

To: Michael J. Hager

Date: August 25, 2021

From: Shanta B. Keller, PE
Katie Kinsella, PWS

Re: Sudbury to Hudson Transmission Reliability and Mass Central
Rail Trail Project
MassDEP File # 301-1287
Inspection of Culverts and Drainage Structures– Town of
Sudbury, Massachusetts

In accordance with Special Condition d. in Part II: Conditions Specific to Phase I: Eversource Underground Transmission Line, VHB performed a visual inspection of the 15 culverts and drainage structures (“structures”) within the Project Site in Sudbury to determine “whether they are structurally sound to (a) function hydrologically, (b) withstand the planned construction activities, and (c) evaluate their wildlife migration functions.” Based on our assessment of the structures, it is our professional opinion that the conditions are consistent with the inspection completed in March 2017 (and reported in the subsequent memorandum dated 5/31/2017), and that all structures except for those proposed to be replaced can withstand the planned construction activities, and they will not be diminished structurally or hydraulically with the proposed construction activities. In addition, the proposed construction activities will not impair or negatively affect each structure’s existing capacity to continue to provide corridors for wildlife movement.

The structures were evaluated to determine whether the planned construction activities could have a significant adverse impact on their integrity. The anticipated loading from proposed construction activities is less than that of the railroad loading for which the culverts were designed. If no major structural deficiencies or signs of imminent failure were observed, it can safely be assumed that the structures will not be adversely affected during construction. The original culvert evaluation memorandum dated 5/31/2017 describes the structures’ conditions as of the March 2017 inspections and informed which structures are candidates for modification or replacement during the subsequent design of the corridor. This memorandum describes the structures’ conditions as of the July 2021 inspections and confirms that no changes in structural condition were observed at any of the structures. The recommendations made in the 2017 memorandum and the proposed construction shown on the project design plans remain consistent. If the existing structures are damaged during construction, they shall be repaired by the Contractor in accordance with any applicable permits.

The evaluation of wildlife habitat passage was based on potential usage by wildlife by size of the opening. There is no evidence that proves the structures are currently being utilized and the evaluation did not include studying wildlife passage movements through or around the structures. In addition, post-construction wildlife habitat passage was evaluated by determining whether a culvert or drainage pipe would be replaced or improved (e.g., removing sediment), which could improve existing passage.

The hydraulic capacity of each existing structure to remain will be equal to the existing conditions, and the proposed work will not adversely impact hydraulic function of the culverts. Hydrology of the project has been studied and designed as part of the stormwater design and permitting efforts.

The following tables summarize the results from the initial 2017 inspection, the supplemental structural and wildlife passage inspections completed on July 8 and July 14, 2021, and the proposed work, if any, followed by photos of the structures.

Structure 129A

Structure ID	129A
Station	368+84
Plan Sheet	44
Type	Drainage Structure
Size/Material	2'x2.5' Stone Box, Metal Pipe at North End
Existing Ground Cover	8.2 feet
2017 Inspection Results	South end partially collapsed; north end not found. Appears clear inside 10 ft. in from south end.
2021 Inspection Results	Structural: North end found; both structure ends partially collapsed. No evidence of instability in interior or slopes. The proposed work is not anticipated to have an adverse impact on the existing structure.
	Wildlife Passage: Existing potential passage for amphibians and small mammals. The existing potential passage capabilities for amphibians and small mammals will be retained post-construction.
Work Proposed	No work is proposed to the existing drainage structure.



View of southern end of Structure 129A



View of southern end of Structure 129A with limited wildlife passage



View of northern end of Structure 129A



View of northern end of Structure 129A with limited wildlife passage

Structure 127J

Structure ID	127J
Station	410+25
Plan Sheet	48
Type	Drainage Structure
Size/Material	2'x2' Stone Box
Existing Ground Cover	8.1 feet
2017 Inspection Results	South headwall and wingwall partial collapse; north end total collapse. Running water audible.
2021 Inspection Results	<p>Structural: South headwall and wingwall partial collapse; north end total collapse. No imminent failure mechanisms or changed structural conditions since 2017 were observed. The proposed work is not anticipated to have an adverse impact on the existing structure.</p> <p>Wildlife Passage: No existing wildlife passage capabilities because the north side is buried.</p>
Work Proposed	No work is proposed to the existing drainage structure.



View of southern end of Structure 127J



View of southern end of Structure 127J



View through Structure 127J from southern end



Possible portion of buried pipe and headwall of northern end of Structure 127J

Structure 127I

Structure ID	127I
Station	517+96
Plan Sheet	51
Type	Culvert
Size/Material	1'x2' Stone Box
Existing Ground Cover	8.1 feet
2017 Inspection Results	South headwall collapsed; north end partially filled with debris. Water visibly flowing.
2021 Inspection Results	Structural: South headwall collapsed; north end partially filled with debris. Water was observed flowing through both ends of the culvert. No imminent failure mechanisms or changed structural conditions since 2017 were observed. The proposed work is not anticipated to have an adverse impact on the existing structure.
	Wildlife Passage: Existing condition allows potential passage for amphibians and small mammals. Clearing out the debris will improve potential passage capabilities for amphibians and small mammals.
Work Proposed	The Contractor shall clear out debris in the north end by hand. The existing structure will remain.



View of southern end of Structure 1271



View of northern end of Structure 1271



Alternate view of northern end of Structure 1271



View through Structure 1271 from the northern end

Structure 127H

Structure ID	127H
Station	521+64
Plan Sheet	51
Type	Drainage Structure
Size/Material	1.5'x3' Stone Box
Existing Ground Cover	10.6 feet
2017 Inspection Results	South end in fair condition but trees located on headwall; north headwall partially collapsed. Clear all the way through.
2021 Inspection Results	Structural: South end in fair condition but trees located on headwall; north headwall partially collapsed. No imminent failure mechanisms or changed structural conditions since 2017 were observed. The proposed work is not anticipated to have an adverse impact on the existing structure.
	Wildlife Passage: Existing condition allows potential passage for amphibians and small mammals. The existing wildlife passage capabilities for amphibians and small mammals will be retained.
Work Proposed	Two approximately 12"-diameter trees will be cut and removed because they are causing wingwall damage; no grubbing will occur. The existing structure will be retained.



View of southern end of Structure 127H



View through southern end of Structure 127H; light through the northern end is visible



View of northern end of Structure 127H



View through northern end of Structure 127H; light through the southern end is visible

Structure 127G

Structure ID	127G
Station	527+30
Plan Sheet	52
Type	Culvert
Size/Material	2'x2' Stone Box
Existing Ground Cover	13.4 feet
2017 Inspection Results	South end in fair condition; north bulged from trees. Clear all the way through.
2021 Inspection Results	Structural: South end in fair condition; north bulged from trees. Clear all the way through. No imminent failure mechanisms or changed structural conditions since 2017 were observed. The proposed work is not anticipated to have an adverse impact on the existing structure.
	Wildlife Passage: Existing condition allows the for potential passage for amphibians and small mammals. The potential passage capabilities for amphibians and small mammals will be retained.
Work Proposed	The culvert will be retained. No work is proposed to existing structure.



View of southern end of Structure 127G. Small window of daylight visible at northern end.



View of northern end of Structure 127G; most of culvert was submerged at time of the inspection



View of headwall at northern end and embankment.



Headwall at northern end has shifted outward.

Structure 127F

Structure ID	127F (Dudley Brook)
Station	539+40
Plan Sheet	54
Type	Culvert
Size/Material	Two 36" Corrugated Metal Pipes, presumably lining original stone boxes
Existing Ground Cover	8.9 feet
2017 Inspection Results	South wingwalls partially collapsed; north wingwalls and headwalls in fair condition. Both ends of pipes heavily corroded. Clear all the way through; interior in fair condition.
2021 Inspection Results	<p>Structural: South wingwalls partially collapsed; north wingwalls and headwalls in fair condition. Both ends of pipes heavily corroded. Clear all the way through; interior in fair condition. No imminent failure mechanisms or changed structural conditions since 2017 were observed. The proposed work is not anticipated to have an adverse impact on the existing structure.</p> <p>Wildlife Passage: The existing two 36-inch pipes allows potential passage for amphibians and small and medium mammals. The potential passage capabilities for amphibians and small and medium mammals will be retained.</p>
Work Proposed	The existing structures will be retained. No work is proposed to the existing structures.



View of southern end of Structure 127F from western bank



View of southern end of Structure 127F from eastern bank



View of northern end of Structure 127F from western bank



View of northern end of Structure 127F from eastern bank

Structure 127E

Structure ID	127E
Station	560+82
Plan Sheet	57
Type	Culvert
Size/Material	3'x2' Concrete Box
Existing Ground Cover	7.5 feet
2017 Inspection Results	Both concrete ends and headwalls have concrete spalling. Clear all the way through. Interior appears to be stone.
2021 Inspection Results	Structural: Both ends and headwalls have concrete spalling. Clear all the way through. No imminent failure mechanisms or changed structural conditions since 2017 were observed. The proposed work is not anticipated to have an adverse impact on the existing structure.
	Wildlife Passage: Both sides are completely open, allowing for potential passage for amphibians and small and medium mammals. The potential passage capabilities for amphibians and small mammals will be retained.
Work Proposed	The culvert will be retained. No work is proposed to the existing structure.



View of southern end of Structure 127E



View through southern end of Structure 127E; visible straight through culvert



View of northern end of Structure 127E



View through northern end of Structure 127E; visible straight through culvert

Structure 127D

Structure ID	127D
Station	577+31
Plan Sheet	58
Type	Drainage Structure
Size/Material	1'x2' Stone Box
Existing Ground Cover	6.7 feet
2017 Inspection Results	South end not found; north headwall mostly buried.
2021 Inspection Results	Structural: Both ends mostly buried. No changed structural conditions since 2017 were observed. The proposed work is not anticipated to have an adverse impact on the existing structure.
	Wildlife Passage: No existing wildlife passage potential because the north and south headwalls are buried.
Work Proposed	The drainage structure will be retained. No work is proposed to the existing structure.



View of north end of Structure 127D



Alternate view of northern end of Structure 127D

Structure 127C

Structure ID	127C
Station	593+18
Plan Sheet	59
Type	Culvert
Size/Material	2'x2' Stone Box
Existing Ground Cover	3.9 feet
2017 Inspection Results	South end filled with dirt; north end not found. Interior in fair condition.
2021 Inspection Results	<p>Structural: No imminent failure mechanisms or changed structural conditions since 2017 were observed. The north end was found, partially buried. South end filled with dirt. Interior in fair condition. The proposed work is not anticipated to have an adverse impact on the existing structure.</p> <p>Wildlife Passage: Both ends allow for potential passage for small amphibians only. The buried condition of both ends of the pipe restricts potential passage for mammals. The potential passage capabilities for small amphibians will be retained.</p>
Work Proposed	The culvert structure will be retained. No work is proposed to the existing structure.



View of south end of Structure 127C



Debris at buried south opening



View of north end of Structure 127C



View inside north end of pipe

Structure 127B

Structure ID	127B
Station	704+56
Plan Sheet	62
Type	Drainage Structure
Size/Material	24" Cast Iron Pipe
Existing Ground Cover	3.0 feet
2017 Inspection Results	South end appears to be catch basin in lumber yard; north end bell end chipped.
2021 Inspection Results	<p>Structural: South end inlet within lumber yard; north end bell end chipped. No imminent failure mechanisms or changed structural conditions since 2017 were observed. The proposed work is not anticipated to have an adverse impact on the existing structure.</p> <p>Wildlife Passage: The southern end of the drainage structure is an inlet within a fenced lumber yard parking lot and, given its location within a developed area, the structure not likely to serve as a wildlife corridor and provides limited to no wildlife passage. Existing wildlife passage, if any, will remain.</p>
Work Proposed	Transmission line will be installed beneath drainage structure. No work is proposed to the existing structure.



North end (outlet) of Structure 127B



Looking through the pipe from the north side to the south side



North end and embankment



Unable to locate south end (inlet) at lumber yard parking lot.

Structure 127A

Structure ID	127A
Station	713+63
Plan Sheet	64
Type	Drainage Structure
Size/Material	24" Cast Iron to be replaced with 24" Ductile Iron Pipe
Existing Ground Cover	1.9 feet
2017 Inspection Results	Lined with metal pipe, resulting in 19-in. pipe opening. Mostly filled with dirt. At south end original pipe broken and liner pipe heavily corroded; minor corrosion of liner pipe at north end.
2021 Inspection Results	<p>Structural: No changed structural conditions since 2017. Mostly filled with dirt; south end original pipe broken; liner pipe heavily corroded. Minor corrosion of liner pipe at north end. Structure will be removed and replaced.</p> <p>Wildlife Passage: Existing pipe provides potential for passage for amphibians and small mammals. Replacing the pipe will improve potential passage capabilities for amphibians and small mammals.</p>
Work Proposed	The drainage structure will be replaced with a 24" ductile iron pipe with concrete headwall.



South End and embankment



Looking through southern end of the pipe



North end and embankment



Looking through the northern end of the pipe

Structure 126D

Structure ID	126D
Station	738+77
Plan Sheet	66
Type	Drainage Structure
Size/Material	18" Cast Iron will be replaced with 18" Ductile Iron Pipe
Existing Ground Cover	2.8 feet
2017 Inspection Results	South end broken and half filled with dirt; north end broken and buried.
2021 Inspection Results	Structural: No changed structural condition since 2017. South end broken and filled with dirt; north end broken and partially buried. Structure will be removed and replaced.
	Wildlife Passage: Existing pipe provides potential passage for amphibians and small mammals. Replacing the structure will improve potential passage capabilities for amphibians and small mammals.
Work Proposed	The drainage structure will be replaced with an 18" ductile iron pipe with concrete headwall.



Looking down at southern end of pipe



Close up view of southern end of pipe



Northern end of pipe



View through northern end of pipe

Structure 126B

Structure ID	126B
Station	747+39
Plan Sheet	67
Type	Culvert
Size/Material	18" Cast Iron
Existing Ground Cover	5.9 feet
2017 Inspection Results	North headwall bulged due to vegetation. Clear all the way through.
2021 Inspection Results	<p>Structural: No imminent failure mechanisms or changed structural conditions since 2017 were observed. North headwall bulged due to vegetation. Clear all the way through. The proposed work is not anticipated to have an adverse impact on the existing structure.</p> <p>Wildlife Passage: Existing culvert provides potential passage for amphibians and small and medium mammals. The existing potential passage capabilities for amphibians and small and medium mammals will be retained.</p>
Work Proposed	Vegetation on the northeast wingwall will be cut and removed; no grubbing will occur. The culvert will be retained. No work is proposed to the existing structure.



South (outlet) end



Looking through stone culvert from the north side to the south side



North (inlet) end and embankment



Bulging and missing stones at north headwall due to vegetation growth

Structure 126A

Structure ID	126A
Station	752+17
Plan Sheet	67
Type	Drainage Pipe
Size/Material	12" Corrugated Metal
Existing Ground Cover	4.9 feet
2017 Inspection Results	Half full of sediment. Both ends in fair condition.
2021 Inspection Results	<p>Structural: Half full of sediment; both ends in fair condition. No imminent failure mechanisms or changed structural conditions since 2017 were observed. The proposed work is not anticipated to have an adverse impact on the existing structure.</p> <p>Wildlife Passage: Existing pipe provides potential passage for amphibians and small mammals. The sediment will be cleared out of the drainage pipe by hand, improving potential passage capabilities for amphibians and small mammals.</p>
Work Proposed	The drainage structure will be retained, and no work is proposed to the existing structure.



South end of culvert, partially filled with sediment. Sediment will be removed.



View through culvert from south end



North end of culvert and embankment



View of the inside of culvert from the north end.

Structure 125B

Structure ID	125B
Station	764+60
Plan Sheet	69
Type	Drainage Pipe
Size/Material	12" Reinforced Concrete Pipe
Existing Ground Cover	2.8 feet
2017 Inspection Results	Completely buried; north end under vernal pool.
2021 Inspection Results	<p>Structural: The existing structure could not be observed, but there is no evidence of recent or imminent structural failures or settlement. The proposed work is not anticipated to have an adverse impact on the existing buried structure.</p> <p>Wildlife Passage: Existing pipe is buried and does not provide any potential passage.</p>
Work Proposed	The existing pipe will be extended to the south to maintain vernal pool hydrology.



View near south end of culvert. Unable to locate inlet or outlet.



View of south embankment.