Baseflow and Baseline Water Quality Monitoring Program for Coldwater Fisheries

Sudbury to Hudson Reliability Project

AUGUST 2021

PREPARED FOR

Eversource Energy

PREPARED BY

SWCA Environmental Consultants

BASEFLOW AND BASELINE WATER QUALITY MONITORING PROGRAM FOR COLD WATER FISHERIES
SUDBURY TO HUDSON RELIABILITY PROJECT

Prepared for

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SWCA Project No. 67849

August 2021

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1 INTRODUCTION

The Sudbury to Hudson Reliability Project (Project) consists of a new, approximately 9-mile-long transmission line between Eversource's existing Sudbury substation in Sudbury, Massachusetts, and the Hudson Light & Power Company's (HL&P) substation in Hudson, Massachusetts. The new underground transmission line will be installed in the municipalities of Sudbury, Hudson, Stow, and Marlborough, Massachusetts. Approximately 7.5 miles of the new transmission line will be installed within an inactive Massachusetts Bay Transportation Authority (MBTA) railroad right-of-way (ROW) which is to be converted into the Massachusetts Central Rail Trail (MCRT).

Special Condition Part I(q) of the Sudbury Order of Conditions (OOC) for the Project requires baseline monitoring of flow and water quality for all Coldwater Fisheries Resources (CFR) crossed by the Project. SWCA has prepared this detailed water quality monitoring plan for the two (2) crossings of CFR in Hop Brook and six (6) other streams or tributaries that contribute to CFR and are crossed by the Project (see Figures).

The following eight streams will be included in this monitoring plan as requested by the Sudbury Conservation Commission:

- Hop Brook – Bridge 128 (400+30): Perennial Stream and State-listed CFR;
- Unnamed Stream (527+30): Intermittent Stream and local CFR;
- Dudley Brook (539+40): Perennial and local CFR;
- Unnamed intermittent stream (560+82): Intermittent and local CFR;
- Unnamed Intermittent stream (593+18): Intermittent and local CFR;
- Intermittent Tributary to Hop Brook (700+50 to 710+50): Intermittent and local CFR;
- Hop Brook (Bridge 127) (725+00): Perennial Stream and State-listed CFR; and
- Intermittent Tributary to Wash Brook (747+39): Intermittent and local CFR.

2 WATER QUALITY MONITORING PARAMETERS

In accordance with the Massachusetts Surface Water Quality Standards (SWQS) (314 CMR 4.00), CFRs have special designated criteria for dissolved oxygen and temperature. All other criteria are the same as those for warm water fisheries. Therefore, to be consistent with the focus of the SWQS for CFRs, we propose that the water quality monitoring program will generally consist of the following:

- temperature, dissolved oxygen, as well as pH, specific conductivity, and oxygen reduction potential (ORP) to be measured with a YSI multi-meter;
- turbidity levels to be measured with a turbidity meter; and
- chlorine, hardness and alkalinity to be measured with field test strips.

This exceeds the special parameters designated for CFRs under the Massachusetts Surface Water Quality Standards.

Stream velocity, which increases as the volume of the water in the stream increases, determines the kinds of organisms that can live in the stream. It also affects the amount of silt and sediment carried by the stream. Sediment introduced to quiet, slow-flowing streams will settle quickly to the stream bottom. Fast moving streams will keep sediment suspended longer in the water column. Because they are aerated better, fast-moving streams generally have higher levels of dissolved oxygen than slower streams. A comparison of the upstream flow velocity and the downstream flow velocity will be made to determine if a variance is present due to the Project. In ideal conditions, the variance would be less than 10%. The following Table 1 includes ranges that are favorable to cold water fisheries. Table 2 indicates ranges that are favorable for freshwater fish.

Table 1. Surface Water Conditions for Cold Water Fisheries

Parameter[1]	Favorable Ranges for Cold Water Fisheries
Temperature	below 20ºC (up to 26ºC for 24 hours)
Dissolved Oxygen	min of 6 mg/L, up to 7 mg/L preferred
pH	6.5 - 8.3

Note: C = Celsius; mg/L = milligrams per liter

Source:

1: 314 CMR 4.00: Massachusetts Surface Water Quality Standards

Table 2. Surface Water Conditions for Freshwater Fish

Parameter	Favorable Ranges for Freshwater Stream or Fish
Specific Conductivity[1]	150 - 500 µs/cm
Turbidity[2]	“free from turbidity that would impair fish habitat”
Chlorine[3]	<4 mg/L
Alkalinity[4,5]	20 - 300 mg/L

Note: ORP = oxygen reduction potential; mg/L = milligrams per liter; µs/cm = microsiemens per centimeter; mV = millivolts

Sources:

1: EPA Volunteer Stream Monitoring: A Methods Manual

2: 314 CMR 4.00: Massachusetts Surface Water Quality Standards

3: EPA National Primary Drinking Water Regulations

4: UMass Dartmouth Northeast Regional Aquaculture Center NRAC Fact Sheet No. 170-1993.

5: EPA National Recommended Water Quality Criteria for Aquatic Life.

SWCA will also collect surface water samples for laboratory analyses of total nitrogen and phosphorous from Hop Brook at both bridge crossings with the Project.

3 MONITORING SCHEDULE

Water quality parameters will be measured at each of the eight stream locations monthly from August 2021 to November 2023 (27 months total). This range will allow for both pre-construction and construction phase measurements of water quality at each sampling location. , The laboratory analyses of the surface water of Hop Brook at both crossings will be conducted once prior to construction and once immediately after construction is complete.

Temperature and dissolved oxygen can fluctuate naturally when the sun rises and enables aquatic plants to release more oxygen. Sampling will be conducted during the same time of day at each

location each month to help ensure comparability over time. It is necessary to avoid sampling during periods of heavy rain or significant storm events, but each sampling event will be performed as close to 30 days apart as possible.

The laboratory analyses of surface water samples will take place once during pre-construction and once immediately post-construction, at the same time as the water quality monitoring events.

4 METHODOLOGY

4.1 General Methods

Water quality parameters will be measured at 16 established sampling locations: one immediately upstream and one immediately downstream of the Project's construction workspace at each of the eight (8) streams crossed by the Project in Sudbury (see Figures). All sample locations will be located within the confines of the limits of the existing MBTA right-of-way. This will allow a more accurate assessment of the construction impacts on the water quality for all CFRs crossed by the Project. Each sampling location has been identified, flagged, and GPS-located for identification and report mapping. The nature and proximity of construction activities to each sampling location will be noted at each sampling event.

The sample will be collected from as close as possible to the center of the channel and at the same location each month. A flag will be placed on the edge of the bank to identify the location of the sample to ensure consistency. Note that of the 8 streams to be monitored in Sudbury, five are intermittent in nature. If an individual stream is dry or if the water is observed to be stagnant during the time of a monitoring event, a water quality sample will not be taken.

The following Table 3 includes the sampling locations with station numbers for identification.

Table 3. Surface Water Sampling Locations

Station No.	Brook/Stream/Tributary	Direction of Flow	Flow Regime Type	State Listed or Local CFR
ST 400 DOWN	Hop Brook	north	perennial	State Listed CFR
ST 400 UP	Hop Brook	north	perennial	State Listed CFR
ST 527 DOWN	Unnamed Stream	south	intermittent	Local only
ST 527 UP	Unnamed Stream	south	intermittent	Local only
ST 540 DOWN	Dudley Brook	north	perennial	Local only
ST 540 UP	Dudley Brook	north	perennial	Local only
ST 561 DOWN	Unnamed Stream	north	intermittent	Local only
ST 561 UP	Unnamed Stream	north	intermittent	Local only
ST 593 DOWN	Unnamed Stream	north	intermittent	Local only
ST 593 UP	Unnamed Stream	north	intermittent	Local only
ST 700 UP	Hop Brook Tributary	east	intermittent	Local only
ST 710 DOWN	Hop Brook Tributary	east	intermittent	Local only
ST 725 UP	Hop Brook	south	perennial	State Listed CFR
ST 725 DOWN	Hop Brook	south	perennial	State Listed CFR
ST 747 DOWN	Wash Brook Tributary	south	intermittent	Local only

Station No.	Brook/Stream/Tributary	Direction of Flow	Flow Regime Type	State Listed or Local CFR
ST 747 UP	Wash Brook Tributary	south	intermittent	Local only

4.2 Sample Collection

If the stream is moving too fast or is too deep to enter safely, a rod or string connected to a sampling container will be utilized to collect each sample from the bank. If the field technician is able to enter the stream to collect the sample, they will wait until any disturbed sediments have settled and position themselves downstream of the container before collecting the sample. Stream water will be used to rinse the sampling container twice before each sample is collected. To collect the sample, the container will be turned upside down and submerged into the water at a depth of 8 to 12 inches below the surface. If the stream reach is less than 16 inches deep, the sample will be collected mid-way between the surface and the bottom. Once submerged to the correct depth, the container will be turned over towards the upstream direction slowly, to prevent creating any turbulence or air bubbles.

For the laboratory analyses events, a sample for nitrogen and phosphorous will each be collected at the upgradient and downgradient side of the project within the surface water of Hop Brook in two locations for a total of four samples collected each round. The samples will be collected utilizing the sampling rod or string to collect a surface water sample from the middle of the channel. The samples will be placed from the sample container into pre-cleaned laboratory containers, labeled, logged and submitted to a Massachusetts certified analytical laboratory for analysis within 48 hours of collection. If the sample bottles contain preservative, care will be taken to not overfill the sample bottle.

If feasible, the YSI meter will be submerged directly into the stream at the proper depth to collect this data. If the stream is too shallow or inaccessible, the sample collected in the container will also be used to measure YSI data. If the sample results appear to be out of a normal range, the sample will be recollected for confirmation.

The reused sample collection bucket will be cleaned and rinsed 3 times with distilled or deionized water between each sampling event. The field technician will wear nitrile gloves during the sampling and cleaning activities. The sampling results will be recorded in a field log attached as Appendix A.

4.3 Field Sampling Parameters

The YSI water meter sensors, except temperature, require periodic calibration to assure high performance. Reagents predefined with standard values are used to calibrate the sensors. The key to successful calibration is to ensure that the sensors are completely submerged when calibration values are entered. The calibration will take place prior to each monthly monitoring event.

YSI water quality measurements will be conducted directly from the sampling container as soon as possible to avoid the sample being affected by the outside temperature. The sample will be left to equilibrate before a reading of temperature, specific conductance, dissolved oxygen, pH and ORP is taken with the YSI meter. If an equilibrium state is not reached within 3 minutes from when the probe was submerged, the reading after 3 minutes will be recorded. After the reading is complete, surface water from the sampling container will be utilized to collect chlorine, hardness and alkalinity data. Field test strips will be submerged into the sampling container for measurement reading.

Temperature in a stream will vary with width and depth. It can be significantly different in the shaded portion of the water on a sunny day. In a small stream, the temperature will be relatively constant if the stream is uniformly in sun or shade. In a large stream, temperature can vary considerably with width and depth regardless of shade. If it is safe to do so, temperature measurements will be collected at varying depths and across the surface of the stream to obtain vertical and horizontal temperature profiles. This would be done at each site at least once to determine the necessity of collecting a profile during each sampling visit. Temperature will be measured at the same place during each sampling event.

To measure turbidity, a clean, dry sample vial included with the turbidity meter will be filled with water from the sampling container. The turbidity meter will be calibrated and tested in the office prior to use in the field. Samples should be measured immediately to prevent changes in particle characteristics due to temperature and settling. Temperature can affect particles by changing their behavior or creating new particles if precipitates are formed. Sample vials should always be handled from the top or by the cap to avoid fingerprints or smudges. Condensation may appear on the vial when the sample is very cold and the relative air humidity is high. When this happens, the turbidity that is read may be higher than the actual turbidity due to the light scattered by the condensate on the vial. A lint-free cloth can may used to wipe the outside of the vial prior to insertion into the meter to ensure that its surface is clear of any obstruction. Samples will not be violently shaken or agitated as particles can be broken apart or air may be entrapped into the fluid. Gentle agitation such as swirling the sample vial will be conducted to reduce particle settling and to remove bubbles. The meter will be placed on a flat and level surface before the vial is inserted. The mark on the vial must be aligned to the meter upon insertion. Once the vial is fully snapped in, the meter will be turned on and the turbidity is reported in Nephelometric Turbidity Units (NTU).

Stream flow velocity will be calculated using a portable velocity meter with a 20-foot cable. Measurements will be taken as close to the middle of the column of water as is possible. Waders may be required for streams with larger widths to measure the flow velocity as close to the center of the stream as possible. The velocity meter can measure up to 20 feet per second (fps) with an accuracy of 2-4% of the reading depending on the velocity.

4.4 Required Equipment

The following equipment will be used for the proposed field effort:

- YSI Water Quality Meter
- Hach FH950 Portable Velocity Meter
- Hach Portable Turbidity Meter
- Hach 5 in 1 Water Quality Test Strips
- Waders/Muck Boots
- Sampling Collector Cup
- Sampling containers provided by laboratory
- Distilled water
- Nitrile gloves
- Field log

5 REPORTING SCHEDULE

Special Condition Part I(q) of the Sudbury OOC requires reporting of the results of the water quality monitoring program for CFRs. A summary memo of the pre-construction monitoring will be provided in September of 2021. Each month, the summary of the data collected in the previous month will be provided as field logs within the progress reports. Within one month of the completion of construction, SWCA will prepare and submit a final water quality monitoring report detailing the methods and results (both in tabular and narrative format) of the water quality monitoring program. The report will compare pre-construction water quality results with construction-phase water quality results in addition to the upstream and downstream monitoring results.

6 REFERENCES

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APPENDIX A

Figures Map Book

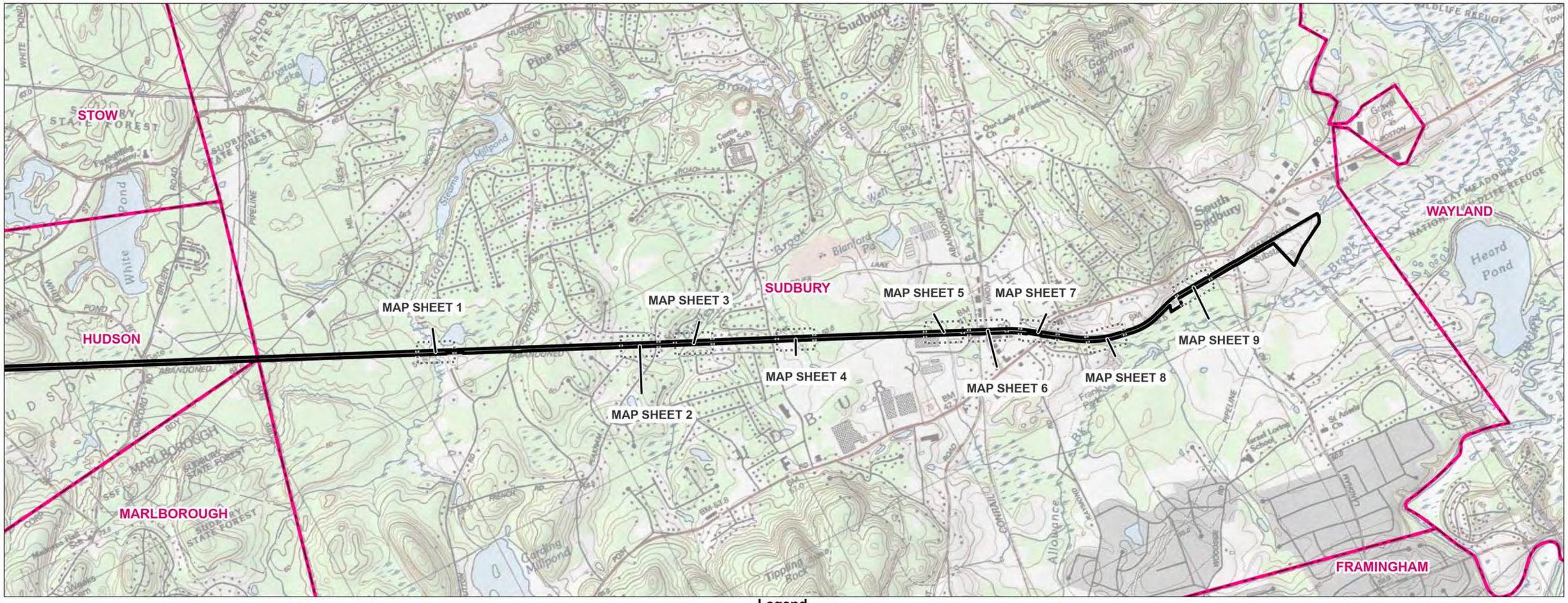
2021 - Sudbury Hudson Reliability Project

HUDSON, STOW, & SUDBURY, MA

Water Sampling Map

DRAFT Map Set

Date: August 11, 2021



Legend

Map Sheet Matchline

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0 0.25 0.5 Miles

INDEX OF FIGURES

Title Sheet / Index Map

Map Sheets 1-9

NO.	DATE	REVISIONS

PREPARED FOR:

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Berlin, CT 06037

PREPARED BY:

SWCA ENVIRONMENTAL CONSULTANTS

15 Research Drive

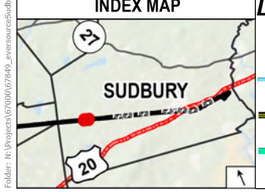
Amherst, MA 01002

SUDBURY

ST-400-D

ST-400-U

INDEX MAP



Legend

- Water Sampling Point
- Watercourse
- Limit Of Work (LOW)
- Coldwater Fisheries Line
- Open Water
- Approximate Wetland (Not Delineated)
- Existing Right-of-Way (ROW)
- Municipal Boundary

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Base Map: MassGIS Ortho 2019, accessed August 2021

NO.	DATE	REVISIONS

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Sudbury Hudson Reliability Project
Water Sampling Map

SUDBURY, MA

MAP SHEET 1 OF 9

Date: August, 2021

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ST-527-U

ST-527-D

SUDBURY

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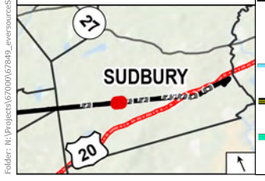

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Sudbury Hudson Reliability Project
Water Sampling Map

SUDBURY, MA | MAP SHEET 2 OF 9

Date: August, 2021

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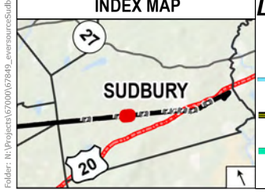
DUDLEY BROOK

ST-540-D

ST-540-U

SUDBURY

INDEX MAP



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Sudbury Hudson Reliability Project
Water Sampling Map

SUDBURY, MA

MAP SHEET 3 OF 9

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ST-561-D

ST-561-U

SUDBURY

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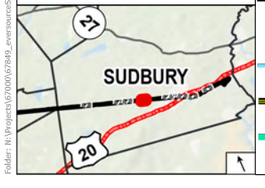

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Sudbury Hudson Reliability Project
Water Sampling Map

SUDBURY, MA | MAP SHEET 4 OF 9

Date: August, 2021

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SUDBURY

ST-593-U

ST-593-D

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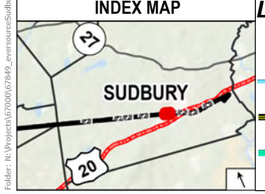

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Sudbury Hudson Reliability Project
Water Sampling Map

SUDBURY, MA | MAP SHEET 5 OF 9

Date: August, 2021

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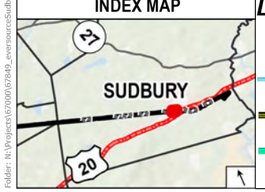
INDEX MAP



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Sudbury Hudson Reliability Project
Water Sampling Map

SUDBURY, MA | MAP SHEET 6 OF 9

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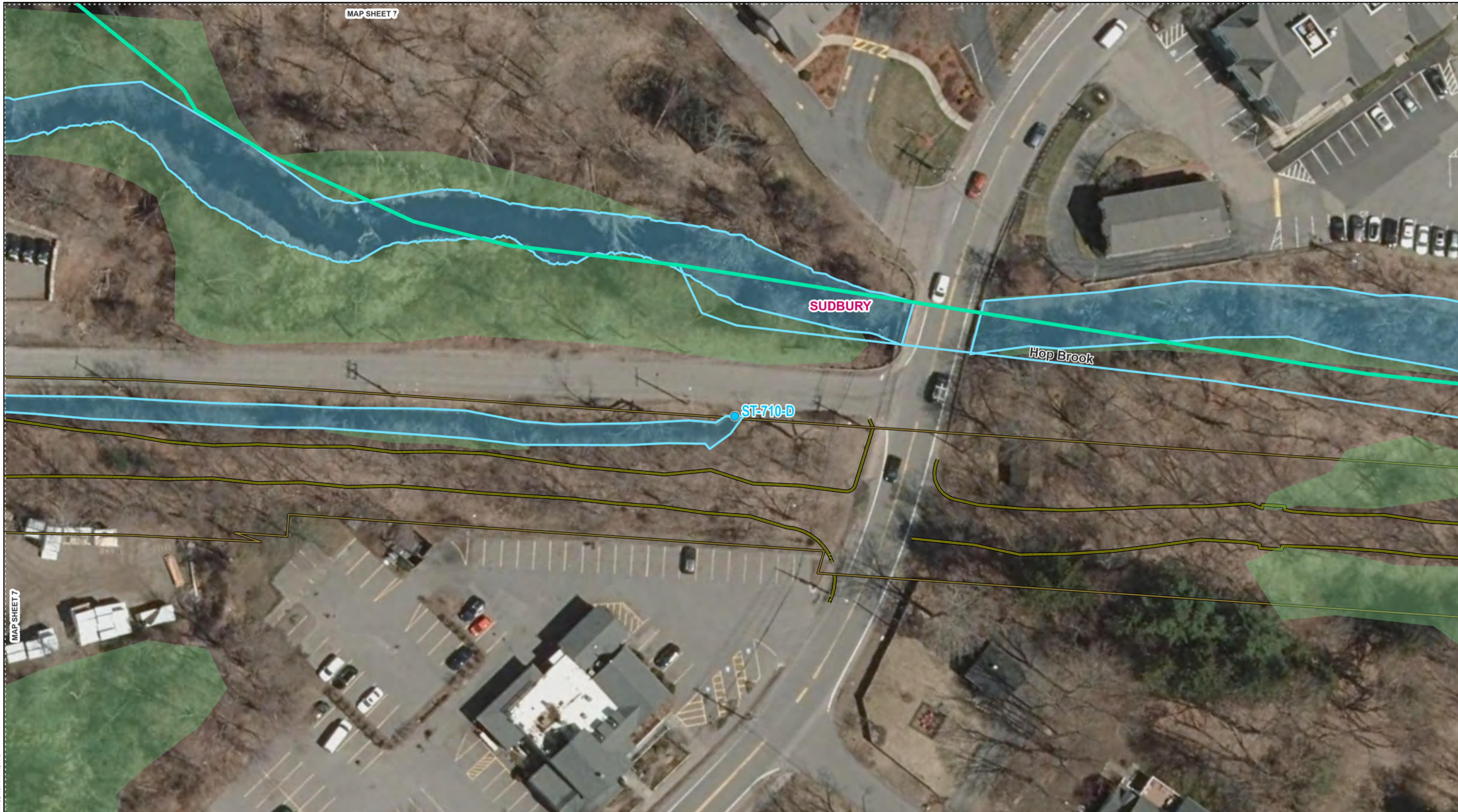

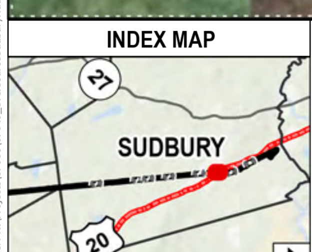

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Sudbury Hudson Reliability Project
Water Sampling Map

SUDBURY, MA

MAP SHEET 7 OF 9

Date: August, 2021

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Hop Brook

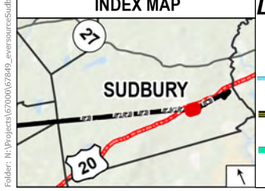
ST-725-U

ST-725-D

SUDBURY

MAP SHEET 8

INDEX MAP



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Sudbury Hudson Reliability Project
Water Sampling Map

SUDBURY, MA

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Date: August, 2021

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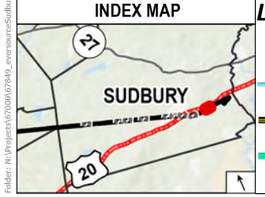
SUDBURY

ST-747-U

ST-747-D

INDEX MAP



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NO.	DATE	REVISIONS

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Sudbury Hudson Reliability Project
Water Sampling Map

SUDBURY, MA

MAP SHEET 9 OF 9

Date: August, 2021

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APPENDIX B

Field Log

SWCA®
ENVIRONMENTAL CONSULTANTS

CWF Monitoring Field Log

Project Name / #	Sudbury to Hudson Reliability Project	Stream ID and Station #	

Weather and Temp		Technician		Date	

Upgradient Station

Flow Velocity	Flow Measurement Depth	Flow Appearance/Color	Flow Odor	Field Measurements	
		☐ Clear	☐ None	Temperature	
		☐ Cloudy/Milky	☐ Chemical	Specific Conductance	
Location		☐ Dark (Tea)	☐ Petroleum	Dissolved Oxygen	
Sampling site	Pool Riffle Open Channel Braided Backwater	☐ Sheen	☐ Sewage	pH	
Signs of Flow	Present- Fast Present- Slow Not Seen	☐ Suspended sediment	☐ Rotten Eggs	ORP	
Floatables	Foam Oil Sheen Floating Solids	☐ Reddish	☐ Sour	Turbidity	
Sampling site	Pool Riffle Open Channel Braided Backwater	☐ Yellow	☐ Other	Alkalinity	
Condition of bottom	Bedrock Cobble Gravel Sand Mud/Fines Other			Chlorine Free	
Comments				Chlorine Total	
				Hardness	

Downgradient Station

Flow Velocity	Flow Measurement Depth	Flow Appearance/Color	Flow Odor	Field Measurements	
		☐ Clear	☐ None	Temperature	
		☐ Cloudy/Milky	☐ Chemical	Specific Conductance	
Location		☐ Dark (Tea)	☐ Petroleum	Dissolved Oxygen	
Sampling site	Pool Riffle Open Channel Braided Backwater	☐ Sheen	☐ Sewage	pH	
Signs of Flow	Present- Fast Present- Slow Not Seen	☐ Suspended sediment	☐ Rotten Eggs	ORP	
Floatables	Foam Oil Sheen Floating Solids	☐ Reddish	☐ Sour	Turbidity	
Sampling site	Pool Riffle Open Channel Braided Backwater	☐ Yellow	☐ Other	Alkalinity	
Condition of bottom	Bedrock Cobble Gravel Sand Mud/Fines Other			Chlorine Free	
Comments				Chlorine Total	
				Hardness	