Bridge Maintenance & Preservation Strategies for Local Agencies

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Contents

Bridge Inventory of Massachusetts

massDOT Massachusetts Department of Transportation Highway Division | vhb

Bridge Ownership in Massachusetts

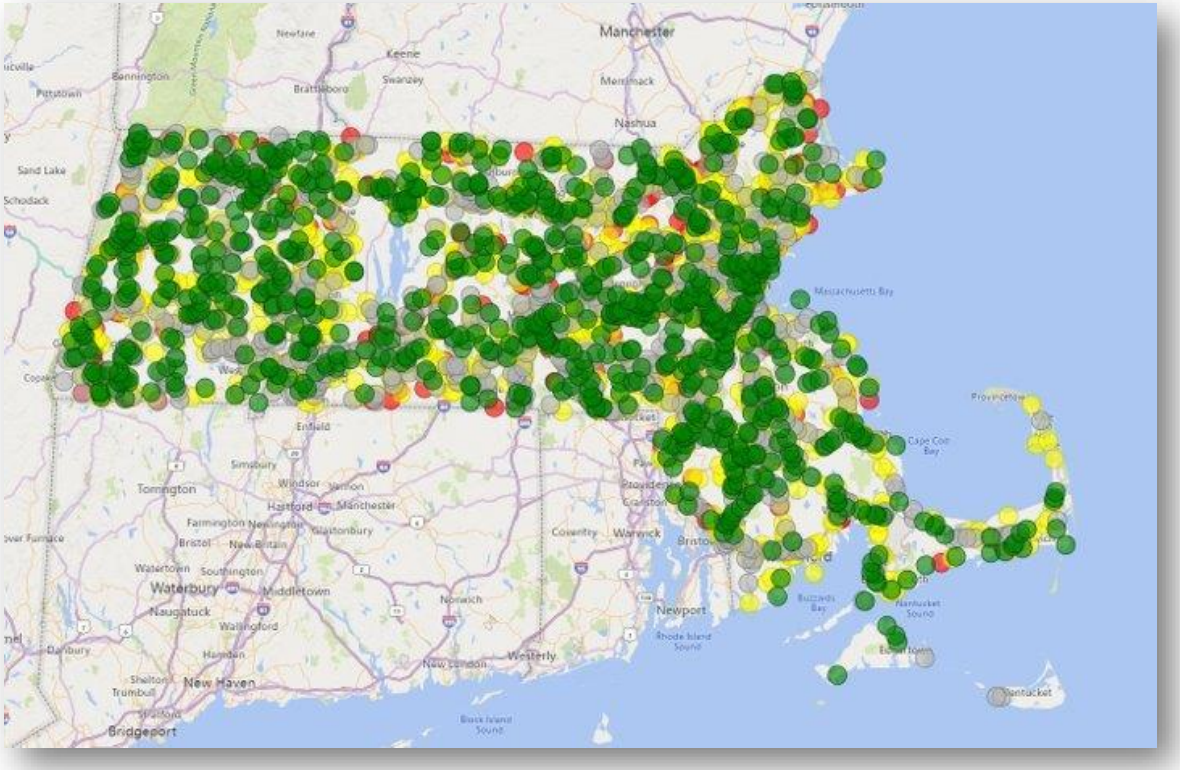
- The table below summarizes federal defined bridges (20 feet or greater in length)
- Additionally, there are 1,600 small bridges (spans that are greater than 10 feet, but less than 20 feet)

JURISDICTION	TOTAL COUNT	TOTAL AREA (SF)	NHS COUNT	NHS AREA (SF)
MASSDOT	3,498	37,742,235	2,220	28,789,544
MUNICIPALITIES	**1,654**	**4,395,273**	**72**	**844,321**
OTHER	116	2,869,887	8	107,907
TOTAL	5,268	45,007,395	2,298	29,741,772

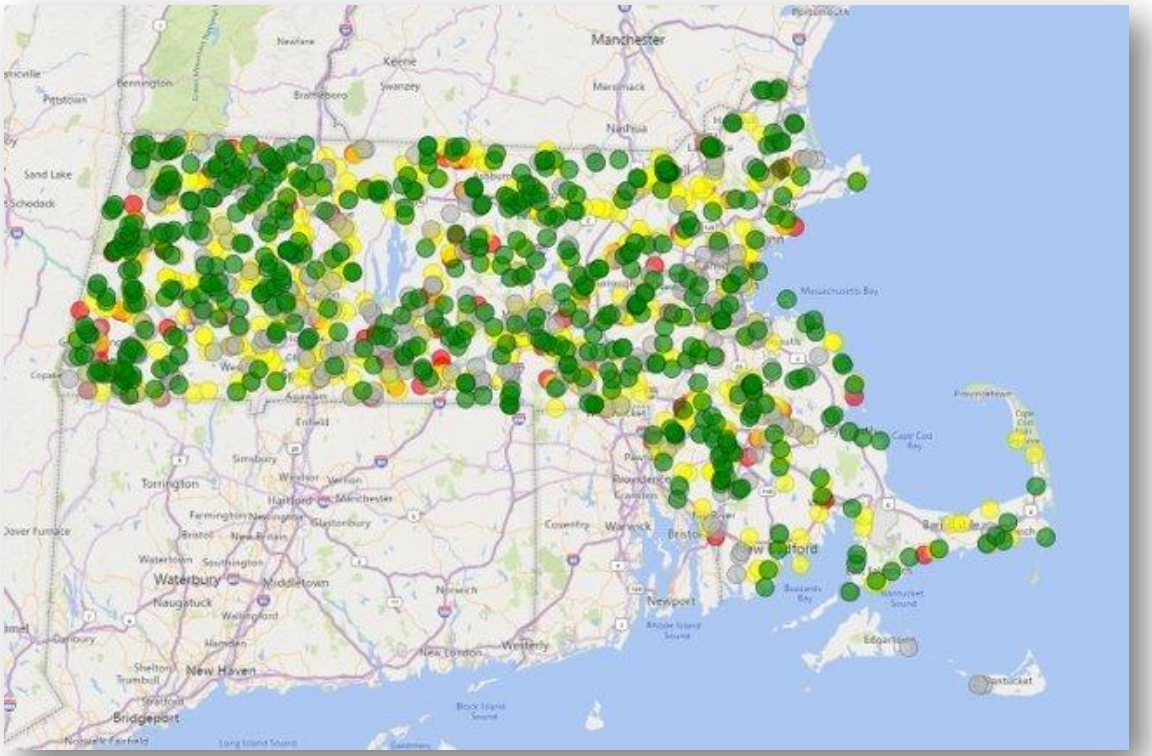
Bridge Conditions

RATING	CONDITION	DESCRIPTION
9	GOOD	Isolated inherent defects
8		Some inherent defects
7		Some minor defects
6	FAIR	Widespread minor or isolated moderate defects
5		Some moderate defects – strength and performance not affected
4	POOR	Widespread defects – strength and performance affected
3		Major defects – strength and performance seriously affected
2		Structure compromised – requires action to keep open
1		Bridge closed – may be possible to save with repair or rehab
0		Bridge closed – replacement required

All Massachusetts Bridges - State of Good Repair



Municipal Bridges – State of Good Repair



Introduction to Bridge Maintenance & Preservation

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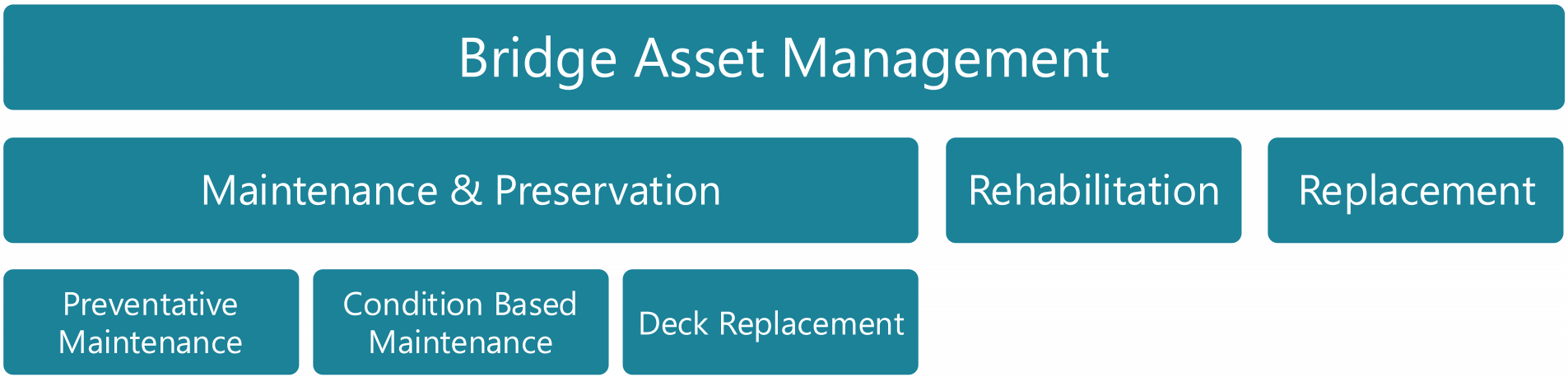
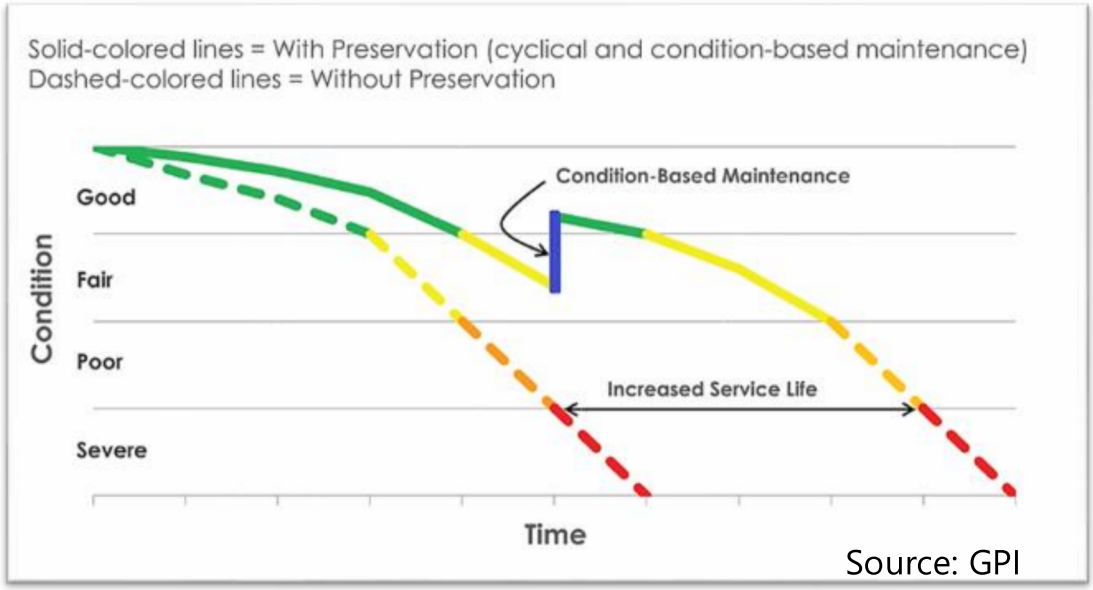
What is it?

- Maintain the bridge inventory in a state-of-good-repair by maximizing the service life of the bridge by implementing preventative and condition-based maintenance activities
- Activities can be as simple as bridge washing and as complex as bridge deck replacement
- Best for bridges in fair (condition-based) to good condition (preventative)
- Maintenance and preservation generally extends the life of the structure 10-20 years

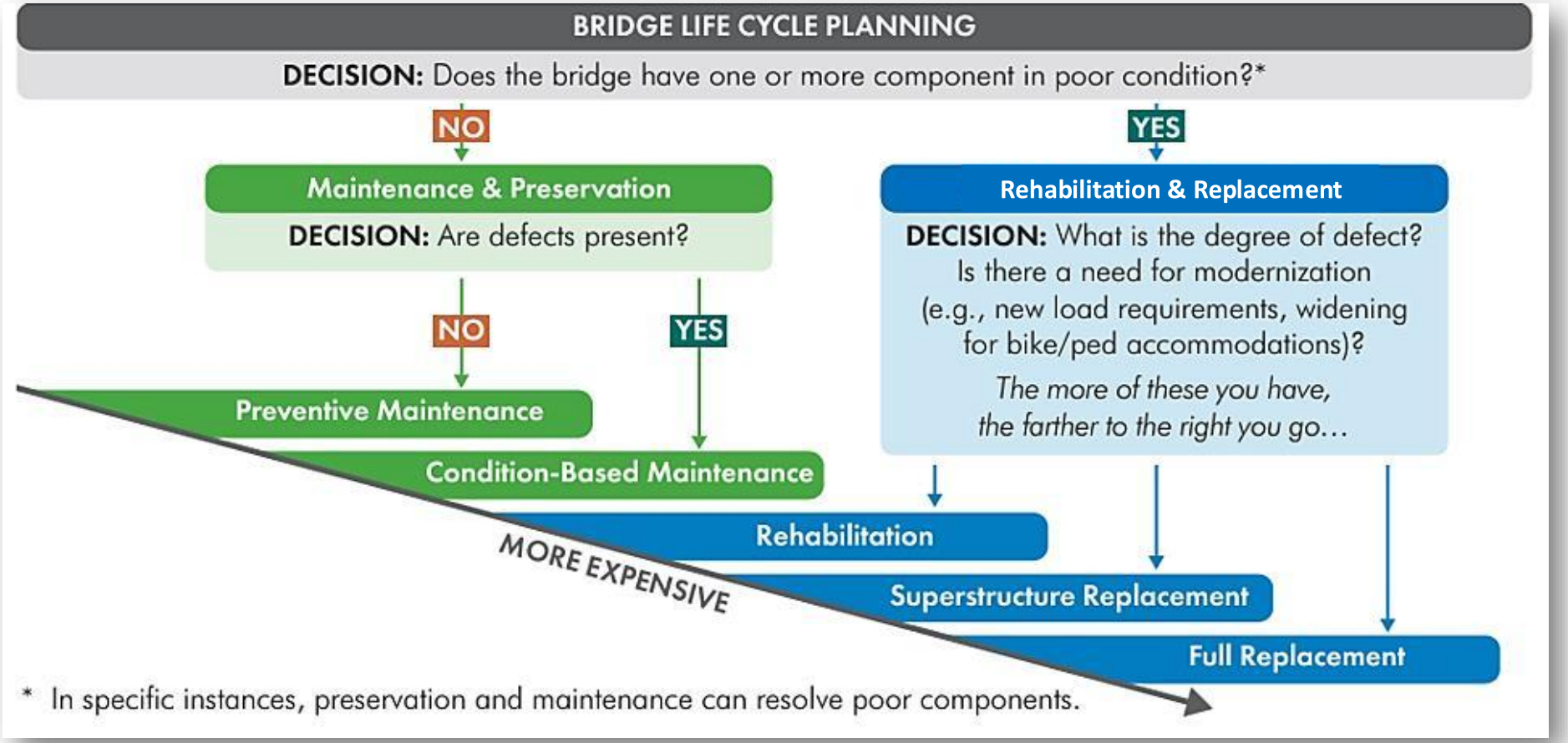


Why is it important?

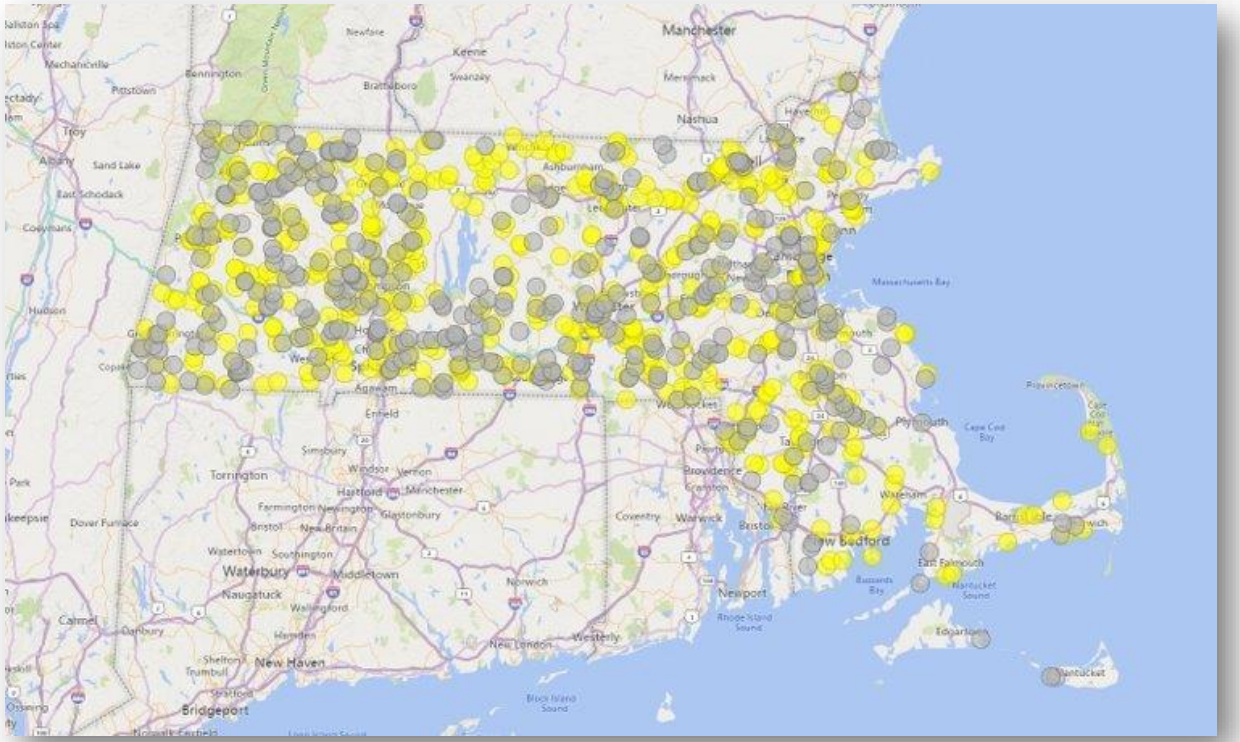
- Maintenance and preservation costs significantly less than rehabilitation and replacement
- The extension of life provides time to secure funding for bigger projects. A vast majority of the bridge infrastructure is aging and deteriorating faster than it can be replaced



Bridge Life Cycle Planning



Municipal Bridges - Preservation Candidates



Recommended Actions

Recommended Actions and Frequencies

	Activity	Target Frequency
Preventative Maintenance	Bridge Sweeping / Debris Removal	Annually
	Bridge Washing & Flushing	Annually
	Cleaning Drainage Systems	Annually
	Sealing Exposed Concrete Surfaces	5 – 10 years
	Replacing Joint Seals	5 – 15 years
Condition based	Clean & Paint	20 – 30 years
	Wearing Surface Replacement	12 – 15 years (HMA) 20 – 25 years (Concrete)
	Concrete Patching	As Needed
	Repair / Replace Joints	As Needed
	Beam Repairs	As Needed

Preventative Maintenance

- Bridge Sweeping / Debris Removal
- Bridge Washing & Flushing
- Cleaning Drainage Systems
- Sealing Exposed Concrete Surfaces
- Sealing Concrete Cracks
- Replacing Joint Seals

Bridge Sweeping and Debris Removal

Benefits:

- Protects concrete curbs on bridge which are most vulnerable to deterioration
- Keeps road salt off the bridge which prevents chloride penetration
- Extends pavement life
- Prevents puddles, vegetation, moss, and algae from forming on the deck

Bridge Sweeping and Debris Removal

Actions:

- Regular street sweeping
- Broom sweep curbs and street
- Clean vertical concrete surfaces with compressed air
- Weed vegetation that has established

Bridge Washing & Flushing

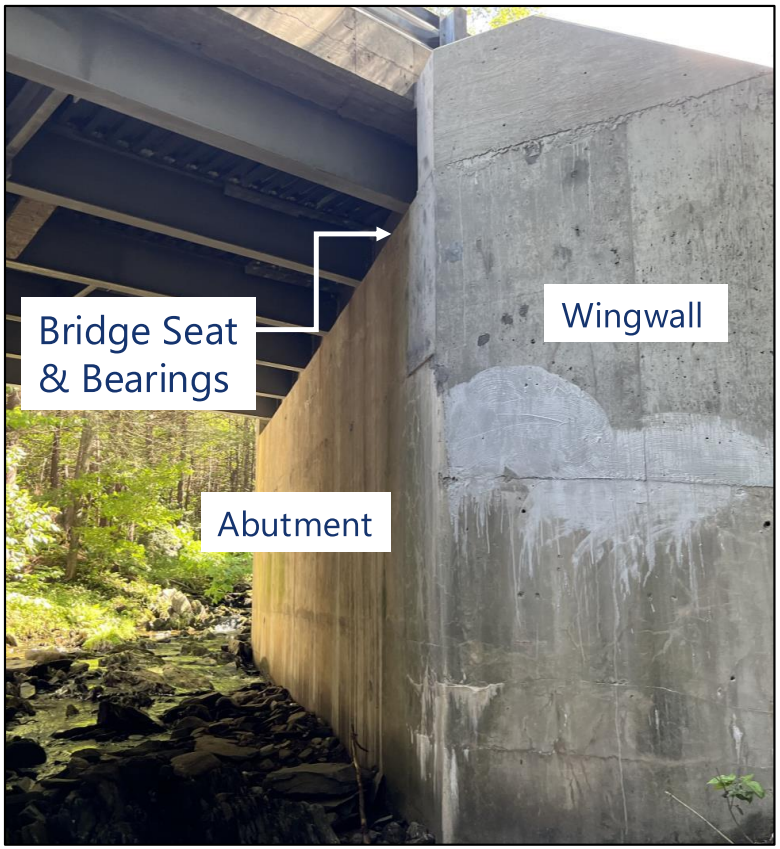
Benefits:

- Flushing and washing reduces the potential of chloride intrusion in the deck
- Essential for proper joint and bearing movement
- Extends the life of steel coating systems
- Annual washing can extend bridge life

Bridge Washing & Flushing

Actions:

- Bring a flusher truck, fire truck, or connect to a hydrant to hose down bridge elements
- Sweep & collect any large debris for disposal
- Flush the deck, barriers, faces of abutments & wingwalls, bridge seats & bearings
- Hose down beam ends, trusses, & end diaphragms
- Rinse steel open grate decks

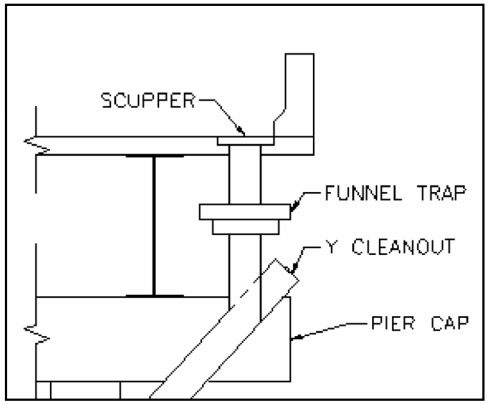


⚠ Be aware of environmental regulations.

Cleaning Drainage Systems

Benefits

- Extends life of the deck and pavement
- Prevents chloride penetration into concrete
- Keeps surfaces free of road salt
- Protects exterior beams from deterioration
- Keeps puddles off the bridge
- Prevents drainpipes from overflowing onto steel girders



Cleaning Drainage Systems

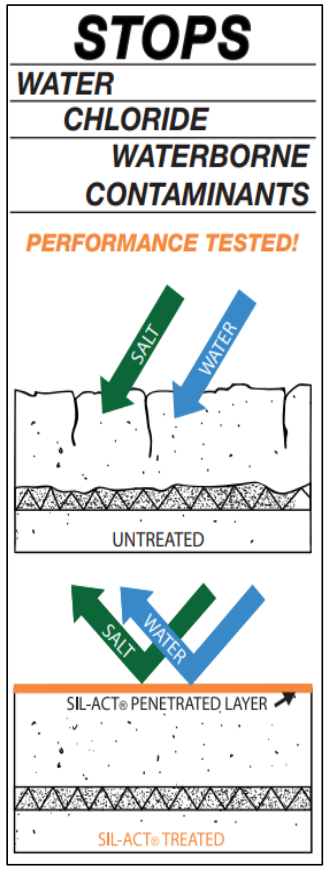
Actions

- Keep catch basins clear
- Extra attention to the bridges at roadway low points
- Ensure swales or catch basins adjacent to bridges are functioning
- Ensure no breaks/misalignments in drainpipes
- Remove and appropriately dispose of debris in catch basins and other parts of the drainage system

Sealing Exposed Concrete Surfaces

Benefits

- Achieves a depth of penetration into the concrete that seals and protects without impacting slip/skid resistance
- Protects concrete including reinforcing against deicing chemicals
- Can be used to protect concrete, brick, masonry, cementitious mortar, and natural stones



Sealing Exposed Concrete Surfaces

Actions

- Select a sealer that is applicable for the intended application since depending on product application may be limited to one or more of the following; horizontal, vertical and overhead surfaces
- Certain products are good for specific applications and other materials (silanes, elastomeric, acrylic, etc.)
- Most have spray, roll on, or brush applications
- Apply every 5 to 10 years, see manufacturer's recommendations

Sealing Concrete Cracks

Benefits

- Seals cracks in the bridge deck concrete or substructure to prevent the intrusion of moisture, de-icing chemicals and other damaging environmental affects
- Most effective when placed early, after initial shrinkage cracking and prior to exposure to de-icing chemicals

Sealing Concrete Cracks

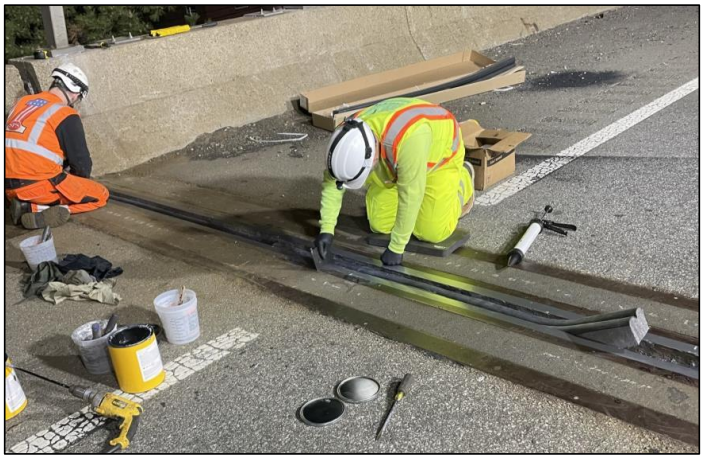
Actions

- Variety of Products and Categories available based on crack sizes
- Great for bare concrete deck bridges (no HMA), concrete railings, and substructures
- Not for paved bridge decks - better to apply a full waterproofing membrane
- Extend the life 25+ years

Replacing Joint Seals

Benefits

- Extends the lifespan of the weakest aspect of the bridge
- Maintaining the joint seals prevents water from getting into your bridge
- Leaky joints lead to rusty steel beam ends - Protect your beams!
- Joint maintenance is the key to bridge longevity!

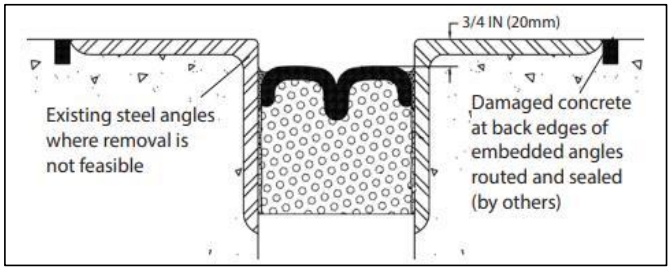


Replacing Joint Seals

Action

- Two seal replacement strategies.
  - Replace seal in kind
  - Replace with a pre-compressed or other seal type that adheres to sides of joint

Retrofit Armored Joint with Pre-compressed



See it in action!
https://dsbrown.com/product/strip-sealer-tool/

Preventative Maintenance Summary

PREVENTATIVE MAINTENANCE ACTION	IN HOUSE?	CONTRACTOR?	ENGINEER?	MASSDOT
BRIDGE SWEEPING / DEBRIS REMOVAL	Yes	Yes	No	Standard Special Provisions
BRIDGE WASHING & FLUSHING	Yes, if no permitting required	Yes	No	Standard Special Provisions
SEALING EXPOSED CONCRETE SURFACES	Yes	Yes	No	QCML, Standard Special Provisions
SEALING CONCRETE CRACKS	Yes	Yes	> 1/8" verify not structural cracking	QCML, Standard Special Provisions
REPLACING JOINT SEALS	Yes	Yes	Only when sizing unknown	QCML, Standard Special Provisions

Condition-Based Maintenance

- Clean and Paint Steel
- Wearing Surface Replacement
- Concrete Patching
- Repair / Replace Joints
- Beam Repairs

Clean and Paint Steel

Benefits

- Maintaining the coating system on steel beams is the key to avoiding corrosion
- Cleaning off failed paint and applying a three-coat paint system can provide 25 to 30 years of protection
- Spot painting extends service life of existing coating system
- Cleaning steel also gives the opportunity to clearly see and measure steel deterioration

Clean and Paint Steel

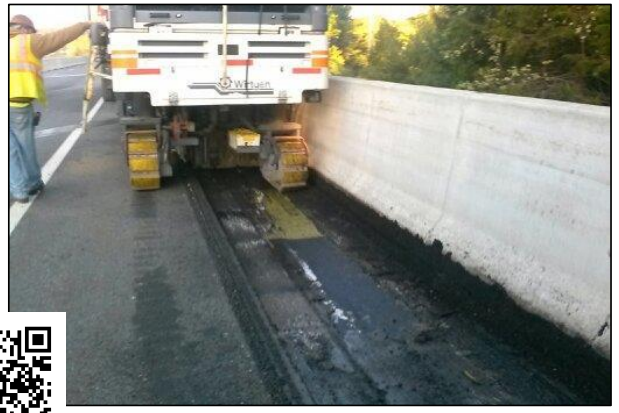
Actions

- Containment installed and paint removed by power tools or blasting
- Prime coat applied by spray, roller, or brush
- Cured between coats (prime, mid, and finish)
- Worker safety and environmental regulations need to be followed
- Maintenance personnel may perform spot paint repairs if properly trained

Wearing Surface Replacement

Benefits

- Protect the deck which is like the roof of your house
- Smooth the riding surface for users
- Most cost effective when installed prior to concrete spalling caused by corrosion of steel reinforcing

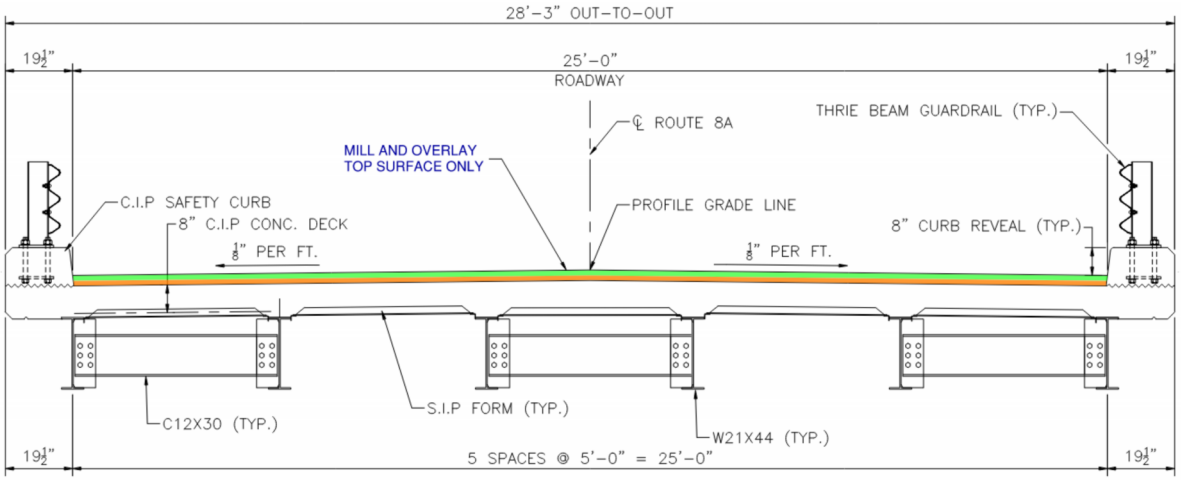


See it in action!
https://www.hydro-technologies.com/videos/

Wearing Surface Replacement

Actions

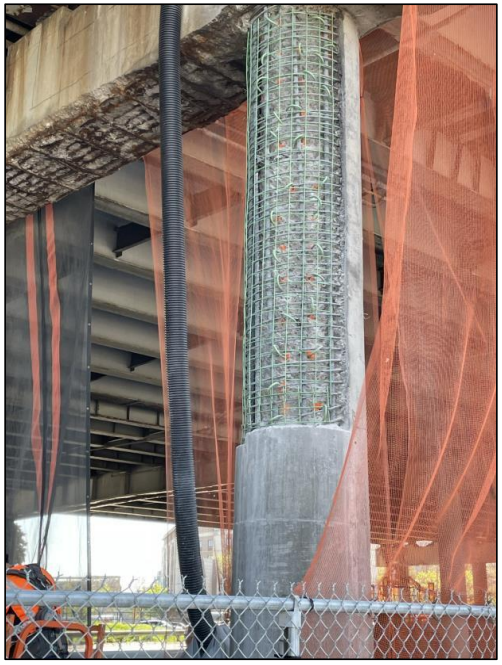
- Asphalt Wearing Surface
  - Determine asphalt thickness
  - Mill & Overlay (top surface only)
  - Full Strip with waterproofing membrane or mix
- Exposed concrete decks hydrodemo and overlay



Concrete Patching

Benefits

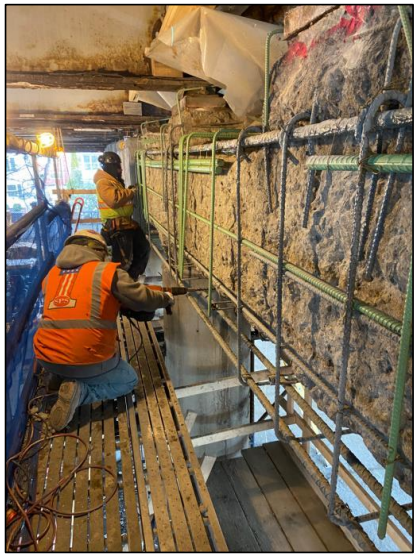
- Aids in the protection of rebar from corrosion
- Chipping out deteriorated concrete will expose deteriorated rebar
- Concrete patch materials are less permeable to further protect rebar
- Extend life of your concrete bridge elements



Concrete Patching

Actions

- Remove pavement (if present)
- Mark out extents of repair and sawcut clean edges then use chipping hammer to remove loose concrete
- Chip out concrete, and expose the rebar (if any) to at least 1" below rebar
- Thoroughly clean concrete surface, clean rebar, and determine if new bars needed
- Pour concrete to fill excavated concrete area
- For Deck Patches
  - Wait until the concrete sets enough and reopen to traffic with a temporary asphalt on top. Typically 2-3 hours with a rapid set.
  - Remove temporary asphalt and place waterproofing and final asphalt at least 14 days after patch has cured.
  - If you can close or partially close the road a regular mix can be used to provide longer life to the patches.



Joint Repair & Replacement

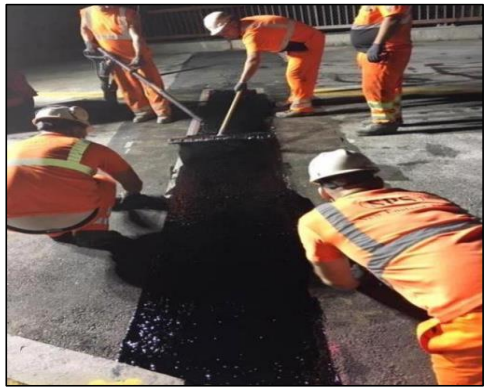
Benefits:

- Proper joints allow the bridge to move transversely and longitudinally as intended
- Protect the superstructure and substructure elements below the bridge deck from water runoff, adverse chemicals, and debris buildup
- Joint replacement is the best investment you can make in your bridge

Joint Repair & Replacement

Actions:

- Vary per joint type but two common examples are strip seal and asphaltic plug
- Strip Seal Joint
  - Retrofit with Pre-compressed joint Replace concrete headers
  - Weld in portion of armoring
- Asphaltic Plug Joint
  - Replace asphaltic binder
  - Replace pre-compressed seal below the binder then do new binder



Beam Repairs – Steel Beams

Benefits:

- Extend the life of steel beams
- Beam end deterioration is the most common issue resulting in a bridge reduced load capacity (i.e. posting and closure)
- Improve capacity of the beams to the original design or better

Beam Repairs – Steel Beams

Actions:

- Clean area of steel
- Ensure area is clean of laitance and oils
- Install repair plates, plates sized to be bigger than deteriorated area
- Paint the repair in-place, existing steel and new plates

Beam Repairs – Concrete Beams

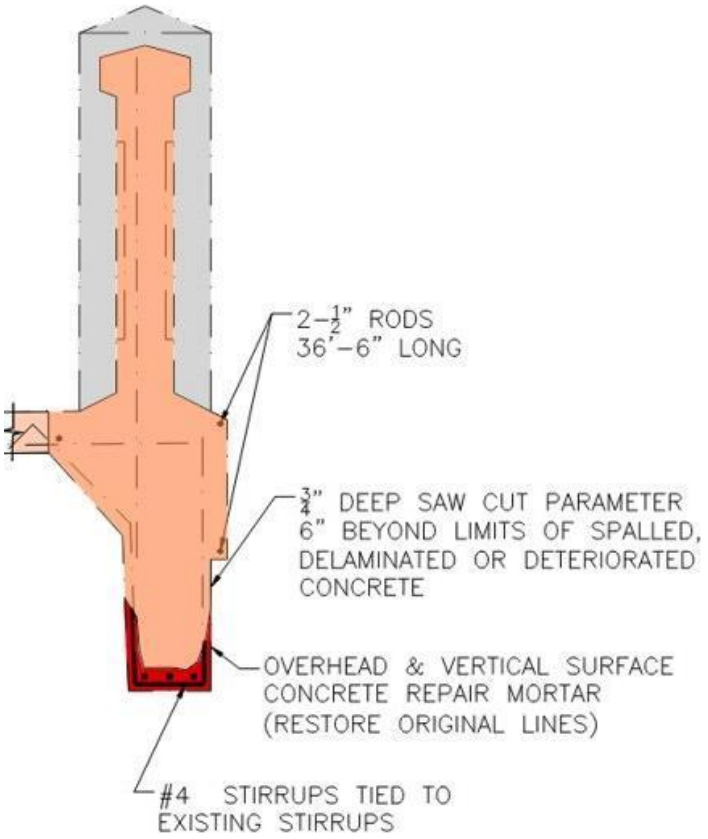
Benefits:

- Extend the life of concrete beams
- Prestressing strand and reinforced steel deterioration effect bridge capacity
- Improve capacity of the beams to the original design or better

Beam Repairs – Concrete Beams

Actions:

- Mark out extents of repair and sawcut neat lines
- Chip out concrete, ensuring space behind the rebar
- Check if rebar is deteriorated and determine if new bars needed
- Clean and prep for grout
- Form to original faces of the beam and cast grout



Condition Based Maintenance Summary

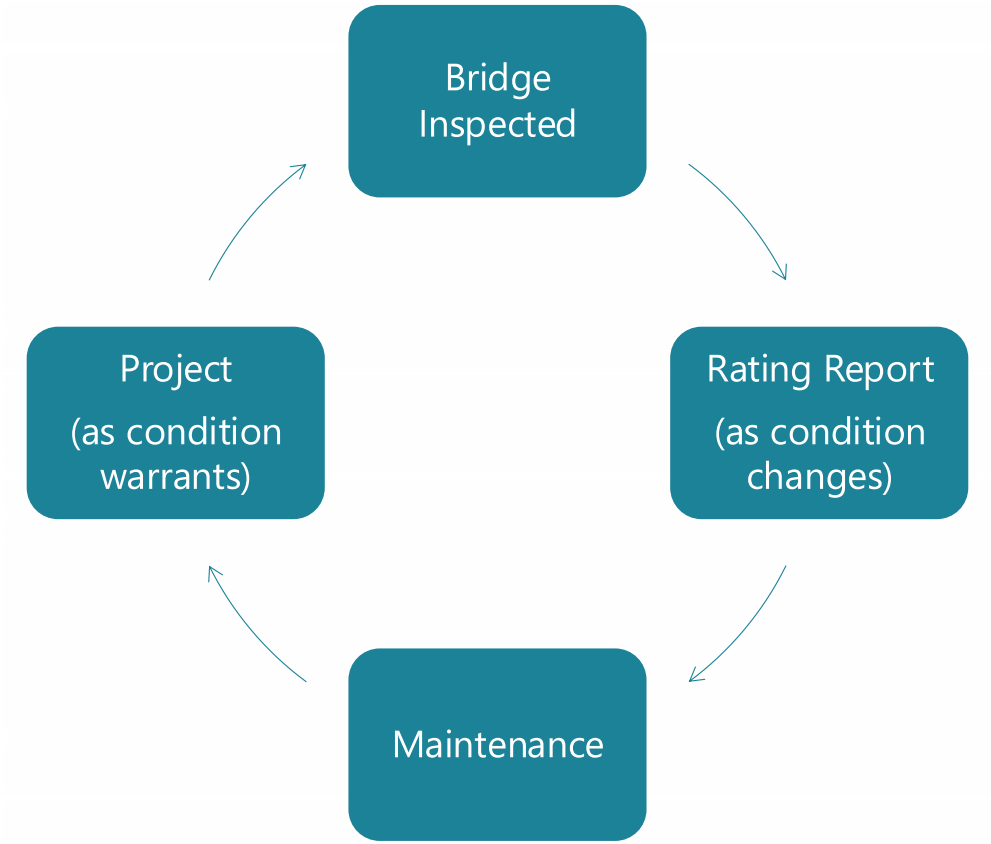
CONDITION BASED MAINTENANCE ACTION	IN HOUSE?	CONTRACTOR?	ENGINEER?	MASSDOT
CLEAN & PAINT STEEL	Potentially Spot Painting	Full removal, lead paint	Potentially if repairs needed	Standard Special Provisions
WEARING SURFACE REPLACEMENT	Potentially	Yes	Yes, check bridge rating for equipment and surface	Standard Special Provisions and Details
CONCRETE PATCHING	Potentially	Yes	Potentially for significant excavation or if shoring required	QCML, Standard Special Provisions and Details
REPAIR / REPLACE JOINTS	Potentially	Yes	Potentially to size joints	Standard Special Provisions and Details
BEAM REPAIRS	Potentially	Yes	Yes	QCML, Standard Special Provisions

From Inspection or Rating to Project

massDOT Massachusetts Department of Transportation Highway Division | vhb

In-Service Bridge Life

During the life of a bridge, it is routinely inspected which can trigger re-rating (evaluation of structural capacity) and maintenance / preservation activities.



What is this report?

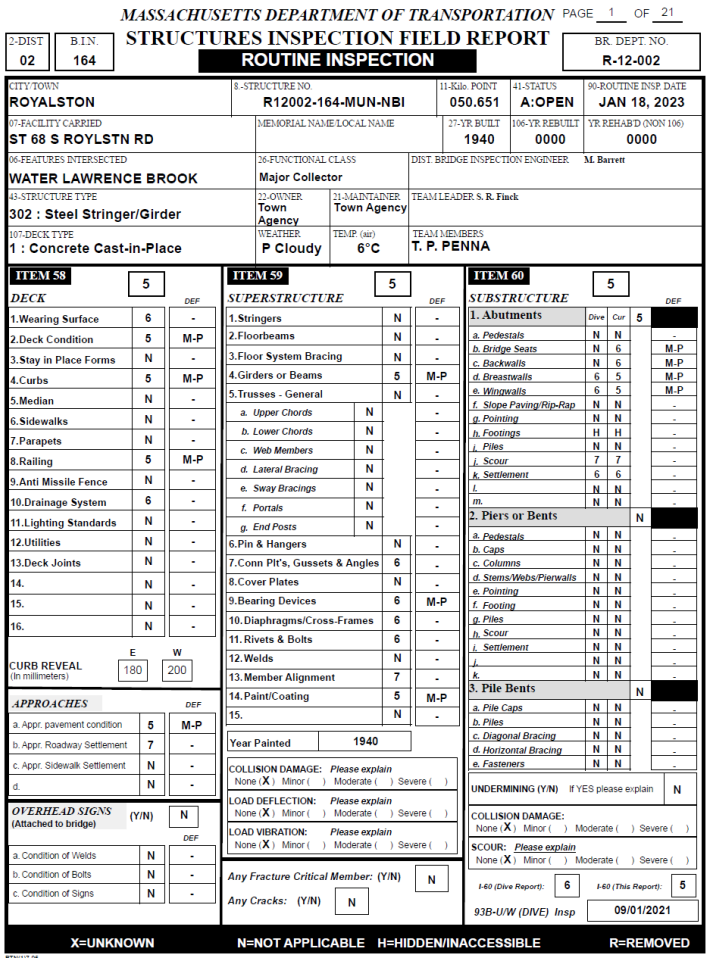
Inspection Report

- A report after a field inspection of a bridge documenting all conditions and deficiencies.
- Many categories from routine inspections (typically every other year) to special member (frequency increases dependent upon need).

Rating Report

- A report documenting the load carrying capacity of the bridge in relation to the expected trucks on the bridge.
- Basis for load posting signs.

Inspection Report – Page 1



MASSACHUSETTS DEPARTMENT OF TRANSPORTATION PAGE 1 OF 21

STRUCTURES INSPECTION FIELD REPORT

ROUTINE INSPECTION

2-DIST	B.I.N.	BR. DEPT. NO.
02	164	R-12-002

CITY/TOWN	8.-STRUCTURE NO.	11-Kilo. POINT	41-STATUS	90-ROUTINE INSP. DATE
ROYALSTON	R12002-164-MUN-NBI	050.651	A:OPEN	JAN 18, 2023

07-FACILITY CARRIED	MEMORIAL NAME/LOCAL NAME	27-YR BUILT	106-YR REBUILT	YR REHAB'D (NON 106)
ST 68 S ROYLSTN RD		1940	0000	0000

06-FEATURES INTERSECTED	26-FUNCTIONAL CLASS	DIST. BRIDGE INSPECTION ENGINEER
WATER LAWRENCE BROOK	Major Collector	M. Barrett

43-STRUCTURE TYPE	22-OWNER	21-MAINTAINER	TEAM LEADER
302 : Steel Stringer/Girder	Town Agency	Town Agency	S. R. Finck

107-DECK TYPE	WEATHER	TEMP. (air)	TEAM MEMBERS
1 : Concrete Cast-in-Place	P Cloudy	6°C	T. P. PENNA

ITEM 58 — 5

DECK

		DEF
1.Wearing Surface	6	-
2.Deck Condition	5	M-P
3.Stay in Place Forms	N	-
4.Curbs	5	M-P
5.Median	N	-
6.Sidewalks	N	-
7.Parapets	N	-
8.Railing	5	M-P
9.Anti Missile Fence	N	-
10.Drainage System	6	-
11.Lighting Standards	N	-
12.Utilities	N	-
13.Deck Joints	N	-
14.	N	-
15.	N	-
16.	N	-

CURB REVEAL (In millimeters)	E	W
	180	200

APPROACHES

		DEF
a. Appr. pavement condition	5	M-P
b. Appr. Roadway Settlement	7	-
c. Appr. Sidewalk Settlement	N	-
d.	N	-

OVERHEAD SIGNS (Attached to bridge) (Y/N) N

		DEF
a. Condition of Welds	N	-
b. Condition of Bolts	N	-
c. Condition of Signs	N	-

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SUPERSTRUCTURE

		DEF
1.Stringers	N	-
2.Floorbeams	N	-
3.Floor System Bracing	N	-
4.Girders or Beams	5	M-P
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 Pl's, Gussets & Angles	6	-
8.Cover Plates	N	-
9.Bearing Devices	6	M-P
10.Diaphragms/Cross-Frames	6	-
11.Rivets & Bolts	6	-
12.Welds	N	-
13.Member Alignment	7	-
14.Paint/Coating	5	M-P
15.	N	-

Year Painted 1940

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

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

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

Any Fracture Critical Member: (Y/N) N

Any Cracks: (Y/N) N

ITEM 60 — 5

SUBSTRUCTURE

	Dive	Cur	DEF
1. Abutments		5	
a. Pedestals	N	N	-
b. Bridge Seats	N	6	M-P
c. Backwalls	N	6	M-P
d. Breastwalls	6	5	M-P
e. Wingwalls	6	5	M-P
f. Slope Paving/Rip-Rap	N	N	-
g. Pointing	N	N	-
h. Footings	H	H	-
i. Piles	N	N	-
j. Scour	7	7	-
k. Settlement	6	6	-
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.	N	N	-
3. Pile Bents		N	
a. Pile Caps	N	N	-
b. Piles	N	N	-
c. Diagonal Bracing	N	N	-
d. Horizontal Bracing	N	N	-
e. Fasteners	N	N	-

UNDERMINING (Y/N) If YES please explain N

COLLISION DAMAGE: None (X) Minor ( ) Moderate ( ) Severe ( )

SCOUR: *Please explain* None (X) Minor ( ) Moderate ( ) Severe ( )

I-60 (Dive Report): 6 *I-60 (This Report):* 5

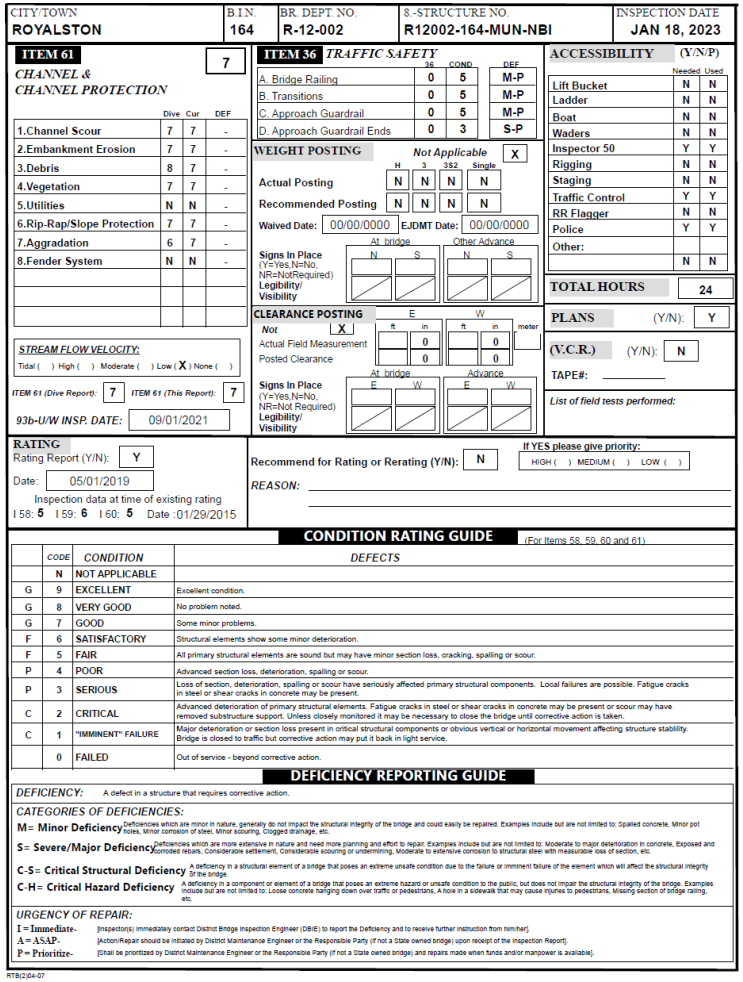
93B-U/W (DIVE) Insp 09/01/2021

X=UNKNOWN N=NOT APPLICABLE H=HIDDEN/INACCESSIBLE R=REMOVED

Inventory & Bridge Information

Condition Information

Inspection Report – Page 2



CITY/TOWN	B.I.N.	BR. DEPT. NO.	8.-STRUCTURE NO.	INSPECTION DATE
ROYALSTON	164	R-12-002	R12002-164-MUN-NBI	JAN 18, 2023

ITEM 61 7 — *CHANNEL & CHANNEL PROTECTION*

	Dive	Cur	DEF
1.Channel Scour	7	7	-
2.Embankment Erosion	7	7	-
3.Debris	8	7	-
4.Vegetation	7	7	-
5.Utilities	N	N	-
6.Rip-Rap/Slope Protection	7	7	-
7.Aggradation	6	7	-
8.Fender System	N	N	-

STREAM FLOW VELOCITY: Tidal ( ) High ( ) Moderate ( ) Low (X) None ( )

ITEM 61 (Dive Report): 7 ITEM 61 (This Report): 7

93b-U/W INSP. DATE: 09/01/2021

ITEM 36 *TRAFFIC SAFETY*

	36	COND	DEF
A. Bridge Railing	0	5	M-P
B. Transitions	0	5	M-P
C. Approach Guardrail	0	5	M-P
D. Approach Guardrail Ends	0	3	S-P

WEIGHT POSTING Not Applicable X

	H	3	3S2	Single
Actual Posting	N	N	N	N
Recommended Posting	N	N	N	N

Waived Date: 00/00/0000 EJDMT Date: 00/00/0000

Signs In Place (Y=Yes,N=No, NR=NotRequired) Legibility/ Visibility — At bridge N S; Other Advance N S

CLEARANCE POSTING Not X

	E ft	E in	W ft	W in	meter
Actual Field Measurement		0		0	
Posted Clearance		0		0	

Signs In Place (Y=Yes,N=No, NR=Not Required) Legibility/ Visibility — At bridge E W; Advance E W

ACCESSIBILITY (Y/N/P)

	Needed	Used
Lift Bucket	N	N
Ladder	N	N
Boat	N	N
Waders	N	N
Inspector 50	Y	Y
Rigging	N	N
Staging	N	N
Traffic Control	Y	Y
RR Flagger	N	N
Police	Y	Y
Other:		
	N	N

TOTAL HOURS 24

PLANS (Y/N): Y

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

TAPE#:

List of field tests performed:

RATING

Rating Report (Y/N): Y

Date: 05/01/2019

Inspection data at time of existing rating I 58: 5 I 59: 6 I 60: 5 Date :01/29/2015

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

If YES please give priority: HIGH ( ) MEDIUM ( ) LOW ( )

REASON:

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].

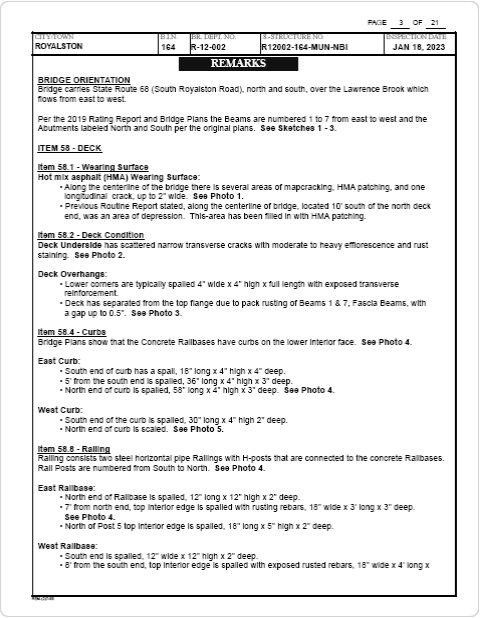
RTB(2)04-07

Condition Information and additional inspection and rating information

Guides for decoding first two pages

Parts of an Inspection Report

Following first two pages are a number of pages of text which explain the details of the conditions for each of the elements with a number on the first two pages. Following these are sketches, charts, and photos all referenced in the text.



PAGE 3 OF 21

CITY/TOWN	B.I.N.	BR. DEPT NO.	E-STRUCTURE NO.	INSPECTION DATE
ROYALSTON	164	R-12-002	R12002-164-MUN-NBI	JAN 18, 2023

REMARKS

BRIDGE ORIENTATION
Bridge carries State Route 68 (South Royalston Road), north and south, over the Lawrence Brook which flows from east to west.

Per the 2019 Railing Report and Bridge Plans the Beams are numbered 1 to 7 from east to west and the Abutments labeled North and South per the original plans. **See Sketches 1 - 3.**

ITEM 58 - DECK

Item 58.1 - Wearing Surface
Hot mix asphalt (HMA) Wearing Surface:
- Along the centerline of the bridge there is several areas of mapcracking, HMA patching, and one longitudinal crack, up to 2" wide. **See Photo 1.**
- Previous Routine Report stated, along the centerline of bridge, located 10' south of the north deck end, was an area of depression. This-area has been filled in with HMA patching.

Item 58.2 - Deck Condition
Deck Underside has scattered narrow transverse cracks with moderate to heavy efflorescence and rust staining. **See Photo 2.**

Deck Overhangs:
- Lower corners are typically spalled 4" wide x 4" high x full length with exposed transverse reinforcement.
- Deck has separated from the top flange due to pack rusting of Beams 1 & 7, Fascia Beams, with a gap up to 0.5". **See Photo 3.**

Item 58.4 - Curbs
Bridge Plans show that the Concrete Railbases have curbs on the lower interior face. **See Photo 4.**

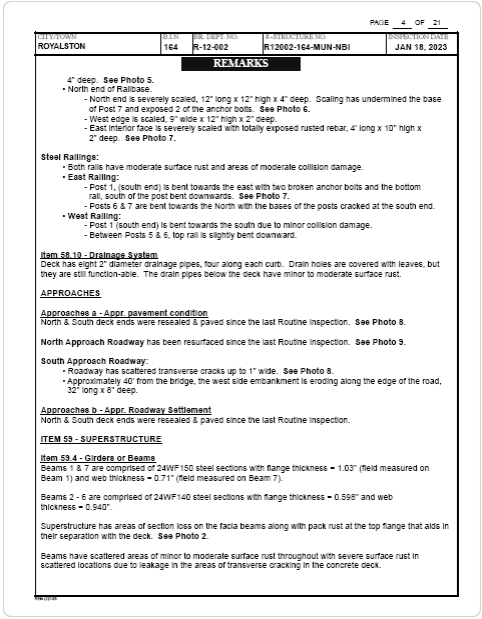
East Curb:
- South end of curb has a spall, 18" long x 4" high x 4" deep.
- 5' from the south end is spalled, 36" long x 4" high x 3" deep.
- North end of curb is spalled, 58" long x 4" high x 3" deep. **See Photo 4.**

West Curb:
- South end of the curb is spalled, 30" long x 4" high 2" deep.
- North end of curb is scaled. **See Photo 5.**

Item 58.8 - Railing
Railing consists two steel horizontal pipe Railings with H-posts that are connected to the concrete Railbases. Rail Posts are numbered from South to North. **See Photo 4.**

East Railbase:
- North end of Railbase is spalled, 12" long x 12" high x 2" deep.
- 7' from north end, top interior edge is spalled with rusting rebars, 18" wide x 3' long x 3" deep. **See Photo 4.**
- North of Post 5 top interior edge is spalled, 18" long x 5" high x 2" deep.

West Railbase:
- South end is spalled, 12" wide x 12" high x 2" deep.
- 8' from the south end, top interior edge is spalled with exposed rusted rebars, 18" wide x 4' long x



PAGE 4 OF 21

CITY/TOWN	B.I.N.	BR. DEPT NO.	E-STRUCTURE NO.	INSPECTION DATE
ROYALSTON	164	R-12-002	R12002-164-MUN-NBI	JAN 18, 2023

REMARKS

4" deep. **See Photo 5.**
- North end of Railbase.
  - North end is severely scaled, 12" long x 12" high x 4" deep. Scaling has undermined the base of Post 7 and exposed 2 of the anchor bolts. **See Photo 6.**
  - West edge is scaled, 9" wide x 12" high x 2" deep.
  - East interior face is severely scaled with totally exposed rusted rebar, 4' long x 10" high x 2" deep. **See Photo 7.**

Steel Railings:
- Both rails have moderate surface rust and areas of moderate collision damage.
- **East Railing:**
  - Post 1, (south end) is bent towards the east with two broken anchor bolts and the bottom rail, south of the post bent downwards. **See Photo 7.**
  - Posts 6 & 7 are bent towards the North with the bases of the posts cracked at the south end.
- **West Railing:**
  - Post 1 (south end) is bent towards the south due to minor collision damage.
  - Between Posts 5 & 6, top rail is slightly bent downward.

Item 58.10 - Drainage System
Deck has eight 2" diameter drainage pipes, four along each curb. Drain holes are covered with leaves, but they are still function-able. The drain pipes below the deck have minor to moderate surface rust.

APPROACHES

Approochse a - Appr. pavement condition
North & South deck ends were resealed & paved since the last Routine Inspection. **See Photo 8.**

North Approach Roadway has been resurfaced since the last Routine Inspection. **See Photo 9.**

South Approach Roadway:
- Roadway has scattered transverse cracks up to 1" wide. **See Photo 8.**
- Approximately 40' from the bridge, the west side embankment is eroding along the edge of the road, 32" long x 8" deep.

Approochse b - Appr. Roadway Settlement
North & South deck ends were resealed & paved since the last Routine Inspection.

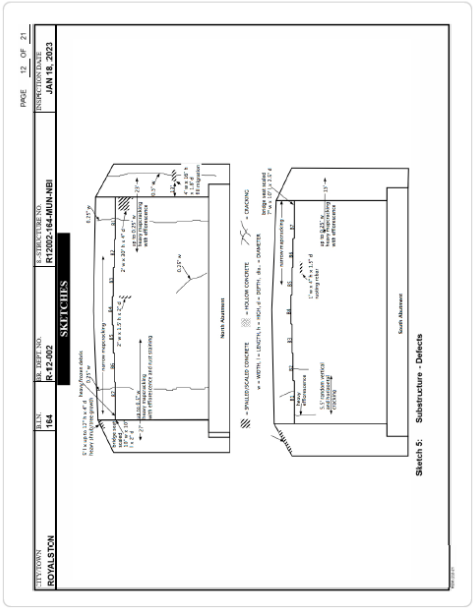
ITEM 59 - SUPERSTRUCTURE

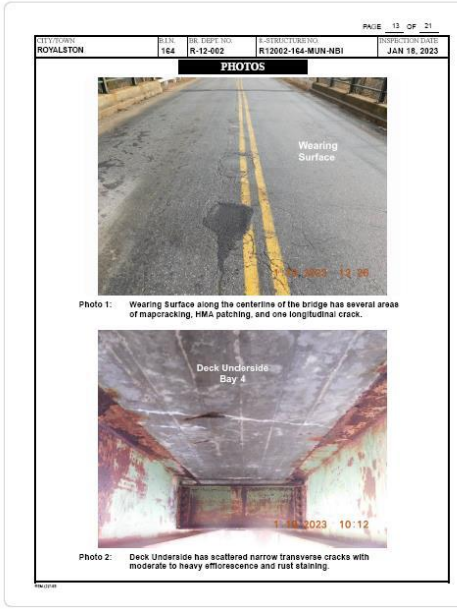
Item 59.4 - Girders or Beams
Beams 1 & 7 are comprised of 24WF150 steel sections with flange thickness = 1.03" (field measured on Beam 1) and web thickness = 0.71" (field measured on Beam 7).

Beams 2 - 6 are comprised of 24WF140 steel sections with flange thickness = 0.598" and web thickness = 0.940".

Superstructure has areas of section loss on the facia beams along with pack rust at the top flange that aids in their separation with the deck. **See Photo 2.**

Beams have scattered areas of minor to moderate surface rust throughout with severe surface rust in scattered locations due to leakage in the areas of transverse cracking in the concrete deck.





PAGE 13 OF 21

CITY/TOWN	B.I.N.	BR. DEPT NO.	E-STRUCTURE NO.	INSPECTION DATE
ROYALSTON	164	R-12-002	R12002-164-MUN-NBI	JAN 18, 2023

PHOTOS

Photo 1: Wearing Surface along the centerline of the bridge has several areas of mapcracking, HMA patching, and one longitudinal crack.

Photo 2: Deck Underside has scattered narrow transverse cracks with moderate to heavy efflorescence and rust staining.

Inspection Report – National Bridge Element Inspection

National Bridge Element Inspection

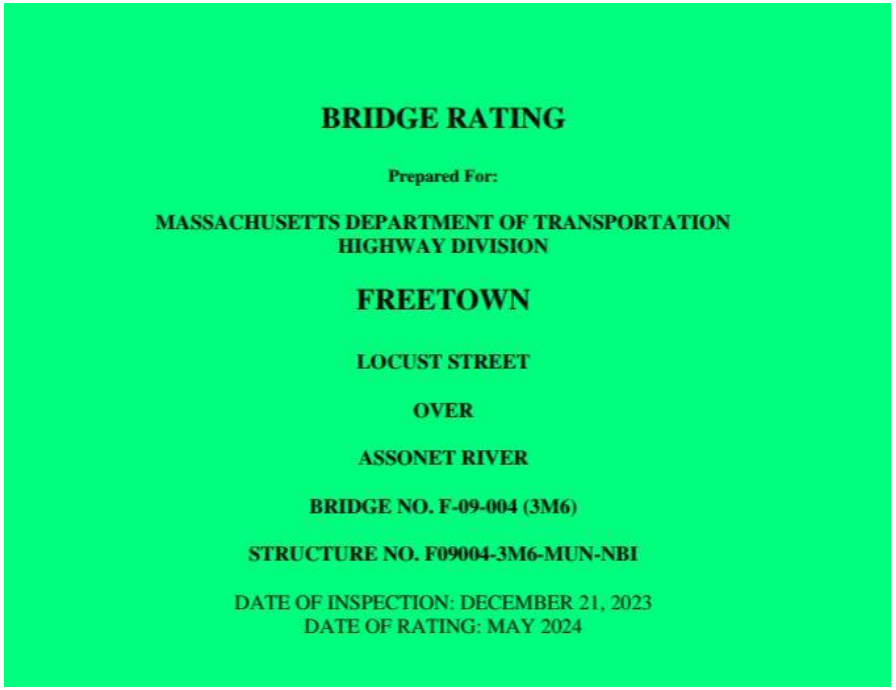
BDEPT#	**R-12-002**	Date	**01/18/2023**
B.I.N.	**164**	District Bridge Inspection Eng'r	**Matthew Barrett**
Item 8	**R12002-164-MUN-NBI**	Inspecting Agency	**Mass. Highway Dept.**
Span Group	**1**	Team Leader	**Steven R. Finck**
Town	**Royalston**	Team Member(s)	**Thomas P. Penna**
District	**2**		

Good Condition to Poor Condition

El #	Element Name	Units	Env.	Total Q.	% or Q	State 1	State 2	State 3	State 4
12	**Re Concrete Deck**	sq feet	2	1,300.000	☐ %	900.000		400.000	
Notes :									
> *1120*	*Efflorescence/Rust Staining*	sq feet	2	400.000	☐ %			400.000	
Notes :									
> 510	Wearing Surfaces	sq feet	2	1,120.000	☐ %	1,069.000		51.000	
Notes :									
> > *3210*	*Del/Spall/Patch/Pot(Wear Surf)*	sq feet	2	3.000	☐ %			3.000	
Notes :									
> > *3220*	*Crack (Wearing Surface)*	sq feet	2	48.000	☐ %			48.000	
Notes :									
107	**Steel Opn Girder/Beam**	feet	2	312.000	☐ %		223.000	89.000	
Notes :									
> *1000*	*Corrosion*	feet	2	312.000	☐ %		223.000	89.000	
Notes :									
> 515	Steel Protective Coating	sq feet	2	2,230.000	☐ %		1,593.000	637.000	
Notes :									
> > *3440*	*Eff (Stl Protect Coat)*	sq feet	2	2,230.000	☐ %		1,593.000	637.000	
Notes :									

Element data gives a quick look at quantities and their condition. This could help determine the types of repairs needed

Rating Report - Cover



BRIDGE RATING

Prepared For:

MASSACHUSETTS DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

FREETOWN

LOCUST STREET

OVER

ASSONET RIVER

BRIDGE NO. F-09-004 (3M6)

STRUCTURE NO. F09004-3M6-MUN-NBI

DATE OF INSPECTION: DECEMBER 21, 2023
DATE OF RATING: MAY 2024

- The color of the over provides information visually so you quickly understand bridge live load carrying capacity
- The front and back cover that shall be color coded as follows:
  - RED, if the rating for any posting vehicle is 6 tons or less
  - YELLOW, if the rating for any posting vehicle is more than 6 tons but less than statutory
  - GREEN if the rating for any posting vehicle is statutory or greater

Rating Report – Summary of Bridge Rating

SUMMARY OF BRIDGE RATING

TOWN/CITY: DANA-PRESCOTT BRIDGE NO.: D-02-033=P-15-015

CARRIES: MAIN STREET OVER: SWIFT RIVER

STRUCTURE NO.: D02033-BG1-DOT-NBI BIN NO.: BG1

RATINGS (TONS)

LRFR RATINGS FOR RATING VEHICLES LOAD RATINGS IN ENGLISH TONS		
VEHICLE TYPE	INVENTORY	OPERATING
H20	48.6	63.2
TYPE 3	48.8	63.4
TYPE 3S2	54.0	70.2
SU4	29.1	45.2
SU5	33.3	49.4
SU6	35.5	51.6
SU7	41.7	58.8
EV2	-	35.0
EV3	-	46.0

HL-93 LOAD AND RESISTANCE FACTOR RATING FACTORS PROVIDED IN COMPLIANCE WITH THE FHWA NBIS CODING GUIDE	
INVENTORY	OPERATING
ITEM 66	ITEM 64
1.2	2.3

A posting recommendation has been made based on the results of this Rating Report. This recommendation is contained in the "Memorandum to the NBIS File" for this bridge, dated _____.

Rating Engineer P.E. Stamp State Bridge Engineer Date

The summary table quickly tells you the two rating levels and truck size for the overall controlling members of the bridge. These can be compared to the overall weight of the vehicles.

Inventory is an infinite life with the loading.

Operating is a finite life with the loading.

These are two different stress ranges allowed and compared to what the load imparts on the structure.

Rating Report – Breakdown of Bridge Rating

BREAKDOWN OF BRIDGE RATING

TOWN/CITY: DANA-PRESCOTT BRIDGE NO.: D-02-033=P-15-015

CARRIES: MAIN STREET OVER: SWIFT RIVER

STRUCTURE NO.: D02033-BG1-DOT-NBI BIN NO.: BG1

BRIDGE ELEMENT[1]		INVENTORY RATING BY LRFR METHOD (ENGLISH TONS)			OPERATING RATING BY LRFR METHOD (ENGLISH TONS)		
		H20	Type 3	Type 3S2	H20	Type 3	Type 3S2
EXTERIOR SIDEWALK BEAMS, NO.1 & 5	CONCRETE SHEAR AT H/2	40.8	47.2	73.2	52.3	61.1	94.9
	CONCRETE TENSION @ SERVICE AT 0.50L	25.3	31.7	48.4	-	-	-
	CONCRETE COMPRESSION @ SERVICE AT 0.50L	30.2	37.8	57.8	-	-	-
	FLEXURAL STRENGTH AT 0.50L	35.0	43.9	67.1	45.4	56.9	87.0
1ST INTERIOR ROADWAY BEAMS, NO.2 & 4	CONCRETE SHEAR AT H/2	32.6	37.7	58.5	42.3	48.8	75.9
	CONCRETE TENSION @ SERVICE AT 0.50L	31.2	39.1	59.8	-	-	-
	CONCRETE COMPRESSION @ SERVICE AT 0.50L	33.4	44.5	68.1	-	-	-
	FLEXURAL STRENGTH AT 0.50L	35.5	44.5	68.1	46.0	57.7	89.1
INTERIOR BEAMS, NO.3 - NO.6	CONCRETE SHEAR AT H/2	32.7	37.7	58.6	42.3	48.9	75.9
	CONCRETE TENSION @ SERVICE AT 0.50L	**18.9**	**23.7**	**36.2**	-	-	-
	CONCRETE COMPRESSION @ SERVICE AT 0.50L	21.2	26.6	40.6	-	-	-
	FLEXURAL STRENGTH AT 0.50L	23.5	29.4	45.0	**30.4**	**38.2**	**58.4**

Shaded cells are controlling ratings
Highlighted values are below statutory

Note:
For this report, beams and bays are numbered from the south consistent with the latest Routine Inspection Report

The breakdown provides more detail and allows you to pinpoint the location of the issues. The colors indicate whether it is above statutory or below. Less than 6 tons would be shaded red similar to the cover.

Rating Report – Evaluation of Rating & Recommendations

EVALUATION OF RATING AND RECOMMENDATIONS

The inventory level ratings by the allowable stress method are governed by flexure at midspan of typical interior roadway Beams 3 through 6 for all vehicles.

The governing inventory values in tons are 12.1, 16.4, 23.9, 19.8, 14.6, 15.6, 15.9, and 17.0 for the H20, Type 3, Type 3S2, HS20, SU4, SU5, SU6, and SU7 vehicles, respectively. All vehicles are below statutory at the inventory level.

The operating level ratings by the allowable stress method are governed by flexure at midspan of typical interior roadway Beams 3 through 6 for all vehicles except for the HS-20 and EV2 vehicles. The HS-20 and EV2 vehicles are governed at the operating level by flexure at 0.40L of typical interior roadway Beams 3 through 6.

The governing operating values in tons are 29.0, 39.3, 57.2, 46.4, 34.9, 37.4, 38.2, 40.8, 38.9, and 37.2 for the H20, Type 3, Type 3S2, HS20, SU4, SU5, SU6, SU7, EV2 and EV3 vehicles, respectively. Only the EV3 vehicle is below statutory at the operating level. Refer to the Breakdown of Bridge Ratings for all other ratings.

The MS18 load factor ratings in metric tons are 31.2 (MS17.4 equivalent) and 52.2 (MS29.0 equivalent) for the inventory and operating levels, respectively. Inventory and operating ratings were governed by flexure at 0.40L of typical interior roadway Beams 3 through 6. The MS18 load factor rating is below statutory at the inventory level.

Based on the Routine and Special Member Inspection Report dated September 5, 2023, the superstructure is in poor condition.

The bridge is not currently posted. recommends that the posting be reviewed to ensure latest load rating is reflected. **It is also recommended that as part of the next inspection cycle, the placement of the temporary barriers are confirmed relative to the assumptions made in this rating report per the direction provided by MassDOT on 3/19/24.**

recommends that general maintenance and inspections of the bridge continue at regular intervals.

Towards the end of the text portion of the report there are recommendations. These explain the rating values and recommended postings.

If a posting is recommended by MassDOT a formal NBIS letter would be included.

These can also indicate the maintenance required.

Project Types

In House Activities (Municipality or Other Owner)	• Crews internal to the organization perform the work as needed typically through a work order system. • Typically most minor level of repairs.
On Call Bridge Maintenance (Contractor)	• A time duration contract with estimated quantities that issues work orders to perform the specific items at a location as inspection findings come up. • Allows for flexibility to do repairs outside the level in house forces can perform but overall are very standardized with methods that apply across many structures.
Site Specific Bridge Preservation Project (Contractor)	• A contract to do work at a specific bridge with known quantities and items through investigation. • Typically for known bridges that need specific work that is outside of the in house forces. Also when scope of work is larger.

What is Chapter 85 Review?

Chapter 85, Section 35 of the Commonwealth of Massachusetts General Laws:

> Section 35. No bridge on a public highway having a span in excess of ten feet, except a bridge constructed under the provisions of chapter one hundred and fifty-nine, shall be constructed or reconstructed by any county or town except in accordance with plans and specifications therefor approved by the department. Said department shall

Municipal Bridge Preservation Projects
MGL Chapter 85 Section 35 Review Process
Design Requirements and Submittals for Bridge Preservation Projects for both BRI (10 feet < span ≤ 20 feet) and NBI (20 feet < clear span) Structures

Note: If the Category of the Structure to be worked on is neither BRI nor NBI (i.e., span ≤ 10 feet), a Chapter 85 review is not required

Preservation Project Type	Hydraulic Design	Geotechnical Design	Structural Design	Construction Details	Design Review Submittals	Other Considerations
Cleaning and painting of Structural Steel (if performed without repairs)	Not required	Not required	Not required	Not required	Project Special Provisions	MGL and federal requirements for lead removal and air quality (see MassDOT specifications for Cleaning and Painting Structural Steel.
Concrete Deck Patching with or without applying waterproofing membranes and wearing surface	Not required	Not required	Not required. If reinforcing bars are deteriorated, provide additional reinforcing in kind and provide proper lap lengths with existing reinforcing. If changing wearing surface thickness from existing (either more OR less) perform a rating calculation to determine the change in load carrying capacity. Can use AASHTO Standard Specs.	Typical details showing limits of concrete deck chipping and forming deck repairs. If additional reinforcing steel is needed, show installation details along with lap lengths. Provide membrane details and wearing surface thickness.	Either a complete final set of Construction Plans (if used) or pages of typical details to be inserted into job Special Provisions (if "book job") as well as the job Special Provisions. If calculations are required, one set of design calculations checked by a second engineer. After MassDOT accepts the design, a complete final set of Construction	Traffic control plan: close bridge during work or work in stages. If working in stages, provide barrier or other delineation of work zone. If more than 50% of deck area requires patching, consider a full deck replacement project instead.

The full table can be found here:

https://www.mass.gov/doc/municipal-small-bridge-program-design-requirements-for-bridge-preservation-projects/download

Available Resources

National Highway Institute Courses

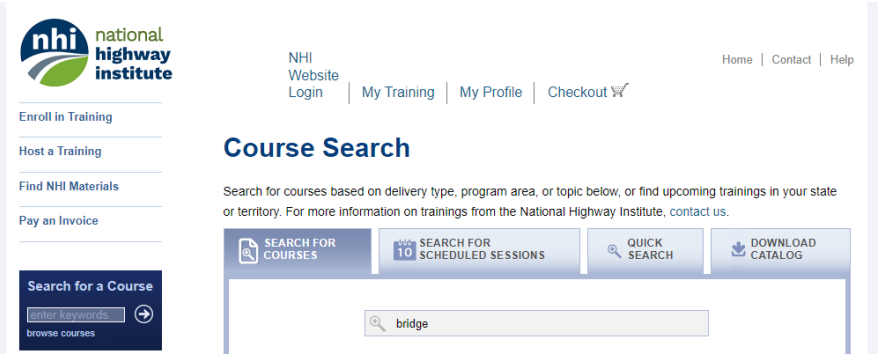
Web Based Bridge Courses: https://www.nhi.fhwa.dot.gov/course-search?tab=0&key=bridge&typ=3&res=1&srt=4

QR Code to Website:

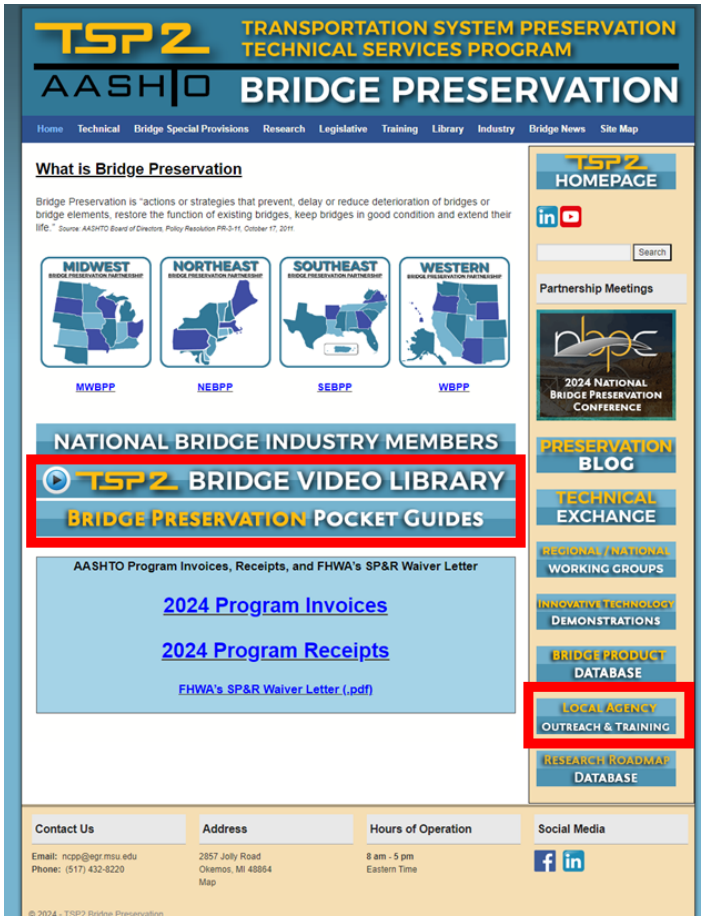
Highly Consider:

- Introduction to Safety Inspection of In-Service Bridges
- Fundamentals of Bridge Maintenance
- Plan Reading – Bridge & Culverts

There are many more!



National Center for Pavement Preservation & AASHTO Preservation Management



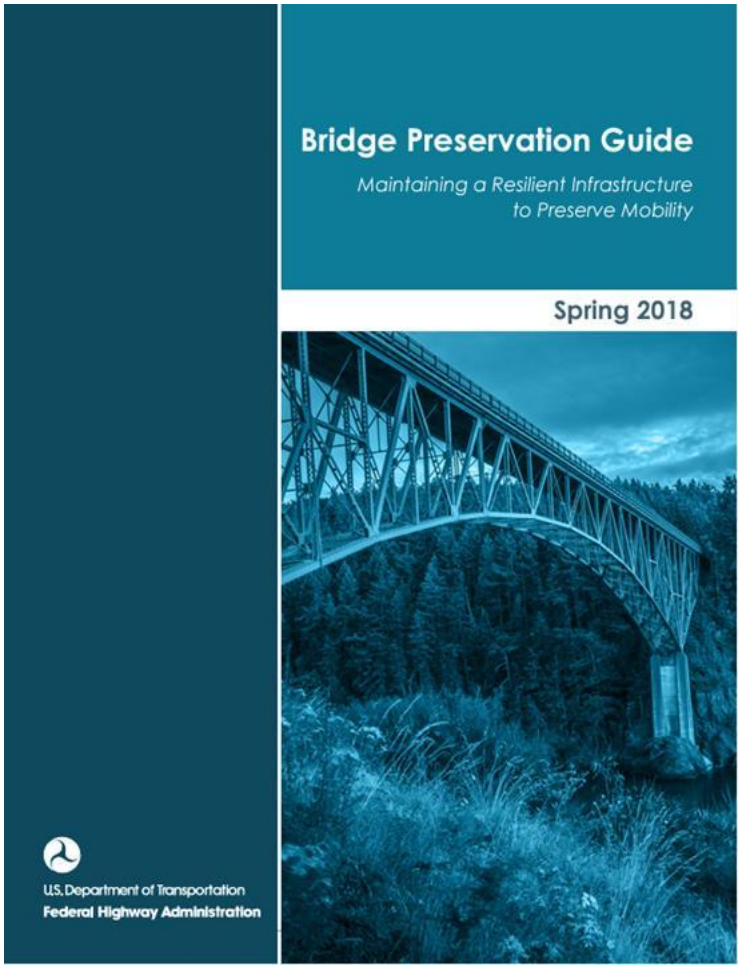
Website:

https://www.pavementpreservation.org/wp-signup.php?new=tsp2.pavementpreservation.org

Website:

https://tsp2bridge.pavementpreservation.org/

FHWA Bridge Preservation Resources



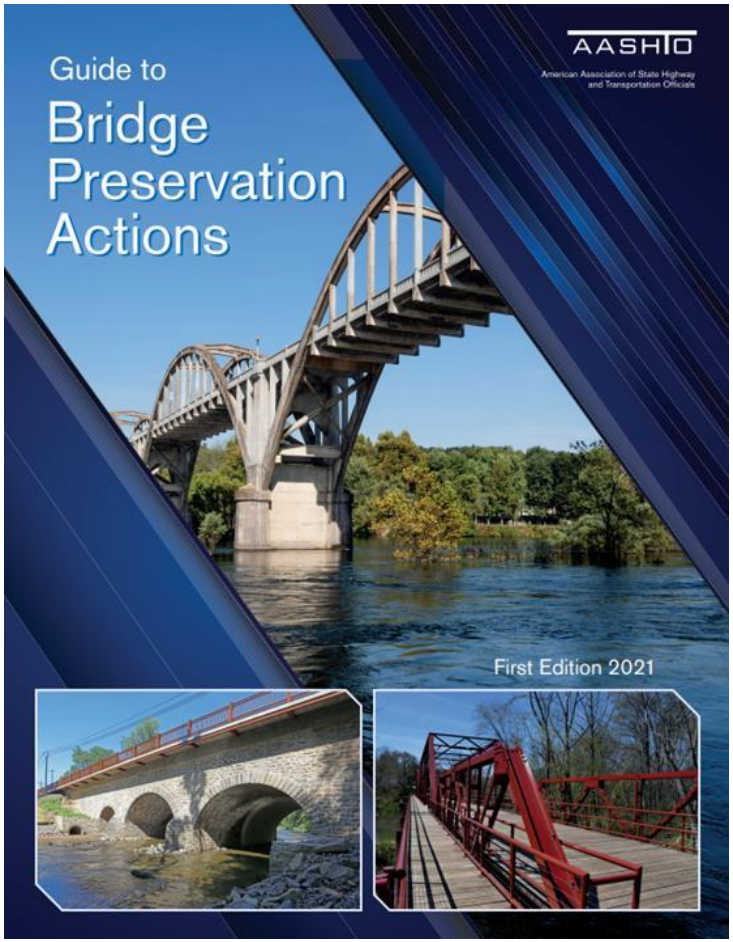
Website:

https://www.fhwa.dot.gov/bridge/preservation/

Website:

https://www.fhwa.dot.gov/bridge/preservation/guide/guide.pdf

AASHTO Bridge Preservation Actions



Website:

https://aashtojournal.transportation.org/aashto-issues-new-bridge-preservation-guide/

QR Code to Website:

MassDOT Maintenance & Preservation Manual

- Coming soon
- Questions can be answered as needed and examples of details and special provisions can be sent out

Alyson Bedard, PE
Bridge Preservation Engineer
MassDOT - Highway
10 Park Plaza - Room 7110
Boston, MA 02116
Phone: 857-202-9141
Email: Alyson.J.Bedard@dot.state.ma.us

MassDOT Bridge Construction Special Provisions

Bridge Construction Special Provisions

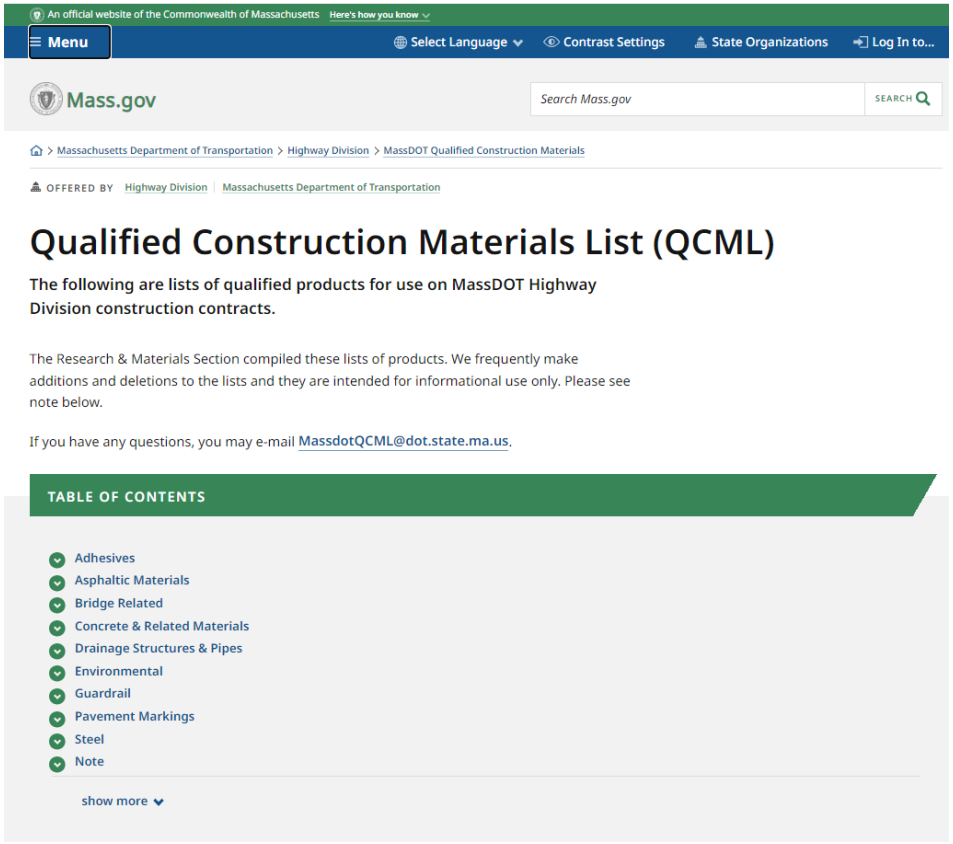
Special Provision Description	Issue Date	Revision Date
Drilled Micropiles	9/30/2019	5/5/2021
Elastomeric Bearing Pads	12/14/2017	5/21/2021
Exposed Deck Crack Sealing	12/14/2017	
Galvanizing Structural Steel	9/30/2019	
Heat Straightening	12/14/2017	10/1/2020
Metallizing Structural Steel	12/14/2017	
Modified Asphaltic Bridge Joint System	3/8/2024	
Precast Concrete Bridge Elements	10/22/2018	5/5/2021
Prefabricated Bridge Units (PBU)	10/8/2019	5/5/2021
Prestressed Concrete Beams	12/14/2017	5/5/2021
Sawing and Sealing Joints at Bridges	12/14/2017	5/15/2018
Tubular Steel Trusses	10/14/2017	10/22/2018
Ultra High Performance Concrete	3/8/2024	

Website:

https://www.mass.gov/info-details/bridge-construction-special-provisions

QR Code to Website:

MassDOT QCML



Website:

https://www.mass.gov/lists/qualified-construction-materials-list-qcml#bridge-related-

QR Code to Website:

MaineDOT Bridge Preservation Guide

MaineDOT

Bridge Preservation Guide

February 2021

Website:

https://www.maine.gov/mdot/publications/docs/dgm/2021/Bridge%20Preservation%20Guide.pdf

QR Code to Website:

NH Municipal Bridge Checklist of Preservation Activities

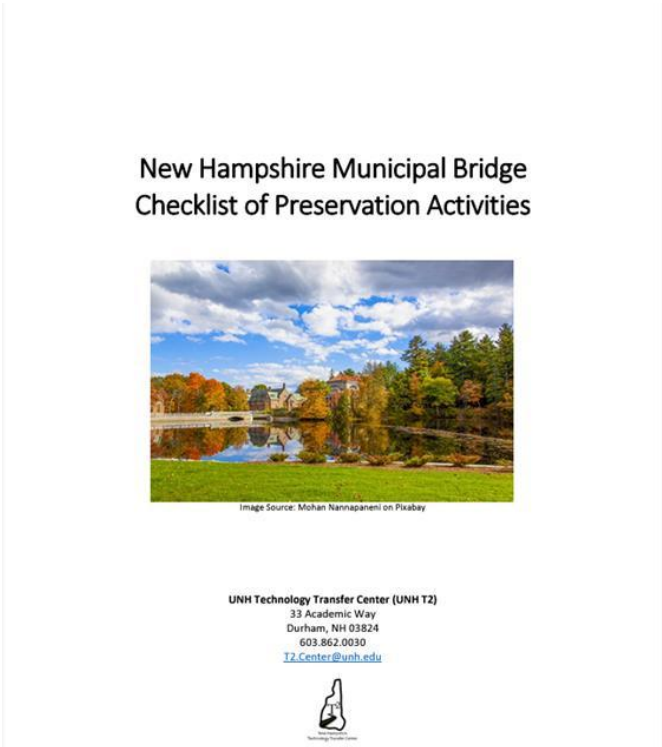

New Hampshire Municipal Bridge
Checklist of Preservation Activities

Image Source: Mohan Nannapaneni on Pixabay

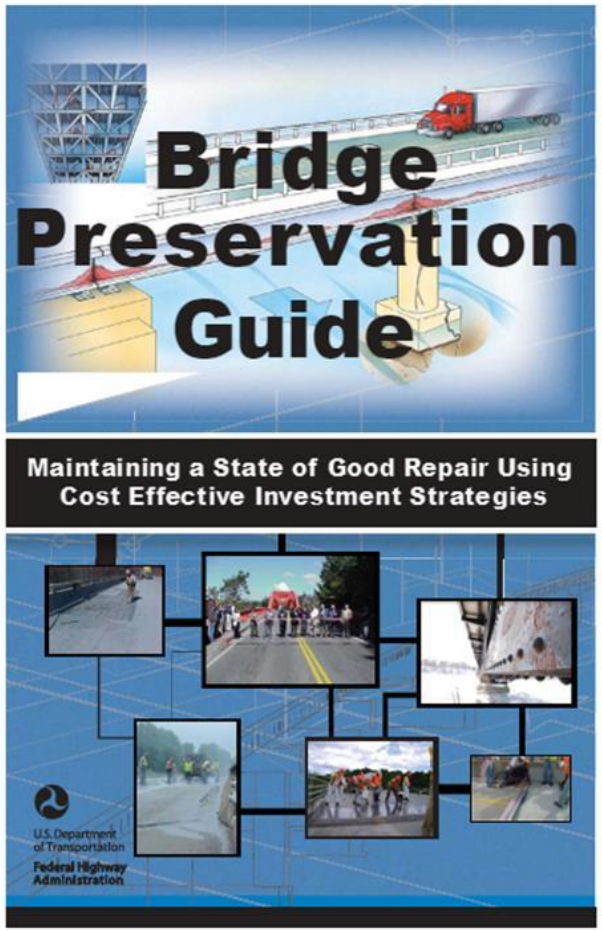
UNH Technology Transfer Center (UNH T2)
33 Academic Way
Durham, NH 03824
603.862.0030
T2.Center@unh.edu

Website:

https://t2.unh.edu/sites/default/files/media/2022-11/municipal-bridge-maintenance-checklist-unh-t2.pdf

QR Code to Website:

ConnDOT Bridge Preservation Guide



Website:

https://portal.ct.gov/-/media/dot/documents/dbridgepubs/preservationguidepdf.pdf

QR Code to Website:

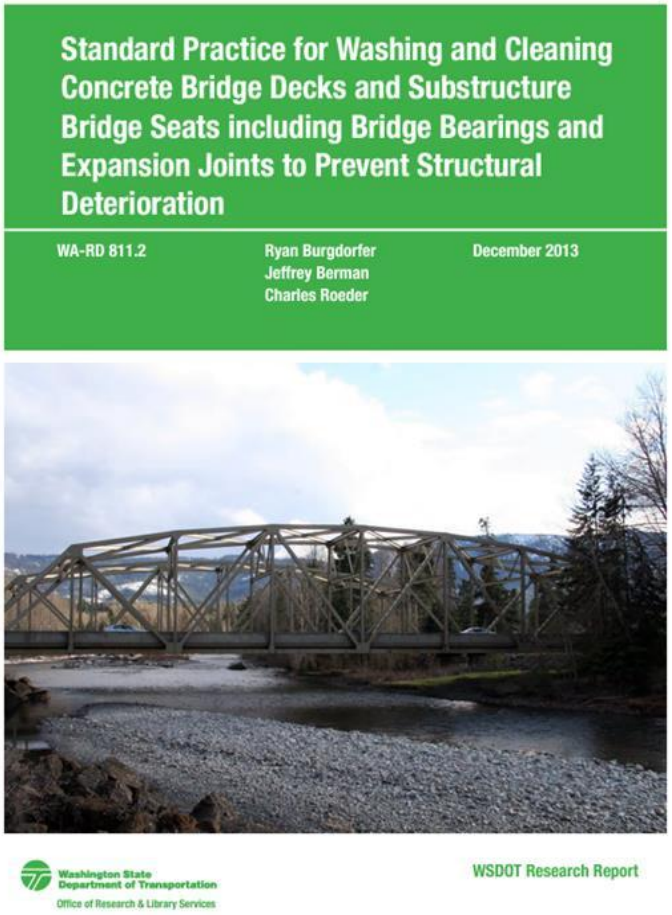
NYSDOT Fundamentals of Bridge Maintenance & Inspection

Website:

https://www.dot.ny.gov/divisions/engineering/structures/repository/manuals/Fund_Br_Maint_Inspect_9-08.pdf

QR Code to Website:

Bridge Washing



Website:

https://www.engineering.pitt.edu/subsites/centers/csti/projects/completed-projects/evaluation-of-bridge-cleaning-methods-on-steel-structures/

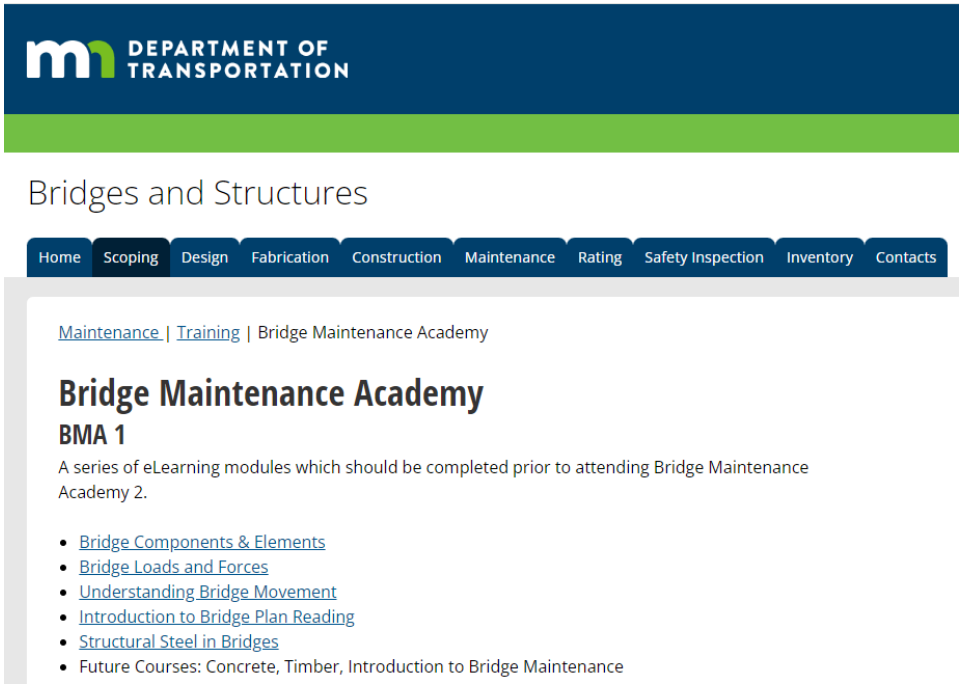
QR Code to Website:

Website:

https://digitalarchives.wa.gov/do/72EDFC8A6273FB8D90CF5D39D39952FE.pdf

QR Code to Website:

MnDOT Bridge Maintenance Academy



Website:

https://www.dot.state.mn.us/bridge/maintenance/training-bma.html

QR Code to Website:

Questions?

Bridge Maintenance & Preservation Strategies for Local Agencies