early Holocene epochs.

Fluted projectile points occur in New England in at least two or three stylistic variations considered to represent early and late complexes, all dating before 8,000 B.C. (Bradley et al. 2008:119-172). The earliest style(s) has been dated to approximately 9,000-8,500 B.C., and is represented by specimens from Bull Brook, Massachusetts; Vail, Maine; and Debert, Nova Scotia, as well as a number of smaller occupation sites (Curran 1984; Gramly 1982; Grimes 1979; Spiess and Wilson 1987). Other stylistic varieties are thought to be slightly more recent, and include examples recovered from the Neponset site in Massachusetts and the Michaud, Lamontagne, Keogh and Taxiway sites in Auburn, Maine (Bartone et al. 2010; Bartone et al. 2007; Bradley et al. 2008). Fluted points in Vermont generally tend to be represented in isolated surface finds, primarily in the Champlain Valley, with the addition of a notable cluster of projectile points found in the town of Milton (Loring 1980). Similar points have been recovered from the Jackson-Gore site in the Green Mountains and the Fairfax locality, and the Reagen site in Highgate (Loring 1980; Robinson 2007, 2009). In Addison County, sites VT-AD-458 in Monkton and VT-AD-7 and VT-AD-126 in Addison have all yielded fluted points (VAI).

Although the lanceolate style of projectile point characteristic of the Late Paleoindian period, ca. 8,000-7,000 B.C., is more typical of sites in the Great Lakes area, occupation during this period is demonstrated in Vermont by components from the Reagen site and the nearby Mazza site (Bradley et al. 2008; Ritchie 1953) and a small number of other sites of comparable age elsewhere in the state (Doyle et al. 1985; Ritchie 1979). Site VT-CH-230 on Indian Brook is reported to be Vermont's first identified Late Paleoindian camp (Thomas 2002). Also, in the general region, the Varney Farm site on the Nezinscot River in Western Maine and the nearby Beaver Pond site are rare examples of single component Late Paleoindian sites, and as such are beginning to shed light on this enigmatic period of Native American history (Bartone and Cowie 2007; Bartone et al. 2007; Petersen et al.2000; Petersen et al. 2002).

Paleoindian remains are relatively rare in the Otter Creek Valley. In Brandon, a fluted point was found on a knoll overlooking Otter Creek (VAI). The Vermont Archaeological Inventory also lists a number of additional sites in Addison and Rutland counties with apparent Paleoindian components, recognized on the basis of other diagnostic artifacts such as scrapers or distinctive flaking debris. These include VT-AD-8 in Orwell; VT-AD-11 on Bristol Pond and VT-AD-160 in Bristol; VT-AD-474 in Middlebury; VT-AD-195 in Ferrisburgh; and VT-RU-80 in Pittsford (VAI).

Archaic Period

The fairly open landscape populated by the Paleoindians only existed for a brief period. By about 7,000 B.C. a change in environmental conditions occurred, as the end of the glacial period brought with it higher temperatures and drier climates, and a subsequent change in plant and animal populations. Over 100 species of megafauna such as mastodons and moose-elk became extinct, while other species such as caribou moved north with the retreating tundra. Within three thousand years of the ice retreat, most of northeastern North America south of the St. Lawrence River was heavily wooded. With these climatic changes came cultural changes. Plant foods were more readily available, and alternative sources of meat were sought in fish as well as smaller mammals such as deer and bear. New hunting and gathering cultures now known as the Archaic tradition developed with these shifts in the ecology of Vermont (Funk 1976; Haviland and Power 1981:44–45; Ritchie and Funk 1973:337–338; Wright 1979:29–36).

The archaeological record documents these changes in the form of new and different stone tool technologies and different locations chosen for campsites. Evidence of these subsequent Archaic

period occupations, ca. 7,000-1,000 B.C., is more common in Vermont than are Paleoindian remains, but not necessarily better understood. Typically, Archaic populations are thought of as hunter-gatherer groups who utilized a broad range of resources found in these evolving Holocene environments. Archaic lithic assemblages often contain many scrapers or minimally modified unifacial tools on quartz, and a significant proportion of quartz flaking debris is a hallmark of an Early Archaic occupation (Bourque 2001; Petersen 1991). Projectile points are often notched or have a bifurcate base, and bone and antler tools have been found in small numbers. Perhaps the most diagnostic lithic tools are ground stone implements, formed by pecking or grinding less brittle and more granular rock types (i.e. those less suitable for flaking). As many of these new tool types appear to be intended for woodworking, they apparently reflect an expansion of wood technology, such as wooden food vessels, dugout canoes, and fish weirs; items which themselves rarely survive in the archaeological record.

The Archaic period is generally divided into three subperiods: the Early Archaic period, ca. 7,000-5,500 B.C.; the Middle Archaic period, ca. 5,500-4,000 B.C.; and the Late Archaic period, ca. 4,000-1,000 B.C. Evidence of Early Archaic period and especially Middle Archaic period occupation is relatively rare in Vermont, although they are becoming more prevalent with more archaeology and better recognition of the tool kits of these elusive time periods.

Fewer than 40 sites of the Early Archaic period have been identified throughout the state (Thomas 1997), and include multiple sites in the Lake Champlain basin. One of the best known Early Archaic period sites the John's Bridge site on the Missisquoi River in Swanton, which produced a series of corner-notched projectile points and an associated assemblage of stone tools that were dated to ca. 6,100 B.C. (Thomas and Robinson 1983). Close to this in Highgate are the Bessette 2 and 3 sites, where bifurcated base points were recovered and radiocarbon dated to 6,080±270 B.C. (Thomas 1991). Additionally, five Early Archaic period sites were identified along Indian Brook during studies conducted for the Chittenden County Circumferential Highway (CCCH) project (Thomas 2002). Close to the project area, site VT-RU-42 in Brandon is a multi-component site which yielded evidence for an Early Archaic period occupation among the 15 recognized projectile point styles recovered (VAI).

The Middle Archaic period is even more poorly known in Vermont, although the reason for this is unclear. They may be a genuine paucity of distinctive artifact types, or failure to recognize them, rather than an absence of people during this period (Petersen et al. 1985:57–59; Thomas 1992). For example, of the 79 archaeological sites that were identified within the CCCH study area, none of the sites contained a Middle Archaic component (Thomas 2002). Generally, Middle Archaic groups used similar locations to those used in the Early Archaic period (Thomas and Robinson 1979). Middle Archaic sites such as the Cheshire Site in Bennington, Franconia 148 in New Hampshire and artifacts recovered along the West River tributary of the Connecticut River and at the Headquarters site on the Missisquoi River offer intriguing glimpses of this period (Brigham et al. 2001; Cowie et al. 2012; Curran and Thomas 1979; Heckenberger et al. 1999; Thomas 1991). Within the Otter Creek drainage, at least one Neville point has been recovered (VAI), and a very unusual Middle Archaic component has been identified at Rutland: site VT-RU-597 has yielded a feature containing a cache-like collection of 16 Neville points in various states of breakage and disrepair, including five complete specimens (Gammon et al. 2010).

The subsequent Late Archaic period is much better represented in the region relative to any of the earlier periods. A warming trend and increase in precipitation resulted in the swelling of river systems and the formation of numerous swamps and marshes, providing more diverse floral and faunal resources. Late Archaic people seem to have adapted their procurement strategies by focusing on the wide range of microenvironments in and around these new wetlands. Changes in projectile point styles and manufacturing techniques alongside the elaboration of food procurement tools has resulted in greater numbers and a wider range of artifacts than those associated with earlier periods, and people during this period appear to have returned to the same sites with some

regularity. Sites in the Champlain Basin show evidence of structures, and sites generally larger and more visible in the Late Archaic than for previous periods (Dewar 1986; McBride and Dewar 1981).

The best known Late Archaic period materials from the state pertain to what has come to be known as the Vergennes Archaic (ca. 4,000-3,000 B.C.), named for the town of Vergennes. This was first defined on the basis of excavations conducted at the Donovan site, situated at the confluence of the Dead and Otter creeks. Typical artifacts include ground slate implements such as points, semilunar knives or ulus, atlatls (spearthrower) weights, gouges, and plummets, as well as the diagnostic "Otter Creek" chipped stone projectile point (Haviland and Power 1994). Several other components attributable to the Vergennes phase have been described for the Otter Creek drainage (Ritchie 1965, 1979), including Ketcham's Island, preserving Late Archaic artifacts, cultural features and even remnants of a dwelling (Ritchie 1968), and the Paper Mill Falls site in Middlebury, evidencing a large hearth tucked up against a large rock face and a focus on the production of biface blanks to be later made into projectile points (Grindle et al. 2011). A wide variety of other Late Archaic occupations are also known from local contexts throughout the Champlain Valley and including the Champlain islands to the north (Bailey 1939; Brooks 1971; Ritchie 1965, 1979; Thomas et al. 1981; Gammon et al. 2011) and the Winooski and Missisquoi Rivers, among others (Cowie et al. 2012; Cox et al. 2004; Petersen et al. 1985; Power and Petersen 1984). Excavations conducted by the University of Maine at Farmington Archaeology Research Center (UMF ARC) at the Cloverleaf site (VT-BE-233) in Bennington have radiocarbon dated a component of the Late Archaic period, the River phase, to 3810±70 B.P. to 4020±70 B.P. (Cox et al. 2010).

The Susquehanna tradition (sometimes referred to as belonging to the "Transitional" or "Terminal" Archaic period), ca. 1,800-1,000 B.C., is represented by the appearance of "broad spear" or "broad stemmed" point types, including contemporaneous Atlantic, Snook Kill and Genesee types (Petersen 1995). In Vermont, Susquehanna variants are present at a number of sites in Bennington, including the Silk Road site, VT-BE-33 (Cox et al. 2002; Cox et al. 2004; Hartgen Archeological Associates 1996), and in the Champlain Valley, Orient Fishtail points, representative of the very latest portion of the Susquehanna Tradition, ca. 1,200-1,000 B.C., are relatively common in the Otter Creek drainage (Haviland and Power 1994). Various other sites and localities throughout the general Late Archaic period tend to be associated with water resources and can be found throughout river drainages in Vermont, including sites in the Winooski River drainage (e.g., Haviland and Power 1981:368–370; Thomas et al. 1981), the Otter Creek drainage, and the Connecticut River drainage (Petersen 1985).

Woodland Period

The final major era of prehistory, the Woodland period, is likewise divisible into three subperiods: Early Woodland, ca. 1,000-100 B.C.; Middle Woodland, ca. 100 B.C.-A.D. 1000; and Late Woodland, ca. A.D. 1000-1600. Evidence of all three Woodland periods are present in local contexts, although the Middle Woodland period remains the best known, primarily from excavations of stratified sites on the Winooski and Missisquoi rivers (Corey et al. 2002; Cowie et al. 2012; Haviland and Power 1981; Haviland and Power 1994; Petersen 1980; Petersen and Power 1983; Thomas and Dillon 1983; Thomas and Robinson 1979, 1983). The introduction of ceramics to the Northeast is the primary distinction between Archaic and Woodland period cultures (Petersen and Hamilton 1984). The introduction of the bow and arrow, perhaps as early as the latter portion of the Early Woodland period, marks another significant manifestation of Woodland period innovations. Long distance exchange networks were comprehensive, and mortuary practices were elaborated during the Woodland period. The first evidence of the cultivation of non-native plants in New England is attributable to the Late Woodland period and a general trend toward larger population densities and decreased mobility was clearly manifested within the Woodland period (Heckenberger et al. 1992).

The Early Woodland period is certainly the least well known portion of the Woodland period in the region although evidence of complex Early Woodland mortuary ceremonialism has been documented from cemetery sites including the Boucher site and the Frink Farm Cemetery on the Missisquoi (Heckenberger et al. 1990; Loring 1985; Perkins 1873). In comparison, little habitation data has been available for the Early Woodland period in the general region. Habitation components have been identified at the Headquarters and Porcupine sites on the southern bank of the Missisquoi (Corey et al. 2002; Cowie et al. 2012), and occupations are known from the Auclair and Ewing sites and from one other site on Shelburne Pond, as well as from a few other sites in the Winooski River drainage (Petersen et al. 1985; Thomas et al. 1981; Thomas et al.1985), including the Pearl Street Park site (VT-CH-234), located in Essex near the headwaters of Sunderland Brook (Heckenberger and Petersen 1988). In general, Early Woodland period patterns follow those of the Late Archaic in terms of subsistence and settlement. There is a sense that there was an overall reduction in population or a settlement shift as suggested by Robinson (pers. comm.) as a response to environmental factors.

The subsequent Middle Woodland period is much better known in Vermont and the broader region. In part, this is likely a result of artifact recognition, given that Native American ceramics manufactured during this period, particularly during the early and middle portions of the Middle Woodland period, are very distinctive. Ceramic decoration techniques were very tightly defined (this is the only time at which pseudo-scallop-shell decoration was utilized) and in addition, the entire surface of the pot was decorated, meaning that even very fragmentary vessels and small sherds are temporally diagnostic, and can be easily identified. Stratified sequences of Middle Woodland period occupations are recognized from extensive excavations at the Winooski site on the lower Winooski River drainage sites (e.g., Haviland and Power 1981:92-115; Petersen 1980; Petersen and Power 1983:368-406) and various sites within the Missisquoi River delta and floodplain, including the Headquarters (VT-FR-318) and Porcupine (VT-FR-326) sites (Corey et al. 2002; Cowie et al. 2012). Despite very distinctive and temporally diagnostic pottery during this time, projectile points are quite the opposite. The most common projectile point of the period is the triangular Levanna type, which overlaps into the Late Woodland period and dates to approximately A.D. 700-1200 or even 1500, although the more diagnostic Middle Woodland point is the Jack's Reef corner notched type (Haviland and Power 1994; Petersen and Power 1983). Generally the Middle Woodland period was a time of shifting trade associations, larger aggregations of people, decreased mortuary elaboration, and an increase in lithic raw material use and ceramic decoration. Aside from regional similarities, diverse technological, settlement, and subsistence data from sites in the Missisquoi and Winooski drainage and farther afield (e.g., Brooks 1971; Petersen and Power 1983:394-406; Petersen et al. 1985:54, 61-62; Thomas and Dillon 1983; Thomas and Doherty 1981:Table 1; Thomas and Doherty 1985:Table 4) document variation among local Middle Woodland components, and may suggest increasing provincialism.

To the north of the project area in Chittenden County, the Ewing site on Shelburne Pond and the Higley Rock, Lague, and Leicester Flats sites similarly possess Middle Woodland components, identified through Petersen's various ceramic studies (Petersen 1977; 1980). Middle Woodland sites within the Otter Creek drainage include components at the Donovan, East Creek Village, and Rivers sites; plus Bristol Pond just to the east of the Otter Creek drainage (Haviland and Power 1994).

Late Woodland period components are no less common than Middle Woodland period components in local contexts (Brooks 1971; Bumstead 1980; Haviland and Power 1981:132–146; Petersen et al. 1985:54–57; Thomas and Dillon 1985:60–67; Thomas and Doherty 1981, 1985), although there is no abrupt change or event that marks the transition from the Middle to the Late Woodland period. Levanna points continued to be the 'standard' projectile points of the period (Haviland and Power 1994), however collections from the Champlain Valley also include the similar but smaller Madison points, which appear at ca. A.D. 800 but are generally thought to gradually have replaced Levanna points in the northeast by about A.D. 1350 (Funk 1976; Ritchie 1971). A slow evolution

of ceramic styles and methods of manufacture is also noted for the period, culminating with the use of globular vessels with castellated collars and incised decoration (Brumbach 1979; Brumbach 1975; Howes 1960; McPherron 1967; Petersen and Power 1983).

The seasonal subsistence round also continued throughout the Late Woodland period, but with one significant innovation: the addition of horticultural products. Maize is documented by at least ca. A.D. 1450 at the Donahue site on the Winooski Intervale (Bumstead 1980) and the Bohannon site (VT-GI-26) in Alburg (Crock 2007) while a direct date of A.D. 1100 from the Skitchewaug site, located on the Connecticut River in Springfield (Heckenberger et al. 1992), and of A.D. 1110 ±40 from a radiocarbon dated maize fragment from a feature at the Headquarters site in Swanton on the lower Missisquoi River (Corey et al. 2002), represent the earliest dates on maize not only in Vermont but in New England. These are closely followed by a date of A.D. 1290-1400 derived from a fire hearth within site VT-CH-994 in South Burlington (Hudgell et al. 2008). A broad spectrum of native floral and faunal utilization includes other horticultural products such as beans at Bohannon and maize, sunflowers, and tobacco at the Headquarters site, which each occur within village settlements with communal longhouse structures (Crock 2007). The introduction of horticulture tended to hasten the already established developmental pattern toward larger, sedentary settlements and promoted population growth (Heckenberger et al. 1992). Furthermore, we can expect to see some alteration in the archaeological record by the start of the seventeenth century, as European explorers and settlers began to move into the region, heralding the start of the Contact period.

Contact Period

The Contact period, ca. A.D. 1600-1750, is typified by traits of both traditional Native American and Euroamerican origin. When the first French and English settlers came to North America, they found themselves ill-equipped to provide for their own subsistence, and so were dependent for a long while on the regular shipment of basic commodities from their homelands. Slowly at first, and then rather rapidly, traditional technologies gave way to European goods as they became more available to the Native American populations, either through diffusion or direct trade and exchange (Bradley 1987; Cowie 1998; Haviland and Power 1994).

Although Champlain "discovered" the lake that bears his name in 1609, European settlement did not begin for at least another half century. The French established Fort Ste. Anne on Isle La Motte in 1666, but it was not long maintained; likewise, a French mission, established somewhere on the east shore of Lake Champlain in 1682, was soon abandoned. Fort Dummer, built by the colonists of Massachusetts Bay in 1724, was the first relatively permanent European settlement in Vermont, attracting settlers into the southern part of the state. Not long after, the French established Fort St. Frederic at Crown Point in 1731, and a mission at Missisquoi in 1743. However, it was not until 1763 and the British takeover from the French in the Great Lakes Region that Europeans began to move into Vermont in any significant numbers, largely coming from Connecticut and Massachusetts (Coolidge 1989; Haviland and Power 1994).

Many highly visible elements of European culture were being absorbed and integrated into Native American culture before substantial European settlement of the Champlain Valley, however (Cowie et al. 1992; Fitzhugh 1985; Haviland and Power 1994). Although traditional work in ceramics, bone, stone and shell still continued, manufactured implements of iron, such as axes, hatchets, knives, and fishhooks had largely replaced their traditional stone implements by the years around 1763. In addition, items such as kaolin pipes, implements of European brass, manufactured cloth, and muskets were being adopted into the native culture and economy. Most of such trade and exchange was derived from the fur trade, initiated mainly by the French. Most early French settlements in the northeast were originally trading stations rather than permanent colonies, and much of the early contact between European and Native American populations developed from the Native tradition of utilizing trade as a means of maintaining contact and communication between different communities that might otherwise be hostile toward one another (Day 1978).

In addition to a shift in available material culture, European settlement created other significant and negative changes in the region. Disease had been brought to the Americas throughout the period of European exploration and colonization, and by the time of significant settlement in the region, estimates state that the population of Vermont had been reduced by at least ninety percent (Snow 1980; Snow and Lanphear 1988). Native populations were rapidly dispossessed of hunting and farming lands, and ultimately forced northward into Quebec and Northern Vermont, where Native peoples still live today (Day 1981). Overall, then, early contact was a dynamic period wrought with violence and disease, ultimately leading to a near collapse of traditional lifeways.

The ethnographic record of Native American occupations in Vermont begins with records of Western Abenaki people in the seventeenth century. The Western Abenaki practiced mixed hunting-fishing-gathering and horticulture, with seasonal aggregation and dispersal even during the historic period. Large villages are known from the historic period. Although these villages were typically in the lower reaches of the major river valleys, exploitation of various upland areas and adjacent drainages is well substantiated. At the time of Samuel de Champlain's journey down Lake Champlain in 1609, there were two cultural groups speaking Eastern Algonquian languages living in what is now Vermont – the Mahicans, occupying the southwestern portion of the state, and the Western Abenakis (Calloway 1990). The Missisquoi band of the Western Abenaki has continued to the present in the area of Swanton, Vermont, and is closely related to groups in Quebec (Day 1978; Day 1981; Day 1987; Haviland and Power 1981:148–263).

Conclusive evidence of Contact period sites is rare in any local context, although at least one date from the Donahue site, A.D. 1720 ± 80, plus perhaps that cited above for an earlier occupation (A.D. 1440 ± 125) (Bumstead 1980), and two dates from the Ewing site, A.D. 1690 ± 90 and A.D. 1700 ± 50 (Petersen et al. 1985), suggest Contact period occupations. Several nearly whole ceramic vessels have been recovered near the Winooski River which are attributable to the Contact period (Willoughby 1909, 1935). In Burlington, numerous Contact period sites are known along Potash Brook and its tributaries; and three further sites of the period were identified during the Chittenden County Survey (Petersen 1977). Further afield, Contact period occupation along the Missisquoi River in Highgate and Swanton is demonstrated at a number of separate sites via radiocarbon dates and diagnostic artifacts (Corey et al. 2002; Cowie et al. 2012; Hudgell et al. 2015b). The paucity of site data may reflect some degree of depopulation of the Lake Champlain drainage during the early Contact period (Day 1981, 1987), and/or difficulty in recognizing such components due to population aggregation, differential site destruction, or currently unknown diagnostic artifacts. As with many other aspects of local Native American history, the apparent scarcity of Contact period sites in the Lake Champlain drainage bears further study.

Project Specific Native American Sites

As noted above, the Otter Creek drainage possesses a number of Native American archaeological sites of various time periods, and several sites have been identified within the Weybridge Hydroelectric Project, or within two kilometers of site VT-AD-44. Most of these sites have yielded quartzite lithic materials, and only a few have been identified to a particular cultural period. Also located on Wyman Island, towards the northern portion of the island, is VT-AD-43, while VT-AD-42 is located on the northern bank of Otter Creek just to the southwest of the Weybridge Dam. VT-AD-45 is located immediately across the Otter Creek to the southeast of VT-AD-44. Site VT-AD-148 is located on the north bank of Otter Creek close to the southern tip of Wyman Island; this route was used by the NE ARC to access the island during phase II testing of VT-AD-44, and numerous pieces of chert and quartzite debitage were noted on the ground surface within the VT-AD-148 site area. Slightly further afield, at least 15 sites are located along the banks of Otter Creek, upstream of the Weybridge Dam, and within 2.0 km of site VT-AD-44. Of these, VT-AD-43, VT-AD-105, VT-AD-148, VT-AD-350, VT-AD-915 and VT-AD-1513 are attributable to the Woodland period based on the recovery of diagnostic projectile points (usually Levannas)

or Native American ceramics (VAI). Downstream of Wyman Island, at least ten sites have been identified within 2.0 km of site VT-AD-44, including VT-AD-496, which has produced diagnostic projectile points and Native American ceramics dating to the Middle and Late Woodland periods (Hudgell et al. 2015a). A cluster of sites are known from the confluence of the Otter Creek and the Lemon Fair River, located approximately 1.9 km to the west of VT-AD-44 (VAI).

IV. FIELD AND LABORATORY METHODS

Field Work Methods

Archaeological phase II testing at previously identified site VT-AD-44 was designed using a systematic sampling strategy aimed at a more precise determination of the extent of the site, and to better understand the potential effects of erosion on this historic property. Archaeological sensitivity and the general placement of phase II test pits and units were based on prior archaeological investigations.

Phase II testing began with the establishment of an arbitrary metric grid within the previously defined site area. This area was located utilizing remaining pin flags which marked previous phase IB testing transects (T1 and T2) utilized by Tetra Tech in 2009 (Tetra Tech Inc. 2011). These previous transects roughly follow the curve of the eroding embankment. During the phase II testing, variably sized excavation units were placed on the grid in order to explore the nature and extent of previously identified subsurface deposits. The grid was aligned to fall well to the north and east of an arbitrary datum point N0 E0. All current and former test pits and units were marked on project maps, and were recorded using a Trimble GeoXT GPS.

Phase II excavation units included 0.5 m x 0.5 m test pits, 1.5 m x 0.5 m test units, 2.0 m x 1.0 m units, and 1.0 m x 1.0 m units. The larger test units specifically utilized in order to penetrate deep alluvial sediments. Excavations proceeded by hand, employing a standardized, systematic methodology with the removal of sediment by arbitrary 10 cm levels within natural soil strata from the highest point downward. Smaller 0.5 m x 0.5 m test units were excavated to depths of approximately 1.0 m, beyond which sediment removal is increasingly impractical due to the small size of the pit. For example, 0.5 m x 1.5 m test units (and larger) enable deeper excavation as they allow sufficient space for an archaeological technician to work standing inside the pit. At a depth of approximately 1.0 m, or "waist deep", excavation of the full 0.5 x 1.5 m area was terminated, at which point one end of the unit, measuring 0.5 m x 0.5 m, was excavated an additional 0.75 m to 1.0 m, thereby testing to a total depth of up to 2.0 m. Thus, all OSHA regulations with regard to working in confined spaces were strictly followed.

All excavated sediments were screened through 6.4 mm (1/4 in) hardware cloth; cultural material was bagged and labeled according to site, test pit and depth below the ground surface. Field provenience numbers, or "pn" designations, were assigned to a particular test pit for cultural remains from each 10 cm arbitrary excavation level, or any other more discrete provenience. For instance, all artifact classes (e.g., lithic debitage, lithic tools, fire-cracked rock, pottery, etc.) from a level share a unique "pn" for that particular unit and level. This unique "pn" number therefore identifies all associated cultural remains from a common provenience. Test pit and test unit forms were also completed for each test pit and test unit to record artifact and provenience information. The sediment profile of each test pit was measured and schematically drafted, and a written description of each profile was recorded in the field (Appendix I). All provenience and general artifact information was directly entered in the field onto digital tablets (using *Microsoft Excel*).

The site area was mapped in detail with all excavations noted on the schematic plan. Detailed notes about area specifics such as the nature of the topography, stratigraphy and any recovered cultural remains were recorded in a log kept by the field supervisor. All aspects of the field work, including photography, were recorded in digital format.

Laboratory Methods

After the completion of phase II field work, artifacts and records were returned to the laboratories of the NE ARC. Once in the lab, artifacts were organized by provenience and inventoried; the records and bags containing the artifacts were checked against each other in order to ensure accuracy of the

provenience data. Discrepancies were corrected and the field provenience inventory forms were downloaded into a computer database program (Microsoft *Access*). Digital information from the GPS and digital cameras as well as scanned field record files was downloaded onto the NE ARC server.

Wet and dry cleaning methods were employed for artifacts as appropriate, and after cleaning and initial processing, all artifacts/samples were catalogued. Artifacts that underwent processing in the laboratory were first sorted into artifact or descriptive classes (e.g., lithic debitage, lithic tools, Native American ceramics), and other descriptive information was also included, such as material, decoration, functional category, and temporal attribution, where applicable. For lithic debitage, counts were minimally attained, while lithic tools were weighed and sized as well. All catalogue information was directly entered into a computer database (*Microsoft Access*). The catalogue and provenience databases were linked, queried and checked then printed on acid-free archival paper. Certain artifacts and samples such as pottery, bone, and select floral remains received more extensive attribute analysis. As with the field inventory and catalogue, the analyses were also directly entered into a linked computer database program and checked for accuracy. Samples of bone recovered in the field or through flotation were analyzed by Dr. Ellen Cowie. A sample of carbonized floral remains was recovered from a cultural feature at the site. Paleobotanist Nancy Asch Sidell analyzed selected samples of these remains, and the result of her analysis is presented in Appendix II. A sample of maize was then submitted to Beta Analytic, Inc., for radiocarbon dating, as is discussed below and reported in Appendix III.

After cataloging and analysis, the artifact information was printed on archival paper tags that were then included in the bags along with the artifact. Lithic tools were individually labeled. All artifacts/samples were then placed in zip-lock polyethylene bags, with certain items such as bone and pottery protected in non-acidic film vials with non-buffered acid-free tissue paper. The exterior of the polyethylene bags were labeled with permanent ink as well. Materials were carefully organized, generally by material type and provenience, then stored in clearly labeled and numbered banker's boxes.

Documents and records, including all field and lab material, were generally printed on acid-free paper and written materials such as field notes, lab records, correspondence etc. were organized, scanned, and prepared for curation in standard-sized (10" x 12" x 15") acid-free boxes. Photographic material and other digital information was also curated/copied onto DVD and included with the records collection. The collection, including artifacts and records, will be housed at the Vermont Archaeology Heritage Center (VT AHC) in Barre, Vermont.

V. FIELD WORK AND RESULTS

Project Description and Cultural Resources

The Weybridge Hydroelectric Project (FERC No. 2731) measures 5.6 km (3.5 mi) in total length, and extends to either side of the Project dam. The dam is located at the head of a rock-walled gorge at river mile 19.5 on the Otter Creek, in the Towns of New Haven and Weybridge. The impoundment extends approximately 2.5 km (1.5 mi) upstream within the natural channel of the river to the tailwater of the Huntington Falls Hydroelectric Project (FERC No. 2558), and also extends 3.3 km (2.0 mi) downstream to the upper limits of the Vergennes Hydroelectric Project (FERC No. 2674) (Baker et al. 2002).

A Historic Properties Management Plan for the Project was completed on behalf of the former owners, CVPS (Baker et al. 2002), and outlines procedures that are intended to continuously protect and maintain historic properties during the 30-year terms of the FERC license to operate the Weybridge generating station. This license was transferred from CVPS to GMP in 2012. CVPS and then GMP have undertaken a phased study approach to determine whether any archaeological sites are being adversely affected by the presence and operation of the Project. This approach was used to determine the potential for archaeological sites, and the potential for Project-induced erosion. Some of the agents that currently affect riverbank stability include seasonal and storm floods, ice jams and flows, wind-induced wave action, cattle paths and watering areas, hydroelectric impoundment fluctuations, and waves created by recreational boating.

Several archaeological sites have been identified near the limits of the Project (Baker et al. 2002: Table 2), including two Euroamerican sites and 15 Native American sites. Of these, both Euroamerican sites and six Native American sites were newly identified during cultural resource management studies relating to the FERC relicensing of the existing project by CVPS (submitted 1998), while nine Native American sites were previously known and recorded in the Vermont Archaeological Inventory, including site VT-AD-44. Phased archaeological studies previously undertaken within the Project include a 1996 phase IA archaeological site sensitivity study (Petersen and Petersen 1997) and phase IB archaeological site identification studies undertaken during 1997 and 1998 (Corey and Cowie 1998) and also in 2009 (Tetra Tech Inc. 2011). In addition, the Project shoreline is monitored each year in accordance with Section 3.2.4. of the HPMP for the Project, with specific attention given to locations surrounding these identified and potential archaeological sites. The 2013 inspection confirmed that the majority of Project shorelines remain stable and healthy, but significant erosion continues to affect the landform containing site VT-AD-44 (Baker 2013).

VT-AD-44 Site Setting

The overall area of Native American site VT-AD-44 is located on a level terrace and slightly raised landform three to four meters above and immediately adjacent to the Otter Creek (Figures 6 and 7). The site is located at the eastern edge of Wyman Island, owned by the Town of Weybridge. While the site was originally identified towards the northeastern edge of Wyman Island (VAI), archaeological deposits extend towards the southernmost, downstream extremity of the island, at UTM coordinates E642650 N487990 to E642780 N4870183. As currently defined on the basis of phase I and II archaeological investigations, the site measures minimally 300 m (984 ft) in length and at least 20 m (66 ft) in width inland from the edge of the embankment of Otter Creek, for a total area of approximately 6,000 sqaure meters (0.6 hectares, or 1.48 acres).

Elevation ranges from approximately 150 ft a.m.s.l. at the edge of the eroding embankment to 152 ft a.m.s.l. in the center of Wyman Island, and the defined site area along the edge of the embankment is flat and level. The site area is mostly open and vegetated with goldenrod and brambles, and was originally an agricultural field (previous to ca. 1970). To the southwest is a

Figure 6. View northeast of terrace landform and eroding bank within site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont. Otter Creek is to the right of the photograph.

Figure 7. View southwest of terrace landform and eroding bank within site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont. Otter Creek is to the left of the photograph.

stand of mature deciduous trees including oak and ash while brushy undergrowth, bushes, thick brambles and young deciduous growth is located to the northeast of the main site area. Historic bridge abutments are located approximately 50 m to the east-northeast of the site area and mark the last access to the island; this bridge collapsed sometime in the 1970s (Eliason pers. comm.)

Continued bank erosion is in action along the shoreline of Wyman Island within the defined area of site VT-AD-44. The shoreline fronting the site demonstrates slumping/slippage (mass wasting), bank collapse and undercutting, most notably within an area measuring 130 lateral meters (see Figures 6 and 7).

Previous Archaeological Work at VT-AD-44

Surface collection by A. Stensrud, T. Vogelman and G. Nielsen on Wyman Island in the early 1970s produced an assemblage of quartzite flakes and triangular points in two separate locations, including the northern and southern sides of the island. In 1971, these locations were subsequently recorded in the Vermont Archaeological Inventory site files as VT-AD-43 and VT-AD-44, respectively (VAI). However, official archaeological investigations at the sites were undertaken much later, following cultural resource management related to FERC relicensing of the Weybridge Hydroelectric Project. Phase IA visual archaeological reconnaissance and annual monitoring assessments of site VT-AD-44 have been conducted on behalf of Central Vermont Public Service Corporation (CVPS), the previous owners of the Weybridge Hydroelectric Project, as part of the overall 2002 Historic Properties Management Plan (HPMP) for the project (Baker et al. 2002). These site assessments have resulted in the recovery of various artifacts from the eroding embankment, including several quartzite flakes and at least one Levanna-type projectile point (Baker 2008).

The CVPS HPMP also stipulated annual monitoring of the shoreline throughout the project for erosion and destabilization, and in the event that the effects of eroding or destabilized shorelines in the vicinity of identified and potential archaeological sites was noted, to initiate cooperative actions with landowners. Under these conditions, an archaeological phase IB survey of site VT-AD-44 was conducted in 2009 by Tetra Tech, Inc. in order to establish the presence and specific location of the site, whether the site was at risk of erosion, and whether the site was potentially eligible for inclusion on the NRHP (Tetra Tech Inc. 2011). The phase IB study was focused in an area of 0.53 acres at the southeastern extremity of Wyman Island and included surface collection of the eroding embankment and the excavation of 42 0.5 m x 0.5 m shovel test pits, resulting in the recovery of 134 pieces of lithic debitage, a number of fragments of fire-cracked rock, a core fragment, an end scraper, one complete Madison-type projectile point and two projectile point tips, likely Levannas, temporally placing site occupation in the Middle to Late portion of the Woodland period, ca. A.D. 750-1600. Subsurface artifacts were recovered from various intact and separated buried surfaces, suggesting repeated occupation of the landform separated by flood episodes. On the basis of the evidence recovered during phase IB survey, Tetra Tech recommended that the site is eligible for inclusion on the NRHP (Tetra Tech 2011:21).

Annual monitoring of the shoreline of the project has continued following the transfer of the license of the Weybridge Hydroelectric Project from CVPS to GMP. During the 2013 inspection, a quartzite flake scatter and a quartzite core fragment were observed and mapped, an ongoing erosion was noted (Baker 2013). GMP consulted with the SHPO and landowner in its efforts to protect archaeological information. Following consultations with the Natural Resources Conservation Service (NRCS) and Vermont Agency of Natural Resources (ANR), bank stabilization is not considered a good alternative, in part also due to difficulties in accessing the location. Current plans include continued monitoring with increasing archaeological efforts to document and recover cultural material before it is lost. Archaeological phase II testing was thus recommended for the site, and is discussed below.

Figure 8. View south of Native American ceramics on the eroding bank within site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont.

This report also includes analysis of a sample of material recovered from the eroding embankment by Charity Baker, Beth Eliason and Ellen Cowie, including 25 lithic artifacts and 121 pieces of Native American ceramic, representing a single vessel (Figure 8). These items are included in the general discussion of artifacts recovered during the phase II testing, presented below.

Archaeological Phase II Testing

Archaeological phase II testing of site VT-AD-44 was conducted by NE ARC from November 4-6 and November 11-15, 2014. A total of 15 0.5 m x 0.5 m test pits, six 1.5 m x 0.5 m test units, five 2.0 m x 1.0 m units, and one 1.0 m x 1.0 m unit were placed on the arbitrary grid, for a total excavated area of 19.25 square meters. These were placed within the general area of previous phase IB survey excavations, and also along the 130-meter long section of site area at most risk to erosion (Figure 9). A temporary hub placed roughly in the center of the previously defined site area was assigned grid coordinates N200 E400, such that any location within the defined site (and on Wyman Island as a whole) would fall to the east and north of arbitrary position N0 E0 and thus retain positive coordinate numbers. The general testing strategy involved relocation of previous phase IB test pits, marking these on the newly established grid, and filling in and extending the grid from these initial excavations. This grid was thus utilized to establish and maintain horizontal control of the site area, and to provide correspondence between current and former testing.

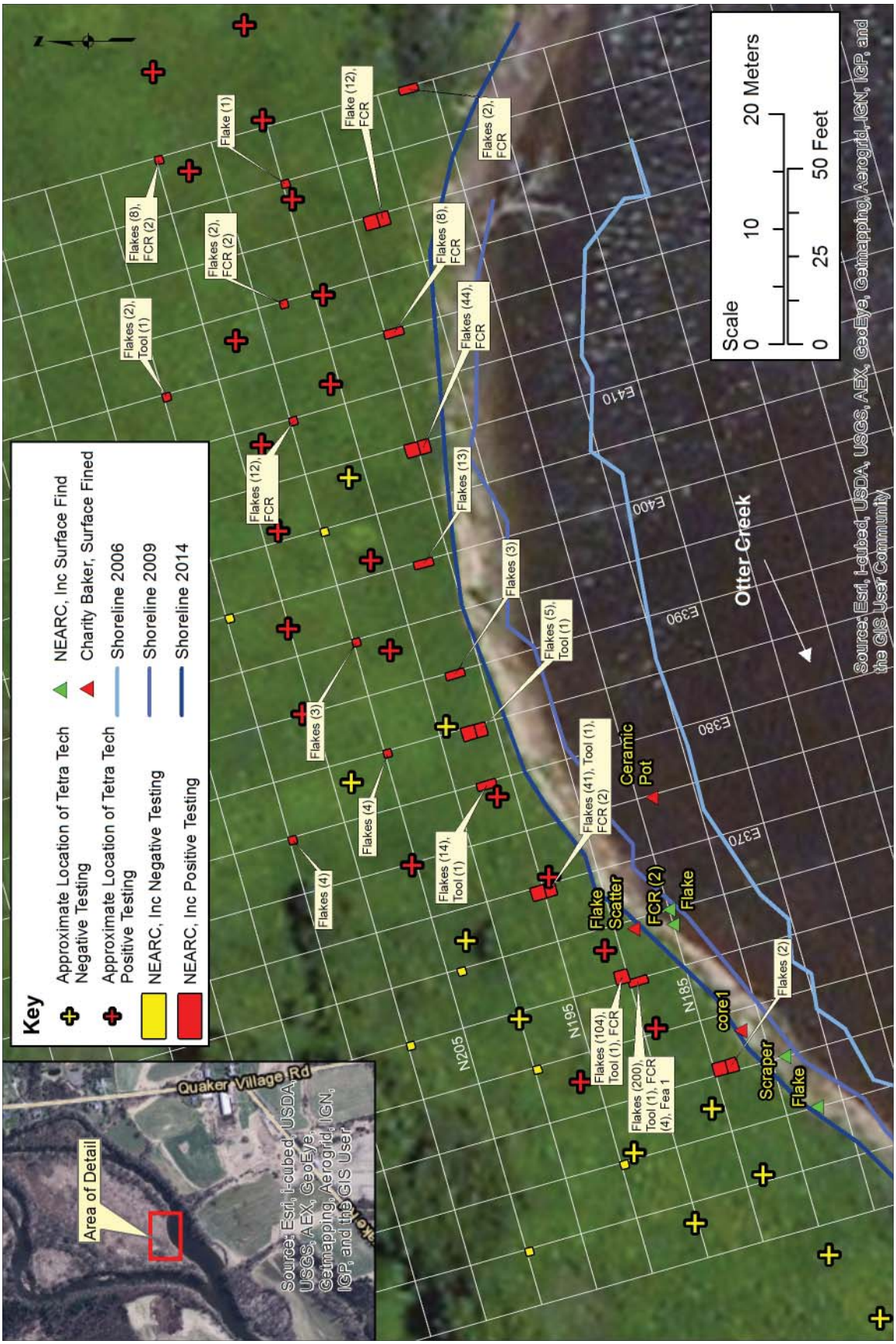

Figure 9. Map showing the location of phase II test pits and test units within site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont. Note also the position of previous survey and testing by Tetra Tech.

Figure 10. View west of crew members excavating test units N195-196 E410 (foreground) and N197-198 E385 (background) at site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont.

Phase II testing commenced with the placement of 1.5 m x 0.5 m and larger 2.0 m x 1.0 m units test units at 5.0 and 10.0 m intervals close to the edge of the eroding embankment and were used to sample site stratigraphy to depths of 2.0 m below ground surface (Figure 10). One 1.0 m x 1.0 m test unit was also placed in order to explore a cultural feature. Smaller, shallower 0.5 m x 0.5 m test pits were utilized to explore the nature of the archaeological deposits farther back from the eroding embankment, and were arranged in two rows: the first with test pits placed at 10.0 m intervals at a distance of roughly 10-15 m from the bank, and the second with test pits at 20.0 m intervals roughly 20-25 m from the bank. This strategy was utilized to more firmly establish site boundaries and to determine the location and preliminary extent of any artifact clusters or activity loci. In addition, the eroding embankment was also inspected for cultural material.

All of the excavation units and seven of the test pits were positive for Native American cultural material. In addition, two lithic flakes, two pieces of fire-cracked rock, and a quartzite scraper were recovered from the eroding bank (Figures 11 and 12). In total, 539 Native American artifacts and 47 fragments of calcined bone were recovered, and are discussed below (Table 1). Artifacts previously recovered from the eroding bank by Baker and Cowie and included in this analysis include an additional four lithic tools, 21 pieces of debitage, and 121 pieces of Native American ceramic (see Figure 8).

Figure 11. View southwest of eroding bank at site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont. The pink pin flags are marking surface collected artifacts.

Figure 12. View northeast of eroding bank at site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont. The pink pin flags are marking surface collected artifacts.

Table 1. Cultural Material Recovered from Site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont.

			Native American															Native American Total	Questionable		Question-able Total	Grand Total
			Bone	Lithic Debitage				Fire-cracked Rock	Lithic, Other			Lithic Tool, Flaked				Lithic Tool, Ground	Pottery			Manuf. Scrap		
				Flake					Frag-ment	Manu-port	Pebble	Core Frag.	Projectile point	Scraper	Utilized Flake	Hammer-stone			Pebble			
Provenience	Level/ Stratum	Feature	Burned	Chert	Quartz	Quartz-ite	Un-known	Un-known	Un-known	Un-known	Un-known	Quartz-ite	Quartzite	Quartz ite	Quartz ite	Un-known			Un-known	Slag		
Surface	Eroding embankment					21						1		1	2		121	146				146
	N178 E345					1												1				1
	N179 E350													1				1				1
	N185 E364							2										2				2
	N185 E365					1												1				1
Subsurface	N185 E351 4ap					2												2				2
	N185 E351 Total					2												2				2
	N187 E440 8c					1												1				1
	N187 E440 Total					1												1				1
	N188 E440 1ap					1		1										2				2
	4ap																		1		1	1
	9c							1										1				1
	N188 E440 Total					1		2										3	1		1	4
	N189 E360 3ap					2												2				2
	4b														1			1				1
	5b					1												1				1
	6b					7												7				7
	7b					5												5				5
	N189 E360 Total					15									1			16				16
	N190 E360 3ap			1														1				1
	4b					3		1										4				4
	6b		21			178		1							1			201				201
	6b	F.1	25			26		2										53				53
	7b					6					1		1					8				8
	8b		1															1				1
	N190 E360 Total		47	1		213		4			1		1		1			268				268
	N191 E361 2ap					1												1				1
	3ap					3												3				3
	4 buried a					2												2				2
	6 buried a					84				1			1					86				86
	7a/c					16												16				16
	8a/c							1										1				1
	N191 E361 Total					106		1		1			1					109				109
	N193 E430 3ap			1		1												2				2
	4b					1												1				1
	5b			1		1												2				2
	6b					1												1				1
	N193 E430 Total			2		4												6				6
	N194 E420 1ap					1		1										2				2
	2ap					1												1				1
	N194 E420 Total					2		1										3				3
	N194 E430 2ap					2		1										3				3
	4ap					4												4				4
	N194 E430 Total					6		1										7				7

Table 1. Continued.

			Native American																Native American Total	Questionable		Question-able Total	Grand Total
			Bone	Lithic Debitage				Fire-cracked Rock	Lithic, Other			Lithic Tool, Flaked				Lithic Tool, Ground	Pottery						
				Flake					Frag-ment	Manu-port	Pebble	Core Frag.	Projectile point	Scraper	Utilized Flake	Hammer-stone			Pebble	Manuf. Scrap Slag			
Provenience	Level/ Stratum	Feature	Burned	Chert	Quartz	Quartz-ite	Un-known	Un-known	Un-known	Un-known	Un-known	Quartz-ite	Quartzite	Quartz ite	Quartz ite	Un-known			Un-known				
N195 E370	1ap			1														1					1
	2ap					3												3					3
	4a/c					4												4					4
	5a/c					1												1					1
	6a/c					1												1					1
	7a/c					2												2					2
	9a/c					1												1					1
N195 E370 Total				1		12												13					13
N195 E410	1ap					3												3					3
	2ap					5		1										6					6
	3ap			1		6												7					7
	4ap					7												7					7
	5b				1	1												2					2
N195 E410 Total				1	1	22		1										25					25
N195 E420	1ap					1												1					1
	2ap					3												3					3
	3ap					2												2					2
N195 E420 Total						6												6					6
N196 E370	1ap					1												1					1
	2ap					2												2					2
	3a/c					3												3					3
	4a/c					4												4					4
	5a/c					8												8					8
	6a/c					2												2					2
	7a/c					6												6					6
	8a/c					1		3	1									5					5
N196 E370 Total						27		3	1									31					31
N196 E410	1ap					4												4					4
	2ap			1	1	4												6					6
	3ap					10		1										11					11
	4ap					1												1					1
N196 E410 Total				1	1	19		1										22					22
N197 E380	1a																			1	1		1
	3a					1												1					1
	4a					5												5					5
	5b						1											1					1
N197 E380 Total						6	1											7		1	1		8
N197 E385	1ap			1		1												2					2
	4ap					1												1					1
N197 E385 Total				1		2												3					3
N197 E400	2a					1												1					1
	3a					2												2					2
N197 E400 Total						3												3					3
N198 E380	1a					2												2					2
	3a					1												1					1
	4a					4												4					4

Table 1. Continued.

			Native American																Native American Total	Questionable		Question-able Total	Grand Total
			Bone	Lithic Debitage				Fire-cracked Rock	Lithic, Other			Lithic Tool, Flaked				Lithic Tool, Ground	Pottery						
				Flake					Frag-ment	Manu-port	Pebble	Core Frag.	Projectile point	Scraper	Utilized Flake	Hammer-stone				Pebble	Manuf. Scrap Slag		
Provenience		Level/ Stratum Feature	Burned	Chert	Quartz	Quartz-ite	Un-known	Un-known	Un-known	Un-known	Un-known	Quartz-ite	Quartzite	Quartz ite	Quartz ite	Un-known				Un-known			
	N198 E380 Total					7												7				7
	N198 E385	2ap				1												1				1
		4ap				3												3				3
	N198 E385 Total					4												4				4
	N198 E390	2a				1												1				1
		3a				3												3				3
	N198 E390 Total					4												4				4
	N198 E400	1a				2												2				2
		2a				4												4				4
		3a				4												4				4
	N198 E400 Total					10												10				10
	N200 E435	2ap				1												1				1
	N200 E435 Total					1												1				1
	N203 E425	4ap				2												2				2
		5b						2										2				2
	N203 E425 Total					2		2										4				4
	N205 E385	1ap				1												1				1
		2ap				1												1				1
		3ap				1												1				1
		4 ap/b				1												1				1
	N205 E385 Total					4												4				4
	N205 E395	2ap				1												1				1
		3ap				1	1											2				2
	N205 E395 Total					2	1											3				3
	N205 E415	2ap				1		1										2				2
	N205 E415 Total					1		1										2				2
	N210 E440	1ap						1								1		2				2
		2ap				3												3				3
		3ap				5												5				5
	N210 E440 Total					8		1								1		10				10
	N215 E380	2a/c				1												1				1
		3a/c							1									1				1
		4a/c				1												1				1
		6 buried ap				1												1				1
	N215 E380 Total					3			1									4				4
	N215 E420	2ap		1														1				1
		3ap		2														2				2
	N215 E420 Total			3														3				3
Grand Total			47	10	2	516	2	20	2	1	1	1	2	2	4	1	121	732	1	1	2	734

Stratigraphy

Test pits were excavated to depths of 55 to 100 cm below ground surface, with an average of 78 cm. Test units were excavated to depths of 90 to 200 cm below ground surface and averaged 132 cm (see Appendix I). Site stratigraphy varies with distance from the embankment, with alluvial deposits within approximately 10 m of the embankment, and a "forest soil sequence" of 'A', 'B' and 'C' soil horizons beginning approximately 15-20 m back from the embankment. Essentially this appears to reflect less impact from flood events (less active deposition) at distances further back from the embankment, resulting in sterile 'C' sediments being encountered at increasingly shallow depths with increasing distance from the embankment.

Alluvial stratigraphy, found generally within all of the test units placed close to the edge of the embankment, demonstrated an overlying grey brown to yellowish brown 'Ap' plow zone and a buried 'A' soil horizon, together occurring to depths of 39 to 48 cm below ground surface. These strata were difficult to distinguish as they were very close in color and sediment grain size. Beneath this was generally a 'B' soil horizon of brown or strong brown coloration, ranging from 15 to 32 cm in thickness, which in turn overlay and graded into pale colored alluvial strata representing flood deposits. Dark colored paleosols were intermittent and variably present and generally occurred within the 'B' stratum and undeveloped alluvium; where present, paleosols ranged in thickness from 6 to 24 cm. All sediments were very fine sandy loam, increasing in sand content with depth; paleosols tended to have a slightly higher silt content (Figures 13-16). A more developed forest soil sequence was encountered in test pits placed farther from the embankment; such profiles typically demonstrated an overlying dark grayish brown 'Ap' plow zone or 'A' soil horizon from 27 to 38 cm in depth, overlying a dark brown to strong brown developed 'B' soil horizon from 22 to 35 cm in thickness, overlying a light olive brown 'C' soil horizon. These sediments were slightly siltier than those at the edge of the embankment, and were generally classed as silt loams. All excavations were terminated within a sterile 'C' horizon or basal alluvium. These soil descriptions corroborate the USDA soil descriptions for the site area, which are described as Hadley series very fine sandy loams, developed from a parent material of coarse-silty alluvium (USDA 2014).

Identification of site stratigraphy generally followed the results of the phase IB survey, which characterized the deposits as a complex of seasonal alluvial depositional events with evidence of buried developed 'A' soil horizons or paleosols (see Figures 13-15). Paleosols were identified at depths generally ranging between 50 and 80 cm below ground surface, with deeper paleosols occurring to the west of the site area. The paleosols yielded the highest density of cultural material, and likely demonstrate separate occupations. Artifacts were recovered to a maximum depth of 110 cm below ground surface. Paleosols were not present at the western extent of the defined site area, and likewise, artifact density drops off sharply in this area. The most westerly unit, N184-185 E351, showed no paleosol, and instead demonstrated distinctive laminated sand deposits beginning at about 60 cm below ground surface (Figure 16). It is possible that this represents the farthest extent of the original site landform.

Figure 13. View south of unit N195-196 E370, showing typical stratigraphy within site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont. Note the crew member marking a paleosol. Otter Creek is visible in the background.

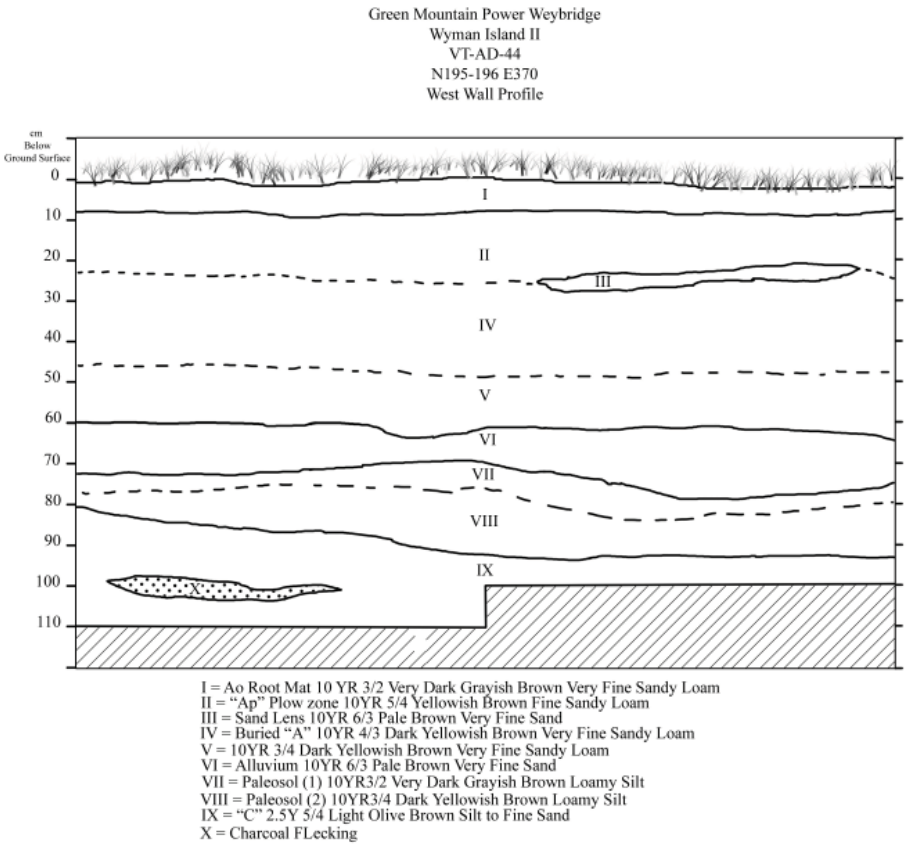

Figure 14. View west of unit N195-196 E410, showing typical stratigraphy within site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont. Note dark overlying 'Ap' and 'A' soil horizons, overlying yellow brown alluvial strata. Paleosols are visible as dark bands within the lighter alluvium.

Figure 15. West wall profile of unit N195-196 E410, showing typical stratigraphy within site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont.

Figure 16. View east of unit N184-185 E351, showing alluvial stratigraphy within site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont. Note fine sand laminations towards the base of the excavation.

Cultural Feature

One cultural feature was identified, and was designated feature F.1 (Figure 17). This was identified close to the western extent of the defined site area in unit N190 E360 at approximately 56 cm below ground surface, within a 'buried A' or developed 'B' soil horizon (differences between these soil horizons are difficult to distinguish in this portion of the site area as their coloration and texture is very similar). This feature first became apparent with a sharp increase in the quantity of lithic flakes and fragments of calcined bone in the excavated sediment, and then eventually appeared as a very faint, slightly reddened, amorphous soil stain with charcoal flecking. One piece of fire-cracked rock was also noted. The soil stain was separated into two areas of coloration defined as zones 1a and 1c. A small dark patch located at the northern extent of the excavated feature was designated zone 1b. Sediment from each of the three zones was retained for flotation in the laboratory and kept separate. Unit N191 E361 was opened up adjacent to unit N190 360 in order to determine the extent of the feature, however the soil coloration was not visible in the new unit. Relatively large quantities of lithic debitage were recovered within the same level and stratum, however.

Owing to the very faint soil staining, amorphous or indistinct shape, and only a single piece of fire-cracked rock, feature F.1 likely represents an area of activity or paleosol located close to a fire hearth, or a hearth remnant. Evidence of the hearth itself was not identified, however the charcoal flecking, slight reddening of the soil, and fire-cracked rock indicate that a hearth was either located nearby or has been partially dispersed by natural processes such as flooding of the landform. The small dark area, zone 1b, may represent a post mold.

The feature boundaries are not distinct, and artifacts potentially associated with this activity area include all artifacts recovered from the same, or adjacent, level and stratum in units N190 E360 and N191 E361, as well as artifacts recovered from ¼" screening of stained sediment in the field and artifacts recovered from flotation of feature sediment in the laboratory. In total, these artifacts include at least 310 pieces of lithic debitage, one piece of fire-cracked rock, and likely all 47 fragments of calcined bone recovered from the site (see Table 1). One piece of bone recovered from slightly deeper in the excavation, approximately 75 cm below ground surface, may be out of context due to biotubation. The bone specimens are all small and fragmentary, and weigh a combined total of 4.16 grams. These could only be assigned to class, and all are certainly mammal or turtle.

Additional debitage was noted in the heavy fraction of floated feature sediment but was not counted due to its small size. Overall, debitage recovered from contexts associated with feature F.1 account for at least 58.5% of the lithic debitage recovered during phase II testing at the site.

Floral remains recovered via flotation of the feature in the laboratory were sent to Nancy Ash Sidell for paleobotanical analysis. Of particular note, fragments of carbonized maize were recovered from the feature, along with an assortment of other plant remains including goosefoot, bramble, elderberry, blueberry, and vervain seeds, and a variety of wood including hickory, bitternut hickory, butternut, beech, ash, hop hornbeam, white pine, red oak, and elm (Appendix II). A sample of maize was sent to Beta Analytic, Inc. for radiocarbon dating, and returned a conventional radiocarbon age of 550±30 B.P., ca. A.D. 1400 (Beta-405628). Calibration at 2-sigma (95% probability) gives date ranges of A.D. 1315-1355 and A.D. 1390-1430 (Appendix III).

Cultural Material

Native American artifacts recovered from the site during phase II testing include six lithic tools, 509 pieces of lithic debitage, 20 fragments of fire-cracked rock, and four other lithic artifacts including two fragments, a manuport, and a curated pebble. A total of 47 fragments of calcined

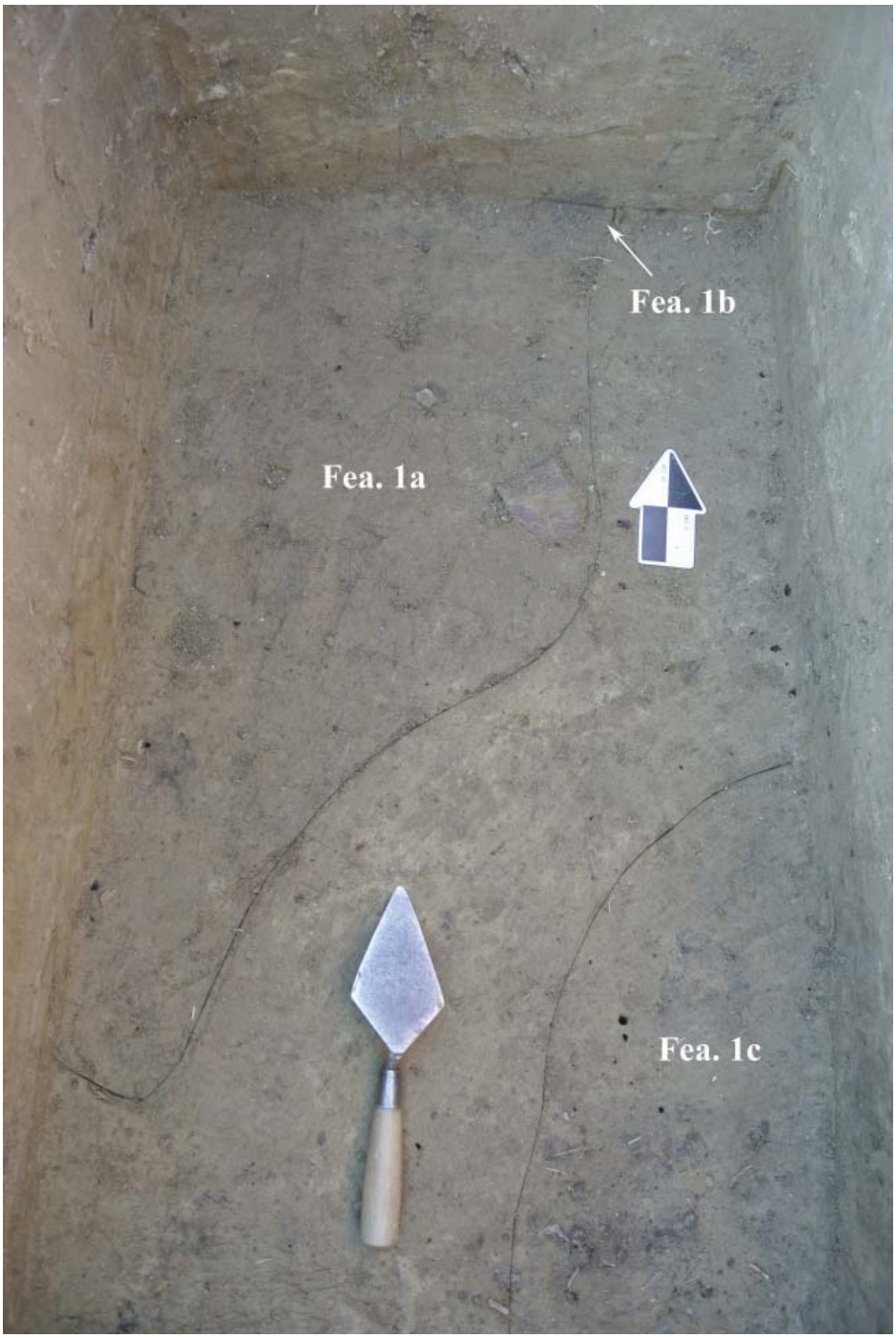

Figure 17. Plan view of cultural feature F.1 within unit N189-190 E360 at site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont.

bone were also recovered from contexts associated with the cultural feature, as noted previously. Additional artifacts recovered from the eroding embankment by Baker, Cowie, and Eliason and included in this analysis include a further four lithic tools, 21 pieces of debitage, and 121 pieces of Native American ceramic (see Table 1).

Lithic raw materials represented at the site include quartzite, chert, quartz, and an unknown material, which accounts for one tool – a hammerstone – as well as two flakes. The majority of lithic artifacts at the site are quartzite, and include all nine of the flaked stone tools and 516 flakes (97.4% of the flake sample). Quartzite is locally available all along the western edge of the Green Mountains and its foothills, and is also present in cobble form throughout much of the Otter Creek drainage. Chert is not as immediately available, but various chert quarries are known throughout western Vermont, primarily close to the eastern shore of Lake Champlain. Quartz is ubiquitous throughout the northeast, and can be found in veins of bedrock or in cobble form.

Lithic Tools

Lithic tools recovered during phase II testing include a hammerstone, two projectile point fragments, two utilized flakes, and a unifacial scraper. Tools recovered from the eroding embankment by Baker, Cowie and Eliason include two utilized flakes, a core fragment, and another unifacial scraper.

The hammerstone, pn 262-1, is a slightly reddened and cracked cobble, possibly a type of sandstone. It has been cracked along a natural fracture, and one side is thus naturally flattened. This artifact demonstrates heavy battering on one end, and has certainly been used as a hammerstone, likely in the process of manufacturing other lithic tools, but may also have been used as an anvil stone for such tasks as subsistence resource processing (crushing and grinding nuts and seeds, for example). This artifact also shows some plow damage in the form of a scrape across the flat surface, which is not surprising given that it was recovered from the uppermost 10 cm of the plow zone. The hammerstone was recovered from the eastern extent of the site in test pit N210 E440.

As noted, the remaining nine tools are all of quartzite. The two projectile point fragments were recovered from adjacent units N190 E360 and N191 E361. The first, pn 286-1, is a concave basal fragment of a triangular point, and is finely thinned and apparently a broken piece of a finished point which has been snapped in half, probably as a result of use (Figure 18). It is relatively small (2.3 cm wide at base), and likely represents a small Levanna-type point. Levannas are the characteristic point type of the later portion of the Woodland period throughout much of the Northeast, particularly New York and Vermont. This point type was used almost exclusively through the local Champlain Valley "Colchester phase" of the later Middle Woodland period, ca. A.D. 750-1000, and was also the standard point type utilized through the Late Woodland period, ca. A.D. 1000-1500 (Haviland and Power 1994; Ritchie 1980:260). Given that the general trend was for Levannas to decrease in size through time, it is likely that specimen pn 286-1 is attributable to the later period of their use. Levanna points are commonly found along every major stream in Vermont from the Canadian border to the southern end of Lake Champlain, on the shores of such ponds as Shelburne, Bristol, and Monkton, and throughout the Otter Creek drainage. Levannas are also thought to represent arrowheads, rather than spear points (Haviland and Power 1994).
The second projectile point, pn 22-1, is a tip fragment (see Figure 18). This artifact is not well thinned, although it may still represent a finished point; again, this has been snapped in half, and it is difficult to tell if the break was sustained through use or through manufacture. This artifact appears too narrow to be a Levanna type point, however it is too fragmentary to designate to a particular point typology.

Two unifacial scrapers were recovered from the eroding embankment (see Figure 18). The first, pn 302-1, was found approximately 10 m west (downstream) of the projectile points. This artifact is quite thick, measuring 1.4 cm in thickness, and 2.9 cm in length. It has a roughly pentagonal

Figure 18. Select artifacts recovered from site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont. Top row, left to right: Levanna base pn 286-1, point tip pn 22-1. Middle row, left to right: scrapers pn 302-1, pn 306-5. Bottom row: curated pebble pn 281-1.

shape, and shows evidence for intensive scraping use wear on the very steep distal end, in addition to lighter use around all of the margins. While the only temporally diagnostic material recovered thus far from site VT-AD-44 has been attributable to the Middle and Later Woodland period, including the Levanna projectile point, above, pn 302-1 is not similar to scrapers typical of the Woodland period, and instead resembles thick quartz scrapers of the Gulf of Maine Archaic tradition. However, as this artifact was recovered from the base of the eroding embankment, its true provenience is not known, and unlike items such as projectile points, it is not diagnostic to the extent that it cannot be placed within any temporal period on the basis of morphology alone. The second scraper, pn 306-5, possesses a morphology more typical of scrapers of the Woodland period, in its "thumbnail" shape. Scrapers, with their thick and steep working edge, were likely used for such tasks as cleaning fat from animal skins, and may have been hafted and used as woodworking tools such as chisels and shavers.

Core fragment pn 306-4 is essentially a large, thick flake. Flake scars on the dorsal surface, as well as a patch of cobble cortex, indicate that it is a core rejuvenation flake, and thus an identifiable fragment of a core (which is a tool rather than debitage). These specific types of flakes are removed to refresh the working edge of a core, usually to decrease an edge angle back down to less than 90 degrees to enable the removal of other flakes to continue. This type of artifact suggests that flakes themselves were viewed as an intended product, and were useful in themselves as tools. Evidence of this is also demonstrated by the fact that the remaining four flaked tools are utilized flakes. The first, pn 14-1, shows unifacial use along one margin, possibly as a cutting tool, while pn 16-1 is an elongate, pointed spall fragment, and the pointed end shows some use, likely as a perforator. These artifacts were recovered from adjacent units N189 E360 and N190 E360. The last two, pn's 306-2 and 306-3, were recovered from the eroding embankment, and both show relatively light use wear along the lateral margins. Utilized flakes such as these were likely used as immediate and expedient items for a variety of simple, everyday tasks such as cutting and slicing.

Lithic Debitage

A total of 530 pieces of lithic debitage were analyzed, including 509 recovered during phase II testing, and 21 previously recovered from the eroding embankment (see Table 1). As is often the case at Native American sites, this constitutes the most numerous artifact class identified at the site. These specimens represent the waste products of stone tool manufacture and rejuvenation, and in addition to the stone tools themselves, represent an important record of lithic technologies employed by Native Americans at the site. As noted, the majority (n=516, 97.4%) is quartzite, with a much smaller amount of chert (n=10, 1.9%) and quartz (n=2, 0.4%), and also of an unidentified material (n=2, 0.4%). The two quartz flakes were recovered from adjacent units N195 E410 and N196 E410, while chert is more widespread, being recovered from across the site but with a slight focus (three flakes) recovered from test pit N215 E420. Quartzite flakes were recovered across the site landform and also from the eroding embankment.

The majority of debitage is 1-3 cm in maximum dimension (n=351; 66.2%), followed by material less than 1 cm in maximum dimension (n=171, 32.3%). Only eight pieces (1.5%) are 3-5 cm in maximum dimension, and all are quartzite. Size ranges in lithic debitage primarily represent differences in lithic reduction processes, which themselves represent the working down of lithic raw materials into finished products in the form of lithic tools. Primary, or early, reduction stages include tasks such as preparation of cobbles, tool blanks, and simple/expedient tools, while secondary reduction includes the finishing of items into recognizable forms such as projectile points. Smaller sizes of debitage suggest that secondary reduction was commonplace on the site. As well as being generally smaller, secondary reduction pieces are very thin with multiple, relatively flat flake scars on the dorsal surface, and often also evidence for soft-hammer percussion or pressure flaking, namely a diffuse bulb of percussion, platform preparation, and a lip between the platform and ventral surface. All of the chert debitage is attributed to secondary reduction

processes, while quartzite debitage includes primary reduction as well as secondary reduction. Primary flakes are larger, thicker and have step and hinge fractures on the dorsal surfaces, and show evidence for hard-hammer percussion such as noticeable bulbs and battering on the platform. That a wider range of lithic reduction processes are demonstrable in the quartzite flake sample is not surprising given that this material is more readily available in local contexts than chert, and this pattern is also followed through in the tool sample, in that all flaked lithic tools recovered during phase II testing are quartzite, including both primary items (a scraper, two utilized flakes) and secondary items (projectile points).

As described above, the majority of lithic debitage (about 58%) was recovered from the general vicinity of Feature F.1, in adjacent units N190 E360 and N191 E361. Only one of these flakes is chert, and the remainder are quartzite. Other than this concentration, debitage was recovered across the site landform and within all strata, ranging from one flake to 27 flakes per unit or test pit (see Table 1). Lithic reduction activities were thus an important component of site occupation throughout all periods of use of this location, and a particular area of intensive lithic reduction is preserved at the western extent of the site in the vicinity of feature F.1.

Fire-Cracked Rock

Another type of lithic artifact at site VT-AD-44, fire-cracked rock, represents a byproduct of cooking and heating activities, such as fire hearths and food processing through both stone boiling and platform roasting techniques. Fire-cracked or heat-altered rocks are typically recognized on the basis of a distinct reddish to brown discoloration, extensive fractures which are sometimes incompletely detached, an overall irregular or blocky shape, often curved fracture surfaces and occasional charcoal smudges. A total of 20 fragments of fire-cracked rock, weighing a total of 1095 grams, were recovered from the site as a result of phase II testing. Two were recovered from the eroding embankment, while the remainder were recovered from subsurface contexts spread horizontally throughout the site, with no particular clusters noted. Pieces were also recovered from variable depths below ground surface and within all soil horizons. The presence of this artifact class suggests that stone boiling and other food processing activities were taking place across the site landform, for example as in the area of cultural feature F.1, described previously. It is thus likely that other cultural features are preserved within the site area.

Other Lithic Artifacts

Other lithic artifacts recovered from the site include two fragments that may possibly be flakes produced during the manufacture of ground stone tools, or alternatively, that may be small pieces of fire-cracked rock. A pebble measuring 4.3 cm in maximum dimension) was recovered from the 'B' soil horizon within unit N190 E360, close to feature F.1, and may have been used as a small hammerstone or similar tool during lithic reduction activities. Finally, pn 281-1 is an interesting artifact, and is a small (1.6 cm) naturally rounded pebble, somewhat like a marble in size and appearance (see Figure 18). This was also recovered from the vicinity of feature F.1 (unit N191 E361, 50-60 cm below ground surface). This artifact was likely picked up due to its tactile nature and aesthetically pleasing appearance – almost a perfect sphere – and may have been kept as a personal item such as a totem/lucky charm, game piece, child's toy, or "pocket rock".

Native American Ceramics

A sample of Native American ceramics was also recovered from the site. Four possible specimens were noted during phase II testing, and all were less than 0.5 cm in maximum dimension and exceedingly friable and degraded, and possessed no discernable surfaces. Alternatively, these may simply have been sediment concretions. They were noted on the excavation form but were discarded in the field. All were recovered from unit N190 E360, immediately beneath cultural feature F.1.

Far better ceramic specimens were recovered from the eroding embankment previous to the phase II testing (Figures 19, 20, and 21). These include 121 individual specimens, all designated as pn 305, and all belonging to a single vessel (designated vessel V.1). This includes 111 sherds and 10 fragments, including 12 rim sherds. This is a coil-made grit-tempered vessel with s-twist cord-wrapped stick decoration and circular punctate design. The cord-wrapped stick impressions have a chevron pattern on the exterior rim, diagonal pattern on the interior rim, and horizontal pattern on the exterior body. The surface is smoothed and not fabric paddled. The vessel is typical of Ceramic Period (CP) 4-5 examples in the region, pertaining to the later portion of the Middle Woodland period into the Late Woodland period, ca. A.D. 600-1300, although is most similar to specimens dating to approximately A.D. 800-1300.

Historic Euroamerican Artifacts

Despite the presence of a plow zone at the site, indicating agricultural use, the only historic Euroamerican artifact recovered is a small piece of iron slag. Nineteenth century maps of the area do not show any structures on Wyman Island (See phase IB report, Tetra Tech, Inc. 2011), and the only Euroamerican features in the general vicinity of the site are bridge abutments located just to the east of the defined site area.

Site Overview and Discussion

Native American site VT-AD-44 is attributable minimally to the late Middle Woodland to Late Woodland period of Native American history for the region, which dates to ca. A.D. 600-1500, based on the recovery of diagnostic artifacts including projectile points and ceramics, and a radiocarbon date. However, the combination and overlaps of the known time ranges for each of these suggest tighter dates of ca. A.D. 800-1400.

Levanna-type projectile points are the standard point type utilized throughout the later Middle Woodland period, ca. A.D. 750-1000, and the Late Woodland period, ca. A.D. 1000-1500 (Haviland and Power 1994; Ritchie 1980), and so are only very generally diagnostic. The distinctive smoothed and cord-wrapped stick decorated ceramics recovered from the site are attributable to CP4-5, ca. A.D. 600-1300, although as noted previously, appear most similar to specimens dating from A.D. 800-1300. These diagnostic artifacts were recovered from various instances of surface collection, as well as archaeological phase IB survey and phase II testing. Subsurface contexts demonstrate the presence of separate paleosols which document at least two separate occupations of the site area, although at this point it is not possible to tell how far apart in time these occupations occurred, or for how long each lasted. A direct radiocarbon date on maize recovered from remnant hearth feature/activity area F.1 falls at 550±30 B.P., ca. A.D. 1400 (Beta-405628), with calibration curve intersections (2-sigma) at A.D. 1315-1355 and A.D. 1390-1430. The earliest of the possible radiocarbon dates falls close to the date range suggested by the ceramic specimens. Unfortunately, it was not possible to discern the original provenience of the ceramic specimens, as they were recovered from the foot of the eroding embankment rather than from the wall of the bank itself. The cultural feature was identified at approximately 56 cm below ground surface within the 'B' soil horizon, at a similar depth to the uppermost identified paleosol, and thus may represent the date for one of the later of the site occupations.

Horizontally, the greatest artifact density was identified at the western extent of the site. Two adjacent test units yielded in excess of 300 flakes, most associated with a remnant hearth feature or activity area, F.1. This area also gave the highest density of lithic tools with two utilized flakes and two projectile point fragments recovered from the same units. However, artifact densities are not universally high throughout the site, and average no more than 10 flakes per excavation unit (per sq m). A total of 29 of the lithic artifacts and 121 ceramic specimens analyzed in this report

Figure 19. Select Native American ceramic rim sherds (pn 305) recovered from site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont. Note cord=wrapped stick impressions and circular punctate design on the sherds.

Figure 20. Select Native American ceramic body sherds (pn 305) recovered from site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont. Note cord-wrapped stick impressions on the sherds.

Figure 21. Select Native American ceramic body sherds (pn 305) recovered from site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont. Note smoothed surface treatment of the sherds.

were recovered from the eroding embankment. It appears that the densest portion of the site and thus the focus of occupation and site activity occurred at the western extent of the defined site area. A noted lack of paleosols and appearance of laminated alluvial strata in excavations beyond this point may suggest that at one time, this location represented a point of land. Site density also decreases moving back away from the eroding landform.

The types of activities undertaken at the site are suggested by various artifact classes. The lithic tools and debitage present demonstrate a focus on the working of quartzite material. Some large flakes and a core fragment suggest early lithic reduction stages, such as reducing a cobble core down to a set of useable flake tools, and a small sample of such expedient, simple, and "disposable" tools was recovered, including four utilized flakes. Later lithic reduction stages are demonstrated by the presence of a large quantity of small-sized debitage as well as the tip of a broken an unfinished projectile point and a finished, broken, and used Levanna, which suggest the working of preforms into finished projectile point forms, likely in order to refurbish and replace broken items in the hunting kit. Two scrapers further support this idea, as such tools may have been used to prepare arrow shafts or various wooden and bone tools. Also, scraping and cutting tools (such as utilized flakes) indicate resource processing tasks such as butchery or hide processing, while the bone sample from the site demonstrates the presence of mammal and/or turtle, and hints at the types of subsistence resources being consumed. Additional plant resources include gathered wild varieties as well as cultivated species, and include fruit seeds such as bramble, elderberry, and blueberry; vervain, which may have had a medicinal use; goosefoot, which may be used as a leaf vegetable or type of cereal grain; and maize, which was certainly cultivated. However, it is not known whether maize was grown at the site or in close proximity to Wyman Island, or whether it was grown elsewhere and brought to the site for consumption or storage.

The size of the site is not currently known, given that site boundaries have not been defined in a northerly direction, and are incompletely defined to the northeast. Cultural deposits identified thus far extend a minimum of 300 m (984 ft) in length and at least 20 m (66 ft) inland from the edge of the embankment of Otter Creek, for a minimum site area of 6,000 m2 (0.6 hectares, 1.48 acre). However, as noted, the densest portion of the site appears to be at the western extent of the identified site area, and immediately adjacent to the eroding embankment, while only a few individual flakes have been found at the northern and eastern limits of excavation, and may represent outliers.

The presence of Native American ceramics is often indicative of a semi-sedentary occupation, given that being large, relatively heavy, and somewhat breakable, pots are not particularly portable objects. Along with the horizontal extent and vertical separation of the cultural deposits, a medium-sized encampment occupied by a few families for a few weeks, or on a seasonal basis, is suggested.

External Correlations: Site VT-AD-44 in Local and Regional Context

Temporally diagnostic material recovered from site VT-AD-44 demonstrates that at minimum, the site was occupied during the later portion of the Middle Woodland period, into the Late Woodland period, ca. A.D. 600-1500, or possibly a tighter time frame of A.D. 800-1400, as discussed previously. It is thus worthwhile to consider other archaeological manifestations of this time period in the local, and wider, area.

There is a particular abundance of dated Middle Woodland sites within the Lake Champlain drainage and along the valleys of the various watercourses that empty into the lake, including the Otter Creek drainage. However, the number of sites confidently dated to the Late Woodland period drops off quickly. Despite their abundance, the functional characteristics of Middle Woodland sites between ca. 100 B.C. and A.D. 1050 are not perfectly known; and while residential sites dating to the subsequent Late Woodland period, ca. A.D. 1050-1600, have been recognized in a number of settings, such as along the Missisquoi River in northern Vermont (Corey et al. 2002; Cowie et al.

2012; Hudgell et al. 2015b), the Winooski River and its tributaries (Hudgell et al. 2008; Hudgell et al. 2013; Petersen and Power 1983), and in the locality of Shelburne Pond (Petersen 1977, 1980), few detailed excavations have been undertaken in the local area. Thus, for both of these periods, changes that may have occurred in regional settlement systems remain relatively poorly understood (Cowie et al. 2012; Haviland and Power 1994; Thomas 1991).

While the settlement pattern of the preceding Paleoindian and Archaic periods are characterized by varying degrees of mobility, based primarily on hunting and gathering and the seeking and exploitation of either seasonal or mobile resources, that of the Woodland period demonstrates a marked change in that it may be characterized by increasing sedentism, or decreased mobility. During the earlier periods, relatively small bands or family groups would spend much of the year travelling in search of resources, and setting up temporary encampments for a few days to perhaps a month or so. The Woodland period, on the other hand, is in part defined by the production of pots, which work far better as relatively stationary objects than as part of a convenient travelling kit. More importantly, and intimately tied to the manufacture and use of ceramics, was the increasing dependence on plant foods and the advent of horticulture, adopted gradually throughout the span of the Woodland period (Haviland and Power 1994).

In Vermont, various Middle Woodland period components are anchored in time by radiocarbon dates. By roughly A.D. 750-800, community populations were on the rise and extensive settlements could be found in the lower reaches of all major rivers in Vermont (Cowie et al. 2012, Thomas and Doherty 1981). An association of Middle Woodland period sites with rivers, streams and ponds suggests that fishing, along with hunting and gathering of wild plant resources, was an important subsistence activity. Canoe travel was likely important, however given the rarity of heavy woodworking tools compared to the Archaic period, bark canoes were possibly replacing dugout forms. During some seasons, groups congregated in areas where fish, plant and game species were dense and varied, and at other times of the year, large communities broke up into smaller family or specialized task groups in order to better exploit dispersed food resources away from the major rivers and lakeshore, extending well into the uplands. The overall pattern of Middle Woodland sites in the Champlain valley is thus one of large base camps, or "villages", on the lower reaches of major rivers (the Otter Creek, Winooski, Lamoille, and Missisquoi Rivers) not far from the lake, with smaller sites aimed at resource procurement located in a variety of environmental settings such as high terraces, small tributary streams, and pond edges (Haviland and Power 1994).

Although archaeological data related to the Late Woodland period are limited within Vermont, a general riverine-lake-pond focus appears to continue from the preceding period. For example, ca. A.D. 1050, utilization and occupation of the general locality of Shelburne Pond made a notable increase, with at least 15 sites dating to this period. Again, seasonal mobility appears to have been a characteristic response to the environment and social system, with movement between villages consisting of dispersed houses close to cultivated fields and smaller encampments occupied by nuclear family or small task groups for shorter time periods. Site VT-AD-44 fits well within this general pattern, as medium-sized, possibly task-specific encampment located on a fairly significant drainage and likely occupied by a small group. Maize recovered from VT-AD-44 presents evidence of cultivation of crops, too, although it is not known where the fields were located, or indeed if the sample represents locally grown maize or food brought in from further afield.

The Winooski site, located on the Winooski River Intervale, has become the type site for understanding artifact assemblages and the sequence of change between the Middle and early Late Woodland periods within western Vermont (Petersen and Power 1983). This deeply stratified site has yielded a significant quantity of cultural remains from a number of different phases, with one of the most important analyses being that undertaken on ceramic vessels. From these studies, and other site data, Petersen defined three distinct phases of the Middle Woodland period: the Winooski phase, the Intervale phase, and the Colchester phase.

The Colchester phase is most relevant to understanding the context of site VT-AD-44, being the point at which Levanna projectile points appear in the cultural sequence at the Winooski site. At the Winooski site, the phase is dated to roughly A.D. 800-1050, and contains a fairly narrow range of artifacts. Levannas are the predominant projectile point type (38 specimens), and other flaked stone tools include 70 retouched flakes and end scrapers, a drill, four wedges, and an abrading stone. Colchester phase lithic assemblages at various other sites in the region (e.g. the McNeil and McNeil Borrow sites; other smaller sites in the area; plus likely other undated sites) tend to reflect the exclusive use of local quartzite and Champlain valley chert, which is also seen at VT-AD-44. This shift to a focus on local raw materials may reflect a breakdown in long distance exchange networks, which may be related to the movement and increasing territoriality of various peoples at this time. The use of cordage and basketry are suggested by impressions on pottery from the Winooski site, and Colchester phase pottery exhibits a restricted range of decoration, primarily S-twist cord-wrapped stick and circular punctate stamps, although other cord-wrapped-cord and cordage and linear punctate stamps are sometimes exhibited (Petersen and Power 1983; Haviland and Power 1994:119-121). The principal form of decorative application at the Winooski site during this time period was simple vertical stamping which was restricted to the upper neck, rim, lip and upper interior portions of each vessel; smoothed exterior and interior surfaces were common (Thomas 1991:10-10). These similarities resonate with vessel V.1 sherds recovered from VT-AD-44.

Generally, the characteristics of flaked stone and ceramic assemblages of the Colchester phase in the Winooski Intervale, on the Missisquoi delta and in Highgate, on Shelburne Pond, and also at the mouth of Dead Creek in the Otter Creek valley all echo similar patterns in projectile point types, lithic raw materials, and ceramic decorative motifs which fit in with the data recovered from site VT-AD-44 (Thomas 1991). However, the multicomponent Rivers site, and to some extent the Donovan site, both located in the Otter Creek valley near Vergennes, produced a wider range of tool types within their Colchester phase occupations, including bone and antler fishhooks, gorges, awls, and needles (Thomas 1991). The Rivers site, dating to approximately A.D. 800-1100, has yielded a variety of evidence. Of 39 identified refuse pits, 14 have been sampled, and yielded 77 stone tools including blades, scrapers, and drills. Wear patterns and other refuse suggests that the contents of each pit represents refuse from various proximate activity areas, with tasks including woodworking, stone working, skin or hide working, food preparation, bone working, and heavy butchering. Postholes suggest dwellings (of an undefined shape), and organic remains represent subsistence and other resources and include nutshells, cherry pits, clamshells, and a large bone sample including deer, bear, dog, beaver, elk, fish (catfish, perch), fisher cat, moose, muskrat, porcupine, and turtle. Four burials were identified, of a child, two women, a man; these had no elaborate grave goods. Despite various faunal remains, stable isotope analysis of the human bone indicates that their diet emphasized carbohydrate plant resources rather than high-protein meat and fish, which is a contrast to Archaic and Early Woodland people, who appear to have been highly dependent of hunting and fishing (Haviland and Power 1994:129-130). The Rivers site was apparently a recurrently occupied seasonal base camp.

The settlement pattern proposed for the Colchester phase is based on the environmental settings of sites assigned to this period. While large sites (up to approximately 1.6 acres, in the case of the McNeil site) are generally situated on floodplains, e.g. along the lower Winooski, Lamoille, and Missisquoi Rivers and the Otter Creek, small sites of up to 400 m2 (1/10 acre) occur along the middle and upper reaches of such rivers, along interior and even smaller streams such as Muddy, Potash and Sunderland Brooks, and on bluffs and high terraces overlooking the valley bottom. Small sites may also be present around lakes and ponds. Site VT-AD-44 sits between these site sizes at approximately 6,000 m2 (1.48 acre, although the focal point of the site may be a smaller area), and located approximately 23 km upriver of the mouth of the Otter Creek and less than 15 km from the Rivers and Donovan sites, forms an ideal midpoint in the settlement system. Site VT-AD-496, the Wales site, located less than a mile downstream of VT-AD-44, is another candidate for a similar site (Hudgell et al. 2015a). As resource availability tapered off during the fall, fish,

plant foods and small mammals became less abundant and a shift to larger game likely occurred. Small to medium sites, possibly including VT-AD-44, were likely used during the fall and winter to provision larger settlements near the lake. Overall, the pattern for the later Middle Woodland period substantiates the presence of three kinds of sites: large aggregated village settlements, likely occupied during the spring and summer; smaller residential camps, possibly utilized during cold weather; and primarily extractive camps located proximate to ponds or small streams. According to Petersen and Power (1983), by the beginning of the Late Woodland period this trend was shifting towards a more semipermanent, sedentary pattern.

Sites of the Late Woodland period are more difficult to identify, likely because temporally diagnostic stone tools which could be used to subdivide the Late Woodland period do not exist. Levanna points were used from the late Middle Woodland throughout the Late Woodland period, and other stone tools show no apparent change in form (Haviland and Power 1994:132). Stylistic changes in ceramic vessels provide finer chronological control, however pottery has not been recovered at the majority of sites containing Levanna points (Thomas 1991:11-4). Thus, although small, the ceramic sample from site VT-AD-44 adds to regional research. Radiocarbon dates are fairly scarce other than for large sites such as Skitchewaug (A.D. 1100-1370) in the Connecticut River drainage; Donohue (A.D. 1440) in the Winooski River drainage; and the Headquarters site (A.D. 1100-1540) on the Missisquoi River. A radiocarbon date from site VT-AD-44 of 550±30 B.P., ca. A.D. 1400, is thus informative for regional contexts.

As with the Middle Woodland period, some of the most informative Late Woodland sites are larger, semi-sedentary occupations that were utilized by a reasonably large number of people. Considerable information has been obtained from multicomponent sites along the Missisquoi River floodplain (Cowie et al. 2012). For the Late Woodland occupations here, numerous cultural features were identified, including a variety of functional types such as hearths, storage pits, living surfaces, post molds, and other pits, which combine with other site data (diagnostic tools, an exceptional ceramic sample, floral and faunal remains) to demonstrate a multi-seasonal, village-based fishing and farming community. The use of locally available wild plant foods and medicinal varieties including wild rice, seasonal berries, and various seeds is demonstrated, and maize is clearly documented (dating to ca. A.D. 1100, which alongside Skitchewaug, is the earliest date on maize in Vermont) as the product of horticultural activities. Overall, such communities were beginning to emerge in the lower reaches of other rivers (and similar locations) throughout Vermont at this time, such as the Ewing site on Shelburne Pond, and the Donohue site on the Winooski River floodplain (Haviland and Power 1994; Thomas 1991:11-6). Data from site VT-AD-44 is thus an important addition to regional studies, as the site documents the presence of similar occupations in the Otter Creek drainage, and also preserves evidence for berries, medicinal plants, and maize.

Small residential camps are likely the most numerous type of site, however, occurring in a wide range of settings in order to take advantage of various seasonal resources. For example, in Chittenden County, archaeological deposits dating to the Late Woodland period were identified at eight sites and 11 loci located along the final alignment of the CCCH (Thomas 2002), and include two distinct site types: provisioning sites, and base camps. Similar smaller sites are known on Shelburne Pond, in the Winooski valley, and also a number of sites with Levanna points throughout the Otter Creek (see Cultural Setting, above), as well as further afield in southwestern Vermont (Thomas 1991). As with the Middle Woodland period, small residential camps such as these may have been used in provisioning larger settlements during one or more seasons of the year, and may, in a sense, be viewed as a “residential extractive camp”.

Much remains to be learned about how different Late Woodland sites functioned, how various types of sites were integrated into larger settlement systems, and how such systems may have changed through time, particularly as communities shifted to an increasing use of horticulture. The complete system would have included additional locales, and other site types expected within the settlement system include bedrock quarries, quarry workshops where preforms were created,

and also sites of ritual significance such as the locations of burials. As ever, the occasional find spot resulting from occasional loss or discard of a single item such as a projectile point also adds to the data. Within this scheme, the information retrieved from site VT-AD-44 adds to understanding of the overall settlement pattern at the end of the Middle Woodland period and into the succeeding Late Woodland period; a time of change which remains to be fully understood in local contexts.

VI: SITE SIGNIFICANCE AND NATIONAL REGISTER OF HISTORIC PLACES ELIGIBILITY

To qualify for listing in the NRHP, cultural resources must possess integrity and meet at least one of the four National Register criteria presented by the National Park Service (National Park Service 1991:2) as follows: The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, material, workmanship, feeling, and association and

(a) that are associated with events that have made a significant contribution to the broad patterns of our history; or
(b) that are associated with the lives of persons significant in our past; or
(c) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
(d) that have yielded, or may be likely to yield, information important in prehistory or history. [36 CFR§ 60.4]

Associated criteria include an assessment of a site's overall integrity, the specific data sets documented, the applicable historic context(s), the identification of research questions that are considered important and the site's potential to answer those questions. The National Park Service states that an archaeological site must also "possess integrity of location, design, setting, materials, workmanship, feeling and association" and further states that integrity is the "ability of a property to convey its significance" (NPS 2000:35). In terms of site VT-AD-44, integrity of location, design, materials and, association are the most important aspects of the consideration of integrity for the site to be eligible under *Criterion D*. Measures of integrity of archaeological sites generally include the presence of intact cultural features, identifiable activity areas with temporally diagnostic material remains, and associated ecofacts. In terms of the integrity of association, the measure of association between the pertinent data sets and the important research questions is germane.

The state of Vermont utilizes the same criteria as the National Park Service in terms of evaluating a site's eligibility for the Vermont State Register of Historic Places (VTSHPO 2002). In particular, the state emphasizes a site's ability to address one or more broad research themes. Site VT-AD-44 contains sufficient categories of data to address a number of these important research questions, and topics which can potentially be addressed using data sets from the site minimally include Chronology, Technology, Trade/Exchange, Settlement System, Subsistence System, and Environmental Context. Data sets preserved at site VT-AD-44 which can help address these topics include cultural features, faunal remains, carbonized floral remains for paleobotanical identification and radiocarbon dating, Native American ceramics, lithic debitage and lithic tools, and fire-cracked and heat altered rock. The spatial analysis and attribute analysis of these varied cultural materials could enable investigation of a number of research questions considered important for our continued exploration of past Native American societies. These research topics can be thought of individually and/or overlapping within a framework of overarching cultural, historical, anthropological and archaeological concerns, and range of related research questions with associated expected data sets is provided below (Table 2). The specific Historic Context for site VT-AD-44 is the later Middle Woodland to Late Woodland period of Native American history for the region.

Table 2. Research Themes, Research Questions and Expected Data Sets For Site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont.

Research Theme	Research Questions	Potential Data Sets
Culture History/ Chronology	How does data from the site compare with local and regional chronologies and how can this help clarify the cultural history for this time period in the area? What is the range of artifact classes at the site and how do they compare to other sites of comparable age in Vermont and the broader region?	Temporally diagnostic artifacts Radiocarbon dateable organics from cultural features
Technology	Are the artifact inventories from the site representative of a small part of a larger tool kit with the potential differences related to site function and seasonal adaptation, or are other factors at work?	Lithic artifacts including tools and debitage from stone tool manufacture Native American ceramics
Trade/Exchange	Is there evidence of trade among the artifact classes that would suggest local or long distance trade activities?	Lithic artifacts including tools and debitage from stone tool manufacture Material(s) that can be identified to a specific lithic source location
Settlement Pattern	Based on the information available, can we determine the various levels of settlement patterning, namely: Can we distinguish between activity areas? Can we determine overall size of the settlement present at the site? Does the combined set of data present at the site represent a typical settlement pattern that is recognized for this area of Vermont? What does evidence from the site tell us about Middle to Late Woodland period settlement patterns on a regional scale?	Analysis of site structure through examination of artifacts and additional potential information such as subsistence data, feature types and functions
Subsistence	What is the range of subsistence remains represented among the cultural deposits at the site? Do the subsistence remains suggest seasonally occupied settlement? Maize is present at the site. Was this grown at this location, or brought in?	Faunal and paleobotanical remains, such as those recovered from cultural features
Environment	Can we reconstruct the environment of the site at the time of occupation?	Faunal and paleobotanical remains, such as those recovered from cultural features

VII: CONCLUSIONS AND RECOMMENDATIONS

The Project's effects on the archaeological resources in the Weybridge Hydroelectric Project potentially include 1) site damage/loss as a result of shoreline erosion and 2) site damage/loss as a result of operations and maintenance activities.

Because archaeological sites are often found immediately adjacent to water bodies, including lakes and rivers, bank and shoreline erosion can affect historic properties at hydropower projects. Natural precipitation cycles, wind and ice formation and movement and subsequent Project operation results in water level fluctuations within the impoundment and in the river downstream of the Project. Water-level fluctuations, in turn, can alter shorelines through deposition, movement or erosive action. In addition, wave action caused by wind and boat wakes can contribute to shoreline erosion which can affect archaeological sites within the Project boundary.

The purpose of the HPMP for the Weybridge Hydroelectric Project (Baker et al. 2002) is to develop an ongoing method to protect and maintain Historic Properties within the Project boundary, and as such, outlines procedures that are intended to continuously protect and maintain historic properties during the term of GMP's FERC license to operate its Weybridge Project. The Project shoreline is monitored each year in accordance with Section 3.2.4 of the HPMP with specific attention given to locations surrounding identified and potential archaeological sites. Archaeological investigations detailed herein have confirmed that site VT-AD-44 represents a Historic Property, in that it is deemed significant and eligible for inclusion in the National and State Registers for Historic Places, and also that this Historic Property exhibits variable effects from the Project.

Continued and severe bank erosion is in action along the shoreline of Wyman Island within the defined area of site VT-AD-44. The shoreline fronting the site demonstrates slumping/slippage (mass wasting), bank collapse and undercutting, most notably within an area measuring 130 lateral meters. Previous archaeological work at the site included a phase IB survey aimed at determining the presence of archaeological deposits and extent of erosion within the site area. This work was conducted by Tetra Tech, Inc. in 2009, and concluded that some of the most severe erosion evident at that time was immediately adjacent (within eight meters or less) to a sizeable artifact concentration (Tetra Tech, Inc. 2011:21). Since the phase IB survey, and given the GPS mapping data provided therein, up to 5.0 m (perpendicular to the riverbank) have eroded since 2009, and in places, up to 15 m have eroded since 2006 (Figure 22; see Figure 9). Over the 130 m distance of the site, this constitutes about 650 m2 since 2009 and 1560 m2 since 2006.

While the site is reasonably large in area extent, and portions of the site to the north and east are not in immediate danger of loss of integrity due to erosion, the densest portion of the site identified during both phase IB survey and phase II testing is located at the southern extent of the site and immediately adjacent to the eroding embankment. Dense cultural deposits identified as part of the phase II testing including high artifact counts, intact paleosols and a cultural feature, as well as artifact concentrations identified within phase IB test pits, are now located approximately 4 m from the embankment (see Figure 9). In addition, annual monitoring reports describe continued erosion along the shoreline, and artifacts are frequently encountered eroding from the embankment within the site area (Baker 2013).

As noted previously, GMP has consulted with the SHPO and landowner in its efforts to protect archaeological information. Following consultations with the Natural Resources Conservation Service (NRCS) and Vermont Agency of Natural Resources (ANR), bank stabilization is not considered a good alternative, in part also due to difficulties in accessing the location.

Current plans include continued monitoring with increasing archaeological efforts to document and recover cultural material before it is lost. Toward that end a plan for mitigation of adverse effect through archaeological phase III data recovery is being developed by GMP in consultation with the VT DHP, to be focused within the areas of most severe erosion at the site, namely, along the 130 m stretch of river frontage. Data recovery excavations are planned for 2015.

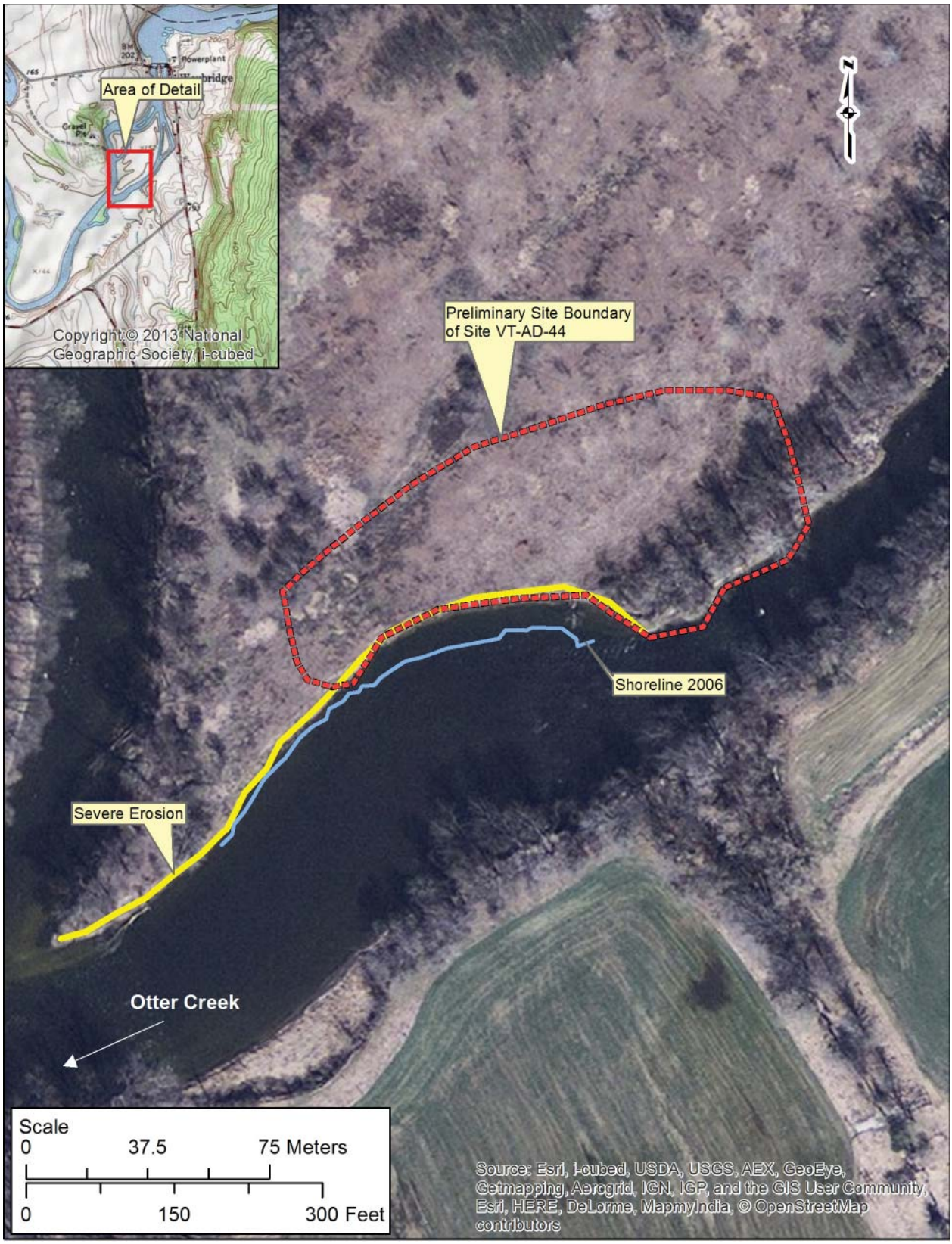

Figure 22. Aerial photograph showing areas of severe bank erosion at site VT-AD-44 within the Weybridge Hydroelectric Project (FERC No. 2731), Weybridge, Addison County, Vermont.

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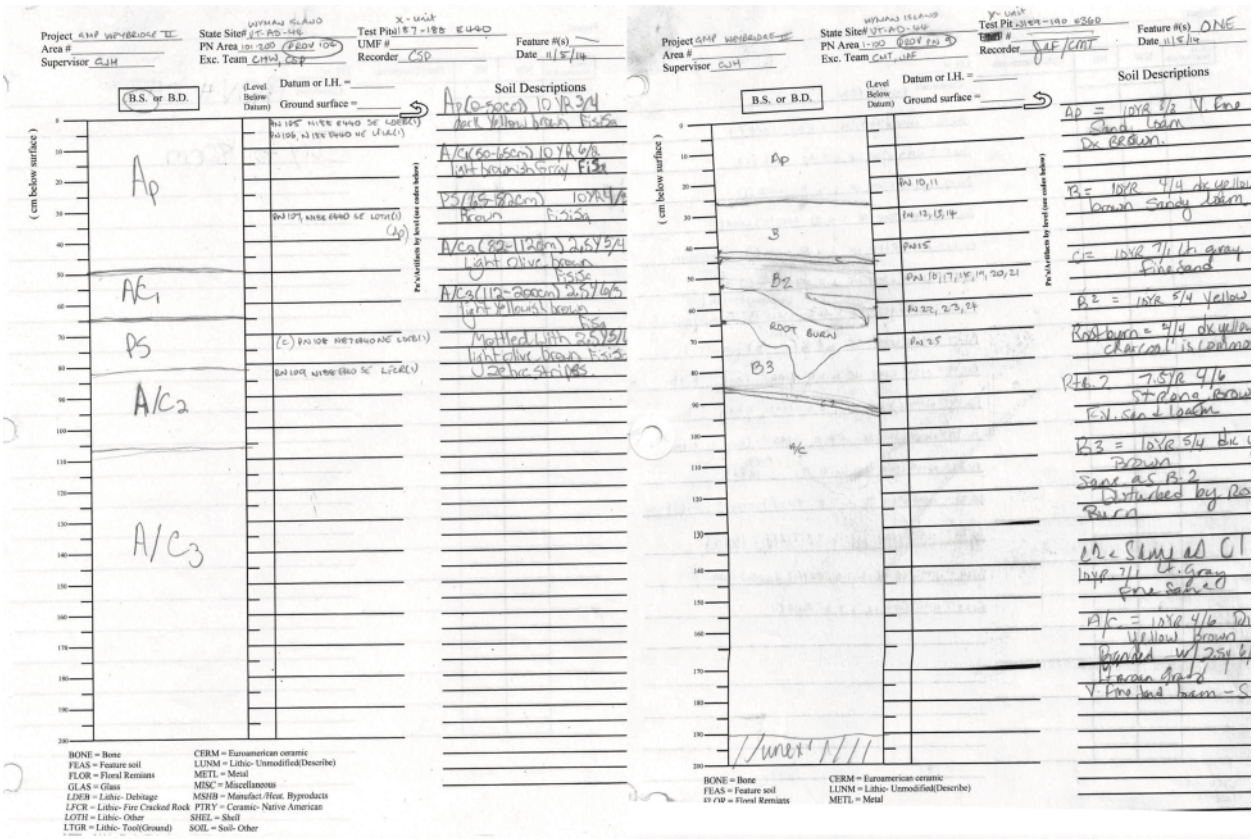
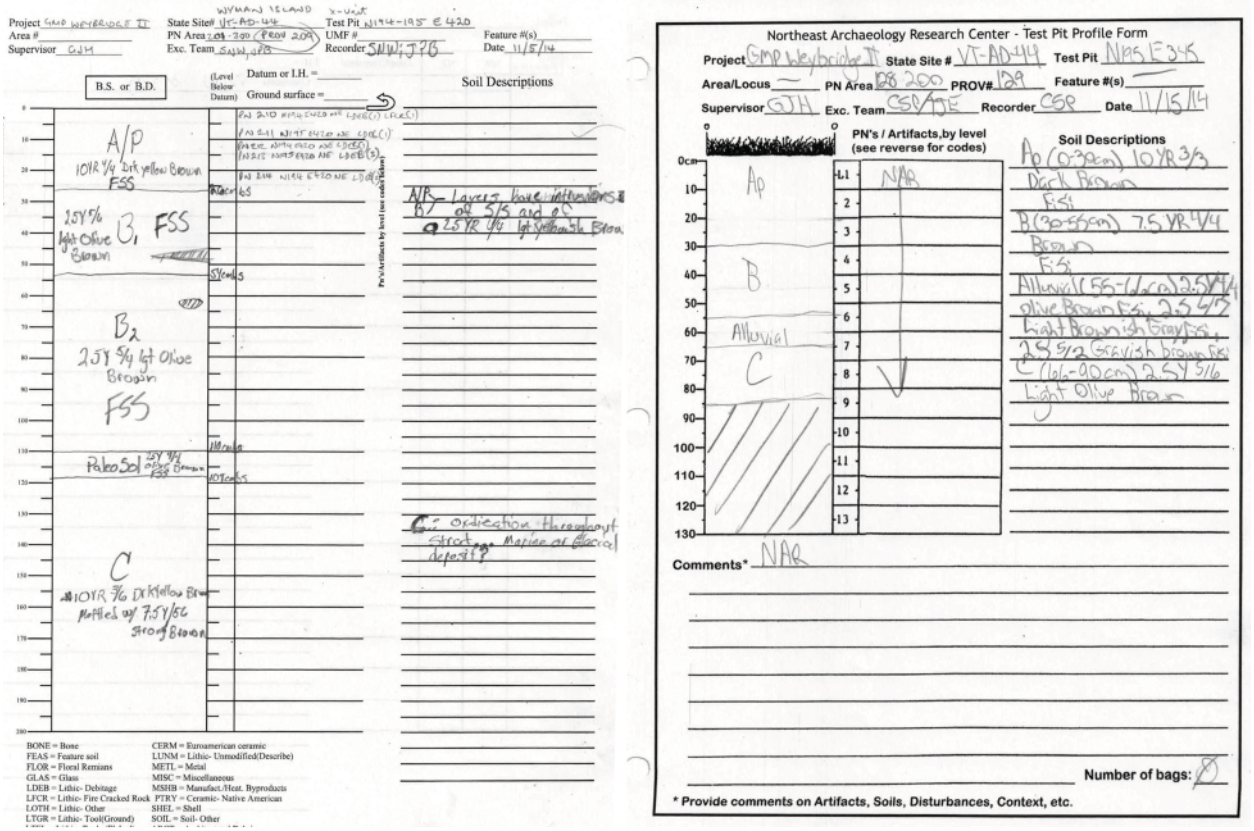
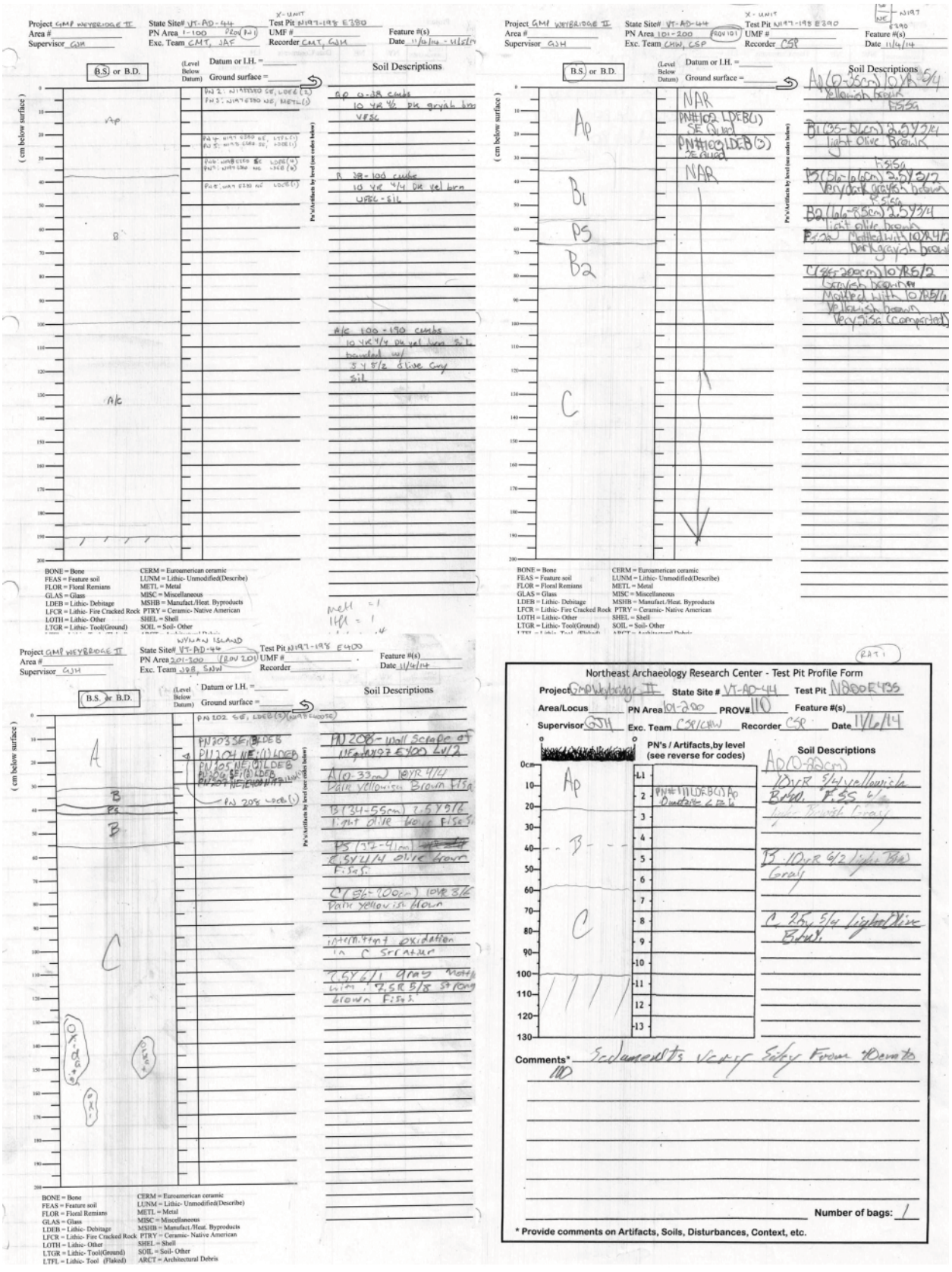
APPENDIX I: TEST PIT PROFILES







Northeast Archaeology Research Center - Test Pit Profile Form

Project GMP Weybridge II — State Site # VT-AD-44 — Test Pit N800 E435

Area/Locus — PN Area 101-200 — PROV# 110 — Feature #(s)

Supervisor GJH — Exc. Team CSR/CHW — Recorder CSR — Date 11/6/14

PN's / Artifacts, by level (see reverse for codes)

Soil Descriptions

Ap (0-22cm) 10YR 5/4 yellowish brown

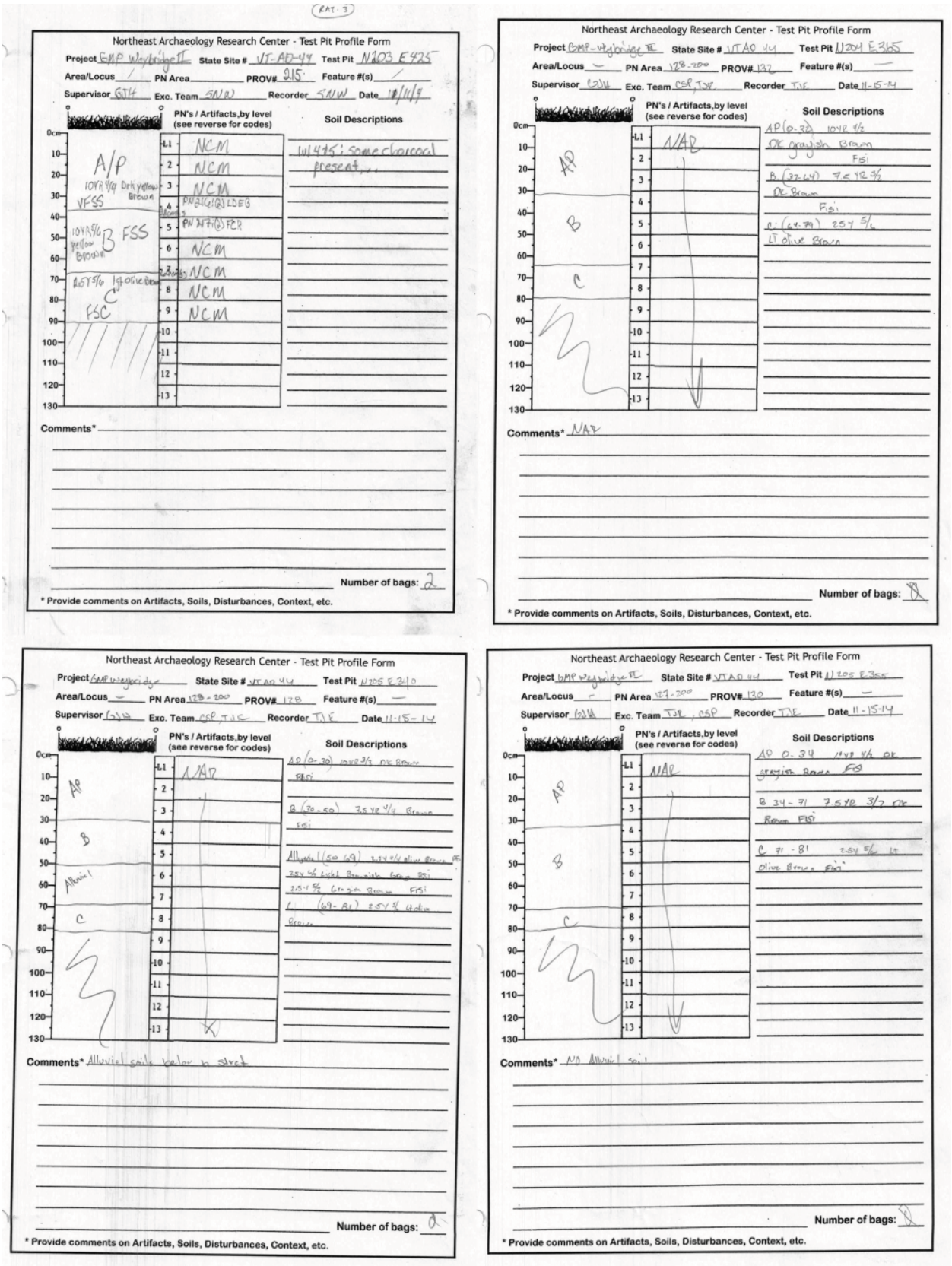
B (10YR 6/2 light brownish gray)

C 2.5Y 5/4 light olive brown

Comments* Sediments vary fairly from 4 pits

Number of bags: 1

* Provide comments on Artifacts, Soils, Disturbances, Context, etc.



Northeast Archaeology Research Center - Test Pit Profile Form

Project EMP Weybridge TE State Site # VT-AD-44 Test Pit N203 E425
Area/Locus — PN Area — PROV# 015 Feature #(s) —
Supervisor GJH Exc. Team SNW Recorder SNW Date 10/11/14

PN's / Artifacts,by level (see reverse for codes)

Level	
L1	NCM
2	NCM
3	NCM
4	PN 2[illegible] LDEG
5	PN 2[illegible] FCR
6	NCM
7	NCM
8	NCM
9	NCM
10	
11	
12	
13	

Soil Descriptions

10YR 4/4; some charcoal present...

Comments* —

Number of bags: 2

* Provide comments on Artifacts, Soils, Disturbances, Context, etc.

Northeast Archaeology Research Center - Test Pit Profile Form

Project EMP-Weybridge TE State Site # VT AD 44 Test Pit N204 E365
Area/Locus — PN Area 128-200 PROV# 132 Feature #(s) —
Supervisor GJH Exc. Team CSR, TJE Recorder TJE Date 11-15-14

PN's / Artifacts,by level (see reverse for codes)

Level	
L1	NAR
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	

Soil Descriptions

AP (0-32) 10YR 4/3 DK grayish Brown FSi

B (32-64) 7.5YR 3/4 DK Brown FSi

C (64-79) 2.5Y 5/4 LT olive Brown

Comments* NAR

Number of bags: X

* Provide comments on Artifacts, Soils, Disturbances, Context, etc.

Northeast Archaeology Research Center - Test Pit Profile Form

Project EMP Weybridge State Site # VT AD 44 Test Pit N205 E310
Area/Locus — PN Area 128-200 PROV# 128 Feature #(s) —
Supervisor GJH Exc. Team CSR, TJE Recorder TJE Date 11-15-14

PN's / Artifacts,by level (see reverse for codes)

Level	
L1	NAR
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	X

Soil Descriptions

AP (0-30) 10YR 3/3 DK Brown FSi

B (30-50) 7.5YR 4/4 Brown FSi

Alluvial (50-69) 2.5Y 4/4 olive Brown FSi
2.5Y 4/4 light Brownish Gray FSi
2.5Y 5/2 Grayish Brown FSi
C (69-81) 2.5Y 5/4 Olive Brown

Comments* Alluvial soils below in strat

Number of bags: 0

* Provide comments on Artifacts, Soils, Disturbances, Context, etc.

Northeast Archaeology Research Center - Test Pit Profile Form

Project EMP Weybridge TE State Site # VT AD 44 Test Pit N205 E355
Area/Locus — PN Area 128-200 PROV# 130 Feature #(s) —
Supervisor GJH Exc. Team TJE, CSR Recorder TJE Date 11-15-14

PN's / Artifacts,by level (see reverse for codes)

Level	
L1	NAR
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	X

Soil Descriptions

AP 0-34 10YR 4/3 DK grayish Brown FSi

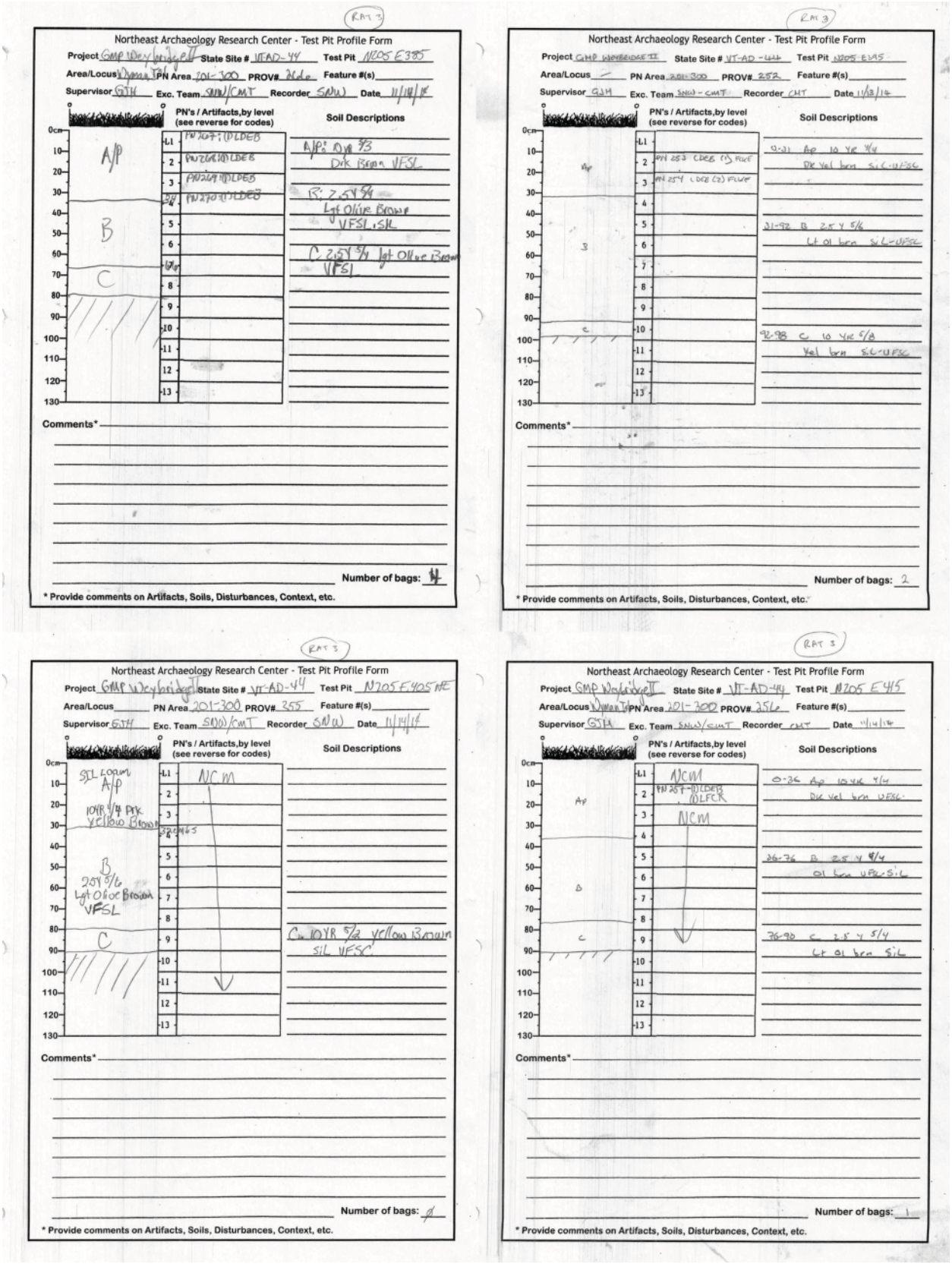
B 34-71 7.5YR 3/3 DK Brown FSi

C 71-81 2.5Y 5/4 LT olive Brown FSi

Comments* NO Alluvial soil

Number of bags: 0

* Provide comments on Artifacts, Soils, Disturbances, Context, etc.



Northeast Archaeology Research Center - Test Pit Profile Form

Project GMP Weybridge II State Site # VT-AD-44 Test Pit N205 E385
Area/Locus Upper Terrace PN Area 201-300 PROV# 266 Feature #(s)
Supervisor GJH Exc. Team SNW/CMT Recorder SNW Date 11/14/14

PN's / Artifacts,by level (see reverse for codes)

L1 PN 267: (1) CDEB
2 PN 268 (1) CDEB
3 PN 269 (1) CDEB
4 PN 270 (1) CDEB
5
6
7
8
9
10
11
12
13

Soil Descriptions

A/P: 10YR 3/3 Dk Brown VFSL

B: 2.5Y 5/4 Lgt Olive Brown VFSL, SiL

C 2.5Y 5/4 Lgt Olive Brown VFSL

Comments*

Number of bags: 4

* Provide comments on Artifacts, Soils, Disturbances, Context, etc.

RAT 3

Northeast Archaeology Research Center - Test Pit Profile Form

Project GMP Weybridge II State Site # VT-AD-44 Test Pit N205 E385
Area/Locus — PN Area 201-300 PROV# 252 Feature #(s)
Supervisor GJH Exc. Team SNW - CMT Recorder CMT Date 11/13/14

PN's / Artifacts,by level (see reverse for codes)

L1
2 PN 253 CDEB (1) FLKE
3 PN 254 CDEB (2) FLKE
4
5
6
7
8
9
10
11
12
13

Soil Descriptions

0-31 Ap 10 YR 4/4 Dk Yel brn SiL-VFSL

31-92 B 2.5 Y 5/6 Lt Ol brn SiL-VFSL

92-98 C 10 YR 5/8 Yel brn SiL-VFSL

Comments*

Number of bags: 2

* Provide comments on Artifacts, Soils, Disturbances, Context, etc.

RAT 3

Northeast Archaeology Research Center - Test Pit Profile Form

Project GMP Weybridge II State Site # VT-AD-44 Test Pit N205 E405 NE
Area/Locus — PN Area 201-300 PROV# 255 Feature #(s)
Supervisor GJH Exc. Team SNW/CMT Recorder SNW Date 11/14/14

PN's / Artifacts,by level (see reverse for codes)

L1 NCM
2
3
4
5
6
7
8
9
10
11
12
13

Soil Descriptions

SIL Loam A/P 10YR 4/4 Dk Yellow Brown

B 2.5Y 5/6 Lgt Olive Brown VFSL

C 10YR 5/8 Yellow Brown SiL VFSL

Comments*

Number of bags: 0

* Provide comments on Artifacts, Soils, Disturbances, Context, etc.

RAT 3

Northeast Archaeology Research Center - Test Pit Profile Form

Project GMP Weybridge II State Site # VT-AD-44 Test Pit N205 E405
Area/Locus Upper Terrace PN Area 201-300 PROV# 256 Feature #(s)
Supervisor GJH Exc. Team SNW/CMT Recorder CMT Date 11/14/14

PN's / Artifacts,by level (see reverse for codes)

L1 NCM
2 PN 257 (1) CDEB (1) LFCR
3 NCM
4
5
6
7
8
9
10
11
12
13

Soil Descriptions

0-26 Ap 10 YR 4/4 Dk Yel brn VFSL

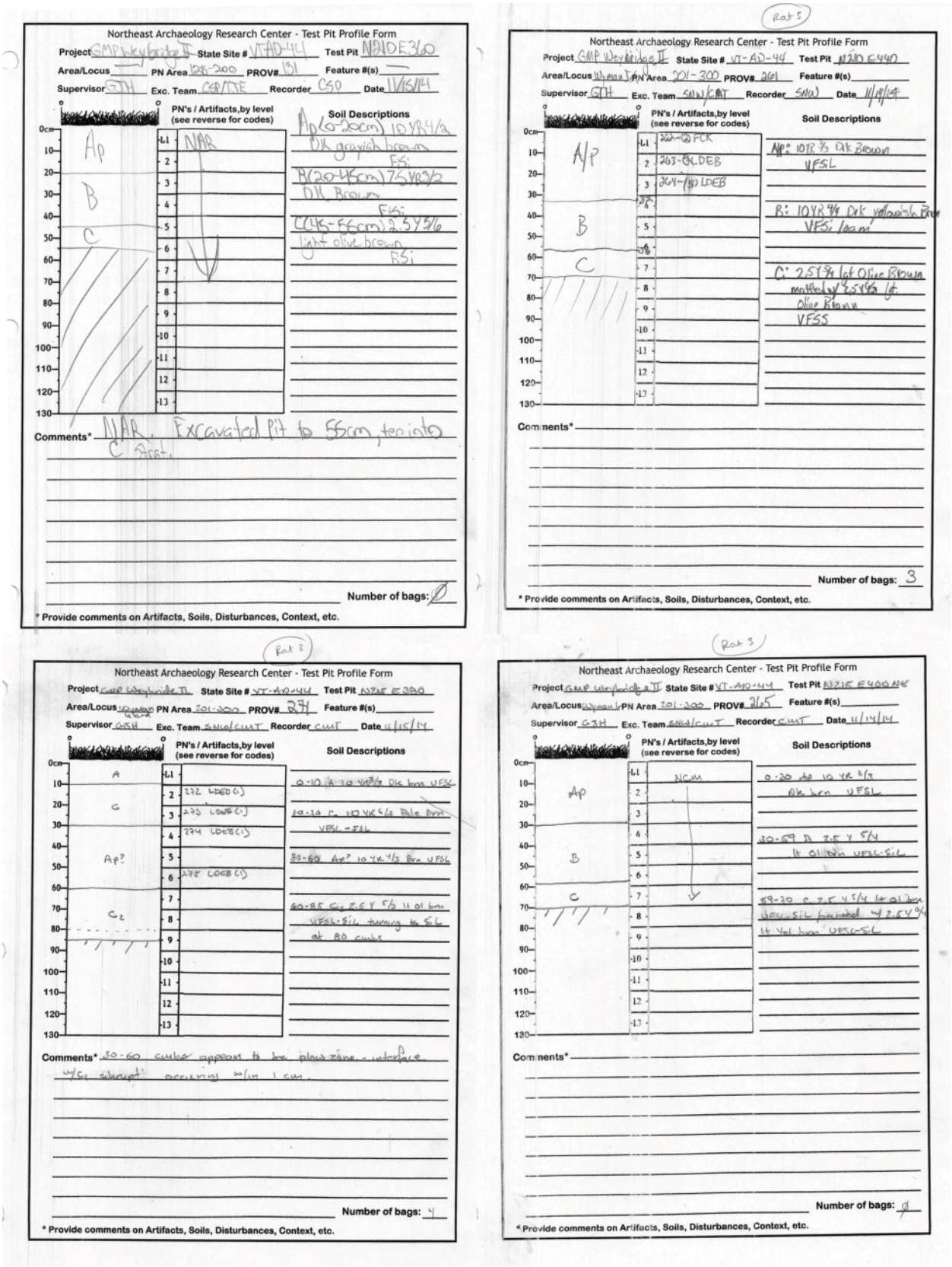
26-76 B 2.5 Y 4/4 Ol brn VFSL-SiL

76-90 C 2.5 Y 5/4 Lt Ol brn SiL

Comments*

Number of bags: 1

* Provide comments on Artifacts, Soils, Disturbances, Context, etc.



Northeast Archaeology Research Center - Test Pit Profile Form

Project GMP Weybridge II State Site # VT-AD-44 Test Pit N310 E360
Area/Locus ____ PN Area 128-200 PROV# 191 Feature #(s) ____
Supervisor GTH Exc. Team CSD/TTE Recorder CSD Date 11/15/14

PN's / Artifacts, by level (see reverse for codes)

Soil Descriptions

Ap (0-20cm) 10YR4/3 Dk grayish brown FSi
B (20-45cm) 7.5YR3/2 Dk Brown FSi
C (45-55cm) 2.5Y5/6 light olive brown FSi

Comments* NAR. Excavated Pit to 55cm, terminated at C Strat.

Number of bags: 0

* Provide comments on Artifacts, Soils, Disturbances, Context, etc.

Rat 5

Northeast Archaeology Research Center - Test Pit Profile Form

Project GMP Weybridge II State Site # VT-AD-44 Test Pit N310 E440
Area/Locus Upland PN Area 201-300 PROV# 201 Feature #(s) ____
Supervisor GTH Exc. Team SNW/CMT Recorder SNW Date 11/8/14

PN's / Artifacts, by level (see reverse for codes)

Soil Descriptions

Ap: 10YR 3/3 Dk Brown VFSL
B: 10YR 4/4 Dk yellowish Brown VFSL loam
C: 2.5Y 6/4 lgt Olive Brown mottled w/ 2.5Y 5/3 lgt Olive Brown VFSS

Comments* ____

Number of bags: 3

* Provide comments on Artifacts, Soils, Disturbances, Context, etc.

Rat 3

Northeast Archaeology Research Center - Test Pit Profile Form

Project GMP Weybridge II State Site # VT-AD-44 Test Pit N315 E380
Area/Locus Upland PN Area 201-300 PROV# 237 Feature #(s) ____
Supervisor GTH Exc. Team SNW/CMT Recorder CMT Date 11/15/14

PN's / Artifacts, by level (see reverse for codes)

Soil Descriptions

0-10 A 10 YR 3/3 Dk brn VFSL
10-30 C 10 YR 6/3 Pale Brn VFSL - FSL
30-60 Ap? 10 YR 4/3 Brn VFSL
60-85 C2 2.5 Y 5/3 lt oli brn VFSL-SiL turning to SiL at 80 cmbs

Comments* 30-60 cmbs appears to be plow zone - interface w/ C2 abrupt occurring 0/in 1 cm.

Number of bags: 4

* Provide comments on Artifacts, Soils, Disturbances, Context, etc.

Rat 3

Northeast Archaeology Research Center - Test Pit Profile Form

Project GMP Weybridge II State Site # VT-AD-44 Test Pit N315 E400 NE
Area/Locus Upland PN Area 201-300 PROV# 265 Feature #(s) ____
Supervisor GTH Exc. Team SNW/CMT Recorder CMT Date 11/14/14

PN's / Artifacts, by level (see reverse for codes)

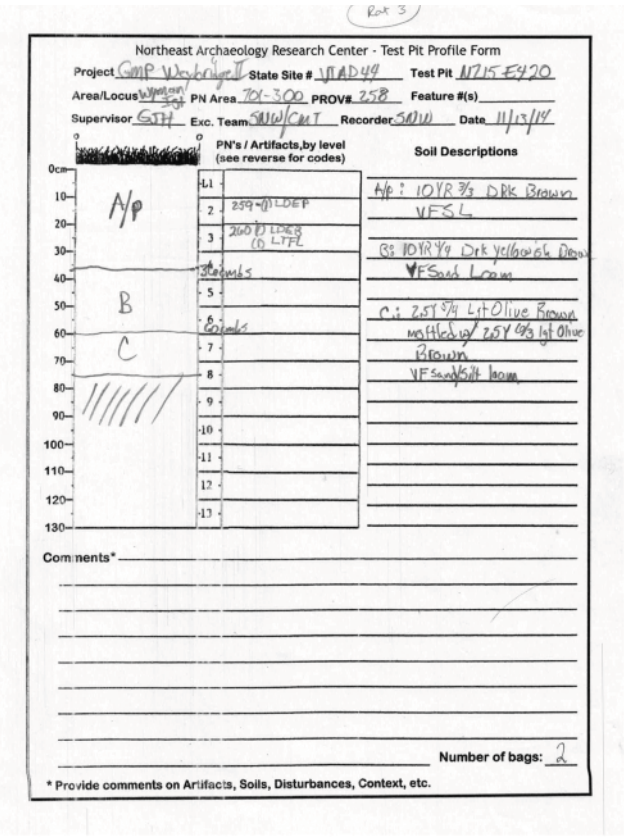
Soil Descriptions

0-20 Ap 10 YR 3/3 Dk brn VFSL
20-59 B 2.5 Y 5/4 lt oli brn VFSL-SiL
59-70 C 2.5 Y 5/4 lt oli brn VFSL-SiL laminated w/ 2.5Y 6/4 lt Yel brn VFSL-SiL

Comments* ____

Number of bags: 0

* Provide comments on Artifacts, Soils, Disturbances, Context, etc.



Box 3

Northeast Archaeology Research Center - Test Pit Profile Form

Project GMP Weybridge II State Site # VT AD 49 Test Pit N715 E420

Area/Locus Upland Terr PN Area 701-300 PROV# 258 Feature #(s)

Supervisor GTH Exc. Team SMW/CMT Recorder SMW Date 11/13/14

PN's / Artifacts,by level (see reverse for codes)

Soil Descriptions

0cm 10 20 30 40 50 60 70 80 90 100 110 120 130

A/p

B

C

L1: 259-M LDEP

2: 260-M LDEP (D LTFL

3:

4: Charcoals

5:

6: Charcoals

7:

8:

9:

10:

11:

12:

13:

A/p: 10YR 3/3 Dark Brown VFSL

B: 10YR 4/4 Dark yellowish Brown VFSand Loam

C: 2.5Y 5/4 Light Olive Brown mottled w/ 2.5Y 6/3 light Olive Brown VFSand/Silt loam

Comments*

Number of bags: 2

* Provide comments on Artifacts, Soils, Disturbances, Context, etc.

APPENDIX II: PALEOBOTANICAL ANAYLIS

Vermont Sites: Carbonized Plant Remains

Site	VT-AD-44	VT-AD-44	VT-AD-44	VT-AD-44
Feature	19	19?	19	19?
Unit	N190 E360	N190 E360	N190 E360	N190 E360
Level	6B	6	6B	6
Quad	NE	NE	SE	SE
Sample no.	19	16	20	17
Sample type	F	1/4"	F	1/4"
SAMPLE WEIGHT (g)				
>4 mm	0.40	2.52	0.04	0.87
2-4 mm	0.57	0.31	0.13	0.20
1-2 mm	0.37	0.12	0.06	0.10
0.5-1 mm	0.05	P	0.02	P
Total	1.39	2.96	0.26	1.17
SAMPLE COMPOSITION (>2 mm ct.)				
Nutshell				
Butternut	-	-	-	-
Wood	110	57	23	50
Bark	2	4	2	-
Twig	2	-	-	-
Pitch	1	-	1	-
White pine needle	(1)	-	-	-
Maize	-	-	-	-
Cupule	(3)	-	-	-
Kernel	2	2	-	-
Seeds <2 mm	27	-	5	-
Total >2 mm	117	63	26	50
SEED IDENTIFICATIONS				
Amaranthus, amaranth/*Chenopodium*	-	-	-	-
Chenopodium spp., goosefoot	1	-	-	-
Gaylussacia spp., huckleberry	-	-	-	-
Rubus spp., bramble	1	-	1	-
Sambucus spp., elderberry	2	-	-	-
Vaccinium spp., blueberry	1	-	-	-
Verbena spp., vervain	22	-	4	-
Total	27	0	5	0
WOOD IDENTIFICATIONS				
Acer spp., maple	1	1	-	-
Betula spp., birch	-	-	-	-
Carya spp., hickory	10	12	6	9
C. cordiformis, bitternut hickory	-	1	-	-
Fagus grandifolia, beech	1	3	-	4
Fraxinus spp., ash	1	-	-	-
Juglans cinerea, butternut	2	-	-	-
Ostrya virginiana, hop hornbeam	-	-	1	-
Pinus strobus, white pine	2	3	-	-
Quercus spp., oak	-	-	-	-
Red oak group	2	-	-	-
White oak group	-	-	-	-
Ulmus spp., elm	1	-	3	7
Total	20	20	10	20
Note: F = flotation. P = present in 0.5-2 mm charcoal. ( ) = count in 0.5-2 mm charcoal.				
1-2 mm subsam	-	-	-	-
1-2 mm contam	-	-	-	-
1-2 mm remain	-	-	-	-
0.5-1 mm subsam	-	-	-	-
0.5-1 mm contam	-	-	-	-
0.5-1 mm remain	-	-	-	-

APPENDIX III: RADIO CARBON DATES

BETA

Consistent Accuracy . . .
. . . Delivered On-time

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www.radiocarbon.com

Darden Hood
President

Ronald Hatfield
Christopher Patrick
Deputy Directors

March 10, 2015

Dr. Ellen Cowie
Northeast Archaeology Research Center
382 Fairbanks Road
Farmington, ME 04938
USA

RE: Radiocarbon Dating Results For Samples VTAD44F1 (pn19), VTAD496F1 (pn209)

Dear Dr. Cowie:

Enclosed are the radiocarbon dating results for two samples recently sent to us. As usual, the method of analysis is listed on the report with the results and calibration data is provided where applicable. The Conventional Radiocarbon Ages have all been corrected for total fractionation effects and where applicable, calibration was performed using 2013 calibration databases (cited on the graph pages).

The web directory containing the table of results and PDF download also contains pictures, a cvs spreadsheet download option and a quality assurance report containing expected vs. measured values for 3-5 working standards analyzed simultaneously with your samples.

Reported results are accredited to ISO/IEC 17025:2005 Testing Accreditation PJLA #59423 standards and all chemistry was performed here in our laboratories and counted in our own accelerators here in Miami. Since Beta is not a teaching laboratory, only graduates trained to strict protocols of the ISO/IEC 17025:2005 Testing Accreditation PJLA #59423 program participated in the analyses.

As always Conventional Radiocarbon Ages and sigmas are rounded to the nearest 10 years per the conventions of the 1977 International Radiocarbon Conference. When counting statistics produce sigmas lower than +/- 30 years, a conservative +/- 30 BP is cited for the result.

When interpreting the results, please consider any communications you may have had with us regarding the samples. As always, your inquiries are most welcome. If you have any questions or would like further details of the analyses, please do not hesitate to contact us.

The cost of the analysis was charged to the VISA card provided. Thank you. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely,

Darden Hood

Digital signature on file

BETA ANALYTIC INC.
DR. M.A. TAMERS and MR. D.G. HOOD
4985 S.W. 74 COURT
MIAMI, FLORIDA, USA 33155
PH: 305-667-5167 FAX:305-663-0964
beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Dr. Ellen Cowie — Report Date: 3/10/2015

Northeast Archaeology Research Center — Material Received: 2/23/2015

Sample Data	Measured Radiocarbon Age	d13C	Conventional Radiocarbon Age(*)
Beta - 405268	290 +/- 30 BP	-9.3 o/oo	550 +/- 30 BP
SAMPLE : VTAD44F1 (pn19)			
ANALYSIS : AMS-Standard delivery			
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid			
2 SIGMA CALIBRATION : Cal AD 1315 to 1355 (Cal BP 635 to 595) and Cal AD 1390 to 1430 (Cal BP 560 to 520)			
Beta - 405269	360 +/- 30 BP	-10.7 o/oo	590 +/- 30 BP
SAMPLE : VTAD496F1 (pn209)			
ANALYSIS : AMS-Standard delivery			
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid/cellulose extraction			
2 SIGMA CALIBRATION : Cal AD 1295 to 1370 (Cal BP 655 to 580) and Cal AD 1380 to 1415 (Cal BP 570 to 535)			

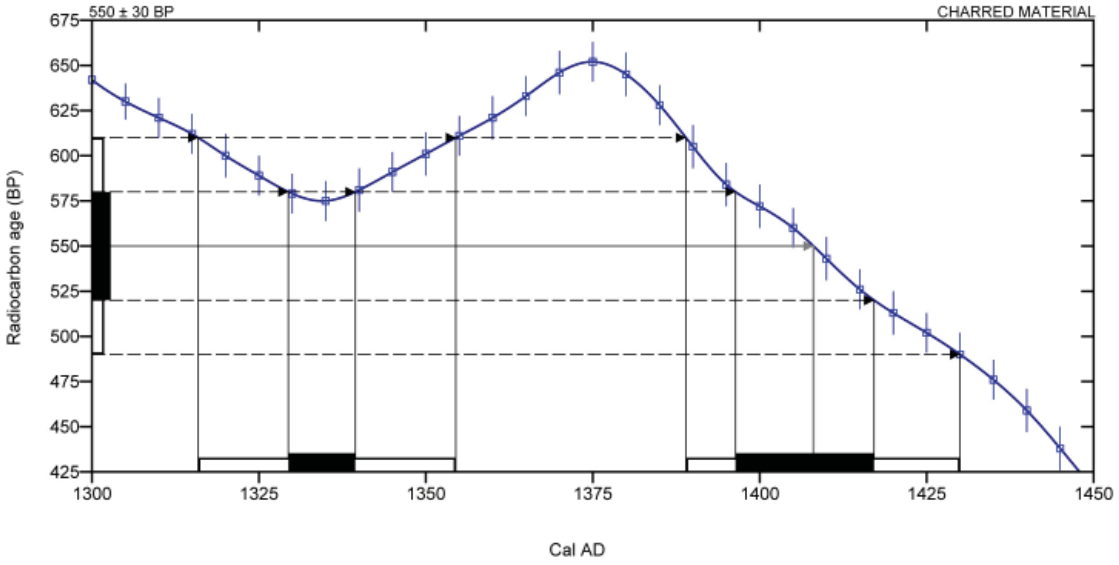
Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12 = -9.3 o/oo : lab. mult = 1)

Laboratory number	**Beta-405268**
Conventional radiocarbon age	**550 ± 30 BP**
Calibrated Result (95% Probability)	**Cal AD 1315 to 1355 (Cal BP 635 to 595)** **Cal AD 1390 to 1430 (Cal BP 560 to 520)**
Intercept of radiocarbon age with calibration curve	Cal AD 1410 (Cal BP 540)
Calibrated Result (68% Probability)	Cal AD 1330 to 1340 (Cal BP 620 to 610) Cal AD 1395 to 1415 (Cal BP 555 to 535)



Database used

INTCAL13

References

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates, Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

References to INTCAL13 database

Reimer PJ et al. IntCal13 and Marine13 radiocarbon age calibration curves 0– 50,000 years cal BP. Radiocarbon 55(4):1869– 1887., 2013.

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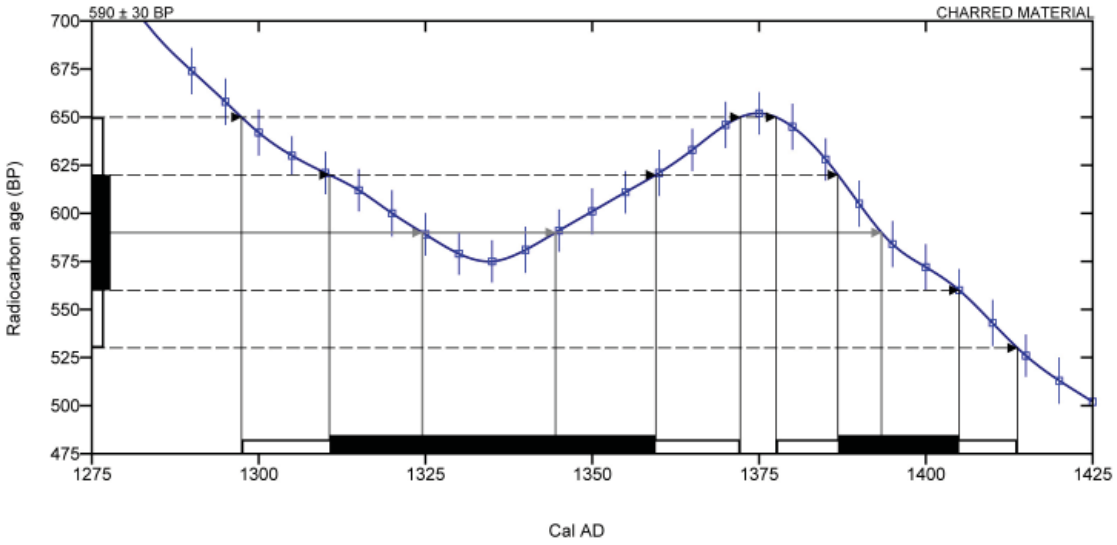
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12 = -10.7 o/oo : lab. mult = 1)

Laboratory number	**Beta-405269**
Conventional radiocarbon age	**590 ± 30 BP**
Calibrated Result (95% Probability)	**Cal AD 1295 to 1370 (Cal BP 655 to 580)** **Cal AD 1380 to 1415 (Cal BP 570 to 535)**
Intercept of radiocarbon age with calibration curve	Cal AD 1325 (Cal BP 625) Cal AD 1345 (Cal BP 605) Cal AD 1395 (Cal BP 555)
Calibrated Result (68% Probability)	Cal AD 1310 to 1360 (Cal BP 640 to 590) Cal AD 1385 to 1405 (Cal BP 565 to 545)



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