

Bridge Assessment and Ranking

Town of Lunenburg, MA

May 2024

PREPARED FOR

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CHAPTER 1: INTRODUCTION

1.1 SUBCHAPTER 1.1

The purpose of this report is to provide the Town of Lunenburg with a greater understanding of the bridges and culverts owned by the community. This report also provides the town with specific information on their structures, how they became deficient, and steps to prevent further deterioration. This report and priority ranking gives Lunenburg options for preventative maintenance, repairs, and possible replacement of their municipally owned bridges and culverts. There are 30 bridges and numerous culverts within town limits, of these 28 are municipally owned structures. Included in the 28 municipally owned structures are several culverts that are not currently included in MassDOT's inspection database. BSC has ranked the six most critical bridges and culverts.

The bridges and culverts chosen for this study were evaluated by their structural deficiencies, span lengths, school bus routes, emergency services, and importance to the residents and businesses of the community. The 6 chosen structures were priority ranked 1-6, with 1 being the most critical to the town's needs and the degree of structural deficiencies.

BSC reviewed available information on all the municipally owned structures consisting of MassDOT inspection and BSC's own field evaluation. Under federal guidelines, bridges with spans greater than or equal to 20'-0" in length are required to be inspected biannually. Shorter span bridges (10'-0" to 20'-0") and culverts (under 10'-0" span) are not held to the same inspection intervals.



CHAPTER 2: RESULTS

Current and previous inspection reports were reviewed for municipally owned deficient structures. Table 1 below shows the structural assessment priority ranking from most critical to least critical. The condition rating guide in Table 2 is used for MassDOT inspected bridges.

Table 1: Structural Assessment Priority Ranking

Priority Ranking	Bridge No.	BIN	Over (Facility Carried)	Under (Facility Intersected)
1	L-17-025	6T4	Lancaster Avenue	Catacoonamug Brook
2	L-17-029	767	New West Townsend Road	Pearl Hill Brook
3	L-17-014	6T3	Lancaster Avenue	Easter Brook
4	L-17-031	6T7	Chase Road	Mulpus Brook
5	L-17-030	768	Howard Street	Mulpus Brook
6	L-17-001	6RY	White Street	Pearl Hill Brook

Table 2: Condition Rating Guide

	N	NOT APPLICABLE	
	N	NOT APPLICABLE	Excellent Condition
G	9	EXCELLENT	No problem noted.
G	8	NO PROBLEM NOTED	Some minor problems.
G	7	GOOD	Structural elements show some minor deterioration.
F	6	SATISFACTORY	All primary structural elements are sound but may have minor section loss.
F	5	FAIR	Advanced section loss, deterioration, spalling or scour.
P	4	POOR	Loss of section, deterioration, spalling or scour have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.
P	3	SERIOUS	Advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored it may be necessary to close the bridge until corrective action is taken.
C	2	CRITICAL	Major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic, but corrective action may put it back in light use.
C	1	“IMMINENT” FAILURE	Out of service – beyond corrective action.
	0	FAILED	Out of service – beyond corrective action.



2.1 LANCASTER AVENUE OVER CATACOONAMUG BROOK NO. L-17-025

Description

L-17-025 is a Cast-in-Place concrete rigid frame bridge that carries Lancaster Avenue over Catacoonamug Brook. The brook flows from West to East and the roadway runs in a North-South direction. The rigid frame has a clear span of 14'- 1", the curb-to-curb width is 25'- 11" and the out-to-out width is 36'- 9". The wingwalls are oriented in line with the roadway and are 6' long. There is highway guardrail on both sides of the road that runs for the length of the bridge plus the length of the wingwalls. The Functional Class of Lancaster Avenue is Rural Minor Arterial which is used by commuters and also services nearby farms and residents.

2.1.1 DEFICIENCIES

Based on the most recent MassDOT report from 3/8/2024, bridge L-17-025 has a deck rating of 5 (fair), a superstructure rating of 5 (fair), a substructure rating of 5 (fair), an approach rating of 6, and channel protection rating of 7 (satisfactory). The wearing surface has several minor cracks on the northbound lane and both approaches have a large crack spanning the width of the wearing surface (Figure 1-1).

There are several areas of significant concrete deterioration. The west end of the deck slab has a 11'- 6" long by full height spall that is 16" deep and 13" wide on the underside, with exposed rebar that is heavily corroded and exhibits significant section loss (Figure 1-2). The east elevation has a 12'-6" long by full height by 6" deep spall with exposed corroded rebar (Figure 1-3). The deck has map cracking extending up to 7'-0" long with efflorescence throughout the underside (Figure 1-4).

There is a 30' long x 20" high x 2" deep spall on the South Abutment and Southeast Wingwall at the water line (Figure 1-5). Efflorescence and hairline cracks are present and continue for the full height of the abutment. The structure is undersized for the current volume of water that passes through. According to Streamstats, an online water resources tool maintained by the USGS, the bankfull width at the location of the crossing is 23.2-feet. Debris can be seen both in the upstream and downstream directions, with the upstream debris greatly restricting flow due to large branches and other buildup (Figure 1-6).





Full width of
pavement crack

Figure 1-1 L-17-025 North Approach



Spalling and
efflorescence

Corroded
reinforcing bars

Figure 1-2 L-17-025 West end of slab





Figure 1-3 L-17-025 East end of slab

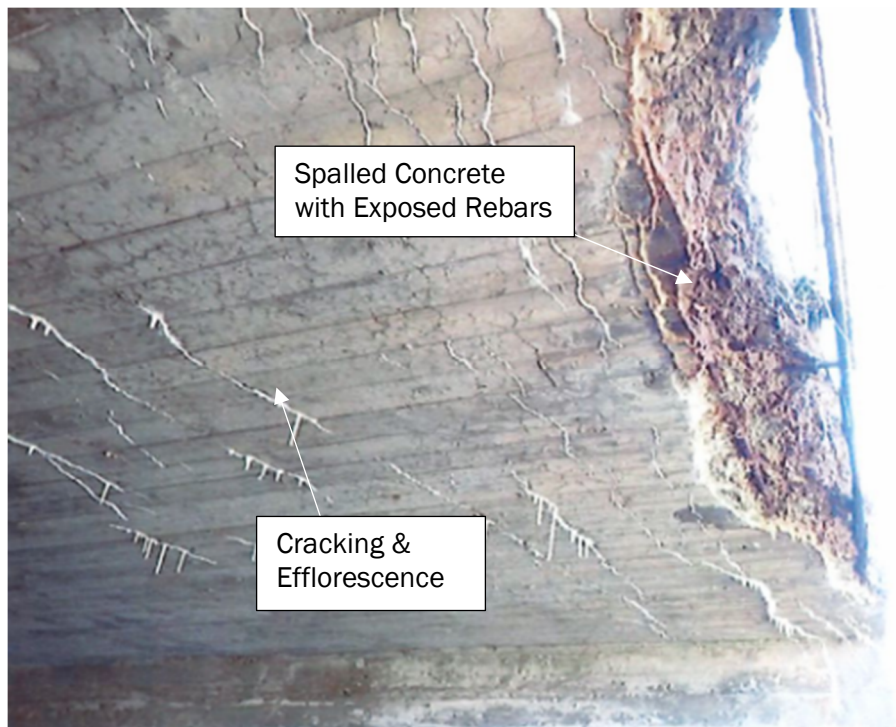


Figure 1-4 L-17-025 West End Underside





Figure 1-5 L-17-025 South Abutment



Figure 1-6 L-17-025 Upstream





Figure 1-7 L-17-025 south breastwall and southeast wingwall



Figure 1-8 L-17-025 Northwest wingwall



2.1.2 RECOMMENDATIONS

Based on the deteriorated state of the bridge, a complete bridge replacement is the most preferred option. The bridge meets all of the qualifying criteria for a MassDOT Municipal Small Bridge grant. The MassDOT Municipal Small Bridge grant is broken into two phases, Phase 1 (Design Grant) and Phase 2 (Construction Grant). MassDOT provides Phase 1 awardees with direct MassDOT-led consultant support for all design services. The design of the new bridge will meet the requirements of Massachusetts General Law Chapter 85 Section 35.

A 3-sided rigid frame bridge or a 4-sided box bridge would be the best options for a replacement. Both rigid frame and box bridges are constructed by installing several bridge units approximately 5'-0" wide, set side-by-side. The units are precast monolithically with reinforced concrete, creating a rigid connection between the bridge deck and the vertical walls. There are economical and structural advantages of using precast bridge units. Rigid frames are built with rigid connections at the corners of the units, which reduce the maximum bending moment at the center of the bridge, allowing for a shallower superstructure. The shallower superstructure depth helps maximize the bridge's hydraulic opening, optimizing the structure for meeting design flood criteria. The system also offers an economic advantage because less material is used to construct the units compared to other systems, such as concrete deck beams on cantilever abutments. The units are precast offsite, allowing for rapid installation and minimizing traffic disruption and construction cost.

A hydraulic report will be conducted to determine the size of the hydraulic opening and depth of scour based on design storm elevations. Design considerations will be made for: duration of construction, environmental impacts, hydraulic capacity, and impacts to abutments. The foundation type will depend on the recommendations of the geotechnical report.

An alternative solution would be a thorough repair of all spalled, delaminated, and other deteriorated concrete, as well as the installation of new scour protection. Ground Penetrating Radar (GPR) may be used to scan the bridge deck and substructure elements for corrosion and delamination not visible to the eye. Existing concrete that has deteriorated would be replaced with a MassDOT approved grout/concrete. Reinforcing bars that have deteriorated should be removed and new reinforcing bars would be spliced onto the existing rebar. A MassDOT approved bridge guardrail system would be installed to replace the current highway guardrail over the bridge.



2.2 NEW WEST TOWNSEND ROAD OVER PEARL HILL BROOK NO. L-17-029

Description

New West Townsend Road runs in a north-south direction over Pearl Hill Brook, which flows from west to east. The structure consists of 9 steel beams spaced approximately 3'-0" apart encased in concrete with a clear span of 6'-4". The out-to-out width of the culvert is approximately 40' and the pavement width is approximately 20'. The beams and deck are rigidly connected to the concrete abutments which are approximately 6'-2" high and there are dry-fit stone wingwalls up to 20'-0" long that run parallel with the road. The deck is 14" deep with a 12" layer of fill on top. The culvert carrying New West Townsend Road is critical to the commuters, residents living along the road, as well as emergency vehicles and school buses.

2.2.1 DEFICIENCIES

There is no MassDOT Inspection report for L-17-029; a field investigation was conducted by BSC Group on 4/17/2024. The deck, wingwalls, abutments, and channel all have major deficiencies that impact the structural stability of the culvert.

There is heavy deterioration of the concrete throughout the structure. The cast-in-place concrete abutments are approximately 3'-0" thick and appear to be unreinforced. The outside edges of each of the abutments are severely spalled at both the East and West elevations, with spalls up to 6'-0" long by 3'-0" wide and up to 10" deep (Figure 2-1). These spalls have exposed some of the larger stones (18" ± diameter) used as aggregate. Both abutments have undermining for the entire length, up to 24" deep in some locations, exposing boulders which are sitting below the abutment (Figure 2-2). Inside the culvert both abutment walls are deteriorated with spalling and delaminated concrete. At the North abutment there are a series of horizontal and vertical cracks, close to the east elevation, which start beneath the beam seat and extend down to the bottom of the abutment and are up to ½" wide. There are several full-length horizontal cracks on both the North and South abutments up to 1" wide with moderate amounts of efflorescence (Figure 2-3). In between the encased beams on the South abutment wall there are several areas of honeycombing. The concrete around some of the encased beams has spalled, exposing the bottom flange. The exposed portions of the steel beams exhibit heavy rust and possible section loss (Figure 2-4). The underside of the deck exhibits typical cracking, spalling and honeycombing similar to the abutment walls. The exterior of the deck slab shows various spalls, and multiple full length cracks up to ½" wide (Figure 2-5). There are presently no guardrails at the crossing, causing safety concerns due to the substantial drop.

The culvert is undersized for the volume of water present, which has led to the significant scour and undermining of the abutments. According to Streamstats, the bankfull width at this location is 12.9-feet.





Figure 2-1 L-17-029 West Elevation



Figure 2-2 L-17-029 Northeast face of abutment



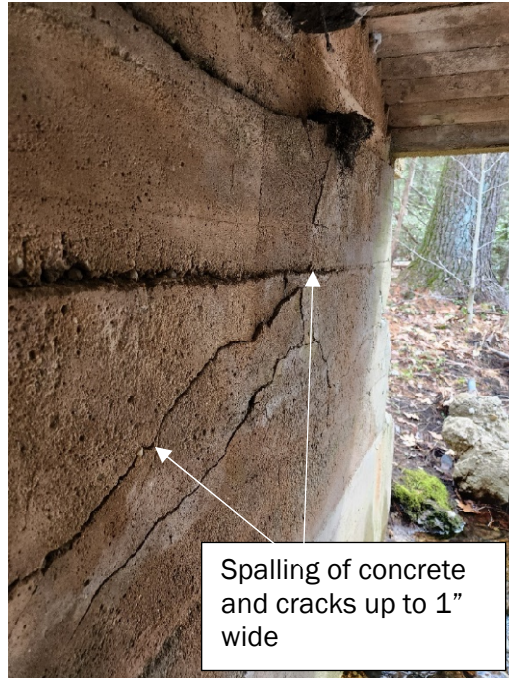


Figure 2-3 L-17-029 North Abutment



Figure 2-4 L-17-029 Northeast abutment



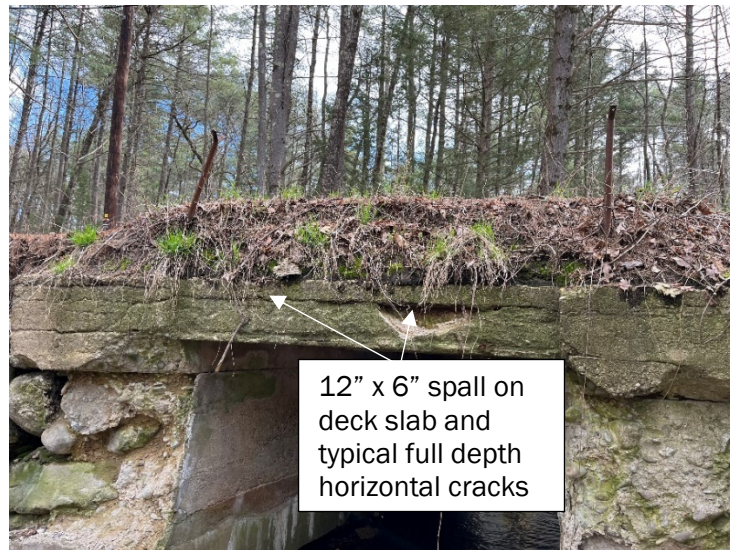


Figure 2-5 L-17-029 West elevation



Figure 2-6 L-17-029 South Abutment





Figure 2-7 L-17-029 Southwest Corner



Figure 2-8 L-17-029 North abutment



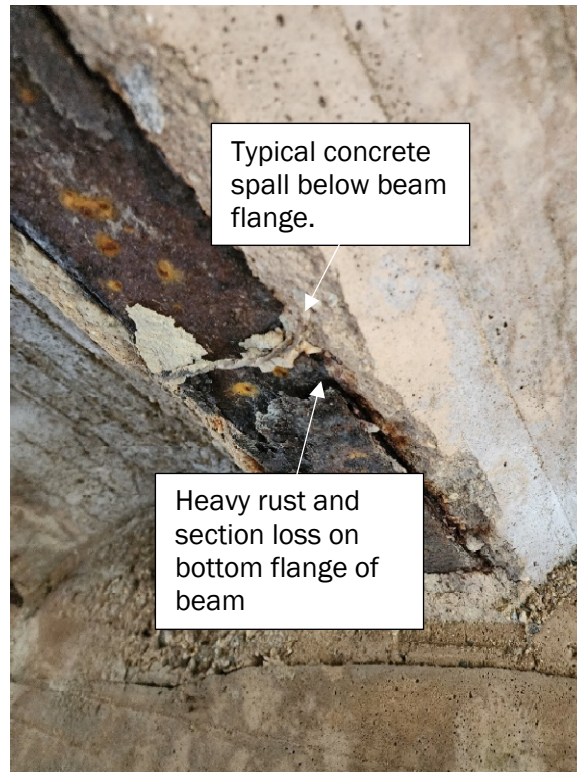


Figure 2-9 L-17-029 Beam Flange

2.2.2 RECOMMENDATIONS

Due to the inadequate size of the current structure, it is recommended that it be replaced. Performing a hydraulic analysis would assist in determining the optimal dimensions for a replacement structure. The hydraulic opening will likely need to be increased for improved hydraulic capacity. The replacement structure would likely be a small bridge with a span greater than 10-feet, to accommodate the current bankfull width and help satisfy the requirements of the Massachusetts Stream Crossing Standards to the maximum extent practicable. If the proposed structure is 10'-0" or greater it would be required to be designed to MGL Chapter 85 Section 35 requirements.

A 3-sided rigid frame or a 4-sided box bridge would be the preliminary options for a proposed replacement. The bridge type chosen will be based on the findings of a geotechnical report. For locations with soils that have a low bearing capacity, a box bridge would be the preferred option due to the larger bearing surface. Rigid frame bridges have a higher applied bearing pressure but are preferred by environmental agencies. Considerations will also be made for duration of construction, environmental impacts, and impacts to abutments.



2.3 LANCASTER AVENUE OVER EASTER BROOK NO. L-17-014

Description

L-17-014 is a 3-barrel pipe culvert carrying Lancaster Avenue which runs in a North–South direction over Easter Brook, which flows from west to east. The pipes are numbered from South to North with pipes #1 and #2 being corrugated steel with diameters 40” and 36” and pipe #3 being reinforced concrete with a 48” diameter. The roadway width at the culvert is 38’-9”. The headwall and surrounding retaining walls are constructed from dry-fit stones. Refer to the L-17-014 MassDOT culvert inspection for more information.

2.3.1 DEFICIENCIES

According to the most recent MassDOT culvert inspection from 3/8/2024, the culvert and retaining walls received a rating of 5 (fair), a channel & channel protection rating of 5 (fair), and an approach condition of 6 (satisfactory).

The wearing surface can be seen to have several cracks. There is a 10’ longitudinal crack in the northbound lane and a 9’ long transverse crack above pipe #3 (Figure 3-1). The west guardrail has collision damage and two bent posts (Figure 3-2). The east guardrail has moderate collision damage at the north end and is bent towards the slope (Figure 3-3). There is an area of erosion measuring the full slope height x 4’ wide x 2’ deep, present in the west embankment next to pipe #1 and minor erosion of the east embankment near pipe #3. Stone has been added to prevent further erosion. The headwalls on both the east and west elevations have voids up to 2’ x 2’ with a penetration depth of 2’. The east headwall has evidence of deformation over pipes #1 and #2 (Figure 3-4). Debris is visible in the upstream direction restricting water flow (Figure 3-5).

There is minor deformation of the steel pipes beneath the headwall at both elevations which probably occurred at the time of construction. According to the most recent MassDOT inspection report the deformation has not changed over time. The StreamStats for this location list the bankfull width as 15.5 feet, the total combined span for this crossing is 11’-4”, which is inadequate for the current flow.





Figure 3-1 L-17-014 Wearing Surface



Figure 3-2 L-17-014 West Guardrail





Figure 3-3 L-17-014 East Rail

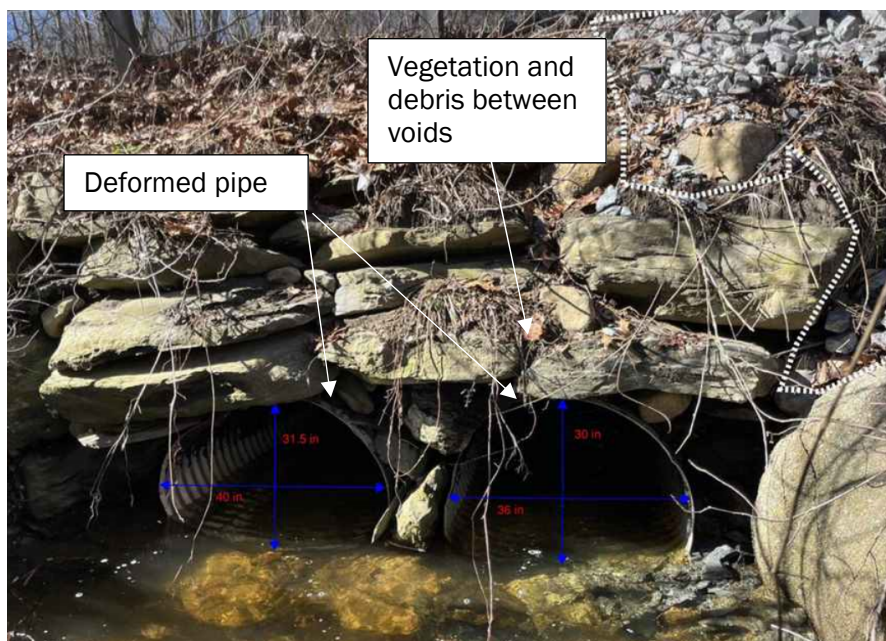


Figure 3-4 L-17-014 East Elevation





Figure 3-5 L-17-014 Upstream



Figure 3-6 L-17-014 West Elevation



2.3.2 RECOMMENDATIONS

At a minimum, the highway guardrail and dry-fit stone headwalls should be removed and replaced. The new guardrail posts shall consist of a series of steel and Control Release Terminal (CRT) wood posts with spacing specific to designs for a Long-Span Guardrail over Culvert. MassDOT approved Steel W-beam should then be installed spanning the guardrail posts on both the approaches and over the structure. To minimize maintenance concrete or masonry headwalls are recommended to be installed to retain the fill above the pipe. It is not crucial that this structure be replaced at this time but if flooding becomes a problem, or the structure is washed out, a replacement may be warranted with a precast concrete box or a larger steel pipe. The structure is currently classified in the MassDOT Database of Bridges and Culverts as a culvert, but based on the size of the pipes and the distance in between them the structure should be classified as a small bridge (10'-20'). It is recommended that a MassDOT Small Bridge Grant application be filed during the next cycle. The grant money could be used for either designing repairs to the existing structure or for the design of a replacement bridge.



2.4 CHASE ROAD OVER MULPUS BROOK NO. L-17-031

Description

Chase Road Over Mulpus Brook Bridge No. L-17-031 is a steel pipe culvert that transitions into a stone culvert. The roadway approaches from the north and south, while Mulpus Brook flows from west to east. The total length of the structure has an out-to-out distance of approximately 65' and a pavement width of 40'. There is a highway guardrail that runs along the west side of the road; there is no guardrail along the east side. The steel pipe consists of multiple bolted pipe segments extending 45' to the stone culvert. The west elevation pipe diameter is 7'-6" with a 3'-6" high stone headwall under 12" of fill. The stone wingwalls are both 10' long.

The east elevation is a stone culvert that has a square opening and is approximately 20' long before transitions into the pipe. The square culvert opening is approximately 7'-6" in width and 8'-6" in height. There are stone deck beams that are approximately 9'-6" long x 18" tall. Above the stone deck is a stone retaining wall 4' tall and 10' long. The stone wingwalls on the east elevation are both 10' long.

2.4.1 DEFICIENCIES

There are no current MassDOT inspection reports for culvert L-17-031 listed in the MassDOT Bridge Inspection Management System. BSC Group performed a field investigation of the structure on 4/17/2024.

The wearing surface over the structure has some minor cracking but otherwise appears to be in good condition. The east elevation wingwalls show several voids up to 12" wide along with loose stones (Figure 4-1). The abutment walls in the stone section of the culvert have additional voids, up to 6" in diameter, due to deteriorated grout between the stones (Figure 4-2). The stone deck beams do not have a consistent shape or width. There are large gaps and deteriorating grout at the location where the stone culvert meets the pipe culvert (Figure 4-3).

The west elevation masonry headwall and wingwalls have failing grout and show several voids up to 12" wide between the stones. There is heavy corrosion throughout the pipe and large areas of section loss at the 4 o'clock and 8 o'clock positions for most of the length of the pipe (Figure 4-4). There are several large holes throughout the pipe at other locations which measure up to 10' in length. Holes towards the bottom of the pipe show honeycombed concrete due to water intrusion (Figure 4-5). There are gaps between segments up to 3", causing sections to be misaligned. Several of the rivets have fallen out, leading to further corrosion (Figure 4-5). Streamstats list the bankfull width at this location at 18.3', with a span of 7'-6" this culvert is significantly undersized.





Figure 4-1 L-17-031 East Elevation



Figure 4-2 L-17-031 South Abutment





Figure 4-3 L-17-031 Grout at Culvert Transition



Figure 4-4 L-17-031 Steel Pipe



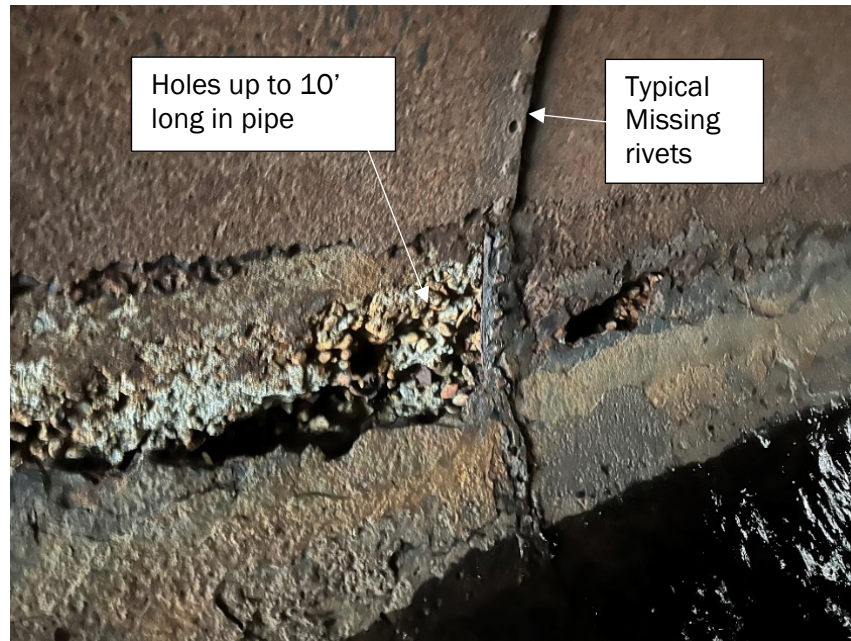


Figure 4-5 L-17-031 Steel pipe

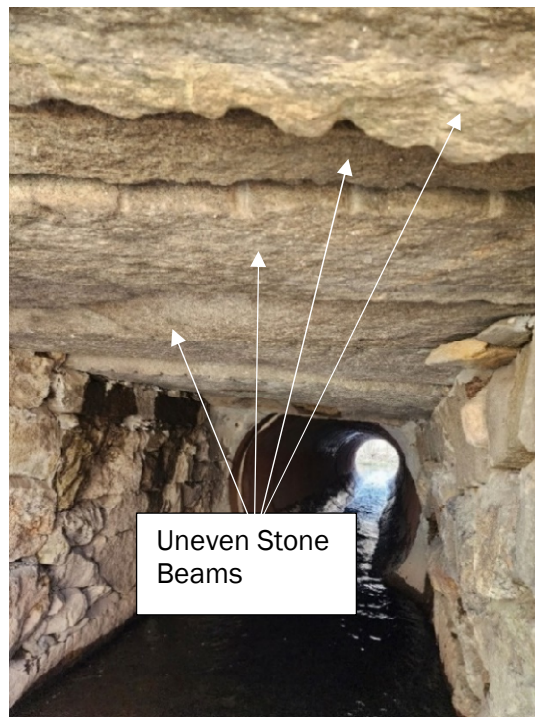


Figure 4-6 L-17-031 West Elevation Stone Beams



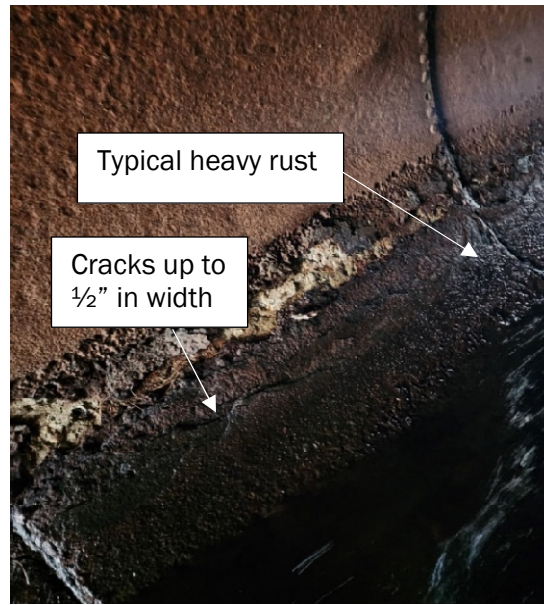


Figure 4-7 L-17-031 Steel pipe

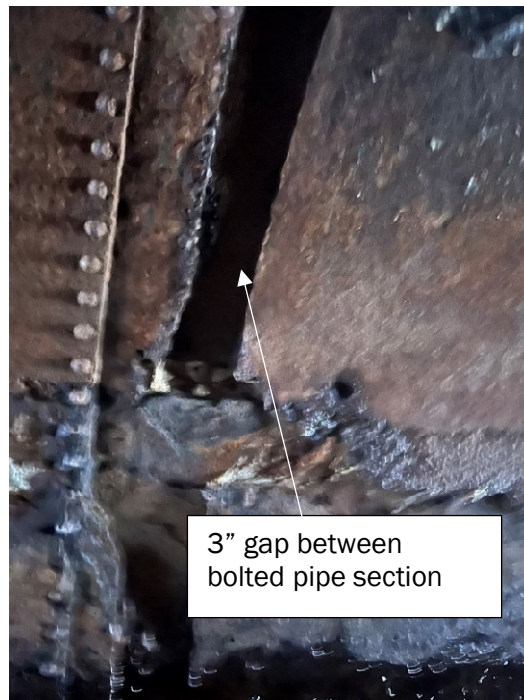


Figure 4-8 L-17-031 Steel pipe section gap



2.4.2 RECOMMENDATIONS

Due to the deteriorated state of the steel pipe and the stone culvert, it is recommended to completely replace the structure. Rapid construction would be essential for minimizing traffic disruptions at this busy intersection; therefore, the optimal bridge type would be either a precast 4-sided box bridge or a precast 3-sided ridged frame. The hydraulic opening for the new structure will be required to meet the Massachusetts Stream Crossing standards to the maximum extent practicable. Both types of structures utilize rigid connections to help maximize the hydraulic opening. The foundation type will depend on the recommendation of the geotechnical report. A hydraulic report should be compiled to help determine the necessary size of the hydraulic opening and the depth of scour based on design storm water volume and flow velocity. The structures would be constructed and designed in accordance with Massachusetts General Law Chapter 85 Section 35. The highway guardrail would be replaced by a MassDOT approved crash-tested guardrail system.



2.5 HOWARD STREET OVER MUPUS BROOK NO. L-17-030

Description

Howard Street runs east-west over Mulpus Brook which flows from north to south. The structure is a 4'-0" diameter corrugated steel pipe. The pavement width is 27'-0" and the out-to-out width is 38'-0". The south elevation has a stone wingwall that is 8'-0" long, and a stone wingwall that is 6'-0" long. The headwall is approximately 2'-0" tall, with another 12" of fill above. The north elevation has two 4'-0" long wingwalls and a 2'-0" tall headwall with 4" of fill above. The north elevation also has a PVC drainage pipe at the edge of the steel pipe.

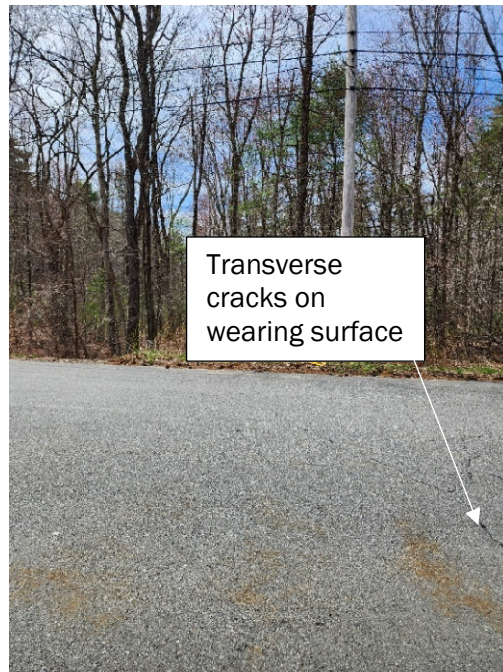
2.5.1 DEFICIENCIES

There are no current MassDOT inspection reports for culvert L-17-030 listed in the MassDOT Bridge Inspection Management System, BSC Group performed a field investigation of the structure on 4/17/2024. There were deficiencies found with the steel pipes, wingwalls, headwalls, and the wearing surface.

The culvert has no guardrail present, which can be a danger to vehicular traffic due to poor visibility of the structure and close proximity of the pavement to the edge of the culvert. The wearing surface over the culvert has several transverse cracks along the east approach (Figure 5-1). Close to the north elevation there is a 12" diameter pothole approximately 12" deep which is filled with debris. The hole is located directly above the wingwall and at the edge of the pavement (Figure 5-2).

Both the south and north elevations have headwalls with missing stones and large voids up to 8" wide. The large gaps and encroaching vegetation are causing debris to accumulate between the stones (Figure 5-3 & 5-4). The pipe south elevation can be seen with full section loss towards the waterline (Figures 5-5). The wingwalls have similar issues, with several loose stones as well. The pipes have heavy rust towards the bottom, with the north and south elevations both experiencing areas of section loss up to 5' long. The pipe at the north elevation has moderate deformation and has a large amount of debris, restricting flow downstream (Figure 5-5). Streamstats list the bankfull width at this location at 12.2' making the current 4'-0" diameter pipe significantly undersized for this crossing.





Transverse
cracks on
wearing surface

Figure 5-1 L-17-030 Wearing Surface



Collapsed
pavement

12" diameter, 12"
deep pothole at
end of pavement

Figure 5-2 L-17-030 Northwest Edge of Wearing Surface





Figure 5-3 L-17-030 North Elevation



Figure 5-4 L-17-030 Northeast Wingwall





Typical full section
loss of pipe

Figure 5-5 L-17-030 South Elevation



Debris and
broken pipe
section

5' of section loss
of pipe

Figure 5-6 L-17-030 North Elevation drainage pipe



2.5.2 RECOMMENDATIONS

Due to the inadequate size of the culvert, it is recommended that it be replaced. A hydraulic analysis would assist in determining the appropriate opening dimensions. The hydraulic opening of the existing culvert will likely need to be increased for improved hydraulic capacity. Roadway alignment would likely remain the same. A geotechnical investigation and hydraulic analysis would assist in determining the appropriate structure type. Due to the bankfull width being 12.2', the replacement would likely be a small bridge (10'-0" +). If the proposed structure is 10'-0" or greater it would be required to be designed to MGL Chapter 85 Section 35 requirements.

The preliminary bridge option for a proposed replacement would be either a precast 4-sided box bridge or precast 3-sided rigid frame bridge with precast wingwalls and a new guardrails system. The type of bridge chosen will be largely based on the existing soil properties. A box bridge has more bearing surface area resulting in reduced applied bearing pressure. This is beneficial if the existing soils have low bearing capacity. Rigid frame bridges have higher applied bearing pressures but are generally preferred by environmental agencies.



2.6 WHITE STREET OVER PEARL HILL BROOK NO. L-17-001

Description

White Street runs east to west over Pearl Brook which flows from north to south. The structure consists of two steel pipes 55" and 52" in diameter and each elevation is surrounded by masonry stone with mortar. The roadway is 27'-0" wide and the steel pipes are both 45'-0" long. The stone headwall on the north elevation is 4'-7" high with no fill above. The headwall on the south elevation is 24" high with 6" of fill above. The south elevation stone wingwalls are each 8'-0" long and there are 15" diameter concrete drainage pipes on either side of the bridge structure. The northeast wingwall measures 6' in length and the northwest wingwall measures 8' in length.

2.6.1 DEFICIENCIES

There are no current MassDOT inspection reports for culvert L-17-001 listed in the MassDOT Bridge Inspection Management System, BSC Group conducted a field investigation of the structure on 4/17/2024. There were deficiencies found with the steel pipes, wingwalls, and headwalls.

There are no guardrails on either side of the road over the structure, which can pose a major hazard to oncoming vehicles (Figure 6-1). The steel pipes both have section loss up to 2' long and 3' wide below the water line (Figure 6-2). Heavy rust is present along the full length of the pipes below the water line and smaller areas of rust appear throughout the pipes (Figure 6-3). The pipes at the north elevation have debris and vegetation severely restricting flow downstream (Figure 6-4). The current will cause further blocking of the water flow by pushing small branches and leaves downstream.

Originally the structure had been fully mortared, but weathering has deteriorated much of the mortar. The headwall on the north elevation has multiple voids up to 6" long x 2" high (Figure 6-5). Several of the longer stones on the headwall show vertical cracks up to 1" wide. The wingwalls on the north elevation also show large voids between the stones where the mortar has eroded, and many stones are loose due to the lack of bonding material (Figure 6-6). Similar deficiencies with the mortar and stones are repeated on the South elevation. Streamstats list the bankfull width at this location at 21', with the span being 10'-11", this culvert is significantly undersized.





Figure 6-1 L-17-001 South Elevation



Figure 6-2 L-17-001 South Elevation Pipe 1



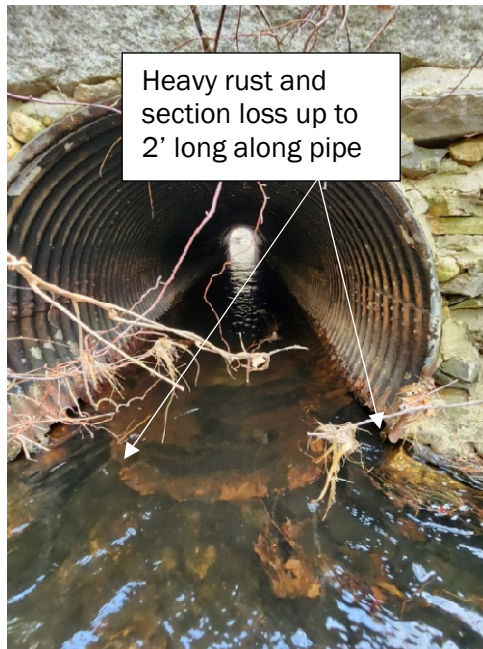


Figure 6-3 L-17-001 North Elevation Pipe 1



Figure 6-4 L-17-001 North Elevation Pipe 2



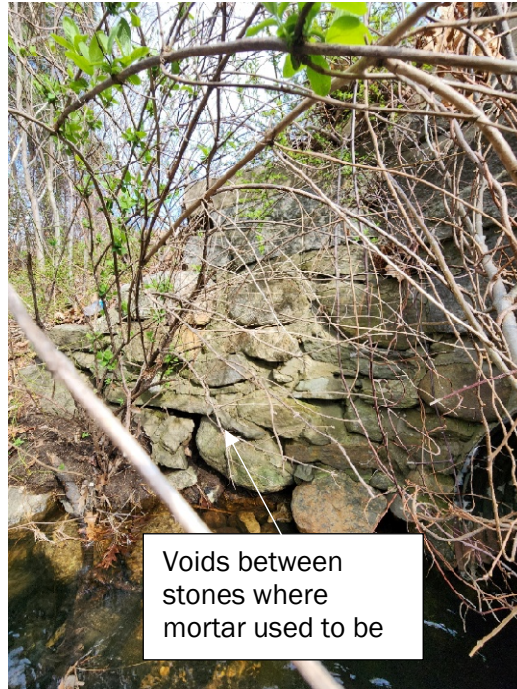


Figure 6-5 L-17-001 Northeast Wingwall



Figure 6-6 L-17-001 North Elevat



2.6.2 RECOMMENDATIONS

Based on the current condition, construction methods, and materials use there is no safe suitable repair to prolong the life of this structure. A complete replacement is recommended to bring the bridge up to current design/safety standards. Because the distance between the two pipes is less than half the diameter of the smallest pipe, this crossing is defined by MassDOT as a single span, the total span length of this crossing is 10'-11" which would classify the structure as a small bridge and qualify it for a MassDOT Small Bridge Grant. Multiple bridge types should be investigated including precast 3-sided rigid frames and precast 4-sided box bridges. Considerations should be made for the duration of construction, environmental impacts, hydraulic capacity, and impacts to abutments. The foundation type will depend on the recommendation of a geotechnical report. A hydraulic report will help determine the size of the hydraulic opening and the depth of scour based on the design storm event. The proposed structure would have a MassDOT approved, crash tested, guardrail system to increase public safety.



CHAPTER 3: CONCLUSIONS

BSC has investigated the available information for 28 of the inventoried town-owned bridges and culverts, as well as several structures not listed in the MassDOT Bridge Management system. Six of the most critical structures were ranked. The ranking is to provide Lunenburg with a greater understanding of the severity of the deficiencies of their bridges. The six ranked bridges have various degrees of deterioration, span lengths, and structure types.

The report presented recommended possible repair and replacement options for specified culverts and bridges. It should be noted that the possible repair and replacement options would require analysis and design before being implemented.

BSC will work with Lunenburg to secure grant funding for bridge replacement projects. We understand the financial constraints that the town is confronted with. We are hopeful this report will assist Lunenburg in pursuing additional grants and seeking MassDOT's technical and financial assistance. BSC will gladly assist Lunenburg on future grant applications as well as discussions with MassDOT.

CHAPTER 4: REFERENCES

MADOT BMS Client [Computer software on CD-ROM]. (n.d.).

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4 Appendices



APPENDIX A: INSPECTION REPORTS



STRUCTURES INSPECTION FIELD REPORT

BR. DEPT. NO.

L-17-025

2-DIST
03B.I.N.
6T4

ROUTINE INSPECTION

CITY/TOWN LUNENBURG		8-STRUCTURE NO. L17025-6T4-MUN-BRI		11-Kilo. POINT 000.000	41-STATUS A:OPEN	90-ROUTINE INSP. DATE MAR 8, 2024
07-FACILITY CARRIED HWY LANCASTER AV		MEMORIAL NAME/LOCAL NAME		27-YR BUILT 1938	106-YR REBUILT 0000	YR REHAB'D (NON 106) 0000
06-FEATURES INTERSECTED WATER CATACOO NAMUG BK		26-FUNCTIONAL CLASS Urban Minor Arterial		DIST. BRIDGE INSPECTION ENGINEER M. Azizi		
43-STRUCTURE TYPE 101 : Concrete Slab		22-OWNER Town Agency	21-MAINTAINER Town Agency	TEAM LEADER D. Simkhovich		
107-DECK TYPE 1 : Concrete Cast-in-Place		WEATHER sunny	TEMP. (air) 0°C	TEAM MEMBERS M. A. LA O GONZALEZ		

ITEM 58 <div>5</div> DECK <div>DEF</div> <table border="1"> <tr><td>1. Wearing surface</td><td>7</td><td>-</td></tr> <tr><td>2. Deck Condition</td><td>5</td><td>S-P</td></tr> <tr><td>3. Stay in Place Forms</td><td>N</td><td>-</td></tr> <tr><td>4. Curbs</td><td>N</td><td>-</td></tr> <tr><td>5. Median</td><td>N</td><td>-</td></tr> <tr><td>6. Sidewalks</td><td>N</td><td>-</td></tr> <tr><td>7. Parapets</td><td>N</td><td>-</td></tr> <tr><td>8. Railing</td><td>8</td><td>-</td></tr> <tr><td>9. Anti Missile Fence</td><td>N</td><td>-</td></tr> <tr><td>10. Drainage System</td><td>N</td><td>-</td></tr> <tr><td>11. Lighting Standards</td><td>N</td><td>-</td></tr> <tr><td>12. Utilities</td><td>N</td><td>-</td></tr> <tr><td>13. Deck Joints</td><td>N</td><td>-</td></tr> <tr><td>14.</td><td>N</td><td>-</td></tr> <tr><td>15.</td><td>N</td><td>-</td></tr> <tr><td>16.</td><td>N</td><td>-</td></tr> </table> <div> <div>CURB REVEAL (In millimeters)</div> <div> <div>E</div> <div>W</div> </div> <div> <div>N</div> <div>N</div> </div> </div>			1. Wearing surface	7	-	2. Deck Condition	5	S-P	3. Stay in Place Forms	N	-	4. Curbs	N	-	5. Median	N	-	6. Sidewalks	N	-	7. Parapets	N	-	8. Railing	8	-	9. Anti Missile Fence	N	-	10. Drainage System	N	-	11. Lighting Standards	N	-	12. Utilities	N	-	13. Deck Joints	N	-	14.	N	-	15.	N	-	16.	N	-	ITEM 59 <div>5</div> SUPERSTRUCTURE <div>DEF</div> <table border="1"> <tr><td>1. Stringers</td><td>N</td><td>-</td></tr> <tr><td>2. Floorbeams</td><td>N</td><td>-</td></tr> <tr><td>3. Floor System Bracing</td><td>N</td><td>-</td></tr> <tr><td>4. Girders or Beams</td><td>N</td><td>-</td></tr> <tr><td>5. Trusses - General</td><td>N</td><td>-</td></tr> <tr><td> a. 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Slab</td><td>5</td><td>S-P</td></tr> </table> <div> <div>Year Painted</div> <div>N</div> </div> <div> <div>COLLISION DAMAGE: Please explain</div> <div>None (X) Minor () Moderate () Severe ()</div> </div> <div> <div>LOAD DEFLECTION: Please explain</div> <div>None (X) Minor () Moderate () Severe ()</div> </div> <div> <div>LOAD VIBRATION: Please explain</div> <div>None (X) Minor () Moderate () Severe ()</div> </div> <div> <div>Any Fracture Critical Member: (Y/N)</div> <div>N</div> </div> <div> <div>Any Cracks: (Y/N)</div> <div>N</div> </div>			1. Stringers	N	-	2. Floorbeams	N	-	3. Floor System Bracing	N	-	4. Girders or Beams	N	-	5. Trusses - General	N	-	a. Upper Chords	N	-	b. Lower Chords	N	-	c. Web Members	N	-	d. Lateral Bracing	N	-	e. Sway Bracings	N	-	f. Portals	N	-	g. End Posts	N	-	6. Pin & Hangers	N	-	7. Conn Plt's, Gussets & Angles	N	-	8. Cover Plates	N	-	9. Bearing Devices	N	-	10. Diaphragms/Cross Frames	N	-	11. Rivets & Bolts	N	-	12. Welds	N	-	13. Member Alignment	7	-	14. Paint/Coating	N	-	15. Slab	5	S-P	ITEM 60 <div>5</div> SUBSTRUCTURE <div>DEF</div> <table border="1"> <tr><td>1. Abutments</td><td>Dive</td><td>Cur</td><td>5</td><td>-</td></tr> <tr><td> a. Pedestals</td><td>N</td><td>N</td><td></td><td>-</td></tr> <tr><td> b. Bridge Seats</td><td>N</td><td>N</td><td></td><td>-</td></tr> <tr><td> c. Backwalls</td><td>N</td><td>N</td><td></td><td>-</td></tr> <tr><td> d. Breastwalls</td><td>N</td><td>5</td><td></td><td>M-P</td></tr> <tr><td> e. Wingwalls</td><td>N</td><td>6</td><td></td><td>M-P</td></tr> <tr><td> f. Slope Paving/Rip-Rap</td><td>N</td><td>N</td><td></td><td>-</td></tr> <tr><td> g. Pointing</td><td>N</td><td>N</td><td></td><td>-</td></tr> <tr><td> h. Footings</td><td>N</td><td>H</td><td></td><td>-</td></tr> <tr><td> i. Piles</td><td>N</td><td>X</td><td></td><td>-</td></tr> <tr><td> j. Scour</td><td>N</td><td>7</td><td></td><td>-</td></tr> <tr><td> k. 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Fasteners</td><td>N</td><td>N</td><td></td><td>-</td></tr> </table> <div> <div>UNDERMINING (Y/N) If YES please explain</div> <div>N</div> </div> <div> <div>COLLISION DAMAGE:</div> <div>None (X) Minor () Moderate () Severe ()</div> </div> <div> <div>SCOUR: Please explain</div> <div>None (X) Minor () Moderate () Severe ()</div> </div> <div> <div>I-60 (Dive Report):</div> <div>N</div> <div>I-60 (This Report):</div> <div>5</div> </div> <div> <div>93B-U/W (DIVE) Insp</div> <div>00/00/0000</div> </div>			1. Abutments	Dive	Cur	5	-	a. Pedestals	N	N		-	b. Bridge Seats	N	N		-	c. Backwalls	N	N		-	d. Breastwalls	N	5		M-P	e. Wingwalls	N	6		M-P	f. Slope Paving/Rip-Rap	N	N		-	g. Pointing	N	N		-	h. Footings	N	H		-	i. Piles	N	X		-	j. Scour	N	7		-	k. Settlement	N	N		-	l.	N	N		-	m.	N	N		-	2. Piers or Bents			N	-	a. Pedestals	N	N		-	b. Caps	N	N		-	c. Columns	N	N		-	d. Stems/Webs/Pierwalls	N	N		-	e. Pointing	N	N		-	f. Footing	N	N		-	g. Piles	N	N		-	h. Scour	N	N		-	i. Settlement	N	N		-	j.	N	N		-	k.	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d. Stems/Webs/Pierwalls	N	N		-																																																																																																																																																																																																																																																																																						
e. Pointing	N	N		-																																																																																																																																																																																																																																																																																						
f. Footing	N	N		-																																																																																																																																																																																																																																																																																						
g. Piles	N	N		-																																																																																																																																																																																																																																																																																						
h. Scour	N	N		-																																																																																																																																																																																																																																																																																						
i. Settlement	N	N		-																																																																																																																																																																																																																																																																																						
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3. Pile Bents			N	-																																																																																																																																																																																																																																																																																						
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b. Piles	N	N		-																																																																																																																																																																																																																																																																																						
c. Diagonal Bracing	N	N		-																																																																																																																																																																																																																																																																																						
d. Horizontal Bracing	N	N		-																																																																																																																																																																																																																																																																																						
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X=UNKNOWN

N=NOT APPLICABLE H=HIDDEN/INACCESSIBLE

R=REMOVED

CITY/TOWN LUNENBURG	B.I.N. 6T4	BR. DEPT. NO. L-17-025	8.-STRUCTURE NO. L17025-6T4-MUN-BRI	INSPECTION DATE MAR 8, 2024
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ITEM 61 CHANNEL & CHANNEL PROTECTION <table border="1" style="width:100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th></th> <th>Dive</th> <th>Cur</th> <th>DEF</th> </tr> </thead> <tbody> <tr><td>1.Channel Scour</td><td>N</td><td>7</td><td>-</td></tr> <tr><td>2.Embankment Erosion</td><td>N</td><td>7</td><td>-</td></tr> <tr><td>3.Debris</td><td>N</td><td>7</td><td>-</td></tr> <tr><td>4.Vegetation</td><td>N</td><td>7</td><td>-</td></tr> <tr><td>5.Utilities</td><td>N</td><td>N</td><td>-</td></tr> <tr><td>6.Rip-Rap/Slope Protection</td><td>N</td><td>N</td><td>-</td></tr> <tr><td>7.Aggradation</td><td>N</td><td>7</td><td>-</td></tr> <tr><td>8.Fender System</td><td>N</td><td>N</td><td>-</td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table> <div style="margin-top: 10px;"> STREAM FLOW VELOCITY: Tidal () High () Moderate () Low (X) None () </div> <div style="margin-top: 10px;"> ITEM 61 (Dive Report): N ITEM 61 (This Report): 7 </div> <div style="margin-top: 10px;"> 93b-U/W INSP. DATE: 00/00/0000 </div>		Dive	Cur	DEF	1.Channel Scour	N	7	-	2.Embankment Erosion	N	7	-	3.Debris	N	7	-	4.Vegetation	N	7	-	5.Utilities	N	N	-	6.Rip-Rap/Slope Protection	N	N	-	7.Aggradation	N	7	-	8.Fender System	N	N	-													<div style="border: 1px solid black; width: 30px; height: 30px; margin: 0 auto; display: flex; align-items: center; justify-content: center; font-weight: bold;">7</div>	ITEM 36 TRAFFIC SAFETY <table border="1" style="width:100%; border-collapse: collapse; margin-top: 5px;"> <thead> <tr> <th></th> <th>36</th> <th>COND</th> <th>DEF</th> </tr> </thead> <tbody> <tr><td>A. Bridge Railing</td><td>1</td><td>8</td><td>-</td></tr> <tr><td>B. Transitions</td><td>N</td><td>N</td><td>-</td></tr> <tr><td>C. Approach Guardrail</td><td>1</td><td>8</td><td>-</td></tr> <tr><td>D. 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Bridge Railing	1	8	-	B. Transitions	N	N	-	C. Approach Guardrail	1	8	-	D. Approach Guardrail Ends	0	8	-		H	3	3S2	Single	Actual Posting	N	N	N	N	Recommended Posting	N	N	N	N	At bridge		Other Advance		N	S	N	S						E		W				ft	in	ft	in	meter	Actual Field Measurement		0		0		Posted Clearance		0		0		At bridge		Advance		E	W	E	W					ACCESSIBILITY (Y/N/P) <table border="1" style="width:100%; border-collapse: collapse; margin-top: 5px;"> <thead> <tr> <th></th> <th>Needed</th> <th>Used</th> </tr> </thead> <tbody> <tr><td>Lift Bucket</td><td>N</td><td>N</td></tr> <tr><td>Ladder</td><td>N</td><td>N</td></tr> <tr><td>Boat</td><td>N</td><td>N</td></tr> <tr><td>Waders</td><td>Y</td><td>Y</td></tr> <tr><td>Inspector 50</td><td>N</td><td>N</td></tr> <tr><td>Rigging</td><td>N</td><td>N</td></tr> <tr><td>Staging</td><td>N</td><td>N</td></tr> <tr><td>Traffic Control</td><td>N</td><td>N</td></tr> <tr><td>RR Flagger</td><td>N</td><td>N</td></tr> <tr><td>Police</td><td>N</td><td>N</td></tr> <tr><td>Other:</td><td></td><td></td></tr> <tr><td></td><td>N</td><td>N</td></tr> </tbody> </table> <div style="margin-top: 5px;"> TOTAL HOURS 8 </div> <div style="margin-top: 5px;"> PLANS (Y/N): N </div> <div style="margin-top: 5px;"> (V.C.R.) (Y/N): N </div> <div style="margin-top: 5px;"> TAPE#: _____ </div> <div style="margin-top: 5px;"> List of field tests performed: </div>		Needed	Used	Lift Bucket	N	N	Ladder	N	N	Boat	N	N	Waders	Y	Y	Inspector 50	N	N	Rigging	N	N	Staging	N	N	Traffic Control	N	N	RR Flagger	N	N	Police	N	N	Other:				N	N
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RATING Rating Report (Y/N): N Date: 00/00/0000 Inspection data at time of existing rating I 58: - I 59: - I 60: - Date :00/00/0000	Recommend for Rating or Rerating (Y/N): N If YES please give priority: HIGH () MEDIUM () LOW () REASON: _____
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CONDITION RATING GUIDE			(For Items 58, 59, 60 and 61)
CODE	CONDITION	DEFECTS	
N	NOT APPLICABLE		
G 9	EXCELLENT	Excellent condition.	
G 8	VERY GOOD	No problem noted.	
G 7	GOOD	Some minor problems.	
F 6	SATISFACTORY	Structural elements show some minor deterioration.	
F 5	FAIR	All primary structural elements are sound but may have minor section loss, cracking, spalling or scour.	
P 4	POOR	Advanced section loss, deterioration, spalling or scour.	
P 3	SERIOUS	Loss of section, deterioration, spalling or scour have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.	
C 2	CRITICAL	Advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored it may be necessary to close the bridge until corrective action is taken.	
C 1	"IMMINENT" FAILURE	Major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic but corrective action may put it back in light service.	
0	FAILED	Out of service - beyond corrective action.	

DEFICIENCY REPORTING GUIDE	
DEFICIENCY:	A defect in a structure that requires corrective action.
CATEGORIES OF DEFICIENCIES:	
M= Minor Deficiency	Deficiencies which are minor in nature, generally do not impact the structural integrity of the bridge and could easily be repaired. Examples include but are not limited to: Spalled concrete, Minor pot holes, Minor corrosion of steel, Minor scouring, Clogged drainage, etc.
S= Severe/Major Deficiency	Deficiencies which are more extensive in nature and need more planning and effort to repair. Examples include but are not limited to: Moderate to major deterioration in concrete, Exposed and corroded rebars, Considerable settlement, Considerable scouring or undermining, Moderate to extensive corrosion to structural steel with measurable loss of section, etc.
C-S= Critical Structural Deficiency	A deficiency in a structural element of a bridge that poses an extreme unsafe condition due to the failure or imminent failure of the element which will affect the structural integrity of the bridge.
C-H= Critical Hazard Deficiency	A deficiency in a component or element of a bridge that poses an extreme hazard or unsafe condition to the public, but does not impair the structural integrity of the bridge. Examples include but are not limited to: Loose concrete hanging down over traffic or pedestrians, A hole in a sidewalk that may cause injuries to pedestrians, Missing section of bridge railing, etc.
URGENCY OF REPAIR:	
I = Immediate-	[Inspector(s) immediately contact District Bridge Inspection Engineer (DBIE) to report the Deficiency and to receive further instruction from him/her].
A = ASAP-	[Action/Repair should be initiated by District Maintenance Engineer or the Responsible Party (if not a State owned bridge) upon receipt of the Inspection Report].
P = Prioritize-	[Shall be prioritized by District Maintenance Engineer or the Responsible Party (if not a State owned bridge) and repairs made when funds and/or manpower is available].

CITY/TOWN LUNENBURG	B.I.N. 6T4	BR. DEPT. NO. L-17-025	8.-STRUCTURE NO. L17025-6T4-MUN-BRI	INSPECTION DATE MAR 8, 2024
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REMARKS

BRIDGE ORIENTATION

According to the map the approaches are North and South and the elevations are East and West. This structure is a cast-in-place concrete slab with abutments labeled North and South. The brook flows from West to East. **See sketch 1.**

ITEM 58 - DECK

Item 58.1 - Wearing surface

There is minor wheel line cracking in the northbound lane. **See photo 1.**

Item 58.2 - Deck Condition

See Item 59.15.

Item 58.8 - Railing

Both bridge rails are doubled W-beam guardrail continuous with abbreviated approach rails and boxing glove ends. The Northeast end is not turned from traffic.

APPROACHES

Approaches a - Appr. pavement condition

Both approaches have isolated transverse cracking. There is minor wheel line cracking in the northbound lane. **See photo 2.**

ITEM 59 - SUPERSTRUCTURE

Item 59.15 - Slab

The West end has an 11.5' long x full height (21") x 16" deep spall x up to 16" wide along the bottom, exposing heavily corroded rebar with as little as 7/16" remaining section. **See photos 3 and 4.**

The East end has a 12.5' long x full height x 6" deep spall/delamination exposing corroded rebar. **See photo 5.**

Note: The ends of the slab are over 5' away from the edges of the roadway.

There are several longitudinal hairline cracks with efflorescence at both ends, extending up to 7' in at the West end and 3' in at the East end. Some of these cracks extend into the breastwalls at all four corners.

ITEM 60 - SUBSTRUCTURE

Item 60.1 - Abutments

Item 60.1.d - Breastwalls

Due to high water the spalls along the water line were spot checked, no additional deterioration was found.

Previous report comments:

The South breastwall has a 30' long x up to 20" high x 2" deep spall along the waterline that extends 2' into the Southeast wingwall.

Both breastwalls have hairline cracks with efflorescence at the interface with the slab at the East and West ends, heaviest at the North breastwall West end (area of highest flow).

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REMARKS

Item 60.1.e - Wingwalls

All wingwalls but the Southeast have minor hairline map cracking with efflorescence.

TRAFFIC SAFETY

Item 36a - Bridge Railing

See Item 58.8.

Item 36c - Approach Guardrail

See Item 58.8.

Item 36d - Approach Guardrail Ends

See Item 58.8.

Sketch / Chart / Photo Log

Sketch 1 : Location map.
 Chart 1 : Stream bed monitoring chart.
 Photo 1 : Cracking in the northbound lane.
 Photo 2 : Approach pavement cracking.
 Photo 3 : West end of the slab.
 Photo 4 : West end of the slab, underside.
 Photo 5 : East end of the slab.

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SKETCHES



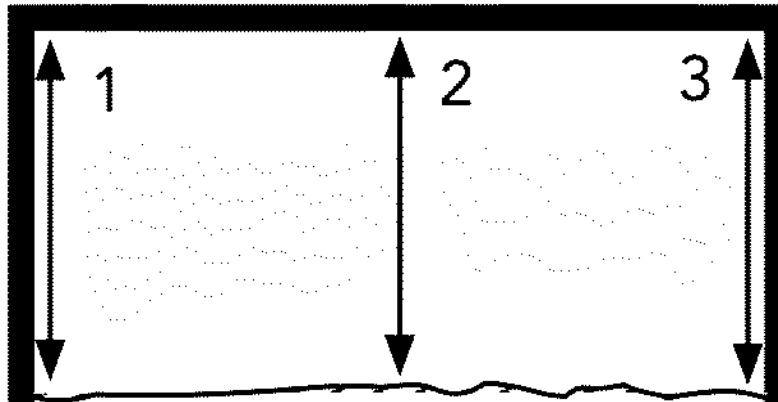
Sketch 1: Location map.

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CHARTS

SCOUR MONITORING CHART @ Upstream/Downstream end of the structure

Measurement Location	Measurment date						
Downstream (East) end	3/8/24						
1 North wall	5.6'						
2 Center	5.7'						
3 South wall	5.7'						
Upstream (West) end							
1 North wall	6.2'						
2 Center	6.4'						
3 South wall	6.6'						



Measurment Location

Chart 1: Stream bed monitoring chart.

CITY/TOWN LUNENBURG	B.I.N. 6T4	BR. DEPT. NO. L-17-025	8.-STRUCTURE NO. L17025-6T4-MUN-BRI	INSPECTION DATE MAR 8, 2024
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PHOTOS

Photo 1: Cracking in the northbound lane.



Photo 2: Approach pavement cracking.

CITY/TOWN LUNENBURG	B.I.N. 6T4	BR. DEPT. NO. L-17-025	8.-STRUCTURE NO. L17025-6T4-MUN-BRI	INSPECTION DATE MAR 8, 2024
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PHOTOS

Photo 3: West end of the slab.



Photo 4: West end of the slab, underside.

CITY/TOWN LUNENBURG	B.I.N. 6T4	BR. DEPT. NO. L-17-025	8.-STRUCTURE NO. L17025-6T4-MUN-BRI	INSPECTION DATE MAR 8, 2024
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PHOTOS

Photo 5: East end of the slab.

State Information				Classification				Code							
BDEPT#= L17025				Agency Br.No.				(112) NBIS Bridge Length				N			
Town= Lunenburg				L.O.				(104) Highway System				N			
B.I.N= 6T4				AASHTO= 006.6				(26) Functional Class - Urban Minor Arterial				16			
RANK= 0 H.I.= NA				FHWA Select List= N (6/21/2017)				(100) Defense Highway				0			
Identification								(101) Parallel Structure				N			
(8) Structure Number				L170256T4MUNBRI				(102) Direction of Traffic - 2-way traffic				2			
(5) Inventory Route				151000000				(103) Temporary Structure				N			
(2) State Highway Department District				03				(105) Federal Lands Highways				0			
(3) County Code 027 (4) Place code				37420				(110) Designated National Network				N			
(6) Features Intersected				WATER CATACOO NAMUG BK				(20) Toll - On free road				3			
(7) Facility Carried				HWY LANCASTER AV				(21) Maintain - Town Agency				03			
(9) Location				2.6 MI N OF LEOM-SHIRL RD				(22) Owner - Town Agency				03			
(11) Kilometerpoint				0000.000				(37) Historical Significance undetermined							
(12) Base Highway Network				N				Condition				Code			
(13) LRS Inventory Route & Subroute				0000000000000				(58) Deck				5			
(16) Latitude				42 DEG 34 MIN 27.14 SEC				(59) Superstructure				5			
(17) Longitude				71 DEG 42 MIN 44.42 SEC				(60) Substructure				5			
(98) Border Bridge State Code				Share %				(61) Channel & Channel Protection				7			
(99) Border Bridge Structure No. #								(62) Culverts				N			
Structure Type and Material								Load Rating and Posting				Code			
(43) Structure Type Main: Concrete				Code 101				(31) Design Load - Unknown				0			
Slab				Jointless bridge type: Not applicable				(63) Operating Rating Method - Allowable Stress (AS)				2			
(44) Structure Type Appr: Other				Code 000				(64) Operating Rating				00.0			
(45) Number of spans in main unit				001				(65) Inventory Rating Method - Allowable Stress (AS)				2			
(46) Number of approach spans				0000				(66) Inventory Rating				00.0			
(107) Deck Structure Type - Concrete Cast-in-Place				Code 1				(70) Bridge Posting				0			
(108) Wearing Surface / Protective System:								(41) Structure - Open				A			
A) Type of wearing surface - Bituminous				Code 6				Appraisal				Code			
B) Type of membrane - Unknown				Code 8				(67) Structural Evaluation				3			
C) Type of deck protection - None				Code 0				(68) Deck Geometry				3			
Age and Service								(69) Underclearances, vert. and horiz.				N			
(27) Year Built				1938				(71) Waterway adequacy				7			
(106) Year Reconstructed				0000				(72) Approach Roadway Alignment				6			
(42) Type of Service: On - Highway								(36) Traffic Safety Features				1 N 1 0			
Under - Waterway				Code 15				(113) Scour Critical Bridges				6			
(28) Lanes: On Structure 02 Under structure				00				Inspections							
(29) Average Daily Traffic				004333				(90) Inspection Date 03/08/24				(91) Frequency 24 MO			
(30) Year of ADT 2022 (109) Truck ADT				06 %				(92) Critical Feature Inspection:				(93) CFI DATE			
(19) Bypass, detour length				005 KM				(A) Fracture Critical Detail N 00 MO A)				00/00/00			
Geometric Data								(B) Underwater Inspection N 00 MO B)				00/00/00			
(48) Length of maximum span				0004.3 M				(C) Other Special Inspection N 00 MO C)				00/00/00			
(49) Structure Length				00004.6 M				(*) Other Inspection () N 00 MO *)				00/00/00			
(50) Curb or sidewalk: Left 00.0 M Right 00.0 M								(*) Closed Bridge N 00 MO *)				00/00/00			
(51) Bridge Roadway Width Curb to Curb				007.9 M				(*) UW Special Inspection N 00 MO *)				00/00/00			
(52) Deck Width Out to Out				011.2 M				(*) Damage Inspection				MO *) 00/00/00			
(32) Approach Roadway Width (w/shoulders)				007.9 M				Rating Loads							
(33) Bridge Median - No median				Code 0				Report Date 00/00/00 H20				Type 3 Type 3S2 Type HS			
(34) Skew 00 DEG (35) Structure Flared				N				Operating 0.0 0.0 0.0 0.0							
(10) Inventory Route MIN Vert Clear				99.99 M				Inventory 0.0 0.0 0.0 0.0							
(47) Inventory Route Total Horiz Clear				07.9 M				Field Posting							
(53) Min Vert Clear Over Bridge Rdwy				99.99 M				Status				Posting Date 00/00/00			
(54) Min Vert Underclear ref N				00.00 M				2 Axle 3 Axle 5 Axle				Single			
(55) Min Lat Underclear RT ref N				00.0 M				Actual							
(56) Min Lat Underclear LT				00.0 M				Recommended							
Navigation Data								Missing Signs N							
(38) Navigation Control - No navigation control on waterway				Code 0				Bridge Name							
(111) Pier Protection				Code				N Anti-missile fence N Acrow Panel N Jointless Bridge							
(39) Navigation Vertical Clearance				000.0 M				Freeze/Thaw N : Not Applicable							
(116) Vert-lift Bridge Nav Min Vert Clear				M				# Stairs On/Adjacent 0 Stair Owner(s)							
(40) Navigation Horizontal Clearance				0000.0 M				Accessibility (Needed/Used)							
								N / N Liftbucket N / N Rigging N / N Other							
								N / N Ladder N / N Staging							
								N / N Boat N / N Traffic Control							
								Y / Y Wader N / N RR Flagperson				Inspection			
								N / N Inspector 50 N / N Police				Hours: 008			

STRUCTURES INSPECTION FIELD REPORT

2-DIST
03B.I.N.
6T3

CULVERT INSPECTION

BR. DEPT. NO.
L-17-014

CITY/TOWN LUNENBURG	8-STRUCTURE NO. L17014-6T3-MUN-BRI	11-Kilo. POINT 000.000	41-STATUS A:OPEN	90-ROUTINE INSP. DATE MAR 8, 2024
07-FACILITY CARRIED HWY LANCASTER AV	MEMORIAL NAME/LOCAL NAME	27-YR BUILT 1960	106-YR REBUILT 1970	YR REHAB'D (NON 106) 0000
06-FEATURES INTERSECTED WATER EASTER BROOK	26-FUNCTIONAL CLASS Urban Minor Arterial	DIST. BRIDGE INSPECTION ENGINEER M. Azizi		
43-STRUCTURE TYPE 319 : Steel Culvert	22-OWNER Town Agency	21-MAINTAINER Town Agency	TEAM LEADER D. Simkhovich	
107-DECK TYPE N : Not applicable	WEATHER Sunny	TEMP. (air) 7°C	TEAM MEMBERS M. A. LA O GONZALEZ	

TYPE OF CULVERT:

SHAPE:	ROUND
MATERIAL:	STEEL
COATING:	ASPHALT

BARRELS: (In Meters)

SIZE:	0.90Wx0.90H	NUMBER:	3
-------	-------------	---------	---

DEPTH OF COVER

(To the nearest tenth of a meter)

E	W
1.8	1.8

CURB REVEAL

(In millimeters)

N	N
---	---

ITEM 62 CULVERT & RETAINING WALLS

5

162 (Dive Report):

N

162 (This Report):

5

	Dive This Rpt.	DEF		Dive This Rpt.	DEF		Dive This Rpt.	DEF			
1. Roof	N	N	-	7. Protective Coating	N	5	S-P	13. Member Alignment	N	6	-
2. Floor	N	N	-	8. Embankment	N	5	S-P	14. Deformation	N	5	S-P
3. Walls	N	N	-	9. Wearing Surface	N	6	M-P	15. Scour	N	7	-
4. Headwall	N	5	S-A	10. Railing	N	5	S-A	16. Settlement	N	7	-
5. Wingwall	N	N	-	11. Sidewalks	N	N	-	17.	N	N	-
6. Pipe	N	5	S-P	12. Utilities	N	N	-	18.	N	N	-

UNDERMINING (Y/N) If YES please explain **N**

COLLISION DAMAGE: **Please explain**
None (X) Minor () Moderate () Severe ()

LOAD VIBRATION: **Please explain**
None (X) Minor () Moderate () Severe ()

ITEM 61 CHANNEL & CHANNEL PROTECTION

5

STREAM FLOW VELOCITY:

Tidal () High () Moderate () Low (X)

APPROACH CONDITION

	Dive This Rpt.	DEF		Dive This Rpt.	DEF		
1. Channel Scour	N	7	-	5. Utilities	N	N	-
2. Embankment Erosion	N	7	-	6. Rip-Rap/Slope Protection	N	N	-
3. Debris	N	5	M-P	7. Aggradation	N	7	-
4. Vegetation	N	5	S-P				

ITEM 61 (Dive Report): **N**

ITEM 61 (This Report): **5**

93b- U/W INSP DATE: **00/00/0000**

At bridge		Advance	
N	S	N	S

WEIGHT POSTING

Not Applicable **X**

Actual Posting

H	3	3S2	Single
N	N	N	N

Recommended Posting

N	N	N	N
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Waived Date:

00/00/0000

EJDMT Date:

00/00/0000

Signs In Place
(Y=Yes, N=No,
NR=Not Required)

Legibility/
Visibility

ITEM 36 TRAFFIC SAFETY

ACCESSIBILITY (Y/N/P):

TOTAL HOURS

8

	36	COND	DEF		Needed	Used	Needed	Used
A. Bridge Railing	0	5	S-A	Ladder	N	N		
B. Transitions	N	N	-	Boat	N	N	N	N
C. Approach Guardrail	1	6	M-P	Waders	Y	Y		
D. Approach Guardrail Ends	0	6	M-P					

PLANS (Y/N): **N**

(V.C.R.) (Y/N): **N**

TAPE#:

RATING

Rating Report (Y/N): **N**Date: **00/00/0000**

Inspection data at time of existing rating
I 62: - Date: **00/00/0000**

Recommend for Rating or Rerating (Y/N): **N**

REASON:

If YES please give priority:

HIGH () MEDIUM () LOW ()

X=UNKNOWN

N=NOT APPLICABLE

H=HIDDEN/INACCESSIBLE

R=REMOVED

CITY/TOWN LUNENBURG	B.I.N. 6T3	BR. DEPT. NO. L-17-014	8.-STRUCTURE NO. L17014-6T3-MUN-BRI	INSPECTION DATE MAR 8, 2024
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REMARKS, PHOTOS & SKETCHES

BRIDGE ORIENTATION

According to the compass, the approaches are North and South and the elevations are East and West. This is a 3 barrel pipe culvert, with the barrel numbering beginning from South to North. Barrels #1 and #2 are corrugated steel and barrel #3 is reinforced concrete. The brook flows West to East.

ITEM 62 - CULVERT

Item 62.4 - Headwall

Both dry laid stone masonry headwalls have several missing chinking stones creating small voids. Both headwalls have up to 2 foot x 2 foot areas of missing stones with 2 feet of penetration South of barrel #1 and between barrels #2 and #3. The East headwall over barrels #1 and #2 appears to be moving to the East. The stone over barrel #1 appears to be furthering the deformation to the end. **See photos #1 and #2.**

Item 62.6 - Pipe

There are minor deformations to barrels #1 and #2 that are assumed to have occurred during construction of the headwalls, which appears to be heavier in the East end. The East ends of barrels #1 and #2 were measured vertically and horizontally to document existing deformation. Readings have not changed. **See photo #2.**

Item 62.7 - Protective Coating

The asphalt coating is missing at the bottom of barrels #1 and #2. **See photo #3.**

CONDITION RATING GUIDE

CODE	CONDITION	DEFECTS
N	NOT APPLICABLE	Use if structure is not a culvert.
G 9	EXCELLENT	No deficiencies.
G 8	VERY GOOD	No noticeable or noteworthy differences which affect the condition of the culvert. Insignificant scrape marks caused by drift.
G 7	GOOD	Shrinkage cracks, light scaling, and insignificant spalling, which does not expose reinforcing steel. Insignificant damage caused by drift with not misalignment and not requiring corrective action. Some minor scouring has occurred near curtain walls, wingwalls, or pipes. Metal culverts have a smooth symmetrical curvature with superficial corrosion and no pitting.
F 6	SATISFACTORY	Deterioration or initial disintegration, minor chloride contamination, cracking with some leaching, or spalls on concrete or masonry walls and slabs. Local minor scouring at curtain walls, wingwalls, or pipes. Metal culverts have a smooth curvature, non-symmetrical shape, significant corrosion or moderate pitting.
F 5	FAIR	Moderate to major deterioration, or disintegration, extensive cracking and leaching, or spalls on concrete or masonry walls and slabs. Minor settlement or misalignment. Noticeable scouring or erosion at curtain walls, wingwalls, or pipes. Metal culverts have significant distortion and deflection in one section, significant corrosion or deep pitting.
P 4	POOR	Large spalls, heavy scaling, wide cracks, considerable efflorescence, or opened construction joints permitting loss of backfill. Considerable settlement or misalignment. Considerable scouring or erosion at curtain walls, wingwalls, or pipes. Metal culverts have significant distortion and deflection throughout, extensive corrosion or deep pitting.
P 3	SERIOUS	Any condition described in Code 4 but which is excessive in scope. Severe movement or differential settlement of the segments, or loss of fill. Holes may exist in walls or slabs. Integral wingwalls, nearly severed from culvert. Severe scour or erosion at curtain walls, wingwalls, or pipes. Metal culverts have extreme distortion and deflection in one section, extensive corrosion, or deep pitting with scattered perforations.
C 2	CRITICAL	Advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored it may be necessary to close the bridge until corrective action is taken.
C 1	"IMMINENT" FAILURE	Bridge closed. Corrective action may put back in light service.
0	FAILED	Bridge closed. Replacement necessary.

DEFICIENCY REPORTING GUIDE

DEFICIENCY: A defect in a structure that requires corrective action.

CATEGORIES OF DEFICIENCIES:

M= Minor Deficiency (Examples include but are not limited to: Spalled concrete, minor to moderate corrosion to steel culverts, minor settlement or misalignment, minor scouring, minor damage to guardrail, etc.)

S= Severe/Major Deficiency (Examples include but are not limited to: Large spalls, wide cracks, moderate to major deterioration in concrete, considerable settlement, considerable scouring or undermining, extensive corrosion and deflection in steel culverts, etc.)

C-S= Critical Deficiency - A deficiency in a structural component or element of a bridge that poses an extrémé hásárd or únsafe condition to the public. (Follow-up Critical Deficiency Report must be submitted separately)

URGENCY OF REPAIR:

I = Immediate [Inspector(s) stay at the bridge until the District Maintenance crew or the responsible Agency crew (if not a State bridge) show up and corrective action is taken.]

A = ASAP [Action will be taken by the District Maintenance Engineer or the Responsible Agency (if not a State owned bridge) upon receipt of the Inspection Report].

P = Prioritize [Shall be prioritized by District Maintenance Engineer or the Responsible Party (if not a State owned bridge) and repairs made when funds and/or manpower is available].

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REMARKS

Item 62.8 - Embankment

There is erosion to the South of barrel #1 in the West embankment. The erosion is full slope height x up to 4 foot wide x 2 foot deep. There is also erosion to the South side of barrel #3 in the East embankment. Riprap has been added to prevent the slopes from eroding any further in both East and West elevations. **See photos #2 and #3.**

Item 62.9 - Wearing Surface

There is a 9 foot long moderate transverse crack above barrel #3. There is a 10 foot long x minor longitudinal crack in the Northbound lane. **See photo #4.**

Item 62.10 - Railing

The West railing has moderate collision damage with 2 bent posts. The East railing has moderate collision damage near the North end. **See photo #5 and #6.**

Item 62.13 - Member Alignment

Pipe #2 has minor misalignment at the midpoint coupling of pipe sections.

Item 62.14 - Deformation

See Item 62.6.

ITEM 61 - CHANNEL AND CHANNEL PROTECTION

Item 61.3 - Debris

The upstream channel has moderate tree debris. **See photo #7.**

Item 61.4 - Vegetation

There is heavy vegetation growth in the upstream and downstream channels. **See photo #7.**

Item 61.7 - Aggradation

Due to previous aggradation not being present at the time of the report, the condition has been raised to 7.

APPROACHES

Approaches a - Appr. pavement condition

The South approach has a full width moderate transverse crack and a longitudinal crack in the Southbound lane. **See photo #4.**

TRAFFIC SAFETY

Item 36a - Bridge Railing

Both bridge railings are single panel W-beam steel guardrail that are continuous with the approach guardrails. See Item 62.10.

Item 36c - Approach Guardrail

The Southeast approach guardrail has minor collision damage near the north end. The Northwest approach guardrail has minor collision damage near the south end. **See photo #5 and #6.**

Item 36d - Approach Guardrail Ends

The Northwest guardrail end has moderate collision damage, and the Southeast guardrail end has severe collision damage **See photos #5 and #6.**

CITY/TOWN LUNENBURG	B.I.N. 6T3	BR. DEPT. NO. L-17-014	8.-STRUCTURE NO. L17014-6T3-MUN-BRI	INSPECTION DATE MAR 8, 2024
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REMARKS**Sketch / Photo Log**

Sketch 1 : Location map
Photo 1 : West elevation displaying masonry headwall and barrels #1 and #2.
Photo 2 : East elevation displaying deformed barrels and added embankment.
Photo 3 : West elevation, South embankment displaying added riprap and erosion.
Photo 4 : Wearing surface typical cracking.
Photo 5 : West rail collision damage.
Photo 6 : East rail collision damage.
Photo 7 : Upstream debris.

CITY/TOWN	B.N.	BR. DEPT. NO.	S-STRUCTURE NO.	INSPECTION DATE
LUNENBURG	6T3	L-17-014	L17014-6T3-MUN-BRI	MAR 8, 2024

SKETCHES



Sketch 1: Location map

CITY/TOWN LUNENBURG	B.I.N. 6T3	BR. DEPT. NO. L-17-014	8-STRUCTURE NO. L17014-6T3-MUN-BRI	INSPECTION DATE MAR 8, 2024
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PHOTOS

Photo 1: West elevation displaying masonry headwall and barrels #1 and #2.



Photo 2: East elevation displaying deformed barrels and added embankment.

CITY/TOWN LUNENBURG	B.I.N. 6T3	BR. DEPT. NO. L-17-014	8.-STRUCTURE NO. L17014-6T3-MUN-BRI	INSPECTION DATE MAR 8, 2024
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PHOTOS

Photo 3: West elevation, South embankment displaying added riprap and erosion.



Photo 4: Wearing surface typical cracking.

CITY/TOWN LUNENBURG	B.I.N. 6T3	BR. DEPT. NO. L-17-014	8.-STRUCTURE NO. L17014-6T3-MUN-BRI	INSPECTION DATE MAR 8, 2024
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PHOTOS

Photo 5: West rail collision damage.



Photo 6: East rail collision damage.

CITY/TOWN LUNENBURG	B.I.N. 6T3	BR. DEPT. NO. L-17-014	8.-STRUCTURE NO. L17014-6T3-MUN-BRI	INSPECTION DATE MAR 8, 2024
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PHOTOS

Photo 7: Upstream debris.

State Information										Classification										Code																			
BDEPT#= L17014										Agency Br.No.										(112) NBIS Bridge Length										N									
Town= Lunenburg										L.O.										(104) Highway System										N									
B.I.N= 6T3										AASHTO= 035.8										(26) Functional Class - Urban Minor Arterial										16									
RANK= 0 H.I.= NA										FHWA Select List= N (6/21/2017)										(100) Defense Highway										0									
Identification										L170146T3MUNBRI										(101) Parallel Structure										N									
(8) Structure Number										151000000										(102) Direction of Traffic - 2-way traffic										2									
(5) Inventory Route										03										(103) Temporary Structure										N									
(2) State Highway Department District										37420										(105) Federal Lands Highways										0									
(3) County Code 027 (4) Place code										WATER EASTER BROOK										(110) Designated National Network										N									
(6) Features Intersected										HWY LANCASTER AV										(20) Toll - On free road										3									
(7) Facility Carried										50 FT S OF GIBSON ST										(21) Maintain - Town Agency										03									
(9) Location										0000.000										(22) Owner - Town Agency										03									
(11) Kilometerpoint										N										(37) Historical Significance built after 1949 presumed to be not eligi										Z									
(12) Base Highway Network										000000000000										Condition										Code									
(13) LRS Inventory Route & Subroute										42 DEG 32 MIN 45.56 SEC										(58) Deck										N									
(16) Latitude										71 DEG 42 MIN 42.93 SEC										(59) Superstructure										N									
(17) Longitude										Share %										(60) Substructure										N									
(98) Border Bridge State Code																				(61) Channel & Channel Protection										5									
(99) Border Bridge Structure No. #																				(62) Culverts										5									
Structure Type and Material																				Load Rating and Posting										Code									
(43) Structure Type Main: Steel										Code 319										(31) Design Load - Unknown										0									
Culvert										Jointless bridge type: Not applicable										(63) Operating Rating Method - Allowable Stress (AS)										2									
(44) Structure Type Appr:																				(64) Operating Rating										00.0									
Other										Code 000										(65) Inventory Rating Method - Allowable Stress (AS)										2									
(45) Number of spans in main unit										003										(66) Inventory Rating										00.0									
(46) Number of approach spans										0000										(70) Bridge Posting										0									
(107) Deck Structure Type - Not applicable										Code N										(41) Structure - Open										A									
(108) Wearing Surface / Protective System:																				Appraisal										Code									
A) Type of wearing surface - Not applicable=no deck										Code N										(67) Structural Evaluation										3									
B) Type of membrane - Not applicable=no deck										Code N										(68) Deck Geometry										N									
C) Type of deck protection - Not applicable=no deck										Code N										(69) Underclearances, vert. and horiz.										N									
(71) Waterway adequacy																														7									
(72) Approach Roadway Alignment																														6									
(36) Traffic Safety Features																				0 N 1 0																			
(113) Scour Critical Bridges																														6									
Age and Service																				Inspections																			
(27) Year Built										1960										(90) Inspection Date 03/08/24										(91) Frequency 24 MO									
(106) Year Reconstructed										1970										(92) Critical Feature Inspection:										(93) CFI DATE									
(42) Type of Service: On - Highway																				(A) Fracture Critical Detail N 00 MO A)										00/00/00									
Under - Waterway										Code 15										(B) Underwater Inspection N 00 MO B)										00/00/00									
(28) Lanes: On Structure 02 Under structure										00										(C) Other Special Inspection N 00 MO C)										12/11/18									
(29) Average Daily Traffic										006734										(*) Other Inspection () N 00 MO *)										00/00/00									
(30) Year of ADT 2022 (109) Truck ADT										06 %										(*) Closed Bridge N 00 MO *)										00/00/00									
(19) Bypass, detour length										005 KM										(*) UW Special Inspection N 00 MO *)										00/00/00									
Geometric Data																				(*) Damage Inspection										MO *) 00/00/00									
(48) Length of maximum span										0000.9 M										Rating Loads																			
(49) Structure Length										00003.3 M										Report Date 00/00/00										H20 Type 3 Type 3S2 Type HS									
(50) Curb or sidewalk: Left 00.0 M Right 00.0 M																				Operating										0.0 0.0 0.0 0.0									
(51) Bridge Roadway Width Curb to Curb										000.0 M										Inventory										0.0 0.0 0.0 0.0									
(52) Deck Width Out to Out										011.8 M										Field Posting																			
(32) Approach Roadway Width (w/shoulders)																				Status										Posting Date 00/00/00									
(33) Bridge Median - No median										Code 0										2 Axle 3 Axle 5 Axle Single																			
(34) Skew 00 DEG (35) Structure Flared										N										Actual																			
(10) Inventory Route MIN Vert Clear										99.99 M										Recommended																			
(47) Inventory Route Total Horiz Clear										11.8 M										Missing Signs N																			
(53) Min Vert Clear Over Bridge Rdwy										99.99 M										Misc.																			
(54) Min Vert Underclear ref N										00.00 M										Bridge Name																			
(55) Min Lat Underclear RT ref N										00.0 M										N Anti-missile fence N Acrow Panel N Jointless Bridge																			
(56) Min Lat Underclear LT										00.0 M										Freeze/Thaw N : Not Applicable																			
Navigation Data																				# Stairs On/Adjacent 0 Stair Owner(s)																			
(38) Navigation Control - No navigation control on waterway										Code 0										Accessibility (Needed/Used)																			
(111) Pier Protection										Code										N / N Liftbucket N / N Rigging N / N Other																			
(39) Navigation Vertical Clearance										000.0 M										N / N Ladder N / N Staging																			
(116) Vert-lift Bridge Nav Min Vert Clear										M										N / N Boat N / N Traffic Control																			
(40) Navigation Horizontal Clearance										0000.0 M										Y / Y Wader N / N RR Flagperson										Inspection Hours: 008									
																				N / N Inspector 50 N / N Police																			