**TRANSCANADA HYDRO NORTHEAST INC.**

# ILP Study 28
# Fowler's Toad Survey

## *Study Report*

## *CLASSIFICATION - PUBLIC*

**In support of Federal Energy Regulatory Commission Relicensing of:**

Wilder Hydroelectric Project (FERC Project No. 1892-026)
Bellows Falls Hydroelectric Project (FERC Project No. 1855-045)
Vernon Hydroelectric Project (FERC Project No. 1904-073)

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# EXECUTIVE SUMMARY

This report presents the results of TransCanada's 2014 Fowler's Toad Survey (ILP Study 28). Fowler's toad was listed as endangered by the State of Vermont in 2015 and is considered a Species of Special Concern in New Hampshire. It has no federal status. The goal of this study was to conduct a survey to obtain baseline distributional and abundance data on Fowler's toad and its potential habitat along the Connecticut River from the Wilder riverine reach downstream to the Vernon riverine reach. This species is rare and has specialized habitat requirements that consist of a combination of both wetland pools and bare soils. Fowler's Toad habitat may benefit from shoreline disturbance as a result of flooding, scour, and/or wave action. Sandy, un-vegetated shorelines, river banks, and floodplains may provide small pools for breeding and suitable substrate for digging aestivation and hibernation burrows.

A desktop analysis of prior species reports, existing data from relevant existing and concurrent study reports, maps and aerial photos was conducted to identify the location and distribution of potentially suitable habitat available to Fowler's toad within the study area. In general, suitable wetland pools appear to be more abundant than suitable bare soils within the study area. Locations with both a potential breeding pool and bare soils appear to be uncommon within the study area. Survey sites were subsequently chosen from potentially suitable habitat areas based on accessibility and a field check to verify habitat suitability. A total of 15 study sites were selected for surveys. Fowler's toads are most effectively located by their calls during the breeding season and standard call surveys were used to identify and map species occurrence. Automated acoustic monitoring equipment was also used to survey in four locations. Surveys were conducted during June 2014.

Fowler's toad was confirmed at one location, an extensive backwater area with a direct hydrologic connection to the river on Stebbins Island in the Vernon riverine reach. Stebbins Island and the Stebbins Road area in Vernon, Vermont have the most and the most recent Fowler's toad records in the study area, consisting of 17 verified records from 1994 through 2007. Five of the 15 study sites were determined during the course of the study to not provide fully suitable habitat. Of the remaining ten sites, one was determined to have no surface water connection to the Connecticut River, one was determined to be outside the project-affected area, one was undetermined since it was located potentially within the project-affected area but beyond the extent of modeled cross sections from Study 4 – Hydraulic Modeling Study), and one was determined to have a minimum habitat elevation higher than the normal project operating range. Of the remaining six sites, four sites all within the Wilder riverine reach were subject to potentially large project-related effects due to water level fluctuations, and two sites were subject to more moderate project-related effects. At two sites with minimum habitat elevations within the normal project operating range habitat features may serve to buffer potential project effects.

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| | |
|---|---|
| FERC | Federal Energy Regulatory Commission |
| RSP | Revised Study Plan |
| RTK | Real Time Kinematic Unit |
| SGCN | Species of Greatest Conservation Need |
| SSR | Site Selection Report |
| TransCanada | TransCanada Hydro Northeast Inc. |
| USR | Updated Study Report |
| VANR | Vermont Agency of Natural Resources |
| WSE | Water surface elevation |

# 1.0 INTRODUCTION

This report presents the results of the 2014 Fowler's Toad Study (ILP Study 28) conducted in support of Federal Energy Regulatory Commission (FERC) relicensing of the TransCanada Hydro Northeast Inc. (TransCanada) Wilder Hydroelectric Project (FERC Project No. 1892), Bellows Falls Hydroelectric Project (FERC No. 1855), and Vernon Hydroelectric Project (FERC No. 1904). TransCanada has initiated the Integrated Licensing Process (ILP) for these projects in order to renew their operating licenses beyond the current expiration date of April 30, 2019 for each project.

In its study request, Vermont Agency of Natural Resources (VANR) identified potential issues with operations of the Wilder, Bellows Falls, and Vernon projects that may have effects on Fowler's toads (*Anaxyrus fowleri*) and their habitat that may be present within project-affected areas. This species requires early successional habitats that provide suitable breeding, estivation, and hibernation habitat. For breeding, pools with sparse to no vegetation and relatively stable hydrology during the breeding season are required. For estivation and hibernation sandy or gravelly unvegetated soils which toads can burrow into are required. Early successional habitats along riverbanks, shorelines, and floodplains that are maintained by hydraulic regimes, (e.g., flooding, scour and/or wave action) that deposit sand and gravel, clean away vegetation, and create and support backwater pools potentially provide suitable habitat for this species. The Revised Study Plan for Study 28 was approved without modification in FERC's September 13, 2013 Study Plan Determination.

# 2.0 STUDY GOALS AND OBJECTIVES

The goal of this study was to conduct a survey to obtain baseline distribution and abundance data on Fowler's toad along the Connecticut River in the sections of the river spanned by previous, verified reports of this species. Although only one of those species reports is from the Connecticut River itself, the rest are primarily from towns adjacent to the river and therefore define the possible range of Fowler's toad within the study area. Fowler's toad is considered a high priority Species of Greatest Conservation Need (SGCN) in Vermont and is listed as an S1 "Very Rare" species in Vermont's Wildlife Action Plan (VT WAP Team, 2015). This species was listed as endangered by the State of Vermont in 2015 and is considered a Species of Special Concern in New Hampshire. It has no federal status.

Prior to this work, no studies had been conducted to specifically identify the location or size of Fowler's toad populations within the project-affected areas or to assess whether project operations could affect Fowler's toad populations or habitat. The 2012 Species Status Review (provided in VANR's study request document dated March 1, 2013) for Fowler's toad by the State of Vermont Endangered Species Committee indicated that Fowler's toad had been recorded in towns bordering the Connecticut River in both Vermont and New Hampshire. Fowler's toad was first reported and photographed in Vermont in 1983 in the Hillcrest neighborhood of

White River Junction, Town of Hartford, VT where it was reported as numerous. There was one 1985 report from Westminster, and a 2002 report from along the Saxton's River in Rockingham, Vermont. A population in Vernon was well documented from 1994 through 2007 (Vermont Endangered Species Committee, 2012). The descriptions of the locations for these records are not detailed, but the Hartford and Saxton's River report are clearly from locations that are not affected by project operations. The Westminster report is from a site located within 600 feet of the Connecticut River and may have a hydrological connection to it. The ten Vernon records include at least two records that are from the Connecticut River or Stebbins Island in a reach affected by Turners Falls and Northfield Mountain Pumped Storage projects as well as discharge from the Vernon project.

In New Hampshire, Fowler's toad has been documented in Cheshire County in the Towns of Hinsdale (2002) and Westmoreland (2001) (NHFGD, 2010). The records from New Hampshire are away from the Connecticut River and therefore are not within the area affected by project operations. Based on the literature reviewed, no studies have been conducted in New Hampshire to characterize the habitat occupied by Fowler's toad in the vicinity of the Connecticut River or to identify apparently suitable breeding habitat along the river.

The objectives of this study were to:

- Develop additional information regarding the distribution and relative abundance of Fowler's toad;
- Develop additional information regarding the distribution and condition of suitable Fowler's toad breeding habitat within the study area; and
- Assess whether project operations are likely to have an effect on suitable Fowler's toad breeding habitat, and if those effects are likely to be positive or negative.

## 3.0 STUDY AREA

The study area included the shorelines and terrestrial project lands between Hartford VT, the northernmost verified record of Fowler's toad along the Connecticut River, and Vernon, VT, the southernmost record within the project-affected area. The southernmost record is within the approximate 1.5 mile riverine reach downstream of Vernon dam. The Wilder impoundment is unlikely to support Fowler's toad because this areas lies north of the northernmost Vermont record for the species, which is also the northernmost record in the Northeast, with the exception of a disjunct population in Canada (Vermont Endangered Species Committee, 2012). While the RSP inadvertently limited the study area from the Bellows Falls impoundment to downstream of Vernon, the species records indicated potentially suitable habitat in the Wilder riverine reach as well. Surveys conducted for this study were restricted to TransCanada's fee-owned project lands, flowage easement lands that may be hydrologically connected to the Connecticut River, and/or lands that were publicly accessible by boat or by foot, or where landowner permission was obtained.

# 4.0 METHODS

## 4.1 Habitat Suitability Assessment and Survey Site Identification

A desktop analysis of existing data was conducted to identify potentially suitable habitat available to Fowler's toads within the study area. Sources of data included relevant reports and maps created from concurrent studies as well as existing maps and aerial photos. Survey sites were subsequently chosen from these habitat areas based on accessibility and field checks to verify the habitat suitability.

Suitable habitat for Fowler's toad consists of areas with bare, loose soils composed of sand or gravel above the waterline but below the frost line for aestivation and hibernation burrows, in close conjunction with suitable breeding pools. This combination of features must be in close proximity because this species is not highly mobile. Bare ground or sparse vegetation is required as dense vegetation impedes the ability of this species to burrow into suitable soils. Fowlers' toad will use a wide range of pool types and sizes, including ponds with aquatic predators (fish and other, larger frog species) present. Suitable breeding pools have minimal or no vegetation, and relatively stable water levels that allow water temperatures to become warm. Relatively stable hydrology also prevents tadpoles from being stranded or washed away. Because of the Fowler's toads' low mobility, suitable breeding pools were considered the primary indicator of overall habitat suitability. Fowler's toads are also most readily documented through their distinctive breeding call, which was another reason to focus on suitable breeding pools.

Data sources used during the preliminary analysis included the aquatic and terrestrial habitat maps for the study area (from Studies 7 – Aquatic Habitat Mapping Study and Study 27 – Floodplain, Wetland, Littoral, and Riparian Habitats Study), site-specific high resolution stereo true-color aerial photography, and other aerial photos (e.g., Google Earth). Additional preliminary research included requesting records from New Hampshire Natural Heritage Bureau and the Vermont Natural Heritage Bureau regarding historic and recent locations and extent of Fowler's toads in Vermont and New Hampshire. Jim Andrews, expert herpetologist and curator of the Vermont Reptile and Amphibian Atlas, was also contacted for recent data from his long-term studies on this species in Vernon, Vermont and other parts of the state.

### 4.1.1 Identification of Potentially Suitable Habitat

Potentially suitable habitat areas were identified through aerial photography interpretation and the results of the Study 27 habitat mapping, based on the presence of suitable, bare soils and/or apparently suitable breeding pools. The identified probable breeding locations were also assessed as to the likelihood that the areas would be potentially affected by project operations.

The initial list of potential sites identified through Study 27 mapping was narrowed down to include only those locations that appeared to support a suitable breeding

pool. Most of these sites also had suitable bare soils directly adjacent or nearby, but a few large wetlands without apparent suitable soils were also retained for further consideration, to check if these types of otherwise high-quality wetlands might offer suitable breeding habitat. Suitable hydrology was also considered, surmised by examining aerial photography from nine different years to get a sense of the variation that could occur in a particular location. If a suitable appearing breeding pool and the surrounding sandbars that separated it from the river were completely inundated in most of the available photos, this was assumed to be an indication that the pool would be inundated too often to accommodate the 5 to 10 week period in early summer required for Fowler's toad tadpoles to reach metamorphosis.

### 4.1.2 Identification of Survey Sites

Field visits were made to all sites determined to be potentially suitable as described above. All sites that had land-based public access or that could be observed from a publically accessible area were visited, as well as some privately–owned sites to which the land-owners granted access. Some potentially suitable sites were located on private property and not visited, as landowners either refused entry or did not respond to requests for permission to cross their property. From the group of potentially suitable habitat sites visited, locations were chosen for the field survey based on accessibility to the site. Some sites were eliminated from the survey due to thick vegetation, fences, and/or steep banks that would be unsafe to navigate in the dark during the field surveys. Section 6 and Figure 5.1 and Table 5.1 present information on the locations of the final sites chosen for survey.

## 4.2 Standard Call Surveys

Fowler's toads are most effectively located by their calls during the breeding season. In Northern New England, timing of the breeding season is weather dependent and may extend from late May into early July (Tupper et al., 2007). As requested by VANR in its study request, a standard, widely-used call survey methodology was used to identify and map the occurrence of calling amphibians. These survey methods followed the protocol of Droege (undated) and Tupper et al. (2007). Under this protocol, selected survey locations are visited three times, approximately two weeks apart. Surveys consisted of a three-minute listening period at each potentially suitable breeding pool, conducted within three hours after sunset under conditions with minimal wind, and water temperature above 17.8°C (Droege, undated; Tupper et al., 2007).

All survey conditions and results were recorded on standardized data forms (Appendix A). Information collected included time of survey period, weather conditions (wind and precipitation), air temperature, water temperature when feasible to collect, and qualitative notes regarding ambient noise levels. All species of amphibians heard calling were recorded. For each species of amphibian heard, calls were coded as: 1 = non-overlapping calls; 2 = intermittently overlapping calls; or 3 = continuously overlapping calls, for that species. This method was used at 11

of 15 survey locations; a twelfth location (on the West River) was surveyed following this method except that only two visits were made.

## 4.3 Acoustic Monitoring

Automated acoustic monitoring equipment was used to survey for Fowler's toad in four of the 15 survey locations: Stebbins Island, the West River, and two locations on Hart Island. These locations were chosen because surveys were conducted at dusk/night and these locations were difficult to access in darkness. Additionally, the Stebbins Island location downstream of Vernon dam was the last known location for Fowler's toads in the study area with 17 verified records from 1994 through 2007, thus more extensive coverage provided by acoustic equipment was warranted. Acoustic recorders were not the primary method used for the survey as a whole because the call of Fowlers' toad is distinctive and easily perceived, making direct listening a more efficient option for surveying across large areas.

The recording devices deployed were Song Meter SM2 units developed by Wildlife Acoustics, Inc., which are autonomous audio recorders and data logging platforms. Song Meter units were placed directly adjacent to potential breeding pools. Acoustic monitoring equipment was configured using the Song Meter Configuration Utility produced by Wildlife Acoustics, Inc. All units were configured to record data on a nightly basis from 8:00 to 11:00 pm. Data from the nightly recordings was stored on secure digital (SD) cards installed in the Song Meters. The functionality of the units was checked during the standard call survey periods and the data downloaded for analysis.

## 4.4 Data Analysis and Processing

Upon completion of the standard call surveys, data was entered into spreadsheets for review and summary. Following completion of acoustic monitoring, data were transferred from the SD cards to a computer loaded with the analysis software. The Song Meters collected data in WAV file format. The software used to analyze the WAV files was Song Scope 4.1.3A (Wildlife Acoustics, Inc.).

Song Scope software is designed to review recordings made by Song Meter or other conventional bioacoustic recording equipment. Song Scope features a Spectrogram Viewer for visually displaying data associated with audio files; examples of survey recordings are presented in Appendix B. Song Scope is designed to automatically scan through recordings to search for patterns of interest. Song Scope can also be used to build custom "recognizers" which are then used as filters to sort through audio recordings to find specific types of audio files. To create a Fowler's toad call recognizer in Song Scope, downloadable recordings of Fowler's toad were gathered from online and multi-media sources (Hunter et al. 1999; Keller, 2010; Stafa, undated) and imported into Song Scope with annotations created for each file. Annotations were manually entered by selecting only the portion of each audio file containing a Fowler's toad vocalization. The annotations were then imported into a new recognizer in Song Scope. Each annotation was viewed in Song Scope to determine its suitability for use in generating the recognizer. Annotations that were

not detected in Song Scope were not selected for use in creating the recognizer (317 annotations were used in the recognizer).

Before generating the recognizer, various adjustments were made in Song Scope to limit the number of false positives identified when scanning the data with the recognizer. The vocalization of Fowler's toad is relatively simple with little variation in frequency; therefore, frequency limits were applied in Song Scope to refine the recognizer. Song Scope uses an algorithm called the Fast Fourier Transform (FFT) that transforms a time domain signal into the frequency domain. After viewing spectrograms of several vocalizations of Fowler's toad, a minimum frequency of 20 and a maximum frequency of 27 were determined to be appropriate for creating the recognizer. These frequency range values indicate the number of FFT bins. Additional settings that were adjusted prior to generating the recognizer included setting various parameters including the FFT size at 256 and the sample rate at 16,000 Hz; applying a background filter of 1 second; and setting the maximum complexity at 16, the minimum resolution at 6, the maximum syllable at 2000 milliseconds (ms), the maximum syllable gap at 152 ms, and the maximum song at 4088 ms. After these adjustments were made, the recognizer was created in Song Scope. Prior to running the recognizer, additional refinements were implemented in Song Scope to further minimize the detection of false positive results. The minimum quality value was set at 35, and the minimum score was set at 63. Some of these parameters (complexity, resolution, quality value, and minimum score) are unit-less values created within the Song Scope software. The recognizer was then used to scan the Song Meter audio files.

After all the audio files were evaluated using the recognizer, the identified calls were spot checked by ear to confirm Fowler's toad calls. The distribution of calls across nights and across the entire survey period was also assessed. A subset of calls was evaluated by ear and visually in Song Scope to identify the average duration of a single toad call. Song scope generates basic statistics about each audio file recorded, including file duration. The duration of all files identified as Fowler's toads by the recognizer were compared to the average duration of a single Fowler's toad call to determine how many recordings were likely of a single toad call, as opposed to multiple, overlapping calls.

# 5.0 RESULTS AND DISCUSSION

## 5.1 Site Selection for Call Surveys

Initially, the desktop analysis identified 58 potentially suitable breeding habitat areas in the area encompassed by the historic Fowler's toad records. These 58 potential sites were identified based on the availability of suitable bare soils and/or apparently suitable breeding pools. These locations included islands within the Connecticut River, sandbars and backwaters associated with the shoreline, wetlands with direct hydrological connection to the river, floodplain wetlands, and wetlands and shorelines associated with tributaries to the Connecticut River. These locations were clustered within towns having historical Fowler's records (Vernon, Westminster, Rockingham, and Hartford, Vermont, and Hinsdale and

Westmoreland, New Hampshire), or within towns adjacent to the towns with historical records. Additional desktop analysis narrowed down the initial 58 sites to 40 locations that had both a suitable breeding pool and suitable bare soils in close proximity; or sites that consisted of extensive, high quality wetlands with multiple breeding pools. This group of 40 was then reduced to 29 (Figure 5.1) through field checks and/or comparisons of aerial photography from different years/seasons that revealed unsuitable hydrology. Specifically, a number of river bank locations that appeared to have pools associated with backwater areas on the aerial photography turned out to be completely submerged much of the time.

Of the remaining 29 locations, 13 were deemed to have reasonable access to allow further study. Inaccessibility at the other sites resulted from dense vegetation, fences, and/or steep banks that would be unsafe to navigate in the dark, or due to private property issues, when landowners either refused entry or did not respond to inquiries requesting permission to cross their property. During the field check, two additional study sites (28-03 and 28-10) that had not been part of the initial list were identified. Thus a total of 15 sites were selected within the following towns: Rockingham, Brattleboro, and Vernon, Vermont; and Lebanon, Plainfield, Cornish, and Charlestown, New Hampshire. The locations included five sites in the Wilder riverine reach, six sites in the Bellow Falls impoundment, two sites in the Vernon impoundment, and two sites in the Vernon riverine reach (Figure 5.1). The characteristics of survey locations are listed in Table 5.1. Site GPS coordinates are included in Appendix C of the privileged version of this report.

It should be noted that the geographic locations of study sites are locations where the surveyors stood and listened during the call surveys, or are the locations where the acoustic monitors were placed for the acoustic surveys. Site locations are not where amphibians called from. The apparent location from which a sound emanates is affected by a variety of environmental conditions, including surrounding ambient noise, humidity, and the amount and density of obstructions the sound waves must pass through. Making an accurate judgment about the location of calling amphibians would have been difficult, at best. In some cases during the call surveys, amphibians appeared to calling from less than 10 feet away; in other cases the calls heard could have been up to 500 feet away.

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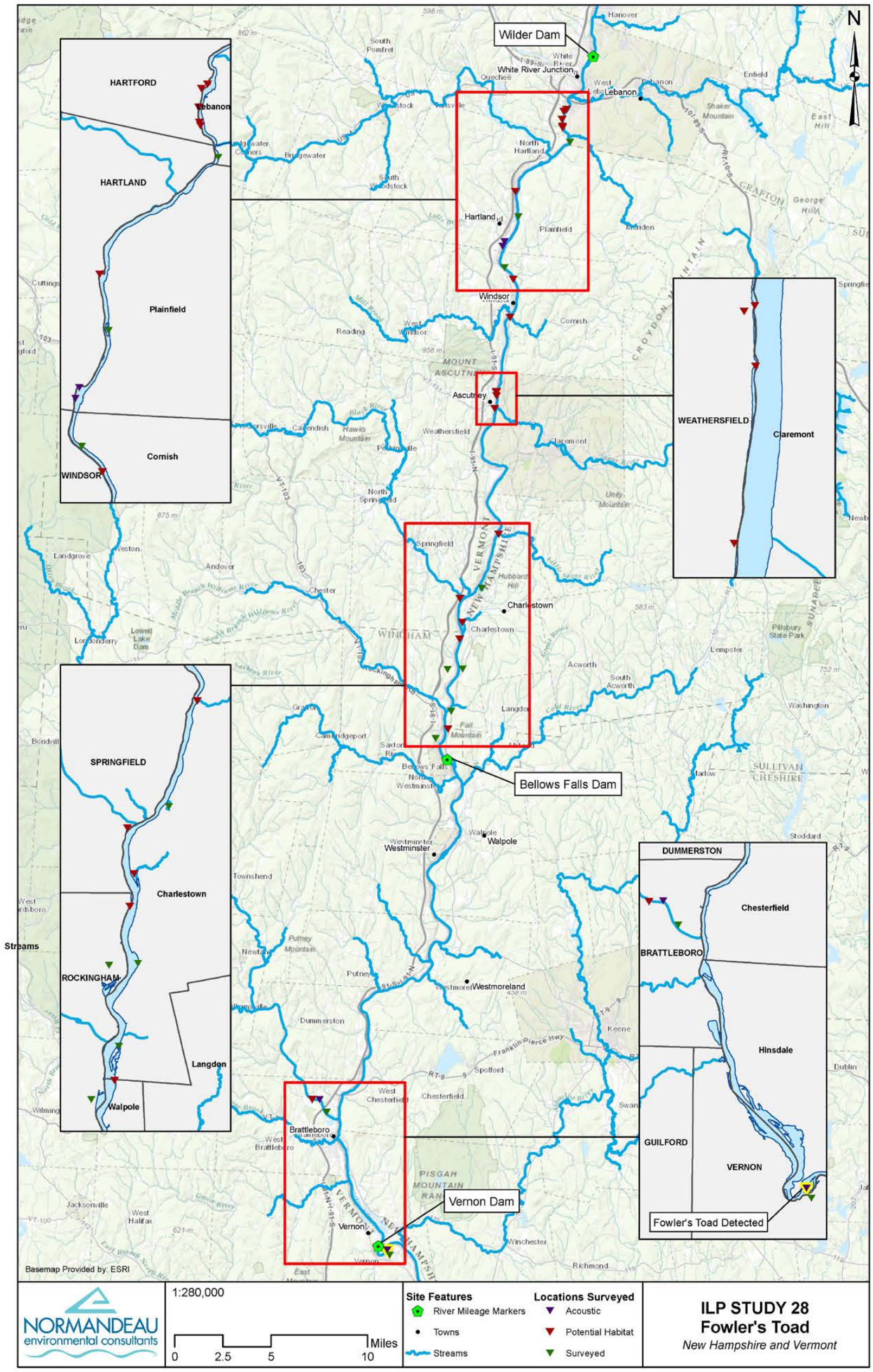


Figure 5.1. Survey locations, acoustic locations, and additional potential habitat areas.

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Table 5.1. Characteristics of survey locations.

| Site ID | Site Name | Location | Feature Type | Dominant Veg | Substrate | Size |
|---|---|---|---|---|---|---|
| 28-01 | NHFG Wildlife Management Area | Wilder riverine | Pools in CT River sandbar/shoreline | none/grasses and sedges | sand/gravel | small pool/backwater area |
| 28-02 | New England Wildflower Sanctuary | Wilder riverine | Pools in CT River sandbar/shoreline | none/grasses and sedges | sand/gravel | small pool/backwater area |
| 28-03 | Hart Island Backwater | Wilder riverine | Backwater pool connected to CT River | none | Sand | small pool |
| 28-04 | Hart Island Vernal Pool | Wilder riverine | Vernal pool on island | none/grasses and sedges | sand/silt | small pool |
| 28-05 | Bertalamy | Wilder riverine | CT River sandbar | none | sand/gravel | backwater area |
| 28-06 | Roadside Parking Area | Bellows Falls impoundment | Extensive ox bow wetland | emergent wetland? | unknown | Extensive wetland |
| 28-07 | Private docks | Bellows Falls impoundment | CT River sandbar/shoreline | none/grasses and sedges | sand/gravel | Large shoreline wetland area |
| 28-08 | Charlestown floodplain | Bellows Falls impoundment | Temporary pools in agricultural lands | grasses and sedges/ag crops | sandy loam | small/med pools |
| 28-09 | Upper Meadows Road | Bellows Falls impoundment | Meander wetland, not directly connected to CT River | emergent wetland | unknown | Extensive wetland complex |
| 28-10 | NH Route 12 | Bellows Falls impoundment | Floodplain wetlands/pond | emergent wetland | unknown | extensive pond/wetland complex |
| 28-11 | VT Route 5 | Bellows Falls impoundment | Meander wetland, cut off from CT River by train tracks | emergent wetland | unknown | Extensive wetland complex |

| Site ID | Site Name | Location | Feature Type | Dominant Veg | Substrate | Size |
|---|---|---|---|---|---|---|
| 28-12 | West River Trail 2 | Vernon impoundment | backwater pool connected to the West River at high water only | none/grasses and sedges | sand/silt | medium pool |
| 28-13 | West River Trail 1 | Vernon impoundment | backwater pool connected to the West River | none/grasses and sedges | sand/silt | medium backwater pool |
| 28-14 | Stebbins Road | Vernon riverine | beaver pond and exiting stream | none/grasses and sedges | sand/gravel | medium pond, likely beaver |
| 28-15 | Stebbins Island | Vernon riverine | back water pool connected to the CT River | none | sand/silt | large backwater area |

### 5.1.1 Standard Call Survey

Initially 12 of the 15 selected points were surveyed using the standard call survey protocol. Site 28-13, on the West River trail, was subsequently changed to an acoustic monitoring site as it was over a mile from the parking area. Walking to this point at dusk was reasonable but potentially unsafe after dark. With the exception of this site which was visited twice, all sites were visited three times, and surveys were conducted at various times during the three-hour post-sunset survey timeframe.

No Fowler's toads were detected during the standard call surveys, but amphibians were heard calling at all survey locations (Table 5.2). All other amphibian species potentially present in the survey area based on their known distribution, and that are expected to call during the month of June were detected (American toad, spring peeper, green frog, bull frog, gray treefrog). American toad was the species most commonly heard, both in terms of number of times detected and geographic distribution throughout the study area.

Direct observations of the amphibians present at the survey locations were limited. These sites were mostly visited in the dark and most did not allow direct observation of the breeding pools, even under daylight conditions. Bullfrogs and green frogs were directly observed at Sites 28-12 and 28-13 on June 17; up to 100 metamorph spring peepers were observed emerging from the pool at Site 28-08 on June 30; and an adult male American toad was observed calling at Site 28-05 on July 1.

Table 5.2. Results of the standard call surveys, by location and date at the twelve standard monitoring sites.

| Site ID | Site Name | Date | Start Time | Amphibians Detected |
|---|---|---|---|---|
| 28-01 | NHFGD Wildlife Management Area | 06-08-2014 | 11:16 pm | American toad |
| | | 06-17-2014 | 9:46 pm | American toad |
| | | 07-01-2014 | 10:47 pm | American toad |
| 28-02 | New England Wildflower Sanctuary | 06-08-2014 | 10:44 pm | American toad |
| | | 06-17-2014 | 10:16 pm | American toad |
| | | 07-01-2014 | 10:17 pm | American toad |
| 28-05 | Bertalamy property | 06-08-2014 | 10:01 pm | American toad, Bullfrog |
| | | 06-17-2014 | 10:42 pm | American toad |
| | | 07-01-2014 | 9:49 pm | American toad |

| Site ID | Site Name | Date | Start Time | Amphibians Detected |
|---|---|---|---|---|
| 28-06 | Roadside parking area | 06-02-2014 | 11:12 pm | American toad, Spring peeper |
| | | 06-16-2014 | 8:17 pm | American toad, Gray treefrog |
| | | 06-30-2014 | 8:09 pm | None |
| 28-07 | Private docks | 06-08-2014 | 9:14 pm | American toad, Spring peeper |
| | | 06-17-2014 | 11:24 pm | American toad, Gray treefrog |
| | | 07-01-2014 | 8:59 pm | None |
| 28-08 | Charlestown floodplain | 06-02-2014 | 9:56 pm | American toad, Spring peeper |
| | | 06-16-2014 | 8:30 pm | American toad |
| | | 06-30-2014 | 8:34 pm | Bullfrog, Green frog |
| 28-09 | NH Route 12 | 06-02-2014 | 10:13 pm | American toad, Bullfrog, Green frog, Spring peeper |
| | | 06-16-2014 | 8:43 pm | American toad, Bullfrog |
| | | 06-30-2014 | 8:21 pm | Gray treefrog, Green frog |
| 28-10 | Upper Meadows Rd | 06-02-2014 | 9:35 pm | American toad, Bullfrog, Green frog, Spring peeper |
| | | 06-16-2014 | 9:06 pm | American toad, Bullfrog, Gray treefrog, Spring peeper |
| | | 06-30-2014 | 8:58 pm | Bullfrog, Green frog, Gray treefrog |
| 28-11 | VT Route 5 | 06-02-2014 | 9:05 pm | American toad, Spring peeper |
| | | 06-16-2014 | 9:24 pm | American toad, Bullfrog |
| | | 06-30-2014 | 9:15 pm | Gray treefrog, Green frog |
| 28-12 | West River Trail 2 | 06-08-2014 | 8:24 pm | Gray treefrog |
| | | 06-17-2014 | 8:00 pm | Bullfrog |
| | | 07-01-2014 | 8:07 pm | None |
| 28-13 | West River Trail 1 | 06-08-2014 | 8:02 pm | None |
| | | 06-17-2014 | 8:21 pm | Gray treefrog |
| 28-14 | Stebbins Road | 06-02-2014 | 8:00 pm | None |
| | | 06-16-2014 | 10:26 pm | Gray treefrog, Bullfrog |
| | | 06-30-2014 | 10:16 pm | Gray treefrog, Green frog |

### 5.1.2 Acoustic Monitoring

Acoustic monitoring devices were deployed at four locations for varying time periods (Table 5.3). Initially, one unit was deployed at Stebbins Island on June 3; a second monitor slated to be deployed at Hart Island was found to be defective and instead returned to the manufacturer for repair. The repaired unit was subsequently deployed at the vernal pool on Hart Island (Site 28-04) on June 9. While deploying this unit on Hart Island, a separate backwater pool suitable for breeding was identified and a unit was deployed at this pool (Site 28-03) on June 17. Also on June 17, an acoustic monitor was deployed at Site 28-13 on the West River trail, and data cards were pulled from the Stebbins Island and the Site 28-04 Hart Island unit. When these cards were subsequently checked after returning from the field, it became apparent that the unit at Site 28-04 on Hart Island was still malfunctioning. There was not enough time left in the survey period to warrant retrieving that unit, returning it to the manufacturer for repair, and then redeploying it. However, the functional unit at Site 28-03 provided data for Hart Island.

Fowler's toad was confirmed at one location, an extensive backwater area with a direct hydrologic connection to the river on Stebbins Island (Table 5.3). A preliminary identification of Fowler's toad at Hart Island, as reported in the Initial Study Report (September 15, 2014), was eliminated as being an errant preliminary result during the final QA/QC process.

Table 5.3. Results of acoustic monitoring, reported by location and date.

| Site ID | Site Name | Begin | End | Amphibians Detected |
|---|---|---|---|---|
| 28-03 | Hart Island Backwater | 6/17/2014 | 6/30/2014 | American toads |
| 28-04 | Hart Island Vernal Pool | 6/09/2014 | 6/30/2014 | No data - equipment failed |
| 28-12 | West River Trail 2 | 6/17/2014 | 6/29/2014 | American toad, green frog |
| 28-15 | Stebbins Island | 6/03/2014 | 6/29/2014 | Fowler's toad, American toad |

In addition to recording Fowler's toads at Stebbins Island, a large number (exceeding 1,000) of toad tadpoles was observed in the backwater area on June 30. The tadpoles observed could have been Fowler's toads, American toads, or a mix of the two species. It is virtually impossible to differentiate between American and Fowler's toad tadpoles by casual observation without a dissecting scope, and both species were recorded during the acoustic survey (Table 5.3).

Fowler's toads were recorded on all but two of the 26 survey nights at Stebbins Island. Calling generally began either shortly before or after sunset, and on most nights lasted for the duration of the survey time (until 11 pm). Analysis of the recordings using the recognizer software detected 8,560 individual Fowler's toad call files over the course of the survey period. Based on the duration of these call files, 78% were likely the call of a single toad, 15% were multiple, overlapping toad calls, and 7% were of indistinct duration and could not be evaluated.

## 5.2 Discussion

Fifteen survey sites were identified based on breeding habitat preferences of Fowler's toad. Due to equipment malfunction, no data was collected at one of the two Hart Island sites (survey site 28-04). However, acoustic data was successfully collected at the other Hart Island site. Of the remaining 14 survey sites, Fowler's toad was detected at one, Stebbins Island (Site 28-15). Of the verified records used to define the extent of the study area, the combined area of Stebbins Island and Stebbins Island Road in Vernon, Vermont has the most and most recent Fowlers toad's records in the study area, consisting of 17 verified records from 1994 through 2007.

### 5.2.1 Habitat Conditions at the Fowler's Toad Location

The breeding pool on Stebbins Island (Figure 5.2) is a large backwater channel on the northwestern side of the island. The channel is about 950 feet long and connects directly to the river on its downstream end at some flows. The width and depth of this channel appeared to vary to some degree during the study period with river flow and elevation of the Turners Falls impoundment. This backwater area is essentially un-vegetated and covered by bare mineral soils (sand and silt). While mature hardwood trees grow on either side of the channel and create some shade along the edge of the channel, no accumulation of leafy detritus was observed in the channel. The conditions in the backwater appeared to be ideal breeding habitat for American and Fowler's toads, both of which readily use persistent, shallow pools with little to no vegetation.

The photo in Figure 5.2 was taken on June 3, 2014. On that day and during a subsequent visit on June 30, the varying moisture levels of the substrate around the pool indicated that the water level in the pool had varied and fallen recently. The general lack of vegetation in the backwater area suggested that these variations are relatively frequent in spring and early summer. Substrate conditions also indicated that variations in water level create fluctuations in the width and depth of the pool, as well as in length, though a small sand bar at the mouth likely holds a minimum amount of water to maintain a persistent pool. In general, the slope of the backwater area to its lowest elevation appeared consistent and smooth, enabling the pool to remain connected to the main water body. Unconnected pools can trap tadpoles or dry out and strand tadpoles. That does not appear to be the condition at this site.

Conditions on June 3, 2014, the day the pool was photographed, suggested that the water had likely been higher in the previous few days. The pool was about 750 feet long, and about 10 feet wide (at the mouth) to 3 feet wide farther back. It was deeper near the mouth, up to approximately 10-12 inches deep. Variations in depth are likely to be positively related to variations in width, given the topography of this feature.

Figure 5.2. Fowler's toad breeding pool on Stebbins Island (looking upstream).

### 5.2.2 Distribution and Abundance of Fowler's Toads in the Study Area

Fowler's toad was only detected at one location, Stebbins Island (Site 28-15). Estimating abundance is difficult since acoustic data cannot give information about absolute abundance. Analysis of acoustic data cannot determine whether one animal was recorded calling ten times or ten animals were recorded calling once. Additionally, the extent of the area sampled by a recording device varies with environmental conditions, including humidity which affects the distance sound travels, and ambient noise levels.

Because amphibians are usually heard and not seen, the intensity of amphibian chorusing is commonly assessed using the system discussed in Section 4.2 (intensity 1 = non-overlapping calls; 2 = intermittently overlapping calls; 3 = continuously overlapping calls). The toads recorded at Stebbins Island had a calling intensity of 1 or 2, with no more than three toads distinctly calling at any given time. However, it is possible that additional toads were calling, but were in perfect synchrony and therefore sounded like a single toad, and/or were outside of the range of the detector. Visual inspection of a selection of Fowler's toad sonograms in conjunction with direct listening to the recordings clearly indicated that multiple

toads were calling in some of the recorded audio files. Sonograms of a single Fowler's toad calling and multiple Fowler's toads calling are presented for comparison in Appendix B.

Additionally, like many amphibians, some male Fowler's toads in a breeding aggregation may never call (personal communication, T. Tupper, Assoc. Professor of Biology, Northern Virginia Community College, Springfield, VA, October 24, 2014). These silent toads avoid exposure to predators hunting by sound and gain mating opportunities by intercepting females attracted by their noisier counterparts.

### 5.2.3 Distribution and Condition of Habitat in the Study Area

As discussed in Section 4.1, suitable habitat for Fowler's toad requires the presence of pools with reasonably stable hydrology for breeding, and bare, sandy soils suitable for estivation and hibernation in close proximity. This combination of conditions in close proximity to each other appears to be inherently rare on the Connecticut River. In general, persistent, shallow pools tend to be concentrated in and around large wetland features associated with bays and old oxbows (e.g., Herricks Cove). However, the most extensive areas of bare, sandy soils in the study area are associated directly with the banks of the river, and some of the islands. Locations with both potential breeding pools and bare soils appear to be most abundant in the Wilder riverine section and the Bellows Falls impoundment (Figure 5.1). In this part of the study area, potential breeding pools form on sand bars and behind scour deposits along the river's edge or on islands, as well as at some riverbank-associated wetlands, while islands, sandbars, and some other riverbank features provide some areas of bare soils.

Based on the aerial photo analysis and field surveys, five study sites (28-06, 28-08, 28-09, 28-10, and 28-11) appeared to have potentially suitable breeding pools, but lacked nearby exposed soils. As described in Section 4.1.1, they were included in the study to test if both breeding habitat and bare soil areas are required for Fowler's toad to use an area. Therefore, analysis of project effects was not required or conducted for those sites. None of these sites had Fowler's toads however, indicating that they do not provide suitable habitat overall. The remaining ten study sites had both pools and bare soils and were evaluated further (Section 6.0).

## 6.0 ASSESSMENT OF PROJECT EFFECTS

### 6.1 Water Level Fluctuation Effects on Fowler's Toads and Their Habitat

Periodic (every 5-15 years) high water elevations and velocities due to high energy water events are required to expose and maintain the bare substrates that Fowler's toads require for estivation and hibernation. However, during the breeding season daily water level fluctuations due to project operations may affect Fowler's toads breeding habitat because this species is not adapted to relatively rapid, frequent fluctuations in water depth. During the period when eggs are laid until tadpoles metamorphose into toadlets, relatively persistent pools are required. This requires stable water levels during the breeding season (approximately the third week of

May through the third week of July), at a flow level low enough to create pools in bare substrates preventing eggs and tadpoles from being washed out of a breeding pool but high enough to prevent stranding caused by lack of connectivity to the main body of water. Stable water levels also allow water temperature in a breeding pool to rise, and warmer temperatures allow eggs and tadpoles to develop more rapidly. Riverine environments typically do not support stable water levels during this critical two-month period.

## 6.2 Modeling Project-related Water Level Fluctuations at the Survey Sites

In 2015, study sites were revisited and habitat elevation data were collected using a Real Time Kinematic (RTK)-GPS in order to provide more definitive elevation data for use in modeling, than did the relative habitat elevation data (water surface level at the time of site visits) that was collected in 2014. Water levels were analyzed using the RTK data and the Hydraulic and Operations Models (Studies 4 and 5). Using the hydraulic model, water surface elevations (WSEs) were calculated for each study site and compared to the RTK derived minimum habitat elevation at each site. Sites 28-12 and 28-13 located on the West River approximately 1.5 and 0.75 miles, respectively, from the confluence of the Connecticut River, are beyond the extent of modeled cross sections and therefore could not be included in the modeling analysis. No water level loggers from other studies were located close enough to these sites to make an evaluation. Based on topography and visual observations conducted in fish spawning studies (Studies 14/15 and 16) the upstream extent of the project-influenced reach of the West River is approximately located at the I-91 bridge. Therefore, Site 28-12 is likely beyond the project-affected area while Site 28-13 could be within the range of project effects but the extent of potential project effects cannot be determined. It is also likely that high tributary flows would most likely be the cause of habitat inundation and/or scouring experienced at this site.

Site 28-14 (Stebbins Road) was also excluded from model analysis due to the site being located well away from, and with an elevation well above the range modeled WSEs. This site has no surface water connection to the Connecticut River.

For the seven study sites that have both suitable breeding pools and suitable bare soils and that may be affected by project operations, Hydraulic Model (Study 4) cross sections were identified at, or nearest to, the study sites. Rating curves at those locations were analyzed to determine if the range of measured habitat elevations fell within the modeled range of normal project operations WSEs at each study site in order to screen each site for potential project effects (Table 6.1).

Table 6.1. Hydraulic model screening for project effects under normal project operations[1].

| Site ID# | Location | Project Area | Model Node# | Range of Model WSE (ft) NAVD88[a] | Min Habitat Elev (ft) NAVD88 | Habitat Inundation Under Normal Project Operations Based on Hydraulic Model Output | Additional Analysis Required |
|---|---|---|---|---|---|---|---|
| 28-01 | NHFG WMA | Wilder Riverine | 816 | 313.7 - 321.6 | 315.3 | Min Habitat Elev inundated at project-controlled flows ~1,300 cfs or higher. | Yes |
| 28-02 | New England Wildflower Sanctuary | Wilder Riverine | 768 | 299.2 - 307.2 | 303.1 | Min Habitat Elev inundated at project-controlled flows ~4,100 cfs or higher. | Yes |
| 28-03 | Hart Island Backwater | Wilder Riverine | 751 | 298.2 - 304.5 | 300.0 | Min Habitat Elev inundated at project-controlled flows ~2,500 cfs or higher. | Yes |
| 28-04 | Hart Island Vernal Pool | Wilder Riverine | 751 | 298.2 - 304.5 | 311.0 | Min and Max Habitat Elevs never inundated at project-controlled flows. | No |
| 28-05 | Bertalamy | Wilder Riverine | 737 | 295.7 - 302.4 | 297.8 | Min Habitat Elev inundated at project-controlled flows ~2,500 cfs or higher. | Yes |
| 28-07 | Private docks | Bellows Falls Impoundment | 555 | 289.2 - 291.2 | 289.6 | Min Habitat Elev inundated at all project-controlled flows at Bellows Falls dam WSE >= 289.6 ft. | Yes |
| 28-15 | Stebbins Island | Vernon Riverine | 125 VR | 180.6 - 186.0 | 182.7 | Min Habitat Elev inundated at project-controlled flows from ~ 5,500 cfs or higher to >~8,500 cfs or higher, within Turners Falls dam normal operational WSE. | Yes |

a. Approximate hydraulic model WSE elevation range at the site under normal project operations.

[1] All WSE values are reported in the North American Vertical Datum of 1988 (NAVD 88).

The hydraulic model data indicated that the habitat elevation range at Site 28-04 – Hart Island vernal pool would never be inundated under normal project operations and would not be inundated under any of the modeled flows (up to 25,000 cfs). Therefore, no additional analysis using the operations model was required. The operations model was used to further analyze the remaining six sites for timing, frequency, and duration of water level fluctuations during the period of interest (May 21 – July 21), the primary breeding season of Fowler's toad.

## 6.3 Assessment of Project Effects on Study Sites

Project effects deemed most relevant to Fowler's toad breeding habitat suitability were:

- The magnitude of project-related water level fluctuations on any given day during the Fowler's toad breeding season (May 21 – July 21).

- The frequency of project-related water level fluctuations large enough to inundate the Fowler's toad breeding habitat.

The effect of changes in WSE at any given site is mediated by the relative arrangement of potential breeding habitat (pools), its connection to the river (direct, indirect, upstream, downstream), and any features (banks, sandbars, wetlands, man-made structures) that could slow water fluctuations and buffer their magnitude. Each site is unique in this regard and experienced changes in WSE uniquely. Effects of water level fluctuations will vary with each site and among years, acknowledging that if the topography of features at a given location changes over time, water fluctuation effects may also change.

The magnitude and frequency of project-related water level fluctuations and their potential effects on Fowler's toad breeding habitat at the six study sites determined to have suitable habitat was examined in the context of the topography of each site. These effects are described in Table 6.2. The "relative level of effect" described in the table is based on the frequency and size of water level fluctuations at the site. For purposes of this study, the relative level of project effect was qualitatively defined as "none", "negligible", "moderate", or "large" based on the frequency and magnitude of WSE fluctuation.

The four study sites with suitable habitat in the Wilder riverine reach are estimated to have "large" project effects (Table 6.2), which is not surprising given that water level fluctuations are typically higher in the riverine sections than in the impoundments. However, one of those sites (28-05) also contains features that may protect it, thus buffering WSE fluctuations and hence, reducing project effects. The single site with suitable habitat in the Bellows Falls impoundment (Site 28-07) showed "moderate" effects experiencing daily WSE fluctuations up to 2.3 feet, but 1.5 feet or less over 70% of days during the breeding period.

At the Stebbins Island site, the only site where Fowler's toad occurred, the modeled WSEs indicate "moderate" project effects. While water level fluctuations of more than 3 feet occurred more than 90% of days during the breeding season, the site's

topography and orientation tends to protect it from scour during non-flooding conditions, and it does not appear to entirely dewater except at low water levels and low flows. Given its location downstream of Vernon, these effects are likely due to Turners Falls operations more than Vernon discharge.

Table 6.2. Summary of water level fluctuations on suitable Fowler's toad habitat based on normal project operations.

| Site ID | Location | Relative Level of Project Effect |
|---|---|---|
| 28-01 | NHFG WMA | Large - during the breeding season the daily WSE fluctuation ranges from 0.0 to 7.5 feet and is >3 feet >90% of the modeled days within normal project operations. The features at this site where toads could breed would be essentially inundated daily, and directly impacted by river flows when inundated. |
| 28-02 | New England Wildflower Sanctuary | Large - during the breeding season the daily WSE fluctuation ranges from 0.6 to 7.5 feet and is >3 feet >90% of the modeled days within normal project operations. The features at this site where toads could breed would be essentially inundated daily, and directly impacted by river flows when inundated. |
| 28-03 | Hart Island Backwater | Large - during the breeding season the daily WSE fluctuation ranges from 0.2 to 5.9 feet and is >3 feet >90% of the modeled days within normal project operations. The features at this site where toads could breed would be essentially inundated daily, and directly impacted by river flows when inundated. |
| 28-05 | Bertalamy | Large (Moderate) - during the breeding season the daily WSE fluctuation ranges from 0.4 to 6.2 feet and is >3 feet >90% of the modeled days within normal project operations. The backwater closest to the river would be inundated daily, but additional features that could provide breeding habitat are buffered from direct river flows by river bank features. |
| 28-07 | Private docks | Moderate - during the breeding season the daily WSE fluctuation never exceeds 2.3 feet within normal project operations and is less than 1 ft 39% of modeled days. However, the features that could provide breeding habitat are directly connected to the Connecticut River and experience these moderate fluctuations unbuffered. |
| 28-15 | Stebbins Island | Moderate – during the breeding season the daily WSE fluctuation ranges from 0.2 to 6.6 feet, and is >3 feet >90% of the modeled days within normal project operations. However, the orientation of the backwater is unique and protects breeding habitat from river scour and its topography prevents drying at low flows. |

## 6.4 Study Conclusions

Periodic (every 5-15 years) high energy, high water events are needed to maintain suitable estivation and hibernation habitat for Fowler's toads on the Connecticut River. In the absence of major flood events, smaller daily WSE fluctuations can also create conditions that scour away litter and/or discourage vegetation from growing. However, these daily WSE fluctuations can also make otherwise physically suitable breeding pools unsuitable as toad eggs and tadpoles can be easily washed into the river by WSE fluctuations, where they will not survive.

Therefore, the best Fowler's toad habitat along the river is created in locations that are affected by large water fluctuations and high velocities due to flood flows, but during the breeding season, the adverse effects of scour and dewatering are buffered by the topography of the site. This type of WSE fluctuation regime is uncommon along the Connecticut River as a whole, but occurs at the one site (28-15) where Fowler's toad was confirmed present and, based on historical records, where the population is persistent.

Other study sites where Fowler's toad was not found also provide suitable habitat, and in some cases, protections from water level fluctuations (Site 28-05). Other sites with suitable habitat were determined to be outside of the project-affected range of WSEs under normal project operations (Site 28-04), not hydrologically connected to the Connecticut River (Site 28-14), outside the project-affected area (Site 28-12) or undetermined but likely more heavily influenced by tributary flows than normal project operations (Site 28-13).

There are a variety of other factors, alone or in combination, that could also contribute to low populations of Fowler's toad in the study area. These factors include flood control dams on tributaries to the Connecticut River, chemical use, tilling, increased traffic, and/or migration barriers that "may have limited available habitat for Fowler's toads, their access to it, and/or their ability to survive in it." [2] Fowler's toads are more sensitive than other toad species to insecticides, herbicides, lowered pH due to acid rain, mycobacterial and parasitic infections, as well as to weather extremes (cold without snow or drought).

[2] State of Vermont Species Status Review, 2012, as included in Appendix B of VANR's March 1, 2013 study request.

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# APPENDIX A

## Data Sheet for Direct Survey

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## Fowler's Toad Survey Protocol

Surveys are conducted as a three minute listening period at each survey point. Calls will be recorded as: 0 = no calling; 1 = non-overlapping calls; 2 = intermittently overlapping calls; 3 = continuously overlapping calls. All surveys will be conducted under the following conditions:

## Data Sheet

**Date** _____ **Surveyors** _____

| Point | Town | Begin Time | Water Temp | Air Temp | Wind | Precip | Fowler's Toad | Other Species | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
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# APPENDIX B

## Sample Sonograms of Fowler's Toad Calls

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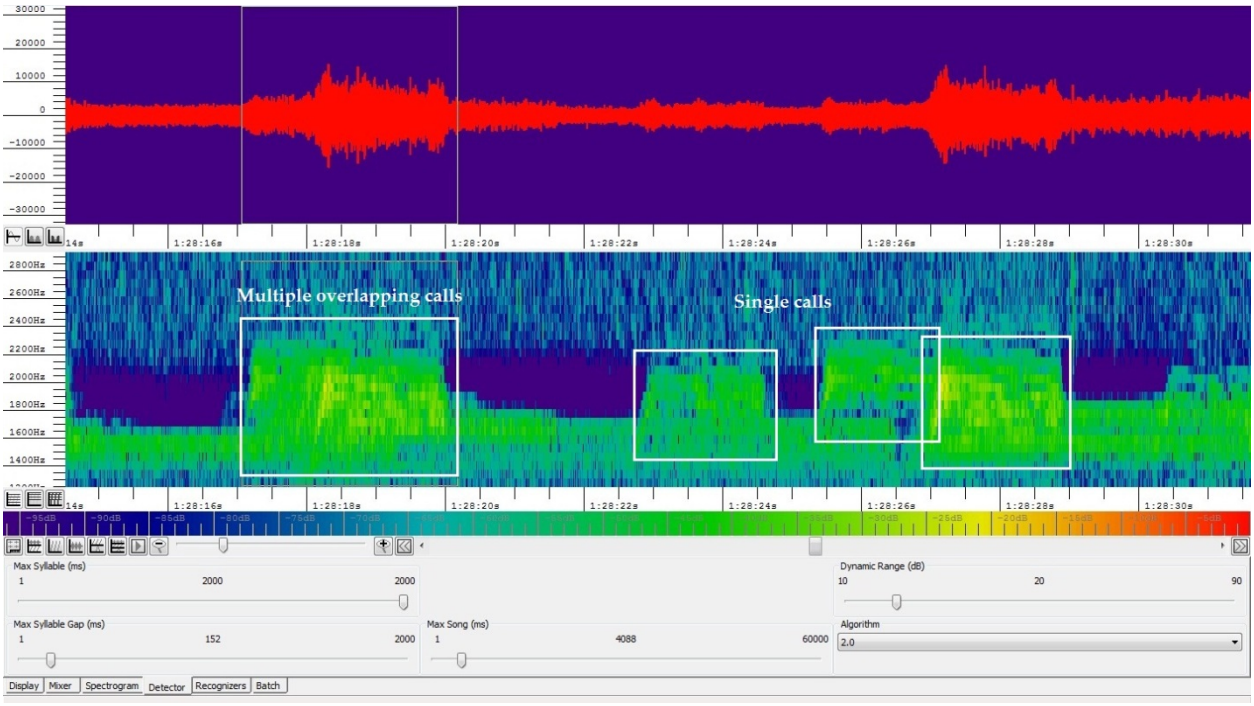


Figure B1. Fowler's toad calls – overlapping calls vs. single calls

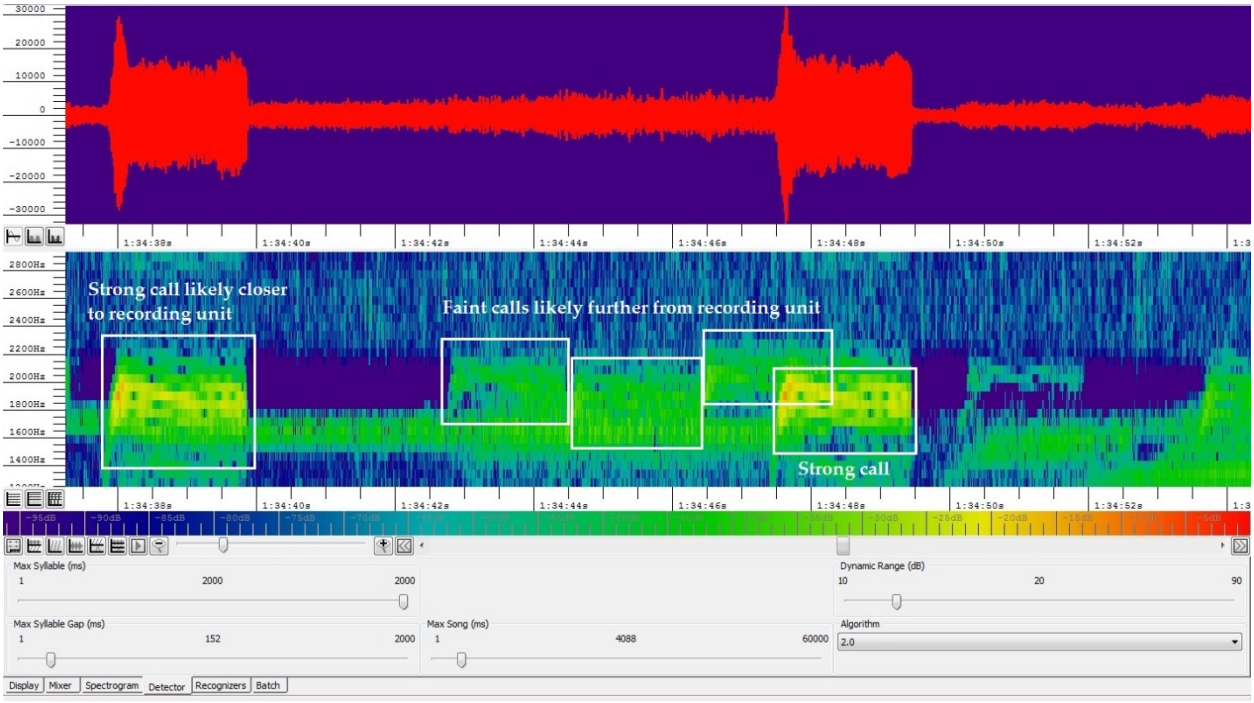


Figure B2. Fowler's toad calls – single calls from different distances.

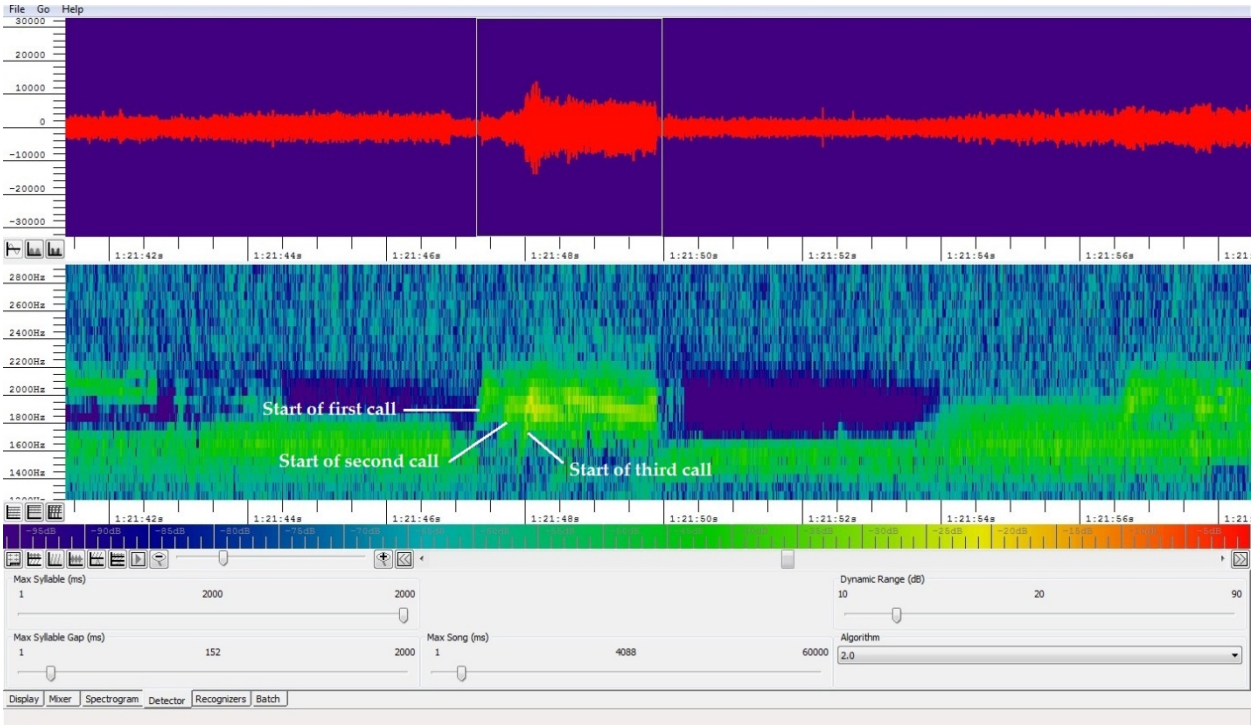


Figure B3. Fowler's toad calls – multiple overlapping calls.

# APPENDIX C

## Field Survey Site Coordinates – Privileged Information

## Not included in the Public Version of this Report