Docket No. _____
Exh. TDI-JAN-8

Stream Alteration Review Report – Overland/ Terrestrial

TDI NEW ENGLAND (TDI-NE)
NEW ENGLAND CLEAN POWER LINK PROJECT (NECPL)

Grand Isle, Rutland, and Windsor Counties, Vermont

Prepared for **Champlain VT, LLC d/b/a TDI New England**
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1.0 Introduction

At the request of Champlain VT, LLC, d/b/a TDI New England ("TDI-NE"), Vanasse Hangen Brustlin, Inc. and TRC Environmental, Inc. ("VHB/TRC") conducted stream alteration reviews for the proposed New England Clean Power Link ("NECPL" or "Project"). The NECPL is a high voltage direct current ("HVDC") electric transmission line that will provide electricity generated by renewable energy sources in Canada to the New England electric grid. The transmission line will consist of two parallel cables run from the Canadian border at Alburgh, Vermont to Ludlow, Vermont along underwater and terrestrial ("overland") routes. The overland portion of the route will traverse through portions one town in Grand Isle County, Vermont and thirteen towns in Rutland and Windsor Counties. An overview of the overland portion of the proposed route can be seen on the Stream Alteration Review Index Map included in Appendix 1.

This Stream Alteration Review focuses on locations where the Project would cross perennial streams within the overland segment of the route south of Benson, Vermont. There are no stream crossings proposed within the overland segment of the route in Alburgh. Field delineation of streams crossed by the Project were completed by VHB/TRC or its sub-consultants. Additional field studies related to natural resources, including delineation of wetlands, were also conducted and are presented in the Natural Resources Report for the Project (VHB 2014). Although the map series provided in conjunction with the Natural Resources Report contains additional information that is not discussed within this report, the supplemental information that it provides may be useful for purposes of evaluating the context of the project at each crossing location.

This review has been conducted for the primary purpose of providing supporting documentation for the Project's pending petition to the Vermont Public Service Board ("PSB") for a Certificate of Public Good ("CPG") under 30 V.S.A. § 248(b)(5). This study and associated reporting will also provide supporting documentation for other state and/or federal permit applications collateral to the CPG petition to be filed subsequently, specifically the Vermont Stream Alteration General Permit. Due to the scope and extent of the work, TDI-NE anticipates seeking coverage under the Individual Permit category of the Vermont Stream Alteration General Permit.

2.0 Project Description

From the US/Canadian border in Alburgh, Vermont, the high-voltage, direct current transmission line would be located underground for approximately 0.5 miles within public roadway right-of-way ("ROW") and then within a privately-owned parcel on the shore of Lake Champlain that is owned by TDI-NE. The transmission line would then enter Lake Champlain via horizontal directional drill ("HDD") and would be constructed within the lake for approximately 98 miles. The HVDC transmission line would exit the lake in the town of Benson via HDD onto a privately-owned parcel owned by TDI-NE. From there, the overland portion of the transmission line, approximately 56 miles in length, would traverse through thirteen towns from Benson to Cavendish. The transmission line would be buried approximately four feet underground within existing public (state and town) road rights-of-way (ROWs) for most of its length, and a portion of the Green Mountain Rail Corp. (GMCR) railroad ROW for approximately 3.5 miles in the towns of Shrewsbury and Wallingford. The HVDC transmission line would terminate at a proposed converter station location proposed to be built on privately-owned parcel off Nelson Road in Ludlow, Vermont that is owned by TDI-NE. A short segment of alternating current (AC) cable would continue from the proposed convertor station to the nearby VELCO Coolidge substation in Cavendish, where power from the transmission line would be connected to the New England electric grid.

As proposed, the cables would be installed underground within this section of the overland segment as follows:

- Benson town roads (in ROW or within road) west of Vermont Route 22A (4.4 miles)
- Vermont Route 22A ROW south to U.S. Route 4 in Fair Haven (8.1 miles)
- U.S. Route 4 ROW east to U.S. Route 7 in Rutland (17.2 miles)
- U.S. Route 7 ROW south to Vermont Route 103 in North Clarendon (2.6 miles)
- Vermont Route 103 ROW south/southeast to the RR option in Shrewsbury (3.9 miles)
- Green Mountain Railroad Corporation ("GMRC") ROW in Shrewsbury to Vermont Route 103 in Shrewsbury (3.5 miles)
- Vermont Route 103 ROW to Vermont Route 100 in Ludlow (10.4 miles)
- Vermont Route 100 ROW north to Ludlow town roads (0.8 miles)
- Ludlow town roads to HVDC convertor station (4.8 miles)
- HVDC convertor station to VELCO Coolidge Substation (0.3 miles)

Use of the previously disturbed roadway/railroad ROWs would allow the Project to avoid and minimize impacts to natural resource features. Furthermore, unavoidable impacts, when necessary, would occur primarily to natural resource features that have been previously impacted due to road/railroad construction and ongoing operational management activities.

As is described in the Natural Resources Report, the lands along the proposed transmission line drain to five major Vermont watersheds, including the Lake Champlain Direct Main Lake, Lake Champlain Direct South End, Poultney River, Otter Creek, and the Black River. Eleven named streams were identified that would be crossed by the proposed project alignment, including the Hubbardton River, Mud Brook, North Brenton Brook, Castleton River, Clarendon River, Otter Creek, Cold River, Freeman Brook, Branch Brook (crossed twice), Coleman Brook, and Black River. The project would also cross an additional 39 unnamed tributaries that were identified and delineated in the field as perennial streams. A summary table that presents information about each of the stream crossings is included in Appendix 2.

3.0 Stream Crossing Analysis

Through a combination of field, database, and off-site resources review, VHB/TRC has assessed proposed stream crossings associated with the proposed project alignment. In addition, field studies included approximate mapping of an additional 50 feet on either side of the road or railroad right-of-way. This is to account for any resources that would not be captured by the detailed Study Area and which may retain buffers to be accounted for during Project planning and permitting, and/or to map approximate resources on private lands on which construction activity may be required. The following sections describe the field delineation and remote sensing methods that were used to identify streams that would be crossed by the Project.

Field Delineation

VHB/TRC environmental scientists conducted field delineation and assessment of stream features during the period May 2014 to October 2014. Streams were identified according to federal delineation procedures (USACE 2005) and were flagged with blue survey tape. Flagging was coded with the consultant identification (T or V), Town Name Abbreviation (West Rutland, WR) and stream number, along with the specific flag number (e.g., T-WR-S-1-1). Generally, perennial and intermittent streams (channels > 6 feet or wider) are flagged along the stream Top-of-Bank (TB) or Top-of-Slope (TOS), according to guidelines in the *Guidance for Agency Act 250 and Section 248 Comments Regarding Riparian Buffers* (VT ANR 2005). Narrow features, including most ephemeral channels, are flagged along the center line. Ditches or constructed ponds are typically not included in the delineation if such features are due to excavation from upland. However, such features were included in the delineation if these features were determined to be modified, naturally occurring streams or wetlands that would meet state or federal criteria for jurisdiction. Stream flags were located in the field using a Trimble® GPS unit capable of sub-meter accuracy and post-processed using Trimble® Pathfinder software.

Stream identification and ordinary high water ("OHW") width was also assessed, according to methods detailed in the "Regulatory Guidance Letter: Subject – Ordinary High Water Identification" (USACE 2005). The OHW width for each channel segment is determined from an average of measurements of bank-to-bank OHW widths taken at regular intervals along the surveyed portion of the watercourse. During field work, flow regimes are preliminarily classified as perennial, intermittent, ephemeral or jurisdictional ditch and are determined based on qualitative observations of in-stream hydrology indicators at the time of observation and existing geomorphic characteristics. The Summary of Proposed Stream Crossings table included in Appendix 2 provides information about each crossing, including:

- Mile Post
- VHB/TRC Stream ID
- Stream Name (Geographic Names Information System ("GNIS"))
- Right of Way Name
- Town
- Flow Regime (Perennial, Intermittent, Ephemeral)
- Average OHW
- Drainage Area (square miles)
- Proposed Crossing Method
- Comments / Crossing Description

Approximate Delineations

In addition to the direct Study Area that VHB/TRC had access to in order to conduct detailed field delineations, an area 50-feet wide adjacent to the direct Study Area in most locations (e.g. the linear components within road or railroad ROW) was added in order to approximate the boundaries of potential water resources. Such “Approximate Streams” are indicated on the Natural Resources Report Maps and can be identified by the “AS” designation in the feature name. Approximated resources are based on a combination of information gathering from off-site lands during field site visits with reconnaissance-level verification and mapping from off-site resource review/interpretation. Four perennial streams that would be crossed by the project were mapped as approximate: an unnamed tributary to Lake Champlain (V-BE-AS-3), an unnamed tributary to Hubbardton River (V-BE-AS-10), and two unnamed tributaries to the Black River (T-MH-AS-20 and T-MH-AS-23). All streams that were mapped as approximate are small streams (OHW width less than 5 feet) and cross beneath the roadway in culverts that extend outside of the ROW.

River Corridors

As part of the Vermont’s River Management Program, River Corridors have been identified by the Vermont Agency of Natural Resources (“VT ANR”) for certain streams and rivers. The River Corridor or fluvial erosion hazard (“FEH”) area is the lateral width of a stream corridor that may be subject to fluvial erosion from stream channel lateral migration over time. The FEH, when applicable, is determined by geomorphic assessments of channel bank full width, meander centerline, confining lateral topography, channel type, and current channel adjustments; the resultant FEH is typically defined by a channel-width to belt-width ratio, which is dependent on stream sensitivity type and adjacent landform (VT ANR 2009). The purpose of identifying River Corridors and managing activities within them is to prevent new development or infrastructure from being constructed in areas that would be at risk from the processes associated with channel evolution and dynamic equilibrium. By avoiding the construction of new features in these areas, future costs and impacts that would be associated with protecting these features are also avoided.

The River Corridor Protection Guide (VT ANR 2008) details the application of these principles and identifies existing transportation corridors (roads and railways) as limiting the ability of streams to fully express their plan form and to migrate laterally across the valley floor. In these situations, the public infrastructure serves as the valley wall and constrains the River Corridor on that side of the channel. Because the Project corridor is co-located within existing road and railroad ROWs, the River Corridor associated with the streams crossed by or adjacent to the Project is assumed to be truncated at the toe of the embankment or at a reasonable distance away from the toe of the embankment and the transmission cable would not impact the existing River Corridor. In those locations where the transmission cable would cross beneath a stream or river channel beyond the toe of the ROW embankment, the cable would be buried at a sufficient depth below the stream channel to prevent future downcutting or channel migration from exposing the cable.

Because the Project would cross beneath stream and rivers with varying channel slopes, valley types, and substrate, the exact depth for each crossing would need to vary accordingly. Guidelines for the required burial depths associated with each proposed construction type are provided below in Section 4.0. The cable profile and final burial depth for each crossing will be incorporated into the final design plans. VT ANR provided River Corridor polygons for twenty eight locations where the proposed alignment would cross or run parallel to a perennial stream. Smaller streams have a minimum 50-foot buffer zone set back from the top of each bank. These River Corridors and buffer zones are shown on the Natural Resource Report maps.

Drainage Areas

The contributing drainage area tributary to each proposed perennial stream crossing location was assessed using the town maps available from the VT ANR River Management Program (VT ANR 2011) or with the watershed delineation tool available on the U.S. Geological Survey StreamStats website (USGS 2014). A summary of the proposed crossings is as follows:

- 10 of the stream crossings are located at sites with contributing drainage areas greater than 10 square miles.
- 10 of the stream crossings are located at sites with contributing drainage areas between 1 and 10 square miles.
- 8 of the stream crossings are located at sites with contributing drainage areas between 0.5 and 1 square miles.
- 23 of the stream crossings are located at sites with contributing drainage areas less than 0.5 square mile.

Summary

Based on the field delineation and approximate resource mapping that has been performed, the proposed project alignment would cross 51 perennial streams, 78 intermittent streams, and 38 ephemeral features.

Because the proposed alignment follows road and railroad ROWs for all of the overland segment of the Project, the stream crossings associated with the Project must be coordinated with existing transportation infrastructure, such as bridges and culverts. As part of the analysis that will be completed prior to final design, some of these structures may likely need to be evaluated for what impact, if any, they have on the geomorphic condition of the stream. If the structure’s configuration (size or geometry) results in significant departure from a naturally stable channel and the replacement of the structure in the future would be likely to result in major alterations to the stream's profile, the specific crossing design would be modified to account for the likely future condition. The following section describes the types of proposed crossing methods that would be used by the Project and how the Project would account for potential alterations of the roadway infrastructure in the future.

4.0 Proposed Crossing Methods

Four different crossing methods are proposed for use by the Project to cross streams within the project area: aerial/headwall crossings, "At Culvert" and "Over Culvert" crossings, horizontal directional drill ("HDD") crossings, and open trench excavation ("OTE") crossings. Typical construction details for these crossing techniques will be included as part of the Erosion Prevention and Sediment Control ("EPSC") plan set, to be included with the construction stormwater discharge, Section 401 WQC, and stream alteration permit applications. Narrative descriptions of these methods and the locations that they will be used are described below.

Aerial/Headwall Crossings

At aerial/headwall crossings, the transmission cable may be suspended above the stream being crossed at locations where the fascia of an existing bridge or the headwall of an existing culvert would provide a suitable face for attachment and the structure owner allows this configuration. With the current project alignment and layout, there are two locations where this type of stream crossing would be used, both within the town of Ludlow on East Lake Road. One is the bridge crossing of the Black River immediately downstream from the Lake Rescue Dam (T-LU-S1) and the other over an unnamed tributary to the Black River (T-LU-S21) that crosses beneath East Lake Road in a culvert. No in-stream work is proposed for these crossings.

At Culvert Crossings

As described above, many of the streams that would be crossed by the Project are already conveyed beneath the roadway within a culvert. Where feasible, the Project proposes to complete "At Culvert" crossings by excavating a trench within the roadway or within the embankment adjacent to the roadway and installing the transmission cable a minimum of one foot beneath the existing culvert. This burial depth is intended to provide sufficient separation between the transmission cable and culvert for the future culvert maintenance or replacement to be conducted without impacting the cable.

To complete this type of installation, the existing culvert would either be supported in place and a trench excavated beneath it to the required depth, or a segment of the culvert would be removed and replaced following installation of the transmission cable. Pipe bands or other appropriate construction techniques would be used to secure the segment of culvert that was being replaced to the remaining undisturbed segments of the culvert. This approach would avoid direct disturbance of the natural channel.

Twenty-one of the proposed perennial stream crossings would be constructed using this method. The largest culvert that is proposed for an "at culvert" crossing is 6 feet in diameter, however the majority of culverts proposed for this type of crossing are between two and four feet in diameter.

Over Culvert Crossings

The proposed cable would be installed in the roadway embankment above an existing culvert in three locations where site constraints limit the ability of the cable to be installed beneath the culvert.

In Shrewsbury, an unnamed tributary to the Mill River (V-SH-S-14) crosses through the Route 103 embankment in a concrete box culvert located near the toe of the embankment with approximately 20 feet of fill over the top of the culvert. Applying the typical trench construction approach at this location would result in a prohibitively deep excavation. In Mount Holly, an unnamed tributary to Branch Brook (T-MH-S14) crosses beneath Route 103 in a concrete box culvert. The stream channel at this location is deeply incised, private residential structures and road crossings are in close proximity to the culvert, and there is insufficient room in the ROW to construct an alternative crossing type. In Ludlow, an unnamed tributary to Black River (T-LU-S5) crosses beneath Route 100 in an existing 42-inch corrugated metal pipe ("CMP") culvert. A duct bank is proposed to be installed beneath the road surface in conjunction with a VTrans roadway improvement project along this portion of Route 100. The existing culvert may be replaced as part of the roadway improvement project, however, the cable would be installed inside the duct bank (above the culvert), thereby avoiding any additional disturbance to the stream.

Horizontal Directional Drilling

Under certain conditions, the use of HDD techniques for stream crossings allows in-stream impacts to be completely avoided. However, secondary impacts to the riparian corridor and adjacent lands may occur due to the need to clear large areas on either end of the HDD for pullback and receiving areas. HDD requires that two boreholes (a drill pit and a receiving pit) be excavated on either side of the drilled segment, and cleared areas at each end of the drill to provide sufficient distance for the drill string and cable to be handled and fed through the drill borehole. The specific requirements for the entry and exit angle of the cables, the channel width, and the required depth below the channel bottom will be evaluated at each site during final design. HDD crossings will be a minimum of 20 feet below the stream channel in order to provide sufficient depth to allow dynamic stream processes to continue and to allow future bridge or culvert construction projects to be completed without disturbing the cable. This method is proposed for use at 17 crossings where suitable soils, topography, and alignment permit it to be used. With the exception of the Black River crossing (T-LU-S1) described above as an Aerial crossing, all streams with watersheds greater than 10 square miles would be crossed using HDD construction methods.

Open Trench Excavation

The alternative method for stream crossings involves deploying temporary in-stream flow diversion structures, digging an open trench excavation ("OTE") across the stream channel, installing the transmission cable, backfilling with suitable materials, and restoring the stream bank and channel bottom. This construction method resembles the method used to construct the remainder of the transmission cable through upland areas, but involves added EPSC measures and increased burial depth to avoid and minimize impacts to the waterway. Timber matting will be used to protect bordering wetlands and smaller stream channels from impacts by mechanized equipment. Typical details for dewatering, such as using diversion flumes or coffer dam and pump-around systems, will be included in the EPSC plan set to illustrate the proposed management of flow associated with the OTE crossings.

Stream crossings that are proposed for open trench excavation are generally limited to sites with smaller channels (OHW width less than 10 feet). Three crossings larger than 10 feet are proposed to be completed with OTE construction methods and would occur at locations where substrate and channel geometry would allow the cable to be installed with minimal stream impacts. The cable would be buried a minimum of 5 feet below the channel bottom where OTE construction methods are proposed. This method is proposed for use at eight crossings.

5.0 Summary

The project alignment for the NECPL was evaluated for locations where crossings of perennial streams would occur and suitable construction methods were identified for each site. The project team is aware that many of the existing bridges and culverts that carry perennial streams beneath town and state roadways may be undersized with respect to the current Stream Alteration / River Management criteria and that future upgrades by the agencies responsible for these structures may result in their replacement with wider and potentially deeper structures. Undersized or improperly installed structures that interrupt the stream profile (i.e. upstream sediment wedge and/or perched outlet) need to be identified and the burial depth of the cable beneath the structure or location of the cable in relation to the structure may need to be adjusted in order to accommodate future changes by the responsible agencies that may be necessary to restore the natural stream profile through the reach to the degree feasible. Furthermore, it is anticipated that the structural condition of some structures will preclude their modification during the construction of this project. Therefore, as appropriate some structures in poor condition may need to be replaced in their entirety. In these cases, TDI-NE will work with the responsible agencies to identify the degree to which the replacement structure could be sized to accommodate the full bankfull width of the channel and be installed according to the requirements of the Vermont Stream Alteration General Permit. Prior to the completion of final design plans, a detailed constructability investigation would evaluate crossing locations in order to identify those structures that would be likely to require complete replacement during construction.

Of the 51 perennial streams that would be crossed by the project, 43 of these crossings would be conducted without disturbing the natural stream bed, either by using HDD construction, by installing the cable above or below an existing culvert, or by suspending the cable from the side of an existing structure. In locations where in-stream construction activities are proposed, the use of appropriate EPSC measures and construction details will minimize the impact to aquatic resources. The Project alignment was designed to minimize impacts to streams and rivers by proposing to construct the transmission cable within existing road and railroad ROWs. This approach avoids creating placing new infrastructure within otherwise unconstrained River Corridors and minimizes the amount of in-stream work by installing crossings at the locations of existing culverts and bridges.

6.0 References

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