STATE OF RHODE ISLAND
DEPARTMENT OF TRANSPORTATION

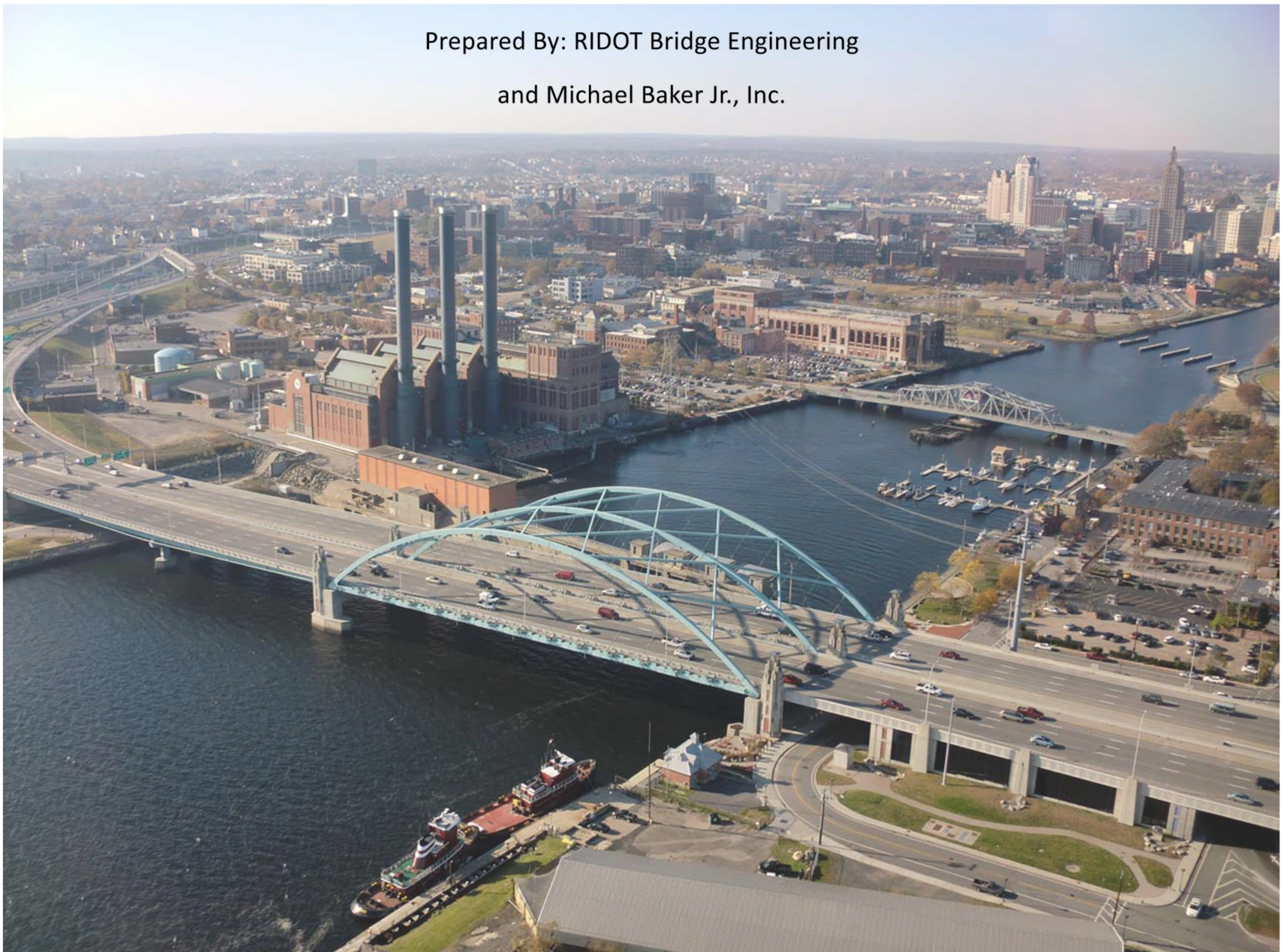
BRIDGE INSPECTION MANUAL

October 2013

July, 2016 Addendum 1

Prepared By: RIDOT Bridge Engineering

and Michael Baker Jr., Inc.



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State of Rhode Island Department of Transportation

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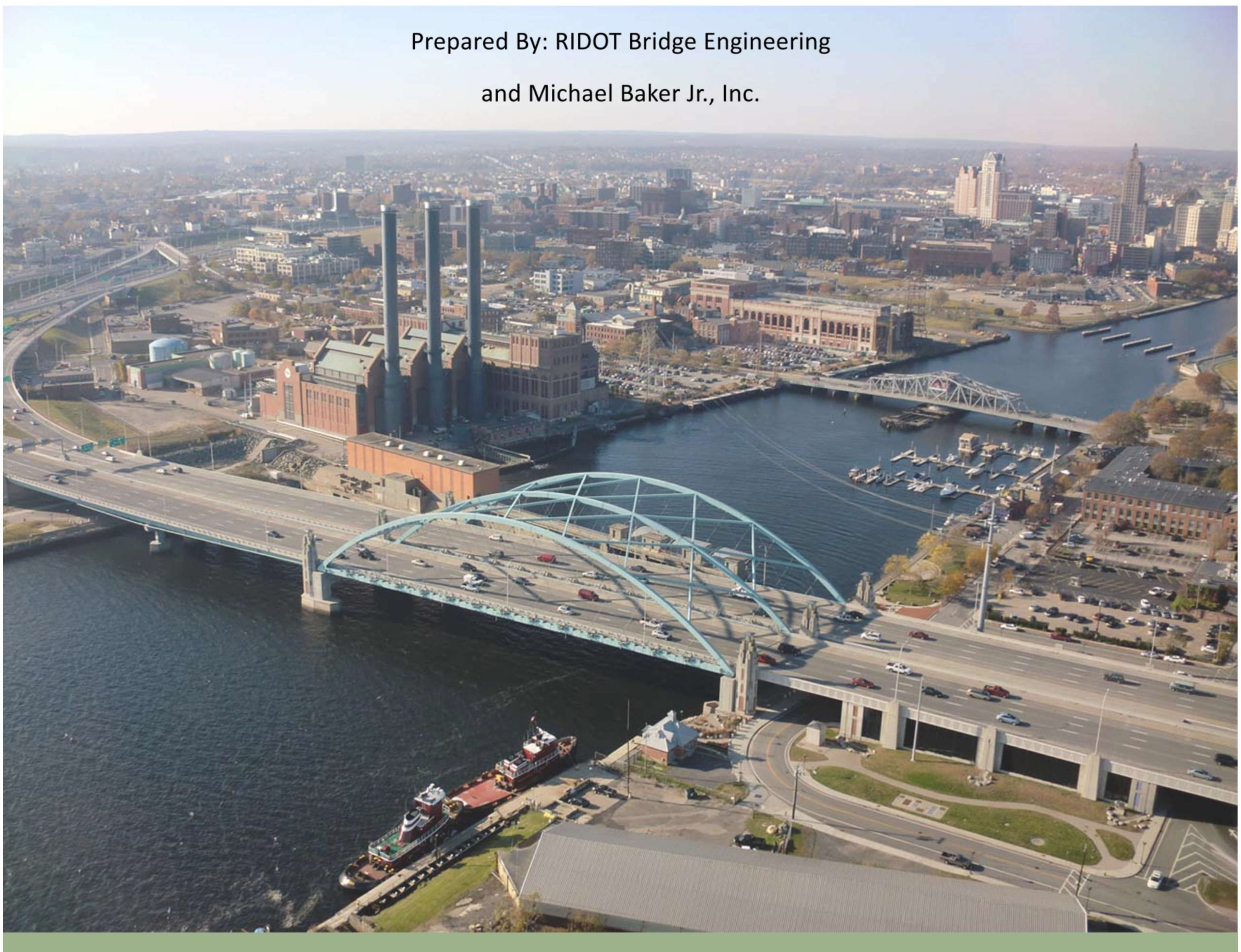

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ACKNOWLEDGMENTS

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Rhode Island Department of Transportation:

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Connecticut Department of Transportation: *Bridge Inspection Manual*; September 2001
Pennsylvania Department of Transportation: *Bridge Safety Inspection Manual*; March 2010

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- Collins Engineers, Inc.;
- TranSystems; and
- WSP.

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July 2016 Addendum 1 consists of the following changes:

3.1.6.2.2 Intensity
This section was updated.

3.1.6.2.2 Intensity
This section was updated.

4.2.8 Channel Cross Sections
This section was updated.

Appendix A
Existing appendices A.14 through A.21 are now referred to as appendices A.21 through A.28.

Appendix A.14 was modified to be Underwater Bridge Inspection Procedures – Form BI-14.

Appendices A.15 through A.20 are now reserved for the inclusion of future forms.

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Chapter 1 Administrative

1.1 Purpose and Scope

The purpose of this Inspection Manual is to compile the policies and procedures of the Rhode Island Department of Transportation (hereby referred to as the State or the Department) as related to the Bridge Inspection Program to ensure:.

- Public safety on bridges;
- Compliance with Federal and State regulations; and
- Accurate and adequate information to manage bridges.

The provisions of this manual are intended for the safety inspection and management of in-service bridges and culverts carrying public roadways in the State of Rhode Island. These provisions are not included for bridges used solely for railway, rail-transit, or public utilities that are not related to public highways. The provisions of this manual may be applied to cover bridges outside of the scope of this manual if supplemented with the additional required information and rating criteria.

This manual is not intended to supplant proper training or judgment by the owner, engineer, team leader or staff inspector. Instead, this manual serves to state only the minimum requirements necessary to provide for public safety. The owner, engineer, team leader and/or staff inspector may require inspection procedures, load rating or the testing of materials to be greater than the minimum requirements.

The information contained in this manual is to supplement the Bridge Inspector's Reference Manual (BIRM). This manual is not intended to be all inclusive. The inspection guidelines contained herein are component level and not intended to be element level. For information outside the scope of this manual, refer to the publications listed in Section 1.1.2 Applicable Standards and References.

1.1.1 Permissions and Acknowledgements

The State of Rhode Island has been granted permission for the use of the following copyrighted material in the development of this Inspection Manual:

- Connecticut Department of Transportation Bridge Inspection Manual is the intellectual property of the Connecticut Department of Transportation (CTDOT). The State of Rhode Island is using this work with the expressed permission of CTDOT and acknowledges that it has no property interest in this Bridge Inspection Manual.
- Publication 238, *Bridge Safety Inspection Manual*, is the intellectual property of the Commonwealth of Pennsylvania, Pennsylvania Department of Transportation (PennDOT). The State of Rhode Island is using this work with the expressed permission of PennDOT and acknowledges that it has no property interest in this Publication.

1.1.2 Applicable Standards and References

Applicable standards and references included in the development of this inspection manual and in the scope of work for Rhode Island bridge inspections may include the following:

- AASHTO *Guide Manual for Bridge Element Inspection*, American Association of State Highway and Transportation Officials, 2013
- AASHTO *LRFD Bridge Design Specifications*, American Association of State Highway and Transportation Officials, 2012
- AASHTO *Manual for Bridge Evaluation*, American Association of State Highway and Transportation Officials, 2011
- *Bridge Inspection Field Manual*, Minnesota Department of Transportation (MnDOT), Version 1.9, November 2011
- *Bridge Inspection Manual*, Connecticut Department of Transportation (CTDOT), September 2001, Revised March 2008
- *Bridge Safety Inspection Manual*, Publication 238, Pennsylvania Department of Transportation (PennDOT), March 2010
- *Bridge Inspector's Reference Manual*, Federal Highway Administration & National Highway Institute, Publication No. FHWA NHI 12-049 and FHWA NHI 12-050, Revised February 2012
- *Evaluating Scour at Bridges,* FHWA Technical Advisory, Federal Highway Administration, Publication No. T 5140.23, October 1991
- *Inspection of Fracture Critical Bridge Members*, Federal Highway Administration, Publication No. FHWA IP 86-26, September 1986
- *Manual on Uniform Traffic Control Devices for Streets and Highways*, Federal Highway Administration, 2009 Edition
- National Bridge Inspection Standards, *Code of Federal Regulations*, Title 23 (Highways), Part 650, Subpart C, United States Department of Transportation
- NCHRP *Synthesis 353: Inspection and Maintenance of Bridge Cable Systems*, National Cooperative Highway Research Program, Transportation Research Board, 2005
- *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges*, Report No. FHWA-PD-96-001, Federal Highway Administration, December 1995
- Rhode Island Department of Transportation Contact and Distribution Matrix (to be distributed by RIDOT to the Consultant upon the award of bridge inspection contract)

- Rhode Island Department of Transportation *LRFR Guidelines*, Rhode Island Department of Transportation, Latest Edition

- Rhode Island Department of Transportation *Traffic Design Manual*, Rhode Island Department of Transportation, Traffic Design Section, Latest Edition

- *Underwater Bridge Inspection*, Federal Highway Administration & National Highway Institute, Publication No. FHWA NHI 10-027, June 2010

- The latest applicable Department To All Consultant and Design Policy Memorandums

1.1.3 FHWA Requirements

The National Bridge Inspection Standards (NBIS) were first established as a result of the Federal-Aid Highway Act of 1968. This act directed the States to maintain an inventory of Federal-aid highway system bridges. Shortly afterward, the Federal-Aid Highway Act of 1970 set forth limitations on the NBIS to the Federal-aid highway system. In 1978, the Surface Transportation Assistance Act (STAA) extended NBIS requirements to bridges greater than twenty (20) feet on all public roads. The NBIS was later extended as a result of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (STURRA) to include special inspection procedures for fracture critical members (FCMs) and underwater inspection.

The NBIS, as established in the *Code of Federal Regulations* and referenced in the *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges*, is mandated by Federal Law and is intended to ensure the proper inspection of the Nation's bridges located on public roadways with lengths greater than twenty (20) feet.

Regarding bridge management systems (BMS), a 1991 sponsorship from the FHWA first initiated the development of the *Bridge Management Software*. The Bridge Management Software system was designed to have (and currently allows) flexibility for customization to any agency or organization responsible for maintaining a network of bridges. The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 was also enacted during this time and required that each state implement a comprehensive bridge management system by October 1995.

The National Highway System (NHS) Act of 1995 rescinded the requirement for bridge management systems, though many states elected to keep the Bridge Management Software system. A few years later, the Transportation Equity Act of the 21st Century (TEA-21) was signed into law in June 1998. This act built on and improved the initiatives established in ISTEA, but rescinded the mandatory BMS requirement. Following TEA-21, the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) was signed into law in August 2005, which built upon and improved the initiatives established in ISTEA and TEA-21.

1.1.4 NBI Bridges

The NBIS applies to all publicly owned highway bridges that are longer than twenty (20) feet and are located on public roads. These bridges make up the majority of the National Bridge Inventory (NBI).

The NBI also contains approximately 2,200 privately owned bridges, nationwide. These bridges are not required to be reported by the States to the FHWA, even if carrying a public road. However, the FHWA strongly encourages private bridge owners to follow the NBIS as the standard for inspecting their highway bridges.

1.1.4.1 Greater Than 20 Feet

The NBIS defines the minimum bridge length (Item 112 - NBIS Bridge Length) as being greater than twenty (20) feet. In order for the bridge to be included in the NBI, the structure must be classified as *bridge length* and carry traffic on a public roadway. Culverts are considered *bridge length* if the length is greater than twenty (20) feet and the culvert is located on a public road.

The *Code of Federal Regulations*, Title 23, Part 650 Subpart C, Section 650.305 (23 *CFR* 650.305) outlines the following definition for a *bridge*:

> *Bridge*. A structure including supports erected over a depression or an obstruction, such as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than [twenty] 20 feet between undercopings of abutments or spring lines of arches, or extreme ends of openings for multiple boxes; it may also include multiple pipes, where the clear distance between openings is less than half of the smaller contiguous opening.

The *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges* outlines the following definition for a *culvert*:

> *Culvert*. A structure designed hydraulically to take advantage of submergence to increase hydraulic capacity. Culverts, as distinguished from bridges, are usually covered with embankment and are composed of structural material around the entire perimeter, although some are supported on spread footings with the streambed serving as the bottom of the culvert. Culverts may qualify to be considered *bridge length*.

1.1.5 Non-NBI Bridges

Bridges (and culverts) that are not included in the NBI are considered *non-NBI* bridges. The owner of a non-NBI bridge (primarily one that is between five (5) and twenty (20) feet in length) may elect to collect the inventory information and generate a local database accordingly. Examples of bridges and culverts that are not part of the NBI include:

- Privately owned bridges and culverts (on public or private roadways);
- Tribally owned bridges and culverts (excluding those receiving Federal funding);
- Bridges and culverts with lengths of twenty (20) feet or less; and
- Railroad and pedestrian bridges that do not carry public highways.

1.1.5.1 Pedestrian Bridges

Pedestrian bridges that do not carry highways are not part of the NBI. As previously mentioned, bridge owners may choose to collect inventory information for pedestrian bridges that do not carry highways.

1.2 Contract Administration

1.2.1 Scheduling Work to Consultants

In general, bridges will be assigned to the Consultant approximately three to six months prior to their respective inspection due date. It is the responsibility of the Consultant to coordinate the necessary resources and equipment to complete the bridge inspection no later than the due date listed on the assignment list. For all inspections, the Consultant shall coordinate and arrange access to the structures.

The State requires that all inspections are completed by their due date. Refer to Section 1.2.6 for more information regarding time requirements.

For inspections due in the winter, the State may require Consultants to advance inspections from the months of January and February into the previous calendar years. This practice may be considered to avoid possible adverse weather conditions that could potentially delay the inspection.

Schedules may have to be adjusted to avoid construction lane closures or other maintenance activities. The Consultant is required to check the State's website (www.dot.ri.gov) for up-to-date construction and maintenance related traffic information that could impact the schedule for an inspection. It is the Consultant's responsibility to coordinate their field inspection to avoid delays to the schedule.

1.2.2 Preparation of Cost Proposals/PO Approval Process

The Consultant shall submit a detailed cost proposal and work order to the State for approval prior to performing the inspection. The Consultant may need to visit the site prior to submitting the proposal to properly identify the estimated labor and direct expenses associated with a particular inspection. This proposal shall be submitted to the personnel listed in the Contact and Distribution Matrix (obtained from the State). The cost proposal and work order shall be submitted in both electronic and hard copy formats. Cost proposal templates in electronic format can be obtained from the Department. For a sample cost proposal, see Figure 1.2-1. Below is a summary of the minimum required information to be included in the cost proposal:

- Estimated time (in hours) for preparation, coordination, field inspection, data/reporting, drawings, and QA/QC for the project manager, team leader, staff engineer, load rater;

- Pertinent estimates for load ratings (if applicable), including file search and review, field inspection, structural analysis, rating report generation, and QA/QC;

- Master Price Agreement (MPA) hourly rates for each labor category;

- Direct expenses for each bridge to be inspected or load rated, along with an individual breakdown of dollar amounts; and

- Proposed inspection equipment and fees (usually listed under direct expenses).

Typically, once the proposal is approved by Bridge Engineering, the purchase order will generally be issued approximately one month after approval. The purchase order will be sent via electronic mail to the Consultant's project manager. However, the time for the issue of purchase orders varies and it is up to the Consultant to submit cost proposal/work order promptly to avoid any delays to the schedule. For scheduling purposes, it is recommended to forward the proposal to the State as quickly as possible, but no later than two months prior to the anticipated start of inspections. The Consultant must pay for the cost of the cost proposal.

Rhode Island Department of Transportation
BRIDGE INSPECTION COST PROPOSAL
MPA No. XXX, AWARD No. XXXXXXX
Group XX / Assignment XX
[Consultant Name]

Bridge ID:	______	**Length:**	______
City/Town:	______	**Width:**	______
Facility Carried:	______	**Deck Area:**	______
Feature Intersected:	______	**Spans:**	______
Structure Type:	______		
Inspection Type:	______		

Task	WORK HOURS/LABOR COSTS					
	Project Manager	**Staff Engineer**	**Team Leader**	**Staff Inspector**	**Total Hours**	**Total Labor**
HOURLY RATES	$0.00	$0.00	$0.00	$0.00		
Preparation/Coordination	0	0	0	0	0	**$ -**
Field Inspection	0	0	0	0	0	**$ -**
Data/Report	0	0	0	0	0	**$ -**
CADD Drawings	0	0	0	0	0	**$ -**
Traffic Management	0	0	0	0	0	**$ -**
QA/QC	0	0	0	0	0	**$ -**
TOTAL HOURS	**0**	**0**	**0**	**0**	**0**	$ -
TOTAL COST	**$0.00**	**$0.00**	**$0.00**	**$0.00**		

FIELD INSPECTION	
Estimated Crew Size[1]	
Estimated Crew Days[2]	

1. Enter number of anticipated crew members to inspect this bridge
2. Enter anticipated duration (in days) for crew to inspect this bridge

DIRECT EXPENSES	
Direct Expense – Item	**Cost**
Boat	**$ -**
Underbridge Inspection Vehicle	**$ -**
Lift Bucket	**$ -**
Light Tower	**$ -**
Crash Truck	**$ -**
Arrow Board	**$ -**
Traffic Control	**$ -**
RR Flagger	**$ -**
RRP Insurance	**$ -**
TOTAL DIRECT EXPENSES	$ -

TOTAL COST: **$0.00**

Figure 1.2-1
Sample Cost Proposal

1.2.3 Submission of Actual Hours and Cost Data

The Consultant is required to submit the actual expenditures to RIDOT/Bridge for each structure included in their group. This submittal is in addition to the monthly invoice required by the RIDOT/Financial Management Section. The Consultant is required to submit the actual hours upon completion of each group/assignment. This document should be in electronic format and include, but not be limited to:

- Type of inspection performed.
- Total actual hours billed for each classification; and
- Submitted in the same format as the original cost proposal (see Figure 1.2-1).

1.2.4 Submitting Invoices to RIDOT

The information contained herein is for general guidance purposes only. The Consultant shall check with RIDOT/Financial Management for the latest policies and procedures. It is noted the invoice shall contain the Purchase Order (PO) number and the Consultant contact information. Invoices for payment shall be submitted monthly and shall include, but not be limited to:

- Total hours billed that period for each classification;
- Corresponding detailed time sheets; and
- Eligible reimbursable costs with receipts.
- Disadvantaged Business Enterprise (DBE) documentation if applicable.

Invoices shall be submitted to:

Rhode Island Department of Transportation
Financial Management Room 245
ATTN: Accounts Payable
Two Capitol Hill
Providence, RI 02903

Receipts for eligible reimbursable items shall be attached to each work order for which said costs were incurred. When applicable, time sheets shall show the bridge number and task performed. The Consultant shall coordinate with RIDOT/Financial Management for specifics related to logistics of invoicing the State if necessary.

In addition, the Consultant shall submit a monthly progress report as part of each invoice package, documenting the overall project status including total hours used, total dollars spent and the number of bridge inspections completed to date.

No work shall be permitted until a duly executed Purchase Order Release document has been issued for the specific work to be performed. All changes to the release document must be submitted to Financial

Management, Central Purchasing prior to commencement of the work to carry out the necessary modifications.

1.2.5 Disadvantaged Business Enterprise (DBE)

Disadvantaged Business Enterprise (DBE) firm(s) and applicable documentation must be coordinated through the following office:

RIDOT Office of Business and Community Resources
Two Capitol Hill
Providence, RI 02903
(401) 222-3260

1.2.6 Time Requirements

The State requires that all inspections be performed according to the requirements listed below (see Figure 1.2-2). It is important to note that changes to the established time requirements are not permitted unless unusual circumstances exist. Furthermore, all proposed changes must be met with Department approval.

Item	Time Requirement
Completion of Inspection	No later than the due date listed in the inspection report and no earlier than one month prior to the due date* unless directed otherwise by the State. RIDOT prefers to keep the completion date within the same month of the inspection due date, but not later than the due date.
Report Submittal	No later than thirty (30) days from the Completion of Inspection date. For complex or large bridges, subject to the approval of the Department, report submittal time can be extended. However, at a minimum, Structure Inventory and Appraisal (SI&A) data for complex or large bridges is required within 60 days of the date of inspection. For damage inspections, the report shall be submitted no later than 5 days after inspection.

*Due date: Last inspection date plus the frequency of the inspection

Figure 1.2-2
Time Requirements

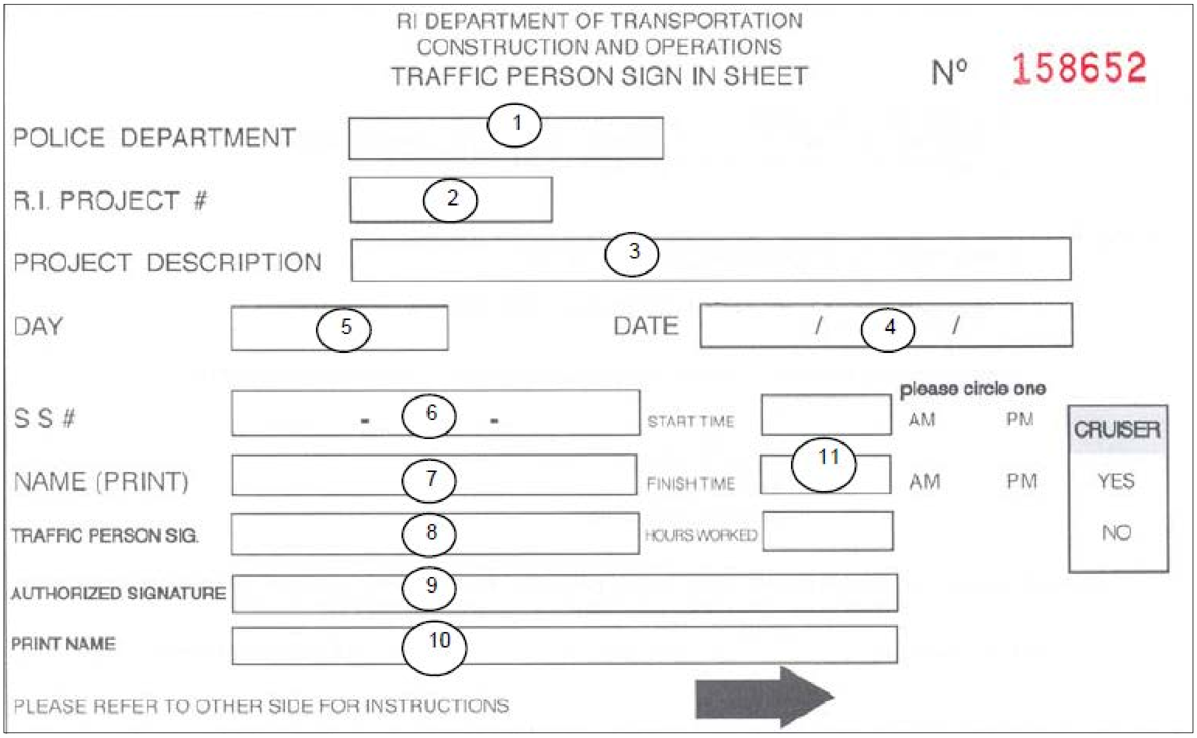
1.2.7 Police Details

The following procedures are required for obtaining and scheduling police details, should they be necessary. It is noted that the State pays the applicable Police Department directly:

- For state police details on interstate highways, submit the Police Detail Request Form to the appropriate person listed on the form. This request shall be completed a minimum of one week prior to the week when police details are needed. The Police Detail Request Form can be obtained from RIDOT/Construction or Bridge Inspection Section. An example is included in Appendix A.23.

- For local police details on non-interstate routes, the Consultant shall contact the police with jurisdictional authority where the bridge is located and schedule the police detail following the authority's approved procedure.

- The Consultant is responsible to complete the Traffic Person Sign-In Sheet (see Figure 1.2-3) every time a police detail is required. The Consultant shall retain the white (original) copy of the form and forward to the State for payment to the appropriate Police Department. Please refer to the Contact & Distribution Matrix for submittal requirements.



RI DEPARTMENT OF TRANSPORTATION
CONSTRUCTION AND OPERATIONS
TRAFFIC PERSON SIGN IN SHEET

N° 158652

POLICE DEPARTMENT (1)

R.I. PROJECT # (2)

PROJECT DESCRIPTION (3)

DAY (5) DATE / (4) /

please circle one

S S # - (6) - START TIME AM PM

NAME (PRINT) (7) FINISH TIME (11) AM PM

TRAFFIC PERSON SIG. (8) HOURS WORKED

AUTHORIZED SIGNATURE (9)

PRINT NAME (10)

CRUISER YES NO

PLEASE REFER TO OTHER SIDE FOR INSTRUCTIONS

Figure 1.2-3
Example Traffic Person Sign-In Sheet

Note:

Section 1: Name of Police Department

Section 2: Place text "*Bridge Inspection Program*"

Section 3: Place text "*Statewide Bridge Inspection*"

Section 4: Date of Police Detail

Section 5: Day of Week for Police Detail

Section 6: Social Security Number (Last 4 Digits) or Badge Number of Policeman/Policewoman

Section 7: Printed Name of Policeman/Policewoman

Section 8: Signature of Policeman/Policewoman

Section 9: Signature of Inspection Team Leader

Section 10: Printed (Legible) Name of Inspection Team Leader

Section 11: Start/Finish Time and Number of Hours Worked for Police Detail

1.3 Personnel Policies

1.3.1 Work Rules

The Consultant (and its Sub-consultants) shall conduct work in accordance with all State, local and Federal rules and regulations to preserve high ethical and moral standards, avoid conflicts of interest, and adhere to all legal requirements.

1.3.2 Safety

The Consultant shall conduct work in accordance with all State, local, and Federal governing safety rules and regulations.

1.3.3 Media/Public Relations

If the Consultant is approached by a member of the media while conducting an inspection, please direct all requests to the Department's Office of Communications.

Chapter 2 Organization

The Bridge Engineering Section of the Rhode Island Department of Transportation is contained within the Infrastructure Development Division. Organizational charts for RIDOT can be found on the RIDOT website (http://www.dot.ri.gov/).

For a complete list of RIDOT points of contact and distribution requirements refer to the latest Contact and Distribution list. This list is intended for all inspection related personnel and is supplied by RIDOT to each inspection Consultant upon any updates.

2.1 Program Manager (RIDOT)

2.1.1 Description

The program manager is the individual in charge of the bridge inspection program, who provides overall leadership within the bridge inspection program and provides guidance to bridge inspection team leaders when requested. At a minimum, one statewide program manager is required by the FHWA.

2.1.2 Qualifications

The minimum qualifications of a program manager are established in the *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.309 (23 *CFR* 650.309) and are listed below:

(a) A program manager must, at a minimum:

(1) Be a registered Professional Engineer, or have ten years bridge inspection experience; and

(2) Successfully complete a Federal Highway Administration (FHWA) approved comprehensive bridge inspection training course.

In addition to the minimum Federal qualifications, the State requires that program managers successfully complete an FHWA approved bridge inspection refresher training course once every four (4) years.

2.1.3 Responsibilities

The statewide program manager is assigned the duties and responsibilities for bridge inspection, reporting and inventory. These duties and responsibilities may then be delegated by the statewide program manager to project managers (Consultants) and team leaders within the State. Although the statewide program manager may choose to delegate some or all functions to other bridge inspection personnel, the statewide program manager retains all responsibility for bridge inspection operations for which he or she was assigned.

2.2 Project Manager (Consultant)

2.2.1 Description

The project manager serves as the link between the Consultant and the State and is therefore in charge of the organizational unit within the firm that has been delegated the responsibilities for all aspects of the inspection project.

2.2.2 Qualifications

State policy requires that, at a minimum, project managers have the following qualifications:

- Registered Professional Engineer in the State of Rhode Island in civil or structural engineering;
- Five (5) years experience in bridge structures (inspection and/or design);
- Successful completion of an FHWA approved comprehensive bridge inspection training course; and
- Successful completion of an FHWA approved bridge inspection refresher training course once every four (4) years.

2.2.3 Responsibilities

The responsibilities of the project manager (Consultant) are defined within the scope of work for the project. Below is a summary of general responsibilities and inspection training responsibilities of the project manager (Consultant):

State policy includes the following general responsibilities for project managers (Consultants):

- The Consultant shall be responsible for the timely inspection and reporting of bridge inspections to the State in accordance with the guidelines contained in the scope of work.
- The Consultant shall submit a cost proposal and work order for approval detailing the work as described below prior to performing the inspection(s). Refer to Section 1.2.2 for more information.
- The Consultant shall be responsible for updating the NBI data contained in element level field inspections. Refer to Chapter 4 for detailed submittal requirements.
- The Consultant shall follow specific procedures for reporting critical findings as defined in Section 3.2.19.

- The Consultant is required to keep the State updated on a regular basis by providing the following notifications: 2-WEEK Work Schedule; 2-DAY Inspection Notification; and Weekly Inspection Summary Reports. Refer to Section 3.2.3.1 for more information regarding these Notifications. Additionally, the Consultant is also required to submit a 1-WEEK Prior notification should police details be required. Refer to Section 1.2.7 for more information regarding 1-WEEK Prior Notifications.

- The Consultant shall verify that all applicable bridges are properly posted and signed for both posting and vertical clearance. Furthermore, the Consultant is responsible to notify the Department if a load rating should be revised based on a change in condition from the previous inspection affecting the structural capacity. Refer to Section 4.2.13 for more information about minimum vertical clearances.

- The Consultant shall draft bridge elevation, plan, and section orientation plans if required. Refer to Section 4.2.4 for more information.

- The Consultant shall submit inspection reports to the State no later than thirty (30) calendar days after completion of the field inspection. Any exception must be requested in writing by the Consultant and approved by the State. Refer to Section 1.2.6 for more information.

- The Consultant shall conduct work in accordance with all governing rules and regulations. Refer to Section 1.3 for more information.

- The Consultant shall be responsible to submit actual hours and cost data to the State upon completion of a work order assignment. This is in addition to and separate from invoicing. Refer to Section 1.2.3 for more information.

State policy includes the following responsibilities regarding inspection training:

- The Consultant's project manager(s) and team leaders are required to successfully complete a comprehensive training or refresher course based on the *Bridge Inspector's Reference Manual* (Report Nos. FHWA NHI 12-049 and FHWA NHI 12-050). Consultants are required to complete an approved bridge inspection refresher-training course once every four (4) years.

- All personnel must receive the appropriate railway safety training prior to work on structures involving railways. It is the responsibility of the Consultant to arrange for, and acquire the required Amtrak or appropriate railroad training.

- The Consultant's staff is encouraged to participate in additional training programs related to bridge inspection offered by FHWA. Please refer to http://www.nhi.fhwa.dot.gov for available course information.

State policy also includes responsibilities for program managers (Consultants) regarding quality control/quality assurance. Those responsibilities are discussed in Section 5.1.

2.3 Team Leader

2.3.1 Description

The team leader is the individual who performs the field inspection of an individual bridge. At a Federal minimum, one team leader is required by the FHWA at all times during each initial, routine, in-depth, fracture critical member and underwater inspection as per the *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.313 (23 *CFR* 650.313). Additionally, the State requires that a team leader be present for each field inspection team (including damage and special inspections), with a minimum of two inspection teams available for the project at all times and the right of the State to request additional inspection teams if needed. The team leader will have the assistance of one or two staff inspectors for each inspection team. Refer to Section 2.4 for the description and qualifications of a staff inspector.

2.3.2 Qualifications

The minimum qualifications of a team leader are established in the *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.309 (23 *CFR* 650.309) and are listed below:

(b) There are five [5] ways to qualify as a team leader. A team leader must, at a minimum:

(1) Have the qualifications [of a program manager] specified in paragraph (a) of this section [Section 2.1]; or

(2) Have five [5] years bridge inspection experience and have successfully completed an FHWA approved comprehensive bridge inspection training course; or

(3) Be certified as a Level III or IV Bridge Safety Inspector under the National Society of Professional Engineer's program for National Certification in Engineering Technologies (NICET) and have successfully completed an FHWA approved comprehensive bridge inspection training course; or

(4) Have all of the following:

(i) A bachelor's degree in engineering from a college or university accredited by or determined as substantially equivalent by the Accreditation Board for Engineering and Technology;

(ii) Successfully passed the National Council of Examiners for Engineering and Surveying Fundamentals of Engineering examination;

(iii) Two [2] years of bridge inspection experience; and

(iv) Successfully completed an FHWA approved comprehensive bridge inspection training course; or

(5) Have all of the following:

(i) An associate's degree in engineering or engineering technology from a college or university accredited by or determined as substantially equivalent by the Accreditation Board for Engineering and Technology;

(ii) Four [4] years of bridge inspection experience; and

(iii) Successfully completed an FHWA approved comprehensive bridge inspection training course.

In addition to the minimum Federal qualifications, the State requires the following:

- At least fifty (50) percent of experience be from NBIS bridge safety inspections to qualify as a team leader in the State; and

- Successful completion of an FHWA approved bridge inspection refresher training course once every four (4) years.

2.3.3 Responsibilities

Prior to the bridge inspection, the team leader is responsible for planning and preparing for the inspection, which includes reviewing the bridge structure file and evaluating any bridge site conditions (such as confined spaces, nondestructive evaluation and traffic control). While performing the field inspection, the team leader is responsible for all judgments made concerning a bridge's condition, including recognizing and reporting any critical findings, as well as maintaining safe inspection practices throughout the entire bridge inspection. Upon completion of the bridge inspection, the team leader finalizes the bridge inspection report and submits all required information within the specified timeframe.

The following procedures have been established within the *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.313 (23 *CFR* 650.313) regarding inspection, bridge files, reporting and recording the inspection results. These procedures are listed below:

(a) Inspect each bridge in accordance with the inspection procedures in the AASHTO *Manual for Bridge Evaluation* (incorporated by reference, see §650.317).

(d) Prepare bridge files as described in the AASHTO *Manual for Bridge Evaluation* (incorporated by reference, see §650.317). Maintain reports on the results of bridge inspections together with notations of any action taken to address the findings of such inspections. Maintain relevant maintenance and inspection data to allow assessment of current bridge condition. Record the findings and results of bridge inspections on standard State or Federal agency forms.

2.4 Staff Inspector

2.4.1 Description

The staff inspector is an individual who assists the team leader during the bridge inspection. The State requires that one (1) or two (2) staff inspectors assist the team leader for each inspection team.

2.4.2 Qualifications

State policy requires that, at a minimum, staff inspectors have either of the following:

- Minimum of three (3) years of bridge inspection experience; or
- Degree in civil or structural engineering.

No minimum Federal qualifications for inspectors have been established within the NBIS (Code of Federal Regulations, Title 23, Part 650, Subpart C).

2.4.3 Responsibilities

The primary responsibility of the staff inspector is to assist the team leader during the field inspection and report writing. As with the team leader, the staff inspector also has the responsibility of maintaining safe inspection practices throughout the entire field inspection.

2.5 Underwater Bridge Inspection Diver

2.5.1 Description

The underwater bridge inspection diver is a trained diver who inspects the substructure unit(s) and foundation(s) underneath the water's surface. An underwater bridge inspection diver may inspect for permanent reasons (such as a bridge over a lake or deep river), or for temporary reasons (such as high water or turbidity).

2.5.2 Qualifications

The minimum qualifications of an underwater bridge inspection diver are established in the *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.309 (23 *CFR* 650.309) and are listed below:

(d) An underwater bridge inspection diver must complete an FHWA approved comprehensive bridge inspection training course or other FHWA approved underwater diver bridge inspection training course.

Diving standards that are accepted for diver training include the following:

- Occupational Safety and Health Administration (or OSHA) safety requirements – https://www.osha.gov/

- American National Standards Institute (or ANSI) standards for commercial diver training – http://www.ansi.org/

- Association of Diving Contractors International (or ADC International) requirements – http://www.adc-int.org/

- United States Navy - http://www.navy.com/careers/special-operations/diver.html

Select any of the above links to learn more information about the standards for diving.

2.5.3 Responsibilities

The underwater bridge inspection diver is responsible for evaluating the physical condition of the substructure unit(s) and foundation(s) when above-water inspection methods (often probing) cannot adequately determine the condition of the members below the water's surface. The level of responsibility required from an underwater bridge inspection diver may even be greater than that of an above-ground inspector, since the underwater bridge inspection diver is often the only individual who will evaluate the condition of a member submerged below the water's surface.

The following procedures have been established within the *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.313 (23 *CFR* 650.313) regarding underwater inspections and are listed below:

(e) Identify bridges with [fracture critical members or] FCMs, bridges requiring underwater inspection, and bridges that are scour critical.

(2) Bridges requiring underwater inspections. Identify the location of the underwater elements and include a description of the underwater elements, the inspection frequency and the procedures in the inspection records for each bridge requiring underwater inspection. Inspect those elements requiring underwater inspections according to these procedures.

In addition to the inspection of underwater members, the underwater bridge inspection diver is often surrounded by a combination of hazards. Examples of these hazards include increased stream velocity, poor visibility due to dark and polluted water, marine traffic, floating timber, and debris accumulation at the substructure unit(s). Therefore, the underwater bridge inspection diver has a responsibility to safety and awareness of his or her surroundings throughout the entire underwater inspection.

2.6 Load Rater

2.6.1 Description

The load rater is the individual who determines the live-load-carrying capacity of an existing bridge using information contained in the existing bridge plans supplemented by information gathered from the most recent bridge inspection. The load rater is sometimes referred to as a load rating engineer.

2.6.2 Qualifications

The minimum qualifications of a load rater are established in the *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.309 (23 *CFR* 650.309) and are listed below:

(c) The individual charged with the overall responsibility for load rating bridges must be a registered Professional Engineer.

Therefore, a registered Professional Engineer is required to perform the load rating. Alternatively, the load rating may also be performed by an unlicensed engineer and then checked by a registered Professional Engineer. The qualifications for an unlicensed engineer include a degree in civil or structural engineering and have performed under the supervision of a registered Professional Engineer.

2.6.3 Responsibilities

The load rater is responsible for determining the load-carrying capacity of the bridge in its current condition according to various live loads (design, legal, and permit trucks). Load ratings are typically expressed in tons (tonnage) for each truck load, although some design truck loads are expressed as a fractional number (known as a rating factor). Bridges with rating factors that are greater than or equal to 1.0 (statutory level) are deemed satisfactory. Otherwise, bridges with rating factors less than 1.0 do not have the capacity to support that particular vehicular load and therefore shall be analyzed for load posting (restricting the weight that can be applied to the bridge) in accordance with the Department's *LRFR Rating Guidelines*.

The following procedures have been established within the *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.313 (23 *CFR* 650.313) regarding load rating and are listed below:

(c) Rate each bridge as to its safe load-carrying capacity in accordance with the AASHTO *Manual for Bridge Evaluation* (incorporated by reference, see §650.317). Post or restrict the bridge in accordance with the AASHTO *Manual for Bridge Evaluation* or in accordance with State law, when the maximum unrestricted legal loads or State routine permit loads exceed that allowed under the operating rating or equivalent rating factor.

2.7 Staff Engineer

2.7.1 Description

The staff engineer is an individual who assists with performing tasks such as, but not limited to, load rating and office engineering.

2.7.2 Qualifications

State policy requires that, at a minimum, staff engineers have the following:

- Degree in civil or structural engineering.

No minimum Federal qualifications for inspectors have been established within the NBIS (*Code of Federal Regulations*, Title 23, Part 650, Subpart C).

2.7.3 Responsibilities

The primary responsibility of the staff engineer is to assist with performing duties such as, but not limited to, determining the live-load-carrying capacity of existing bridges and bridge analysis.

2.8 Nondestructive Testing Qualifications

For nondestructive testing (or NDT), the inspector must have a familiarity and understanding of magnetic testing (or MT) and dye penetrant testing (or PT) in order to perform the procedures properly to get the appropriate results. However, if ultrasonic testing (or UT) is performed, a technician with minimum Level II specifications will be required to properly perform the testing. Refer to https://www.asnt.org/ and http://www.ndt-ed.org/ for more information about NDT testing and certification levels.

2.9 Inspection Team Composition

In general, a team leader and staff inspector will be required at each inspection for every inspection type. For underwater inspections, at two least staff inspectors will be required.

The overall composition of underwater inspection teams will be determined based on the type of structure to be inspected and the waterway conditions where the bridge is located. Each member of the team must have necessary experience, qualifications and skills for the demand of the inspection. For most underwater inspections, the size of the team and selection of the equipment will be dictated by all the considerations necessary for safe diving operations. A particular bridge that is to be inspected will dictate including personnel that have enhanced inspection or the ability to dive. The size of a crew for an underwater diving inspection, at a minimum, will require a three person team. More may be required based upon the type of dive and the site conditions. Reference the National Highway Institute (or NHI) *Underwater Bridge Inspection Reference Manual*, Publication Number FHWA-NHI-10-027, and the latest Occupational Safety and Health Standards (or OSHA) Code of Federal Regulations, Chapter 29, Part 1910, Subpart T for additional crew size requirements for the various dive types and different site conditions.

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Chapter 3 Inspection

3.1 General Inspection Types and Requirements

3.1.1 Inventory

An inventory (or initial) inspection is the first inspection of the bridge as it is entered into the bridge file. The inventory inspection verifies the safety of a bridge, in accordance with the NBIS and Department standards, before it is put into service. An inventory inspection also serves to provide the required inventory information of the *As-Built* structure type, size, and location, and to document its structural and functional conditions. In addition to being the first inspection of the bridge as its entered into the bridge file, an inventory inspection may also apply when the structure's configuration has changed (e.g., widening, lengthening, supplemental supports) or the structure has changed ownership. The inventory inspection shall be completed prior to the final construction inspection (if applicable), and made available to the final inspection team.

As stated within the NBIS, *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.313 (23 *CFR* 650.313), the following requirements are applicable for inventory inspections:

(b) Provide at least one team leader, who meets the minimum qualifications stated in §650.309, at the bridge at all times during each initial, routine, in-depth, fracture critical member and underwater inspection.

Refer to Section 2.3 and Section 2.4 for the description, qualifications, and responsibilities of a team leader and a staff inspector. Refer to Section 4.2 for further details pertaining to inspection report requirements.

3.1.1.1 Scope

The scope of an inventory inspection includes:

- Identification of Structure Inventory and Appraisal (SI&A) data;
- Identification of fracture critical members (FCMs), including their problematic details;
- Identification of underwater members;
- Establishment or revision of weight restrictions on the structure;
- Documentation of baseline structural conditions;
- Documentation of existing problems or locations;
- A fully documented inspection report complete with appropriate photographs and recommendations;

- Preparation/review of a punch-list, identifying items that require completion or correction (refer to Figure 3.1-1, Figure 3.1-2, and Figure 3.1-3 for a sample punch-list); and a

- Load rating analysis (may be performed by others).

Page 1 of 2

CONSTRUCTION PUNCH LIST
RIDOT MPA #XXX

SUBMITTED BY: **XXXX**
DATE of Initial Inspection: **07/18/20XX**

Construction Project Number: **XXXX-YY-ZZZ**

Bridge No. **041501** Town: **Lincoln** Bridge Name: **Wilbur Road**
Feature Carried/Crossed: **Wilbur Road over Route 146 (Eddie Dowling BLVD)**

Bridge Type: **Steel Multi-Girders**

Construction Company Name and representative: **XXXX**

Consultant Inspection Company: **XXXX**

D.O.T. Construction Inspector or Project Manager: **XXXX**

List of Items to be Corrected or Completed (see attached plan views of areas inspected):

No.	Punch List Item	Addressed	Not Addressed
1.	The railing posts at the pier on the north fascia and on the south fascia at the west abutment and pier have two (2) of four (4) anchor bolt nuts loose. Tighten anchor bolt nut(s) as required. See photo 1.		
2.	There is missing joint filler material between the granite curbs over the pier on the north sidewalk. Install the missing joint filler as required. See photo 2.		
3.	There is missing polyurethane elastomeric joint sealant in the sidewalk joints over the abutments and pier. Install the missing joint sealant as required. See photo 3.		
4.	There is missing polyurethane elastomeric joint sealant between the parapet and retaining walls at all four corners of the bridge. Install the missing joint sealant as required. See photo 4.		
5.	The retaining walls at the west approach are missing the white concrete covering/coating. Apply the covering/coating as required. See photo 5.		
6.	There are partial wood forms still in place on the north sidewalk in span 1. Remove the forms; install joint filler/sealant as required. See photo 6.		
7.	There are joints in the parapets along both fascias in spans 1 and 2 with missing joint sealant. Install the missing joint sealant as required. See photo 7.		
8.	The bottom flange edges at the bearing, the welds and the sole plate of the bearings on the west abutment are not painted. Provide proper paint coating at all eight (8) locations on the west abutment. See photo 8.		
9.	There is a 1 ft. long x 1 in. wide area of missing paint along the bottom of the bottom flange adjacent to the bearings on all girders at the west abutment, girders 1-5 and girder 8 in span 2 on the pier and girders 3 and 4 on the pier and east abutment in span 2. Provide proper paint coating at all eighteen (18) locations on the substructure units. See photo 9.		

Figure 3.1-1
Example Punch-list Page 1

Page 2 of 2

CONSTRUCTION PUNCH LIST
RIDOT MPA #XXX

Photo Log: (comments)

1. The railing post at the pier on the south fascia has two (2) of four (4) anchor bolt nuts loose.
2. Missing joint filler material between the granite curbs over the pier on the north sidewalk.
3. Missing polyurethane elastomeric joint sealant in the sidewalk joint over the east abutment on the north sidewalk.
4. Missing polyurethane elastomeric joint sealant between the parapet and retaining walls at the southwest approach corner. (Foam backerod is in place)
5. The retaining walls at the west approach are missing the white concrete covering/coating (southwest wall shown).
6. There are partial wood forms still in place on the north sidewalk in span 1.
7. Missing sealant in the joints/gaps in the parapets along both fascias in spans 1 and 2.
8. The bottom flange edges at the bearing, the welds and the sole plate of the bearings on the west abutment are not painted.
9. Missing areas of Paint at the top of the web stiffeners, top flange and webs on girders 8 of the pier.
10. All diaphragm to web stiffener connection s, connection bolts and nuts are not painted.
11. Missing areas of paint at the top of the web stiffeners, top flange and webs on girders 8 of the pier.
12. There is formwork still in place along the underside of the deck joint over the west abutment.
13. There is "over-pour" concrete from the deck stuck to the top flange of the fascia (girder #8) in span 2.
14. There is "over-pour" concrete from the deck stuck to girders 1 and 2 on the east abutment in span 2.
15. An area of honeycombing exposing the deck reinforcement between girders 1 and 2 in span 1 near the west abutment.
16. There is a 3/8 in. thick wood shim between the diaphragm channel and web stiffener on girder 8 over the west abutment.
17. The west elevation of the pier has areas which are cut but not patched and repaired; this condition has exposed some reinforcement.
18. The south (±6 ft. long) end of the asphaltic plug joint over the east abutment is not properly finished with honeycombing.
19. Active leakage and dampness at the underside of the deck at the south fascia over the pier.
20. The elastomeric bearings exhibit up to 6 in. long x up to 1.5 in. x ±1/8 in. gap at the front of the pad on girder 6 of the east abutment.

Additional Comments for Construction

1. The south (±6 ft. long) end of the asphaltic plug joint over the east abutment is not properly finished with honeycombing. The joint should be finished and smoothed off throughout its entire length. See photo 18.
2. There is active leakage and dampness at the underside of the deck at the fascias over the pier. See photo 19.
3. The elastomeric bearings exhibit up to 6 ft. long x up to 1.5 in. x ±1/8 in. gaps at the front of the pads at girders 4, 5 and 8 on the pier in span 1 and on girders 3, 4 and 6 of the east abutment. See photo 20.

Date punch list copy sent/emailed to Construction: _____________
To: ________________________________

Please complete the **Addressed / Not Addressed** *portion of the punch list upon the completion of the project and return this form to the ________________________________ for the bridge records.*

Submitted By: **XXXX** Date: **07/20/20XX**

Checked By: ____________________ Date: ______________

Figure 3.1-2
Example Punch-list Page 2

Bridge No.	041501	**Inspected by:**	XXXX
Town:	Lincoln	**Inspected by:**	XXXX
Feature Carried:	Wilbur Road	**Date Inspected:**	07/18/20XX
Feature Crossed:	Route 146	**Project No.:**	MPA XXX

Photo #1 :
The railing post at the pier on the south fascia has two (2) of four (4) anchor bolt nuts loose.

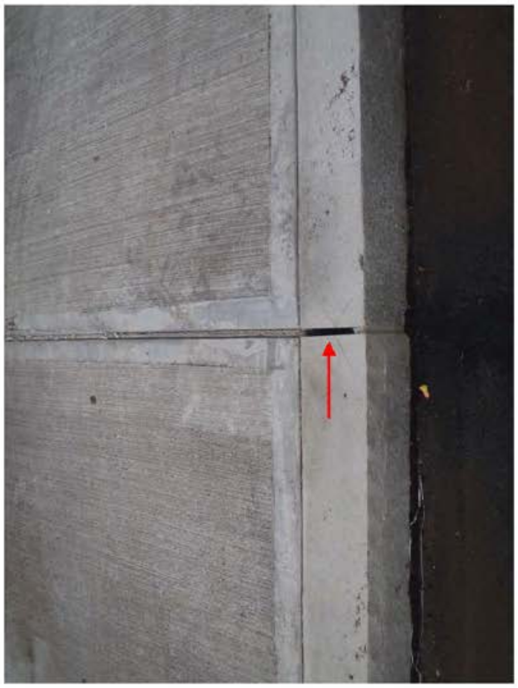


Photo #2 :
Missing joint filler material between the granite curbs over the pier on the north sidewalk.

Prepared by:
XXXX

Page **1** of **12**

Figure 3.1-3
Example Photo Sheet for a Punch-list

Documentation for an inventory inspection includes photographs, drawings (design, as-built, and shop drawings), scour analysis results, foundation information, and hydrologic data. Construction records (e.g., pile driving records, field changes) may contain valuable information in the future and should be included if possible. It is noted construction records are generally stored with the Department's Construction Section. For inventory inspections where the structure is not newly constructed, such as a change in an existing structure's configuration or a change in ownership, maintenance records are also provided.

3.1.1.2 Intensity

An inventory inspection is a fully documented, close-up, hands-on investigation of the bridge complete with a report. Although the exact level of effort required to perform an inventory inspection will depend on the structure's type, size, design complexity, and location, an inventory inspection provides all Structure Inventory and Appraisal (SI&A) data required by State and Federal regulations, all pertinent information typically collected by the owner, established maintenance and preventative measures for the structure, and baseline structural conditions and existing conditions that may cause future problems. For inventory inspections where the structure is not newly constructed, some or all aspects of an in-depth inspection may apply. Refer to Section 3.1.4 for more information regarding in-depth inspections.

3.1.1.3 Frequency

The frequency for an inventory inspection is the first inspection of the bridge as it's entered in the bridge file, the first inspection after the structure's configuration has changed, or a change of recording methods or elements. Therefore, it is possible for the physical structure to undergo only one inventory inspection in its lifetime, or for a bridge to undergo several inventory inspections if the structure's configuration has been modified or the bridge has changed ownership. For all inventory inspections, at a minimum, all bridges are to be inspected and the data entered into the Bridge Management System within forty-five (45) days of the date of inspection. Therefore, reports shall be submitted to the Department in accordance with Section 1.2.6 to meet this goal. The best practice is for initial inspections to be performed prior to the structure being put into service and the data submitted as quickly as possible.

3.1.2 Routine

A routine (or periodic) inspection is one of the many regularly scheduled inspections of the bridge that serves to evaluate the physical and functional conditions of the structure as compared to the initial or previously recorded conditions. This type of inspection is sometimes referred to as a *regular inspection* or an *NBIS inspection*. Routine inspections help to ensure that all present service requirements are satisfied. It is normal procedure to perform an in-depth inspection, especially in critical areas. If an in-depth inspection is not feasible for portions of a bridge the Department or Consultant may request a routine level inspection, which may be utilized on a case-by-case basis. The inspector will document any areas that receive a Routine Inspection. Refer to Section 3.1.4 for the description of in-depth inspections.

As stated within the NBIS, *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.313 (23 *CFR* 650.313), the following requirements are applicable for routine inspections:

(b) Provide at least one team leader, who meets the minimum qualifications stated in §650.309, at the bridge at all times during each initial, routine, in-depth, fracture critical member and underwater inspection.

Refer to Section 2.3 and Section 2.4 for the description, qualifications, and responsibilities of a team leader and a staff inspector. Refer to Section 4.2 for further details pertaining to inspection report requirements.

3.1.2.1 Scope

The scope of a routine inspection includes:

- Evaluation of the physical and functional condition of the bridge based on field observations and/or measurements;
- Inspection of the structure from the deck, walkways/structure platforms/access equipment (as applicable) to reach within fifteen (15) feet of all portions of the structure, and ground and/or water level;
- Inspection of the submerged substructure member(s) at low water levels from above the water surface through a wading inspection (refer to Section 3.1.6.1 for more information);
- Identification of changes from previously recorded conditions;
- Determination of the need for establishing or revising a weight restriction;
- Assessment of urgent maintenance needs; and a
- Fully documented inspection report complete with appropriate photographs and recommendations.

In some cases, a routine inspection may also warrant:

- An in-depth inspection for problematic area(s) shall be performed during the routine inspection. Problematic areas shall include critical or non-critical areas of the bridge that can pose safety or structural capacity issue(s);
- A separate underwater inspection when the wading inspection provides only a limited evaluation of underwater substructure elements; or
- A load rating analysis.

3.1.2.2 Intensity

A routine inspection is a documented investigation of the bridge that serves to compare the current condition with the previously documented condition. Although the information contained within the Structure Inventory and Appraisal (SI&A) data should be mostly up-to-date, minor changes and/or corrections to the SI&A data may be required based on current field observations and measurements.

The routine inspection should be comprehensive, such that a load rating analysis (if required) can be performed with existing information and the information collected in the field. If the bridge condition worsens and the structural adequacy compromised, it should be documented during the inspection using the Bridge Load Rating and Posting Recommendation Form (Form BI-005). Refer to Appendix A.5 for a blank version of the Bridge Load Rating and Posting Recommendation Form.

The following sequence is suggested for most routine inspections. Note that for some situations, the evaluation of the bridge substructure beneath the water surface may be limited to a wading inspection (low-flow conditions and/or probing to detect undermining of the substructure). Refer to Section 3.1.6.1 for more information regarding wading inspections.

Suggested Routine Inspection Sequence:

1. Inspect the bridge approaches and traffic safety features.
2. Inspect the deck at the top surface.
3. Inspect the underside of the deck.
4. Inspect the superstructure (e.g., slabs, beams, girders, trusses).
5. Inspect the bridge bearings.
6. Inspect the abutments and wingwalls.
7. Inspect the intermediate piers (if applicable).
8. Inspect the waterway/channel.

The level of effort for a routine inspection is dependent on the structure's type, size, design complexity, existing conditions, and location. Generally, a routine inspection will not require that every bridge element receive a hands-on inspection in order to provide an acceptable assessment of the bridge's condition. Good engineering judgment is required for all inspections, including routine inspections, in order to make the proper differentiation between critical and non-critical areas.

The following guidance is offered below for determining the level of detail required to achieve a sufficient inspection of a structure. Note that these guidelines should be treated as such and do not relieve the team leader or other inspection personnel from the responsibility to perform the tasks required to ascertain the condition of the bridge and assure its safety.

1. The following are examples of areas/elements that may have an increased difficulty in obtaining access, but warrant a close-up, hands-on inspection:

   - Load-carrying members or areas of members in Poor condition;
   - Fracture critical members or problematic details in fair or lesser condition, or where the estimated remaining fatigue life is less than ten (10) years, or where displacement-induced (out-of-plane bending) fatigue problems are critical;
   - Redundancy retrofit systems (e.g., catcher-beams) for fracture critical details (pin hangers, etc.);
   - Critical sections of controlling members on posted bridges;
   - Scour critical substructure units;
   - End regions of steel girders or beams under a deck joint;
   - Cantilevered portions of concrete piers or bents in Fair or lesser condition;
   - Ends of prestressed concrete beams at continuity diaphragms;
   - Precast concrete bridge barriers; and
   - Other areas determined by the team leader to be potentially critical.

Following the routine inspection, the results are presented in a written report with appropriate photographs. Additionally, any urgent maintenance recommendations, repairs, or scheduling for follow-up inspections are noted within the report. A load rating may also be recommended if the current condition has changed from the previous condition such that the structural capacity may have been affected.

3.1.2.3 Frequency

The frequency for routine inspections is established in the NBIS, *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.311 (23 *CFR* 650.311) and is listed below:

(a) *Routine inspections*:

(1) Inspect each bridge at regular intervals not to exceed twenty-four [24] months.

(2) Certain bridges require inspection at less than twenty-four-month [24-month] intervals. Establish criteria to determine the level and frequency to which these bridges are inspected considering such factors as age, traffic characteristics, and known deficiencies.

(3) Certain bridges may be inspected at greater than twenty-four month [24-month] intervals, not to exceed forty-eight [48] months, with written FHWA approval. This may be appropriate when past inspection findings and analysis justifies the increased inspection interval.

For bridges that require a reduced inspection interval, only a portion or portions of the bridge may warrant more frequent inspection. For these situations, an interim inspection of limited scope for the critical portions may be used to satisfy the reduced interval requirement while helping to reduce overall inspection costs. Refer to Section 3.1.7 for more information regarding interim inspections.

3.1.3 Damage

A damage inspection is an unscheduled inspection that evaluates structural damage to the bridge that was caused by environmental effects and/or human actions. Damage inspections help ensure that the safety of motorists crossing the bridge and/or passing under the bridge is preserved following the incident, as well as verifying that all present service requirements are still met. The inspection reports for damage inspections shall be submitted no later than 5 days after inspection.

Although the NBIS does not specify minimum qualifications of inspection personnel for a damage inspection, the State requires that a team leader be present for each field inspection team. The team leader is accompanied by one or two staff inspectors. Refer to Section 2.3 for the description and qualifications of a team leader to Section 2.4 for the description and qualifications of a staff inspector. Refer to Section 3.2.19 for critical finding procedures. Refer to Section 4.2 for further details pertaining to inspection report requirements.

3.1.3.1 Scope

The scope of a damage inspection includes the following:

- Assessment of the damage to the bridge and surrounding environment;
- Determination of the need for immediate closing or emergency load restrictions for vehicles or pedestrians utilizing the bridge;
- Evaluation of the effort required for the repair of the bridge; and
- Documentation of measurements, calculations/analyses, photographs, and all other findings.

In some cases, a damage inspection may be followed by a separate in-depth inspection. The subsequent in-depth inspection may provide:

- Further evaluation of damaged conditions;
- Verification of field measurements and calculations performed during the damage inspection;
- Adjustment or establishment of load restrictions through a detailed analysis; or
- Advancement of the required follow-up procedures as mandated by the owner.

3.1.3.2 Intensity

A damage inspection is a documented investigation of the bridge that provides an assessment of the damage to the bridge, whether from environment effects, human actions, or both. The complexity of field observations and measurements made during a damage inspection can vary greatly depending on the intensity of the damage and the area for which the damage encompasses. Note that in some cases, the damage may cause a structure to be incapable of supporting the loading caused by standard inspection access equipment and alternative means of access must be considered during the structure's evaluation.

The results of a damage inspection are presented in a written report complete with measurements, photographs, and all findings. In addition, on-site calculations and analyses may be required to evaluate the load-carrying capacity of the bridge in its damaged state, which may lead to the inspector recommending emergency load restrictions, temporary closure of the structure, or permanent closure of the structure until the necessary repairs have been completed. If the bridge condition worsens and the structural adequacy compromised, it should be documented during the inspection using the Bridge Load Rating and Posting Recommendation Form (Form BI-005). Refer to Appendix A.5 for a blank version of the Bridge Load Rating and Posting Recommendation Form.

3.1.3.3 Frequency

The frequency for damage inspections is established in the NBIS, *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.311 (23 *CFR* 650.311) and is listed below:

(d) Damage, in-depth, and special inspections. Establish criteria to determine the level and frequency of these inspections.

The Department assigns damage inspections on an as-needed basis. Follow-up inspections are dictated by the severity of the damage and resulting condition of the structure.

3.1.4 In-Depth

An in-depth inspection is a detailed inspection that determines the condition of the bridge or bridge element(s), either above or below the water level, using close-up, hands-on inspection techniques. An in-depth inspection may be performed for any of the following reasons:

- Regularly scheduled/included as part of an inventory, routine, special, or damage inspection; or
- Scheduled as a follow-up to an inventory, routine, or damage inspection;

As stated within the NBIS, *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.313 (23 *CFR* 650.313), the following requirements are applicable for in-depth inspections:

(b) Provide at least one team leader, who meets the minimum qualifications stated in §650.309, at the bridge at all times during each initial, routine, in-depth, fracture critical member and underwater inspection.

Refer to Section 2.3 and Section 2.4 for the description, qualifications, and responsibilities of a team leader and a staff inspector. Refer to Section 4.2 for further details pertaining to inspection report requirements.

3.1.4.1 Scope

The scope of an in-depth inspection can vary greatly depending on the context from which it was assigned. In general, an in-depth inspection is used to detect and document deficiencies and conditions that are not readily detectable by other inspection types and their procedures.

An in-depth inspection may require one or more of the following:

- Specialized inspection equipment (e.g., boats, barges, rigging, inspection vehicles);
- Specialized inspection personnel (e.g., divers, riggers, certified technicians);
- Nondestructive testing or other material testing; or a
- Load rating analysis.

3.1.4.2 Intensity

An in-depth inspection is a fully documented investigation of the bridge or bridge element(s), complete with a report and providing detailed descriptions of all activities, procedures, and findings from the inspection. Depending on the structure's configuration, existing and current conditions, and surrounding environment of the bridge, the inspection sequence/procedure for an in-depth inspection may be all-inclusive, inspecting all elements and components within one inspection, or may be selective to designated sections, groups of elements, connections, and/or details. If requested as a follow-up to a damage inspection, the in-depth inspection may require additional calculations or analyses to evaluate the effort needed for repair or necessity of load restrictions, temporary closure, or permanent closure of the structure.

The results of an in-depth inspection are presented in a written report complete with measurements, photographs, and all findings, including results from any nondestructive or material testing performed. If a load rating was warranted, a summary of the load rating analysis should also be included within the inspection report. For some in-depth inspections, the extent of documentation required may well exceed that for an inventory, routine, or damage inspection. If the bridge condition worsens and the structural adequacy compromised, it should be documented during the inspection using the Bridge Load Rating and Posting Recommendation Form (Form BI-005). Refer to Appendix A.5 for a blank version of the Bridge Load Rating and Posting Recommendation Form.

3.1.4.3 Frequency

The frequency for in-depth inspections is established in the NBIS, *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.311 (23 *CFR* 650.311) and is listed below:

(d) Damage, in-depth, and special inspections. Establish criteria to determine the level and frequency of these inspections.

As previously stated, an in-depth inspection may be scheduled/included as part of an inventory, routine, special, or damage inspection, may be a follow-up to an inventory, routine, or damage inspection, or may be scheduled independently of a routine inspection (though generally at a longer interval than routine inspections). For an independently scheduled in-depth inspection that satisfies the requirements of the NBIS, that in-depth inspection is permitted to replace the routine inspection for that inspection cycle.

3.1.5 Fracture Critical

A fracture critical inspection is a detailed inspection that evaluates the condition of fracture critical members (FCMs) including problematic details using hands-on inspection methods and possibly other nondestructive evaluation techniques.

Refer to Appendix D, Item 71 for the definition of a fracture critical member.

A bridge (or a bridge element) is considered fracture critical if no load path redundancy is present. In other words, the bridge or bridge element is non-redundant and will collapse partially or completely if the load path fails. Although other types of redundancy exist – structural redundancy and internal redundancy – only load path redundancy determines if a bridge or bridge element is fracture critical. The three types of redundancy are listed below:

- Load path redundancy – A main or primary load-carrying member represents the load path of a structure. For a bridge with four (4) or more load paths (main load-carrying members), the bridge is considered to have redundant load paths and is therefore considered to be a redundant structure. For a bridge with three (3) load paths, a structural analysis is required to determine if load path redundancy exists. For a bridge with two (2) or fewer load paths, the structure is not load path redundant and is considered to be fracture critical. An example of a fracture critical bridge is a two-girder bridge. Two load paths are present within the structure, one for each of the girders. Should one of the girders (load paths) fail, only one load path would remain and that single load path is insufficient to support that structure. As a result, the structure or a portion thereof would collapse.

- Structural redundancy – Bridges that provide continuity of the load path from span to span (multi-span continuous bridges) are considered to have structural redundancy. Bridges with structural redundancy may avoid complete collapse should a main load-carrying member (load path) fail. For continuous spans with more than two spans, failure of a main load-carrying member within an interior span could even result in no collapse, since the adjacent spans may be able to support the cantilevered segments of the intermediate span temporarily. A fracture critical bridge with no structural redundancy is considered more susceptible to failure than a fracture critical bridge with structural redundancy. The presence of structural redundancy (or lack thereof) does not determine if a structure is fracture critical.

- Internal redundancy – Bridge members that are constructed from multiple elements that are mechanically fastened together (either through riveted or bolted connections) are said to have multiple local (internal) load paths within the member. For this reason, internal redundancy is also referred to as member redundancy. An example of internal redundancy is a built-up plate girder, which has several plate elements that form the flanges and web, connected through angle elements and fastened with rivets or bolts. As with structural redundancy, a fracture critical bridge with no internal redundancy is considered more susceptible to failure than a fracture critical bridge with internal redundancy. The presence of internal redundancy (or lack thereof) does not determine if a structure is fracture critical.

Below is a general list of areas to be inspected:

- All exposed surfaces of metal load path nonredundant superstructure elements shall receive a close-up, "hands-on" visual inspection during each inspection. Areas to receive this "hands-on" inspection include areas subject to tension stress and stress reversal. Members may consist of riveted, bolted, or welded construction. For bridge inspection purposes, superstructures consisting of two girders (including box girders), floor systems (floorbeams), suspension bridges, rigid frames, tied arch tied girders or trusses are considered load path nonredundant.

- All exposed surfaces of metal load path nonredundant pier caps or cross girders shall receive a close-up, "hands-on" visual inspection during each inspection. This includes areas subject to tension stress and stress reversal.

- For bridges with no load path redundancy, all AASHTO fatigue category D, E, or E' details shall receive a close-up, "hands-on" visual inspection as part of each inspection for fracture critical bridges.

- All exposed surfaces of all pin and hanger details and all exposed primary member surfaces within 3 feet of pin and hanger details shall receive a close-up, "hands-on" visual inspection during each inspection. This shall be done regardless of redundancy.

- Tension and stress reversal zones of metal members shall be examined for the presence of tack welds, remaining original welded erection aids, remaining original groove weld back-up bars, plug welded holes, and other existing weld details, situations, or conditions not part of the original design. If any of these situations exist, they shall receive a close-up, "hands-on" visual inspection during each inspection. This shall be done regardless of redundancy.

- In general, all connections welded to a primary member shall be considered part of the primary member.

- When a bridge element receives a close-up, "hands-on" visual inspection under these provisions, a note shall be placed under Additional Notes on inspection forms stating that the required "hands-on" inspection was performed. This note shall specifically list those elements of the bridge that received the required "hands-on" inspection.

- Other details, situations, or conditions of special concern may be highlighted for special inspection emphasis even if the specific situation is not itemized in this list of elements to be inspected.

Other fracture critical members or fracture critical zones may exist which are not listed. The list above is considered guidance and does not relieve the team leader or other inspection personnel from the responsibility of identifying and properly inspecting all fracture critical members, fracture critical zones of members, fatigue-prone details, and other problematic areas, all of which is required to ascertain the condition of the bridge and assure its safety.

As stated within the NBIS, *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.313 (23 *CFR* 650.313), the following requirements are applicable for fracture critical inspections:

(b) Provide at least one team leader, who meets the minimum qualifications stated in §650.309, at the bridge at all times during each initial, routine, in-depth, fracture critical member and underwater inspection.

(e) Identify bridges with FCMs, bridges requiring underwater inspection, and bridges that are scour critical:

(1) Bridges with fracture critical members. In the inspection records, identify the location of FCMs and describe the FCM inspection frequency and procedures. Inspect FCMs according to these procedures.

Refer to Section 2.3 and Section 2.4 for the description, qualifications, and responsibilities of a team leader and a staff inspector. Refer to Section 3.2.19 for critical finding procedures. Refer to Section 4.2 for further details pertaining to inspection report requirements.

A Fatigue and Fracture (F&F) Inspection Plan includes fracture critical member identification and locations of problematic details, which are to be identified prior to performing the inspection. An F&F plan shall include the following:

- Sketch(es) of the superstructure with locations of problematic details identified (refer to Section 4.2.14.5 for more information):
    - Use a grid diagram (framing plan) with detail locations labeled by letters or numbers and a legend explaining the numbering or lettering scheme.
    - Use an elevation view for a truss superstructure.
    - Classify similar problematic details as *types* (e.g., end of a partial cover plate).
- A table of fatigue/fracture prone details indicating the following (refer to Section 4.2.14.6 for more information):
    - Type of detail (e.g., end of a partial cover plate, short web gap);
    - Location of each occurrence of the detail;
    - AASHTO fatigue category of the detail;

- Any previously installed retrofits; and a
- Table that can be organized by span or type of detail.

3.1.5.1 Scope

The scope of a fracture critical inspection includes the following:

- Identification of fracture critical members (FCMs), including the location of the FCM and all history pertaining to the FCM;
- Identification of problematic details, including the location of the detail and all history relating to the detail;
- Development of a plan for inspecting FCMs and problematic details;
- Detection of cracks using very detailed, close-up, visual hands-on methods;
- Surface preparation (where necessary) prior to inspection and detection of deficiencies; and
- Documentation, including photographs and sketches, for both newly detected deficiencies and pre-existing deficiencies for comparison and monitoring.

A fracture critical inspection may also include nondestructive evaluation and other material testing, as well as additional lighting and magnification for the detection of deficiencies.

3.1.5.2 Intensity

A fracture critical inspection is a fully documented investigation of the fracture critical members (FCMs), including problematic details, that are located on the bridge. Given the inherent nature of FCMs and problematic details, the intensity of this type of inspection is significant. For the detection of cracks in steel members, surface preparation may be necessary and could require additional effort (e.g., removing rust scale prior to inspecting for cracks). During the inspection and detection process, lighting and magnification may also be required. Furthermore, fracture critical inspections may utilize nondestructive and/or other material evaluations.

The results of a fracture critical inspection are presented in a detailed written report complete with measurements, photographs, sketches, explanation of activities and procedures performed, and all findings, including results from any nondestructive or material evaluation performed. If the bridge condition worsens and the structural adequacy compromised, it should be documented during the inspection using the Bridge Load Rating and Posting Recommendation Form (Form BI-005). Refer to Appendix A.5 for a blank version of the Bridge Load Rating and Posting Recommendation Form.

3.1.5.3 Frequency

The frequency for fracture critical member (FCM) inspections is established in the NBIS, *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.311 (23 *CFR* 650.311) and is listed below:

(c) *Fracture critical member (FCM) inspections*:

(1) Inspect FCMs at intervals not to exceed twenty-four [24] months.

(2) Certain FCMs require inspection at less than twenty-four-month [24-month] intervals. Establish criteria to determine the level and frequency to which these members are inspected considering such factors as age, traffic characteristics, and known deficiencies.

RIDOT typically inspects fracture critical bridges at a frequency of 12-month intervals. This frequency will supersede FHWAs 24-month CFR requirement for fracture critical bridges.

3.1.6 Underwater

An underwater inspection is an inspection that determines the condition of the underwater portion of the bridge substructure and surrounding channel. Underwater inspections may be conducted as wading inspections or as underwater diving inspections depending on the channel conditions, channel depth, and/or bridge configuration.

Regardless of the specific type of underwater inspection, the NBIS requires that scour evaluations be performed for all bridges that are scour critical. This requirement and the applicable underwater inspection requirements are listed below, per the NBIS, *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.313 (23 *CFR* 650.313):

(b) Provide at least one team leader, who meets the minimum qualifications stated in §650.309, at the bridge at all times during each initial, routine, in-depth, fracture critical member and underwater inspection.

(e) Identify bridges with FCMs, bridges requiring underwater inspection, and bridges that are scour critical:

(2) Bridges requiring underwater inspections. Identify the location of underwater elements and include a description of the underwater elements, the inspection frequency and the procedures in the inspection records for each bridge requiring underwater inspection. Inspect those elements requiring underwater inspections according to these procedures.

(3) Bridges that are scour critical. Prepare a plan of action to monitor known and potential deficiencies and to address critical findings. Monitor bridges that are scour critical in accordance with the plan.

Refer to Section 2.3, Section 2.4 and Section 2.5 for the description, qualifications, and responsibilities of a team leader, staff inspector and an underwater bridge inspection diver.

3.1.6.1 Wading Inspections

A wading inspection is a type of inspection that is made during low-flow periods, or when probing for signs of undermining or deterioration is sufficient to evaluate the underwater portions of the bridge substructure. Refer to Section 3.1.2 for NBIS requirements regarding routine inspections and Section 3.1.6 for NBIS requirements regarding underwater inspections. Refer to Section 4.2 for further details pertaining to inspection report requirements.

3.1.6.1.1 Scope

The scope of a wading inspection includes:

- An evaluation of the physical and functional condition of the channel based on field observations and/or measurements;
- A visual inspection of the submerged substructure member(s) at low water levels from above the water surface;
- The identification of changes from previously recorded conditions;
- The determination of the need for established or revising a weight restriction;
- An assessment of maintenance needs regarding the bridge substructure units and waterway; and
- An assessment of the risk of failure due to scour.

Furthermore, a wading inspection may also include one or more of the following:

- Probing of the substructure member(s) from above the water surface; and a
- Scour evaluation, if the bridge is considered scour critical.

3.1.6.1.2 Intensity

Included as part of a routine inspection, a wading inspection is a documented investigation of the bridge substructure and surrounding channel that serves to compare the current conditions of the submerged members and channel with the previously documented conditions.

When performing a wading inspection, scour can vary significantly from one end of a footing to the other. Therefore, multiple readings should be taken along the length of the footings to properly assess the bridge substructure. Particular attention should be given to foundations on spread footings where scour or undermining can be more critical. In addition, scouring and undermining should be carefully evaluated for deep foundations since these deficiencies can greatly affect the horizontal stability. This situation is especially of concern when scour has occurred on only one face of the substructure unit, causing asymmetrical horizontal loading of the substructure unit.

For channels, multiple readings should also be taken to account for local extremes that may not otherwise be apparent when determining the waterway opening cross section, which is critical in completing the bridge scour assessment.

The results of a wading inspection are presented in a written report (as part of the main inspection report) with appropriate photographs. Any maintenance recommendations, repairs, or scheduling for follow-up inspections regarding the underwater substructure members or channel are noted. A load rating may also be recommended if the current condition of the substructure and/or foundation(s) has changed from the previous condition such that the structural capacity may have been affected. If the bridge condition worsens and the structural adequacy compromised, it should be documented during the inspection using the Bridge Load Rating and Posting Recommendation Form (Form BI-005). Refer to Appendix A.5 for a blank version of the Bridge Load Rating and Posting Recommendation Form.

3.1.6.1.3 Frequency

The frequency for a wading inspection is established according to the NBIS for a routine inspection. Refer to Section 3.1.2.3 for more information.

3.1.6.2 Underwater Diving Inspections

An underwater diving inspection is a type of underwater inspection that is made when wading inspections are not sufficient, or when the substructure members (located below the water level) cannot be adequately inspected through visual or probing methods. Refer to Section 3.1.6 for NBIS requirements regarding underwater inspections. Refer to Section 4.2 for further details pertaining to inspection report requirements.

3.1.6.2.1 Scope

The scope of an underwater diving inspection includes:

- An evaluation of the physical and functional condition of the underwater substructure member(s) based on field observations and/or measurements, which are conducted by specialized inspection personnel (e.g., divers);
- Specialized inspection tools (e.g., wetsuits, SCUBA equipment, surface-supplied air equipment);
- The identification of changes from previously recorded conditions;
- The determination of the need for establishing or revising a weight restriction;
- An assessment of maintenance needs regarding the bridge substructure units and waterway;
- An assessment of the risk of failure due to scour; and
- A fully documented inspection report complete with appropriate photographs and recommendations.

Furthermore, an underwater diving inspection may include some or all of the following:

- Specialized inspection equipment (e.g., boats, barges, sounding equipment);
- Advanced inspection procedures (e.g., underwater imaging);
- Nondestructive or other material evaluation;
- Scour evaluation, if the bridge is considered scour critical; and a
- Load rating analysis.

3.1.6.2.2 Intensity

An underwater diving inspection is a fully documented investigation of the bridge substructure elements that are located below the water surface. An underwater diving inspection provides a complete and detailed description of all activities, procedures and findings from the inspection including scour evaluations, if the bridge is considered scour critical.

When performing an underwater diving inspection, scour can vary significantly from one end of a footing to the other. Therefore, multiple readings should be taken along the length of the footings to properly assess the bridge substructure. Particular attention should be given to foundations on spread footings where scour or undermining can be more critical. In addition, scouring and undermining should be carefully evaluated for deep foundations since these deficiencies can greatly affect the horizontal stability. This situation is especially of concern when scour has occurred on only one face of the substructure unit, causing asymmetrical horizontal loading of the substructure unit.

For channels, multiple readings should also be taken to account for local extremes that may not other be apparent when determining the waterway opening cross section, which is critical in completing the bridge scour assessment.

Minimum Required Water Depth Soundings:

- Along each of the substructure units soundings shall be taken at equally spaced intervals not to exceed 15’ inclusive of soundings at the corners. Additionally, soundings shall be taken at distances of 5’ and 10’ off of the substructure units perpendicular to the soundings taken along the substructure units.
- At the upstream and downstream noses of piers, and at distances of 5’ and 10’ off of the noses.
- Along the upstream and downstream fascias soundings shall be taken at equally spaced intervals not to exceed 20’ (or tenth points for spans over 200’ long) in each span not including the soundings at the substructure noses.
- At locations where scour is found soundings shall be taken as needed to determine the full extent of the scour condition including but not limited to size, depth, location and possibility of undermining.

- Additional soundings as deemed necessary by the inspector to adequately evaluate the substructure and channel conditions.

- At the discretion of RIDOT, the locations of soundings may be adjusted on a case by case basis.

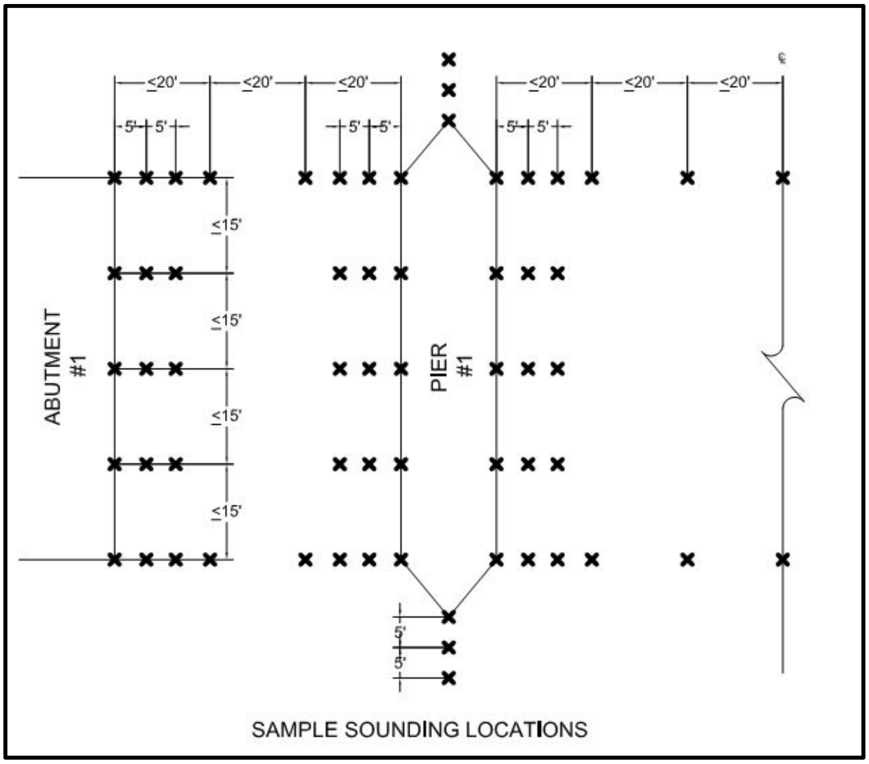


Figure 3.1-4 Sample Sounding Locations

Water velocities (measured in feet per second or FPS) are required to be taken for all bridges. These are taken at the center of each span within the channel. In each span, the measurements are taken along the water column at 20 percent of the water depth, 60 percent of the water depth and 80 percent of the water depth. These should be taken on all non-tidal channels. They are not necessary to take in tidal waters due to varying velocities during the tide cycle. Channels that are tidal in nature should be approximated to give maximum water velocity during a tide cycle.

The results of an underwater diving inspection are presented in a written report complete with measurements, photographs, and all findings, including scour evaluations and the results from any nondestructive or material testing, if performed. If a load rating was warranted, a summary of the load rating analysis should also be included within the inspection report. If the bridge condition worsens and the structural adequacy compromised, it should be documented during the inspection using the Bridge Load Rating and Posting Recommendation Form (Form BI-005). Refer to Appendix A.5 for a blank version of the Bridge Load Rating and Posting Recommendation Form.

Each underwater diving inspection requires Computer Aided Design (or CAD) drawings and Portable Document Format (or PDF) files. The drawings should include the location map for the bridge, a channel cross section at the bridge upstream fascia, a sounding plan of the channel showing both current and historic sounding data and a drawing with the location and description of the deficiencies. The sounding plan should show sufficient information so that the location of each sounding can be determined. Additionally, the sounding plan should reference a single point as a local vertical datum and the sounding values shall be reported with a vertical tolerance of ~6”.

The soundings taken along the upstream profile shall be provided to the above water inspection team so that the data may be used to supplement data gathered for the Channel Cross Section as described in Section 4.2.8 of this manual.

3.1.6.2.2.1 Diving Inspection Intensity Levels

Originating in the offshore diving industry and adopted by the United States Navy, the designation of standard levels of underwater diving inspection intensity has gained widespread acceptance. Three diving inspection intensity levels have evolved as follows:

- Level I: Visual, tactile inspection
- Level II: Detailed inspection with partial cleaning
- Level III: Highly detailed inspection with non-destructive testing (NDT) or partially destructive testing(PDT)

Routine underwater inspections normally include a 100 percent Level I intensity inspection and a 10 percent Level II intensity inspection, but it may include a Level II and Level III intensity inspection to determine the structural condition of any submerged portion of the substructure with certainty. Intensity level of the inspection shall be determined and documented prior to the inspection by the Consultant and approved by RIDOT.

3.1.6.2.2.1.1 Level I

Level I intensity inspection consists of a close visual inspection at arm's length with minimal cleaning to remove marine growth of the submerged portions of the bridge. This intensity level of inspection is used to confirm the continuity of the members and to detect any undermining or elements that may be exposed that would normally be buried. Although the Level I intensity inspection is referred to as a "swim-by" inspection, it needs to be detailed enough to detect obvious major damage or deterioration. A Level I intensity inspection is normally conducted over the total (100%) exterior surface of each underwater element, involving a visual and tactile inspection with limited probing of the substructure and adjacent streambed. In areas where light is minimal, handheld lights may be needed. If the water clarity is poor enough that the inspector cannot inspect the member visually, a tactile inspection may be performed by making a sweeping motion of the hands and arms to cover the entire substructure.

The results of the Level I intensity inspection provide a general overview of the substructure condition and verification of the as-built drawings. The Level I intensity inspection can also indicate the need for Level II or Level III intensity inspections and aid in determining the extent and the location of more detailed inspections.

3.1.6.2.2.1.2 Level II

Level II intensity inspection is a detailed inspection that requires that portions of the structure be cleaned of marine or aquatic growth. In some cases, cleaning is time consuming, particularly in salt water, and needs to be restricted to critical areas of the structure. However, in fresh water, aquatic coatings can be removed by just wiping the structural element with a glove.

Generally, the critical areas are near the low waterline, near the mud line, and midway between the low waterline and the mud line. On pile structures, horizontal bands, approximately 6 to 12 inches in height, preferably 10 to 12 inches, need to be cleaned at designated locations:

- Rectangular piles - the cleaning includes at least three sides
- Octagonal piles - at least six sides
- Round piles - at least three-fourths of the perimeter
- H-piles - at least the outside faces of the flanges and one side of the web

On large elements, such as piers and abutments, clean areas at least 1 square foot in size at three or more levels on each face of the element. For a structure that is greater than 50 feet in length, clean an additional three levels on each exposed face. It is important to select the locations to clean to help minimize any potential damage to the structure and to target more critical locations. Measure and document any deficient areas, including both the extent and severity of the damage.

It is intended to detect and identify high stress, damaged and deteriorated areas that may be hidden by surface growth. A Level II intensity inspection is typically performed on at least 10% of all underwater elements. Govern the thoroughness of cleaning by what is necessary to determine the condition of the underlying material. Complete removal of all growth is generally not required.

3.1.6.2.2.1.3 Level III

A Level III intensity inspection is a highly detailed inspection of a critical structure or structural element, or a member where extensive repair or possible replacement is contemplated. The purpose of this type of inspection intensity is to detect hidden or interior damage and loss in cross sectional area. This level of inspection intensity includes extensive cleaning, detailed measurements, and selected nondestructive and other testing techniques such as ultrasonics, sample coring or boring, physical material sampling, and in-situ hardness testing. The use of testing techniques is generally limited to key structural areas; areas that are suspect; or areas that may be representative of the entire bridge element in question.

3.1.6.2.3 Frequency

The frequency for underwater diving inspections is established in the NBIS, *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.311 (23 *CFR* 650.311) and is listed below:

(b) *Underwater inspections*:

(1) Inspect underwater structural elements at regular intervals not to exceed sixty [60] months. (Typically true for all dive inspections)

(2) Certain underwater structural elements require inspection at less than sixty-month [60-month] intervals. Establish criteria to determine the level and frequency to which these members are inspected considering such factors as construction material, environment, age, scour characteristics, condition rating from past inspections and known deficiencies.

(3) Certain underwater structural elements may be inspected at greater than sixty-month [60-month] intervals, not to exceed seventy-two [72] months, with written FHWA approval. This may be appropriate when past inspection findings and analysis justifies the increased inspection interval.

Factors that may shorten the frequency of an underwater diving inspection to be less than the maximum frequency established in the NBIS may include one or more of the following:

- Structural damage;
- Scour and undermining from streamflow;
- Drift and debris;
- Streambed load;
- Ice loading;
- Vessel impact (collision);
- Adverse effects to the structure from streamflow; and
- Adverse effects to the structure from elements within the streamflow.

3.1.7 Interim (Special) and Miscellaneous

An interim (special) inspection may be used to evaluate a load posted bridge between the typical inspection intervals, inspect a bridge that is out of service, monitor a suspected or known deficiency, or assess the bridge or bridge member(s) following a manmade or natural emergency.

Although the NBIS does not specify minimum qualifications of inspection personnel for an interim inspection, the State requires that a team leader be present for each field inspection team. The team leader is accompanied by one or two staff inspectors. Refer to Section 2.3 for the description and qualifications of a team leader. Refer to Section 2.4 for the description and qualifications of a staff inspector.

The Department establishes guidance on what to observe and what to evaluate during an interim inspection for each specific bridge on the Special Inspection Requirement Form BI-011 (see Appendix A.11).

3.1.7.1 Posted Bridge

A posted bridge (special) inspection is performed for a bridge located on a public roadway that can no longer support the minimum live loads (truck loads) for the prescribed rating method (e.g., inventory, operating, legal) and must be restricted in the maximum weight that can be carried. Posted bridge inspections help to verify that all service requirements are being met for load posted bridges for periods between the scheduled routine inspection intervals. Refer to Section 4.2 for further details pertaining to inspection report requirements.

3.1.7.1.1 Scope

The scope of a posted bridge (special) inspection will typically resemble that similar to a routine inspection. A posted bridge inspection includes:

- Evaluation of the physical and functional condition of the bridge based on field observations and/or measurements;
- Inspection of the structure from the deck, walkways/structure platforms/access equipment (as applicable) within arm's reach of all critical component(s) of the structure;
- Verification of the proper posting restrictions for the given structure configuration, condition, and appropriate other factors that may lead to a reduction in the bridge's load-carrying capacity;
- Verification of all signing requirements (locations, content, and readability); and
- A fully documented inspection report complete with appropriate photographs and recommendations. Photographs should include posting signs.

In some cases, a posted bridge inspection may also warrant:

- A separate in-depth inspection for all critical component(s);
- A separate underwater inspection when the routine inspection provides only a limited evaluation of underwater substructure elements; or
- A load rating analysis.

3.1.7.1.2 Intensity

A posted bridge (special) inspection is a documented investigation of the bridge that determines if the bridge is appropriately load posted based upon the structure's configuration, existing and current conditions, and other factors that may reduce the load-carrying capacity of the bridge. For load posted bridges, all load posting signing should be verified as being:

- Correctly placed at the bridge and at advance warning locations;
- Accurate for the given load posting of the bridge; and
- Clear and legible for approaching motorists.

In general, the level of effort required for a load posted inspection is similar to that of a routine inspection.

The results of a posted bridge inspection are presented in a written report complete with measurements, photographs, and findings. Recommendations for a load rating analysis to verify the current load posting or further reduce the load posting may be warranted from the posted bridge inspection. If the bridge condition worsens and the structural adequacy compromised, it should be documented during the inspection using the Bridge Load Rating and Posting Recommendation Form (Form BI-005). Refer to Appendix A.5 for a blank version of the Bridge Load Rating and Posting Recommendation Form.

3.1.7.1.3 Frequency

The frequency for posted bridge (special) inspections is established in the NBIS, *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.311 (23 *CFR* 650.311) and is listed below:

(d) Damage, in-depth, and special inspections. Establish criteria to determine the level and frequency of these inspections.

The frequency of posted bridge inspections typically range from 3 to 12-months depending on the severity and location of deterioration. The frequency is established on a case by case basis by the Department for each specific bridge.

3.1.7.2 Closed Bridge

A closed bridge (special) inspection is performed for a bridge located on a public roadway that is closed to vehicular traffic. The following policies are set forth by the NBIS and the Department for closed bridges:

- For an NBI bridge, the closed bridge must be inspected in accordance with NBIS and Department standards.
- For a non-NBI bridge, the closed bridge must be inspected in accordance with the NBIS and Department standards.

- For a bridge (NBI or non-NBI) that is on the inventory of public roads but has been closed completely for replacement, it is not required to keep the inspection record current. However, if public pedestrian traffic is to be maintained on the bridge, the need for inspection will remain.

- For an NBI bridge that has been partially closed to vehicular traffic for a staged construction project (rehabilitation or replacement), the bridge is still part of the public road and must be inspected according to the NBIS and Department standards.

- For an NBI bridge that has been completely closed for rehabilitation, it is not required to keep the inspection record current during construction. However, upon the essential completion of work and prior to the bridge going back into service, an initial inspection is required.

Note that for all situations where the bridge has been closed to vehicular traffic, but the portion for pedestrian traffic remains open to pedestrians, the structural capacity for the portion of the bridge for pedestrians must be verified according to AASHTO specifications for pedestrian loading. Additionally, appropriate signing must also be in place, both at the bridge and at advance locations of the bridge.

Although a bridge may be closed to vehicular (and possibly pedestrian) traffic, the inspection must remain current. This practice helps to maintain a safe environment for public access on, under, and around the closed bridge.

Refer to Section 4.2 for further details pertaining to inspection report requirements.

3.1.7.2.1 Scope

The scope of a closed bridge (special) inspection can vary greatly depending on the structural configuration, existing and current conditions, and surrounding environment of the bridge. For a bridge that was closed due to structural deficiencies, a closed bridge inspection may closely resemble a routine inspection. While closed bridge inspections may resemble a routine inspection, hands-on (in-depth) inspections are not typically performed on closed bridges.

A closed bridge inspection requires the following:

- Assessment of the physical integrity of the bridge such that public safety is maintained;

- Evaluation of the need for further closure to pedestrians (if applicable) or complete demolition of the bridge;

- Inspection of the vehicular barriers preventing access to, under, or around the bridge;

- Verification of the appropriate signing indicating that the bridge is closed, both at the bridge and at advance warning locations;

- Determination of the load-carrying capacity of the bridge for pedestrian loads (if applicable); and

- Documentation of measurements (if required), calculations/analyses (if required), photographs, and all other findings.

Additionally, a closed bridge inspection may require one or more of the following:

- Inspection of the pedestrian barriers or fencing preventing access to, under or around the bridge (if applicable);
- Specialized inspection equipment (e.g., boats, barges, rigging, inspection vehicles);
- Nondestructive or other material evaluation; or a
- Load rating analysis for pedestrian loading only.

3.1.7.2.2 Intensity

A closed bridge (special) inspection is a documented investigation of the bridge that ultimately determines if a bridge is safe to remain in place in its current condition. Depending on the structural configuration, existing and current conditions, and surrounding environment, the intensity of a closed bridge inspection can vary greatly, but is generally less than that of a routine inspection for an in-service bridge. In some cases, the level of effort may be reduced for non-critical areas of the bridge, but ONLY with the approval of someone from the State Bridge Inspection Staff. The level of effort may also be increased for critical areas, especially for those areas that warranted the structure's closing, areas preventing access to, under, or around the bridge, such as vehicular/pedestrian barriers and pedestrian fencing, and signing that indicates the bridge's closure at the bridge and at advance warning locations.

The results of a closed bridge inspection include a written report complete with measurements, photographs, and findings. Additional calculations and/or analyses may also be required to evaluate the stability and safety of the closed bridge. Recommendations for a load rating analysis, closure to pedestrians, or complete demolition of the bridge may be warranted from the closed bridge inspection. If the bridge condition worsens and the structural adequacy compromised, it should be documented during the inspection using the Bridge Load Rating and Posting Recommendation Form (Form BI-005). Refer to Appendix A.5 for a blank version of the Bridge Load Rating and Posting Recommendation Form.

3.1.7.2.3 Frequency

The frequency for closed bridge (special) inspections is established in the NBIS, *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.311 (23 *CFR* 650.311) and is listed below:

(d) Damage, in-depth, and special inspections. Establish criteria to determine the level and frequency of these inspections.

The maximum interval of inspection of closed bridges is twenty-four (24) months. For bridges in critical condition, more frequent inspections may be warranted. Typically, the Department requires that closed bridges be inspected every 12 months.

3.1.7.3 Deteriorated Condition

A deteriorated condition (special) inspection is performed for a bridge located on a public roadway that has suspected or known deterioration on one or more of its members. Deteriorated condition inspections help to quantify the deterioration and the effect of the deterioration on the load-carrying capacity and safety of the bridge. Refer to Section 4.2 for further details pertaining to inspection report requirements.

3.1.7.3.1 Scope

The scope of a deteriorated condition (special) inspection is similar to an in-depth inspection such that it will vary greatly depending on the complexity of the deficiencies being inspected. In general, an in-depth inspection is used to investigate member deterioration that could not be properly evaluated through other inspection types and their procedures.

A deteriorated condition inspection may require one or more of the following:

- Specialized inspection equipment (e.g., boats, barges, rigging, inspection vehicles);
- Specialized inspection personnel (e.g., divers);
- Nondestructive or other material evaluation; or a
- Load rating analysis.

3.1.7.3.2 Intensity

A deteriorated condition (special) inspection is a documented investigation of a bridge with deteriorated members that clarifies the extent of deterioration on one or more of the bridge's members and the overall impact of the deterioration on the performance and safety of the bridge. The complexity of a deteriorated condition inspection will vary according to the magnitude of each deficiency, as well as the number of deficiencies that are being investigated. Other factors that may affect the inspection include the structure's configuration, the need for advanced inspection procedures, and the surrounding environment. Overall, the intensity of a deteriorated condition inspection will generally be equivalent to that of an in-depth inspection for an in-service bridge.

The results of a deteriorated condition inspection include a written report complete with measurements, photographs, and findings resulting from the deterioration. Additional calculations and/or analyses may also be required to evaluate the extent of the deterioration or its effect on the load-carrying capacity of the bridge. Recommendations for a load rating analysis may be warranted from the deteriorated condition bridge inspection. If the bridge condition worsens and the structural adequacy compromised, it should be documented during the inspection using the Bridge Load Rating and Posting Recommendation Form (Form BI-005). Refer to Appendix A.5 for a blank version of the Bridge Load Rating and Posting Recommendation Form.

3.1.7.3.3 Frequency

The frequency for (special) inspections of bridges with deteriorated conditions is established in the NBIS, *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.311 (23 *CFR* 650.311) and is listed below:

(d) Damage, in-depth, and special inspections. Establish criteria to determine the level and frequency of these inspections.

The frequency of deteriorated condition bridge inspections typically range from 3-12 months depending on the severity and location of deterioration. The frequency is established on a case by case basis by the Department for each specific bridge.

3.1.7.4 Flood Monitoring

Flood monitoring is performed for bridges over waterways during and after a flood event. This process serves to indicate real-time flood-related scouring or undermining of the channel and bridge substructure. Flood monitoring is established according to the scour criticality of a bridge, which is determined from the bridge's scour assessment. Flood monitoring helps to effectively reduce the possibility of a partial or total bridge failure during or shortly after a flood.

Refer to Section 3.2.7 for more information regarding Scour Critical Bridges. Refer to Section 4.2 for further details pertaining to inspection report requirements.

3.1.7.4.1 Scope

The scope of flood monitoring is dependent on the severity of the flood event and the scour criticality of the bridge. Overall, flood events with widespread damage and significant flood depths are more likely to require a more detailed inspection. Refer to Section 3.2.7 for more information regarding procedures to be used for significant storm events and how they affect scour critical bridges.

3.1.7.4.2 Intensity

The intensity of flood monitoring is largely dependent on the assigned scour critical category of the bridge. Additional factors that may impact the inspection/monitoring include:

- Bridge configuration, including span length, number of spans, support types, and member redundancy;
- Overtopping frequency of bridge and/or roadway approach; and
- Traffic volumes.

3.1.7.4.3 Frequency

The frequency for (special) inspections for flood monitoring is established in the NBIS, *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.311 (23 *CFR* 650.311) and is listed below:

(d) Damage, in-depth, and special inspections. Establish criteria to determine the level and frequency of these inspections.

The State prioritizes each bridge's importance for flood monitoring based upon the individual scour assessment. After the scour assessment has determined a bridge's vulnerability to scour, that bridge is assigned one of four categories with the more critical bridges given inspection precedence over the less critical bridges. In addition, the frequency between inspections is also established according to the scour critical categories.

3.1.8 Non-NBI Inspections

As stated in Section 1.1.5, bridges (and culverts) that do not meet the requirements of the NBIS, Code of Federal Regulations, Title 23, Part 650, Subpart C are considered non-NBI. Non-NBI structures include bridges with spans that clear less than 20 feet measured along the centerline of the roadway. Bridges that carry a private railroad or are privately owned are not inspected by RIDOT. Refer to Section 4.2 for further details pertaining to inspection report requirements.

3.1.8.1 Scope

The scope of a non-NBI inspection can vary greatly depending on the classification type as shown in Figure 3.1-5. Once the classification is determined, the scope of the appropriate NBI inspection type (see Section 3.1) will be used to determine how the bridge will be inspected.

3.1.8.2 Intensity

The intensity of a non-NBI inspection can vary based upon the classification type (see Figure 3.1-5). Non-NBI structures are to be inspected on an element level basis and documented in a manner similar to structures considered NBI as described in Section 3.1.

3.1.8.3 Frequency

Structures that are classified as non-NBI are classified into multiple groups with their frequency based upon the classification, as seen in Figure 3.1-5.

Classification	**Max Frequency (months)**
NBI Rating≤ 3	12
Posted and Closed Bridges	12
NBI Rating = 4	24
NHS Bridges	24
Fracture Critical Bridges (Non-Pedestrian)	24
All Others	48

Figure 3.1-5
Inspection Frequency for Non-NBI Structures

3.2 Policies

3.2.1 General

The policies contained within this section have been set forth by the Department. Note that this section is intended to provide a summary of the Department's policies (where applicable) and is not considered all-inclusive of State or Federal policy.

3.2.2 Planning and Scheduling

Planning and scheduling is essential for any bridge inspection, regardless of size, location, or complexity. By addressing these two fundamental activities prior to going out into the field, the following outcomes can be obtained:

- The safest bridge inspection. Inspection personnel (team leader and staff inspectors) can minimize the *rushed* feeling during the inspection, which often leads to careless actions that may result in injury or damage to the equipment.

- The most efficient bridge inspection. Inspection personnel can progress through the inspection in the most logical and flowing nature, which often provides for the least number of setups during the inspection and the least number of (or possibly no) changes in the temporary traffic control.

- The most complete bridge inspection. Inspection personnel can inspect the structure in the most complete manner, since an organized and well-planned inspection will minimize the chances of overlooking a bridge element or deficiency.

- The most seamless bridge inspection. Inspection personnel may need to coordinate with other parties during the bridge inspection (e.g., police, equipment operators, traffic control personnel, railroad officials), which with the proper coordination between parties, can be made as seamless as possible.

Bridges shall be inspected no later than the frequency interval for that particular structure. For example, if a bridge is on a twenty-four-month (24-month) routine inspection cycle and was last inspected on April 1, 2012, it shall be inspected no later than April 1, 2014. This is to ensure that bridges are inspected in a consistent and timely manner and in accordance with the required inspection frequency set forth by the NBIS.

Proper planning and scheduling allows for hundreds of bridges to be inspected every year across the State, and each inspection to be performed at the highest level possible. Key considerations when addressing planning and scheduling include document review, field review, inspection equipment, access to State land, coordination, and weather considerations. These considerations are listed in the next several sections.

3.2.2.1 Document Review

One of the first considerations when planning and scheduling for a bridge inspection is to collect the appropriate information about the bridge, which may be found in the bridge file. This information may include, but is not limited to:

- Plans, including construction plans, shop and working drawings, and as-built drawings (refer to Section 3.2.2.1.1 for more information);

- Previous inspection reports, including any special or interim reports (refer to Section 3.2.2.1.2 for more information);

- Bridge maintenance and repair records/correspondence (refer to Section 3.2.2.1.3 for more information); and

- Load rating records (refer to Section 3.2.2.1.4 for more information);

3.2.2.1.1 Plans

Bridge plans contain information that shows the materials used in the construction of the bridge and how the bridge was assembled. Member types and sizes, connection details, intended bearing details or deck joint configurations and the presence (or absence) of piles in the substructure are all pieces of information that are useful to the inspector, all of which should be specified on the plans. The inspector should be able to recognize and question details in the field that do not agree with the information shown on the plans. Refer to Section 4.3.1 for more information regarding bridge plans.

3.2.2.1.2 Previous Inspection Reports

Previous inspection reports assist the inspector's awareness for any areas on the bridge that may be of concern, which might warrant special attention. Additionally, previous inspection reports also provide a standard with which to gage the progress of a previously noted deficiency. Special equipment or access requirements necessary to complete the inspection are also typically noted in previous reports. Overall, a thorough review of the last inspection report (and possible reviews of subsequent reports) not only gives the inspector a *feel* for the bridge, but helps to ensure completeness in the inspection and consistency in the evaluation ratings. Refer to Section 4.3.14 for more information regarding previous inspection reports.

3.2.2.1.3 Bridge Maintenance and Repair Records/Correspondence

Maintenance and repair records provide the inspector with information of any repairs requested or repairs performed. While performing the bridge inspection, the team leader and staff inspector(s) should assess the repair(s) for completion and evaluate the quality of the repair work that was previously requested. Refer to Section 4.3.2 and Section 4.3.7 for more information regarding maintenance and repair records/correspondence.

3.2.2.1.4 Load Rating Records

A complete record of the determination of the bridge's load-carrying capacity is included in the bridge record. Load rating records include the design load (to indicate for which load the bridge was designed for), the analytical methods used to determine the load ratings, and the actual load ratings for the bridge. Note that the load-carrying capacity calculations will be signed and dated by the Professional Engineer who determined/reviewed them, along with any assumptions made during the process. Refer to Section 4.3.4 for more information regarding load rating reports.

3.2.2.2 Field Review

Any and all field reviews are the responsibility of the Consultant. Field reviews may be necessary for structures with changing conditions. Reasons to conduct field reviews include, but are not limited to, the following:

- Significant precipitation;
- Freeboard height;
- Tidal waters;
- Maintenance and protection of traffic; and
- Access equipment requirements.

3.2.2.3 Inspection Equipment

Document review and field review are important considerations in the planning and scheduling process, all of which are designed to help the inspector become familiar with the bridge prior to arriving at the bridge site. Another key consideration when planning and scheduling for a bridge inspection is determining the inspection equipment and access requirements. In making this determination, the inspector must ask him- or herself the following questions:

- Will temporary traffic control be required? If so, does the Department have a pre-approved Temporary Traffic Control (TTC) (sometimes referred to as Maintenance and Protection of Traffic (MPT))? Consultant should follow the requirements from the Traffic Management Plan (TMP). If a pre-approved TTC plan is not available or not suitable, will a proposed TTC plan be submitted to the Department with sufficient time for approval? Refer to Section 3.2.17 for more information or Appendix B for a list of pre-approved TTC plans.

- Does the bridge inspection require additional personnel, such as police, equipment operators, traffic control personnel, or railroad officials? If so, have these persons been contacted with sufficient advance notice from the anticipated inspection date?

- Will access to any locked or gated areas be required?

- Does the structure contain hatches (box beams), fenced-in areas, machinery pit areas (movable bridges), or other areas where a key may be required to gain access to the structural elements?

- Will a bucket truck or under bridge inspection vehicle be required for the inspection? If so, what size of bucket truck or under bridge inspection vehicle will be required? Has the appropriate personnel been contacted for this request with sufficient advance notice from the anticipated inspection date. Some bridges are load restricted and under bridge inspection vehicles will have to be evaluated by the Consultant prior to placing the load of the vehicle on the bridge.

- Will any special equipment be required, such as scaffolding, rigging, boats, or rafts? If so, has the appropriate arrangements been made with sufficient advance notice from the anticipated inspection date?

By answering the above questions, the inspector can better determine the necessary inspection equipment that will be required to properly inspect the structure. Refer to Section 4.2.10 for a list of inspection equipment.

Note that it is Department policy that all inspection equipment and traffic protection be the responsibility of the Consultant unless otherwise directed by the Department and shall be paid as a direct expense, where allowed. The Consultant and the Sub-consultant shall maintain daily records on equipment including but not limited to the mileage (odometer readings), hours, expenses, and daily activities and include this information as part of the monthly invoice submission to the Department. Expenses from misuse or neglect will not be reimbursed to the Consultant. For structures over railways, should any special equipment be required for access, it is Department policy for the Consultant to arrange for this special equipment. The expense of this rental equipment will be covered as a direct cost with prior approval from the Bridge Engineering Office.

3.2.2.4 Access to State Land

Access to State-owned land may be required in order to perform preliminary engineering tasks. In the event that access to State land is required through a secured gate, Property Management can assist in obtaining a key. When barriers and such fencing must be temporarily removed to access a site, it is the responsibility of the Consultant to ensure that the State's land is secured at the close of each work day. It is also the responsibility of the Consultant to verify that the barrier is restored to the same or better condition upon completion of the task work.

3.2.2.5 Coordination

Coordination efforts relating to the bridge inspection are the responsibility of the Consultant, unless otherwise identified by the Department. In general, parties that require coordination from the Consultant may include, but are not limited to, the following:

- Bridge owner/stakeholders;
- State Police;
- Railroad personnel and officials;
- Equipment operators;
- Traffic control personnel; and
- Park/facility directors and officials.

3.2.2.5.1 Active Construction Projects

For bridge inspections that are scheduled to be performed during active construction, additional coordination efforts (beyond those listed in Section 3.2.2.5) may be required on behalf of the Consultant. The Consultant should verify construction projects on the RIDOT web site prior to performing any inspection. If there appears to be a conflict with a traffic control setup, the Consultant shall contact the Department.

3.2.2.5.2 Lane Restrictions

For bridge inspections that require lane restrictions, the Consultant is required to complete the Traffic Report Form, which identifies the nature of the restriction, dates and times of the restriction, and all other pertinent information related to the restriction.

Refer to Section 3.2.17 for more information regarding maintenance and protection of traffic and lane closures. Refer to Appendix A.24 for blank versions of the Traffic Report Form.

3.2.2.6 Weather Considerations

Proper planning and scheduling of bridge inspections must also consider the weather. Inspections that are performed during adverse or uncomfortable weather conditions may lead to increased safety risks, reduced efficiency, increased field time during the inspection, a rushed or hastened inspection, or a less-detailed inspection in order to avoid the inclement weather conditions.

Seasonal problematic weather conditions include the inspection of large, open structures over water during the middle of winter. This structure-weather combination often produces cold temperatures that negatively impact inspection personal and may also inhibit climbing, while potential snow/ice conditions may preclude traffic control operations. Conversely, the inspection of box beam or box girder members during hot summer months, where the interior must be accessed, should be avoided, as the temperatures inside these members can easily reach unhealthy levels.

3.2.3 Pre and Post Inspection Requirements

Pre and post inspection requirements are discussed in the following sections. They include Two Week Work Schedules and Two-Day Inspection Notifications (both pre-inspection requirements), and Weekly Inspection Summary Reports, which is a post inspection requirement.

3.2.3.1 E-mail Notifications

Consultants are required to submit inspection schedules and weekly summaries to the Department. The following sections outline the requirements set forth by the Department.

3.2.3.1.1 Two-Week Work Schedule

The Consultant is required to complete a two-week (2-week) anticipated work schedule, every week, detailing what structures will be inspected and when the inspections will occur.

3.2.3.1.2 Two-Day Inspection Notification

The Consultant is required to notify the Department two days prior to the inspection of a structure. This notification serves to notify applicable staff of the confirmed start date of inspection and detailed traffic restrictions for the upcoming inspection. The Bridge Inspection Traffic Report form shall be submitted in this notification. Refer to Appendix A.24 for blank versions of the Traffic Report Form.

3.2.3.1.3 Weekly Inspection Summary Reports

The Consultant is required to submit weekly updates of the status of bridge inspections and report submissions through the duration of the contract. The Consultant will forward the Weekly Inspection Summary Report (Form BI-007) every week (Monday) via e-mail to the Department. This form lists the bridge numbers, bridge names, primary inspection types, group numbers, inspection completion dates, and report submission dates. Refer to Appendix A.7 for a blank version of the Weekly Inspection Summary Report.

3.2.4 Bridge Inspection Limits of Work

The following items listed below may represent potential limits of work during a bridge inspection:

- Approaches (up to 100 feet from the abutment)
- Continuing parapets/bridge railing (up to 100 feet from the abutment)
- Traffic safety features (up to 100 feet from the abutment)
- Channel walls

- Upstream features/deficiencies
- Downstream features/deficiencies
- Underwater features/deficiencies
- Aerial limits (near hospitals, airports)

3.2.5 Decreased Inspection Frequency

In specific situations, the NBIS and Department inspection frequencies and requirements may be too stringent for some structures, particularly newly constructed bridges. Using good engineering judgment, the Consultant may recommend that the inspection interval be lengthened (decreased inspection frequency). This recommendation shall be submitted in writing and provide the reasoning for decreasing the inspection frequency. The Department will then review this recommendation and, if in agreement, forward the recommendation to FHWA for approval.

3.2.6 Increased Inspection Frequency

Although the NBIS establishes inspection frequencies and requirements, with the Department further supplementing those requirements, certain conditions or developing trends may necessitate shorter inspection intervals (increased inspection frequencies) in order to sufficiently monitor the condition of a structure. The Consultant shall use good engineering judgment while assessing the structural condition of the structure and, if deemed necessary, shall supply a recommendation to the Department to increase the inspection frequency. This recommendation shall be submitted in writing and provide the reasoning for increasing the inspection frequency (e.g., previous load rating results, current sketches).

3.2.7 Scour Critical Bridges

As stated in Appendix D, Item 127, a scour critical bridge is a bridge whose foundation(s) has been determined to be unstable for the anticipated scour conditions.

The procedures listed in the following subsections illustrate the process for determining the scour criticality of the State's bridges and establishing the appropriate scour plans of action. This allows for bridge inspectors and owners to concentrate their inspection/monitoring efforts and corrective actions at bridges that are vulnerable to scour.

3.2.7.1 Scour Assessment

The primary purpose of providing a scour assessment of an existing bridge is to determine the vulnerability of that bridge to scour. The results of a scour assessment are used in conjunction with information collected from most recent bridge inspections (i.e., routine inspections, underwater inspections) to help ensure that the most current conditions have been considered for the ongoing scour evaluation. By actively seeking the most up-to-date stream and streambed conditions (e.g., scour depth/location, aggradation, degradation, debris, installation of countermeasures), the safety of the bridge can be maximized.

Scour assessments are required to be updated for NBIS bridges as part of the Routine Inspection. For bridges that are not part of the NBIS – those with span lengths between five (5) and twenty (20) feet – scour assessments are not required, but are highly encouraged for any bridges that are at risk due to scour.

In the State of Rhode Island, the two (2) acceptable methods of performing scour assessments are:

1. Theoretical scour calculations; and the
2. Observed Scour Assessment for Bridges methodology.

3.2.7.1.1 Theoretical Scour Calculations

Theoretical scour calculations refer to a method that is based on hydrologic and hydraulic analyses of the stream and waterway opening. Guidance on this methodology can be found within the FHWA Technical Advisory *Evaluating Scour at Bridges* (T 5140.23 October 1991) which can be accessed at
http://www.fhwa.dot.gov/engineering/hydraulics/policymemo/t514023.cfm

When applying this methodology, if the existing scour at the bridges is deeper than the calculated scour, the theoretical scour analysis is not correctly modeling actual conditions and the scour assessment should be re-analyzed. Additionally, if the bridge or channel should experience any significant change, the scour calculations should be re-visited. Otherwise, the following guidance is provided for checking the calculated depth of the theoretical scour to the substructure unit foundation:

- For spread footing foundations:
  - If the calculated scour is above the bottom of the footings, the bridge is not scour critical.
  - If the calculated scour is below the bottom of the footings founded on soil or erodible rock, the bridge is scour critical.
- For deep foundations (piles or caissons):
  - If the calculated scour is above the bottom of the footings, the bridge is not scour critical.
  - If the calculated scour is below the bottom of the footing and above the bottom of a pile/caisson, a structural analysis of the foundation is required to determine its stability. If the foundation is not stable, the bridge is scour critical.
  - If the calculated scour is below the bottom of a pile/caisson, the bridge is unstable and scour critical.

3.2.7.1.2 Observed Scour Assessment for Bridges Methodology

Developed as an alternative method of scour assessment to the theoretical scour calculations, the observed scour assessment for bridges methodology utilizes the observation of geomorphic, hydrologic, and hydraulic features at the bridge site. This multi-disciplinary assessment, which has been approved by the FHWA, is considered a cost-effective approach to meeting the NBIS requirements for evaluating existing bridges without relying on theoretical scour computations.

3.2.7.2 Scour Plans of Action

The Department implements the following procedures to be used for a significant storm event affecting scour critical bridges. These procedures are intended to be used as a guide before, during, and after a significant storm event (rainfall or storm surge). The Department will use the Bridge Scour Management System (BSMS) to monitor flow levels. This system will forward email notifications when a pre-determined event threshold has been reached or exceeded. These pre-determined event thresholds have been established in the Plan of Action for each specific scour critical bridge in the bridge inventory (see Appendix A.26). The BSMS relies on data from the USGS stream gauges and the individual Plan of Action for scour critical bridges.

The Consultant shall verify the information in the plan of action for any scour critical bridge during a routine inspection. If any changes are required, the inspection team shall notify RIDOT in the Data Changes document. Refer to Section 4.2.3 for more information about data changes to documents.

3.2.7.2.1 Pre-Event

Members of the Bridge Engineering Section are to meet and discuss a plan for the upcoming event which shall include, but are not limited to, the following:

- Review the current and anticipated conditions to develop possible problem locations.
- Identify teams and assignments.
- Identify backup staff/on-call personnel if necessary.

Teams will then prepare the appropriate backup information and equipment for the event which may include the following:

- Plan of Action for each bridge
- Location maps
- Contact lists
- Flood Monitoring Record (BI-009) (see Appendix A.9)
- Field equipment (i.e., hard hat, safety vest, digital camera, flashlight, tape measure, waders, probing rod, cellular phone, etc.)

3.2.7.2.2 During the Event

During a storm event, the designated staff is to monitor the Bridge Scour Management System (BSMS) which shall include the following:

- Periodically monitor the BSMS. The BSMS will also send email alerts for critical flows that trigger monitoring. Staff will monitor this system during storm event and not solely rely on email notifications.
- Monitor National Weather Service website for forecasts and flood watch/warnings/alerts.
- Initiate review of the comprehensive Plan of Action (POA) for possible affected bridges to examine the scour monitoring protocol and bridge closure plan for affected bridges.
- Prioritize bridges for inspection teams to investigate and monitor.

Inspection teams will be dispatched to monitor affected bridges if warranted. Each inspection team will perform site visits to affected bridges and collect the following information using the Flood Monitoring Record (Form BI-009) (see Appendix A.9):

- Overtopping of the bridge deck or approach roadway
- Freeboard below low chord elevation on the upstream side of the bridge
- Vertical or lateral displacement of the superstructure
- Excessive horizontal or vertical separation at the expansion joints
- Shifting of substructure units
- Settlement or sinkholes in the roadway
- Undermining of roadway
- Debris buildup

If any of the above listed items or other signs of structural distress are present at any time, the inspection team should immediately contact the appropriate RIDOT authorities during the event and recommend a bridge closure. If failure of the bridge may be possible, the inspection team should close the bridge immediately via the local police and notify the Supervising Engineer.

If the water elevation reaches the known critical water surface elevation or flow rate the team should immediately contact the Supervising Engineer and recommend a bridge closure. Continue flood monitoring until the water level recedes below critical levels or as directed by the Supervising Engineer.

3.2.7.2.3 Post Event

Once the event has passed, compile a list of bridges where follow-up inspection is required. In general, this should include, but not limited to, bridges that meet the following conditions:

- Bridge that has experienced a critical event (i.e., trigger flows, overtopping, etc.) according to the Plan of Action (POA) or as directed by the appropriate RIDOT authority
- Obvious signs of distress which include:
  - Vertical or lateral displacement of the superstructure
  - Excessive horizontal or vertical separation at the expansion joints
  - Shifting of substructure units
  - Settlement or sinkholes in the roadway
  - Undermining of the roadway
  - Heavy debris buildup

Follow-up substructure and underwater inspections will be performed to investigate any possible scour damage. Necessary repairs for bridges with scour damage are to be programmed or scheduled.

Bridges that are closed due to a significant storm event will remain closed until it receives a post flood inspection that determines that the structure is safe to reopen to traffic.

3.2.8 Fatigue Sensitive Details

Fatigue is defined as the tendency of a member to fail at a stress level below the yield stress when subjected to cyclical loading. The three factors that are used to help determine the probability for fatigue to occur or the remaining fatigue life:

- Stress range of cyclic load – increased stress range increases the probability of fatigue;
- Number of cycles of that stress range – increased number of load cycles for a given stress range increases the probability of fatigue; and
- Type of detail – AASHTO defines categories for details based on their susceptibility to load-induced fatigue. Certain details are more susceptible to fatigue than others.

Damage due to fatigue can be categorized by either load-induced or displacement-induced stresses. Load-induced fatigue damage is the result of fatigue crack propagation at structural details subjected to normal in-plane stresses for which they were designed. Displacement-induced fatigue damage is due to secondary stresses caused by the interaction between longitudinal and transverse members that are not quantified within the design of the bridge, or also known as out-of-plane bending.

Refer to Appendix F for the different types of fatigue sensitive details.

3.2.8.1 Procedures after a Fatigue Crack has been Identified

Fatigue cracks are most detrimental to the safety and performance of a structure or component when they are orientated in a direction perpendicular to the applied stress. If a crack is detected, the following steps are recommended:

- Report the fatigue crack of a primary member immediately in accordance with the critical finding procedures outlined in Section 3.2.20. A sketch and photographs shall be prepared so that the crack location, size and orientation can be evaluated.

- Determine the locations of the ends of the crack visually. The crack tip will, in general, extend beyond the crack in the paint film and beyond any oxide indication.

- Examine any other similar details on the bridge. Additional fatigue cracks are likely to occur at any time in similar details at the same relative location within the detail. Those details attached to members located under the most heavily traveled truck lanes should be examined first in multiple girder bridges.

- When examining other similar details, look carefully for breaks in the paint and the formation of oxide dust at the location where the first crack originated.

- If a suspect area is located in a detail found in many areas throughout the bridge or at a location of high primary stress, a more detailed examination of all such details should be carried out, such as having the paint removed in the area and applying dye penetrant, magnetic particle testing or a visual examination with a 10 times power magnifier. Other types of nondestructive testing are acceptable with prior approval of the Department.

- Evaluate the significance of the crack on the load-carrying capacity of the bridge, considering the crack size, known material characteristics, and temperature. Steel is much more brittle during periods of extreme low temperature, and brittle fracture is more likely to occur in cold weather than during warm weather.

- If the crack is moving perpendicular to the stress field in a primary member, the inspector shall immediately contact the Department. The Department, in coordination with the inspection team, may arrange to have holes drilled at the crack ends. The drilled holes are typically ¾ of an inch to 1 inch in diameter. The edge of the holes should be placed at the presumed end of the crack. After holes are drilled, it is desirable to check the hole to insure that the crack tip has been removed and does not pass through the hole. This is generally a temporary retrofit pending development of a permanent repair.

- Determine if special nondestructive tests are desirable at other locations (i.e., dye penetrant, mag-particle, ultrasonic testing or a more thorough visual examination).

- Review results of examination of other locations on the bridge. Determine if a pattern develops related to truck traffic lanes and geometry of the structure.

- Determine if the crack or cracks have developed from normal fabrication conditions or as a result of an unusual flaw.

- Possible follow-up actions requiring coordination with and approval from the Department:

    - Perform a load rating of affected members or systems.

    - Develop a repair and retrofit scheme for the fatigue damaged area(s).

    - Determine if a more frequent inspection cycle will be required for certain details or retrofits.

    - Determine whether or not other structures exist with similar details and conditions. Those structures located on the more heavily traveled roads with the highest average daily truck traffic should receive the highest priority for any subsequent inspection.

3.2.9 Complex Bridge Inspection

As defined in Appendix D, Item 24, a complex bridge is a bridge that has unusual characteristics or an atypical design configuration, therefore requiring additional or unfamiliar procedures, additional inspection personnel training, or additional personnel experience in order to adequately satisfy the NBIS inspection criteria. As stated within the NBIS, *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.313 (23 *CFR* 650.313), the following requirements are applicable for complex bridges:

(f) *Complex bridges.* Identify specialized inspection procedures, and additional inspector training and experience required to inspect complex bridges. Inspect complex bridges according to those procedures.

The following subsections describe applicable inspection procedures for cable-stayed, prestressed concrete segmental, and network tied-arch complex bridges, as mandated by the NBIS and implemented by the Department.

3.2.9.1 Cable Supported Bridges: Suspension, Cable-Stayed

A suspension bridge has a deck, which is supported by vertical suspender cables that are in turn supported by main suspension cables. The suspension cables can be supported by saddles atop towers and are anchored at their ends or self-anchored to the bridge superstructure. Suspension bridges are normally constructed when intermediate piers are not feasible because of long span requirements. Modern suspension bridge spans are generally longer than 1400 feet.

A cable-stayed bridge is a long-span cable-supported bridge whose cables (or stays) directly support the superstructure and are anchored to the tower(s) located at the main pier(s). Typical span lengths for cable-stayed bridges range from 700 feet to 1,400 feet, though many cable-stayed bridges have easily exceeded the typical length and several have even exceeded 3,000 feet. Additionally, cable-stayed bridges may utilize one tower or multiple towers, though the most common arrangement is two towers.

Design characteristics for these bridge types are discussed in more detail in the *Bridge Inspector's Reference Manual*.

The inspection of cable supported bridges is considered to be complex according to the NBIS. Therefore, as required by the NBIS, specialized inspection procedures are developed by the Department for a cable supported bridge. These procedures may include additional inspection personnel training, certification, and experience requirements. Each cable supported bridge is then inspected according to these procedures. Note that due to the unique characteristics pertaining to each cable supported bridge, the bridge inspection is typically led by an inspector who is familiar with that particular bridge or at least that type of bridge. Furthermore, many cable supported bridges will include an inspection and maintenance manual that is specific to that bridge. This inspection and maintenance manual is similar to an owner's manual and should be used throughout the inspection process, when available.

Detailed descriptions of general inspection locations and procedures are given in the *Bridge Inspector's Reference Manual* and the National Cooperative Highway Research Program (NCHRP)'s *Synthesis 353: Inspection and Maintenance of Bridge Cable Systems*. However, in general, the following areas listed below should be given specific attention for a cable supported bridge:

- Cable wrapping and wrap ends (near the tower and deck);
- Cable sheathing assemblies;
- Dampers;
- Anchorages;
- Anchor pipe clearances;
- Flange joints;
- Polyethylene expansion joints; and
- Cable and tower lighting systems.

Specific procedures and inspection details, including applicable inspection forms, can be obtained directly from the Department. These forms, which are customized to the cable supported bridge and preprinted prior to the inspection, should be used for documenting deficiencies. Having customized and preprinted forms helps to promote a methodical inspection of the complex structure and consistent documentation/recording of that structure's deficiencies.

3.2.9.2 Prestressed Concrete Segmental

A prestressed concrete segmental bridge is a medium to long-span box girder that has been constructed in small concrete pieces, or segments. The segments may be precast or cast-in-place, and are then prestressed (post-tensioned) together during construction. Note that precast segments may also be prestressed (pretensioned) together prior to being assembled into the larger structure. This and other design characteristics of prestressed concrete segmental bridges are discussed in more detail in the *Bridge Inspector's Reference Manual*.

A prestressed concrete segmental bridge is considered to be a complex bridge type. Therefore, as required by the NBIS, specialized inspection procedures are developed by the Department for each prestressed concrete segmental bridge. These procedures may include additional inspection personnel training, certification, and experience requirements. Each prestressed concrete segmental bridge is then inspected according to these procedures. Note that due to the more complex characteristics pertaining to a prestressed concrete segmental bridge, the bridge inspection may be led by an inspector who is familiar with that particular bridge or at least that type of bridge. Furthermore, prestressed concrete segmental bridges may incorporate their own inspection and maintenance manual, which is specific to that bridge. This inspection and maintenance manual is similar to an owner's manual and should be used throughout the inspection process, when available.

Detailed descriptions of general inspection locations and procedures are given in the *Bridge Inspector's Reference Manual*. However, in general, the following areas listed below should be given specific attention for a prestressed concrete segmental bridge:

- Shear and tension zones (direct tension zones, flexure zones, and flexure-shear zones);
- Anchor blocks;
- Deviation blocks or deviation saddles;
- Internal diaphragms;
- Post-tensioned grout pockets;
- Camber; and
- Miscellaneous cracking, including effects from torsion and shear, thermal gradients, post-tensioning, unintentional load path, structure alignment, and radial cracking.

Specific procedures and inspection details, including applicable inspection forms, can be obtained directly from the Department. These forms, which are customized to the prestressed concrete segmental bridge and preprinted prior to the inspection, should be used for documenting deficiencies. Having customized and preprinted forms helps to promote a methodical inspection of the complex structure and consistent documentation/recording of that structure's deficiencies.

3.2.9.3 Tied-Arch

The tied arch is a variation of the through arch with one significant difference. In a through arch, the horizontal thrust of the arch reactions is transferred to large rock, masonry, or concrete foundations. A tied arch transfers the horizontal reactions through a horizontal tie which connects the ends of the arch together, like the string on an archer's bow. The tie is a tension member.

A network tied-arch bridge combines the behavior of a tied-arch bridge (which is a variation of a through-arch bridge) with the efficiency of a network cable system (having each arch cable intersect at least twice, which mimics truss behavior). This configuration allows for a design that is more efficient, therefore requiring less steel and smaller member cross sections. The Providence River Bridge (or *Iway* Bridge) utilized the first network tied-arch in the U.S., with a 400-foot main span that helped to complete the seven-span, 1250-foot structure (see Figure 3.2-1). Note that specific design characteristics of arches, including tied-arches, are discussed in more detail in the *Bridge Inspector's Reference Manual*.

Figure 3.2-1
Providence River Bridge (*Iway* Bridge)

The inspection of the Providence River Bridge, along with other network tied-arches, is considered to be complex according to the NBIS. Therefore, as required by the NBIS, specialized inspection procedures are developed by the Department for the Providence River Bridge. These procedures include additional inspection personnel training, certification, and experience requirements. The Providence River Bridge is to be inspected according to these procedures, which can be found within the *Inspection and Maintenance Manual, Providence River Bridge No. 108101*. Note that the appropriate preprinted forms are also located within the appendices of the aforementioned *Inspection and Maintenance Manual*.

Detailed descriptions of general inspection locations and procedures are given in the *Bridge Inspector's Reference Manual*, the *Inspection and Maintenance Manual*, and the National Cooperative Highway Research Program (NCHRP)'s *Synthesis 353: Inspection and Maintenance of Bridge Cable Systems*. However, in general, the following areas listed below should be given specific attention for a tied-arch bridge:

- Arch members (arch ribs, arch rib splice plates, pins, and hanger connections);
- Hangers;
- Gusset plates;
- Tied girders; and
- Problematic details.

Specific procedures and inspection details, including applicable inspection forms, can be obtained directly from the Department. These forms, which are customized to the tied-arch bridge and preprinted prior to the inspection, should be used for documenting deficiencies. Having customized and preprinted forms helps to promote a methodical inspection of the complex structure and consistent documentation/recording of that structure's deficiencies.

3.2.10 Bridges under Construction

Bridges under construction may require additional effort on behalf of the Consultant. As discussed within Section 3.2.2.5.1, the Consultant is responsible for ensuring that the proper coordination has been established with the Contractor for bridges under construction. For bridges under staged construction, the portion of the bridge carrying traffic is to be inspected according to NBIS standards. All future lanes do not necessarily have to be open to traffic, but lanes that are open to traffic will be inspected according to National Bridge Inspection Standards.

When bridges or any portion of a bridge is open to traffic, it is to be inspected according to National Bridge Inspection Standards. The complete SI&A data shall be entered into the appropriate inventory within the timeframes established by the NBIS standards after the construction/rehabilitation is determined to be complete (i.e., all lanes open to traffic) for a bridge (i.e., not necessarily complete for an entire contract that may include roadwork and other bridges. FHWA recommends that initial inspections on new or rehabilitated bridges are to be complete prior to the bridge being opened to traffic.

3.2.10.1 Existing Bridge Replaced with a New Bridge

For an existing bridge that is to be replaced with a new bridge on a new alignment, the existing bridge is to be inspected according to National Bridge Inspection Standards as along as it remains in service and open to traffic. Details regarding inventory inspections for new bridges are given in Section 3.1.1.

For an existing bridge that is to be replaced with a new bridge on the same alignment and under a staged construction, the portion of the existing or new bridge open to traffic is to be inspected according to National Bridge Inspection Standards. It may be important to include language in the construction documents, which will make the contractor accountable for ensuring the safety of the open portion of the existing/new bridge during the period of the contract, which would include periodic inspections and monitoring. Once the new bridge has been completed and it can carry all traffic, the NBIS inspection is to be finished and the new Structure Inventory and Appraisal (SI&A) data to be inputted into the Department's or the federal agency's inventory within forty-five (45) days of the date of inspection.

3.2.10.2 Existing Bridge Rehabilitation

For an existing bridge that is closed to traffic during rehabilitation work, an NBIS inspection is to be completed with the SI&A data updated and inputted into the Department's or federal agency's inventory within 90 days of the completion of the bridge, with all lanes open to traffic.

For an existing bridge that is open to traffic during rehabilitation work, regularly schedule NBIS inspections are to be performed. If an inspection cannot be performed due to circumstances that are deemed reasonable, such as hazardous project site or conditions unfavorable for an inspection, the inspection is to be rescheduled for the earliest possible date. After the risks have been mitigated, the NBIS inspection is to be completed and the SI&A inputted into the Department's or federal agency's inventory within forty-five (45) days of the date of inspection.

For an existing bridge that is being rehabilitated under staged construction, see Section 3.2.9.1.

3.2.10.3 Temporary Structure Used in Construction

For temporary structures being used to carry traffic while the permanent bridge is closed, the temporary structure is to be inspected according to National Bridge Inspection Standards. The temporary structure, however, is not required to have its own individual SI&A data in the Department's or the federal agency's inventory. The bridge that is being rehabilitated or replaced remains in the inventory and the appropriate SI&A items (Items 10, 41, 47, 53, 54, 55, 56, 70, and 103) are to be coded for the temporary structure. Once the permanent bridge is complete and open to traffic, an NBIS inspection is to be completed and the updated SI&A data is to be inputted into the Department's or federal agency's inventory within forty-five (45) days of the date of inspection.

Policies for existing (closed) bridges that are under construction are described in Section 3.1.7.2.

3.2.10.4 Multiple Bridges Under Construction

For construction involving multiple bridges, the inspection requirements should be determined on a bridge by bridge basis. Bridges not under construction and open to traffic are subject to NBIS standards.

3.2.11 New Bridge Numbers

For a bridge that has already been constructed or is proposed, and is not assigned a bridge identification number, the Department will assign a new bridge number. A Bridge Number Request Form (BI-012) shall be submitted for new bridge numbers. Refer to Appendix A.12 for blank versions of the Bridge Number Request Form.

3.2.12 Special Emphasis on Concrete Haunches

The Department requests that special emphasis be focused on bridges with concrete haunches over roadways. The Consultant shall identify all unsound (delaminated) concrete on these haunches and underneath the deck to determine the areas that should be removed. After detection, the Consultant should then remove any unsound concrete to the best of their ability in the interest of public safety while temporary traffic control is in place. If the Consultant cannot remove the areas that are loose, the Department should be notified immediately so that the appropriate measures can be taken for public safety.

3.2.13 Inspection of Bridge Decks with SIP Forms and Bituminous Wearing Surfaces

For some situations, certain bridge elements or portions of bridge elements may not be able to receive a visual assessment during the inspection. This may be due to other materials or other bridge members obstructing the view. In the case of bridge decks, a visual inspection of one or both sides may not be possible due to SIP forms and/or bituminous wearing surfaces. The following subsections describe each of these features of a bridge in relation to inspecting the structural deck.

3.2.13.1 Bridge Decks with SIP Forms

For cast-in-place (CIP) concrete decks, formwork is utilized while the concrete deck is placed. This formwork can be one of two types: temporary (removable) forms or stay-in-place (SIP) forms. As the names suggest, temporary formwork is only used during the wet placement of the concrete. After the concrete has hardened, the formwork is removed. Conversely, SIP formwork is used both during the wet placement of the concrete and after the concrete has hardened and cured. Note that SIP forms <u>do not</u> contribute to the strength of the deck, superstructure, or any other portion of the bridge. Instead, they are nonworking members that only serve to support the wet concrete during placement. Furthermore, it is also important to differentiate SIP forms with a corrugated steel floor, which does carry and distribute loads to the superstructure. The bridge plans, preferably the *As-Built* plans, should be used to make this determination.

Regarding visual inspection, since SIP forms are present even after the deck has hardened, the underside of the deck cannot be visually evaluated. Therefore, the inspector must rely on the surface condition of the SIP forms, along with the condition of the top of the deck (when possible), to evaluate the component condition of the structural deck. Deterioration and/or corrosion of the SIP forms can often indicate contamination of the concrete deck, since the forms can retain moisture and chlorides that have penetrated through cracks in the deck. Since the SIP form does not add structural capacity or stability to the deck or superstructure, the option to remove a portion of the SIP deck may also be exercised under special circumstances. Such circumstances may include significant deterioration of the SIP form with or without additional deterioration of the concrete deck top surface. The Consultant should notify the Department prior to removing any SIP forms. Appropriate safety considerations need to be considered prior to the removal of the SIP forms.

3.2.13.2 Bridge Decks with Bituminous Wearing Surfaces

For some bridges, wearing surfaces (overlays) may have been incorporated into the original design or may have been added since the initial construction. One such type of wearing surface, a bituminous (asphalt) wearing surface, should be given special attention during a bridge inspection. Bituminous wearing surfaces are commonly found on bridges with concrete decks, steel decks, or timber decks, or bridges with an integral structural deck and top flange (e.g., box girder or bulb-tee superstructure). Unlike concrete wearing surfaces, which are considered nonporous, bituminous wearing surfaces are porous and therefore allow for chlorides and other corrosion agents to come into contact with the structural deck, even if no cracks are present in the bituminous wearing surface. Some bridge designs have worked around this issue by also incorporating a waterproofing membrane between the asphalt and the structural deck/superstructure top flange. However, the effectiveness of the waterproofing membrane may be questionable, especially for bridges with aging waterproofing membranes or indications of seepage from the roadway. Furthermore, unlike a wearing surface that allows for a full or partial visual inspection of the underlying material (such as gravel or timber), bituminous wearing surfaces can completely obscure the structural deck/top flange unless the wearing surface is deteriorated or cracked.

Regarding visual inspection, since bituminous wearing surfaces most often mask the condition of the underlying deck/superstructure member, a proper evaluation cannot be established through a visual inspection. Therefore, the inspector must rely on the condition of the bituminous wearing surface, along with the condition of the underside of the deck/top flange (when possible) and review of previous inspection reports and rehabilitation plans, to evaluate the component condition of the structural deck or top flange. Deterioration and/or severe cracking of the wearing surface or bottom deck/flange surface may indicate problems and may warrant a more-detailed physical inspection investigation.

3.2.14 Inspection of Gusset Plates

Gusset plates are steel plates that connect multiple members together. Gusseted connections are most often used in steel truss and steel arch superstructures, though other applications do exist. When used to connect primary load-carrying members together, gusset plates may be arranged in pairs or as single plates. Gusset plates are considered fracture critical when they connect one or more fracture critical members.

Following the 2007 collapse of the I-35W highway bridge over the Mississippi River (Minneapolis, Minnesota), the attention given to gusset plates has increased significantly. Although the failure of the I-35W highway bridge was due to a design error and was not inspection-related, gusseted connections are now inspected with greater detail as a preventative measure. Similar to other bridge elements, proper inspection of gusset plates is essential to the safe operation of in-service bridges.

Prior to the start of the gusset plate inspection, debris should be carefully cleaned out of the gusset area to allow for a proper inspection. At the start of the inspection, the thickness of the gusset plate should first be verified with field measurements. Next, any significant section loss should be measured and documented. For a gusset plate with significant section loss along the edge of a connecting truss member, several measurements should be taken and the average of those measurements used to determine the percent of section loss at the cross section. For gusset plates that only have one side visible for inspection or the opposing side cannot be accessed, ultrasonic thickness measurements are recommended to determine any section loss.

Gusseted connections should also be inspected for any distortion, which includes out-of-plane bending, bowing, and buckling. Gusset plate distortion can result from several factors including, but not limited to, pack rust, structural loading, or initial construction/fit-up issues. If distortion is present on a primary load-carrying gusset plate, the Department should be notified immediately. A load rating analysis may be performed to determine the significance of the findings and if corrective action should be taken.

3.2.15 Railroad Bridge Inspections

Inspection of railroad bridges requires safety and compliance with the established rules and procedures of the railroad. In the interest of safety, inspection personnel from the Consultant and Department are required to exercise extreme caution when working near the railroad tracks, electrified lines, high speed trains, and other railroad-related hazards and operations.

Refer to Section 3.2.18 for information related to different railroad properties.

3.2.16 Non-Highway Bridges and Inspections

The inspection of non-highway bridges is similar to routine inspections of highway bridges, which are outlined in Section 3.1.2. As with highway bridges, load ratings are considered part of the non-highway bridge inspection process along with any applicable underwater inspection requirements for substructures, all of which must be acceptable to the Department.

For longer bridges, the inspection report to the Department may be limited to only those spans over the highway right-of-way and the substructure units supporting those spans. The Department must approve the elimination of portions of a bridge from these inspection requirements. For the remaining portions, bridge owners are encouraged, but not required, to inspect the remaining portions with the same intensity.

The frequency for non-highway bridge inspections is not to exceed twenty-four (24) months. Furthermore, the Department may require inspections more frequently than twenty-four (24) months if the structure or site conditions warrant.

3.2.17 Culvert Inspections

Culvert and drainage structures that qualify for the definition of a bridge, as presented in the NBIS and in Section 1.1.4.1 of this manual, will be considered a bridge culvert. For a complete discussion of flexible and rigid culvert inspections, please refer to the *Bridge Inspector's Reference Manual* (*BIRM*).

3.2.17.1 Multi-Plate Corrugated Metal Culverts

Large-span multi-plate culverts, including box culverts, arches, pipe-arches, and circular pipes are relatively flexible soil-interaction structures and are consequently more susceptible to failure when their original global cross sectional geometry is lost. Therefore, the inspection of these multi-plate culverts must be sufficiently detailed in order to detect and monitor deformations (e.g., bulging, non-uniformity of the arch soffit, misalignment of the plates, tearing) that could lead to a partial or complete collapse of the culvert structure. Culverts that are located underneath shallow earth are especially vulnerable to such deformations. Bridge inspection personnel should consider the culvert's shape as the primary indicator of any structural distress.

The bridge inspection file may contain sketches indicating the as-built geometry and subsequent measurements to monitor the structure's performance at a minimum of two (2) cross section locations. All flexible culverts should have monitoring points used to measure at each inspection. Paint marks will be added on the culvert, if not already present, to help assist future inspectors and ensure that the measurements are taken at consistent locations.

3.2.18 Temporary Traffic Control

In general, work zone restrictions shall be in accordance with the following guidelines adopted from the Department's *Traffic Management Plan (TMP) for Bridge Inspection.* These restrictions have been listed below in

Figure 3.2-2, Figure 3.2-3, and Figure 3.2-4. Additionally, all inspection activities involving lane closures shall be terminated if an extensive traffic back-up occurs, or as directed by the Department, or the Police with the jurisdictional authority. The Consultant shall be report any extensive traffic back-ups to the Bridge Engineering Office. The *Traffic Management Plan* is subject to change and the latest version should be obtained from the Department.

Any deviations from these Temporary Traffic Control (TTC) guidelines must be approved by the Department.

LOCATION	Time of Day FROM	TO	SUN	MON	TUES	WED	THURS	FRI	SAT
MINIMUM NUMBER OF LANES & SHOULDERS TO REMAIN OPEN TO TRAFFIC [1,2,3,4]			Day of Week						
Freeway & Expressway Mainlines with ONE (1) or TWO (2) Existing Travel Lanes in EACH DIRECTION	0:00	6:00	ALL	1L-e	1L-e	1L-e	1L-e	1L-e	ALL
	6:00	9:00	ALL L-e	ALL	ALL	ALL	ALL	ALL	ALL L-e
	9:00	15:00	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL L-e
	15:00	18:00	ALL L-e	ALL	ALL	ALL	ALL	ALL	ALL L-e
	18:00	21:00	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL	ALL
	21:00	24:00	1L-e	1L-e	1L-e	1L-e	1L-e	ALL	ALL
Freeway & Expressway Mainlines with MORE THAN TWO (>2) Existing Travel Lanes in EACH DIRECTION	0:00	4:00	ALL	ALL EX-3	ALL EX-3	ALL EX-3	ALL EX-3	ALL EX-3	ALL
	4:00	5:00	ALL	ALL EX-2	ALL EX-2	ALL EX-2	ALL EX-2	ALL EX-2	ALL
	5:00	6:00	ALL	ALL EX-1	ALL EX-1	ALL EX-1	ALL EX-1	ALL EX-1	ALL
	6:00	9:00	ALL L-e	ALL	ALL	ALL	ALL	ALL	ALL L-e
	9:00	15:00	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL L-e
	15:00	18:00	ALL L-e	ALL	ALL	ALL	ALL	ALL	ALL L-e
	18:00	21:00	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL	ALL
	21:00	22:00	ALL EX-1	ALL EX-1	ALL EX-1	ALL EX-1	ALL EX-1	ALL	ALL
	22:00	23:00	ALL EX-2	ALL EX-2	ALL EX-2	ALL EX-2	ALL EX-2	ALL	ALL
	23:00	24:00	ALL EX-3	ALL EX-3	ALL EX-3	ALL EX-3	ALL EX-3	ALL	ALL
Freeway & Expressway Ramps with ONE (1) Existing Travel Lane	0:00	6:00	ALL	1L	1L	1L	1L	1L	ALL
	6:00	9:00	1L	ALL	ALL	ALL	ALL	ALL	1L
	9:00	15:00	1L	1L	1L	1L	1L	1L	1L
	15:00	18:00	1L	ALL	ALL	ALL	ALL	ALL	1L
	18:00	24:00	1L	1L	1L	1L	1L	ALL	ALL
Freeway & Expressway Ramps with MORE THAN ONE (>1) Existing Travel Lane	0:00	6:00	ALL	ALL EX-1	ALL EX-1	ALL EX-1	ALL EX-1	ALL EX-1	ALL
	6:00	9:00	ALL L	ALL	ALL	ALL	ALL	ALL	ALL L
	9:00	15:00	ALL L	ALL L	ALL L	ALL L	ALL L	ALL L	ALL L
	15:00	18:00	ALL L	ALL	ALL	ALL	ALL	ALL	ALL L
	18:00	21:00	ALL L	ALL L	ALL L	ALL L	ALL L	ALL	ALL
	21:00	24:00	ALL EX-1	ALL EX-1	ALL EX-1	ALL EX-1	ALL EX-1	ALL	ALL

LEGEND

ALL	All existing travel lanes and shoulders in both directions shall remain open to traffic
ALL L-e	All existing travel lanes in each direction shall remain open to traffic
ALL L	All existing travel lanes shall remain open to traffic
ALL EX-1	All existing travel lanes EXCEPT ONE shall remain open to traffic (see Note 6)
ALL EX-2	All existing travel lanes EXCEPT TWO shall remain open to traffic (see Note 7)
ALL EX-3	All existing travel lanes EXCEPT THREE shall remain open to traffic (see Note 8)
1L	A minimum of ONE 11-foot wide lane shall remain open traffic
1L-e	A minimum of ONE 11-foot wide lane in each direction shall remain open traffic

NOTES

1 The set-up and break-down of temporary traffic control devices within a traveled way shall be construed as a closure of that traveled way.
2 The provisions noted herein shall not free the Contractor from his responsibility to conduct all work in such a manner that assures the least possible obstruction to traffic.
3 Access to and egress from all side streets, driveways, buildings, and other pedestrian pathways intersecting the Project work zones shall be maintained at all times unless otherwise noted or shown on Plans.
4 At locations with a sidewalk(s), a minimum of ONE (1) sidewalk on one side of the roadway shall remain open to pedestrians at all times.
5 An "existing travel lane" is defined as any type of vehicular travel lane (e.g., thru, turn, acceleration, deceleration, etc.) that existed prior to start of the work.
A "lane" is defined as a vehicular travel path that is maintained by the Contractor through or around the work zone during the work.
6 A maximum of ONE (1) existing travel lane and ONE (1) shoulder (in only one direction at a time) may be closed.
7 A maximum of TWO (2) existing travel lanes and ONE (1) shoulder (in only one direction at a time) may be closed.
8 At locations with THREE (3) existing travel lanes in each direction, **ALL EX-2** shall apply. At locations with FOUR (4) or more existing travel lanes in each direction, a maximum of THREE (3) existing travel lanes and ONE (1) shoulder (in only one direction at a time) may be closed.

Figure 3.2-2
Typical Work Zone Restrictions for Freeways and Expressways

Location		Time of Day: From	Time of Day: To	SUN	MON	TUES	WED	THURS	FRI	SAT
				MINIMUM NUMBER OF LANES & SHOULDERS TO REMAIN OPEN TO TRAFFIC[1,2,3,4]						
Non-Freeway/Expressway Facilities That Are... One-Way Roadways with ONE (1) Existing Travel Lane		0:00	6:00	ALL	1L	1L	1L	1L	1L	ALL
		6:00	9:00	1L	ALL L	ALL L	ALL L	ALL L	ALL L	1L
		9:00	15:00	1L	1L	1L	1L	1L	1L	1L
		15:00	18:00	1L	ALL L	ALL L	ALL L	ALL L	ALL L	1L
		18:00	24:00	1L	1L	1L	1L	1L	ALL	ALL
One-Way Roadways with MORE THAN ONE (>1) Existing Travel Lane		0:00	6:00	ALL	ALL EX-1	ALL EX-1	ALL EX-1	ALL EX-1	ALL EX-1	ALL
		6:00	9:00	ALL EX-1	ALL L	ALL L	ALL L	ALL L	ALL L	ALL EX-1
		9:00	15:00	ALL L	ALL EX-1	ALL EX-1	ALL EX-1	ALL EX-1	ALL EX-1	ALL L
		15:00	18:00	ALL L	ALL L	ALL L	ALL L	ALL L	ALL L	ALL L
		18:00	24:00	ALL EX-1	ALL EX-1	ALL EX-1	ALL EX-1	ALL EX-1	ALL	ALL
Two-Way Roadways with ONE (1) Existing Thru Travel Lane in EACH DIRECTION	with Center 2-Way Turn Lane	0:00	6:00	ALL	1L-e	1L-e	1L-e	1L-e	1L-e	ALL
		6:00	9:00	1L-e	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL L-e	1L-e
		9:00	15:00	ALL L-e	1L-e	1L-e	1L-e	1L-e	1L-e	ALL L-e
		15:00	18:00	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL L-e
		18:00	24:00	1L-e	1L-e	1L-e	1L-e	1L-e	ALL	ALL
	without Center 2-Way Turn Lane	0:00	6:00	ALL	1L-alt	1L-alt	1L-alt	1L-alt	1L-alt	ALL
		6:00	9:00	1L-alt	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL L-e	1L-alt
		9:00	15:00	ALL L-e	1L-alt	1L-alt	1L-alt	1L-alt	1L-alt	ALL L-e
		15:00	18:00	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL L-e
		18:00	24:00	1L-alt	1L-alt	1L-alt	1L-alt	1L-alt	ALL	ALL
All Two-Way Roadways NOT DESCRIBED ABOVE		0:00	6:00	ALL	ALL EX-1	ALL EX-1	ALL EX-1	ALL EX-1	ALL EX-1	ALL
		6:00	9:00	ALL EX-1	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL EX-1
		9:00	15:00	ALL L-e	ALL EX-1	ALL EX-1	ALL EX-1	ALL EX-1	ALL EX-1	ALL L-e
		15:00	18:00	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL L-e	ALL L-e
		18:00	24:00	ALL EX-1	ALL EX-1	ALL EX-1	ALL EX-1	ALL EX-1	ALL	ALL

LEGEND

ALL	All existing travel lanes and shoulders in both directions shall remain open to traffic
ALL L-e	All existing travel lanes in each direction shall remain open to traffic
ALL L	All existing travel lanes shall remain open to traffic
ALL EX-1	All existing travel lanes EXCEPT ONE shall remain open to traffic (see Note 6)
1L	A minimum of ONE 11-foot wide lane shall remain open traffic
1L-e	A minimum of ONE 11-foot wide lane in each direction shall remain open traffic
1L-alt	A minimum of ONE 11-foot wide lane shall remain open to alternating traffic

NOTES

1 The set-up and break-down of temporary traffic control devices within a traveled way shall be construed as a closure of that traveled way.
2 The provisions noted herein shall not free the Contractor from his responsibility to conduct all work in such a manner that assures the least possible obstruction to traffic.
3 Access to and egress from all side streets, driveways, buildings, and other pedestrian pathways intersecting the Project work zones shall be maintained at all times unless otherwise noted or shown on Plans.
4 At locations with a sidewalk(s), a minimum of ONE (1) sidewalk on one side of the roadway shall remain open to pedestrians at all times.
5 An "existing travel lane" is defined as any type of vehicular travel lane (e.g., thru, turn, acceleration, deceleration, etc.) that existed prior to start of the work.
A "lane" is defined as a vehicular travel path that is maintained by the Contractor through or around the work zone during the work.
6 A maximum of ONE (1) existing travel lane and ONE (1) shoulder (in only one direction at a time) may be closed.

Figure 3.2-3
Typical Work Zone Restrictions for Non-Freeways and Non-Expressways

Holiday	Restriction
New Year's Day	No day or night work and no work the previous night after 1 PM.
Dr. Martin Luther King, Jr. Day	No Saturday, Sunday, or Monday day or night work until 10 PM on Monday , with general restrictions that shall apply after 10 PM.
Easter Sunday	No Saturday or Sunday day or night work until 10 PM on Sunday, with general restrictions that shall apply after 10 PM.
Memorial Day	No Saturday, Sunday, or Monday day or night work.
Independence Day	No day or night work and no work the previous night after 1 PM.
Victory Day	No Saturday, Sunday, or Monday day or night work until 10 PM on Monday , with general restrictions that shall apply after 10 PM.
Labor Day	No Saturday, Sunday, or Monday day or night work.
Columbus Day	No Saturday, Sunday, or Monday day or night work until 10 PM on Monday , with general restrictions that shall apply after 10 PM.
Veteran's Day	No day or night work until 10 PM, with general restrictions that apply after 10 PM, and no work the previous night after 1 PM.
Thanksgiving Day	No Wednesday night work after 1 PM or Thursday day or night work. No work that impacts traffic shall be performed by the contractor on Wednesday through Sunday of Thanksgiving week in any calendar years. Impacting traffic is defined as inspection operations that reduce the number of travel lanes.
Christmas Day	No day or night work and no work the previous night after 1 PM.

Note: All Friday daytime work on any holiday weekend listed above must end by 1 PM.

Figure 3.2-4
Typical Holiday Work Zone Restrictions

3.2.19 Railroad Coordination

If portions of a highway bridge over a railroad are to be inspected within the railroad's right-of-way, the railroad is to be notified prior to performing the inspection and the inspection is not to proceed until arrangements have been made with the railroad. This may include the railroad issuing a right-of-entry permit with terms and conditions that must be followed upon entry. Furthermore, if the inspection should contain one or more of the following conditions, the railroad ***must*** be notified ***well*** in advance of the inspection because of time periods significantly ranges based on the railroad:

- Equipment (such as an inspection vehicle) is required in the span over the railroad.
- The bridge is located over a railroad that is electrified.
- A possibility exists of physical interference with railroad operations.
- A dangerous condition for the bridge inspection team exists, due to high-speed railroad operations, close horizontal clearances, or other similar conditions.
- The inspection involves work within or above the zone horizontally measured and verified by the railroad, from the center of the track rails.

Note that the right-of-way varies for each railroad. As a precaution or when in doubt, regarding railroad right-of-way, notify the railroad. Notification to the railroad includes a detailed description of work to be performed, number of people on the inspection team, description of any equipment that will be used (e.g., inspection vehicle, scaffolding), anticipated length of time of inspection, and any other pertinent information. Coordination with the railroad is typically done through RIDOT, unless otherwise instructed. However, all the scheduling is done directly between the Consultant and the railroad.

The railroad will furnish the appropriate protective personnel (flaggers and/or ground personnel) in order to provide a safe work zone during the inspection activities for structures over railways. This process will be scheduled and coordinated by the Consultant through the Department.

The railroad will, at its sole discretion, determine the need for and the availability of protective or support personnel. The railroad will provide the appropriate protective forces to the extent that it sees fit, considering operational, maintenance, and construction priorities. The railroad makes no guarantee that protection personnel will be available to meet the Consultant's preferred schedule. The Consultant will not be responsible for the charges accrued for rail protective personnel. All protective payments will be done through the Department.

The Consultant must obey all instructions from the railroad representatives on the job site. Failure to follow instructions shall be considered a sufficient cause for closing the job site to the Consultant and its employees.

The Consultant will be responsible for obtaining permits and railroad liability insurance for the inspection of bridges carrying or crossing railroads. The Department requires that railroad liability insurance be required from the Consultant at the time of assignment. The minimum insurance requirements are established by the applicable railroad. Refer to Section 3.2.18.1.1 for specific insurance requirements for Amtrak. Refer to

Sections 3.2.19.2, 3.2.19.3 and 3.2.19.4 for contact information to obtain specific insurance requirements for the Providence and Worcester Railroad, Seaview Transportation Company, Inc. and the Newport Secondary Railroad.

3.2.19.1 Amtrak

Amtrak works within its own property in the state of Rhode Island. The insurance requirements, entry permits, and safety training is discussed in the subsequent sections. For further information about insurance requirements and entry permits not discussed, coordinate with the National Railroad Passenger Corporation (Amtrak) at one of the following locations:

Project Development Officer
Engineering - I&C
30th Street Station, Box 64
2955 Market Street
Philadelphia, PA 19104
215-349-1750

Director I&C Projects
National Railroad Passenger Corporation
Engineering Department
30th Street Station, 4S-027, Box 64
2955 Market Street
Philadelphia, PA 19104
215-349-1393

Amtrak Maintenance (Providence Office)
National Railroad Passenger Corporation (Railroad)
309 Silver Spring Street
Providence, RI 02904
401-727-7334

3.2.19.1.1 Insurance Requirements

The Consultant, or its Sub-contractors, will be responsible in obtaining the necessary certificates of insurance according to the current requirements and/or specifications with coverage and the limits of liability set by Amtrak. The railroad's certificate must be obtained either through a private insurer and/or Amtrak, if available through a blanket insurance program. All the required certificates must be effective and in place **no later than 15 days prior to** the commencement of any operations and, must remain in force until all of the operations are satisfactorily completed and all personnel, equipment, and materials have been removed from Amtrak's property. Copies of the certificates must be submitted to RIDOTs Bridge Engineering and Inspection section as well as Amtrak, with RIDOT listed as "Additionally Insured" on all certificates.

The latest Railroad specifications must be strictly complied with and are available from RIDOT Bridge Engineering or Amtrak.

3.2.19.1.2 Entry Permits

The Consultant is responsible to notify RIDOTs engineer no later than 45 days prior to commencement of any operations within, adjacent to, on, or over the Amtrak's right-of-way so that any required entry permits may be secured in a timely manner. The Consultant must also notify Amtrak at least 10 days in advance, prior to commencement of any operations within, adjacent to, on or over a Railroad's right-of-way.

The entry permit process for Amtrak consists of the following:

- RIDOT assigns railroad inspections to its inspection Consultants with a preliminary schedule typically a minimum of 6 months in advance of start of inspections.
- Consultant provides personnel safety training certificates and insurance certificates to RIDOT Bridge Inspection.
- RIDOT begins coordination process with Amtrak, verifies the latest list of bridges and submits the list along with safety training certificates and insurance certificates to Amtrak along with estimated durations of the inspections.
- Amtrak submits Force Account Estimate (FAE) to RIDOT along with four signed copies of the entry permit agreement.
- Draft entry permit agreement is circulated internally within RIDOT to legal, RI Public Rail, and the Director's office for review and signature. Once all internal signatures are obtained, the Consultant is contacted to sign the entry agreement. The fully signed agreement is then distributed to RIDOT Bridge, legal, railroad, and Consultant/inspectors.
- Consultant is notified to begin coordination and scheduling of bridge inspections directly with the railroad.

3.2.19.1.3 Safety Training

All staff that will be working within, adjacent to, or on any railroad property must possess current safety training certificates or badges issued by the railroad. Prior to beginning any work on Amtrak property, the Consultant must submit two color copies of the certificates for all staff that will be working on or near railroad property to Bridge Engineering. Amtrak must have these certificates in their possession in order for RIDOT and its Consultants to be issued a temporary permit to enter railroad property. Anyone within, adjacent to, or on railroad property shall have their certificate on them at all times.

Inspection personnel working on Amtrak property are to be certified annually by taking an Amtrak Contractor Orientation/Safety computer based training program. The computer based training is located at http://www.amtrakcontractor.com/. The cost of railroad safety training is not reimbursable by the Department.

3.2.19.2 Providence and Worcester Railroad (P&W RR)

The Providence and Worcester Railroad operates within Amtrak's property as well as within their own property in the state of Rhode Island. When operating within Amtrak property, Amtrak controls all insurance requirements, schedules, and safety requirements in these areas, with all coordination through Amtrak. When Providence and Worcester Railroad operates on property owned by Rhode Island, the scheduling of inspections, insurance and safety requirements, permissions and agreements, is to be coordinated between the State and the company. For further information about insurance requirements, entry permits, and safety training, coordinate with the railroad at the following location:

Providence & Worcester Railroad Co.
Engineering
75 Hammond Street
Worcester, MA 01610
508-755-4000

3.2.19.3 Seaview Transportation Company, Inc.

The Seaview Transportation Company, Inc. operates normally within their own property in the state of Rhode Island. When Seaview Transportation Company, Inc. operates on property owned by Rhode Island, the scheduling of inspections, insurance and safety requirements, permissions and agreements, is to be coordinated between the State and the company. For further information about insurance requirements, entry permits, and safety training, coordinate with the railroad at the following location:

Seaview Transportation Company, Inc.
Davisville Rd
Davisville, RI 02852
401-295-1233

3.2.19.4 Newport Secondary Railroad

The Newport Dinner Train operates solely on property own by the state of Rhode Island. The Consultant or the inspector is bound by the conditions of their State inspection contract when inspecting structures within its property. For further information about insurance requirements, entry permits, and safety training, coordinate with the railroad at the following location:

Newport Dinner Train & Island Tours, Inc.
19 America's Cup Avenue
Newport, RI 02840
401-841-8700

3.2.20 Critical Findings Procedures

The procedures defined herein have been established by the Department and shall be followed to assure that all critically needed maintenance activities or strengthening improvements identified by bridge inspection teams are made in a timely manner. A high priority or critical finding determination shall be made during routine inspections, damage inspections, in-depth inspections, fracture critical inspections, or any other type of inspection where such a finding may be encountered. These procedures are essential to assure that the necessary notifications, documentation, closing, posting, repair work, and other related activities are followed-up and accomplished in a timely manner, as per the requirements of the NBIS, *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.313 (23 *CFR* 650.313):

(h) *Follow-up on critical findings*. Establish a statewide or Federal agency wide procedure to assure that critical findings are addressed in a timely manner. Periodically notify the FHWA of the actions taken to resolve or monitor critical findings.

3.2.20.1 General

If a structural or safety issue is identified during an inspection, the team leader shall immediately notify the Department via the inspection e-mail inbox (SBI@dot.ri.gov) and via phone (see the List of Emergency Contact Personnel, which will be supplied at the start of the contract) based on the severity of the related concern. The email will include a description of the issue, date, location, time, and photographs. The inspection mailbox automatically notifies the appropriate personnel of the issue encountered and initiates the process for documenting and following up on the critical finding(s) and other structural or safety-related issue(s) requiring attention. The Critical Finding Log (Form BI-006) shall be completed and forwarded to the Department as formal documentation unless an e-mail is forwarded to the inspection e-mail box that contains all the information that would otherwise be contained on the Form BI-006. If an all-inclusive e-mail has been provided to the Department, the e-mail shall serve as the documentation for the critical finding. Upon notification, the Department (through the Bridge Inspection Program Manager, Chief Civil Engineer-Bridge Engineering (CCE), or Managing Engineer-Bridge Engineering (ME)) will make a determination if the issue is considered a critical finding as defined below.

Refer to Appendix A.6 for blank versions of the Critical Finding Log.

3.2.20.2 Determination of Critical Findings

In accordance with the *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.309 (23 *CFR* 650.309) and Section 650.313 (23 *CFR* 650.313), and as stated in Appendix D, Item 29, a critical finding is a structural deficiency or safety-related deficiency that requires immediate follow-up action. The FHWA non-regulatory supplement in the *Federal Aid Program Guide* (*FAPG*) provided an example of an FHWA process for follow-up on critical findings that includes criteria for critical findings. Below is the section from the *FAPG*:

- Bridge with recommendations for immediate work on fracture critical members;
- Bridges with recommendations for immediate correction of scour or hydraulic problems;
- Bridges with one or more of NBI Items 58 (Deck), 59 (Superstructure), 60 (Substructure), or 61 (Channel/Channel Protection) rated 3 or less;
- Bridges with recommendations for immediate work to prevent reduction in the safe load capacity; or

- Any bridge determined to be in imminent danger of collapse.

Some specific examples of critical findings are provided below. The following list is not intended to be all inclusive and is provided as a guideline to supplement the criteria from the *FAPG*:

- Existing cracks in primary steel members that have propagated since the last inspection or newly developed cracks located at fatigue sensitive locations and/or tensile areas;
- Significant section loss and/or cracking in primary load carrying members that would result in load restriction if not corrected;
- Hole(s) through the bridge deck and/or sidewalk where the size and location of the hole(s) pose an immediate safety hazard to the public (potholes not considered critical);
- Significant loss of bearing support that warrants immediate attention;
- Major distortion/bowing/buckling/crippling of primary steel members;
- Obvious sagging or unusual deflection of any primary member(s);
- Loose concrete over roadways that pose an immediate safety hazard to the public;
- Significant undermining and/or scouring of a substructure;
- Major damage or deterioration of the bridge barrier system that affects public safety;
- NBI condition rating lowered to 3 or less for either Item 58 (Deck), 59 (Superstructure), or 60 (Substructure);
- Loose expansion joint components that pose a safety hazard to the public;
- Bridge-mounted signs or utilities that pose an immediate safety hazard to the public; or
- Temporary structural support systems that do not appear to be functioning for their intended purpose.

3.2.20.3 Reporting Process

The following list outlines the reporting process for a critical finding:

1. If a critical finding is identified during an inspection, the inspector shall immediately notify the Department via the inspection e-mail box (SBI@dot.ri.gov) and via phone (see the Contact and Distribution Matrix, which is supplied to the Consultant at the start of the contract) based on the severity of the related concern. The Critical Finding Log (Form BI-006) shall be completed and forwarded to the Department as formal documentation unless an e-mail is forwarded to the e-mail

box, containing all the information otherwise on this form. In this case, the e-mail shall serve as the documentation for the critical finding.

2. The Chief Civil Engineer (CCE) and/or other designated Bridge Engineer will review the issue and enter the information into a database. The intent of this database is to track the critical finding, the plan of action, and closure of the issue. Numerous reports are generated from the database for planning and prioritizing the required work. The CCE or Managing Engineer (ME) will notify FHWA if required.

3. If the issue requires immediate attention, such as an imminent structural failure, an immediate phone call is required to one of the emergency contacts listed in the Contact and Distribution Matrix.

3.2.20.4 Plan of Action/Follow-Up

1. Based on the determination that the issue with a bridge is critical, the Department will develop a plan of action. This plan of action may result in the assignment of staff to further investigate and develop the necessary corrective action. Also, the plan of action may be a mitigation measure such as placing barrier(s) to restrict traffic from deteriorated areas, load restriction, etc.

2. Based on the severity of the problem, the Department will produce formal plans to make the corrective action, which will then be transmitted to FHWA for their concurrence. If the problem that is encountered is extremely hazardous to the public, then repairs will take place immediately and follow-up reports will be forwarded to FHWA within 30 days after the repairs are completed. If the critical finding requires major repairs, then a final action plan will be generated and submitted to FHWA as soon as possible for their concurrence.

3. The Department will determine if the critical finding repairs/actions are to be designed by: 1) a Consultant firm; 2) an in-house bridge engineering staff; or 3) a simple maintenance repair operation. Upon this decision, the plan of action and documentation will be completed for the use of RIDOT and FHWA.

4. In the case that a critical finding may require the closure of the bridge, the determination of a closure will be the responsibility of at least one and preferably two members listed in the Contact and Distribution Matrix with concurrence of the Chief Engineer, if available.

5. If significant repairs are performed as a result of a critical finding, a follow-up special inspection will be completed to update the NBI condition rating(s) accordingly.

6. The CCE and/or other Bridge Engineer will "close" the issue in the database once repair(s) or mitigation measure(s) are successfully completed.

Chapter 4 Documentation

4.1 Electronic File Organization

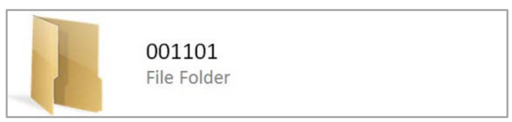
This section describes the Department's data filing structure and naming conventions for electronic data. The organization and labeling structure is vital to the inspection data framework for consistency within the State's inventory of bridges.

4.1.1 Bridge Inspection Data Folder Organization and Naming Conventions

The terms and definitions for describing the layout of the bridge inspection data file folder should be labeled as the six-digit (6-digit) bridge number and include both a *General Info* folder and *Inspection Folder* as described below and illustrated in Figure 4.1-1. Note that the Electronic Folder Quick Reference Guide also shows the organization between these three folders and is located in Appendix C:

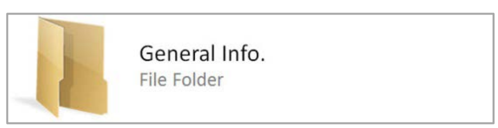
Bridge Inspection Folder: The parent folder for all bridge inspection data pertaining to a particular bridge. This folder includes the *General Info* folder, *Inspection Date Folder*, *Scour* folder (if applicable), *Critical Findings* folder (if applicable), *Sub Aqueous* folder (if applicable), and *Storm Event* folder (if applicable).

For example, a *Bridge Inspection Folder* for Bridge No. 001101 would be labeled as:



General Info Folder: A bridge inspection subfolder containing general information such as contract drawings, orientation sketches, *TTC Folder*, *Plans Folder,* special inspection requirements, Fracture Critical/Fatigue Prone Detail documentation, correspondence, etc. Blank Bridge Vertical Clearance Inventory Data Sheets and Channel Cross Sections are also stored in this folder for use by the Consultant.

For example, a *General Info* folder for Bridge No. 001101 would be labeled as:



Refer to Appendix A.21 for blank versions of the Bridge Vertical Clearance Inventory Data Sheets.

Refer to Appendix A.22 for a blank version of the Channel Cross Section.

Inspection Date Folder: A bridge inspection subfolder containing inspection data specific to the inspection itself, such as inspection photos, Bridge Vertical Clearance Inventory Data Sheets, channel cross sections, inspection sketches, field notes, etc.

To provide consistency within the electronic filing system, the Department requires that the *Inspection Folder* be named using the following format:

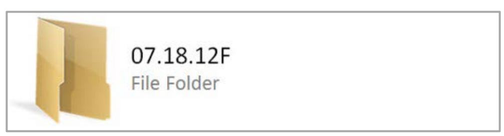
MM.DD.YYT

where:

MM =	Month of inspection (2-digit)
DD =	Completion date (day) of inspection (2-digit)
YY =	Year of inspection (2-digit)
T =	Type of inspection (F = fracture critical, S = special inspection, D = damage, U = underwater, all other types leave blank)

For example, an *Inspection Folder* for Bridge No. 001101 for a routine bridge inspection that was performed on 07-18-2012 would be labeled as:

Alternatively, an *Inspection Folder* for Bridge No. 001101 for a fracture critical inspection that was performed on 07-18-2012 would be labeled as:



The General Info folder is established for all bridges by the Department. When submitting an inspection report to the Department, the Consultant shall only include this folder in the submittal package if any documents located inside the original folder have changed. This includes any Computer-Aided Design and Drafting (or CADD) drawings for use in the bridge inspection, including the CADD reference files. Otherwise, the Consultant should not include a General Info folder in the submittal if it is not necessary. It is noted that only documents with changes shall be included in this folder. Therefore, it is not necessary to place this folder back in the submittal package if there are no changes to the documents within this folder. The only reason for submitting this folder to the Department is to alert the Bridge Inspection staff to update the General Info folder in the Main Database.

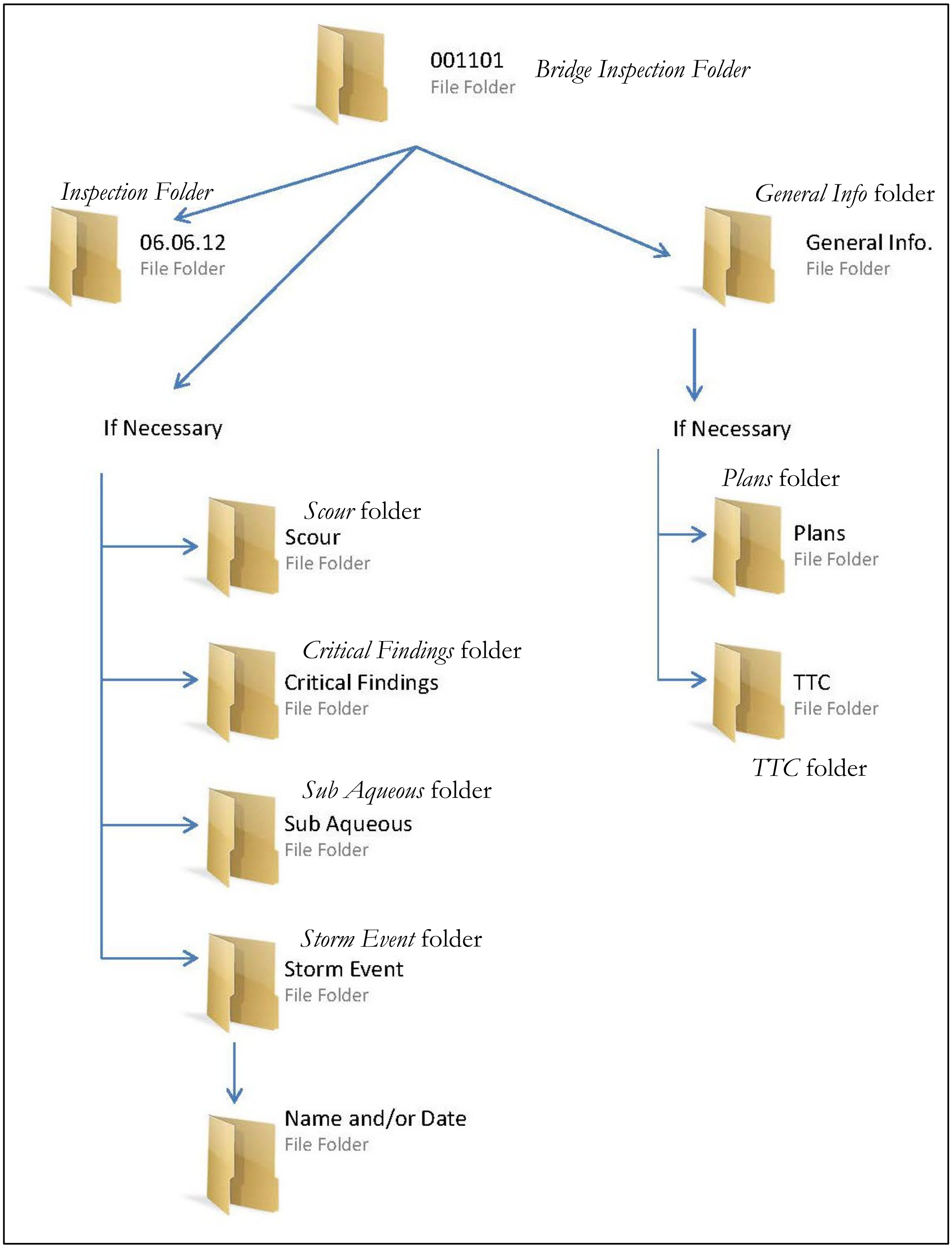


Figure 4.1-1
Bridge Inspection Folder Layout

4.1.2 Bridge Management Software PDI File Naming Convention

To provide consistency within the State's Bridge Management Software data filing system, the Department requires that the Bridge Management Software *.PDI file be named using the following format:

XXXXYyyT

where:

XXXX =	Bridge number (if the last digits of a bridge number are 21, just add a 2 to the end of the bridge number)
Y =	Indicates the year (next two digits)
yy =	Year of inspection
T =	Type of inspection (F = fracture critical, S = special inspection, all other types leave blank)

Examples using the Department's naming convention are listed below according to the type of inspection:

- For a routine inspection (2008) of Bridge No. 030701, the *.PDI file would be labeled as: 307Y08.PDI
- For a routine inspection (2009) of Bridge No. 027621, the *.PDI file would be labeled as: 2762Y09.PDI
- For a routine inspection (2010) of Bridge No. 101501, the *.PDI file would be labeled as: 1015Y10.PDI
- For a fracture critical inspection (2011) of Bridge No. 104401, the *.PDI file would be labeled as: 1044Y11F.PDI
- For a special inspection (2012) of Bridge No. 079201, the *.PDI file would be labeled as: 792Y12S.PDI

4.1.3 Photographic Data Organization and Naming Convention

In addition to the labeled photographs that are to be included within the *Inspection Date Folder* and within the inspection report (refer to Section 4.2.17 and Section 4.3.3 for more information), the Department also requires that three (3) raw digital photographs be included in the *General Info* folder if not already included.

Raw digital photographs are defined as digital images that **do not contain any labeling or markups**. The three (3) photographs should contain a general view of the bridge topside and an elevation view from each side and be no greater than 4000 by 3000 pixels. Note that these photographs shall be in the *.JPG format. The purpose of the raw digital photographs is for use in future inspection reports and presentations by the Department.

To provide consistency within the electronic filing system, the Department requires that the raw photographs be named using the following format:

XXXX_ZZZZ

where:

XXXX = Bridge number

ZZZZ = Abbreviated description (i.e., westelev, topside)

4.1.4 Field Inspection Forms

The following forms are available in Appendix A:

- Bridge Inspection Qualifications Record – Form BI-001
- Inspection Team Report Evaluation – Form BI-002
- Inspection Team Field Performance Evaluation – Form BI-003
- Bridge File Review – Form BI-004
- Bridge Load Rating and Posting Recommendation – Form BI-005
- Critical Finding Log – Form BI-006
- Weekly Inspection Summary Report – Form BI-007
- Bridge Inspection Report Submittal Checklist – Form BI-008
- Flood Monitoring Record – Form BI-009
- Use of Bridge File Record – Form BI-010
- Special Inspection Requirements Form – Form BI-011
- Bridge Number Request Form – Form BI-012
- Photo Log – Form BI-013
- Bridge Vertical Clearance Inventory Data Sheets
- Channel Cross Section
- Police Detail Request Form

- Traffic Report Form
- Field Sketch Templates
- Scour Critical Bridge – Plan of Action
- Bridge Scour Evaluation – Hydraulics/Hydrology Checklist
- Fracture Critical Data

4.2 Inspection Report Requirements

The bridge inspection report documents all signs of distress and deterioration with sufficient precision such that future inspection teams can make comparisons between the structure's past and current condition. The following represents the State's minimum requirements for a sufficient inspection report.

4.2.1 Terminology and Standard Abbreviations

Acceptable bridge terminology and abbreviations shall be used in all inspection reports submitted to the State. Use terminology consistent with the *Bridge Inspector's Reference Manual* (BIRM). Refer to Appendix D for terminology and standard abbreviations.

Note that abbreviations are not permitted for any text located on photographs or within photo documentation.

4.2.2 Report Cover Letter

The report cover letter is typically the first page of the final delivered bridge inspection report. The purpose of the report cover letter is to summarize the following (see Figure 4.2-1):

- Recipient(s) of the finalized bridge inspection report;
- Task or project from which the inspection was assigned (e.g., Statewide Bridge Inspection, Contract No. 012345, Assignment No. 1, Consulting Firm ABC, Project No. 67890);
- Type of bridge inspection performed (e.g., initial, routine, fracture critical, special, etc.);
- Bridge identification number;
- Submission date of the report;
- Date when the bridge inspection was completed;
- Date of the previous inspection and type of inspection performed; and
- Stamp of a Rhode Island registered Professional Engineer certifying the bridge inspection.

May 21st, 20XX
Managing Engineer/Bridge Engineer
Managing Engineer, Bridge Engineering
Rhode Island Department of Transportation
Two Capitol Hill
Room 100I
Providence, RI 02903

Attn: XXXX

Subject: Statewide Bridge Inspection
Contract No. 315XXX
Assignment No. XX
Engineering Firm Project No. XXXX

Dear XXXX:

Engineering Firm is pleased to submit the Routine Bridge Inspection Report for the following bridge:

Bridge No. 033401:	Hill Farm over Johnsons Pond, Coventry
Date Inspection Completed:	04/24/10
Date Submitted:	05/21/10
Previously Inspected:	04/03/08 Routine

Very truly yours,

XXXX
Engineering Firm

CC: XXXX

Figure 4.2-1
Example Report Cover Letter

4.2.3 Data Changes Document

The data changes document provides a list of changes or corrections that were made to the bridge data from the previous inspection report. This document identifies elements and NBI items, as well as the reasoning behind the change or correction (see Figure 4.2-2).

For elements, the element number and name/description is noted, along with any changes to the total quantity and the appropriate reason for the change. For NBI items, the NBI section where the item is located, item number and name/description, and a summary of the change with a reason for the change is provided.

ELEMENT AND NBI ITEM CHANGES
Bridge No. 934307: Butterscotch Road over Martin Creek
Inspection Date: April 24, 2010

The following is a list of changes made to elements and the reasoning behind the changes.

ELEMENT CONDITION:
Element 38:Reinforced Concrete Slab - Changed

- From: 1225 SF
- To: 994 SF
- Reason: To reflect curb-to-curb width of roadway.

Element 215:Reinforced Concrete Abutment - Changed

- From: 61 LF
- To: 68 LF
- Reason: Northwest wingwall was exposed more from last inspection.

Element 220:Reinforced Concrete Footing - Added

- From: 0 EA
- To: 1 EA
- Reason: Footing is now visible due to scouring of Abutment 1 (West Abutment).

The following is a list of changes made to NBI items and the reasoning behind the changes.

IDENTIFICATION:
Item 16:Latitude

- From: 41°40'17"
- To: 41°40'23"
- Reason: Item was previously miscoded.

Item 98:Border Bridge Code

- From: Unknown
- To: Not Applicable
- Reason: Item was previously miscoded, not on state border.

NAVIGATION DATA:
Item 111:Pier Protection

- From: Unknown
- To: Not Applicable
- Reason: Per FHWA Coding Guide, if Item 38 is coded 0 then Item 111 should be coded Not Applicable.

Figure 4.2-2
Example Data Changes Document

4.2.4 Orientation Sketches

In general, orientation sketches are included with each inspection report. If the structure orientation has yet to be established, sketches must be provided and must contain the following information:

- Three bridge views: plan, elevation, and cross section (see Figure 4.2-3 and Figure 4.2-4);
- Separate 8.5 inch by 11 inch layouts for each view;
- Completed drafts using a minimum of AutoCAD 2000 software, with one file for each bridge, having the file name *Orientation_Plans.DWG* and stored in the bridge folder of the bridge; and
- Each view converted into a separate Adobe *.PDF file using the following file names: *Plan_View.PDF*, *Elevation_View.PDF*, and *Section_View.PDF*.

When establishing the orientation of the structure, please follow the procedures listed below:

- The bridge shall be oriented according to the roadway being carried by the structure under inspection. If the roadway being carried is a numbered highway, the direction of the highway is used to orient the bridge. For example, if the bridge carries I-95, then the bridge is oriented in a North/South direction.
- If the roadway being carried by the structure is not a numbered highway, but the roadway beneath the structure is a numbered highway, orient the bridge according to the direction of the numbered highway beneath the structure being inspected.
- If neither the facility carried nor feature intersected is a numbered highway, use either the railroad, general direction of waterway, or compass direction to orient the bridge.
- The South or West Abutment shall always be Abutment No. 1.
- The beam/girder designation shall start from left to right facing Abutment No. 2 (A, B, C, etc.)

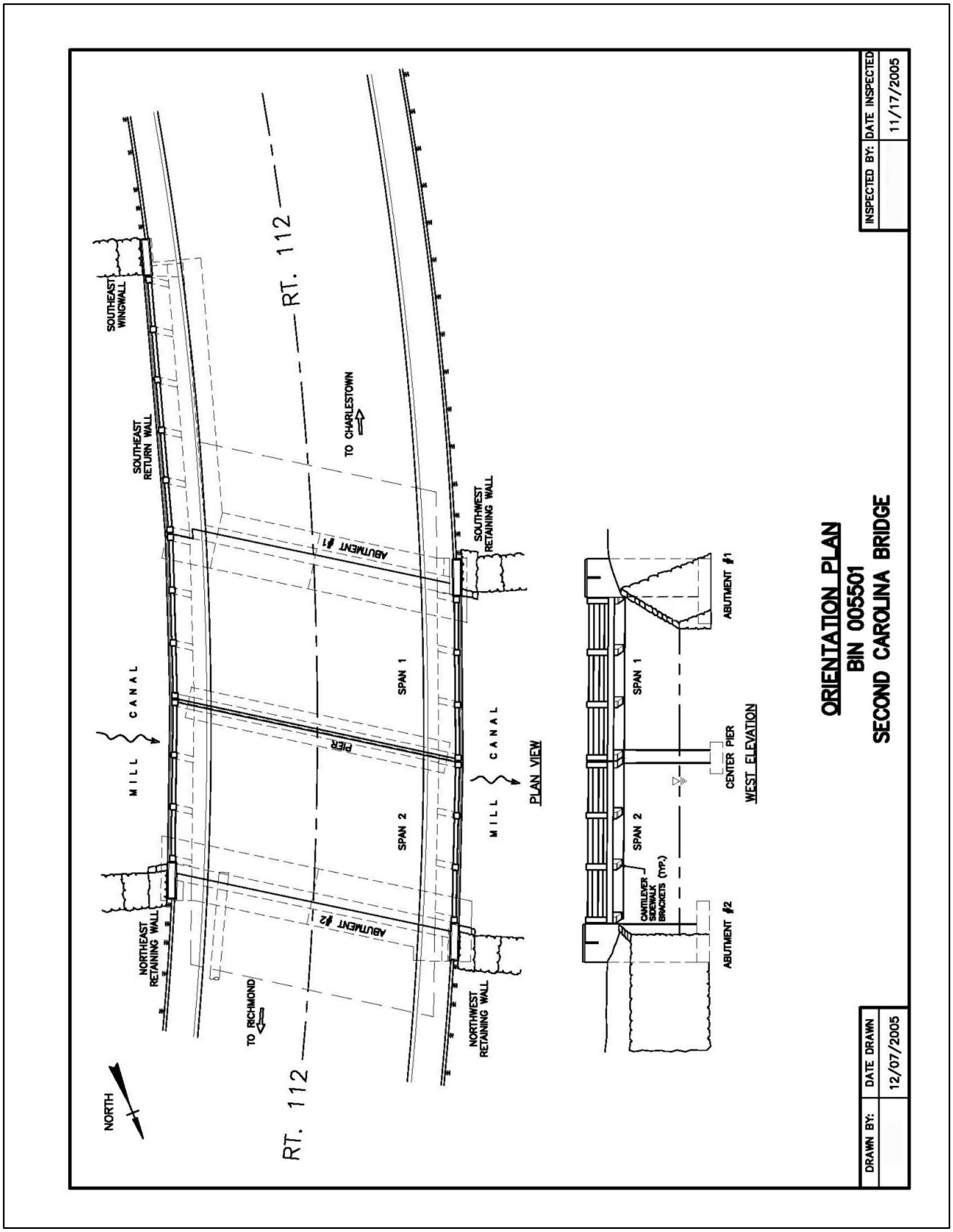


Figure 4.2-3
Example of Bridge Orientation Plan Layout

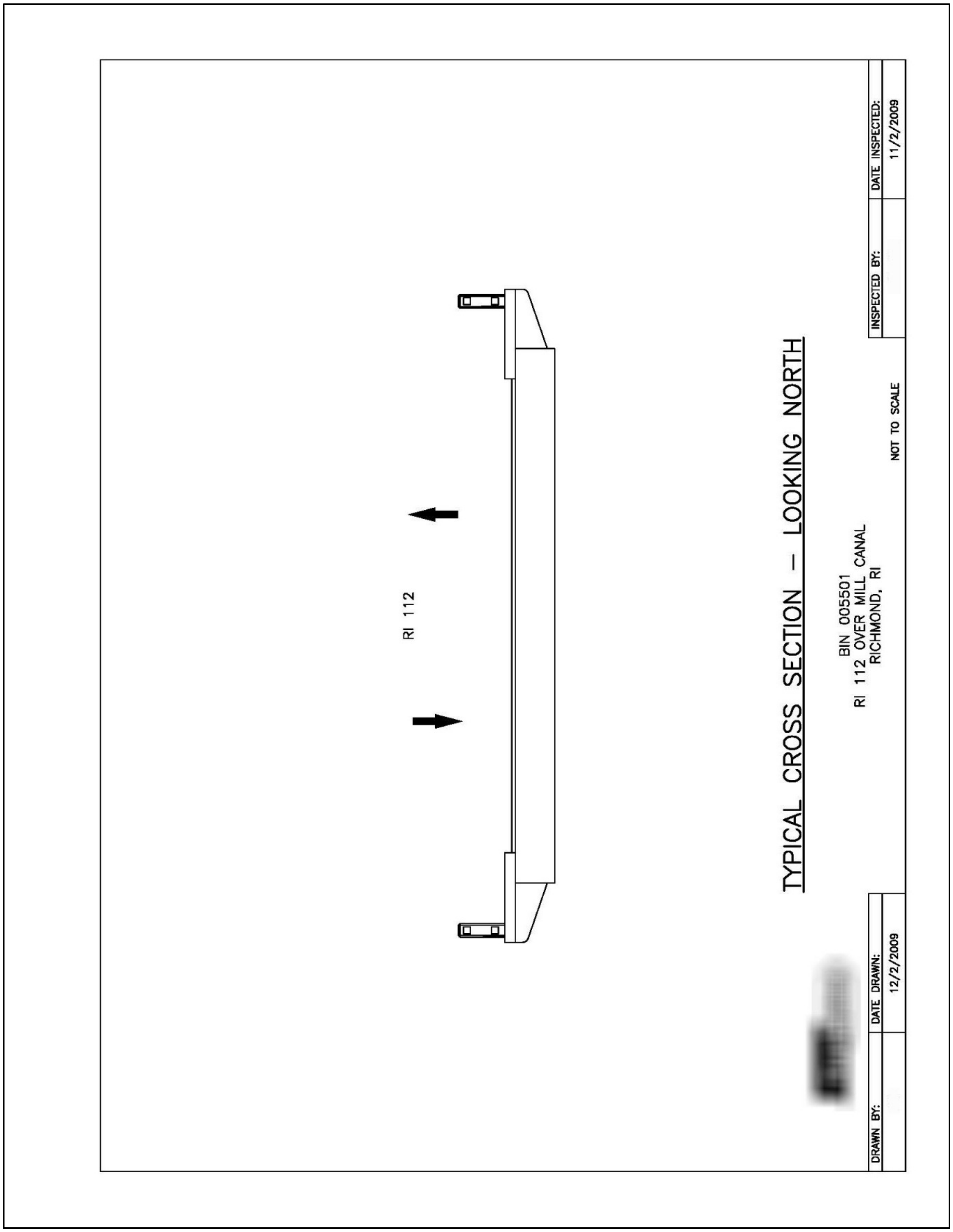


Figure 4.2-4
Example of Bridge Cross Section Orientation Layout

4.2.5 Traffic Control Plan(s)

All traffic control shall be in accordance with the latest edition of the Manual for Uniform Traffic Control Devices (MUTCD), current RIDOT policies, and the RIDOT Transportation Management Plan (TMP) for bridge inspection. In most cases, pre-approved Temporary Traffic Control (TTC) is available from the Department and included within the electronic Bridge Inspection Folder. In the event that TTC plan is not available for a particular location and a lane or shoulder closure is required, the TTC plan shall be submitted to the Chief Engineer for approval prior to performing any inspection. At a minimum, the TTC plan must include the following:

- Each plan shall be 8.5 inch by 11 inch;
- Completed drafts using a minimum of AutoCAD 2000 software, with separate files for each bridge; and
- Each layout converted into a separate Adobe *.PDF.

Refer to Appendix B for pre-approved TTC plans.

4.2.6 Field Sketches

Field sketches are often needed to clarify conditions of structural elements and locations of their deficiencies. The field sketch should include, at a minimum, the bridge number, inspection date, sheet number, crew, brief description, North arrow, identification of bridge components/elements, general notes (if applicable), noteworthy deficiencies complete with field measurements and accompanying notes, legend or key, revision box, scale or *Not to Scale* note, and any other pertinent information (see Figure 4.2-5, Figure 4.2-6, and Figure 4.2-7).

As an alternative, previously recorded sketches may also be modified in the revisions box to account for changes in the bridge's condition. This will save time and effort in the field, as the inspector will only need to note the changes to the previous sketch and not re-record the same deficiencies. The revised field sketch should clearly indicate the revisions made to the original sketch, all information for an otherwise original sketch, and all other pertinent information.

In addition to satisfying the above requirements, sketches shall also be:

- 8.5 inch by 11 inch;
- Legible
- In Adobe *.PDF format; and
- Stored electronically in the inspection folder.

Any field sketch (whether newly established or revised sketches) should be complete and detailed enough such that a load rating can be performed based on the information provided on the sketches.

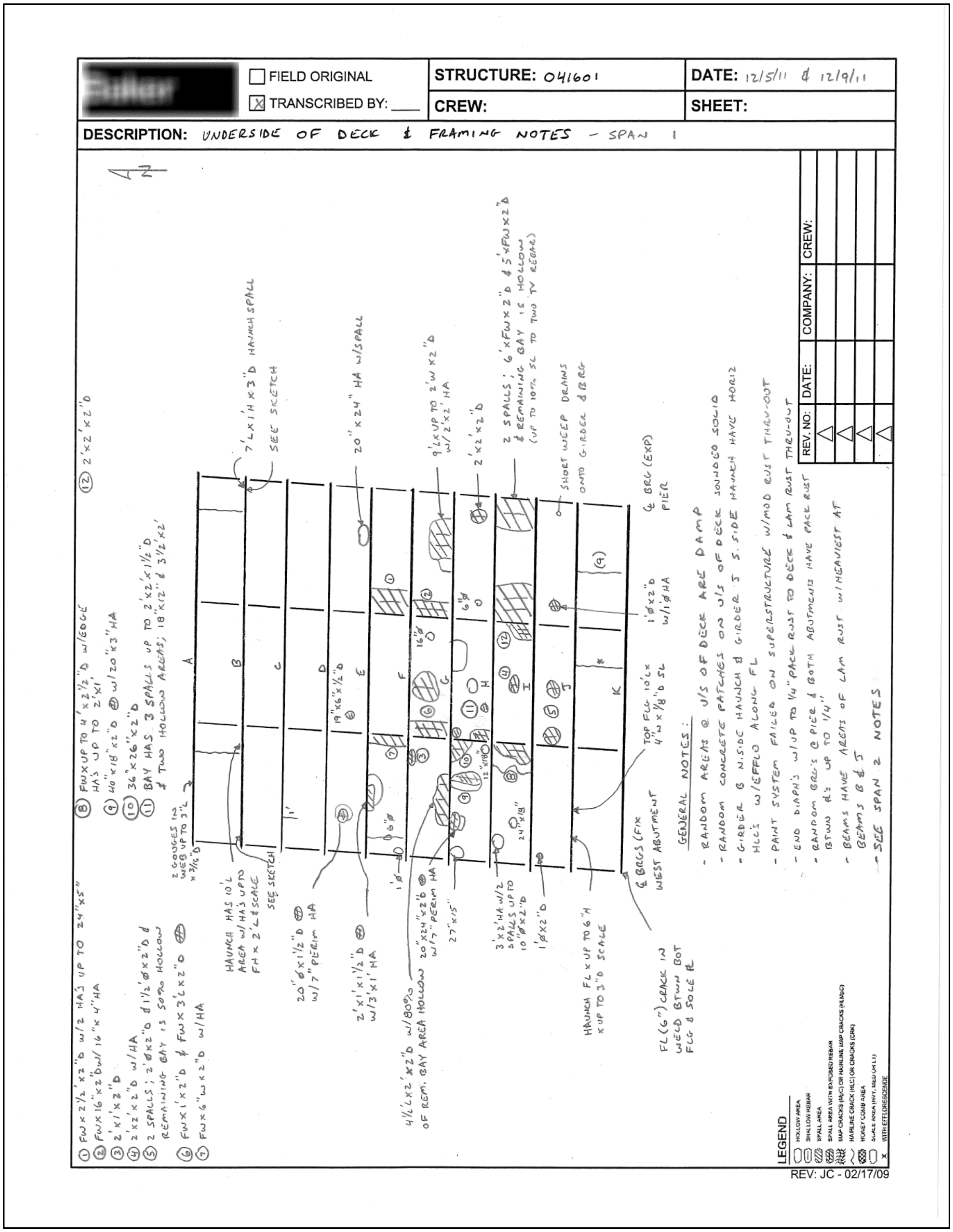


Figure 4.2-5
Example of a Deck Field Sketch

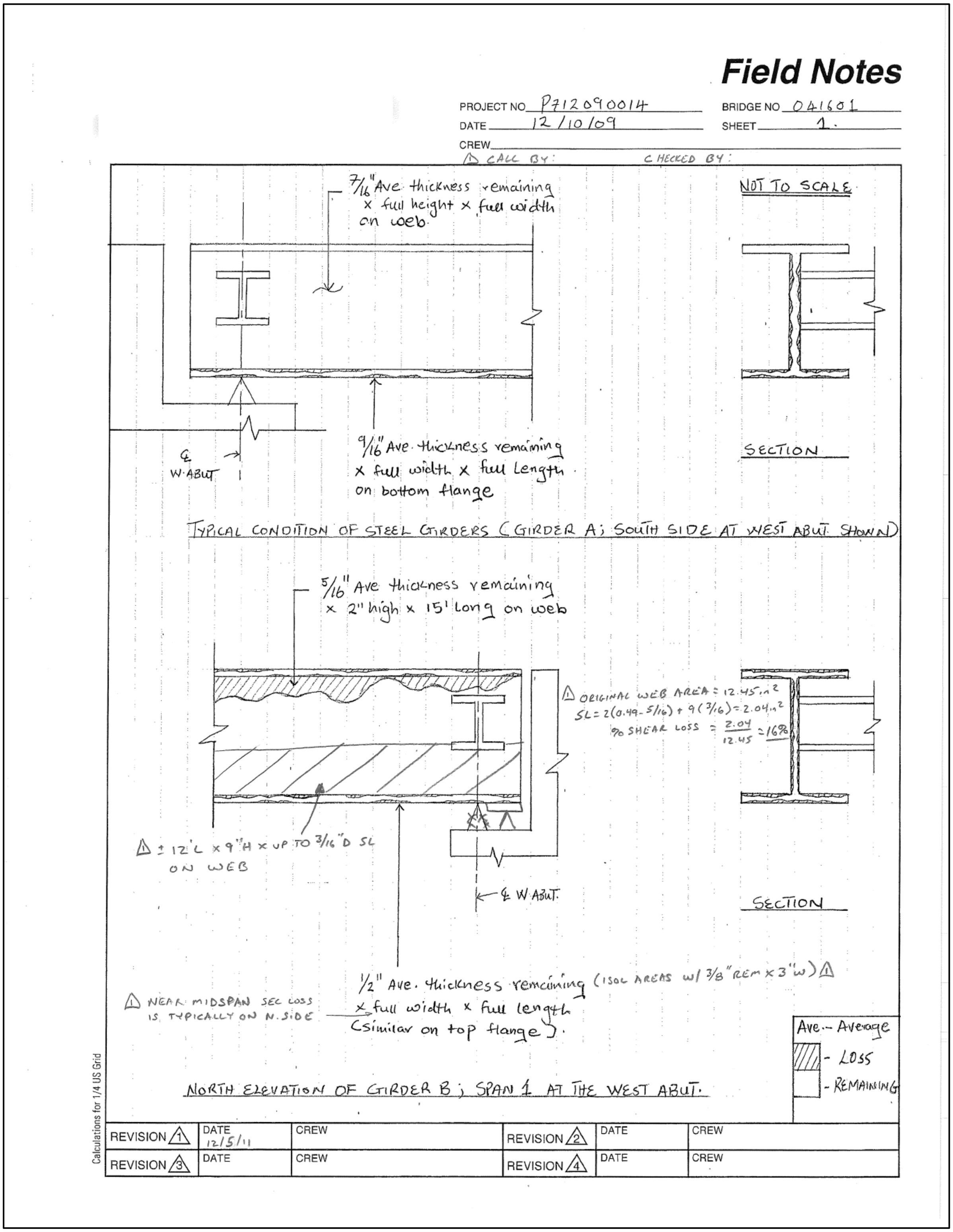


Figure 4.2-6
Example of a Superstructure Field Sketch

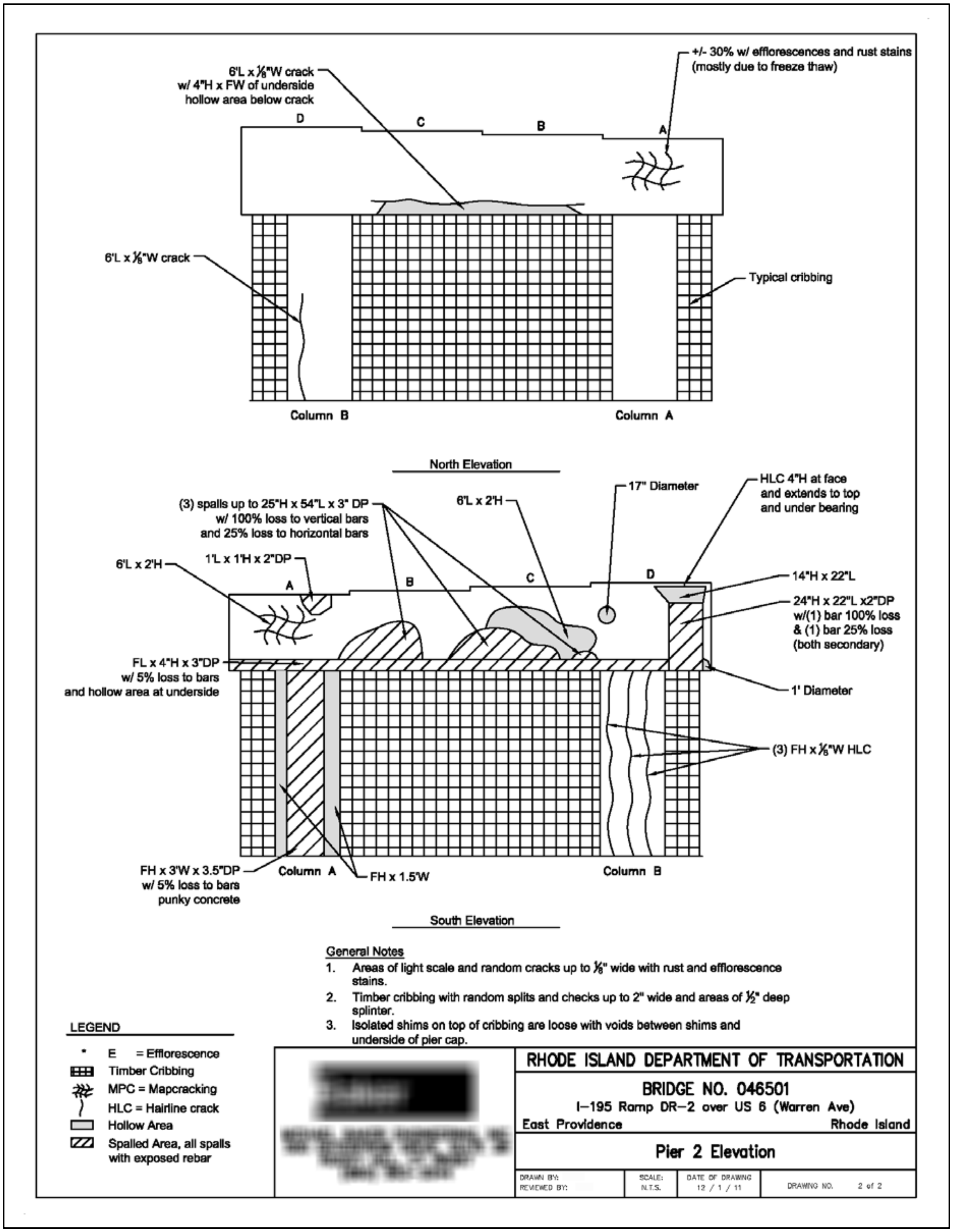


Figure 4.2-7
Example of a Substructure Field Sketch

4.2.7 Waterway and Scour-Related Reports

Hydrology and hydraulics studies and/or scour assessments may have been previously conducted on the channel, and the appropriate report(s) may be available to assist in evaluating the waterway opening and determining the bridge's resistance to scour. Additionally, scour depth computations may be available, either as part of the hydrology and hydraulics report or as stand-alone calculations. If an underwater inspection report has been performed, the inspection findings of the underwater inspection are typically included as a summary within the main report appendix or are cross-referenced to another location within the main report.

4.2.8 Channel Cross Sections

For bridges that intersect a channel, lake, or other body of water, a channel cross section is recorded at the bridge (see Figure 4.2-9). Depending on the complexity of the channel, scour concerns, and/or previous inspection reports, the required level of detail for the channel cross section may increase.

At a minimum, the following information is recorded for the channel cross section at each span:

- Bridge number;
- Waterway (feature intersected);
- Overall channel velocity (fast, moderate, slow, or none);
- Date of inspection;
- Time of inspection;
- Team leader;
- Water surface distance (for each span);
- Maximum water depth (for each span); and
- Water velocity (for each span) (fast, moderate, slow, or none).

Refer to Appendix A.22 for a blank version of the channel cross section.

Channel cross sections are required for routine inspections that require wading inspections or underwater inspections. The following procedures are used to determine the channel cross section on the upstream side of the bridge. These procedures may be performed manually or by entering the values into a spreadsheet (see Figure 4.2-8) to generate the cross section (see Figure 4.2-9):

- Determine non-changing elevations, or a fixed point, such as the top of the parapet, the bridge deck or bottom of superstructure across the width of the channel;

- For wading inspections, use a drop line to determine the freeboard height under the bridge from the fixed point on the bridge, the vertical distance to the bottom of the superstructure (if necessary), and the vertical distance of the average water depth underneath the bridge from the known fixed point;

- For bridges that require underwater inspections, the above water inspectors shall collect the same information as a wading inspection but should incorporate the sounding data from the underwater inspectors. Care should be taken to ensure consistency of the above water and below water data by aligning the measurements in approximately the same locations and by tying both to the same datum;

- Using a surveyors level rod, measuring tape or drop line to determine the vertical distance between the ground elevation and the known fixed point;

- Take measurements at intervals to get general cross section including, but not limited to, the deepest part of the channel, edge of water, at substructure ground elevations, and change in slope (possibly consider $1/10^{th}$ points for medium and long bridges);

- Drop line and surveyors level rod readings are measured at points across the channel from the fixed point and entered into the spreadsheet;

- The channel cross section graph is generated from the points entered into the spreadsheet;

- Perform the above steps each time the channel cross section is to be recorded and compare to previous cross section(s) to determine if scour, undermining or lateral stream migration is occurring.

Bridge No.:	XX	Structure Name:	AA
Consultant:	YY	Town:	BB
Inspection Date:	XX/YY/ZZZZ	Waterway:	CC

	X_0	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}	X_{20}	X_{21}	X_{22}	X_{23}	X_{24}	X_{25}	X_{26}	X_{27}	X_{28}
Distance from beginning of cross-section	0	20	30	30	33	33	40	65	75	90	100	103	103	110	110	115	115	122	122	125	130	150	175	187	187	190	190	200	225
Top of Parapet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Near Abutment			-1.0	-11.0	-11.0	-13.0																							
Pier (near side)												-28.0	-25.0	-25.0	-1.0														
Pier (far side)																-1.0	-25.0	-25.0	-28.0										
Far Abutment																								-13.0	-11.0	-11.0	-1.0		
Bottom of Footing		-13.0	-13.0	-13.0	-13.0	-13.0						-28.0	-28.0	-28.0	-28.0	-28.0	-28.0	-28.0	-28.0						-13.0	-13.0	-13.0	-13.0	
Bottom of Superstructure	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Freeboard	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0
Average Water Depth							-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0						
Ground Elevation - Current (2012)	-1.8	-6.9	-7.5	-7.5	-7.8	-7.8	-7.8	-12.5	-16.0	-17.2	-22.2	-22.5	-22.5	-23.0	-23.4	-24.0	-23.8	-23.6	-23.5	-23.0	-21.0	-11.8	-7.8	-6.5	-6.5	-4.0	-4.0	-1.9	-1.0
Ground Elevation - 2010	-1.8	-6.9	-7.5	-7.5	-7.8	-7.8	-7.8	-12.0	-15.5	-16.0	-22.2	-22.5	-22.5	-23.0	-23.5	-23.5	-23.5	-22.8	-22.5	-22.0	-20.0	-11.8	-7.8	-6.5	-6.5	-4.0	-4.0	-2.0	-1.0
Ground Elevation - 2008	-1.8	-6.9	-7.5	-7.5	-7.8	-7.8	-7.8	-10.0	-15.0	-15.5	-22.2	-22.5	-22.5	-23.4	-23.4	-23.5	-23.5	-22.5	-22.0	-20.0	-17.0	-11.8	-7.8	-6.5	-6.5	-4.0	-4.0	-2.0	-1.0

	X_0	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}	X_{20}	X_{21}	X_{22}	X_{23}	X_{24}	X_{25}	X_{26}	X_{27}	X_{28}
Distance	0	20	30	30	33	33	40	65	75	90	100	103	103	110	110	115	115	122	122	125	130	150	175	187	187	190	190	200	225
Elevation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rod Reading - Current (2012)	1.8	6.9	7.5	7.5	7.8	7.8	7.8	12.5	16	17.2	22.2	22.5	22.5	23	23.4	24	23.8	23.6	23.5	23	21	11.8	7.8	6.5	6.5	4	4	1.9	1
Rod Reading - 2010	1.8	6.9	7.5	7.5	7.8	7.8	7.8	12	15.5	16	22.2	22.5	22.5	23	23.5	23.5	23.5	22.8	22.5	22	20	11.8	7.8	6.5	6.5	4	4	2	1
Rod Reading - 2008	1.8	6.9	7.5	7.5	7.8	7.8	7.8	10	15	15.5	22.2	22.5	22.5	23.4	23.4	23.5	23.5	22.5	22	20	17	11.8	7.8	6.5	6.5	4	4	2	1

Figure 4.2-8
Example Table for Channel Cross Section

Bridge No.: XX Structure Name: AA
Consultant: YY Town: BB
Inspection Date: XX/YY/ZZZZ Waterway: CC Inventory information, consultant and inspection date from previous page

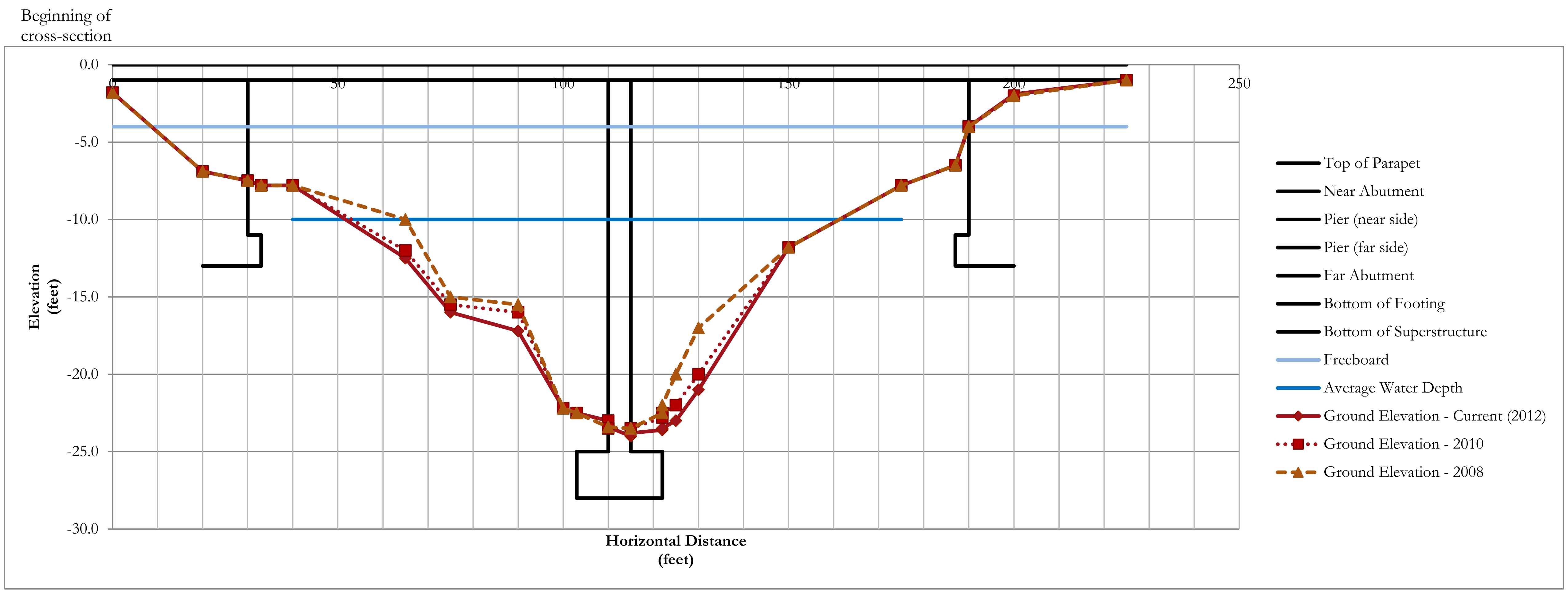


Figure 4.2-9
Example Graph for Channel Cross Section

4.2.9 Detour Route Maps

At a minimum, detour maps provide the following information within the bridge inspection report (see Figure 4.2-10):

- Map of the detour route and surrounding area;
- Six-digit bridge number with call-out on map;
- Facility carried;
- Inspection date and/or date field-verified;
- Additional mileage for detour (Item 19);
- Location of the bridge (city, state); and
- Detour length (total distance for the detour).

Detour route maps may also provide include additional information depending on the bridge and applicability, including:

- Facility intersected;
- Direction of travel (e.g., Eastbound, Southbound, etc.);
- Non-detour mileage;
- Estimated time of detour; and
- General notes.

Detour Route for Bridge #098001 (Point Street) – Westbound Providence, RI
Date field verified: 12/20/11
Total detour mileage: 1.3 miles
Non-detour mileage: 0.3 miles
Additional mileage for detour (NBI Item 19): 1.0 miles

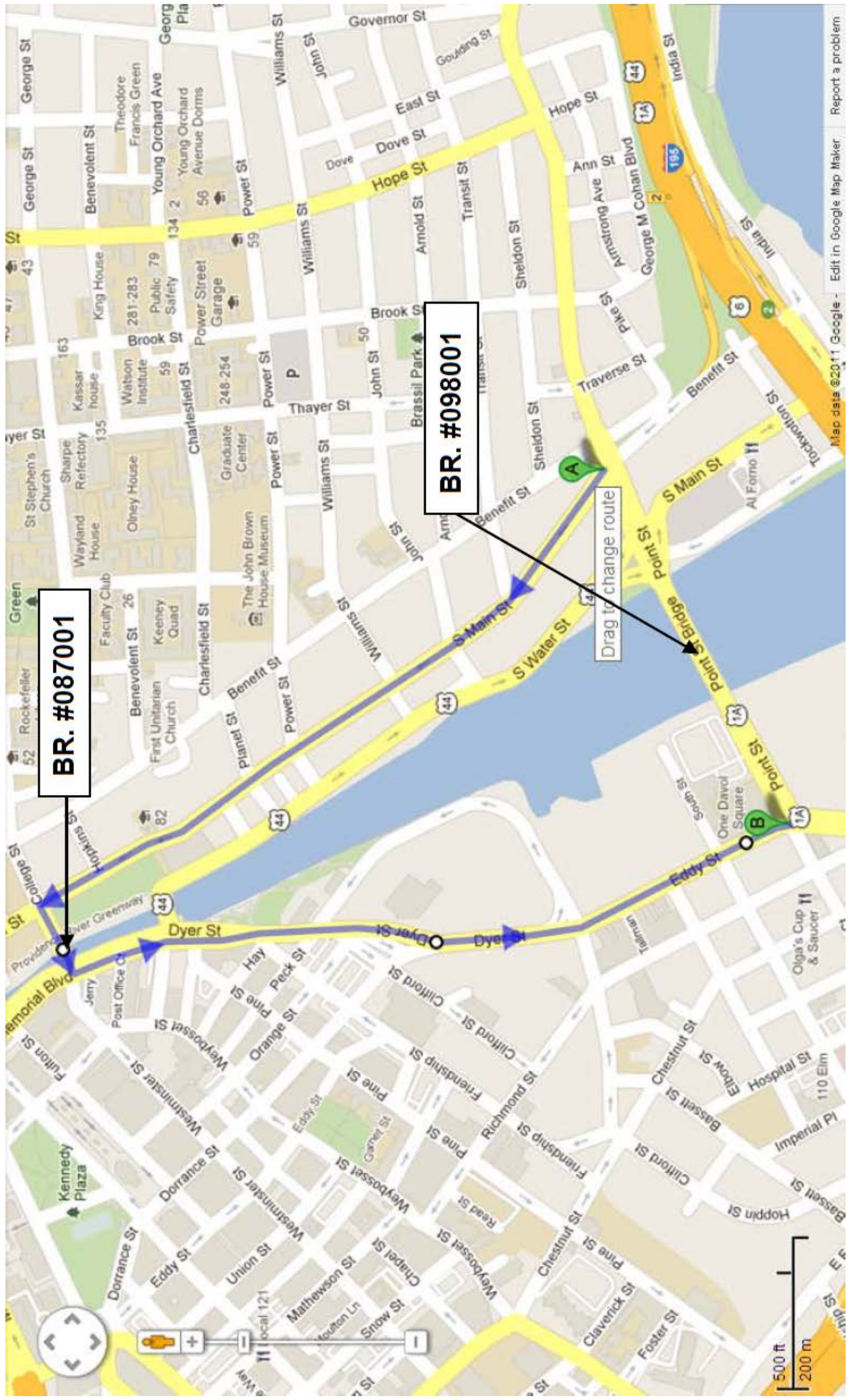


Figure 4.2-10
Example Detour Route Map

4.2.10 Curb Reveal Measurements

The average curb reveal at each sidewalk and/or median shall be measured during all routine inspections. The curb reveal is defined as the vertical face or vertical portion of the curb measured from the top of the bridge wearing surface to the top of the curb. This information is important for load rating analysis calculations to determine if the bridge sidewalks and/or median are mountable. Additionally, this helps to approximate the thickness of the wearing surface for load rating calculations. Curb reveal measurements shall be recorded in the appropriate field in the BMS. Curb reveal measurements shall be taken in each span at each side of the bridge, with the average measurement recorded.

4.2.11 List of Specialized Tools and Equipment

Specialized tools and equipment that were required during the bridge inspection should be noted in the inspection report (see Figure 4.2-11 – highlighted portion).

Examples of specialized tools and equipment include the following:

- Dye penetrant;
- D-meters;
- Ladders, which should be positioned according to the proper 1H to 4V ratio;
- Rigging;
- Scaffolding;
- Boats or barges;
- Floats; and
- Bosun (Boatswain) chairs or rappelling.
- Manlifts;
- Scissors lifts;
- Bucket trucks; and
- Inspection vehicles.

Refer to Section 3.2.2.3 for more information regarding inspection equipment.

Bridge Inspection Report (English Units)

Bridge Notes:

Equipment Used: Lift truck and barge with scaffolding.

Traffic Control: Lane closures on Point Street with local police assistance.

Vertical Clearance Over Bridge: The minimum vertical clearance in the Eastbound direction was measured to be 15 ft.-8 in. at the curb line at U12. The minimum vertical clearance in the Westbound direction was measured to be 15 ft.-11 in. at the curb line at U1.

Cross-Beams: The steel cross-beams supporting the deck in Spans 4 and 5 are in good condition and have scattered areas of light rust (Photo 9).

Bottom Chord Lateral Bracing: The bottom chord lateral bracing angles and horizontal gusset plates have an accumulation of sand and isolated areas of painted over pitting up to 3/16 in. deep at the ends. The lateral brace at the southeast corner of Floorbeam 11 has a pinhole (Photo 33). Lateral bracing hanger rods/bolts connecting the angles to the stringer bottom flanges are bent at random locations. Panel 13 at Stringer B is broken (Photo 34).

Deflection and Vibration: There was no significant vibration or deflection noted.

Utilities: The north fascia has a 4 in. diameter steel galvanized conduit with light rust on the clamps (Photo 92). Below the south sidewalk has six (6) – 6 in. diameter conduits (Photo 93). The electrical conduits for the light standards and navigation lights are typically in good condition with isolated areas of light surface rust. There is loose hanging wire on the south side of the structure, hanging into the water.

Lighting: The lights attached to the top chord were not lit at the time of inspection and have no notable deficiencies (Photos 4, 5, and 35).

See *Bridge Notes Additional Notes.docx* for additional notes.

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Figure 4.2-11
Example of Inspection Notes Indicating Specialized Tools and Equipment

4.2.12 Utility Documentation

Utilities are often exclusively documented within the inspection notes (see Figure 4.2-12 – highlighted portion). Utility locations, configuration, material/size should be documented. If deficiencies are present on the utilities, photographs may also be incorporated within the bridge inspection report for added clarification (see Figure 4.2-13).

Bridge Inspection Report (English Units)

Bridge Notes:

Approach Roadways: The approach bituminous wearing surface has been resurfaced since the previous inspection. Due to severe flooding, the north approach pavement at the east edge has settled up to 2 ft. deep x up to 2 ½ ft. wide x ±50 ft. long and the pavement is undermined up to 15 in. deep (Photo 20). The south approach pavement at the east edge has settled up to 1 ft. deep x 26 in. wide x ± 100 ft. long and the pavement is undermined up to 12 in. deep (Photo 21). There are barrels in place along the east shoulder at both approaches (Photos 20 and 22).

Utilities: There is a 4 ½ in. diameter metal utility conduit along the west curb that has one bracket disconnected. At the east curb of the bridge, there is a concrete-encased water main with through cracks up to 1 ¾ in. wide. There is light sand accumulation and vegetation growth at the top of the concrete encasement. At the southeast end of the bridge, the concrete around the water main has a 10 in. diameter x 3 in. deep spall exposing the water main (Photo 24). A 2 ft. section of water main at this location is missing insulation and has light rust. A water main utility bridge is located just west of the bridge (Photo 2).

Channel Notes:

Vegetation: There is light to moderate vegetation growth along the banks of the pond.

Embankment Erosion: The northeast embankment protection blocks/riprap are partially collapsed/settled along the waterline and there is a newer block wall behind. Along the roadway, one block has shifted east ± 2 in. and has settled ± 1 ½ in. (Photo 23). The southeast embankment has moderate to heavy erosion. The riprap stone along the west embankments have a few scattered areas of minor erosion at the displaced stone locations.

Debris: There is light accumulation of debris along the bottom of the channel where visible.

Aggradation: There was no significant aggradation noted during the inspection.

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Figure 4.2-12
Example of Utility Documentation (Notes)

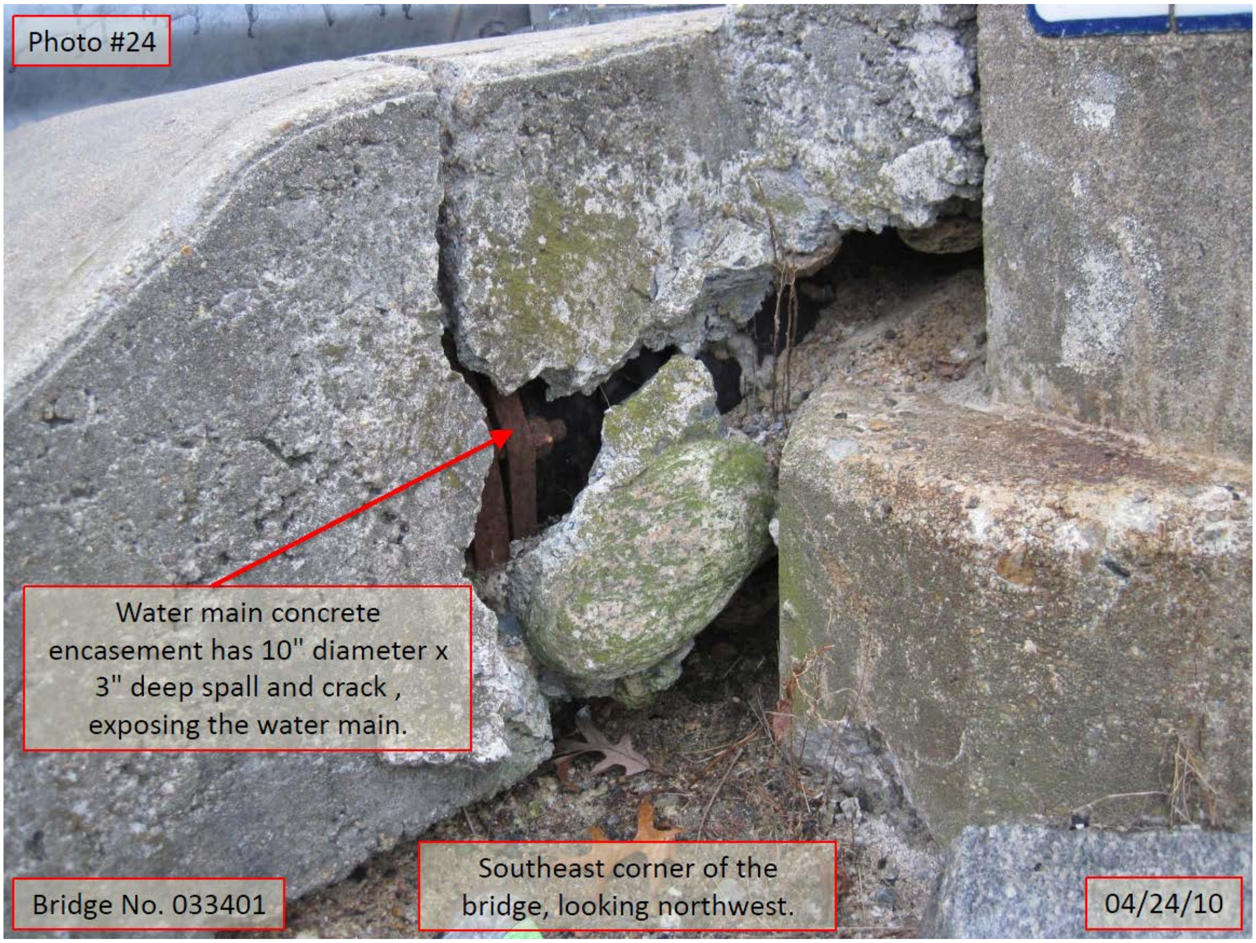

Figure 4.2-13
Example of Utility Documentation (Supplemental Photograph)

4.2.13 Minimum Vertical Underclearance

During a routine inspection, if a bridge intersects a traveled roadway or railroad, the minimum vertical underclearance and posted minimum vertical underclearance shall be verified with the previous inspection report. If the minimum underclearance has changed, it should be indicated on the inspection report to allow for the appropriate measures to be taken. The Bridge Vertical Clearance Inventory Data Sheet shall be completed for each routine inspection and submitted with the inspection report.

The minimum vertical clearance should take into consideration the structure, signing, utilities, and any other appurtenance that are attached to the bridge. Critical points that may determine the minimum vertical underclearance include the edge of the roadway (minimum over the travel lanes is recorded in the Structure Inventory and Appraisal (SI&A)), outside edge of the shoulder, center of the roadway, and locations of change in the bottom elevation of the bridge. Additionally, bridges with a significant variation in the structure depth, such as an arch or frame superstructure, may require special attention in determining the minimum vertical underclearance.

The most critical measured underclearance shall be entered into the SI&A. The minimum underclearance for each direction of travel shall be provided. It is important to note that the SI&A underclearance shall be the lesser of the clearances measured for each bound of traffic.

Refer to Appendix A.21 for blank versions of the Bridge Vertical Clearance Inventory Data Sheets.

4.2.14 Fracture Critical Documentation

As stated in the NBIS, *Code of Federal Regulations*, Title 23, Part 650, Subpart C, the identification of fracture critical members and problematic details shall be done **prior** to the fracture critical inspection. Proper identification of fracture critical members includes:

- Reviewing the plans (performed by the team leader);
- Identifying all fracture critical members (see Figure 4.2-14);
- Identifying problematic details (performed by the team leader), including locating the problematic details on each fracture critical member, assigning AASHTO design fatigue categories, and identifying associated retrofits; and
- Reviewing the permanent record, including plan drawings and/or detail lists.

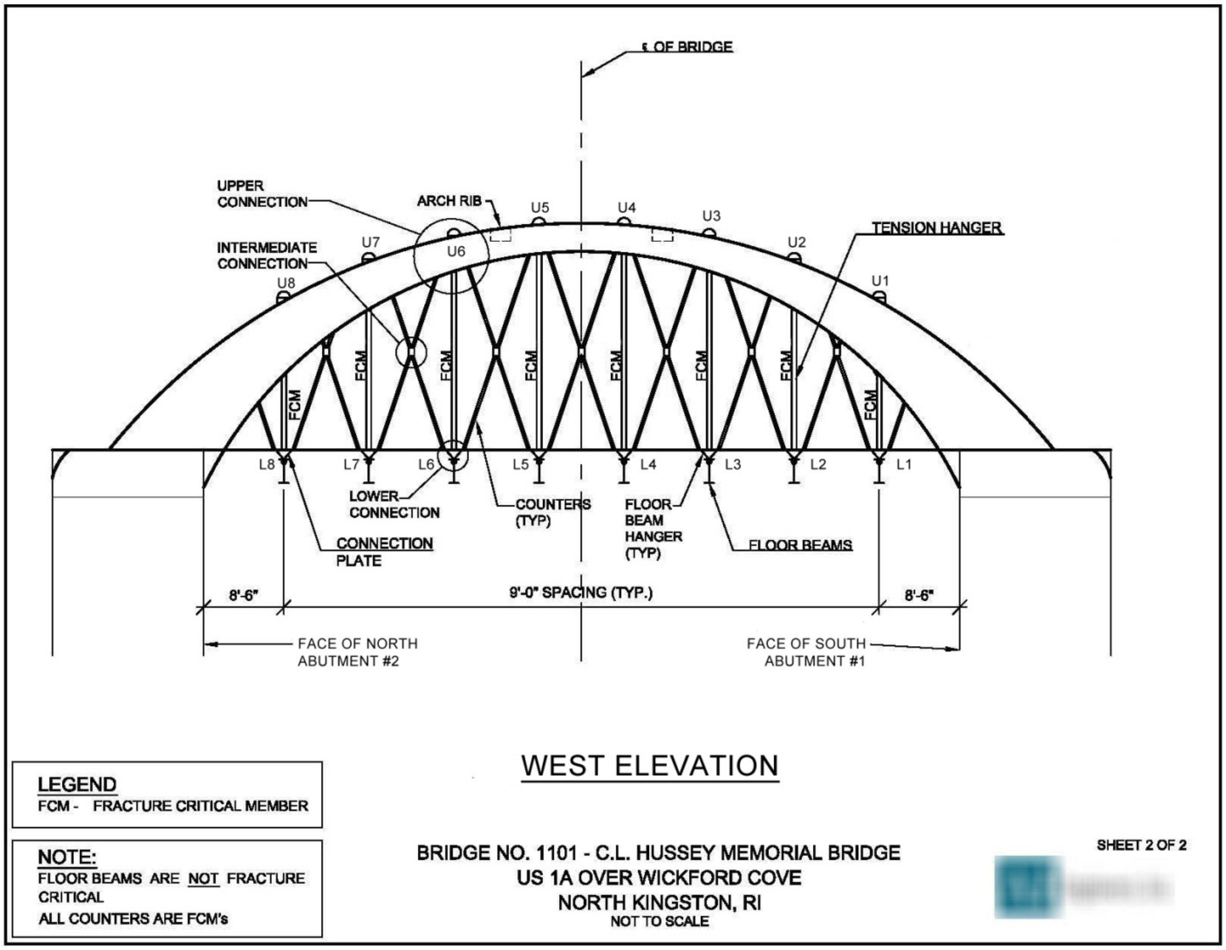

Figure 4.2-14
Example of FCM Identification

A properly documented fracture critical inspection report will ensure proper evaluation and effectively reporting of any changes from the previous condition. The four (4) fundamental components of a fracture critical inspection report include the narrative, documentation support, evaluation, and recommendations. The State also requires a plan showing fracture critical members and a fracture critical data sheet for each fracture critical inspection report. Refer to the following sub-sections for more information.

4.2.14.1 Fracture Critical Inspection Report

The fracture critical inspection report typically contains the following:

- Fracture critical member identification, which establishes the FCMs and their problematic details, determines their respective AASHTO fatigue categories, and provides the inspector with a helpful list to verify that all FCMs and problematic details receive inspection in the field.

4.2.14.2 Fracture Critical Inspection Report: Documentation Support

The documentation support within a fracture critical inspection report typically contains the following information:

- Specialized forms for fracture critical inspections, including those outlined in Section 4.1.4;
- Sketches, which satisfy all requirements for the State as outlined in Section 4.2.4 and Section 4.2.6; and
- Photographs, which satisfy all requirements for the State as outlined in Section 4.2.17 and Section 4.3.3.

4.2.14.3 Fracture Critical Inspection Report: Evaluation

The evaluation portion of a fracture critical inspection report contains both NBI component condition ratings and AASHTO element level evaluation.

4.2.14.3.1 NBI Component Condition Ratings

NBI component condition ratings are required by the NBIS to provide a numerical condition (from 9 to 0 – best to worst) of each bridge component for inclusion in a Federal database. For fracture critical members, the condition rating is heavily dependent on the existence of cracks. Below are excerpts of the general condition ratings for Items 58, 59 and 60, as defined on Page 38 of the *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges*:

Code	Description
4	POOR CONDITION – advanced section loss, deterioration, spalling or scour.
3	SERIOUS CONDITION – 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.
2	CRITICAL CONDITION – 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.

Considering the general condition language for Codes 4 through 2, inspectors may assign the following superstructure component condition ratings for the given situations:

- Superstructure (Item 59) component condition rating of 4 or less for cracks present in secondary members where there is a means of propagation into the primary member.
- Superstructure (Item 59) component condition rating of 3 or less for cracks present in primary members.

Overall, component condition ratings assist the State program manager in making repair or replacement decisions on a network-wide basis within the State's Bridge Management System.

4.2.14.3.2 AASHTO Element Level Evaluation

AASHTO element level evaluation is not required by the NBIS and is not part of the NBI, but offers a greater level of detail in assessing the condition of individual elements that make up a bridge component.

Each steel element, such as Element 107 Steel Girder/Beam, includes condition state language that incorporates cracking and/or fatigue-related deficiencies. Additionally, Defect Flags (previously known as Smart Flags) address steel cracking through Defect Flag 356 – Steel Cracking/Fatigue. In general, the quantity of the Defect Flag is inherited from the parent element and should be assigned according to the applicable quantity of the deficiency determined from the field inspection. For example, a total of 100 LF of Steel Girder/Beam (Element 107) with steel cracking for 4 LF would also require Defect Flag 356 with a quantity of 4 LF.

The State requires using the latest guidelines as established by AASHTO in element level evaluations for all bridge inspections. Refer to Section 1.1.2 for more information.

4.2.14.4 Fracture Critical Inspection Report: Recommendations

Recommendations are made based on field inspection findings and critical findings, if encountered during the inspection. This process helps to minimize the inherent risk associated with fracture critical members.

- Types of recommendations after performing a fracture critical inspection include:
- Immediate repair, which address bridge-threatening deficiencies (critical findings) to help maintain structure serviceability;
- Load rating analysis, which may be required to determine the safe load-carrying capacity of the structure considering the current condition and deficiencies;
- Additional inspection, which may be required to further evaluate the member(s) or structure; and
- Testing, which may be required to further evaluate the member(s).

4.2.14.5 Plan Showing Fracture Critical Members

In addition to the four (4) fundamental components of a fracture critical inspection report - narrative, documentation support, evaluation, and recommendations – a plan showing fracture critical members, fracture critical portions within a member, or other problematic areas is included with the fracture critical inspection report. Figure 4.2-15 shows an example of the fracture critical portions (highlighted areas) of a floorbeam for a fracture critical welded two-girder bridge.

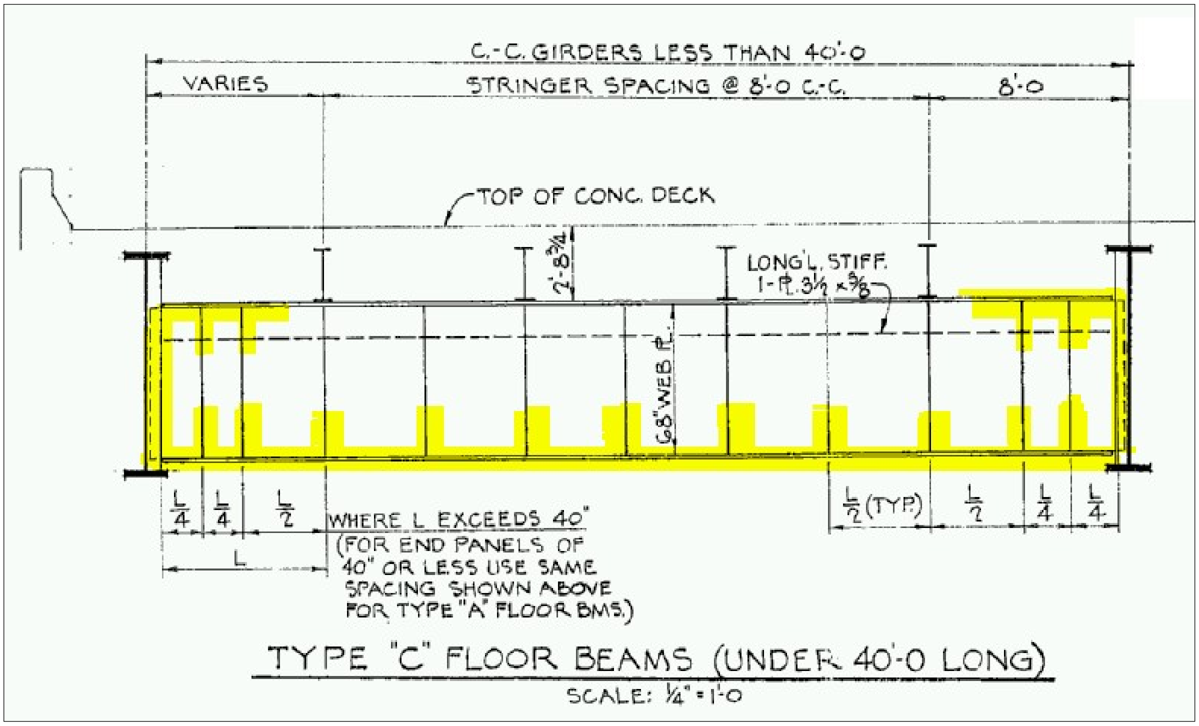

Figure 4.2-15
Plan Showing Fracture Critical Portions for a Steel Floorbeam

4.2.14.6 Fracture Critical Data Sheet

In addition to the four (4) fundamental components of a fracture critical inspection report - narrative, documentation support, evaluation, and recommendations – a fracture critical data sheet is included with the fracture critical inspection report. Figure 4.2-16 shows an example fracture critical data sheet for a single span through-girder bridge. The purpose of this sheet is to list all critical members and identify and problematic or fatigue prone details (AASHTO Fatigue Category C to E').

RIDOT BRIDGE INSPECTION
FRACTURE CRITICAL DATA

BRIDGE NO.:	30701
DESCRIPTION:	SHIPPEE, ROUTE 98 (SHERMAN FARM ROAD) OVER NIPMUC RIVER
LOCATION:	BURRILLVILLE
STRUCTURE TYPE:	SINGLE SPAN THROUGH GIRDER (the TRUSS does not carry liveload)

Span No.	FCM No.	FCM Description	Detail No.	Fatigue Detail Description	AASHTO Category	Remarks
FRACTURE CRITICAL MEMBERS						
1	FCM 1	Girder A				West Girder
1	FCM 2	Girder B				East Girder
Floorbeams on this structure are not Fracture Critical Members based on floorbeam spacing less than 14'-0						
FATIGUE PRONE DETAILS						
1		Main Girder	6	Bearing Stiffener connection plate	C'	Base metal at toe of weld between stiffener plate and flange and between stiffener plate and web
1		Main Girder	6	Intermediate Stiffener connection plate	C'	Base metal at toe of weld between stiffener plate and flange & between stiffener plate and web
1		Trusses	21	Mechanical Connections	D	Base Metal

Bridge No. **BR #30701**

Figure 4.2-16
Example Fracture Critical Data Sheet

4.2.15 Element Level Documentation

Identification of elements and their total quantities as included in the deck, superstructure and substructure components shall be done **prior** to inspections which include element level (Bridge Management Software) documentation (see Figure 4.2-17 and Figure 4.2-18). Proper identification of bridge elements includes:

- Reviewing the original plans, rehabilitation plans, previous inspection reports and photographs;
- Identifying all elements and their element numbers per AASHTO Guide Manual for Bridge Element Inspection (latest edition) and as supplemented by the Department;
- Calculating total quantities for the identified elements; and
- Including the elements, element numbers and their total quantities in the permanent record, including plan drawings and/or calculations.

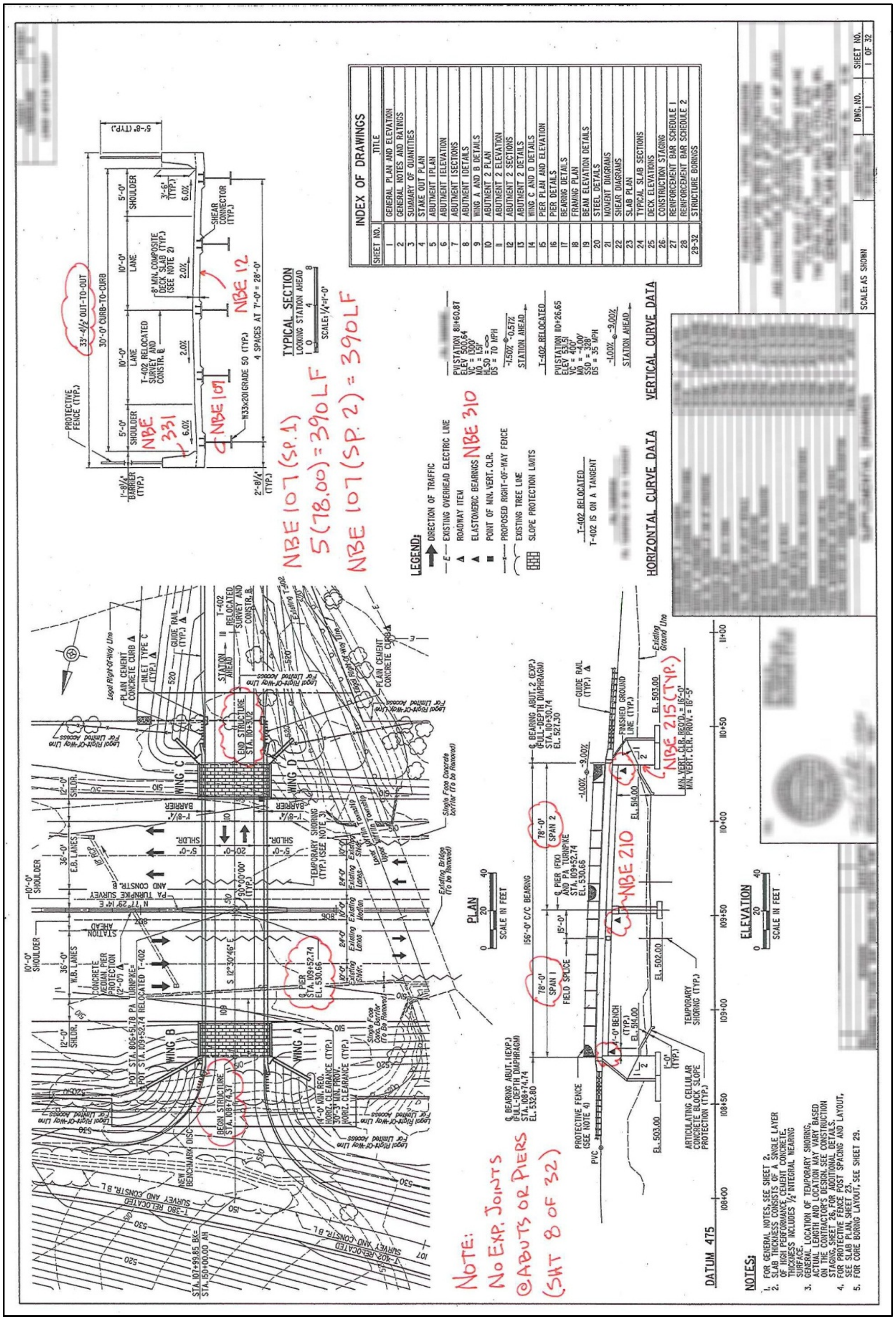

Figure 4.2-17
Element Level Documentation Plans – Sheet 1

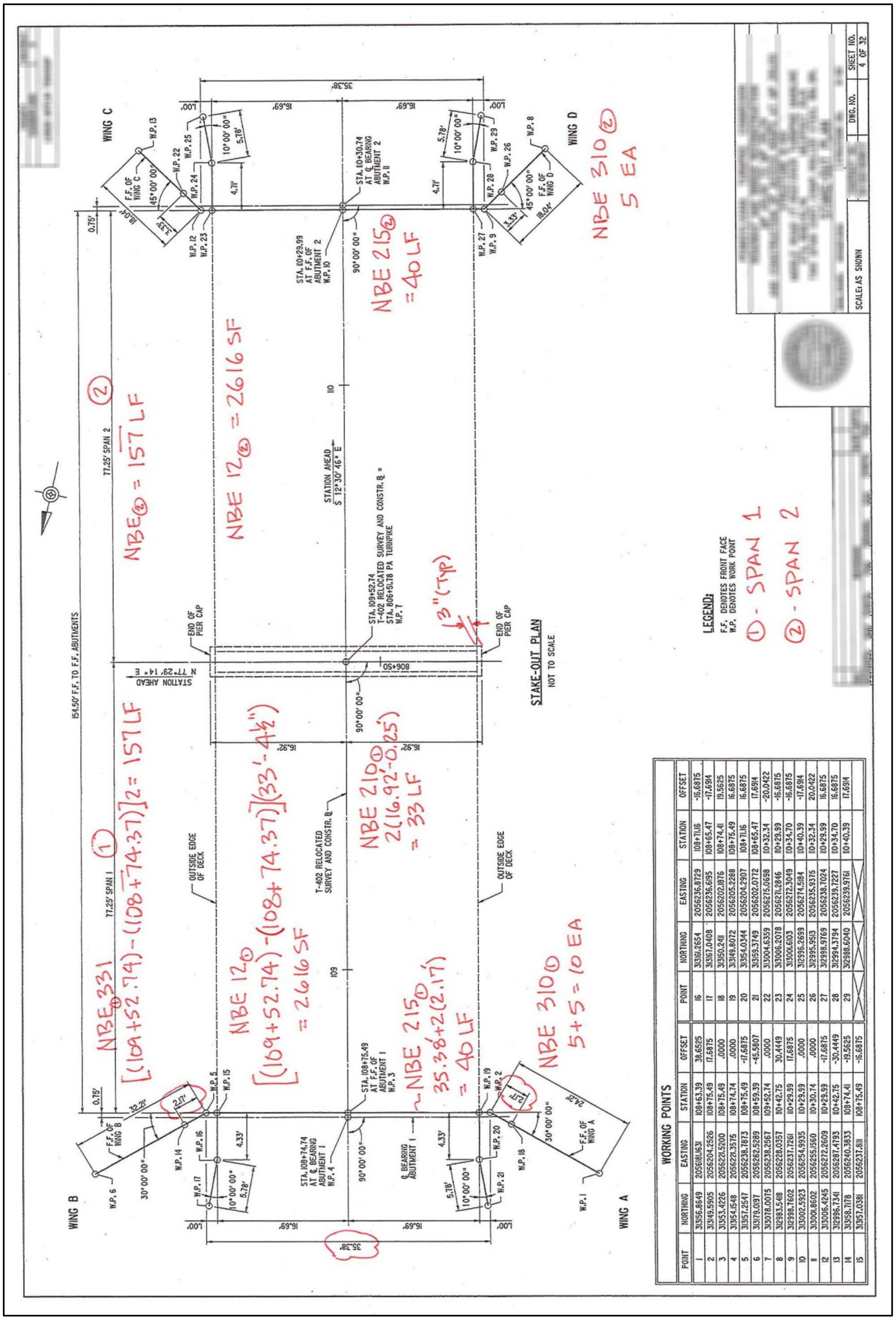

Figure 4.2-18
Element Level Documentation Plans – Sheet 2

4.2.16 Video Documentation

Although not required by the State, video documentation may be a very appropriate and efficient way of documenting a deficiency for certain situations. Examples of video documentation may include documenting differential deflection under traffic loads or a loose expansion joint as traffic passes over the joint.

The video should contain adequate lighting and should be focused adequately to capture the deficiency. If provided to the State, the video should be submitted on a DVD. In the case of a critical finding, a short video should be e-mailed to the State at the time of the finding.

4.2.17 Photo Documentation

Photographs are essential for a good inspection report. The State requires that every photograph include the photo number, annotation of the bridge, comment(s) regarding the structure and location on the structure, six-digit bridge number, photo orientation (viewing angle of the picture relative to the bridge), photo taken date, and any other pertinent information. Abbreviations are not allowed for text entered on the photograph.

A minimum of two photographs are required for the inspection report: one showing the side elevation of the bridge and a second showing the structure from the approach roadway (see Figure 4.2-19 and Figure 4.2-20). It is recommended that pictures also be taken of any problem areas, even if the deficiency can be explained solely in writing (see Figure 4.2-21). However, if the bridge is posted or contains a vertical clearance sign, a photograph of each sign is required, both at the bridge and advanced signs.

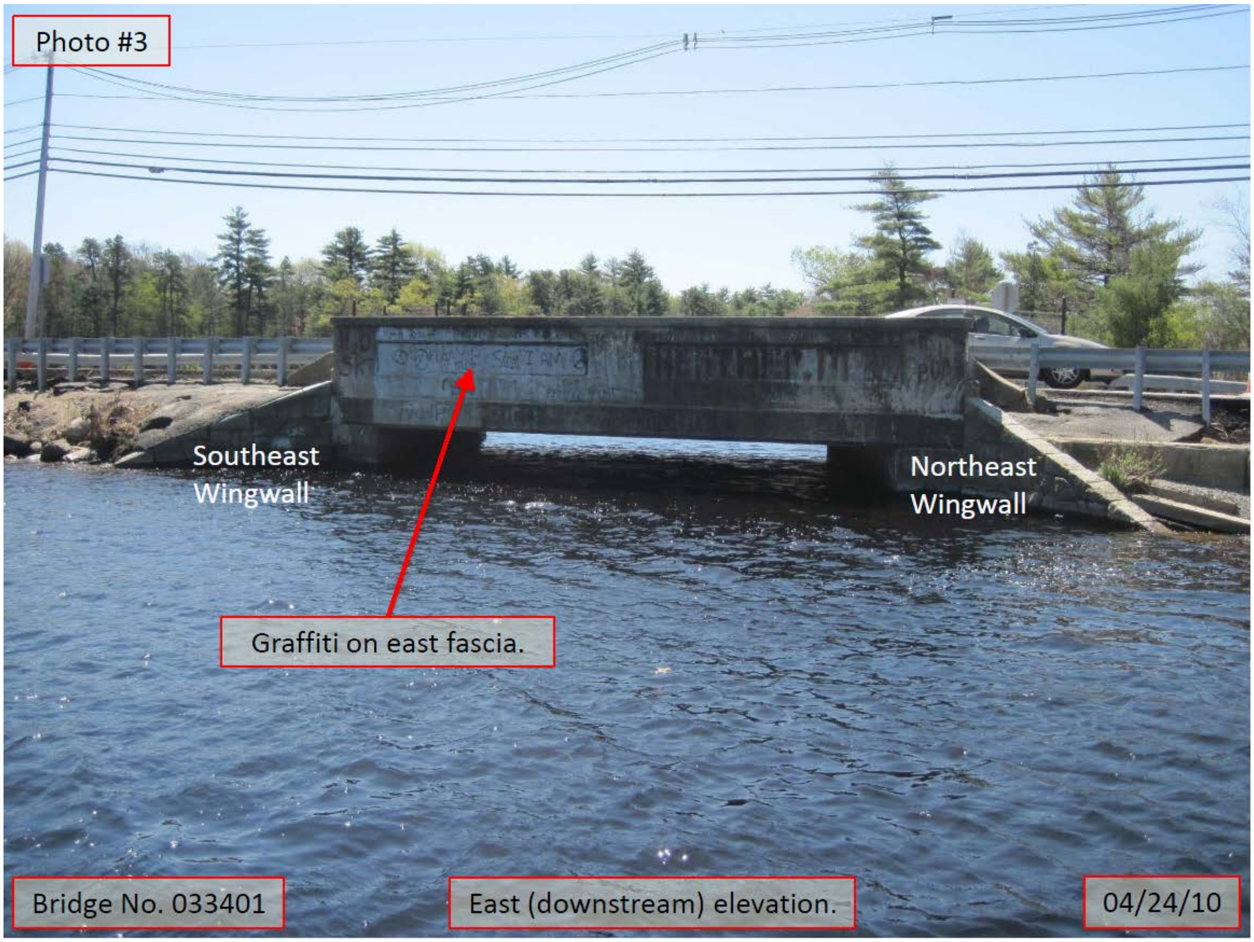

Figure 4.2-19
Example Photo Documentation - Bridge 033401 from East (Downstream) Elevation

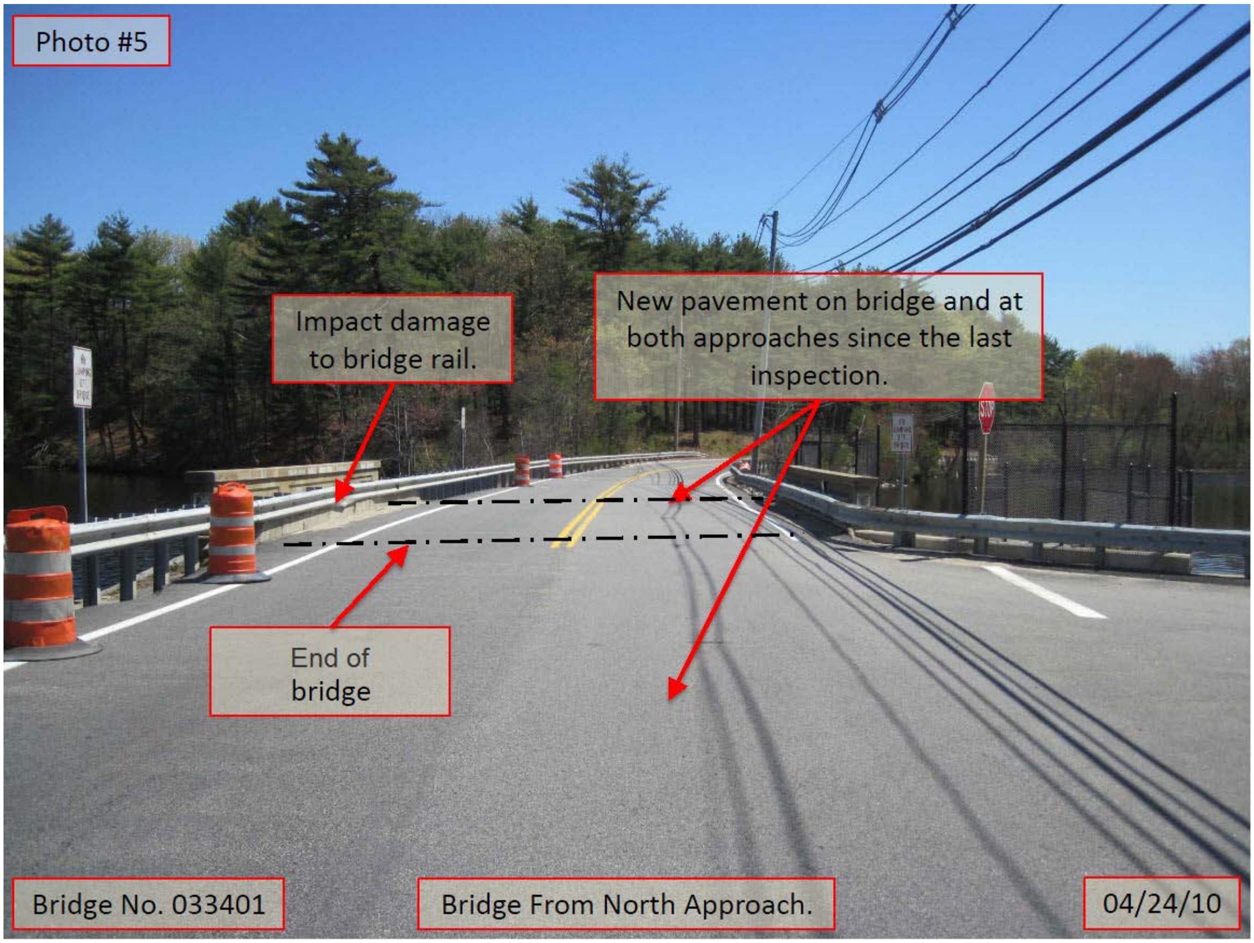

Figure 4.2-20
Example Photo Documentation - Bridge 033401 from North Approach

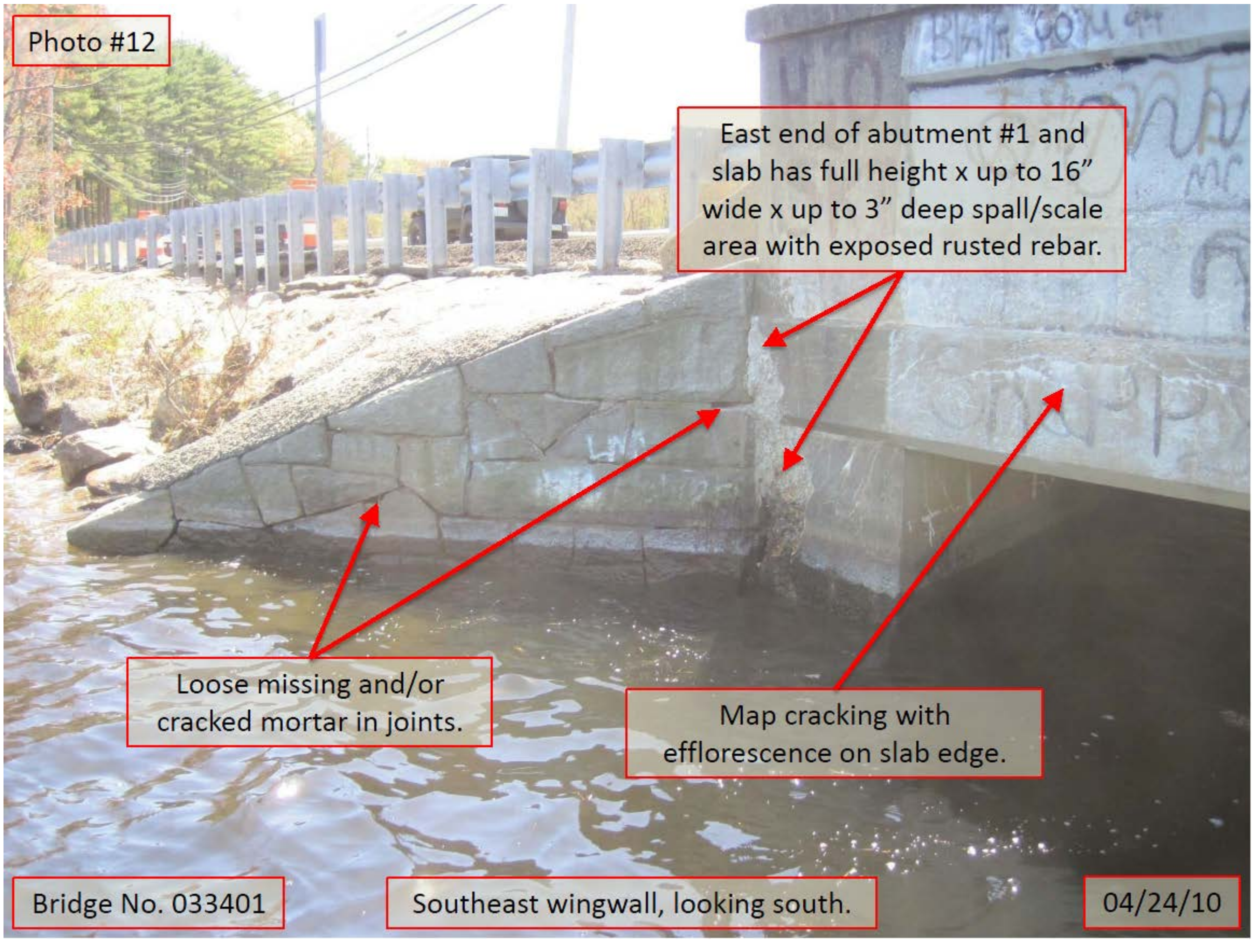

Figure 4.2-21
Example Photo Documentation - Bridge 033401 at Southeast Wingwall, Looking South

4.2.18 Steel Section Loss

Actual field measurements of the remaining structural steel or rebar sections will be recorded in the field and compared against the original dimensions. Estimated percent loss is not permitted. Inspectors can use the current dimensions versus the original dimensions to aid them in giving a condition rating to the component as discussed in Chapter 6 Component Rating Guidelines. Refer to Figure 4.2-6 for an example of a sample sketch showing the reported requirements for steel section loss on a steel superstructure.

4.3 Bridge Files

4.3.1 Bridge Plans

Existing bridge plans are stored electronically and can be accessed the Plan Room (Room 100) of the Rhode Island Department of Transportation.

4.3.2 Correspondence

Bridge files shall contain a copy of any applicable correspondence. Types of correspondence include letters, memos, etc. Correspondence is stored as a hard copy in the bridge files. In some cases, correspondence is stored electronically in the *General Info* folder. Refer to Section 4.1.1 for more information regarding data folder organization.

4.3.3 Photographs

Photographs for bridges are located in both hard files and electronically on the State server. In general, bridge inspections prior to 2003 contain hard copies, while inspections after 2003 are stored electronically on the server and placed in the applicable electronic inspection folder.

The State requires that all photographs be taken using a digital camera. Digital photographs shall be saved into a *.JPG file format, have a minimum resolution of 1024 by 768 pixels and a maximum resolution of 4000 by 3000 pixels, be appropriately labeled as shown in Figure 4.2-19, Figure 4.2-20, and Figure 4.2-21, and shall fulfill all the requirements as outlined in Section 4.2.17. All the photographs for a particular bridge are to be within the same file, with the file size not exceeding 100MB. Should this limit be exceeded, additional files are to be created as needed.

Each photograph shall be named *Photo_N-XXX.XXX* where N is the specific photograph number and *XXX* is the number of photographs contained in the file. The photograph files will be stored in the *Inspection Folder* subfolder of the *Bridge Inspection Folder*.

4.3.4 Load Rating Reports

Load ratings for each bridge are contained in the bridge files in both hard copy and Adobe *.PDF format (on CD). For more information on load rating requirements, please refer to the latest Rhode Island Department of Transportation *LRFR Guidelines*.

Refer to Section 3.2.2.1.4 for information regarding load rating records.

4.3.5 Specifications

Department files shall include a complete copy of the specifications used to design and build the bridge. The edition and date of the general specifications are noted on the Plans.

4.3.6 Materials and Testing Reports

Certificates for the type, grade, and quality of materials used in construction of the bridge are included in the Department records. Examples of certificates include steel mill certificates, concrete delivery slips, and any other manufacturers' certificates. Certificates are retained in accordance with State policy and the statute of limitations.

Testing reports for any NDE or laboratory testing that was performed during or after construction are included in the Department files. If any field load testing was performed, the appropriate reports shall be included in the bridge record.

4.3.7 Maintenance and Repair History

Bridge files shall include information regarding repairs and rehabilitation activities. This information includes details such as the date, project description, contractor, cost, contract number, and any other related data.

Maintenance and repair information can be extremely useful for bridge inspectors. For example, frequency of roadway patching due to recurring settlement over a culvert or approach roadway may indicate serious problems that are otherwise not readily apparent through a visual inspection of the structure.

Refer to Section 3.2.2.1.3 for more information regarding maintenance and repair history.

4.3.8 Coating History

The bridge file may contain a record of the structure's surface protective coatings. This data includes information regarding surface preparation, application methods, dry-film thickness, types of coatings, concrete and timber sealants (if applicable), and other protective membranes.

4.3.9 Accident Records

Bridge files shall include details of accidents or damage to the bridge, including the date of occurrence, description of the accident, bridge member damage and subsequent repairs, and any investigative reports following the accident. Accident damage to bridge structures is typically recorded as a damage inspection and documented within the BMS.

4.3.10 Posting

Load capacity calculations and any required posting arising from the load ratings are included in the bridge file. The summary of posting actions includes the dates of posting and a description of the signing used.

4.3.11 Permit Loads

The bridge file may contain a record of the most significant single-trip permit loads that have crossed the structure. Applicable documentation and calculations are included within the permit load information, if applicable.

4.3.12 Flood and Scour Data

The bridge file may contain a record of the chronological history of major flooding events for bridges that span over waterways (see Figure 4.3-1). This data includes the high water marks at the bridge site, scour evaluations, scour history, and any plans of action.

Figure 4.3-1
Natick Bridge (Kent County) during the Historic March 2010 Flood

4.3.13 Traffic Data

When available, bridge files shall contain a history of the Average Daily Traffic (ADT) and Average Daily Truck Traffic (ADTT), including the frequency and types of vehicles utilizing the bridge. ADT and ADTT are important factors in determining fatigue life. If available, weights of the vehicles using the bridge are also included within the bridge file.

4.3.14 Inspection History

Previous inspection reports are often very useful in determining specific locations that require special attention during the inspection. Furthermore, information from previous inspections can be compared against current conditions to estimate rates of deterioration, help judge the seriousness of the problems detected, and anticipate the remaining life of the structure. Refer to Section 3.2.2.1.2 for more information regarding previous inspection reports.

The inspection history contained in the bridge file includes a chronological record of inspections performed on the bridge, including the dates and types of inspections beginning with the inventory inspection.

4.3.15 Inspection Requirements

Inspections are planned and prepared for by taking into account methods of access, inspection tools and equipment, structural details, inspection types, and the required qualifications of inspection personnel.

Additionally for fracture critical, underwater, and complex bridge inspections, the NBIS, *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.313 (23 *CFR* 650.313) requires that written inspection procedures be developed to address the items that require communication with team leader to ensure a successful and complete bridge inspection. Regardless of the specific procedures to each bridge of these types, the following general items are to be addressed for fracture critical, underwater, and complex bridge inspections:

- Identify each of the critical members to be inspected (fracture critical members, past repairs, underwater elements, complex features, fatigue prone details, scour countermeasures, etc.) on plan sheets, drawings or sketches.
- Identify special access needs or equipment necessary to gain the access required to inspect the bridge features, such as inspection vehicles, manlifts, traveler systems, etc.
- Describe the inspection method(s) and frequency to be used for the elements. An example of possible language: "Visually inspect all identified FCMs at arm's length for cracks, deterioration, missing bolts, loose connections, broken welds, etc. Use dye penetrant testing to verify the existence of suspected cracks."
- Address the required proximity to details (e.g., arm's length) during the inspection.
- Identify the special qualifications required of the inspection personnel as designated by the State's program manager.
- Prepare an appropriate traffic management plan to ensure the safety of the bridge inspectors and public.

In addition, other potential items to be addressed (depending on each unique situation) may include:

- Important contacts and special contacting procedures prior to inspection (e.g., Coast Guard, security, operations personnel);
- Safety concerns (e.g., snakes, bats); and
- Seasonal scheduling considerations (e.g., lake draw down, canal dry time, snow, ice, bird nesting season).

4.3.16 Structure Inventory and Appraisal Sheets

Bridge files shall contain a chronological record of the Structure Inventory and Appraisal (SI&A) forms for all inspections of the bridge.

4.3.17 Inventories and Inspections

Inspection reports are part of the bridge file. This information includes the results of all inventories and bridge inspections. Construction or repair activities may also be included. Refer to Section 4.3.14 for more information.

4.3.18 Use of Bridge Files

All bridge files are vital to the planning, scheduling, inspection, maintenance, and history of each bridge. Therefore, any removal of the bridge files outside of the State must be carefully monitored with the following procedures:

- Removal of any bridge file (unless copied) must be approved by someone from the State Bridge Inspection Staff.
- A reference sheet should be inserted in the place of the removed document noting the date, item removed, person responsible, firm, contact information, etc. (see Appendix A.10).
- Any files damaged during transfer should immediately be brought to the attention of the State Bridge Inspection Staff.
- Files shall be inserted back into the original place upon completion of use.

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Chapter 5 Quality Assurance/Quality Control (QA/QC)

The following chapter is intended to satisfy the requirements of the NBIS, *Code of Federal Regulations*, Title 23, Part 650, Subpart C, Section 650.313 (23 *CFR* 650.313):

(g) *Quality control and quality assurance.* Assure systematic quality control (QC) and quality assurance (QA) procedures are used to maintain a high degree of accuracy and consistency in the inspection program. Include periodic field review of inspection teams, periodic bridge inspection refresher training for program managers and team leaders, and independent review of inspection reports and computations.

5.1 Purpose and Scope of a QA/QC Plan

RIDOTs Quality Control (QC) and Quality Assurance (QA) Plan provides a systematic approach to ensure the quality and consistency of data produced to assess the safety of in-service bridges. Quality Control (QC) is defined as procedures that are intended to maintain the quality of a bridge inspection and load rating at a high level of accuracy and consistency. Quality Assurance is defined as the use of sampling and other measures to assure the adequacy of quality control procedures in order to verify or measure the quality level of the entire bridge inspection and load rating program.

These procedures include, but are not limited to, the qualifications of the staff, quality of field inspections, accuracy of load ratings, staff training, the validation of data collected and entered into the Bridge Management System (BMS), and the identification/resolution of data errors. The goal of this plan is to continuously improve the quality of the bridge inspection process. QA reviews will include a scope which measures the progress of each Consultant. These procedures will assist the State in establishing the foundation for bridge asset management to determine the priorities for maintenance, preservation, repairs, rehabilitation, and replacement projects.

NBI bridge inspections within the State are performed by Consultants retained and managed by RIDOT. Consultants are required to have an internal QA/QC program for bridge safety inspections and load ratings. The objective of this requirement is for each Consultant to have their own systematic approach in addition to RIDOT to ensure the quality and consistency of bridge inspections and load ratings. The RIDOT QA/QC procedures that are defined complement the internal QA/QC procedures provided by the Consultants to achieve the highest level of quality for bridge inspections and load ratings. State policy includes the following responsibilities for program managers (Consultants) regarding quality assurance/quality control:

- The Consultant shall have a quality assurance/quality control (QA/QC) program for the project and provide the State with a plan on implementation and continuation. The Consultant shall also provide a written *Quality Assurance Statement* at the start of the project. The Consultant QA/QC program, at a minimum, should include procedures to ensure proper qualifications, data checking, and compliance with submittal requirements as described in Section 1.2.6.

- All inspection reports shall be reviewed for completeness, accuracy, and content prior to submission to the State. If the prime Consultant engages the services of a Sub-consultant, it is the responsibility of the prime Consultant to ensure all the QA/QC requirements of the sub-Consultant are satisfied. This includes compliance with the time requirements in Section 1.2.6.

- Periodically, the Consultant may be requested to attend meetings during the term of the contract to discuss any questions or concerns with the inspection process or quality of the inspection reports.

- The Consultant will be reviewed on an annual basis as part of the State's QA/QC review process for bridge inspection.

Please refer to the latest *RIDOT Guidelines for Load & Resistance Factor Rating (LRFR) of Highway Bridges* for specific QA/QC procedures related to load ratings.

5.2 Quality Control (QC) Procedures

The objective of the procedures and requirements described in the following sections are intended to provide a systematic approach to ensure the quality and consistency of data produced to assess the safety of in-service bridges. These procedures will be reviewed periodically and updated as required to continually improve the efficiency and integrity of our bridge inspection program.

5.2.1 Staff Qualifications

All staff, which includes program managers (RIDOT and Consultant), team leaders, staff inspectors, load raters, and underwater inspectors, is required to have the minimum bridge inspection qualifications as defined in Chapter 2.

Consultants are required to submit comprehensive documentation with their proposal as part of the Consultant selection process. This documentation consists of, but not limited to, the following:

1. Full disclosure of the proposed inspection team(s). This consists of the following:

    a. Listing of key personnel currently on staff that will be used for bridge inspection

    b. Resumes of proposed key personnel

    c. Applicable documentation showing compliance with staff qualifications as defined herein

2. Proof of certifications (PE license, training certifications, etc.)

If there are changes to the Consultant inspection staff during the contract, the Consultant is required to submit all the above documentation to the Department prior to the individual performing work for RIDOT. RIDOT will then determine if the qualifications of the individual meet the criteria defined in Chapter 2 for staff training requirements.

All inspection staff is encouraged to participate in training sessions when made available. This will ensure that key personnel are aware of any new and revised inspection techniques or data recording and coding methods. All personnel must receive the appropriate Railway Safety Training prior to working on structures involving railroads (see Section 3.2.18).

Team leaders and project managers (Consultant and RIDOT), at a minimum, are required to complete an FHWA refresher training course once every four years, as stated in Chapter 2.

Refer to http://www.nhi.fhwa.dot.gov for course information of the available training programs offered for bridge inspection staff by the FHWA.

5.2.1.1 Tracking Staff Qualifications

RIDOT developed a centralized database to store and track the qualifications of all personnel performing bridge inspections in Rhode Island. The qualifications of each individual are submitted to the Department using the Bridge Inspection Qualifications Record (Form BI-001) (see Appendix A.1). These qualifications, along with proper certifications, are scanned and entered into the Qualifications Database. The inspection staff is required to update this form at the following times:

1. Upon any updates or changes to training courses or licensure, or
2. Upon request of RIDOT, or
3. During a formal QA/QC review.

The program manager (RIDOT) is responsible to track staff qualifications of all bridge inspection personnel and maintain the database containing these qualifications. All supporting documentation is scanned and linked to the database.

5.2.1.2 Special Skills and Equipment

RIDOT requires that all ultrasonic and magnetic particle testing shall be performed by experienced qualified personnel with a Level II or Level III Certification in accordance with the American Society of Non-Destructive Testing (ASNT). Consultants may be required to perform ultrasonic, magnetic particle testing or X-ray testing depending on the location and magnitude of the deficiency. This would typically be handled by a Sub-consultant who specializes in steel inspection/testing. However, dye penetrant testing is generally performed by the Consultant. Other special inspection/equipment for inspection is on a case by case basis and would be performed by specialty contractor as a Sub-consultant.

5.2.2 QC Office Review Procedures

The following sections outline the process of the RIDOT office review.

5.2.2.1 Scheduling

Scheduling of inspections is performed using a "Group" scheduling system. Groups of bridges are assigned to a Consultant approximately 3 to 6 months in advance of their collective due date by the Bridge Inspection Unit (BIU). This will give ample time for the Consultant to develop, submit and obtain approval of cost proposals, to plan their resources accordingly and acquire necessary equipment so inspections can be initiated in a timely manner to avoid possible delays.

RIDOT makes every effort to utilize a "Peer Rotation" system for routine bridge inspections. Peer rotation is a systematic rotation of bridge inspection teams that reduce the probability of having the same inspectors inspect the same bridges which may lead to complacency and potentially reduce the quality of the inspection. By utilizing peer rotation, the quality of each inspection is maintained to a higher level than having the same inspection team inspect the same bridge. Also, this process creates another "check and balance" to document any significant discrepancies between inspection teams and inspections. If any significant discrepancies are found, then corrective action procedures will be implemented as documented herein. It should be noted that a peer rotation sometimes may not be possible due to Consultant workload or scheduling conflicts. However, RIDOT makes every effort to use this system when scheduling bridges for inspection.

RIDOT identifies each bridge in the group and the type of inspection to be performed. The BIU provides all previous bridge inspection information to the Consultant for use in the upcoming inspection. RIDOT provides this information to assist the Consultants in prioritizing and scheduling their inspections.

The frequency of bridge inspections in Rhode Island are typically established based on the condition of the bridge. Typical frequencies for bridge inspections are shown in Figure 5.2-1.

Bridge Condition/Classification	Frequency (months)
Fracture Critical	12
Posted	12
Closed	12
Temporarily Supported	12
Underwater	60
Seismic	Not Performed
Special	3 to 12
Routine/All Other	24

Figure 5.2-1
Bridge Condition/Classification and Frequency Level

5.2.2.2 Tracking Inspections

The following procedures are used by Consultants and RIDOT to track inspections.

5.2.2.2.1 Consultant Procedures

Consultants are required to submit inspection schedules to ensure that bridges are being inspected on time. See Section 3.2.3 for the inspection schedules that are submitted to the Department. These include the Two Week Work Schedule, Two Day Inspection Notification, and the Weekly Inspection Summary Reports.

5.2.2.2.2 RIDOT Internal Procedures

The project manager is primarily responsible to track all bridge inspections and report submissions as a check to make sure inspections are completed on time and reports are submitted within 30 days after completion of inspection. This includes, but is not limited to, the following which is subject to change as Departmental procedures change:

- Keeping track of the completion and submittal dates based on the Bridge Inspection Weekly Summary Report (BI-007) (see Appendix A.7).

- Preparing upcoming inspection lists (3 to 6 month outlook).

- Submitting quarterly status reports to the Chief Engineer. This report contains the number of bridges that were scheduled to be inspected, the number of bridges actually inspected, and the plan of action proposed to get back on schedule if needed for the previous quarter. Furthermore, the report contains the number of inspection reports that should have been submitted, the number of inspection reports that were submitted, and the plan of action proposed to get back on schedule if needed for the previous quarter.

5.2.2.3 Procedures for Review and Validation of Inspection Reports and Data

The Consultant responsible for the bridge inspection is required to implement QA/QC procedures for their respective firm to ensure that all inspection reports are reviewed for completeness, accuracy and content prior to submission to the Department. The project manager (Consultant) is required to affix their PE stamp to the cover letter of the submitted inspection report to attest to the content and accuracy of the report prior to formal submission to RIDOT. Also, the Consultant is required to submit the Bridge Inspection Report Submittal Checklist (Form BI-008) (see Appendix A.8) when submitting reports to RIDOT.

RIDOT, at a minimum, thoroughly reviews 100% of all inspection reports with an NBI condition rating of 5 or less for NBI Component Condition Ratings for Items 58, 59, or 60 (deck, superstructure or substructure). The following are general procedures performed by the BIU for these submittals:

1. Review of the inspection report to check that all applicable fields have been recorded.

2. Review that all information is recorded in accordance with the FHWA Coding Guide.

3. Check to make sure that any critical findings were promptly reported to RIDOT.

4. Check to make sure proper documentation (i.e., cover letter with PE Stamp, list of changes made in Bridge Management Software, etc.) is submitted.

5. Check for posting recommendations, if any, and if load rating should be revised based on the current inspection. Inspection staff is required to complete the Bridge Load Rating and Posting Recommendation (Form BI-005) (see Appendix A.5) if the field inspection warrants the need to revise the load rating. In addition, the same form is used if posting signs are missing or need to be installed at the subject bridge.

6. Check that all photos are properly labeled and referenced in the inspection report.

7. Check for consistency between the previous inspection report and the current inspection report.

8. Check condition ratings for items 58-62 to make sure it is consistent with the condition ratings of the individual elements.

9. For Inventory Inspections, check the inventory data with the construction plans.

10. Verification of the inspection team qualifications.

5.2.3 QC Field Review Procedures

RIDOT will periodically perform a field review of a report submitted by the Consultant as part of the QC review process. The frequency of these field reviews are described in Section 5.3.1. The objective of this field review is to compare the actual field conditions with the submitted report to make sure all deficiencies were properly reported (size and location). As part of this evaluation, RIDOT also checks to make sure all proper notifications and requirements have been satisfied by the inspection team. RIDOT will make every effort to perform a QC Field Review within three months of an inspection that has been performed. Refer to the Inspection Team Report Evaluation (Form BI-002) (see Appendix A.2) for the specific items documented during this field review.

5.2.4 QC Field Performance Review of Inspection Team Procedures

RIDOT will periodically perform a field performance review (a site visit during actual inspection) of the inspection team. The objective of this review is to make certain the inspection team is providing a safe working environment for the public, provide a cursory check of their field inspection process, and verify that inspection staff is qualified per RIDOTs qualification procedures to ensure that RIDOT requirements are satisfied. By reviewing the two-day notifications, RIDOT will arbitrarily select bridges to perform this visit without notifying the inspection team in advance. The frequency of these field performance reviews are described in Section 5.3.1. Refer to the Inspection Team Field Performance Evaluation (Form BI-003) (see Appendix A.3) for the specific items documented during this field review.

5.2.5 Corrective Action for QC Control

The following procedures are used to identify errors and omissions and how RIDOT resolves them for inspection reports or field evaluations.

5.2.5.1 Procedures for Identification and Resolution of Data Errors/Omissions

Upon review of an inspection report, field performance evaluation, or inspection report field verification, the BIU reviewer will forward comments or request immediate action of the Consultant to correct the situation. If significant errors/omissions or hazardous situations are encountered with an inspection report or field evaluation then the procedures for disqualification may be implemented. The following summarizes the typical process for identification and resolution of errors and omissions:

1. BIU reviewer shall indicate any errors/omissions or other comments on the inspection report via email and/or phone to the Consultant. If error/omission is determined to be significant, then the Consultant will be notified in writing and disqualification procedures may be implemented. The responsible party is to correct the report and resubmit to RIDOT within 30 calendar days of notification. Refer to Section 5.3.3.1 for disqualification procedures.

2. If there is a significant safety issue, misbehavior, or other hazardous situation is found during a field performance evaluation, the Consultant will be notified immediately to correct his/her action. If the

issue is determined to be significant, then disqualification procedures may be implemented. Refer to Section 5.3.3.1 for disqualification procedures.

5.3 Quality Assurance (QA) Procedures

Quality Assurance is defined as the required procedures performed by RIDOT to sample and measure the adequacy of quality control procedures. The following procedures describe the process RIDOT follows to provide Quality Assurance.

5.3.1 Procedures for Sampling of Bridges for Review

The following define possible sampling parameters, but are not limited to, to select bridges for review and field spot checks. Consideration for selection will also incorporate traffic control requirements and impacts to traveling public:

1. Bridges with critical findings
2. Structurally Deficient status
3. Bridge posting
4. Bridges in need of rehabilitation/replacement
5. Bridges with condition rating for Items 58, 59, and 60 of less than or equal to 5
6. Bridges with load capacity reduction

The basis for the sampling parameters and minimum frequencies as part of the QA process is described in Figure 5.3-1. The method of field review for the report evaluation will be a field verification of the submitted inspection report as described in the QC procedures.

Sampling Parameter	Frequency
Inspection Reports (NBI Condition Ratings of 5 or less for Items 58, 59, or 60)	100%
Field Review (Inspection Report Field Verification and Bridge File Review)	1 per prime Consultant per calendar year
Inspection Team Field Performance (Site Visit)	2 per prime Consultant per calendar year

Figure 5.3-1
Quality Assurance Sampling Parameters and Frequencies

5.3.2 Selection of QA Review Team

RIDOT QA Review Teams will be established to conduct the reviews described herein. The QA Review Team will consist of, but is not limited to, the following:

1. Chief Civil Engineer-Bridge Engineering (CCE)

2. Bridge Inspection Program Manager (PM)

3. Team leader

4. Bridge Engineering Design Unit (BEU) (Minimum 1 person)

This QA Team will conduct and document an independent inspection/field verification of the bridge and the results of this inspection will be compared with the inspection report under review using Inspection Team Report Evaluation (Form BI-002) (see Appendix A.2). Differences between this inspection and the Consultant inspection will be discussed with the Consultant and the review process will be documented. The RIDOT Team Leader will discuss any discrepancies with the PM and CCE and prepare the necessary documentation. All members of the review team will sign the Form BI-002 and forward to the Consultant. This form contains a section for notable practices and corrective action. Any corrective action requires a written response from the Consultant.

In addition, the QA Review Team will review the bridge file(s) for the selected structure. The goal of this file review is ensure that a complete and accurate current record is maintained. The bridge files are maintained by RIDOT personnel but a comprehensive review of the bridge file will also be performed at the same time of the Consultant bridge inspection report review (field verification). As part of this review, the Load Rating Report for the subject bridge will be verified with the current bridge condition and posting.

The QA Review Team, in conjunction with the Consultant, will complete the following Forms as part of the QA review process:

1. Inspection Team Report Evaluation (Form BI-002) (see Appendix A.2)

2. Inspection Team Field Performance Evaluation (Form BI-003) (see Appendix A.3)

3. Bridge File Review (Form BI-004) (see Appendix A.4)

5.3.3 Corrective Actions

Corrective actions for Consultants that contain significant errors/omissions or hazardous situations encountered with an inspection report or field evaluation are discussed in the following sections. Corrective actions include the disqualification and re-qualification procedures for Consultants, with periodic meetings.

5.3.3.1 Disqualification Procedures for Consultant Inspection Firms

The following are possible reasons for disqualifying a Consultant from performing bridge inspections in Rhode Island:

1. Not completing a field inspection on time
2. Not submitting an inspection report within 30 days of completion of field inspection (unless extension approved by the Department in writing)
3. Lack of follow-up/reporting of critical findings encountered in the field
4. Lack of follow-up on corrective action for load postings
5. Miscoded critical components (i.e., Items 58-62)
6. Recurrence of miscoding of elements
7. Lack of proper traffic control measures during a field inspection
8. Recurrence of errors/omissions in report
9. Failure to attend required continuing education sessions
10. Failure to address corrective action from previous review
11. Improper safety during inspection
12. Recurrence of failure to submit weekly reports/notifications

The Department reserves the right to implement these disqualification procedures at any time (not just during QA review) or extend disqualification for other reasons based on the judgment of the Managing Engineer (ME).

The Department will forward a letter to the Consultant should disqualification be required. The letter will indicate the reason(s) for disqualification and request an action plan outlining the measures the Consultant will take to prevent the issue from re-occurring. This is described in Section 5.3.3.2. However, the Department may also issue a warning letter instead of formal disqualification if the Consultant past performance has been satisfactory and the action plan appears to adequately address the issue. This will be based on the severity and frequency of the issue and determined by the ME.

5.3.3.2 Re-qualification Procedures for Consultant Inspection Firms

If the Consultant is disqualified per the reasons listed in Section 5.3.3.1, RIDOT may choose to implement the following:

1. The Consultant will be placed on probation for a period of three months after the disqualification. The Consultant shall submit an action plan to the Department detailing the methods to be implemented by the Consultant based on the required corrective action from the Department. No additional work is to be assigned to the Consultant during this probation period. A review of the action plan will be conducted by the ME, CCE, PM, and original reviewer. This action plan must be approved by the Department.

2. If the Consultant is disqualified for a 2nd time, the Consultant will be required to formally meet with the Department. The Consultant must again provide a detailed action plan on how the reason for disqualification will be corrected and what measures will be taken to ensure this will not occur again. The Consultant will be placed on a 2nd probation period for another three months. A review of the action plan will be conducted by the ME, CCE, PM, and original reviewer. The Department reserves the right to extend the disqualification time if necessary.

3. After the Consultant is disqualified for a 3rd time, the Consultant will be suspended indefinitely. Reinstatement must be approved by the Director of the Department of Transportation. At a minimum, the Consultant will be required to demonstrate that their work plan, staff, and program management has been modified to address the previously reported deficiencies.

5.3.3.3 Periodic Meetings

Periodic meetings are held with inspection staff and RIDOT Management to address quality issues. The objective of these meetings is to obtain feedback from staff, facilitate knowledge transfer, provide peer collaboration, identify problem areas, and implement corrective action(s) to continuously improve policies and procedures and the inspection process.

Chapter 6 Component Rating Guidelines

The following component rating guidelines are intended to supplement the NBI Component Rating Guidelines of the FHWA Recording and Coding Guide. Please note these are guidelines only, sound engineering judgment shall be exercised to determine the most appropriate rating to be assigned.

6.1 Concrete Decks

The following guidelines have been developed for the condition rating of Reinforced Concrete Decks. They are intended to supplement the NBI Component Condition Rating Guidelines of the FHWA Recording and Coding Guide to make it easier to determine the most appropriate condition rating to be assigned to the reinforced concrete deck (See Item 58 of the FHWA Recording and Coding Guide).

These rating guidelines shall apply to cast in place concrete decks as well as precast concrete deck panels. The condition of railings, joints, drains and other secondary deck components shall not influence the overall rating of the reinforced concrete deck. The condition of the overlay or SIPs in contact with the deck can influence the rating of the concrete deck, if their deterioration appears to reflect or indicate a deteriorated or distressed condition of the reinforced concrete deck which they are covering.

Decks integral with the superstructure, such as concrete slabs, "T"-beams, box beams, rigid frames (without fill), etc., shall be rated based on the condition of the riding surface only. The condition of the underside of the integral deck will not be taken into account when rating the deck but will be considered in the superstructure rating. For integral superstructure bridges where the approach pavement is carried across the bridge on top of fill material, such as filled arches, frames or culverts, there is no deck and the overall deck rating will be "N". However, the condition of any deck members present (overlay, railings, etc.) should be noted in the inspection notes.

Code	Description
9	Excellent Condition • New deck with no noticeable deficiencies or deterioration.
8	Very Good Condition • No spalls, scaling or delamination noted. • Minor honeycombing. • Isolated hairline cracks (up to 1/32 inch) noted with no effect on serviceability of the deck. • Less than 5% of the deck is deteriorated.

7 Good Condition

- Isolated hairline cracks noted on the top or bottom of the deck with no adverse effect on the serviceability of the deck.
- Minor efflorescence bleeding from cracks in concrete may be present.
- Isolated spalls up to 1 inch deep with no exposed reinforcing steel noted on the bottom of the deck.
- Less than 2% of the top of deck surface is delaminated with no visible spalls noted.
- Light surface scaling, abrasion and/or minor honeycombing noted.
- Less than 10% of the deck is deteriorated.
- Decks that have been rehabilitated with a waterproof membrane and new overlay may be placed in this category based on the premise that the membrane will protect the deck from additional contamination and thereby slow the rate of deterioration. Decks must, however, show no evidence of water leakage.

6 Satisfactory Condition

- Random hairline cracks noted on the top or bottom of the deck may have minor efflorescence bleeding from them.
- Areas of map cracking may be present in the overlay or on the underside but without heavy efflorescence or wetness.
- Isolated spalls deep enough to expose the bottom mat of steel reinforcing on the underside of the deck. Light surface corrosion on the reinforcing bars with no section loss.
- No more than 2% of the top of deck surface is spalled or delaminated.
- Less than 20% of the deck is deteriorated.
- Medium surface scaling, abrasion may be present.

5 Fair Condition

- Widespread hairline to narrow cracking on the top or bottom of the deck.
- Moderate efflorescence bleeding from cracks in concrete may be present.

- Random to widespread spalls up to 1 inch deep with no exposed mild steel reinforcing bars.
- Random spalls deep enough to expose the mat of steel reinforcing bars closest to the surface. There may be corrosion on the reinforcing bars with minor section loss.
- Between 2% and 10% of the top of deck surface is spalled or delaminated.
- Less than 30% of the deck is deteriorated.
- Less than 30% of the electrical potential readings are greater than 0.35 volts if test conducted.
- Less than 30% of the chloride test results indicate over 2.0 lbs./CY, if test conducted.
- Heavy surface scaling and/or abrasion noted (up to 1/2 inch in depth) over up to 25% of the deck surface area.
- Widespread discoloration or wet staining on concrete surfaces.

4 Poor Condition

- Widespread hairline to medium cracking noted on the top or bottom of the deck.
- Heavy efflorescence may be noted bleeding from cracks in concrete.
- Localized areas of wetness (not related to cracks).
- Spalls on the bottom of the deck are widespread and/or deep enough to significantly affect the serviceability of the deck. Moderate section loss on exposed steel reinforcing bars.
- Between 10% and 25% of the top of deck surface is spalled or delaminated.
- Less than 40% of the deck is deteriorated.
- Up to 40% of the electrical potential readings are greater than 0.35 volts if test conducted.
- Up to 40% of the chloride test results indicate greater than 2.0 lbs./CY, if test conducted.
- Severe surface scaling and/or abrasion noted (between 1/2 inch and 1 inch in depth) over up to 25% of the deck surface area.

3 Serious Condition

- Widespread cracking of greater than 1/8 inch noted on the top or bottom of the deck.
- Heavy efflorescence may be noted bleeding from cracks in concrete.
- Large areas of wetness (not related to cracks).
- Spalls on the bottom of the deck are widespread enough and/or deep enough to significantly affect the serviceability of the deck. There may be advanced section loss on exposed steel reinforcing bars.
- Greater than 25% of the top of deck surface is spalled or delaminated.
- More than 40% of the deck is deteriorated.
- More than 40% of the electrical potential readings are greater than 0.35 volts if test conducted.
- More than 40% of the chloride test results indicate greater than 2.0 lbs./CY, if test conducted.
- Local punch throughs possible.

2 Critical Condition

- Severe cracking and/or spalling makes local "punch-throughs" probable.
- Structural capacity of the deck is severely reduced.
- Closure of the bridge to traffic may be required until corrective action is taken.

1 "Imminent" Failure Condition

- Local failures have occurred.
- Deck is closed and studies are required to see if rehabilitation is feasible.

0 Failed Condition

- Concrete deck has failed.
- Deck is closed and beyond repair.

6.2 Reinforced Concrete

The following guidelines have been developed for the condition rating of reinforced concrete members. They are intended to supplement the NBI Component Condition Rating Guidelines of the FHWA Recording and Coding Guide to make it easier to determine the most appropriate condition rating to be assigned to reinforced concrete superstructure members. These guidelines should be used in conjunction with the FHWA Recording and Coding Guide, Item 59.

These rating guidelines apply to reinforced concrete T-beams, girders, arch ribs, arch spandrels, floorbeams, slab bridges, and other concrete members reinforced with mild steel. Reinforced concrete decks shall be rated utilizing Section 6.1, Reinforced Concrete Decks. When a reinforced concrete deck is integral with a superstructure member (i.e., concrete slabs, "T-Beams", box girders, etc.), structural deterioration of the deck may influence the superstructure rating. In these instances, the deck is rated based on the top surface (See Section 6.1) and the superstructure rating is affected by the underside condition.

The condition of the bearings, joints, etc., will not normally influence the rating of reinforced concrete superstructure members. Deteriorations noted on previous inspection reports, which have been repaired, should not be considered in assigning condition rating unless the repairs are temporary or inadequate.

Code	Description
9	Excellent Condition • No noticeable deficiencies or deterioration.
8	Very Good Condition • No spalls, scaling or delamination noted. • Minor honeycombing. • Isolated hairline cracks (up to 1/32 inch) noted with no effect on serviceability of the structure unit.
7	Good Condition • Non-structural, hairline cracks (up to 1/32 inch) noted that do not affect the serviceability of the structure unit. • Isolated small spalls up to 1 inch deep with no exposed reinforcing bars or isolated pockets of exposed bars. • A few small locations of concrete delamination are possible in non-critical areas. • Light surface scaling, abrasion and/or minor honeycombing noted. • Less than 5% of the structure unit is deteriorated.

6 Satisfactory Condition

- Non-structural hairline or narrow cracks (up to 1/16 inch wide) noted to an extent that may have minor effects on the serviceability of the member.
- No structural cracks noted.
- Minor efflorescence bleeding from cracks in concrete may be present.
- Small spalls deep enough to expose the mat of reinforcing bars closest to the surface. Surface corrosion on the exposed reinforcing bars with minor section loss.
- Small areas of medium to heavy scaling and/or, abrasion noted with no exposed reinforcing steel.
- Minor discoloration or wet staining on concrete surfaces noted. Concrete surface sounds solid when struck with a hammer.
- Concrete may be delaminated (concrete surface sounds hollow when struck with a hammer) on less than 10% of any individual structure unit (i.e., 10% of one beam).
- Impact damage, which is not structurally significant, may be present.

5 Fair Condition

- Non-structural cracks up to 1/8 inch wide noted to an extent that may moderately affect the serviceability of the member. Minor deterioration or section loss of the concrete reinforcing bars in the vicinity of the cracks may be present.
- Isolated, hairline structural cracks (up to 1/32 inch) may be present, but no consistent pattern of overload or over stress is observed.
- Moderate efflorescence bleeding from cracks.
- Random to widespread spalls up to 1 inch deep with no exposed mild steel reinforcing bars.
- Random spalls deep enough to expose the mat of steel reinforcing bars closest to the surface. There may be corrosion on the reinforcing bars with moderate section loss.
- Severe surface scaling and/or abrasion noted.
- Delaminations (concrete surface sounds hollow when struck with a hammer) may be more wide spread, up to 25% of the surface area on any individual structure member.
- Impact damage that exposes reinforcing steel.

4 Poor Condition

- Non-structural cracks greater than 1/8 in wide noted to an extent that may significantly affect the serviceability of the member. Significant deterioration of the concrete, reinforcing bars in the vicinity of the cracks.
- Structural cracks (up to 1/16 inch) noted on one or more members.
- Heavy efflorescence bleeding from cracks may be noted.
- Spalls are widespread enough and/or deep enough so as to significantly affect the serviceability of the member. Significant section loss on exposed reinforcing bars.
- Severe surface scaling with exposed reinforcing steel.
- Active water leakage through cracks and/or spalls in concrete members noted.
- Extensive concrete delaminations.
- Widespread discoloration, efflorescence or wetness on concrete surfaces noted.

3 Serious Condition

- Non-structural cracks greater than 1/8 inch wide noted to an extent that may severely affect the serviceability of the member. Advanced deterioration of the concrete, reinforcing bars in the vicinity of the cracks.
- Structural cracks up to 1/8 inch wide noted creating significant effects on the structural integrity of the member.
- Spalls are widespread and/or deep enough so as to affect the strength of the member or significantly affect the serviceability of the member. Advanced section loss on exposed reinforcing bars.
- Heavy leakage of water through cracks and/or spalls noted on concrete members.
- Widespread concrete delaminations.
- Significant impact damage.
- Failure of member is possible.

2 Critical Condition

- Structural cracks greater than 1/8 inch wide creating a severe effect on the structural integrity of the member.

- Severe, widespread deterioration of concrete and reinforcing bars. Failure of member probable.
- Large spalls or severe scaling are severely affecting the structural integrity and/or serviceability of the member or an adjacent member.
- Extensive concrete delaminations.
- Severe Impact damage.
- Closure of the bridge or a portion of the structure may be necessary until repairs are made.

1 "Imminent" Failure Condition

- Structure is closed.
- Reinforced Concrete member is non-functional and/or failed.
- Study should determine feasibility of repair or rehabilitation.

0 Failed Condition

- Structure is closed and beyond rehabilitation.
- Reinforced Concrete member is non-functional and/or failed.

6.3 Prestressed Concrete

The following guidelines have been developed for the condition rating of prestressed concrete members. They are intended to supplement the NBI Component Condition Rating Guidelines of the FHWA Recording and Coding Guide to make it easier to determine the most appropriate condition rating to be assigned to prestressed superstructure concrete members. These guidelines should be used in conjunction with the FHWA Recording and Coding Guide, Item 59. Prestressed members are comprised of either pretensioned or post-tensioned reinforcement.

These rating guidelines shall apply to pretensioned and post-tensioned closed web box girders (slab beams and box beams), open web girders (I-beams), arches, floorbeams and other pretensioned or post-tensioned concrete members. In the case of "integral deck" superstructures, the condition of the top surface of the deck shall be considered in the rating of the superstructure. On large box girder bridges, where access to the inside of the box is possible, the condition of the underside of the deck, if it is integral with the girder, should be considered when assigning a condition rating to the superstructure. Normally, the condition of the bearings, joints, etc., shall not influence the rating of the prestressed concrete superstructure members.

Because of the design characteristics of prestressed concrete members, deteriorations in the superstructure, noted on previous inspection reports that have since been retrofitted, must be evaluated using sound engineering judgment. Once a prestressed member has lost load capacity due to concrete and/or steel tendon section loss, it is difficult to restore the member to its original capacity. Repairs undertaken may be cosmetic in nature, intended only to prevent further deterioration of the concrete and/or steel tendons, or they may be intended to restore lost load capacity by rehabilitation of the member incorporating either internal or external post-tensioning details. In the case of cosmetic repairs, the ability of the repair material to protect the base materials (concrete and/or prestressing tendons) from further deterioration shall be noted in the condition evaluation report but shall not be considered in assigning the condition rating. Repairs designed to restore the member to its original capacity, and have documentation as such, shall be evaluated considering the condition of the repair and its continued ability to add strength to the member. In either case, sound engineering judgment must be employed when assigning a component condition rating to the member.

The quantities given in the following guidelines for the number of exposed prestressing tendons and/or broken strands are intended to give the inspector a guide for assigning the condition rating to the member. A greater or lesser degree of deterioration on a single member, or on a series of members, may prove to be more or less critical than indicated in these guidelines. The degree to which it is critical can only be determined through engineering analysis, knowledge of the as-built section(s) and understanding of the prestressing system behavior.

Code	Description
9	Excellent Condition • No noticeable deficiencies or deterioration.
8	Very Good Condition • No spalls, scaling or delamination noted. • Minor honeycombing.
7	Good Condition • Non-structural cracks (up to 1/32 inch). • No exposure of prestressing tendons noted. • Light surface scaling, abrasion and/or minor honeycombing present. • Isolated small spalls up to 1 inch deep with no exposed prestressing tendons.
6	Satisfactory Condition • Non-structural cracks up to 1/16 inch wide noted to an extent that may have minor effects on the serviceability of the member. • Minor efflorescence bleeding from cracks in concrete may be present.

- Isolated, small spalls up to 1 inch deep with little to no deterioration to exposed mild steel reinforcing bars noted.
- Possible partial exposure of prestressing tendons, but no corrosion noted.
- Medium surface scaling, abrasion and/or moderate honeycombing present.
- Minor discoloration or wetness on concrete surfaces. Concrete surface sounds solid when struck with a hammer.
- Small isolated areas of delaminated concrete may be present.
- Minor impact damage noted with minor exposed reinforcing steel.

5 Fair Condition

- Non-structural cracks up to 1/8 inch wide noted to an extent that may moderately affect the serviceability of the member. Minor deterioration or section loss of the concrete, mild steel reinforcing bars in the vicinity of the cracks may be present with up to minor section loss.
- No more than three longitudinal cracks on the bottom of the bottom flange at any one cross section of any member.
- Isolated, hairline structural cracks (up to 1/32 inch) may be present on a small number of members, but no consistent pattern of overload or over stress is observed.
- Moderate discoloration or wetness on concrete surfaces. Concrete surface sounds solid when struck with a hammer.
- Moderate efflorescence bleeding from cracks.
- Random spalls with exposed reinforcement. Minor section loss may be present on these exposed reinforcing bars. Minor effect on member serviceability. No more than three (3) prestressing tendons (or no more than 10%) per beam may be exposed with minor section loss or broken wires present.
- Up to one (1) prestressing tendon is broken or has more than 50% section loss.
- Heavy surface scaling and/or abrasion present.
- Widespread discoloration or wetness on concrete surfaces. Concrete sounds hollow when struck with a hammer.
- Impact damage noted that exposes reinforcing steel or up to three (3) prestressing tendons (or no more than 10%) with minor corrosion or damage to the tendons.

4 Poor Condition

- Structural cracks up to 1/16 inch wide present. Moderate effects on the structural integrity of the member.
- No more than 5 longitudinal cracks (or 3 cracks with staining) at any one cross section of any member.
- Minor, widespread deterioration of concrete and corrosion of prestressing tendons. Up to 20% of the prestressing tendons are exposed with moderate surface rust at any one cross section. Up to 10% of the prestressing tendons are broken at any one cross section of any member.
- Active water leakage through cracks and/or spalls in concrete members.
- Locations within the compression zone of the member exhibit advanced delaminations of the concrete.
- Locations within the tension zone of the member exhibit moderate delaminations of the concrete.
- Impact damage or deterioration with up to three (3) or no more than 10% broken prestressing tendons.
- Documented loss of camber since original construction or noticeable live load deflection.

3 Serious Condition

- Structural cracks up to 1/8 inch wide noted creating significant effects on the structural integrity of the member.
- Longitudinal cracks across the full width of the bottom of the bottom flange (or more than 50% of the width with staining) at any one cross section of any member.
- Moderate, widespread deterioration of concrete and corrosion of prestressing tendons. Up to 30% of the prestressing tendons are exposed with moderate section loss at any one cross section. Up to 20% of the prestressing tendons are broken at any one cross section of any member.
- Heavy, active water leakage through cracks and/or spalls noted on concrete members.
- Impact damage or deterioration with no more than 20% broken prestressing tendons.
- Delaminated concrete is widespread or structurally significant.

- Documented loss of camber since original construction or noticeable live load deflection on multiple members.

- Failure of member is possible due to a deficiency or deterioration.

2 Critical Condition

- Structural cracks of greater than 1/8 inch noted creating a severe effect on the structural integrity of the member.

- Longitudinal cracks across the full width of the bottom of the bottom flange (or more than 50% of the width with staining) at any one cross section in more than one member.

- Severe, widespread deterioration of concrete and corrosion of prestressing tendons. Up to 40% of the prestressing tendons are exposed with significant section loss at any one cross section. Up to 30% of the prestressing tendons are broken at any one cross section of any member.

- Locations within the prestressed compression and/or tension zone of the member exhibit severe delaminations of the concrete.

- Impact damage noted with severe effects on structural integrity.

- Closure of the bridge or a portion of the structure may be necessary until corrective action is taken.

- Documented loss of camber since original construction or noticeable live load deflection on multiple members.

1 "Imminent" Failure Condition

- Structure is closed.

- Prestressed concrete member is non-functional and/or failed.

- Study should determine feasibility of repair or rehabilitation.

0 Failed Condition

- Structure is closed and beyond rehabilitation.

- Prestressed concrete member is non-functional and/or failed.

6.4 Steel

The following guidelines have been developed for the condition rating of steel superstructures. They are intended to supplement the NBI Component Condition Rating Guidelines of the FHWA Recording and Coding Guide to make it easier to determine the most appropriate condition rating to be assigned to the steel components and should be used in conjunction with the FHWA Recording and Coding Guide, Item 58 or 59.

These rating guidelines shall apply to steel multi-girder, girder-floorbeam, box girder, truss, arch, frame, movable bridge superstructures, or steel decks. In the case of composite superstructures, the condition of the deck normally will not influence the condition rating of the superstructure. However, deck condition should be considered if deterioration affects the ability of the superstructure to act compositely with the deck as designed (See Item 59 of the FHWA Recording and Coding Guide). The condition of the bearings, joints, paint system, etc., generally will not influence the rating of the superstructure. Deficiencies in the superstructure noted in previous inspection reports, that have since been retrofitted, shall only consider the condition of the retrofit when establishing the condition code. Note: Section loss is calculated by measuring remaining section and comparing it to the original section. Remaining section thicknesses/widths at critical locations shall be adequately documented during field inspections. The level of documentation shall be detailed enough so that the load capacity calculations can be updated based on this information.

The percentages of loss presented in the following condition coding guide represent estimates for the purposes of aiding the inspector in applying a condition code rating to the member. It does not, however, relieve the inspector of the responsibility of seeking sound engineering judgment when dealing with members with excessive section loss.

Code **Description**

9 Excellent Condition

- No noticeable deficiencies or deterioration.

8 Very Good Condition

- Very minor construction or fabrication defects that do not affect the capacity or function of the member.

7 Good Condition

- Minor deficiencies such as missing fasteners in isolated locations of secondary member connections.
- Minor deterioration such as loose fasteners in isolated locations.
- Light to medium corrosion of the steel surface area (negligible section loss).

6 Satisfactory Condition

- Minor corrosion (< 1/16 inch section loss) on less than 25% of the steel surface area of a critical section.

- Section loss (up to 5% of the total flange cross sectional area, up to 10% of the total web cross sectional area or 20% of the total horizontal bearing area including the web and bearing stiffeners as applicable) noted in a critical section on one or more members.

5 Fair Condition

- Minor corrosion (< 1/16 inch section loss) on greater than 25% of the steel surface area.

- Section loss (up to 10% of the total flange cross sectional area, up to 25% of the total web cross sectional area or 40% of the total horizontal bearing area including the web and bearing stiffeners as applicable) noted in a critical section on one or more members. Percentage numbers can be increased 5%, if the area has been cleaned and coated. Percentage numbers can be increased 5% if loss is on a beam carrying less live load (i.e., fascia beam).

- Fatigue, or out-of-plane distortion, cracks may be present in secondary members with no means of propagation into a primary member.

4 Poor Condition

- Severe corrosion with advanced section loss (10% to 20% of total flange cross sectional area, 25% to 50% of total web cross sectional area or 40% to 60% of the total horizontal bearing area including the web and bearing stiffeners as applicable) noted in a critical section on one or more members. Percentage numbers can be increased 5%, if the area has been cleaned and coated. Percentage numbers can be increased 10% if loss is on a beam carrying less live load (i.e., fascia beam).

- Fatigue, or out-of-plane distortion, cracks may be present in secondary members where there is means of propagation into the primary member.

3 Serious Condition

- Structural integrity or primary members may be compromised.

- Severe corrosion throughout the member and severe section loss (20% to 30% of the total flange cross sectional area, 50% to 75% the total web cross sectional area or 60% to 80% of the total horizontal bearing area including the web and bearing stiffeners as applicable) in a critical section on one or more members. Percentage numbers can be increased 5%, if the area has been cleaned and coated. Percentage numbers can be increased 15% if loss is on a beam carrying less live load (i.e., fascia beam).

- Local failures of structural components possible.
- Fatigue, or out-of-plane distortion, cracks may be present in primary members.

2 Critical Condition

- Severe deterioration of the primary structural members (>30% of the total flange cross sectional area, >75% of the total web cross sectional area or >80% of the total horizontal bearing area including the web and bearing stiffeners as applicable) noted in a critical section of one or more members. Percentage numbers can be increased 15% if loss is on a beam carrying less live load (i.e., fascia beam).
- Local failures of structural components have occurred in primary members.
- Severe weakening of primary members is evident.
- Partial or total closure of the structure may be required.

1 "Imminent" Failure Condition

- Structure is closed
- Study should determine feasibility of repair or rehabilitation.

0 Failed Condition

- Structure is closed and beyond repair or rehabilitation.

6.5 Timber

The following guidelines have been developed for the condition rating of timber bridges. They are intended to supplement the NBI Component Condition Rating Guidelines of the FHWA Recording and Coding Guide to make it easier to determine the most appropriate condition rating to be assigned to the timber components and should be used in conjunction with the FHWA Recording and Coding Guide, Item 58 or 59.

These ratings shall apply to all solid sawn, glued laminated, nail laminated, and stress laminated timber bridge superstructures and decks. The condition of bearings, joints, paint system, etc., shall not influence the rating of the bridge components. Deficiencies or decay noted in previous inspection reports that have since been retrofitted shall only consider the condition of the retrofit when establishing the condition rating.

Code **Description**

9 Excellent Condition

- No noticeable deficiencies or deterioration.

8 Very Good Condition

- No decay, checking, splitting, shakes or pitch pockets in any primary member.
- Deck flooring is tightly secured to the superstructure members.

7 Good Condition

- Minor decay, checking or splitting of any primary members.

6 Satisfactory Condition

- Moderate decay, checking or splitting of any primary members.
- Some loose deck planks.
- Fire damage is limited to surface scorching with no measurable section loss.
- Limited wet areas noted with minor decay.

5 Fair Condition

- Significant decay or deterioration, checking, splitting or minor crushing of any primary members.
- Fire damage limited to surface charring with minor measurable section loss.
- Numerous loose planks.

4 Poor Condition

- Advanced decay or deterioration, checking, splitting, or moderate crushing of any primary members.
- Fire damage is significant with moderate section loss.

3 Serious Condition

- Severe decay or deterioration, checking, splitting, or advanced crushing of any primary members.
- Major fire damage with advanced section loss.
- Local failures may be evident or possible.
- Severe signs of distress in deck planks.

2 Critical Condition

- Severe decay or deterioration is causing severe weakening and significant local failures of primary bridge members.
- Partial or total closure of the structure may be warranted.

1 "Imminent" Failure Condition

- Structure is closed.
- Study should determine feasibility of repair or rehabilitation.

0 Failed Condition

- Structure is closed and beyond repair or rehabilitation.

6.6 Stone Masonry

The following guidelines have been developed for the condition rating of stone masonry. They are intended to supplement the NBI Component Condition Rating Guidelines of the FHWA Recording and Coding Guide to make it easier to determine the most appropriate condition rating to be assigned to the stone masonry and should be used in conjunction with the FHWA Recording and Coding Guide.

These rating guidelines were developed based on Ashlar type masonry and shall be applied to stone masonry used in the bridge superstructure. In general, these guidelines shall apply to other types and shapes of stone masonry. However, these guidelines will have to be adjusted based on engineering judgment if the stone masonry was designed for dry laid conditions. These condition codes evaluate the structural integrity of the stone and joint material and include items such as alignment, settlement and deterioration. In all cases where these guidelines are applied, sound engineering judgment shall be incorporated to ensure an accurate condition rating is assigned.

For the stones that comprise the arch ring, integrity of the structure depends on these stones remaining aligned and in bearing with adjacent stones in the compression ring. If any rotation, sliding, crushing or loss of joint mortar occurs, the bearing area between stones will be reduced increasing the stress in the remaining area. If displacement occurs and stone on stone contact is made, the uneven surface characteristic of stone masonry will produce locations of concentrated stress that could lead to cracking of the stone. In addition, the characteristics of stone behavior are such that minor displacements can suddenly and without warning experience major displacements due to increased stress. Therefore, although minor rotation, sliding, crushing, heaving, settlement or other deterioration noted may not indicate the arch is at that moment unstable, their presence does indicate that the load path is being altered or that the load path has been altered and is now stabilized (Note that it is impossible to discern from visual observation whether or not stabilization has occurred.). The presence of rotation, sliding, crushing, etc., also indicates that stress concentrations are developing, and that close monitoring is warranted. For stones in the spandrel walls, deterioration such as cracking, crushing, heaving, and settlement are generally less serious than those in the arch ring unless the conditions are severe or widespread. However, similar to the arch ring stones, spandrel stones can experience sudden, major displacements due to increased stress. If failure of one spandrel stone occurs, the bearing capacity of the soil fill within the spandrel walls may be seriously affected. Therefore, deformations and displacements of spandrel stones still warrants close monitoring to determine the rate of deterioration and any adverse effects, (both immediate and future), on the integrity of the spandrel wall.

Concrete components of the arch superstructure (i.e., concrete spandrels on a stone masonry arch ring) shall be coded in accordance with Section 6.2, Reinforced Concrete.

Code	**Description**
9	Excellent Condition • No noticeable deficiencies or deterioration.
8	Very Good Condition • Very minor defects that do not affect the capacity or function of the structure. • Isolated locations of lost joint pointing and/or joint cracking.
7	Good Condition • Moderate locations of lost joint pointing and/or joint cracking. • Light efflorescence bleeding from joints. • Evidence of minor water leakage noted at isolated locations through the spandrel or arch ring stones.
6	Satisfactory Condition • Loss of joint pointing material. Cracking and/or minor loss of interior joint mortar observed. • Moderate efflorescence bleeding from the joints. • Minor deterioration of spandrel stones noted. • Evidence of moderate water leakage noted throughout the spandrel or arch ring stones.
5	Fair Condition • Widespread loss of joint pointing material. Widespread cracking with moderate loss of interior joint mortar noted. • Minor displacements or deteriorations of spandrel stones noted with no adverse effect on the structural integrity or capacity of the spandrel wall.

- Isolated spandrel stones cracked. Pieces of stone on both sides of the crack are tight.
- Heavy efflorescence bleeding from the joints.
- Moderate deterioration of the spandrel stones noted.
- Heavy leakage of water through the arch ring and spandrel walls with minor deteriorations present.

4 Poor Condition

- Severe loss or cracking of joint pointing and interior mortar materials.
- Minor displacements or deformations of spandrel stones noted with potential to have adverse effects on the structural integrity or capacity of the spandrel walls.
- Cracks extend through two or more horizontal stone courses in the spandrel area. Pieces adjacent to crack may be loose.
- Signs of minor crushing or other deterioration on the surface of the arch ring stones.
- Signs of minor sliding or rotating of the arch ring stones.
- Advanced deterioration of the spandrel stones noted.
- Advanced deterioration due to water penetration with minor displacements noted.

3 Serious Condition

- Severe loss or cracking of joint pointing and interior mortar materials.
- Moderate displacements or deformations of spandrel stones with moderate adverse effects on the structural integrity or capacity of the spandrel walls.
- Crushing is noted on one or more arch ring stones.
- Cracks extend full height of the spandrel wall at one or more locations. Pieces adjacent to the crack may be loose or tight.
- Moderate sliding or rotating of the arch ring stones observed.
- Serious deterioration of the spandrel stones noted.
- Serious deterioration due to water penetration with moderate displacements noted.

2 Critical Condition

- Severe loss or cracking of joint pointing and interior mortar materials.
- Major displacements or deformations of spandrel stones with severe adverse effects on the structural integrity or capacity of the spandrel walls.
- Crushing is noted on one or more arch ring stones. Localized total failure of stones may have occurred.
- Advanced signs of sliding or rotating of the arch ring stones. Localized failures may have occurred.
- Severe deterioration of spandrel stones noted.
- Severe deterioration due to water penetration with major displacements of stones noted.
- Closure of structure shall be considered.

1 "Imminent" Failure Condition

- Structure is closed.
- Multiple locations of stone failure due to deterioration or displacement of the stone.
- Study should determine feasibility of repair or rehabilitation.

0 Failed Condition

- The arch superstructure has failed by sliding, rotation, or crushing.
- Structure is closed and beyond repair or rehabilitation.

6.7 Waterways

6.7.1 Channel and Channel Protection

The following guidelines have been developed for the condition rating of the channel and channel protection devices. They are intended to supplement the FHWA Recording and Coding Guide to make it easier to determine the most appropriate condition rating to be assigned to the channel and channel protection and should be used in conjunction with the FHWA Recording and Coding Guide, Item 61.

The guidelines presented in this section describe the physical conditions associated with the water flow such as stream stability, condition of scour protection devices such as riprap, spur dikes, and gabions, and slope protection. The inspector should be particularly concerned with excessive water velocity or turbulence, which may cause degradation of the channel, scour and undermining of the channel protection devices or substructure units, erosion of the banks, lateral movement of the channel or aggradation of the channel bed.

Accumulation of debris deposited **on** the superstructure or substructure units shall not influence the condition code assigned to the channel and channel protection. However, accumulation of debris **in** the channel shall have direct influence on the condition rating assigned as applicable.

<u>Code</u>	<u>Description</u>
9	Excellent Condition • No notable deficiencies on protective devices. • No bank erosion, scour or undermining of substructure units. • No channel debris observed.
8	Very Good Condition • No debris accumulation in the channel or along the banks that disrupts water flow through the hydraulic opening. • No water turbulence noted around substructure units or protective devices. No signs of channel scour noted. • Channel protection devices are properly functioning with very minor deterioration or impact damage noted. • Channel banks are stable, well vegetated and show no signs of erosion. • Channel is stable with no signs of aggradation, degradation or lateral movement.
7	Good Condition • There may be minor misalignment between the channel and the substructure units (up to 25 degrees). • Debris buildup in the channel or along the banks is causing minor increases in water flow velocity and turbulence through the hydraulic opening. • Water turbulence and/or increased water flow velocity caused by channel contractions and/or high flow rates are producing minor contraction scour and general scour. No adverse effects on the bridge structure. • Channel protection devices are properly functioning with minor deterioration or impact damage. No undermining or exposure of footings noted. • Channel banks are well vegetated but experiencing minor erosion.

- Channel bed is experiencing very minor aggradation or degradation with no lateral movement observed.

6 Satisfactory Condition

- Debris buildup in the channel or along the banks is causing moderate increases in stream velocity and turbulence through the hydraulic opening.
- Water turbulence and/or increased water flow velocity caused by channel contractions and/or high flow rates are producing moderate contraction scour and general scour.
- Moderate deterioration or impact damage to channel protection devices. Footings are partially exposed with no signs of undermining. Serviceability is slightly diminished.
- Channel banks are experiencing moderate erosion. Sloughing of bank material and vegetation present.
- Minor aggradation or degradation of the channel noted.
- Minor upstream lateral movement of the channel noted since the last inspection.

5 Fair Condition

- Heavy debris buildup in the channel or along the banks is causing significant increase in stream velocity and turbulence through the hydraulic opening.
- Water turbulence and/or increased water flow velocity caused by channel contractions and/or high flow rates are producing contraction scour and general scour but bridge structure is stable. Heavy deterioration or impact damage to channel protection devices. Footings are exposed and have experienced minor undermining with no signs of displacement, tilting, settlement or other movement.
- Channel banks are experiencing extensive erosion. Moderate sloughing of bank material and vegetation present.
- Moderate aggradation or degradation of the channel noted.
- Moderate upstream lateral movement of the channel noted since the last inspection.

4 Poor Condition

- Heavy debris buildup in the channel or along the banks is causing a severe increase in stream velocity and turbulence through the hydraulic opening.

- Water turbulence and/or increased water flow velocity caused by channel contractions and/or high flow rates are producing severe contraction scour and general scour. Potential exists for the stability of the bridge structure to be affected by local scour.

- Severe deterioration or impact damage to channel protection devices. Footings are fully exposed and are experiencing undermining with signs of displacement, tilting, settlement or other movement. Only partial effectiveness remains.

- Channel banks are experiencing severe erosion. Heavy sloughing of bank material and vegetation present.

- Severe aggradation or degradation of the channel noted.

- Extensive upstream lateral movements of the channel noted since the last inspection. Potential exists for lateral movement to adversely affect the approach roadway.

3 Serious Condition

- Severe general scour, contraction scour or local scour is adversely affecting the stability of the substructure units.

- Severe deterioration and undermining, displacement, tilting, settlement or other movement have caused the channel protection devices to fail or become ineffective.

- Channel aggradation, degradation or lateral movement threatens the stability of the structure or approach roadway.

2 Critical Condition

- The structure or approach is severely weakened by channel misalignment.

- Structure or approach is in danger of collapse.

- Debris accumulation significantly blocks the hydraulic opening.

1 "Imminent" Failure Condition

- Structure is closed.

- Study should determine feasibility of repair or rehabilitation.

0 Failed Condition

- Structure is closed.

- Structure or approach roadway has failed and is beyond repair or rehabilitation.

The channel is to be inspected using the above rating guidelines under the bridge, upstream and downstream to a length of where channel deficiencies may cause problems with the structure.

6.7.2 Waterway Adequacy

The condition rating guidelines to be used in the appraisal of waterway adequacy are those developed in the FHWA Recording and Coding Guide for Item 71.

6.8 Culverts

The following guidelines have been developed for the condition rating of culverts. They are intended to supplement the FHWA Recording and Coding Guide to make it easier to determine the most appropriate condition rating to be assigned to the culvert and should be used in conjunction with the FHWA Recording and Coding Guide.

These rating guidelines shall apply to flexible and rigid culverts. Flexible culverts are constructed with steel or aluminum while rigid culverts are constructed with concrete or stone masonry. This condition code evaluates the alignment, settlement, joints, structural condition, scour and other items associated with culverts. The rating code is intended to be an overall condition evaluation of the culvert. Hydraulic Adequacy, Channel and Channel Protection shall be evaluated using the separate condition rating guidelines provided in Section 6.7, Waterways. Integral wingwalls to the first construction or expansion joint shall be included in the evaluation.

The following guidelines for flexible culverts will be used for all flexible culverts, moving forward. For any existing flexible culvert, monitoring points will be established where points are not currently present.

6.8.1 Flexible Culverts

Code **Description**

9 Excellent Condition

- No noticeable deficiencies or deterioration.

8 Very Good Condition

- Barrel shape has good, smooth curvature. See Figure 6.8-1 and Figure 6.8-2.
- Seams and joints are tight with no openings.
- Superficial corrosion with slight pitting on aluminum components.
- Light rust with no pitting on steel components.
- Minor construction defects with the protective coating intact.
- Footings (if present) are in good condition with no scour.

7 Good Condition

- Barrel shape has good curvature. Top half has smooth curvature but minor flattening of bottom half has occurred. See Figure 6.8-1 and Figure 6.8-2.
- Seams and joints have minor cracking at a few bolt holes and minor joint or seam openings with potential for backfill infiltration.
- Moderate corrosion of aluminum components. No attack of core alloy.
- Medium rust with light pitting on steel components.
- Footings (if present) have moderate scour with minor cracking in footing.

6 Satisfactory Condition

- Barrel shape is fair with smooth but non-symmetrical curvature. See Figure 6.8-1 and Figure 6.8-2.
- Minor cracking at bolts is prevalent in one or more seams. Evidence of backfill infiltration through joints and seams.
- Significant corrosion with minor attack of core alloy on aluminum components.
- Heavy rust with medium pitting on steel components.
- Footings (if present) show moderate cracking and differential settlement due to extensive scour.

5 Fair Condition

- Barrel shape is fair with significant distortion at isolated locations. See Figure 6.8-1 and Figure 6.8-2.
- Moderate cracking at bolt holes along the seams. Evidence that backfill infiltration through joints and seams has caused slight deflection of the pipe.
- Significant corrosion with moderate attack of core alloy on aluminum components.
- Advanced section loss with heavy pitting on steel components.
- Footings (if present) show moderate undermining, moderate differential settlement and major cracking.

4 Poor Condition

- Barrel shape has significant distortion throughout. See Figure 6.8-1 and Figure 6.8-2.
- Major cracking at seams with backfill infiltration causing major deflection.
- Extensive corrosion with significant attack of core alloy on aluminum components.
- Advanced section loss with heavy pitting and isolated perforations on steel components.
- Footings (if present) show significant undermining, extreme differential settlement and major cracking.

3 Serious Condition

- Barrel shape is poor with extreme deflection at isolated locations. See Figure 6.8-1 and Figure 6.8-2.
- Barrel seams have up to 3 inch long cracks at bolt holes on at least one seam with moderate amounts of backfill infiltration.
- Extensive corrosion and attack of core alloy with scattered perforations on aluminum components.
- Advanced section loss with heavy pitting and scattered perforations on steel components.
- Footings (if present) are rotated due to scour and undermining. Settlement has caused damage.

2 Critical Condition

- Barrel shape critical with extreme deflection, throughout. See Figure 6.8-1 and Figure 6.8-2.
- Barrel seams have cracks spanning from bolt to bolt on at least one seam with significant amounts of backfill infiltration.
- Extensive perforations due to corrosion on aluminum components.
- Advanced section loss and extensive perforations on steel components.
- Footings (if present), have severe differential settlement with distortion of culvert and are rotated, severely undermined with major cracking and spalling.

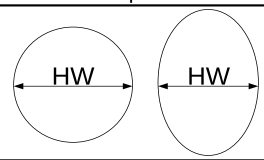
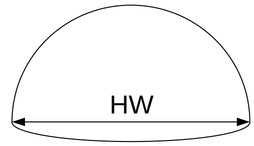
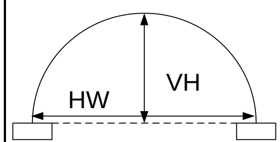
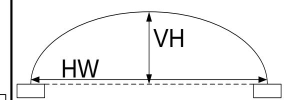
1 "Imminent" Failure Condition

- Structure is closed.
- Barrel shape is partially collapsed
- Barrel seams have failed.
- Study should determine feasibility of repair or rehabilitation.

0 Failed Condition

- Barrel shape has totally failed with backfill pushing in.
- Structure is closed and beyond repair or rehabilitation.

Condition Rating Based on Distortion in Flexible Culverts

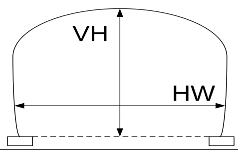
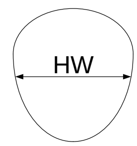
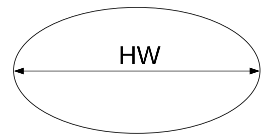
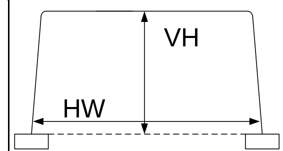
Culvert Type	Round or Vertical Elongated Corrugated Metal Pipe Barrels	Corrugated Metal Pipe Arch Barrels	Structural Plate Arch Barrels	Low Profile Arch Long-Span Culvert Barrels
Figure Condition Rating				
8	HW: within 10% of design	HW: less than 3% greater than design	VH: within 3% of design HW: within 5% of design	VH: within 11% of design HW: within 5% of design
7	HW: within 10% of design	HW: 3% to 5% greater than design	VH: within 3% to 4% of design HW: within 5% of design	VH: within 11% to 15% of design HW: within 5% of design
6	HW: within 10% of design	HW: no more than 5% greater than design	VH: within 4% to 5% of design HW: within 5% of design	VH: within 15% of design HW: within 5% of design
5	HW: 10% to 15% greater than design	HW: 5% to 7% greater than design	VH: within 5% to 7% of design HW: within 5% of design	VH: within 15% to 20% of design HW: within 5% of design
4	HW: 10% to 15% greater than design	HW: more than 7% greater than design	VH: within 7% to 8% of design HW: within 5% to 6% of design	VH: within 15% to 20% of design HW: within 5% to 6% of design
3	HW: 15% to 20% greater than design	HW: more than 7% greater than design	VH: within 8% to 10% of design HW: within 6% to 8% of design	VH: 20% to 30% less than design HW: within 6% to 8% of design
2	HW: excess of 20% greater than design	HW: more than 7% greater than design	VH: greater than 10% of design HW: greater than 8% percent of design	VH: more than 30% less than design HW: greater than 8% percent of design

Legend:
HW - Horizontal width
VH - Vertical height

Above dimensions are identified by permanent means and measured from ridge to ridge

Figure 6.8-1
Distortion in Flexible Culverts – Sheet 1

Condition Rating Based on Distortion in Flexible Culverts

Culvert Type	High Profile Arch Long-Span Culvert Barrels	Pear Shaped Long-Span Culvert Barrels	Horizontal Ellipse Long-Span Culvert Barrels	Corrugated Metal Box Culvert Barrel
Figure Condition Rating				
8	VH: within 3% of design HW: within 5% of design	HW: within 5% of design	HW: within 5% of design	VH: within 11% of design HW: within 5% of design
7	VH: 3% to 4% less than design HW: within 5% of design	HW: within 5% of design	HW: within 5% of design	VH: within 11% to 15% of design HW: within 5% of design
6	VH: 4% to 5% less than design HW: within 5% of design	HW: within 5% to 6% of design	HW: within 5% to 6% of design	VH: within 15% of design HW: within 5% to 6% of design
5	VH: 5% to 7% less than design HW: within 5% of design	HW: within 5% to 6% of design	HW: within 5% to 6% of design	VH: within 15% to 20% percent of design HW: within 5% to 6% of design
4	VH: 7% to 8% less than design HW: within 5% to 6% of design	HW: within 5% to 6% of design	HW: within 5% to 6% of design	VH: within 20% to 30% of design HW: within 5% to 6% of design
3	VH: 8% to 10% less than design HW: within 6% to 8% of design	HW: within 6% to 8% of design	HW: within 6% to 8% of design	VH: within 30% to 40% of design HW: within 6% to 8% of design
2	VH: greater than 10% of design HW: more than 8% percent of design	HW: more than 8% of design	HW: more than 8% of design	VH: more than 40% of design HW: more than 8% of design

Legend:

HW - Horizontal width

VH - Vertical height

Above dimensions are identified by permanent means and measured from ridge to ridge

Figure 6.8-2
Distortion in Flexible Culverts – Sheet 2

6.8.2 Rigid Culverts

Code	**Description**
9	Excellent Condition

- No noticeable deficiencies or deterioration.

8	Very Good Condition

- Alignment is good with no settlement or misalignment.
- Joints are tight with no defects apparent.
- Concrete has no cracking, spalling or scaling present and surface is in good condition.
- Masonry shows no cracking or settlement. No missing or dislocated masonry are present.
- Footings are in good condition with no invert scour.

7	Good Condition

- Alignment is good with minor misalignment at joints and no settlement.
- Joints have minor openings with possible infiltration/exfiltration.
- Concrete has minor hairline cracking at isolated locations. Slight spalling or scaling present on invert.
- Mortar shows shallow deterioration at isolated locations.
- Masonry shows surface deterioration at isolated locations.
- Footings are in good condition with only minor invert scour.

6	Satisfactory Condition

- Alignment between sections is fair with minor misalignment and settlement at isolated locations.
- Slight openings at joints causing minor backfill infiltration. Minor cracking or spalling at joints allowing exfiltration.
- Concrete has extensive hairline cracks, some with minor delaminated areas or spalling and invert scaling less than 1/4 inch deep.

- Mortar shows extensive areas of shallow deterioration. There is missing mortar at isolated locations. There is possible infiltration or exfiltration and minor cracking.

- Masonry shows minor cracking.

- Minor scour near footings.

5 Fair Condition

- Alignment between sections is fair with minor misalignment or settlement throughout with possible piping.

- Joints are open and are allowing backfill to infiltrate with significant cracking or joint spalling.

- Concrete cracks up to 1/8 inch wide with moderate delamination and moderate spalling exposing reinforcing steel at isolated locations. Areas on invert with surface scaling or spalls greater than 1/4 inch deep.

- Alignment of the stones is fair with minor misalignment or settlement.

- Mortar is generally deteriorated. There is loose or missing mortar at isolated locations and infiltration is apparent.

- Masonry exhibits minor cracking with slight dislocation. There are large areas of surface scaling.

- Moderate scour is present along footing.

4 Poor Condition

- Alignment between sections is poor with significant settlement. Evidence of piping. End sections are dislocated and about to drop off.

- Joints show differential movement and separation. Significant infiltration or exfiltration exists at joints.

- Concrete cracks open more than 1/8 inch with efflorescence and spalling at numerous locations. Spalls have exposed reinforcement bars that are heavily corroded. Extensive surface scaling on invert greater than 1/2 inch deep.

- Mortar is severely deteriorated with significant loss. Significant infiltration or exfiltration noted.

- Masonry shows significant displacement.

- Scour along footing with slight undermining.

3 Serious Condition

- Alignment between sections is poor with significant ponding. End section drop off has occurred.
- Joints show significant openings and differential movement. Infiltration or exfiltration is causing misalignment and settlement or depressions in roadway.
- Concrete shows extensive cracking and spalling. Invert scaling has exposed reinforcing steel.
- Extensive areas of missing mortar. Infiltration and exfiltration causing misalignment of the culvert and settlement or depressions in the roadway.
- Masonry in the lower part of the structure is missing or crushed.
- Footing shows severe undermining with slight differential settlement causing minor cracking or spalling in footing and walls.

2 Critical Condition

- Alignment between sections is critical. Culvert is not functioning due to severe misalignment.
- Concrete shows severe spalling of the culvert wall. Invert concrete is completely deteriorated in isolated locations.
- Concrete shows severe cracks with significant differential movement. The concrete is completely deteriorated in isolated locations.
- Masonry in the top of the culvert is missing or crushed.
- Footings show severe undermining with significant differential settlement causing severe cracks in footing and distress in walls.

1 "Imminent" Failure Condition

- Structure is closed.
- Culvert is partially collapsed.
- Study should determine feasibility of repair or rehabilitation.
- Footings show severe undermining resulting in partial collapse of structure.

0 Failed Condition

- Culvert and fill have totally failed.
- Structure is closed and beyond repair or rehabilitation.

6.9 Approach Roadway Alignment

The following guidelines have been developed for the appraisal rating of the approach roadway alignment. The appraisal is based on comparing the alignment of the bridge approaches to the general highway alignment of the section of roadway on which the structure is located. The rating guidelines are correctly applied by determining if the vertical or horizontal curvature of the bridge approaches differs from the section of highway the bridge is on, resulting in a reduction of vehicle operating speed to cross the bridge.

Rating Guidelines

8 No reduction in the operating speed of a vehicle is required compared to the highway.

6 Only a very minor reduction in the operating speed of a vehicle is required compared to the highway.

3 Substantial reduction in the operating speed of a vehicle is required compared to the highway.

The remaining codes between these general values are applied at the inspector's discretion.

A narrow bridge does not affect the Approach Roadway Alignment Appraisal. Items affecting sight distance at the bridge, unrelated to vertical and horizontal curvature of the roadway, such as vegetation growth and substructure units of overpass structures do not affect the Approach Roadway Alignment Appraisal.

6.10 Traffic Safety Features

The traffic safety features included in this item are the bridge railings, transitions between the approach and bridge railings, approach guardrails and the ends of the approach guardrail (this includes concrete barriers and median barriers). The coding of each of these involves an evaluation of their adequacy as systems rather than an evaluation of their physical condition. The items are appraised as to whether they do or do not meet **current** acceptable RIDOT and Federal standards. The appraisal includes such items as height, material strength, geometric features, increased stiffness of the approach rail at transitions, ability to absorb impact forces, ability to redirect errant vehicles, presence of exposed blunt ends, etc. The term "current" is stressed as standards are constantly evolving and systems in place that met applicable standards at some point in the past may no longer be in compliance due to changes to the standard.

The systems shall be coded in accordance with the coding guidelines established for Item 36 in the FHWA Recording and Coding Guide. Each system shall be appraised separately utilizing a one (1) digit code that indicates compliance or noncompliance with current standards or non-applicability. The order in which these systems shall be presented in the four digit code shall be bridge railings, transitions, approach railing and approach guardrail ends (Items 36A, 36B, 36C and 36D, respectively).

Rating Guidelines

1 Inspected feature meets currently acceptable standards.

0 Inspected feature does not meet currently acceptable standards, or a safety feature is required and none is provided. For items coded "0" provide an explanation to describe what is deficient.

N Not applicable or a safety feature is not required.

The above rating guidelines are applicable for traffic safety features on the bridge and up to 100 LF from the beginning/end abutments of the bridge or at the end of the traffic safety feature limited by an intersection or a driveway.

See Appendix E for guidance and photographic examples of how to code Traffic Safety Feature Items 36A through 36D.

6.11 Substructure

The following guidelines have been developed for the condition rating of bridge substructure units. They are intended to supplement the FHWA Recording and Coding Guide to make it easier to determine the most appropriate condition rating to be assigned to the substructure and should be used in conjunction with the FHWA Recording and Coding Guide, Item 60.

These rating guidelines shall apply to steel, concrete, masonry and timber substructures. They shall be used to rate the substructure unit's overall stability and the condition of the substructure material(s). The condition of bearings, joints, paint system, etc., generally will not influence the rating of the substructure. Deficiencies in the substructure noted in previous inspection reports that have since been retrofitted, shall only consider the condition of the retrofit when establishing the condition code.

In the event the condition of the substructure unit's overall stability (i.e., ability to support the superstructure) and the condition of the substructure unit's materials are different, the lower rated condition shall be used.

Code **Description**

9 Excellent Condition

- No noticeable deficiencies or deterioration.

8 Very Good Condition

- Very minor construction or fabrication defects (minor honeycombing of concrete members, minor fabrication or installation dents in steel members, etc.) that do not affect the capacity or function of the member.
- Isolated locations of lost joint pointing or cracking of joint pointing observed in masonry units. *(Masonry joint pointing is defined as surface applied mortar in dry laid masonry or the outer 1 1/2 inch – 2 inch of the mortar bed in cement rubble masonry.)*

7 Good Condition

- Isolated locations of embankment erosion adjacent to the substructure.
- Non-structural, hairline cracks (up to 1/32 inch) noted in concrete units.
- Isolated locations of delamination, scaling, or small spalls up to 1 inch deep in concrete units with only isolated exposed reinforcing bars.
- Isolated locations of loose or missing fasteners.
- Light to medium rust on less than 25% of the steel surface area with no section loss.
- Minor cracking or splitting of timber members with no section loss.
- Widespread (up to 70%) loss of joint pointing with interior joint mortar of masonry units in good condition (maximum depth of loss = 2 inch for mortar laid construction).
- Minor efflorescence bleeding or water leakage from joint mortar of masonry units.

6 Satisfactory Condition

- Numerous or large areas of embankment erosion adjacent to the substructure. No evidence of undermining and/or scour is evident.
- Minor opening of vertical expansion joints with no evidence of substructure tipping.
- Non-structural hairline or narrow cracks (up to 1/16 inch wide) with minor efflorescence noted in concrete units.
- Isolated spalls or scaling of concrete units deep enough to expose the mat of reinforcing bars closest to the surface. Light surface corrosion on the exposed reinforcing bars with no section loss.
- Concrete may be delaminated (concrete surface sounds hollow when struck with a hammer) on less than 10% of any individual substructure unit.
- Minor crushing, denting, section loss, etc. due to impact damage (i.e., damage that is not structurally significant).
- Light to medium rust on greater than 25% of the steel surface area.

- Severe rust (< 1/16 inch section loss) on less than 25% of the steel surface area of a critical section.
- Minor decay, cracking, splitting, fire damage, or wet areas of main timber members (Negligible section loss).
- Widespread (up to 70%) loss of joint pointing material, cracking and/or minor loss of interior joint mortar observed in masonry units (maximum depth of loss = 4 inch for mortar laid construction). Stones are firmly set in their original positions (no settlement).
- Moderate efflorescence bleeding or water leakage from joints of masonry units.

5 Fair Condition

- Advanced erosion or minor scour exists adjacent to substructure with no undermining.
- Vertical joints in the substructure unit may show differential opening.
- Non-structural cracks, spalls, scaling, or impact damage in concrete units which expose the top mat of steel reinforcement, with moderate deterioration or section loss of the reinforcing bars.
- Delaminations (concrete surface sounds hollow when struck with a hammer) may be more wide spread, up to 25% of the surface area on any individual substructure unit.
- Widespread discoloration, efflorescence or wetness on concrete surfaces indicating porous or saturated concrete (not joint leakage), with moderate efflorescence bleeding from cracks in concrete units.
- Severe rust on greater than 25% of the steel surface area with section loss (at least 1/16 inch section loss and more than 5% section loss of the flange or less than 25% in section loss of the total web cross section) noted in a critical section on one or more members.
- Moderate decay, cracking, splitting, fire damage, or wet areas of main timber members with measurable section loss.
- Extensive loss of joint pointing material, cracking and/or minor loss of interior joint mortar (6 inch maximum depth) observed in masonry units. Few stones may be loose but still in original position.
- Widespread efflorescence bleeding or water leakage from joints of masonry units.

4 Poor Condition

- Advanced scour adjacent to the substructure, isolated areas of minor undermining may exist.
- Vertical joints in the abutment are opened wide enough to allow exfiltration of the backfill material.

- Tipping of the substructure unit measured at less than 1% (from original position, accounting for original batter, if any).
- Non-structural cracks, spalls, scaling, or impact damage in concrete units which expose the top mat of steel reinforcement, with advanced deterioration or section loss of the reinforcing bars.
- Critical cracks (up to 1/32 inch) noted on one or more concrete units.
- Extensive efflorescence and/or active water leakage from cracks/spalls in concrete units.
- Extensive concrete delaminations in backwalls, bridge seats and cap beams (not under bearings), footings (except at connection to columns of piles), wingwalls, secondary members, and other areas not in the direct load path of the structure.
- Severe rust on greater than 25% of the steel surface area and/or section loss (up to 10% of the total flange cross sectional area or up to 25% of the total web cross sectional area) noted in a critical section on one or more members.
- Advanced decay, cracking, splitting, fire damage, or wet areas of main timber members with advanced section loss.
- Severe loss and cracking of joint pointing and interior mortar materials of masonry units, with minor displacements or deformations of stones (mortar loss up to 12 inch deep).
- Cracks extend through two or more horizontal stone courses of masonry units. Pieces adjacent to crack may be loose.

3 Serious Condition

- Advanced undermining/scour, causing a loss of contact between the foundation and support material. No evidence of deterioration or settlement of the substructure units caused by the undermining.
- Tipping of the substructure unit is less than 2% (from original position, accounting for original batter, if any).
- Non-structural cracks, spalls, scaling, or impact damage which exposes top mat of steel reinforcement, with advanced deterioration or section loss of the reinforcing bars.
- Critical cracks up to 1/16 inch wide noted creating significant effects on the structural integrity of the member.
- Severe leakage of water through cracks and/or spalls noted on concrete units.
- Extensive concrete delaminations in bearing seats, columns, footings (at connection to columns or piles), piles, or other areas in the direct load path of the structure. Delaminated concrete is loose and poses a potential hazard to pedestrian, vehicular or marine traffic.

- Severe rust throughout steel members with severe section loss.
- Severe decay, cracking, splitting, fire damage, or wet areas of main timber members with severe section loss.
- Severe loss and cracking of joint pointing and interior mortar materials of masonry units, with moderate displacements or deformations of stones.
- Cracks extend full height of masonry units. Pieces adjacent to cracks may be loose.

2 Critical Condition

- Advanced undermining/scour, causing a loss of contact between the foundation and support material in bearing. Item #113 is coded a "2".
- The substructure has moved from its design location and is not providing adequate support for the superstructure. The substructure's ability to remain in service without corrective action should be investigated.
- Tipping of the substructure unit is severe enough for possible displacement of the superstructure.
- Severe deterioration of the concrete, reinforcing bars or anchor bolts in the vicinity of cracks, spalls, scaling, or impact damage.
- Critical cracks greater than 1/16 inch wide in concrete members creating a severe effect on the structural integrity of the member.
- Extensive concrete delamination leading to spalling in critical areas and/or loose concrete is dropping to areas where it may cause damage or injury to people or property below.
- Severe loss and cracking of joint pointing and interior mortar materials of masonry units, with major displacements or deformations of stones.
- Severe deterioration of primary structural units.
- Local failures of structural components have occurred in primary members.

1 "Imminent" Failure Condition

- Structure is closed.
- Item #113 is coded a "1".
- Multiple locations of local member failure.
- The substructure has moved from its design location and is not providing adequate support for the superstructure. The substructure is unable to remain in service without corrective action.

0 Failed Condition

- Structure is closed.
- Item #113 is coded a "0".
- The substructure is not supporting the superstructure, as a result of excessive movement or deterioration, and is beyond repair or rehabilitation. Replacement is required.

6.11.1 Scour Critical Bridges

Item 113 - "Scour Critical Bridges", indicates a bridge's susceptibility to failure due to scour. This item is coded by the office staff based on a scour evaluation of the structure. Bridges that have a rating for Item 113 of "3" or less are considered to be "scour critical". Whenever a rating of "3" or below is assigned to Item 113, the rating for Item 60 - Substructure should also be reviewed to reflect the severity of actual scour conditions, and resultant damage to the bridge. The rating factor given to Item 60 should be consistent with the one given to Item 113 whenever a rating factor of 2 or below is determined for Item 113 - Scour Critical Bridges.

Coding Guidance for Item 60 - Substructure, when Item 113 is "3" or less:

Code 3 **Serious Condition:** for scour having partially removed foundation support, removal of stream bed material below the top of footing for spread footings or exposing the tops of piles. Bridge foundation is potentially unstable. Item 113 is rated "3".

Code 2 **Critical Condition:** extensive scour has occurred at bridge foundations and they have been determined to be unstable. Item 113 is rated "2".

Code 1 **"Imminent" Failure Condition:** scour has removed foundation material resulting in major deterioration of critical structural components with obvious vertical or horizontal movement. Bridge is closed to traffic, but corrective action may put it back in light service. Item 113 is rated "1".

Code 0 **Failed Condition:** Bridge has failed and is closed to traffic. Item 113 is rated "0".

Note: If there is no evidence of scour present, the condition rating should be based solely on the structural condition of the substructure unit. Likewise, the above numbers should be considered "maximum" ratings for substructure units that exhibit the amount of scour indicated. The rating of units in poor structural condition may be controlled by the structural condition and be less than the "scour ratings" given above.

6.12 Bearings

When considering functional condition, the inspector shall look at expansion, contraction and rotation and evaluate both the degree to which these are occurring and whether or not the observed position of expansion, contraction and rotation is within the range expected for the ambient temperature. The inspector shall also observe whether or not noted deficiencies and deteriorations occur at multiple bearings at one particular substructure unit (i.e., all bearings at an abutment or pier). Malfunctioning and misalignment of bearings may cause signs of distress in the superstructure. The condition of the bearing will not be included in the rating of the superstructure, except in extreme circumstances and where safety is a concern. It is important to note the condition of the bearings in the inspection report.

Appendix A - Blank Forms

The following forms are sample forms from RIDOT. The most recent forms can be obtained by contacting RIDOT.

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A.1 Bridge Inspection Qualifications Record – Form BI-001

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

BRIDGE INSPECTION QUALIFICATIONS RECORD
(Form BI-001)

PART I – GENERAL

Name: Phone-Office:

Employer: Phone-Cell:

Address: Email:

City: State: Zip:

PART II – QUALIFICATIONS/RELEVANT EXPERIENCE

Education:
Bachelor's Degree in Civil Engineering?
Associate's Degree in Civil Engineering?

Registrations/Certifications:
Rhode Island Registered Professional Engineer:
P.E. Registration Number: [Attach certification]
NHI Two-Week Training Course: [Attach certification]
NICET Level III or IV Bridge Safety Inspector: [Attach certification]
Engineer-In-Training (EIT): [Attach certification]

Experience:
Years of Bridge Inspection Experience[1]: [Attach resume/relevant experience]

Training:

Training Course[2]	Completion Date
Engineering Concepts for Bridge Safety Inspections (NHI 1-Week Course)	
Safety Inspection of In-Service Bridges (NHI 2-Week Course)	
Bridge Inspection Refresher Training (NHI)	
Fracture Critical Inspection Techniques for Steel Bridges (NHI)	
Other:	
Other:	
Other:	

Form BI-001 (November 2012) **Page 1 of 2**

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

BRIDGE INSPECTION QUALIFICATIONS RECORD
(Form BI-001)

Footnotes:
1. Experience in NBIS bridge safety inspection, bridge design, bridge construction inspection, bridge maintenance, or bridge construction may be used to provide the required experience. However, to qualify as a Team Leader at least 50% of experience must be from NBIS bridge safety inspection experience.
2. Enter the most recent completion date for the courses above. Also, attach applicable documentation and/or certifications for the above courses. If necessary, attach additional sheet(s) as required to list all applicable training.

I, the undersigned, affirm that all information contained in Parts I & II is true and accurate.

______________________________ ________________
(Applicant Signature) (Date)

COMMENTS:

Form BI-001 (November 2012) **Page 2 of 2**

A.2 Inspection Team Report Evaluation – Form BI-002

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

INSPECTION TEAM REPORT EVALUATION
(Form BI-002)

PART I - GENERAL

QA/QC Review Date:

Inspection Group:

Consultant:	
Project Manager:	
Team Leader:	
Staff Inspector 1:	
Staff Inspector 2:	

RIDOT QA/QC Review Team:

Team Member 1:	
Team Member 2:	
Team Member 3:	
Team Member 4:	
Team Member 5:	

Bridge Information:

Bridge ID:	
Structure Name:	
Facility Carried:	
Feature Intersected:	
City/Town:	

Main Material:	
Main Design:	
Spans:	

Inspection Dates:

Consultant Inspection Completion Date:	
Previous Inspection Date:	
QA/QC Review Team Inspection Date:	

PART II – QA/QC FIELD INSPECTION INFORMATION

QA/QC Field Inspection Team:

Team Leader:	
Inspector:	
Inspector:	
Inspector:	

Form BI-002 (August 2012) **Page 1 of 9**

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

INSPECTION TEAM REPORT EVALUATION
(Form BI-002)

PART III – QA/QC REVIEW

Qualifications

1. Is the Project Manager qualified per the Qualifications Record?	
2. Is the Team Leader qualified per the Qualifications Record?	
3. Is the Staff Inspector (1) qualified per the Qualifications Record?	
4. Is the Staff Inspector (2) qualified per the Qualifications Record?	

Comments:

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

INSPECTION TEAM REPORT EVALUATION
(Form BI-002)

Inspection Process Evaluation:

1. Was report submitted within 30 days of field inspection?
   a. Date of Completed Bridge Inspection
   b. Date Report Received
2. Was field inspection completed on time?
   a. Date Inspection Due
3. Were all items (fields) completed in the report?
4. Was the report stamped/signed by a Professional Engineer registered in the State of Rhode Island?
5. Were critical findings reported immediately via email, phone, or fax?
6. If condition changed to warrant a load rating revision, did the Inspection Group properly address recommendations?
7. Did consultant properly address the bridge posting, sign location, and sign visibility in the report if warranted?
8. Did RIDOT receive the following required inspection notifications?
   a. Two Week Notification?
   b. Two day notification?
   c. Weekly Summary Report?
9. Did the contents of the submittal (CD) meet the current requirements of RIDOT?
10. Was a Bridge Inspection Report Submittal Checklist submitted (BI-008)?
11. Did the contents of the submittal package meet the requirements of the Bridge Inspection Report Submittal Checklist (BI-008)?

Comments:

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

INSPECTION TEAM REPORT EVALUATION
(Form BI-002)

Structure & Inspection Notes

1. Did the structure and inspection notes include pertinent information such as special access equipment, crew members, rating summary, weather conditions, posting, utilities, etc.? ☐
2. Were inspection notes pertaining to the bridge approaches included? ☐

Comments:

Miscellaneous

1. Did the consultant complete the inspection within the original budget? ☐
2. Was the consultant responsive to requests from RIDOT? ☐

Comments:

NBI Condition Rating Review for Items 58, 59 and 60

The following tables document the condition of the subject bridge as inspected by the QA Review Team for the overall condition rating for NBI Items 58 (Deck), 59 (Superstructure), and 60 (Substructure).

The following definitions apply to these tables:
Photos: Is the condition of the subject bridge adequately documented by the photos? This shall include adequate photos of deficient areas and proper labeling of photos.
Notes: Is the condition of the subject bridge adequately documented by the notes provided in the report?
Sketches: Is the condition of the subject bridge adequately documented by sketches? If sketches are not applicable please enter NA in the boxes provided.

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

INSPECTION TEAM REPORT EVALUATION
(Form BI-002)

NBI ITEM 058 – DECK

Consultant Deck Rating	
Previous Deck Rating	
QA/QC Team Deck Rating	

	Photos (Y/N/NA)	Notes (Y/N/NA)	Sketches (Y/N/NA)
Wearing Surface			
Deck Condition			
Curbs			
Median			
Sidewalks			
Parapet			
Railing			
Drainage			
Lighting			
Utilities			
Deck Joints			

Comments

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

INSPECTION TEAM REPORT EVALUATION
(Form BI-002)

NBI ITEM 059 – SUPERSTRUCTURE

Consultant Superstructure Rating	
Previous Superstructure Rating	
QA/QC Team Superstructure Rating	

	Photos (Y/N/NA)	Notes (Y/N/NA)	Sketches (Y/N/NA)
Bearings			
Stringers			
Girders or Beams			
Cover Plates			
Floor Beams			
Truss/General			
Truss/Portals			
Truss/Bracing			
Welds, Rivets, or Bolts			
Arch-Rib/Barrel			
Paint/Coating			
Corrosion			
Welds-Cracks			
Deflection Under Load			
Member Alignment			
Diaphragms/Cross Frames			

Comments

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

INSPECTION TEAM REPORT EVALUATION
(Form BI-002)

NBI ITEM 060 – SUBSTRUCTURE

Consultant Substructure Rating	
Previous Substructure Rating	
QA/QC Team Substructure Rating	

	Photos (Y/N/NA)	Notes (Y/N/NA)	Sketches (Y/N/NA)
Abutments			
Stems			
Backwall			
Footing			
Piles			
Scour			
Settlement			
Piers or Bents			
Caps			
Columns/Wall			
Footing			
Piles			
Scour			
Settlement			
Pile Bents			
Debris on Seats			
Wingwalls			
Weep Holes			
Pointing			

Comments	

Form BI-002 (August 2012) **Page 7 of 9**

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

INSPECTION TEAM REPORT EVALUATION
(Form BI-002)

NBI ITEM 061 – CHANNEL

Consultant Channel Rating	
Previous Channel Rating	
QA/QC Team Channel Rating	

Comments:

NBI ITEM 071 – WATERWAY

Consultant Waterway Rating	
Previous Waterway Rating	
QA/QC Team Waterway Rating	

Comments:

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

INSPECTION TEAM REPORT EVALUATION
(Form BI-002)

CONCLUSIONS

Recommendations for Corrective Action:

Overall Evaluation of Report:

GOOD			SATISFACTORY (Minor Improvement Needed)			POOR (Needs Improvement)		
9	8	7	6	5	4	3	2	1

Notable Practices:

Signatures:

Team Member #1: ______________________ Date: __________

Team Member #2: ______________________ Date: __________

Team Member #3: ______________________ Date: __________

Team Member #4: ______________________ Date: __________

Team Member #5: ______________________ Date: __________

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A.3 Inspection Team Field Performance Evaluation – Form BI-003

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

INSPECTION TEAM FIELD PERFORMANCE EVALUATION
(Form BI-003)

Inspection Team
Consultant:
Project Manager:
Team Leader:
Staff Inspector:
Staff Inspector:
Field Review Date:
Time of Visit:

Bridge Information
Bridge ID:
Structure Name:
Facility Carried:
Feature Intersected:
City/Town:

Review Team
Team Member 1:
Team Member 2:

Field Conditions
Temperature:
Weather Condition:

Inspection Team Field Review
For the following questions, if "No" is selected please provide explanation under the "Recommendations/Remarks" section.

1. Did consultant demonstrate sound judgment with traffic control setup and public safety? Yes No NA
2. Did inspectors have proper access equipment for inspection? Yes No NA
   - ☐ Under Bridge Access Unit
   - ☐ Boat
   - ☐ Ladder
   - ☐ Scaffolding
   - ☐ Aerial Lift
   - ☐ Other
3. Did inspectors have proper personal safety equipment for inspection? Please indicate the personal safety equipment present during site visit below. Yes No NA

Form BI-003 (August 2012) Page 1 of 2

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

INSPECTION TEAM FIELD PERFORMANCE EVALUATION
(Form BI-003)

☐ Hard Hat	☐ Safety Harness
☐ Safety Glasses	☐ Ear Protection
☐ Safety Vest	☐ First Aid Kit
☐ Safety Shoes	☐ Dust Mask

4. Was there a qualified Team Leader present during inspection? Yes No NA
5. Did inspection crew display professionalism? Yes No NA
6. Was the consultant responsive to requests from the Department? Yes No NA
7. Was inspection performed in a thorough and timely manner? Yes No NA

Conclusions

Recommendations/Remarks:

Overall Field Evaluation

☐ Satisfactory

☐ Fair-Minor improvement needed. Minor issues.

☐ Poor-Needs improvement. Discuss with Consultant.

A.4 Bridge File Review – Form BI-004

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

BRIDGE FILE REVIEW
(Form BI-004)

Review Date:

Bridge Information
Bridge ID:
Structure Name:
Facility Carried:
Feature Intersected:
City/Town:

Review Team
Team Member 1
Team Member 2
Team Member 3
Team Member 4
Team Member 5

Bridge File Review:

The following denotes abbreviations for common Bridge File Locations:
BI: Bridge Inspection File (Room 100)
LR: Bridge Load Rating File (Room 100)
PR: RIDOT Plan Room (Room 016)
BIL: Bridge Inspection Incident Log and Maintenance Priority List (database)
BMS: Bridge Management System
EL: Bridge Electronic Files

Document:	Yes/No/NA	Document Location
Original Bridge Plans		
Rehabilitation Plans		
Load Rating Analysis		
Bridge Posting Correspondence		
Routine Inspection Report		
Inventory Inspection Report		
In-depth Inspection Report		
Fracture Critical Inspection Report		
Damage Inspection Report		
Underwater Inspection Report		
Scour Report		
Scour Plan of Action (POA)		
Design Calculations		
Bridge Inspection Photographs		
Bridge Maintenance & Repair Record(s)		
Fracture Critical Documentation		
Flood Data		
Special Tools (for Inspection)		

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

BRIDGE FILE REVIEW
(Form BI-004)

1. Did the current Load Rating Analysis reflect the condition/posting of the bridge?
2. Does the Load Rating Report need to be updated?
3. Is the subject bridge going to be or under rehabilitation or replacement at this time?
4. What is the anticipated construction start and completion dates (mm/yyyy) for the subject bridge?

CONCLUSIONS

Recommendations for Corrective Action:

Form BI-004 (August 2012) **Page 2 of 2**

A.5 Bridge Load Rating and Posting Recommendation – Form BI-005

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

BRIDGE LOAD RATING AND POSTING RECOMMENDATION
(Form BI-005)

Bridge Information

Bridge No.
Bridge Name:
Route Carried:
Crossing:
City/Town:
Inspection Date:
Date Notified:
Notified By:

General Recommendation

☐ Recommend verification/revision of existing load rating based on current condition (i.e., condition changed affecting structural capacity).
☐ Load posting sign(s) missing at bridge.
☐ Advanced load posting sign(s) missing from approaches.
☐ Load posting sign(s) damaged. Replace sign.
☐ Recommend verification of existing posting sign with current load rating.

Notes:

1. This form shall be submitted electronically to the appropriate personnel in accordance with the latest Distribution & Contact List.

Remarks

Form BI-005 (August 2012)

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A.6 Critical Finding Log – Form BI-006

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

BRIDGE CRITICAL FINDINGS
(Form BI-006)

Bridge No.:	**Date Reported:**
Bridge Name:	**Time Reported:**
Route Carried:	**Reported By:**
Crossing:	**Firm/Agency:**
City/Town:	

CRITICAL ISSUES SUMMARY

ACTIONS/COMMENTS

Notes:
1. Attach photos with proper labels showing the critical deficiency and any other support documentation.

Form BI-006 (August 2012)

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A.7 Weekly Inspection Summary Report – Form BI-007

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

WEEKLY INSPECTION SUMMARY REPORT
(Form BI-007)

Consultant:

Week Beginning:
(mm/dd/yy)[3]
Week Ending:
(mm/dd/yy)[3]

Completed Bridge Inspections (This Period):
Please only list the bridges that were completed during the time period noted above.

Bridge No.	Bridge Name	Primary Insp. Type	Group No.	Completion Date

Reports Submitted (This Period):
Please only list the bridges with reports submitted during the time period noted above.

Bridge No.	Bridge Name	Primary Insp. Type	Group No.	Completion Date

Notes:
1. *Reports are to be submitted within 30 days after completion of bridge inspection. Exceptions must be requested in writing with reasons for an extension.*
2. *This report shall be submitted via email every Monday by 10:00am.*
3. *Week beginning and week ending dates shall coincide with Sunday through Saturday respectively.*

Form BI-007 (January 2012)

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A.8 Bridge Inspection Report Submittal Checklist – Form BI-008

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

BRIDGE INSPECTION REPORT SUBMITTAL CHECKLIST
(Form BI-008)

BIN NO: **Date:**
Submitted by (Name/Company):

PAPER SUBMITTAL

Y	NA	
☐	☐	Report cover letter with date of inspection, type of inspection, and PE Stamp included.
☐	☐	BMS data changes document included.
☐	☐	Electronic version of report cover letter & BMS data changes document included.

BRIDGE MANAGEMENT SYSTEM (BMS)

Y	NA	
☐	☐	All SI&A and element level data is complete and accurate and has been double-checked. SI&A data satisfies the FHWA Coding Guide.
☐	☐	All elements, condition states, and condition quantities have been verified.
☐	☐	Minimum curb reveal documented in appropriate field.
☐	☐	All notes have been double-checked with photos for correct references and notations.
☐	☐	Environment code for all elements is “3”
☐	☐	Detour length (Item 19) corresponds to length in detour map.
☐	☐	Information on all under routes is completed.
☐	☐	Minimum vertical clearance(s) fields correspond to the measured vertical clearances.
☐	☐	Inspection report checked for consistency with previous report and any notable differences verified.
☐	☐	List of special access equipment, specialized tools and equipment, noted within the bridge inspection notes.
☐	☐	If special access required to the bridge, coordination with certain person/entity, keys required, etc., is noted in bridge inspection notes to aid the next inspector.

ELECTRONIC BACKUP DOCUMENTS & OTHER

Y	NA	
Photos		
☐	☐	All photos have been double-checked with inspection report for proper cross references and descriptions. The narrative in the report matches the descriptions on the photos.
☐	☐	Both elevation views and one topside photo are included in raw jpg format (unmarked). If these photos already exist in the electronic bridge folder, it is not necessary to provide new photos.
☐	☐	All photo descriptions/notations contain full text and no abbreviations.
☐	☐	Photos of posting signs (at bridge and advanced) included within photo file.
Forms/Sketches		
☐	☐	Minimum vertical clearance sheets included. (These sheets are required for all bridges with the exception of bridges that intersect water. Bridges over RR should include this sheet).
☐	☐	Channel cross section/hydraulic documentation included.
☐	☐	Orientation plan, section, and elevation are included and/or up to date.
☐	☐	Maintenance & Protection of Traffic (MPT) Plan included if required.
☐	☐	Detour route plan included and/or up to date.
☐	☐	Appropriate backup sketch (i.e. framing plan) showing primary element(s) condition state quantity derivation.
☐	☐	Load Rating & Posting Recommendation (Form BI-005) submitted if required.
Other		
☐	☐	Electronic folder content, format, and naming structure satisfy RI requirements (see RI Bridge Inspection Manual)
☐	☐	Fracture critical documentation included (i.e., Plan showing FC members, FC detail sheet)
☐	☐	The RI Bridge Inspection Manual has been reviewed and all applicable requirements have been satisfied for this inspection report.

August 2013 **Form BI-008**

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A.9 Flood Monitoring Record – Form BI-009

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

FLOOD MONITORING RECORD
(Form BI-009)

Bridge No: ____________________
Facility Carried: ____________________
Feature Intersected: ____________________
Town: ____________________
Scour Critical (Y/N): __________
Team: __________

Note: If bridge is scour critical, verify the requirements for monitoring and closure in the Plan of Action. Also, immediately report any roadway overtopping, roadway settlement, structure or pavement cracks, roadway undermining, excessive horizontal or vertical separation at the expansion joints, tilting of substructure units, significant erosion around substructure, debris under structure, etc.

Date	Time	Freeboard (Approx)[1]	Flow	Obstructions	Roadway Overtopped (Y/N)	Continue Monitoring (Y/N)

1. Approximate distance (visually if cannot be directly measured) from the water surface to the low chord of the bridge on the upstream side.

NOTES:
(Please include any evidence of high water marks and location; Continue notes on back of this sheet if necessary)

Form BI-009 (November 2012)

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A.10 Use of Bridge File Record Form – Form BI-010

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

USE OF BRIDGE FILE RECORD
(Form BI-010)

This Record shall be inserted into the space occupied by the file retrieved.

Date: ______________________

Bridge No: ______________________

Person: ______________________

Firm: ______________________

Phone No: ______________________

E-mail: ______________________

Item Removed:

Date Returned: ______________________

Initial: ______________________

Form BI-010 (April 2009)

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A.11 Special Inspection Requirements Form – Form BI-011

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

SPECIAL INSPECTION REQUIREMENTS
(Form BI-011)

Bridge No.: ______________________________
Facility Carried: ______________________________
Feature Intersected: ______________________________
City/Town: ______________________________

The following documents the primary reason for a special inspection pertaining to this bridge. The inspector shall focus the primary efforts of this special inspection on the elements described below. If, in the opinion of the engineer, other areas not listed below are deemed critical in terms of load capacity or public safety, then these particular areas shall be inspected as part of this special inspection.

Primary Reason For Special Inspection[1]:	
Posted Bridge (PB)	Settlement (S)
Closed Bridge (CB)	Scour Monitoring (SM)
Deteriorated Condition (DC)	Other (O)
Damage (D)	
Specific Condition/Element Inspection Requirements[2]:	
Date Filed:	**Completed By:**

Notes:
1. *The primary reason for the special inspection is coded in Bridge Management Software under the Agency Bridge Item section of the Inventory/Classification Tab. The Bridge Management Software coding is shown in parentheses next to the primary reason.*
2. *Document the specific component(s) of the bridge to be inspected as part of the special inspection. For example, if deterioration of Girder "A" requires close monitoring then briefly state "Girder A" as the specific element requiring this inspection.*

rev. June 2009 **Form BI-0011**

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A.12 Bridge Number Request Form – Form BI-012

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

BRIDGE NUMBER REQUEST
(Form BI-012)

Date of Request: ___________

Bridge Information

Constructed or Proposed? ________________ (Constructed, Proposed)
Structure Name: ________________
Facility Carried: ________________
Feature Intersected: ________________
City/Town: ________________
Location: ________________ (i.e. 0.25mi S of Jct. Rt 2)
Type of Service On: ________________ (Highway, Pedestrian, Highway/Pedestrian, Pedestrian-Bicycle, Railroad)

FOR PROJECTS IN DESIGN:

Project Information

Project Manager: ________________
Current Design Phase: ________________ (30%, 60%, 90%, PSE, NA)
Anticipated Const. Completion Date: ________________
Replacement of a current bridge #: ________________

FOR ALL OTHER BRIDGES:

General Information

Date Discovered: ________________
Contact Person (follow-up): ________________
Clear Span: ________________ (Face of Abutment to Face of Abutment)
Structure Type: ________________
Location: ________________ (i.e. 0.25mi S of Jct. Rt 2)
Type of Service On: ________________ (Highway, Pedestrian, Highway/Pedestrian, Pedestrian-Bicycle, Railroad)

ASSIGNED BRIDGE NUMBER

Form BI-012 (July 2010)

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A.13 Photo Log – Form BI-013

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING-BRIDGE INSPECTION UNIT

PHOTO LOG
(Form BI-013)

BRIDGE NO:_________ **PHOTOS BY:_________________**

DATE: ___/___/_____ **PAGE _____ OF ______**

Photo #	Description

Form BI-013 (November 2012)

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A.14 Underwater Bridge Inspection Procedures– Form BI-014

State of Rhode Island
Department of Transportation

UNDERWATER BRIDGE INSPECTION PROCEDURES

Bridge/Structure No.	
Latitude/Longitude	
Waterway	
Facility Carried	
City/Town	

Vicinity Map

Location Map

Section 1.0 - Waterway Information

Anticipated Water Conditions:

Max Depth: ___ ft Max Depth at Substructure: ____ ft U/W Visibility: __ ft

Water Temp: __°F Water Type: ☐ Fresh ☐ Salt ☐ Brackish Tidal: ☐ Yes ☐ No

Water Velocity _____ ft/sec. Flow Angle of Attack: ___°___

Bottom Composition: **Stream Bed Stable:** ☐ Yes ☐ No

Max Bottom Penetration:___in._

Description:

The channel bottom consists of gravel, shells and rocks up to 2' diameter with areas of silt / sand infill.

Marine Growth: **Marine Growth Present:** ☐ Yes ☐ No

Growth Impedes Level I Inspection: ☐ Yes ☐ No

Description:

The pile casings have moderate build-up of marine growth consisting of mussels and algae.

Hydraulic Features (check all that apply):

☐ None ☐ Water Control Structures ☐ Flow Training Devices ☐ Adjacent Outfalls/Inlets

Description:

N/A

Waterway Comments:

The old bridge substructure is still in place and causes a minor restriction of flow under the new structure.

Section 2.0 - Elements Requiring Underwater Inspection (Including Adjacent Structures)

#	Element Inspected	Location	Quantity	Recommended Inspection Frequency (Months)

Section 3.0 - Scour / Undermining		
Scour Critical: ☐ Yes ☐ No		**NBI Item 113 Rating:____**
Scour Plan of Action Date: __________		
Scour Countermeasures:		☐ None Present
Type	**Location**	**Inspection Requirements**
Comments:		

Section 4.0 - Risk Factors That May Promote Scour / Undermining or Deterioration
Rapid Stream Flow ☐ Present ☐ Not Present
Significant Debris Accumulation ☐ Present ☐ Not Present
Constricted Waterway Opening ☐ Present ☐ Not Present
Soft or Unstable Streambeds ☐ Present ☐ Not Present
Meandering Channel ☐ Present ☐ Not Present
High Angle of Attack Flow to Substructures Units ☐ Present ☐ Not Present
Frequent Vessel Impact ☐ Present ☐ Not Present
Water Chemistry ☐ Present ☐ Not Present
Microbial Induced Corrosion ☐ Present ☐ Not Present
Comments:

Section 5.0 - Bridge Substructure Information			
Substructure Element	Substructure Type	Foundation Strata	Foundation Depth

Section 6.0 - Structural Defects

Structural Deterioration (check all that apply):

Marine Borer Attack ☐ Present ☐ Not Present

Timber Rot/Decay ☐ Present ☐ Not Present

Significant Concrete Deterioration ☐ Present ☐ Not Present

Significant Steel Section Loss ☐ Present ☐ Not Present

Impact Damage ☐ Present ☐ Not Present

Other___________________________ ☐ Present ☐ Not Present

Other___________________________ ☐ Present ☐ Not Present

Other___________________________ ☐ Present ☐ Not Present

Description of Structural Deterioration:

Description of Unique Structural Details that Would Impact the Inspection:

Section 7.0 - Required Qualifications of Inspection Personnel	
Team Member Role	Bridge Inspection Qualification

Section 8.0 - Inspection / Diving Operations

Inspection Mode (check all that apply):

☐ Commercial SCUBA ☐ Surface Supplied Air ☐ Wading ☐ ROV

☐ Acoustic Imaging ☐ Hydrographic Survey ☐ Basic Sounding Grid

☐ Additional Soundings (Describe): ____

____

____

Inspection Platform (check one):

☐ Boat (Length___’___) ☐Shore ☐Other_____________________

Scheduling Considerations:	
Bridge Access:	
Local Notification:	
USCG Notice to Mariners:	
Other Factors:	

Section 9.0 - Inspection Methods
Inspection Techniques ***Required: 100% Level I, 10% Level II, 0% Level III** Diver Inspection Techniques☐ Visual☐ Tactile Level II Locations: _ _ Level II Cleaning Methods ☐ Hand Level II Percentage____☐ Hand Tools ☐ Pneumatic Tools ☐ Other:________________________________ Level III Methods/Detailed Techniques☐ None Level III Locations: ___________________________ Level III Percentage___%_ ☐ UT Thickness (D-Meter) ☐ Cores (Concrete) ☐ Rebound Hammer ☐ UT Pulse Echo Test (V-meter) ☐ Timber borings ☐ Half-Cell Corrosion Survey ☐ Other: __________________________________

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NOTE: Sections A.15 through A.20 have been reserved for the inclusion of future forms. Existing Appendix numbers have been modified as follows:

Previous Appendix Number	Appendix Title	New Appendix Number
A.14	Bridge Vertical Clearance Inventory Data Sheet	A.21
A.15	Channel Cross Section	A.22
A.16	Police Detail Request Form	A.23
A.17	Traffic Report Form	A.24
A.18	Field Sketch Templates	A.25
A.19	Scour Critical Bridge - Plan of Action	A.26
A.20	Bridge Scour Evaluation – Hydraulics/Hydrology Checklist	A.27
A.21	Fracture Critical Data	A.28

A.15 Place Holder Future Form BI-015

A.16 Place Holder Future Form BI-016

A.17 Place Holder Future Form BI-017

A.18 Place Holder Future Form BI-018

A.19 Place Holder Future Form BI-019

A.20 Place Holder Future Form BI-020

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A.21 Bridge Vertical Clearance Inventory Data Sheet

A.21.1 Bridge Vertical Clearance Inventory Data Sheet for One-Lane Roadway

RIDOT

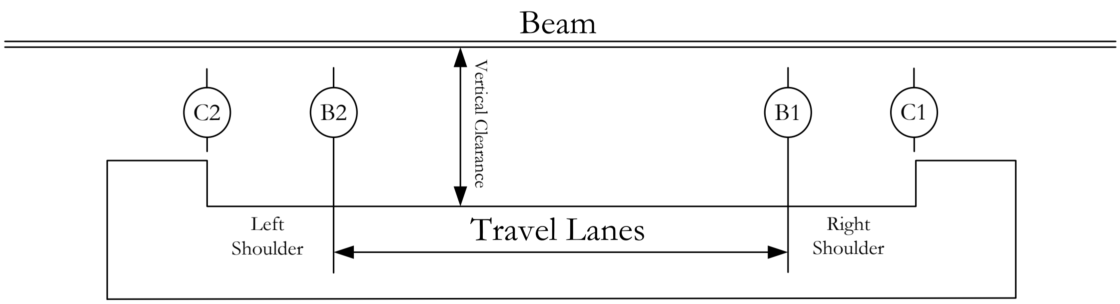
BRIDGE VERTICAL CLEARANCE
INVENTORY DATA SHEET
For One Lane Roadway

Inspection Group	
Team Leader	
Date	
Posted Clearance Sign	

Bridge Number:	
Facility Carried:	
Feature Intersected:	
Minimum Clearance:	
Span Number:	
Number of Beams:	
Route Sub:	Choose (A B C D E F)
Direction of Travel Lanes Under:	

Instructions:

1. Measure and record vertical under-clearances at each beam starting from the right hand side of the roadway in the direction of travel at the following locations:
   a. At each curb
   b. At each shoulder
   c. At each travel lane
2. If a curb or shoulder does not exist for the roadway, enter zeros.
3. For bridges intersecting a divided highway, use a separate sheet for each direction



Beam	Lane Delineator			
	C2	B2	B1	C1
A				
B				
C				
D				
E				
F				
G				
H				
I				
J				
K				
L				
M				
N				
O				

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A.21.2 Bridge Vertical Clearance Inventory Data Sheet for Two-Lane Roadway

RIDOT

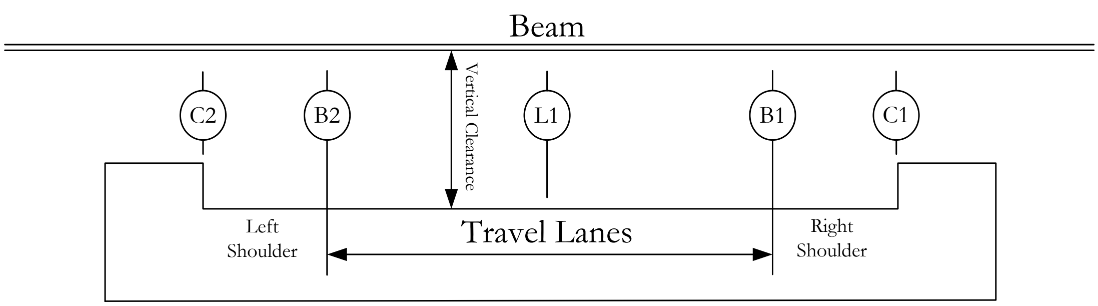
BRIDGE VERTICAL CLEARANCE
INVENTORY DATA SHEET
For Two Lane Roadway

Inspection Group	
Team Leader	
Date	
Posted Clearance Sign	

Bridge Number:	
Facility Carried:	
Feature Intersected:	
Minimum Clearance:	
Span Number:	
Number of Beams:	
Route Sub:	Choose (A B C D E F)
Direction of Travel Lanes Under:	

Instructions:

1. Measure and record vertical under-clearances at each beam starting from the right hand side of the roadway in the direction of travel at the following locations:
    a. At each curb
    b. At each shoulder
    c. At each travel lane
2. If a curb or shoulder does not exist for the roadway, enter zeros.
3. For bridges intersecting a divided highway, use a separate sheet for each direction



Beam	Lane Delineator				
	C2	B2	L1	B1	C1
A					
B					
C					
D					
E					
F					
G					
H					
I					
J					
K					
L					
M					
N					
O					

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A.21.3 Bridge Vertical Clearance Inventory Data Sheet for Three-Lane Roadway

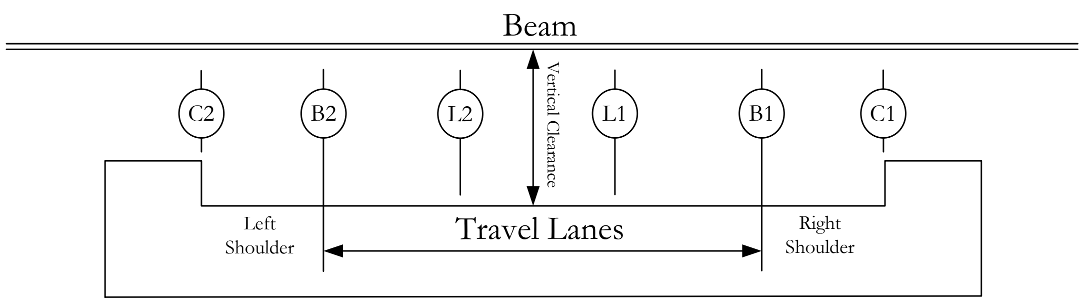
RIDOT

BRIDGE VERTICAL CLEARANCE
INVENTORY DATA SHEET
For Three Lane Roadway

Inspection Group	
Team Leader	
Date	
Posted Clearance Sign	

Bridge Number:	
Facility Carried:	
Feature Intersected:	
Minimum Clearance:	
Span Number:	
Number of Beams:	
Route Sub:	Choose (A B C D E F)
Direction of Travel Lanes Under:	

Instructions:
1. Measure and record vertical under-clearances at each beam starting from the right hand side of the roadway in the direction of travel at the following locations:
   a. At each curb
   b. At each shoulder
   c. At each travel lane
2. If a curb or shoulder does not exist for the roadway, enter zeros.
3. For bridges intersecting a divided highway, use a separate sheet for each direction



Beam	Lane Delineator					
	C2	B2	L2	L1	B1	C1
A						
B						
C						
D						
E						
F						
G						
H						
I						
J						
K						
L						
M						
N						
O						

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A.21.4 Bridge Vertical Clearance Inventory Data Sheet for Four-Lane Roadway

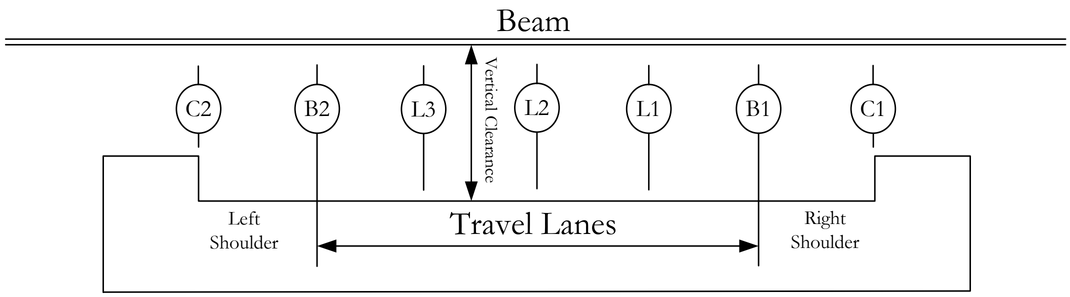
RIDOT

BRIDGE VERTICAL CLEARANCE
INVENTORY DATA SHEET
For Four Lane Roadway

Inspection Group	
Team Leader	
Date	
Posted Clearance Sign	

Bridge Number:	
Facility Carried:	
Feature Intersected:	
Minimum Clearance:	
Span Number:	
Number of Beams:	
Route Sub:	Choose (A B C D E F)
Direction of Travel Lanes Under:	

Instructions:
1. Measure and record vertical under-clearances at each beam starting from the right hand side of the roadway in the direction of travel at the following locations:
    a. At each curb
    b. At each shoulder
    c. At each travel lane
2. If a curb or shoulder does not exist for the roadway, enter zeros.
3. For bridges intersecting a divided highway, use a separate sheet for each direction



Beam	Lane Delineator						
	C2	B2	L3	L2	L1	B1	C1
A							
B							
C							
D							
E							
F							
G							
H							
I							
J							
K							
L							
M							
N							
O							

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A.21.5 Bridge Vertical Clearance Inventory Data Sheet for Five-Lane Roadway

RIDOT

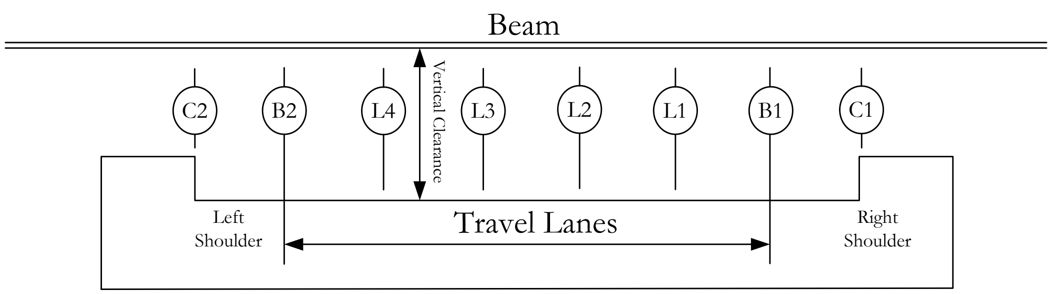
BRIDGE VERTICAL CLEARANCE
INVENTORY DATA SHEET
For Five Lane Roadway

Inspection Group	
Team Leader	
Date	
Posted Clearance Sign	

Bridge Number:	
Facility Carried:	
Feature Intersected:	
Minimum Clearance:	
Span Number:	
Number of Beams:	
Route Sub:	Choose (A B C D E F)
Direction of Travel Lanes Under:	

Instructions:

1. Measure and record vertical under-clearances at each beam starting from the right hand side of the roadway in the direction of travel at the following locations:
    a. At each curb
    b. At each shoulder
    c. At each travel lane
2. If a curb or shoulder does not exist for the roadway, enter zeros.
3. For bridges intersecting a divided highway, use a separate sheet for each direction



Beam	Lane Delineator							
	C2	B2	L4	L3	L2	L1	B1	C1
A								
B								
C								
D								
E								
F								
G								
H								
I								
J								
K								
L								
M								
N								
O								

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A.21.6 Bridge Vertical Clearance Inventory Data Sheet for Railroad

RIDOT

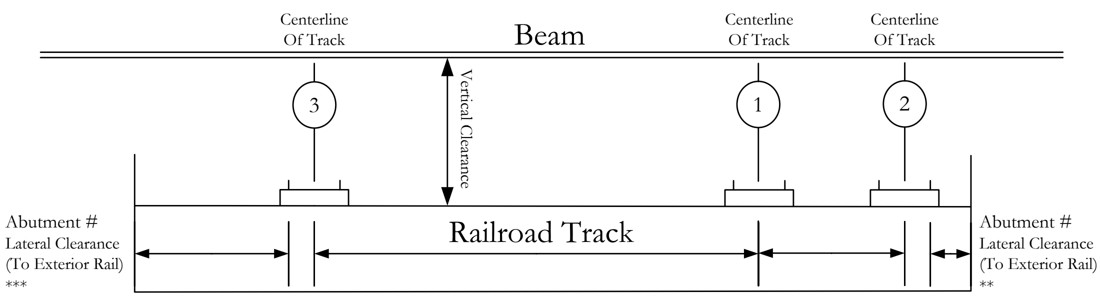
BRIDGE VERTICAL CLEARANCE
INVENTORY DATA SHEET
For Railroad

Inspection Group	
Team Leader	
Date	
Posted Clearance Sign	

Bridge Number:	
Facility Carried:	
Feature Intersected:	
Minimum Clearance:	
Span Number:	
Number of Beams:	
Route Sub:	Choose (A B C D E F)
Direction of Travel Lanes Under:	

Instructions:

1. Measure and record vertical under-clearances at each beam starting from the right hand side of the railway in the direction of travel at the following locations:
   a. Top of Rail #1
   b. Top of Rail #2
2. For bridges intersecting a divided railway, use a separate sheet for each direction.



Beam	Track Delineator					
	Track 3		Track 1		Track 2	
	West Rail	East Rail	West Rail	East Rail	West Rail	East Rail
A						
B						
C						
D						
E						
F						
G						
H						
I						
J						
K						

* Minimum Vertical Underclearance (Item 54B)
** Minimum Right Lateral Underclearance (Item 55B)
*** Minimum Left Lateral Underclearance (Item 56)

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A.22 Channel Cross Section

Bridge No.: ______________________ Structure Name: ______________________

Consultant: ______________________ Town: ______________________

Inspection Date: ______________________ Waterway: ______________________

	X_0	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}	X_{20}	X_{21}	X_{22}	X_{23}	X_{24}	X_{25}	X_{26}	X_{27}	X_{28}
Distance from beginning of cross-section																													
Top of Parapet																													
Near Abutment																													
Pier (near side)																													
Pier (far side)																													
Far Abutment																													
Bottom of Footing																													
Bottom of Superstructure																													
Freeboard																													
Average Water Depth																													
Ground Elevation - Current (20__)																													
Ground Elevation - 20__																													
Ground Elevation - Original																													

	X_0	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}	X_{20}	X_{21}	X_{22}	X_{23}	X_{24}	X_{25}	X_{26}	X_{27}	X_{28}
Distance																													
Elevation																													
Rod Reading - Current (20__)																													
Rod Reading - 20__																													
Rod Reading - Original																													

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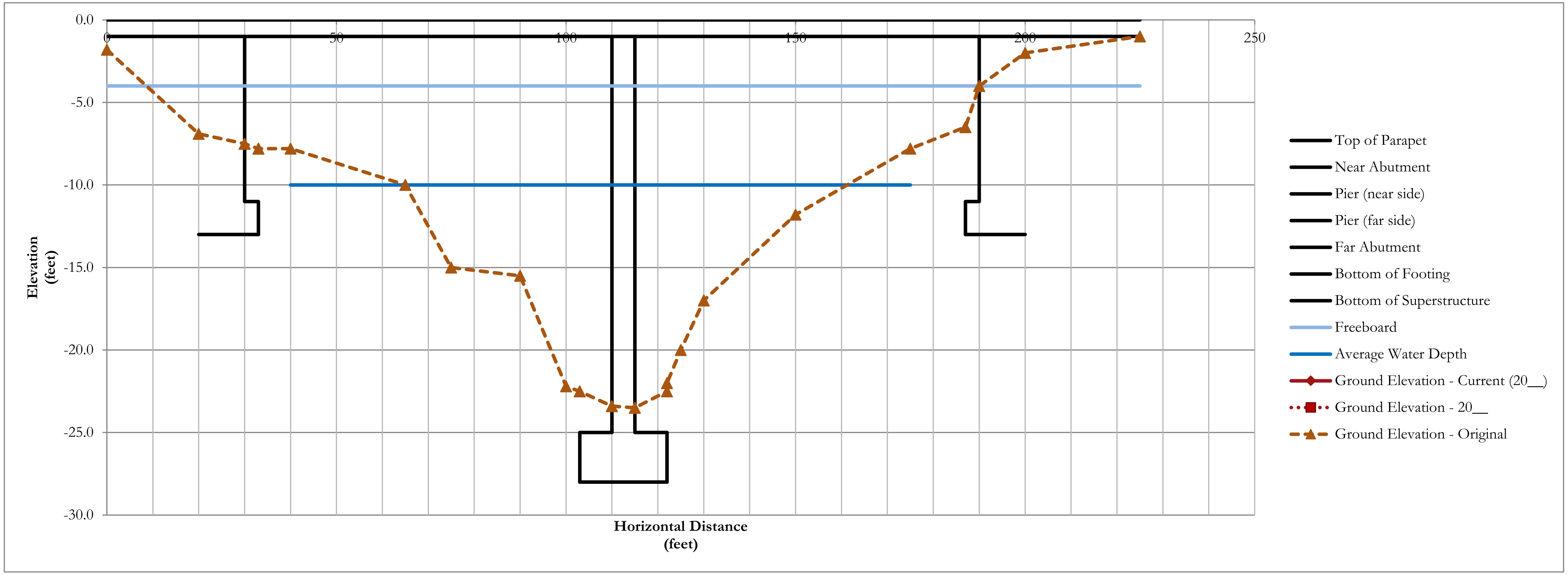
Bridge No.:	XX	Structure Name:	AA
Consultant:	YY	Town:	BB
Inspection Date:	XX/YY/ZZZZ	Waterway:	CC

Inventory information, consultant and inspection date from previous page

Beginning of cross-section



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A.23 Police Detail Request Form

CONTACT PERSON: JAMES F. HARGRAVE
OFFICE: (401)-222-2468 Ext. 4320
FAX: (401)-222-1080

PLEASE NOTIFY THIS OFFICE (NO LATER THAN 2 PM TUESDAY OF EACH WEEK AS TO HOW MANY TROOPERS WILL BE NEEDED FOR THE FOLLOWING WEEK)

SPECIAL NOTICE / CANCELLATIONS

RISP Detail Scheduling Office - (401)-222-5826, Extension 4141
Monday - Friday 6:00 AM - 8 PM

After 8 PM & Weekends Call RISP Headquarters (401)-444-1000

STATE POLICE DETAIL FROM ___/___/___ TO ___/___/___

RI CONTRACT No. MPA.No. 359 FAP No. 2006-SB-001

NAME / LOCATION OF PROJECT:

STATEWIDE BRIDGE INSPECTION

DESCRIPTION OF DETAIL:

DETAIL TROOPERS REPORT LOCATION: ____________________

Office Telephone No: ____________________

HOURS	SUN.	MON.	TUES.	WED.	THUR.	FRI.	SAT.
No. of troopers needed							

RESIDENT ENGINEER

PHONE: ____________________ PAGER: ____________________

cc: Resident Engineer, Detail Scheduling Officer, File

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A.24 Traffic Report Form

RHODE ISLAND DEPARTMENT OF TRANSPORTATION

BRIDGE INSPECTION TRAFFIC REPORT

NOTE: Please be sure that all the information requested below is included in your e-mail to the appropriate staff on the Distribution and Contact List.

OPERATION: Briefly describe the activity taking place:

RESTRICTION REQUIRED:

Right Lane Closed		Right Exit Ramp Closed	
Left Lane Closed		Left Exit Ramp Closed	
Right Shoulder Closed		On-Ramp Closed	
Left Shoulder Closed		Center Lane Closed/Traffic Split	
Moving Operation			

ROUTE:

Interstate		Direction	
US Route		Direction	
State Route		Direction	
Road		Direction	

LOCATION:

Bridge #/Bridge Name	
Start Point	
End Point	

(Use exit numbers or road names if possible.)

TIMES:

Start Date		Start Time	
End Date		End Time	

DAYS OR NIGHTS WORK OCCURS:

Monday		Friday	
Tuesday		Saturday	
Wednesday		Sunday	
Thursday			

SENDER:	**PHONE #:**

- This form must be filled out and e-mailed a minimum of 48 hours in advance of proposed lane closure.
- Any cancellation must be reported as soon as possible, but no later than 2:00pm of business day before scheduled lane closure. Weekend closures and cancellation should be called in directly to TMC: (401) 222-5826 Nextel DC ID - 59

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A.25 Field Sketch Templates

A.25.1 Portrait Field Sketch Template

SUPPLEMENTAL SHEET ☐ FIELD ORIGINAL ☐ TRANSCRIBED BY:______	BRIDGE NO. CREW:	DATE: SHEET
DESCRIPTION:		

LEGEND

- HOLLOW AREA
- SHALLOW REBAR
- SPALL AREA
- SPALL AREA WITH EXPOSED REBAR
- MAP CRACKS (MpC) OR HAIRLINE MAP CRACKS (HLMpC)
- HAIRLINE CRACK (HLC) OR CRACKS (CRK)
- HONEY COMB AREA
- SCALE AREA (HVY, MED OR LT)
- WITH EFFLORESCENCE

UPDATE NO.	DATE	COMPANY	CREW
△			
△			
△			
△			

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A.25.2 Landscape Field Sketch Template

SUPPLEMENTAL SHEET ☐ FIELD ORIGINAL ☐ TRANSCRIBED BY:______	BRIDGE NO.	DATE:
	CREW:	SHEET

DESCRIPTION:

UPDATE NO.	DATE	COMPANY	CREW
△			
△			
△			
△			

LEGEND
HOLLOW AREA
SHALLOW REBAR
SPALL AREA
SPALL AREA WITH EXPOSED REBAR
MAP CRACKS (MpC) OR HAIRLINE MAP CRACKS (HLMpC)
HAIRLINE CRACK (HLC) OR CRACKS (CRK)
HONEY COMB AREA
SCALE AREA (HVY, MED OR LT)
WITH EFFLORESCENCE

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A.26 Scour Critical Bridge - Plan of Action

SCOUR CRITICAL BRIDGE – PLAN OF ACTION

1. GENERAL INFORMATION

Structure number:	**City, County, State:**	**Waterway:**
Structure name:	**State highway or facility carried:**	**Owner:**
Year built:	**Year rebuilt:**	**Bridge replacement plans (if scheduled):** **Anticipated opening date:**

Structure type: Bridge Culvert
Structure size and description:

Foundations: Known Unknown Type:
Depth:

Subsurface soil information (*check all that apply*): Non-cohesive Cohesive
Rock

Bridge ADT:	**Year/ADT:**	**% Trucks:**

Does the bridge provide service to emergency facilities and/or an evacuation route?
If so, describe:

2. RESPONSIBILITY FOR POA

Author(s) of POA (name, title, agency/organization, telephone, page, email):

Date:
Concurrences on POA (name, title, agency/organization, telephone, pager, email):

POA updated by (name, title, agency/organization):

Date of update:
Items updated:

POA to be updated every months by (name, title, agency/organization):

Date of next update:

Scour Critical Bridge – Plan of Action **Page 1 of 9**

3. SCOUR VULNERABILITY				
a. Current Item 113 Code:	3	**2**	1	Other:
b. Source of Scour Critical Code:		Other:		
c. Scour Evaluation Summary:				
d. Scour History				

Scour Critical Bridge – Plan of Action **Page 2 of 9**

4. RECOMMENDED ACTION(S) (see Sections 6 and 7)		
	Recommended	Implemented
a. Increased Inspection Frequency		
b. Fixed Monitoring Device(s)		
c. Flood Monitoring Program		
d. Hydraulic/Structural Countermeasures		

5. NBI CODING INFORMATION		
	Current	Previous
Inspection date		
Item 113 Scour Critical		
Item 60 Substructure		
Item 61 Channel & Channel Protection		
Item 71 Waterway Adequacy		
Comments: (Drift, scour holes, etc. – depict in sketches in Section 10)		

Scour Critical Bridge – Plan of Action Page 3 of 9

6. MONITORING PROGRAM

☐ **Regular Inspection Program** ☐ w/surveyed cross sections
Items to Watch:

☐ **Increased Inspection Frequency of mo.** ☐ w/surveyed cross sections
Items to Watch:

☐ **Underwater Inspection Required**
Items to Watch:

☐ **Increased Underwater Inspection Frequency of mo.**
Items to Watch:

☐ **Fixed Monitoring Device(s)**
Type of instrument:
Installation location(s):

Sample Interval: ☐ 30 min. ☐ 1 hr. ☐ 6 hrs. ☐ 12 hrs. ☐ Other:
Frequency of data download and review: ☐ Daily ☐ Weekly ☐ Monthly ☐ Other

Scour alert elevation(s) for each pier/abutment:

Scour critical elevation(s) for each pier/abutment:

Survey ties:

Criteria of termination for fixed monitoring:

Scour Critical Bridge – Plan of Action **Page 4 of 9**

6. MONITORING PROGRAM (CONT.)

Flood Monitoring Program

Type: (*For Instrument, check all that apply*):

Portable Geophysical Sonar Other:

Flood monitoring event defined by (*check all that apply*):

Discharge

Stage

Elev. measured from

Rainfall (in) per (hours)

Flood forecasting information:

Flood warning system:

Frequency of flood monitoring:

If Other:

Post-flood monitoring required: *If checked Yes, then within days*

Frequency of post-flood monitoring:

If Other:

Criteria for termination of flood monitoring:

Criteria for termination of post-flood monitoring:

Scour alert elevation(s) for each pier/abutment:

Scour critical elevation(s) for each pier/abutment:

Note: Additional details for action(s) required may be included in Section 8.

Action(s) required if scour alert elevation detected (*include notification and closure procedures*):

Action(s) required if scour critical elevation detected (*include notification and closure procedures*):

Agency and department responsible for monitoring:

Contact person (*include name, title, telephone, pager, e-mail*):

Scour Critical Bridge – Plan of Action **Page 5 of 9**

7. COUNTERMEASURE RECOMMENDATIONS

Prioritize alternatives below. Include information on any hydraulic, structural or monitoring countermeasures

☐ **Only monitoring required (see Section 6 and Section 10 – Attachment F)**
Estimated cost $

☐ **Structural/hydraulic countermeasures considered (see Section 10, Attachment F):**

Priority Ranking		**Estimated cost**
(1)	____________________	$
(2)		$
(3)		$
(4)		$
(5)		$

Basis for the selection of the preferred scour countermeasure:

Countermeasure implementation project type:
If Other:

Agency and department responsible for countermeasure program (if different from Section 6 contact for monitoring):

Contact person (*include name, title, telephone, pager, e-mail*):

Target design completion date:

Target construction completion date:

Countermeasures already complete:

8. BRIDGE CLOSURE PLAN

Scour monitoring criteria for consideration of bridge closure:

Water surface elevation reaches
at
Overtopping road or structure
Scour measurement results/Monitoring device (See Section 6)
Observed structure movement/Settlement
Discharge: cfs
Notes: ________________
Flood forecast:

Other: Debris accumulation Movement of riprap/other armor protection
Loss of road embankment

Emergency repair plans (*include source(s), contact(s), cost, installation directions*):

Agency and department responsible for closure:

Contact persons (*include name, title, telephone, pager, e-mail*):

Criteria for re-opening the bridge:

Agency and person responsible for re-opening the bridge after the inspection:

Scour Critical Bridge – Plan of Action **Page 7 of 9**

9. DETOUR ROUTE

Detour route description (route number, from/to, distance from bridge, etc.) – Include map in Section 10, Attachment E.

Bridges on Detour Route:

Bridge Number	Waterway	Sufficiency Rating/ Load Limitations	Item 113 Code

Traffic control equipment (detour signing and barriers) and location(s):

Additional considerations or critical issues (susceptibility to overtopping, limited waterway adequacy, lane restrictions, etc.):

News release, other public notice (include authorized person(s), information to be provided and limitations):

Scour Critical Bridge – Plan of Action **Page 8 of 9**

10. ATTACHMENTS

Please indicate which materials are being submitted with this POA:

☐ **Attachment A: Boring logs and/or other subsurface information**

☐ **Attachment B: Cross sections from current and previous inspection reports**

☐ **Attachment C: Bridge elevation showing existing streambed, foundation depth(s) and observed and/or calculated scour depths**

☐ **Attachment D: Plan view showing location of scour holes, debris, etc.**

☐ **Attachment E: Locus maps and map showing detour route(s)**

☐ **Attachment F: Supporting documentation, calculations, estimates and conceptual designs for scour countermeasures.**

☐ **Attachment G: Photos**

☐ **Attachment H: Monitoring Procedures**

☐ **Attachment I: Hurricane Evacuation Routes**

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A.27 Bridge Scour Evaluation – Hydraulics/Hydrology Checklist

RIDOT BRIDGE SCOUR EVALUATION – PHASE II HYDRAULICS/HYDROLOGY CHECKLIST

BIN:	County:	Town:	
Street:	Route:	Over:	
1. GENERAL			
A. Evidence of Scour at Structure			
1. Abutments Tilting / Moving In:			
2. Slopes Washing In / Sloughing:			
3. Scour Holes Near Abutments / Bents:			
4. Bed Deposits Downstream:			
5. Bridge Railing / Deck Sagging:			
6. Debris:			
7. Highwater Mark:			
B. Feasibility Monitoring During High Flow:			
1. Rod / Pole / Weight From Deck:			
2. Fixed Monitoring Device:			
C. Feasibility of Adding Riprap or Other Scour Countermeasures:		*Yes*	*No*
2. ABUTMENTS			
A. Type:	*Spill Through*	*Vertical Wall*	*Wingwalls*
B. Foundation	Dimensions (LxWxH)	Embedment	Exposure
1. Spread Footings:			
2. Pile Caps:			
3. Piles:			
4. Drilled Shaft:			
5. Source of Data:	*Field Review*	*Design Plans*	*As-Built Drawings*
	Pile Driving Records	*Inspection Reports*	*Other*
C. Location from Bank	Left	Right	
1. Set Back:			
2. At Bank:			
3. In Channel:			
4. In Floodplain:			
D. Protection			
1. Riprap:	*Crushed Stone*	*Commercial Block*	*Grouted*
2. Other:			
3. Condition	Good	Fair	Poor
a. Left:			
b. Right:			

RIDOT BRIDGE SCOUR EVALUATION – PHASE II HYDRAULICS/HYDROLOGY CHECKLIST (Cont.)

3. PIER		Pier No.:		
	A. Type:	*Concrete Wall*	*Pile Bent*	*Column Type*
	B. Shape:	*Square*	*Rounded*	*Sharp Nose*
	C. Dimensions	Width:	Length:	
	D. Foundation (worst pier)	Dimensions (LxWxH)	Embedment	Exposure
	1. Spread Footing:			
	2. Pile Cap:			
	3. Piles:			
	4. Drilled Shaft:			
	5. Source of Data	*Field Review*	*Design Plans*	*As-Built Drawings*
		Pile Driving Records	*Inspection Reports*	*Other*
	E. Evidence of Scour at Structure			
	1. Riprap:	*Crushed Stone*	*Commercial Block*	*Grouted*
	2. Other:			
	3. Condition	*Good*	*Fair*	*Poor*
4. CHANNEL LATERAL STABILITY				
	A. Bends			
	1. Bridge Location:	*Upstream of Bend*	*Downstream of Bend*	*In Bend*
	2. Migration:			
	3. Countermeasures:			
	B. Bank Erosion:	Upstream	Downstream	
	1. Eroding:			
	2. Stable:			
	3. Vegetated: (See Section 17)			
	4. Countermeasures:			
	C. Angles of Attack:	Flood Flow:	Normal Flow:	
	D. Island or Bars			
	1. Upstream:			
	2. Under Structure:			
	3. Downstream:			

RIDOT BRIDGE SCOUR EVALUATION – PHASE II HYDRAULICS/HYDROLOGY CHECKLIST (Cont.)

5. CHANNEL VERTICAL STABILITY						
A. Exposed Footing:						
B. Exposed Piles:						
C. Contraction Scour:	Left		Right			
1. Overbank Flow:						
2. Relief Bridge:						
a. Abutments						
1) Set Back:						
2) At Bank:						
3) In Channel:						
D. Overtopping	Bridge:		Approaches:			
E. Long Term Scour:	*None*		*Aggradation*		*Degradation*	*Unknown*
6. GEOMORPHOLOGY						
A. Dam or Reservoir:						
B. Bridge or Other Structure						
C. Instream Mining:						
D. Headcuts or Nickpoints:						
E. Diversions:						
F. Channel Straightening:						
G. Stream Size:	*Small (<100 ft.)*		*Medium (100-500 ft.)*		*Large (>500 ft.)*	
H. Flow Characteristics:	*Ephemeral*		*Intermittent*		*Perennial*	
I. Bed Material:	*Clay/Silt*	*Sand*	*Gravel*	*Cobbles*	*Boulders*	*Other*
J. Valley Relief:	*Low (<100 ft.)*		*Mod. (100-1000 ft.)*		*High (>1000 ft.)*	
K. Flood Plains:	*Little or None*		*Narrow*		*Wide*	
L. Natural Levees:	*Little or None*		*One Bank Only*		*Both Banks*	
M. Apparent Incision:	*Not Incised*		*Probably Incised*			
N. Channel Boundaries:	*Alluvial*		*Semi-Alluvial*		*Non-Alluvial*	
O. Tree Cover on Banks:	*<50%*		*50-90%*		*>90%*	
P. Sinuosity:	*Straight*	*Sinuous*		*Meandering*	*Highly Meandering*	
Q. Braided Streams:	*Not*		*Locally*		*Generally*	
R. Anabranched Streams:	*Not*		*Locally*		*Generally*	
S. Channel Width:	*Equiwidth*		*Wider at Bends*		*Random Variations*	
T. Point Bars:	*Narrow*		*Wide*		*Irregular*	

RIDOT BRIDGE SCOUR EVALUATION – PHASE II HYDRAULICS/HYDROLOGY CHECKLIST (Cont.)

7. OTHER CONSIDERATIONS					
A. Structure Foundation:	*Known*		*Unknown*		
B. Existing Known Scour Condition:	*Yes*		*No*		
C. Bed Material Sample Location:					
D. Sediment Transport:					
1. Observed Mode:	*Live Bed Condition*		*Clear Water Condition*		
2. Armored Bed:					
b. Abutments					
E. Watershed:	*Agricultural*	*Forested*	*Swamp*	*Urban*	*Suburban*
F. Tributaries:	Distance		% of Total Flow		Angle
1. Upstream:					
2. Downstream:					
G. Observed Stream Velocity:					
H. Manning's n	Channel		Left Overbank		Right Overbank
1. Upstream:					
2. At Structure:					
3. Downstream:					
I. Tidal Influence	*Yes*		*No*		*Possibly*
1. Tidal Features	*Bay*		*Estuary Inlet*		*Barrier Island*
2. Normal range (amplitude):	*Tidal Table*		*Field Observation*		
3. Observed Surface Velocity:	Location:				
4. Seiching (wind setup):					
5. Distance in Mile to Open Ocean Along Thalweg:					
6. Water Traffic:	*Recreation*	*Commercial*	*Ship*		*Barge*
J. Phase I Scour Ratings Scour:			Structural:		
K. Field Inspectors			Weather:		
L. Date of Field Review:			Time of Field Review:		
8. ADDITIONAL COMMENTS					
A. Diving Considerations					
B.					
C.					
D.					
E.					

RIDOT BRIDGE SCOUR EVALUATION – PHASE II HYDRAULICS/HYDROLOGY CHECKLIST (Cont.)

SUPPLEMENTAL CONSIDERATIONS (Based on HEC-20 Field Reconnaissance Sheet)	
9. AREA AROUND RIVER VALLEY	
A. Terrain:	*Uplands* *Hills* *Plains* *Lowlands*
B. Drainage Pattern:	*Dendric* *Parallel* *Multi-Basinal* *Contorted*
C. Surface Geology:	*Weathered Soils* *Glacial Moraine* *Glacial/Fluvial* *Fluvial* *Loess*
D. Bedrock Type:	
E. Vegetation:	*Temperate Forest* *Woodland* *Agricultural* *Suburban* *Urban*
10. RIVER VALLEY AND VALLEY SIDES	
A. Side Slope Angle:	*<5°* *5-10°* *10-20°* *20-50°*
B. Valley Shape:	*Symmetrical* *Asymmetrical*
C. Valley Side Features:	*None* *Occasional* *Frequent*
D. Failure Locations:	*None* *Away From River* *Along River (Undermined)*
E. Failure Type:	
11. FLOOD PLAIN (VALLEY FLOOR)	
A. Valley Floor Type:	*None* *Indefinite* *Fragmentary* *Continuous*
B. Valley Floor Data:	*None* *<1 River Widths* *1-5 River Widths* *5-10 River Widths* *>10 River Widths*
C. Surface Geology:	*Bedrock* *Glacial Moraine* *Glacio/Fluvial* *Fluvial (Alluvium)* *Fluvial (Backswamp)* *Lake Deposits* *Loess*
D. Land Use:	*Natural* *Managed* *Cultivated* *Urban* *Suburban* *Industrial*
E. Vegetation:	*Grass* *Orchards* *Crops* *Shrubs* *Dec. Forest* *Con. Forest* *Mixed*
F. Riparian Buffer Strip:	*None* *Indefinite* *Fragmentary* *Continuous*
G. Strip Width:	*None* *<1 River Width* *1-5 River Widths* *>5 River Widths*
12. VERTICAL RELATION OF CHANNEL TO VALLEY	
A. Terraces:	*None* *Indefinite* *Fragmentary* *Continuous* #____
B. Overbank Deposits:	*None* *Silt* *F Sand* *M Sand* *C Sand* *Gravel* *Boulders*
C. Levees:	*None* *Natural* *Constructed*
D. Levee Data:	*Height (m)* *Side Slope(°)*
E. Instability Status:	*Stable* *Degrading* *Aggrading*
F. Levee Condition:	*None* *Intact* *Local Failures* *Frequent Failures*
G. Levee Description:	*None* *Indefinite* *Fragmentary* *Continuous* *Left Bank* *Right Bank* *Both Banks*
H. Trash Lines	*Absent* *Present* *Height above flood plain (m)*________

RIDOT BRIDGE SCOUR EVALUATION – PHASE II HYDRAULICS/HYDROLOGY CHECKLIST (Cont.)

SUPPLEMENTAL CONSIDERATIONS (Based on HEC-20 Field Reconnaissance Sheet)
13. LATERAL RELATION OF CHANNEL TO VALLEY
A. Planform: *(See 6. P)*
B. Planform Data: Bend Radius _____ Meander Belt Width: _____ Wavelength: ______
Meander Sinuousity ___________
C. Lateral Activity: *None* *Meandering Progression* *Increasing Amplitude* *Progression + cut-offs* *Irregular Terrain* *Abandoned Channel* *Braiding*
D. Floodplain Features: *None* *Meander Scars* *Scroll Bars+Sloughs* *Oxbow Lakes* *Irregular Erosion* *Avulsion* *Braiding*
E. Location in Valley: *Left* *Middle* *Right*
14. CHANNEL DESCRIPTION
A. Dimensions: *Av. Top Bank Width(m)* ____ *Av. Channel Depth(m)* ____ *Av. Water Width(m)* ____ *Av. Water Depth(m)* ____ *Reach Slope*
B. Flow Type: *Uniform/Tranquil* *Uniform/Rapid* *Pool+Riffle* *Steep+Tumbling* *Steep+Step/Pool*
C. Bed Controls: *None* *Occasional* *Frequent* *Confined* *# of Controls*
D. Control Types: *None* *Solid Bedrock* *Weathered Bedrock* *Boulders* *Gravel Armor* *Cohesive Materials* *Bridge Protection* *Grade Control Structures*
E. Width Controls: *None* *Occasional* *Frequent* *Confined* *# of Controls*
F. Control Types: *None* *Bedrock* *Boulders* *Gravel Armor* *Revetments* *Cohesive Materials* *Bridge Abutments* *Dykes or Groins*
15. BED SEDIMENT DESCRIPTION
A. Bed Material: *(See Section 6.I)*
B. Bed Armour: *None* *Static-Armour* *Mobil-Armour*
C. Sediment Depth: *Depth of Loose Sediment (cm):*
D. Surface Size Data: *D50 (mm)* _____ *D84 (mm)* _____ *D16 (mm)* _____
E. Substrate Size Data: *D50 (mm)* _____ *D84 (mm)* _____ *D16 (mm)* _____
F. Bed Forms (Sand): *Flat Bed (none)* *Ripples* *Dunes* *Bed Form Height (m)*
G. Islands or Bars: *None* *Occasional* *Frequent*
H. Bar Types: *None* *Pools and Riffles* *Alternate Bars* *Point Bars* *Mid-Channel Bars* *Diagonal Bars* *Junction Bars* *Sand Waves+Dunes*
I. Bar Surface Data: *D50 (mm)* _____ *D84 (mm)* _____ *D16 (mm)* _____
J. Bar Substrate Data: *D50 (mm)* _____ *D84 (mm)* _____ *D16 (mm)* _____

RIDOT BRIDGE SCOUR EVALUATION – PHASE II HYDRAULICS/HYDROLOGY CHECKLIST (Cont.)

SUPPLEMENTAL CONSIDERATIONS (Based on HEC-20 Field Reconnaissance Sheet)					
18. LEFT (OR RIGHT) BANK CHARACTERISTICS					
A. Type:	*Noncohesive*	*Cohesive*	*Composite*	*Layered*	
	Even Layered	*Thick+Thin Layers*	*# of Layers* _____		
B. Protection Status:	*Unprotected*	*Hard Points*	*Toe Protection*	*Revetments*	*Dyke Fields*
C. Bank Materials:	*Silt/Clay*	*Sand/Silt/Clay*	*Sand/Silt*	*Sand*	*Sand/Gravel*
	Gravel	*Gravel/Cobbles*	*Cobbles/Boulders*	*Boulders/Bedrock*	
D. Layer Thickness:	*Material 1(m)* ____	*Material 2(m)* ____	*Material 3(m)* ____	*Material 4(m)* ____	
E. Average Bank Height (m) _________	Average Bank Slope (°) _________				
F. Tension Cracks:	*None*	*Occasional*	*Frequent*		
G. Crack Depth:	*Proportion of Bank Height* __________				
H. Distribution and Description of Bank Materials in Bank Profile					
1. Material 1:	*Location in Bank* ___________	*D50 (mm)* ______	*Sorting Coef.* _________		
2. Material 2:	*Location in Bank* ___________	*D50 (mm)* ______	*Sorting Coef.* _________		
3. Material 3:	*Location in Bank* ___________	*D50 (mm)* ______	*Sorting Coef.* _________		
4. Material 4:	*Location in Bank* ___________	*D50 (mm)* ______	*Sorting Coef.* _________		
17. LEFT (OR RIGHT) BANK-FACE VEGETATION					
A. Vegetation:	*None/fallow*	*Artificially Cleared*	*Grass and Flora*	*Reeds and Sedges*	
	Shrubs	*Saplings*	*Trees*		
B. Orientation:	*Angle of Leaning (°)* ________				
C. Tree Types:	*None*	*Deciduous*	*Coniferous*	*Mixed*	
D. Tree Species:					
E. Density and Spacing:	*None*	*Sparse/Clumps*	*Dense/Clumps*		
	Sparse/Continuous	*Dense/Continuous*			
F. Location:	*Whole Bank*	*Upper Bank*	*Mid-Bank*	*Lower Bank*	
G. Health:	*Healthy*	*Fair*	*Poor*	*Dead*	
H. Height	*Short*	*Medium*	*Tall*	*Height (m)* _______	
I. Roots:	*Normal*	*Exposed*	*Adventitious*		
J. Diversity:	*Mono-Stand*	*Mixed-Stand*	*Climax Vegetation*		
K. Age:	*Immature*	*Mature*	*Old*		
L. Lateral Extent:	*Wide Belt*	*Narrow Belt*	*Single Row*		

RIDOT BRIDGE SCOUR EVALUATION – PHASE II HYDRAULICS/HYDROLOGY CHECKLIST (Cont.)

SUPPLEMENTAL CONSIDERATIONS (Based on HEC-20 Field Reconnaissance Sheet)					
18. LEFT (OR RIGHT) BANK EROSION					
A. Erosion Location:	*(See Section 4.B.1 and Channel Sketch Map)*				
B. Present Status:	*Intact*	*Eroding: Dormant*	*Eroding: Active*		
	Advancing: Dormant	*Advancing: Active*			
C. Rate of Retreat (m/yr) ________	Rate of Advance (m/yr) ________				
D. Dominant Processes:	*Parallel Flow*	*Impinging Flow*	*Piping*	*Freeze/Thaw*	
Sheet Erosion	*Rilling and Gullying*	*Wing Waves*	*Vessel Forces*	*Ice Rafting*	*Other*
19. LEFT (OR RIGHT) BANK GEOTECH FAILURES					
A. Erosion Location:	*(See Section 2.D.3, 3.E.3 and Channel Sketch Map)*				
B. Present Status:	*Stable*	*Unreliable*	*Unstable: Dormant*	*Unstable: Active*	
C. Failure Scars & Blocks:	*None*	*Old*	*Recent*	*Fresh*	*Contemporary*
D. Apparent Failure Mode:	*Soil/Rock Fall*	*Shallow Slide*	*Rotational Slip*		
	Slab-Type Block	*Cantilever Failure*	*Pop-out Failure*	*Piping Failure*	
	Dry Granular Flow	*Wet Earth Flow*	*Other*		
20. LEFT (OR RIGHT) BANK SEDIMENT ACCUMULATION					
A. Stored Bank Debris:	*None*	*Individual Grain*	*Aggregates+Crumbs*	*Root-bound Clumps*	
Small Soil Blocks	*Medium Soil Blocks*	*Large Soil Blocks*	*Cobbles/Boulders*	*Boulders*	
B. Vegetation:	*None/Fallow*	*Artificially Cleared*	*Grass and Flora*	*Reeds and Sedges*	
	Shrubs	*Saplings*	*Trees*		
C. Age:	*Immature*	*Mature*	*Old*	*Age in years* ______	
D. Health:	*Healthy*	*Unhealthy*	*Dead*		
E. Tree Species:					
F. Roots:	*Healthy*	*Unhealthy*	*Dead*		
G. Existing Debris Storage:	*No Bank Debris*	*Little Bank Debris*	*Some Bank Debris*		
		Lots of Bank Debris			

RIDOT BRIDGE SCOUR EVALUATION – PHASE II HYDRAULICS/HYDROLOGY CHECKLIST (Cont.)

Channel Sketch Map (Modified from Thorne, 1998)			
Map Symbols (To be determined by Field Crew)			
Study Reach Limits	North Point	Cut Bank	Photo Location/Orientation
Cross Section	Flow Direction	Exposed Island/Bar	Sediment Sampling Point
Bank Profile	Impinging Flow	Structure	Significant
Representative Cross Section			

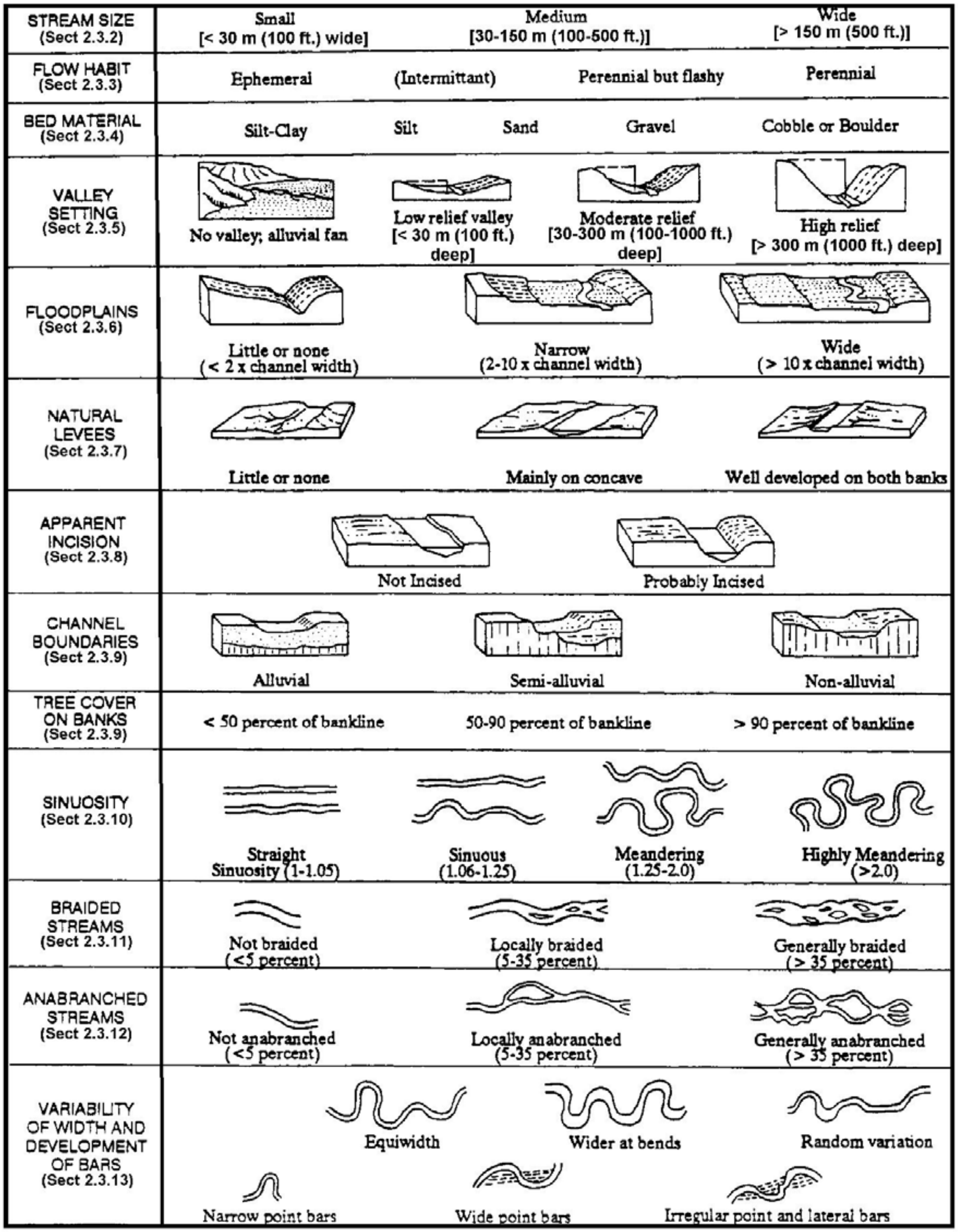

Figure 2.6. Geomorphic factors that affect stream stability (adapted from Brice and Blodgett).[10]

A.28 Fracture Critical Data

RIDOT BRIDGE INSPECTION
FRACTURE CRITICAL DATA

BRIDGE NO.: ____________________
DESCRIPTION: ____________________
LOCATION: ____________________
STRUCTURE TYPE: ____________________

Span No.	FCM No.	FCM Description	Detail No.	Fatigue Detail Description	AASHTO Category	Remarks
FRACTURE CRITICAL MEMBERS						
FATIGUE PRONE DETAILS						

Bridge No. __________

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Appendix B - Pre-Approved Temporary Traffic Control (TTC) Plans

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B.1 Typical Lane Closure on Freeway or Expressway

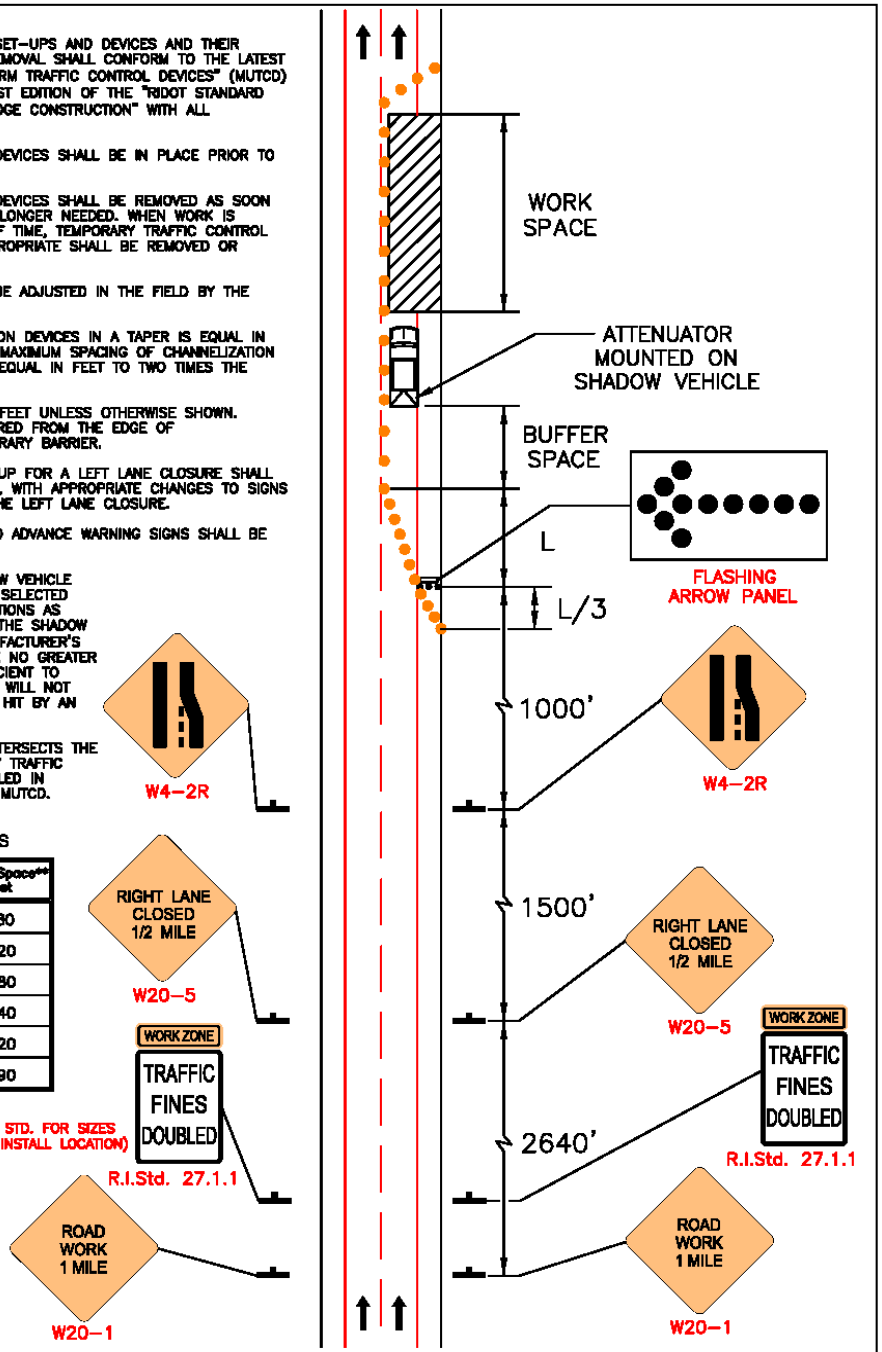
NOTES:

1. ALL TEMPORARY TRAFFIC CONTROL SET–UPS AND DEVICES AND THEIR INSTALLATION, MAINTENANCE, AND REMOVAL SHALL CONFORM TO THE LATEST EDITION OF THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" (MUTCD) WITH ALL REVISIONS, AND THE LATEST EDITION OF THE "RIDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION" WITH ALL REVISIONS.
2. ALL TEMPORARY TRAFFIC CONTROL DEVICES SHALL BE IN PLACE PRIOR TO THE START OF WORK.
3. ALL TEMPORARY TRAFFIC CONTROL DEVICES SHALL BE REMOVED AS SOON AS PRACTICAL WHEN THEY ARE NO LONGER NEEDED. WHEN WORK IS SUSPENDED FOR SHORT PERIODS OF TIME, TEMPORARY TRAFFIC CONTROL DEVICES THAT ARE NO LONGER APPROPRIATE SHALL BE REMOVED OR COVERED.
4. DISTANCES ARE A GUIDE AND MAY BE ADJUSTED IN THE FIELD BY THE ENGINEER.
5. MAXIMUM SPACING OF CHANNELIZATION DEVICES IN A TAPER IS EQUAL IN FEET TO THE SPEED LIMIT IN MPH. MAXIMUM SPACING OF CHANNELIZATION DEVICES IN A TANGENT SECTION IS EQUAL IN FEET TO TWO TIMES THE SPEED LIMIT IN MPH.
6. MINIMUM LANE WIDTH IS TO BE 11 FEET UNLESS OTHERWISE SHOWN. MINIMUM LANE WIDTH TO BE MEASURED FROM THE EDGE OF CHANNELIZATION DEVICES OR TEMPORARY BARRIER.
7. TEMPORARY TRAFFIC CONTROL SET–UP FOR A LEFT LANE CLOSURE SHALL BE SIMILAR TO THE SET–UP SHOWN, WITH APPROPRIATE CHANGES TO SIGNS AND OTHER DEVICES TO INDICATE THE LEFT LANE CLOSURE.
8. THE SIZES OF ALL DIAMOND SHAPED ADVANCE WARNING SIGNS SHALL BE 48" X 48".
9. THE DISTANCE BETWEEN THE SHADOW VEHICLE AND THE WORK SPACE SHOULD BE SELECTED BASED ON TRAFFIC AND SITE CONDITIONS AS WELL AS THE CHARACTERISTICS OF THE SHADOW VEHICLE/ATTENUATOR AND ITS MANUFACTURER'S RECOMMENDATIONS, BUT SHOULD BE NO GREATER THAN THE MINIMUM DISTANCE SUFFICIENT TO ENSURE THAT THE SHADOW VEHICLE WILL NOT ROLL INTO THE WORK SPACE WHEN HIT BY AN ERRANT VEHICLE.
10. WHERE A SIDE STREET OR RAMP INTERSECTS THE WORK ZONE, ADDITIONAL TEMPORARY TRAFFIC CONTROL DEVICES SHALL BE INSTALLED IN ACCORDANCE WITH PART 6 OF THE MUTCD.

TAPER AND BUFFER LENGTHS

Speed Limit	Taper Length* (L) Feet	Buffer Space** Feet
40 MPH	320	180
45 MPH	540	220
50 MPH	600	280
55 MPH	660	340
60 MPH	720	420
65 MPH	780	490

* Required
** Suggested



RHODE ISLAND
DEPARTMENT OF TRANSPORTATION

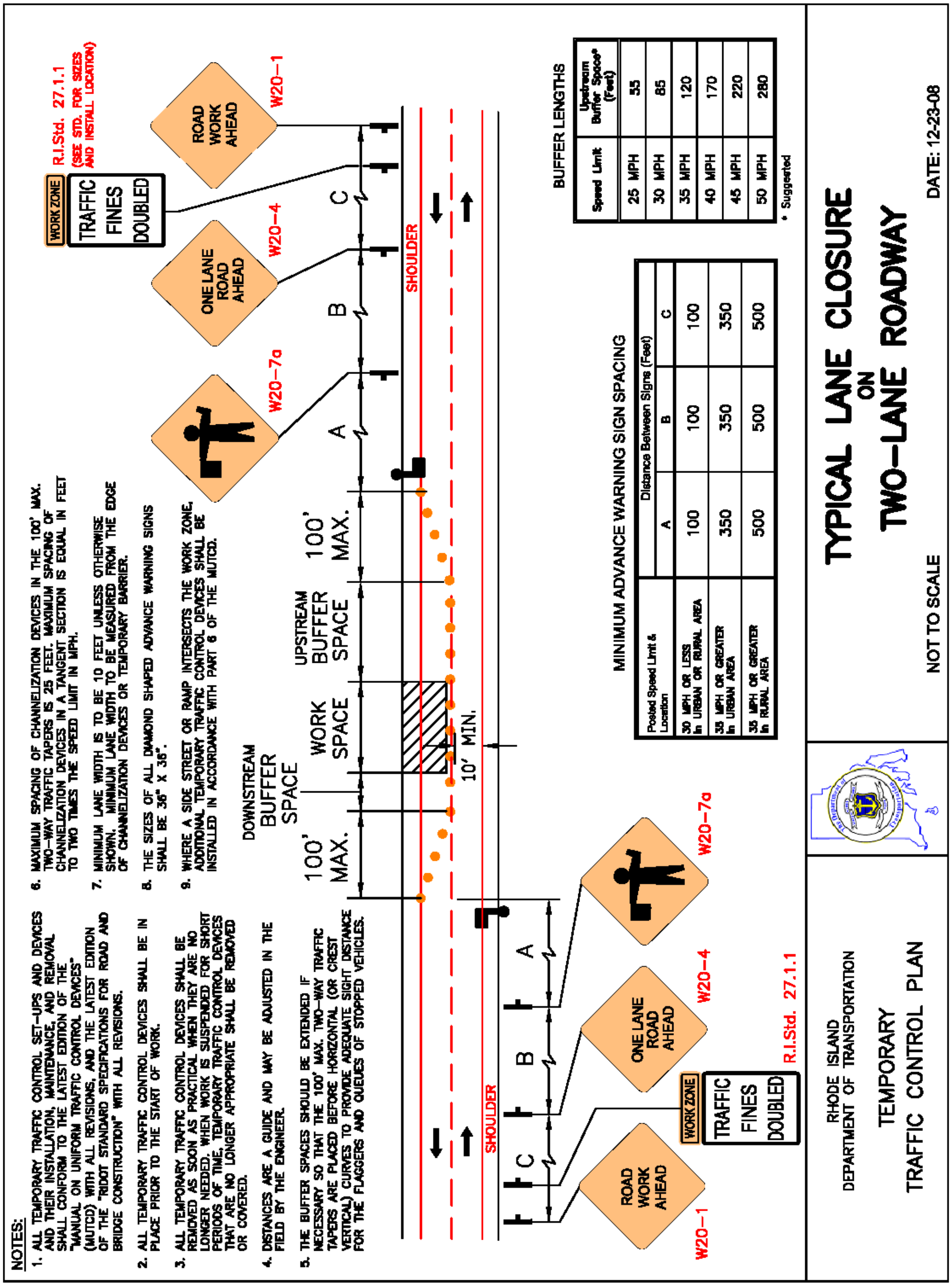
TEMPORARY
TRAFFIC CONTROL PLAN

TYPICAL LANE CLOSURE ON FREEWAY OR EXPRESSWAY

NOT TO SCALE

DATE: 12-23-08

B.2 Typical Lane Closure on Two-Lane Roadway



NOTES:

1. ALL TEMPORARY TRAFFIC CONTROL SET–UPS AND DEVICES AND THEIR INSTALLATION, MAINTENANCE, AND REMOVAL SHALL CONFORM TO THE LATEST EDITION OF THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" (MUTCD) WITH ALL REVISIONS, AND THE LATEST EDITION OF THE "RIDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION" WITH ALL REVISIONS.
2. ALL TEMPORARY TRAFFIC CONTROL DEVICES SHALL BE IN PLACE PRIOR TO THE START OF WORK.
3. ALL TEMPORARY TRAFFIC CONTROL DEVICES SHALL BE REMOVED AS SOON AS PRACTICAL WHEN THEY ARE NO LONGER NEEDED. WHEN WORK IS SUSPENDED FOR SHORT PERIODS OF TIME, TEMPORARY TRAFFIC CONTROL DEVICES THAT ARE NO LONGER APPROPRIATE SHALL BE REMOVED OR COVERED.
4. DISTANCES ARE A GUIDE AND MAY BE ADJUSTED IN THE FIELD BY THE ENGINEER.
5. THE BUFFER SPACES SHOULD BE EXTENDED IF NECESSARY SO THAT THE 100' MAX. TWO–WAY TRAFFIC TAPERS ARE PLACED BEFORE HORIZONTAL (OR CREST VERTICAL) CURVES TO PROVIDE ADEQUATE SIGHT DISTANCE FOR THE FLAGGERS AND QUEUES OF STOPPED VEHICLES.
6. MAXIMUM SPACING OF CHANNELIZATION DEVICES IN THE 100' MAX. TWO–WAY TRAFFIC TAPERS IS 25 FEET. MAXIMUM SPACING OF CHANNELIZATION DEVICES IN A TANGENT SECTION IS EQUAL IN FEET TO TWO TIMES THE SPEED LIMIT IN MPH.
7. MINIMUM LANE WIDTH IS TO BE 10 FEET UNLESS OTHERWISE SHOWN. MINIMUM LANE WIDTH TO BE MEASURED FROM THE EDGE OF CHANNELIZATION DEVICES OR TEMPORARY BARRIER.
8. THE SIZES OF ALL DIAMOND SHAPED ADVANCE WARNING SIGNS SHALL BE 36" X 36".
9. WHERE A SIDE STREET OR RAMP INTERSECTS THE WORK ZONE, ADDITIONAL TEMPORARY TRAFFIC CONTROL DEVICES SHALL BE INSTALLED IN ACCORDANCE WITH PART 6 OF THE MUTCD.

MINIMUM ADVANCE WARNING SIGN SPACING

Posted Speed Limit & Location	Distance Between Signs (Feet)		
	A	B	C
30 MPH OR LESS in URBAN OR RURAL AREA	100	100	100
35 MPH OR GREATER in URBAN AREA	350	350	350
35 MPH OR GREATER in RURAL AREA	500	500	500

BUFFER LENGTHS

Speed Limit	Upstream Buffer Space* (Feet)
25 MPH	55
30 MPH	85
35 MPH	120
40 MPH	170
45 MPH	220
50 MPH	280

* Suggested

RHODE ISLAND DEPARTMENT OF TRANSPORTATION

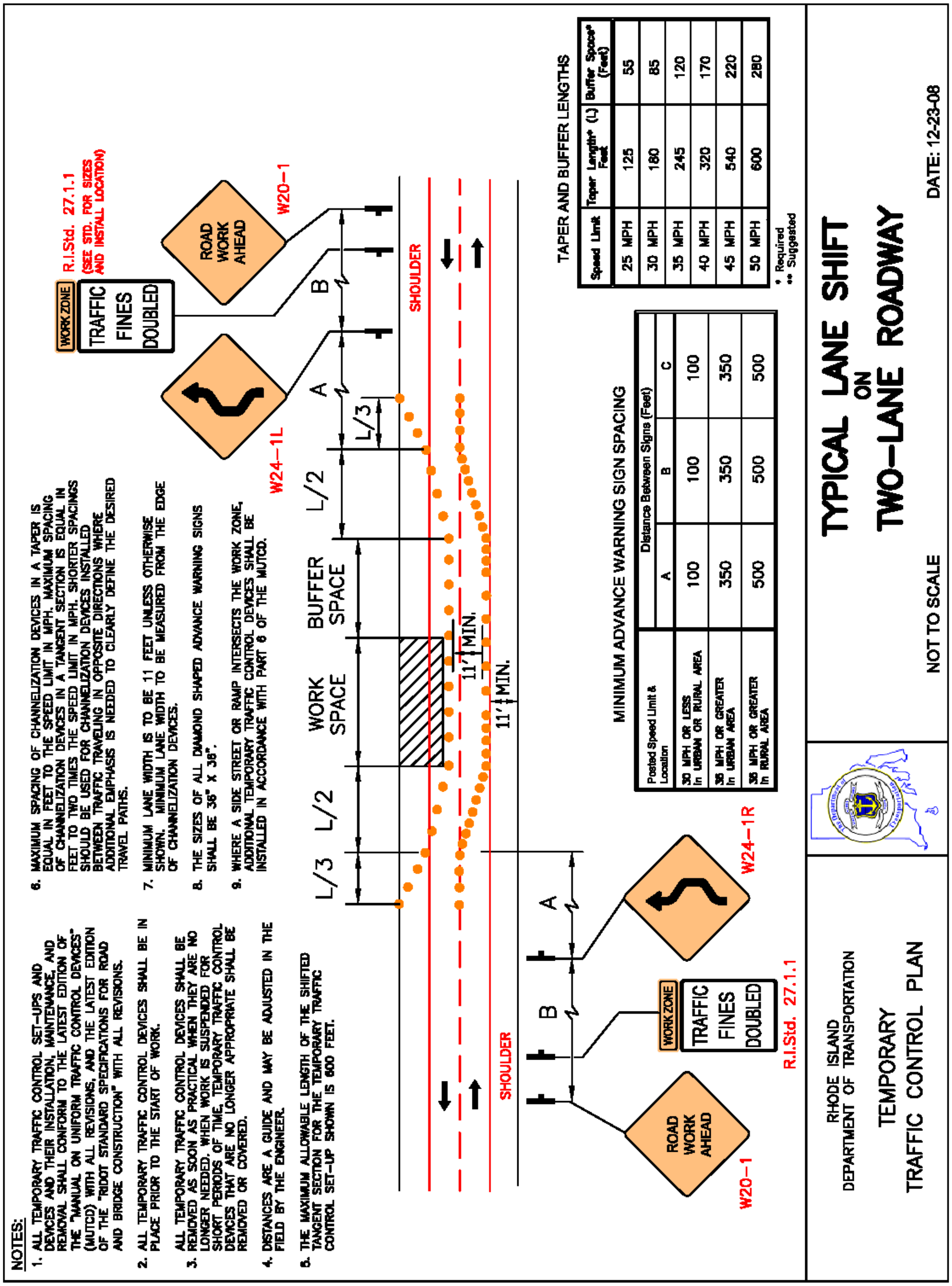
TEMPORARY TRAFFIC CONTROL PLAN

TYPICAL LANE CLOSURE ON TWO–LANE ROADWAY

NOT TO SCALE

DATE: 12-23-08

B.3 Typical Lane Shift on Two-Lane Roadway



NOTES:

1. ALL TEMPORARY TRAFFIC CONTROL SET-UPS AND DEVICES AND THEIR INSTALLATION, MAINTENANCE, AND REMOVAL SHALL CONFORM TO THE LATEST EDITION OF THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" (MUTCD) WITH ALL REVISIONS, AND THE LATEST EDITION OF THE "RIDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION" WITH ALL REVISIONS.
2. ALL TEMPORARY TRAFFIC CONTROL DEVICES SHALL BE IN PLACE PRIOR TO THE START OF WORK.
3. ALL TEMPORARY TRAFFIC CONTROL DEVICES SHALL BE REMOVED AS SOON AS PRACTICAL WHEN THEY ARE NO LONGER NEEDED. WHEN WORK IS SUSPENDED FOR SHORT PERIODS OF TIME, TEMPORARY TRAFFIC CONTROL DEVICES THAT ARE NO LONGER APPROPRIATE SHALL BE REMOVED OR COVERED.
4. DISTANCES ARE A GUIDE AND MAY BE ADJUSTED IN THE FIELD BY THE ENGINEER.
5. THE MAXIMUM ALLOWABLE LENGTH OF THE SHIFTED TANGENT SECTION FOR THE TEMPORARY TRAFFIC CONTROL SET-UP SHOWN IS 600 FEET.
6. MAXIMUM SPACING OF CHANNELIZATION DEVICES IN A TAPER IS EQUAL IN FEET TO THE SPEED LIMIT IN MPH. MAXIMUM SPACING OF CHANNELIZATION DEVICES IN A TANGENT SECTION IS EQUAL IN FEET TO TWO TIMES THE SPEED LIMIT IN MPH. SHORTER SPACINGS SHOULD BE USED FOR CHANNELIZATION DEVICES INSTALLED BETWEEN TRAFFIC TRAVELING IN OPPOSITE DIRECTIONS WHERE ADDITIONAL EMPHASIS IS NEEDED TO CLEARLY DEFINE THE DESIRED TRAVEL PATHS.
7. MINIMUM LANE WIDTH IS TO BE 11 FEET UNLESS OTHERWISE SHOWN. MINIMUM LANE WIDTH TO BE MEASURED FROM THE EDGE OF CHANNELIZATION DEVICES.
8. THE SIZES OF ALL DIAMOND SHAPED ADVANCE WARNING SIGNS SHALL BE 36" X 36".
9. WHERE A SIDE STREET OR RAMP INTERSECTS THE WORK ZONE, ADDITIONAL TEMPORARY TRAFFIC CONTROL DEVICES SHALL BE INSTALLED IN ACCORDANCE WITH PART 6 OF THE MUTCD.

MINIMUM ADVANCE WARNING SIGN SPACING

Posted Speed Limit & Location	Distance Between Signs (Feet)		
	A	B	C
30 MPH OR LESS In URBAN OR RURAL AREA	100	100	100
35 MPH OR GREATER In URBAN AREA	350	350	350
35 MPH OR GREATER In RURAL AREA	500	500	500

TAPER AND BUFFER LENGTHS

Speed Limit	Taper Length* (L) Feet	Buffer Space** (Feet)
25 MPH	125	55
30 MPH	180	85
35 MPH	245	120
40 MPH	320	170
45 MPH	540	220
50 MPH	600	280

* Required
** Suggested

B.4 Typical Shoulder Closure on Freeway or Expressway

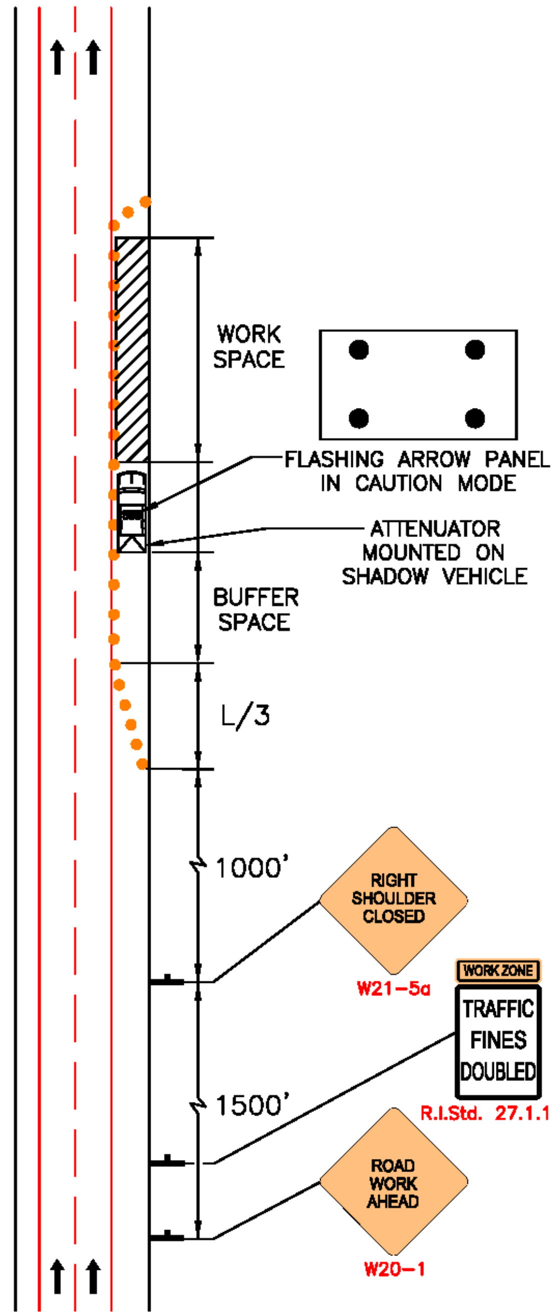
NOTES:

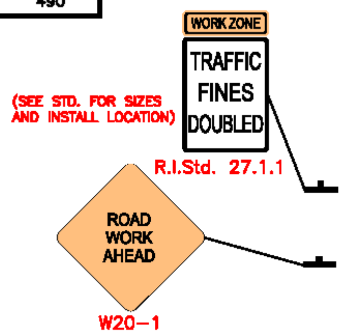
1. ALL TEMPORARY TRAFFIC CONTROL SET-UPS AND DEVICES AND THEIR INSTALLATION, MAINTENANCE, AND REMOVAL SHALL CONFORM TO THE LATEST EDITION OF THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" (MUTCD) WITH ALL REVISIONS, AND THE LATEST EDITION OF THE "RIDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION" WITH ALL REVISIONS.
2. ALL TEMPORARY TRAFFIC CONTROL DEVICES SHALL BE IN PLACE PRIOR TO THE START OF WORK.
3. ALL TEMPORARY TRAFFIC CONTROL DEVICES SHALL BE REMOVED AS SOON AS PRACTICAL WHEN THEY ARE NO LONGER NEEDED. WHEN WORK IS SUSPENDED FOR SHORT PERIODS OF TIME, TEMPORARY TRAFFIC CONTROL DEVICES THAT ARE NO LONGER APPROPRIATE SHALL BE REMOVED OR COVERED.
4. DISTANCES ARE A GUIDE AND MAY BE ADJUSTED IN THE FIELD BY THE ENGINEER.
5. MAXIMUM SPACING OF CHANNELIZATION DEVICES IN A TAPER IS EQUAL IN FEET TO THE SPEED LIMIT IN MPH. MAXIMUM SPACING OF CHANNELIZATION DEVICES IN A TANGENT SECTION IS EQUAL IN FEET TO TWO TIMES THE SPEED LIMIT IN MPH.
6. MINIMUM LANE WIDTH IS TO BE 11 FEET UNLESS OTHERWISE SHOWN. MINIMUM LANE WIDTH TO BE MEASURED FROM THE EDGE OF CHANNELIZATION DEVICES OR TEMPORARY BARRIER.
7. TEMPORARY TRAFFIC CONTROL SET-UP FOR A LEFT SHOULDER CLOSURE SHALL BE SIMILAR TO THE SET-UP SHOWN, WITH APPROPRIATE CHANGES TO SIGNS AND OTHER DEVICES TO INDICATE THE LEFT SHOULDER CLOSURE.
8. THE SIZES OF ALL DIAMOND SHAPED ADVANCE WARNING SIGNS SHALL BE 48" X 48".
9. THE DISTANCE BETWEEN THE SHADOW VEHICLE AND THE WORK SPACE SHOULD BE SELECTED BASED ON TRAFFIC AND SITE CONDITIONS AS WELL AS THE CHARACTERISTICS OF THE SHADOW VEHICLE/ATTENUATOR AND ITS MANUFACTURER'S RECOMMENDATIONS, BUT SHOULD BE NO GREATER THAN THE MINIMUM DISTANCE SUFFICIENT TO ENSURE THAT THE SHADOW VEHICLE WILL NOT ROLL INTO THE WORK SPACE WHEN HIT BY AN ERRANT VEHICLE.
10. WHERE A SIDE STREET OR RAMP INTERSECTS THE WORK ZONE, ADDITIONAL TEMPORARY TRAFFIC CONTROL DEVICES SHALL BE INSTALLED IN ACCORDANCE WITH PART 6 OF THE MUTCD.

TAPER AND BUFFER LENGTHS

Speed Limit	Taper Length* (L) Feet	Buffer Space** Feet
40 MPH	320	180
45 MPH	540	220
50 MPH	600	280
55 MPH	660	340
60 MPH	720	420
65 MPH	780	490

* Required
** Suggested





RHODE ISLAND DEPARTMENT OF TRANSPORTATION

TEMPORARY TRAFFIC CONTROL PLAN

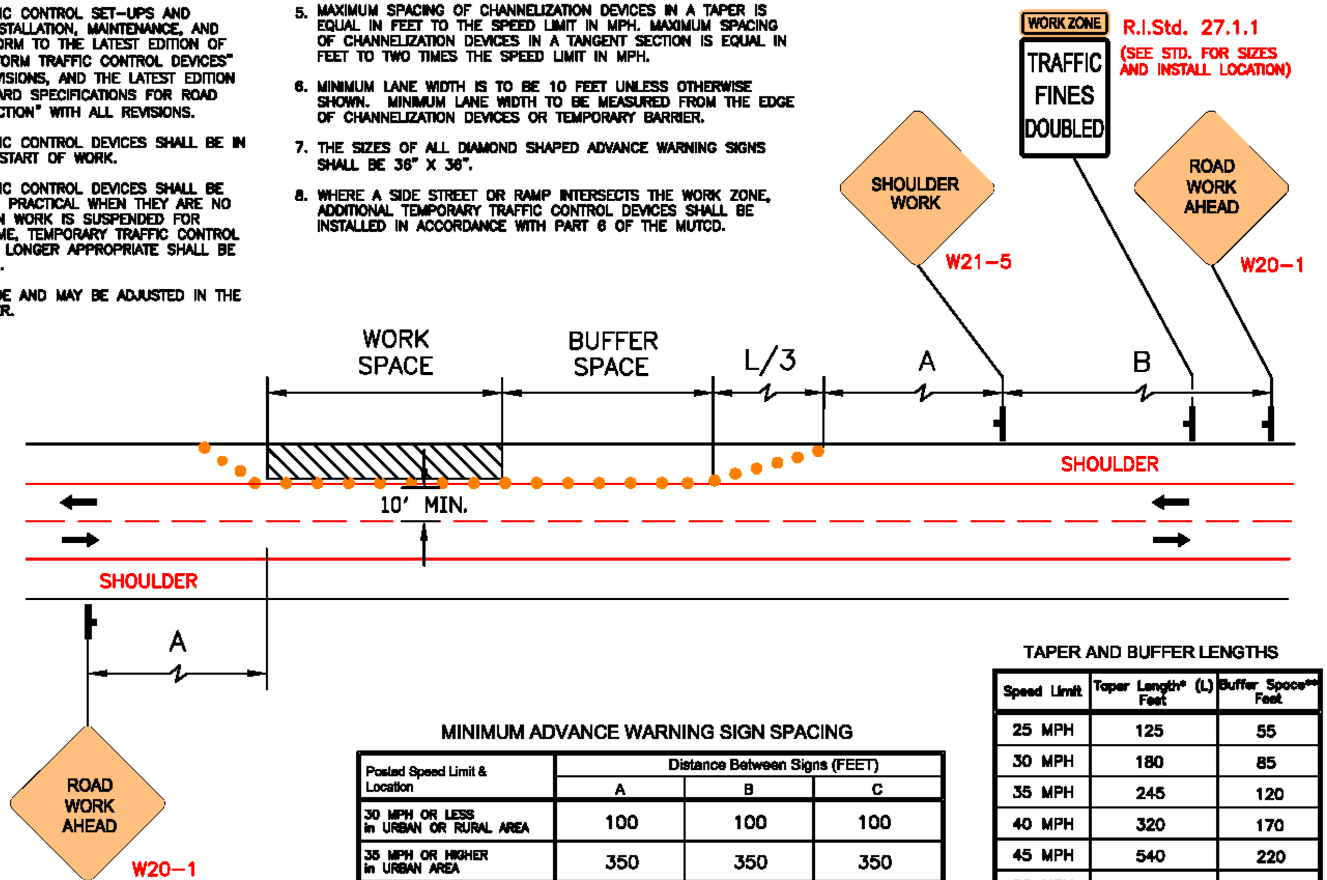
TYPICAL SHOULDER CLOSURE ON FREEWAY OR EXPRESSWAY

NOT TO SCALE DATE: 12-23-08

B.5 Typical Shoulder Closure on Two-Lane Roadway

NOTES:

1. ALL TEMPORARY TRAFFIC CONTROL SET-UPS AND DEVICES AND THEIR INSTALLATION, MAINTENANCE, AND REMOVAL SHALL CONFORM TO THE LATEST EDITION OF THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" (MUTCD) WITH ALL REVISIONS, AND THE LATEST EDITION OF THE "RIDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION" WITH ALL REVISIONS.
2. ALL TEMPORARY TRAFFIC CONTROL DEVICES SHALL BE IN PLACE PRIOR TO THE START OF WORK.
3. ALL TEMPORARY TRAFFIC CONTROL DEVICES SHALL BE REMOVED AS SOON AS PRACTICAL WHEN THEY ARE NO LONGER NEEDED. WHEN WORK IS SUSPENDED FOR SHORT PERIODS OF TIME, TEMPORARY TRAFFIC CONTROL DEVICES THAT ARE NO LONGER APPROPRIATE SHALL BE REMOVED OR COVERED.
4. DISTANCES ARE A GUIDE AND MAY BE ADJUSTED IN THE FIELD BY THE ENGINEER.
5. MAXIMUM SPACING OF CHANNELIZATION DEVICES IN A TAPER IS EQUAL IN FEET TO THE SPEED LIMIT IN MPH. MAXIMUM SPACING OF CHANNELIZATION DEVICES IN A TANGENT SECTION IS EQUAL IN FEET TO TWO TIMES THE SPEED LIMIT IN MPH.
6. MINIMUM LANE WIDTH IS TO BE 10 FEET UNLESS OTHERWISE SHOWN. MINIMUM LANE WIDTH TO BE MEASURED FROM THE EDGE OF CHANNELIZATION DEVICES OR TEMPORARY BARRIER.
7. THE SIZES OF ALL DIAMOND SHAPED ADVANCE WARNING SIGNS SHALL BE 36" X 36".
8. WHERE A SIDE STREET OR RAMP INTERSECTS THE WORK ZONE, ADDITIONAL TEMPORARY TRAFFIC CONTROL DEVICES SHALL BE INSTALLED IN ACCORDANCE WITH PART 6 OF THE MUTCD.



TAPER AND BUFFER LENGTHS

Speed Limit	Taper Length* (L) Feet	Buffer Space** Feet
25 MPH	125	55
30 MPH	180	85
35 MPH	245	120
40 MPH	320	170
45 MPH	540	220
50 MPH	600	280

* Required
** Suggested

MINIMUM ADVANCE WARNING SIGN SPACING

Posted Speed Limit & Location	Distance Between Signs (FEET)		
	A	B	C
30 MPH OR LESS in URBAN OR RURAL AREA	100	100	100
35 MPH OR HIGHER in URBAN AREA	350	350	350
35 MPH OR HIGHER in RURAL AREA	500	500	500

RHODE ISLAND DEPARTMENT OF TRANSPORTATION

TEMPORARY TRAFFIC CONTROL PLAN

TYPICAL SHOULDER CLOSURE ON TWO-LANE ROADWAY

NOT TO SCALE

DATE: 12-23-08

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Appendix C - Electronic Folder Quick Reference Guide

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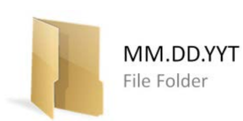
Folder	**Naming Convention**	**Contents**	**Comments**
Bridge Inspection Folder 	Six-digit bridge number Format = xxxxxx	*General Info* folder *Inspection Date* folder *Scour* folder *Critical Findings* folder *Sub Aqueous* folder *Storm Event* folder	Parent folder of *General Info* and *Inspection Date* Folder.
General Info Folder 	General Info	*Plans* folder *TTC* folder Orientation Sketch Elevation Sketch Cross Section Sketch Correspondence Blank Hydraulic Form Blank Vertical Clearance Form Special Inspection Requirements Fracture Critical Member Form Fatigue Sensitive Details Form Scour Documentation Raw Photographs CADD Drawings	This folder includes bridge information related to all inspections.
Inspection Date Folder 	MM.DD.YYT MM = Month of inspection DD = Day of inspection YY = Year of inspection T = Type of inspection (F, S, or leave blank)	Digital photos Vertical Clearance Sheets (Completed) Hydraulic Sheets (Completed) Inspection sketches Field notes Bridge Management Software data changes document	This folder includes inspection information that pertains specifically to the current inspection being performed.
Sub Aqueous Folder 	NA	*.PDI for underwater inspection Underwater inspection support documentation	This folder stores all underwater inspection information.

Folder	Naming Convention	Contents	Comments
Scour Folder 	NA	Scour Evaluation Plan of Action (POA) Traffic Detour Emergency Contact	This folder includes all scour related documentation.
Critical Findings Folder 	NA	Critical Findings Form Applicable Correspondence	This folder stores all critical finding logs and applicable follow-up correspondence.
TTC Folder 	NA	Temporary Traffic Control (TTC)	This folder stores all TTC plans and their backup.
Plans Folder 	NA	Design Plans	This folder stores Bridge Design Plans in PDF and CAD if available.
Storm Event Folder 	"Event name" MM.DD.YY Event name = Name given by NOAA (National Oceanic and Atmospheric Administration) MM = Month of Inspection DD = Day of Inspection YY = Year of Inspection	Digital photos Vertical Clearance Sheets (Completed) Hydraulic Sheets (Completed) Inspection Sketches Field Notes Storm Monitoring Form (Completed)	This folder stores the findings of the bridge condition after a storm event.

Appendix D - Glossary

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1. AASHTO: American Association of State Highway Transportation Officials.
2. Abrasion: The wearing or grinding away of material by water that contains sand, gravel, or stones.
3. ADT: Average Daily Traffic.
4. ADTT: Average Daily Truck Traffic.
5. Aggradation: The general and progressive buildup of the longitudinal profile of a channel bed due to sediment deposition.
6. Approach slab: A reinforced concrete slab on the bridge approach that is seated on the bridge abutment backwall on one end. It may or may not be tied into the backwall with reinforcing bars. Approach slabs are typically provided between concrete roadway pavements and the bridge or at other locations where settlement of fill material may cause a depression in the roadway behind the abutment. Approach slabs reduce impact stresses applied to the bridge by vehicles moving onto the span. Note: If an approach slab exists, but is overlaid, the item should be rated based on the condition of the riding surface. Do not indicate *not visible*
7. Assignment list: A group of bridges assigned to the Consultant for inspection.
8. Back-up bars: Used to prevent groove welds from blowing through the base metal during fabrication.
9. Beam: A linear structural member designed to span from one support to another and support vertical loads (rolled sections).
10. BEU Bridge Engineering Unit.
11. BIU Bridge Inspection Unit.
12. Bridge Management Software (BMS): See Bridge Management System.
13. Bridge Management System (BMS): AASHTO–supported software that is used for the Rhode Island Department of Transportation (RIDOT) for entering, checking, storing, processing, and submitting bridge inspection and inventory information
14. Bridge element: Structural elements that are commonly used in highway bridge construction and are encountered on bridge safety inspections.

15.	Bridge Inspection Folder:	Part of the RIDOT Bridge Inspection Data Folder Organization. Refer to Section 4.1.1.
16.	Cantilevered-suspended span:	Superstructure span composed of cantilevered arms supporting a suspended span.
17.	CCE:	Chief Civil Engineer-Bridge Engineering (RIDOT).
18.	CFR:	Code of Federal Regulations.
19.	Channel:	Typically well-defined, which consists of the bed and banks that confines the streamflow during normal flow conditions.
20.	Checks:	Separations of the wood fibers, normally occurring across or through the annual growth rings, and generally parallel to the grain direction.
21.	Chloride contamination:	The presence of recrystallized soluble salts, which causes accelerated corrosion of the steel reinforcement.
22.	CIP:	Cast-in-place (referring to concrete members).
23.	Coincident area:	Areas of deterioration in the same relative location on the top and bottom of the deck.
24.	Complex bridge:	A bridge that has unusual characteristics or an atypical design configuration, therefore requiring additional or unfamiliar procedures, additional inspection personnel training, or additional personnel experience in order to adequately satisfy the NBIS inspection criteria.
25.	Contamination:	Intrusion of chlorides or other contaminants into the concrete. The extent of contamination is measured by laboratory tests. Generally, a deck is considered contaminated if it contains greater than 2.0 lbs. per cubic yard of concrete (1.2 kg/m^3). Efflorescence is **not** an indication of contamination.
26.	Contraction scour:	The removal of the material under the structure only.
27.	Cover plates:	Welded plates generally used in conjunction with a rolled structural shape that increases the shape's bending capacity by providing additional flange section.
28.	Creep:	A gradual, continuing, irreversible deformation due to a constant stress level below the yield strength.

29.	Critical finding:	A structural deficiency or safety deficiency that requires immediate follow-up inspection and action.
30.	Critical section:	That component of a structural member whose integrity is vital to the success of the member carrying out its design intent. For bending members, the critical section at the bearing areas is the area of the web. For bending members in areas of maximum moment, the critical section is the area of the flanges. For axially loaded members, the critical section is the adjusted gross area as defined in the AASHTO *Manual for Bridge Evaluation*.
31.	Critical spalls:	Spalls that, depending on their location, surface area and depth, could affect the strength, serviceability and stability of the member. Spalls may expose the prestressing tendons that are highly susceptible to corrosion due to the high stress state and relatively small cross sectional area of the tendons and individual wires. The presence of these spalls may indicate a decrease in bond between the concrete and the prestressing tendons, and/or increase in localized concrete and mild steel stresses, that could lead to a nonductile failure of the member with possible partial failure of the structure. A critical spall condition may also exist if the presence of non-critical spalls is widespread enough on a particular member so that the combined effect of the spalling action constitutes a serious situation requiring a large degree of repair or rehabilitation.
32.	Crushing:	Excessive compression. For timber members, occurring perpendicular to the grain, usually at the support points.
33.	Debris:	A collection of tree branches, leaves, litter, and other non-indigenous materials within the stream that have been transported by streamflow, often collecting near bridge substructure units, culvert openings, or shallow water areas.
34.	Decay:	The result of fungi feeding on the cell walls of the wood.
35.	Deficiency (bearings):	Lack or shortage of a structural component (i.e., fasteners, under sizing, etc.) from the quantity specified in design.
36.	Deficiency (concrete deck):	Lack or shortage of a structural component from the quantity specified in design, (i.e., missing concrete components such as haunches, reinforcing bar spacing or size other than that specified by design, etc.). Construction defects such as honeycombing

37.	Deficiency (culverts):	External factors (debris buildup, aggregation or degradation of stream bed, change in flow mass, etc.) and/or lack or shortage of a structural component from the quantity specified by design that affects the ability of the structure to function in its hydraulic design capacity.
38.	Deficiency (prestressed):	Lack or shortage of a structural component from the quantity specified in design, (i.e., missing concrete components, tendon spacing or size other than that specified by design, etc.). Construction defect such as honey combing.
39.	Deficiency (reinf. concrete):	Lack or shortage of a structural component from the quantity specified in design, (i.e., reinforcing bar spacing or size other than that specified by design, etc.). Construction defects such as honey combing or irregularities caused by defective formwork.
40.	Deficiency (steel):	Lack or shortage of a structural component (i.e., missing fasteners, lattice bars, stiffener plate, under sizing, etc.) from the quantity specified by design that affects the ability of the structural component to function in its design capacity.
41.	Deficiency (stone masonry):	Lack or shortage of a structural component from the quantity specified by design that affects the ability of the structure to function in its design capacity.
42.	Deficiency (substructure):	Lack or shortage of structural component (missing fasteners, undersized members, etc.) from the quantity specified by the design that affects the ability of the structural component to function in its design capacity.
43.	Deficiency (timber):	Lack or shortage of a structural component (i.e., missing fasteners, under sizing, etc.) from the quantity specified in design that affects the ability of the structural component to function in its design capacity.
44.	Deflection:	The vertical or horizontal movement of a structure or structural member when subjected to a load.
45.	Deformation:	The local distortion or change in shape of a material due to applied force.
46.	Degradation:	The general and progressive (long-term) lowering of the channel bed due to erosion, over a relatively long channel length.
47.	Delamination:	The subsurface separation of concrete into layers.

48. Deterioration (bearings): Areas exhibiting corrosion, shavings, pitting, impacted rust, section loss, cracks, dings, gouges, impact damage, fire damage, loose fasteners or any other defect that affects the ability of the structural component to function in its design capacity.

49. Deterioration (conc. culvert): Areas exhibiting cracking, spalling, crushing, scaling, delamination, exposed reinforcing bars, efflorescence, water or rust staining or map cracking.

50. Deterioration (concrete deck): Areas exhibiting cracks, spalls, impact damage, map cracking, efflorescence, exposed reinforcing bars (with or without corrosion), delaminations, scaling, wear, abrasion or any other defect, on the topside or underside of the deck, which affects the ability of the reinforced concrete deck to function in its design capacity. On the topside of overlaid bridges, deterioration may be indicated by problems in the bituminous overlay such as map cracking, depressions or evidence of concrete staining coming through the overlay.

51. Deterioration (general culvert): Excessive abrasion, joint or seam defects, water exfiltration, backfill infiltration, scour, undermining, piping, construction or impact damage, fire damage or other defect described below that detracts from the *As-Built* condition of the culvert.

52. Deterioration (masonry culvert): Areas exhibiting cracking, spalling, crushing, loss of joint mortar, displaced, loose or missing stones or weathering.

53. Deterioration (metal culvert): Areas exhibiting corrosion, pitting, impacted rust, section loss, cracks, dings, gouges, racking, peaking, flattening, sagging, bulging, or bent, loose or missing fasteners. Metal culverts include steel and aluminum.

54. Deterioration (prestressed): Areas exhibiting cracks, spalls, impact damage, map cracking, efflorescence, exposed reinforcing bars or prestressing tendons with or without corrosion and section loss, delaminations, water staining, scaling, abrasion or any other defect that affects the ability of the structural component to function in its design capacity.

55. Deterioration (reinf. concrete): Areas exhibiting cracks, spalls, scaling, impact damage, map cracking, efflorescence, exposed reinforcing bars with or without corrosion and section loss, delaminations (hollow areas), abrasion or any other defect that reduces the ability of the structural component to function in its design capacity.

56.	Deterioration (steel):	Areas exhibiting corrosion, pitting, impacted rust, section loss, cracks, dings, gouges, impact or construction damage, fire damage, loose fasteners or any other defect that detracts from the *As-Built* condition of the member.
57.	Deterioration (stone masonry):	Areas exhibiting cracking, spalling, crushing, loss of joint mortar, efflorescence, displaced, loose cracked or missing stones, weathering or other defects.
58.	Deterioration (substructure):	Areas exhibiting conditions which decrease their capacity (concrete: cracks, delamination, efflorescence, scaling, spalls, etc.; steel: cracks, rust, section loss, etc.; timber: checks, cracks, fire damage, insect damage, rot, etc.; masonry: cracks, joint deterioration, missing stones, etc.); movement (vertical, lateral, or rotational) due to settlement; vehicle or vessel impact damage, etc.; loss of bearing area (scour, undermining, etc.); or any other defect that detracts from the *As-Built* condition of the unit.
59.	Deterioration (timber):	Areas exhibiting fungus growth, decay, parasite infestation, fire damage, collision or impact damage, section loss, weathering or warping, splitting, cracking, checking, chemical damage, or signs of overstress that detracts from the *As-Built* condition of the member.
60.	Displacement:	Sliding, tilting, heaving, rotating or settling of the masonry stones. Displacements may be caused by but are not limited to such things as collision, deterioration, water infiltration and freeze/thaw action, and settlement of the substructure.
61.	Drift:	See debris.
62.	Efflorescence:	The leaching out of calcium carbonate and other recrystallized carbonate and chloride compounds.
63.	End rotation:	Occurs when a structure deflects.
64.	Erosion	Wearing away of soil by flowing water not associated with a channel.
65.	Fatigue:	The tendency of a member to fail at a stress below the yield stress when subjected to cyclical loading.
66.	FCM:	Fracture critical member.
67.	FHWA:	Federal Highway Administration.
68.	Field welds:	Welds that are used to repair corroded areas, add strengthening components or to correct fabrication errors.

69.	Floorbeam:	A structural member that spans transversely between frames, girders, arches, or trusses that helps to support a bridge deck and stringers, if present.
70.	Force:	The action that one body exerts on another body.
71.	Fracture critical member:	A steel member in tension, or with a tension element, whose failure would probably cause a portion of or the entire bridge to collapse.
72.	Fracture:	The separation of a member into two (2) parts.
73.	Gabions:	Consist of rectangular rock- or cobble-filled wire mesh baskets or compartmented rectangular containers.
74.	General Info:	Part of the RIDOT Bridge Inspection Data Folder Organization. Refer to Section 4.1.1.
75.	General scour:	The lowering of a streambed across the waterway at the bridge, which may or may not be uniform.
76.	Girder:	A flexural member that is the main or primary support for the structure, spanning longitudinally from substructure unit to substructure unit and which usually receives loads from floorbeams and stringers (built-up sections).
77.	Guide banks:	Dikes that extend upstream from the approach embankment at either or both sides of the bridge opening to direct flow through the opening.
78.	Honeycombs:	Voids in concrete that are caused by the failure of mortar to fill in the spaces between aggregate.
79.	Horizontal shear splits:	Separations of the wood fibers parallel to the grain due to excessive loading.
80.	Insert plates:	Plates that are placed into the girder web in order to change the cross section of the girder.
81.	Inspection Date Folder:	Part of the RIDOT Bridge Inspection Data Folder Organization. Refer to Section 4.1.1.
82.	Inspection due date:	The last inspection date plus the frequency of the inspection.
83.	Integral:	When two different components act as one unit. For example, when the deck portion of a beam is constructed to act together with the stem, which provides greater stiffness and allows for greater span lengths.

84.	Intermittent welds:	Discontinuous welds used to connect bridge steel members.
85.	Internal redundancy:	A bridge member having several elements that are mechanically fastened together.
86.	Intersecting welds:	Welds that run through each other, overlap, touch, or have a gap between their toes of less than ¼ of an inch.
87.	Knots:	Separations of the wood fibers due to the trunk growing around an embedded limb.
88.	Lateral stream migration:	The relocation of the channel due to lateral streambank erosion.
89.	Load path redundancy:	A bridge having four (4) or more main load-carrying members.
90.	Local scour:	The removal of streambed material adjacent to an obstruction in a waterway, that has been placed within the stream (such as a pier or abutment), and causes the acceleration of the flow induced by an abutment or a vortex induced by the obstruction to the flow due to a pier.
91.	Loss of prestress:	Occurs due to the relaxation of steel, debonding of steel-concrete interface, shrinkage, or creep.
92.	ME:	Managing Engineer-Bridge Engineering (RIDOT).
93.	Mechanical fasteners:	Bolts or rivets.
94.	MPT plan:	Maintenance and Protection of Traffic plan (also referred to as temporary traffic control (TTC)).
95.	MUTCD:	Manual on Uniform Traffic Control Devices.
96.	NBI:	National Bridge Inventory.
97.	NBIS:	National Bridge Inspection Standards.
98.	NCHRP:	National Cooperative Highway Research Program.
99.	NDE:	Nondestructive evaluation.
100.	NDT	Nondestructive testing.
101.	NHI:	National Highway Institute.
102.	NICET:	National Certification in Engineering Technologies.

103. Non-structural cracks (prestressed):
Cracks, to include temperature, shrinkage and other cracks that do not pose an immediate threat to the structural integrity of the member but allow penetration of water, corrosion producing agents and other contaminants that cause further deterioration of the concrete, mild reinforcing steel, anchor bolts, etc., and affect the structure over the long term. Spalling, due to freeze/thaw action and bleeding efflorescence may be present around these cracks.

104. Non-structural cracks (conventionally reinforced):
Cracks caused by temperature changes or shrinkage and other cracks that do not pose an immediate threat to the structural integrity of the member but allow penetration of water, corrosion producing agents and other contaminants that may cause further deterioration of the concrete, reinforcing steel, anchor bolts, etc., and negatively affect the structure over the long term. Spalling, due to freeze/thaw action and bleeding efflorescence may be noted around these cracks.

105. Out-of-plane bending: Occurs when a member is loaded causing it to twist about its longitudinal axis.

106. Overload: Occurs when the elastic limit of the member is exceeded.

107. PE: Professional Engineer.

108. Percent deterioration: A span by span estimation of the total surface area of the deteriorated concrete relative to the total deck surface area is required to determine the appropriate component condition rating. Coincident areas are counted only once and superficial defects, such as light scaling, hairline shrinkage or temperature cracks (parallel to primary reinforcement), tight map cracked areas without efflorescence or dry areas of efflorescence that do not appear to have active leakage, shall generally not be included in this calculation. Repaired areas, as defined below, should not be included unless they are of a temporary nature (bituminous concrete patches) or are themselves deteriorated (hollow patches).

109. Pin and hanger assemblies: Hinge connection detail designed to allow for expansion and rotation between a cantilevered and suspended span at a point between supports.

110. Plan of Action:	A report consisting of the process, schedule, and cost estimate to implement corrective action. A plan of action may consist of verbal communication followed by written confirmation in emergency situations.
111. Post-tensioned:	A method of prestressing concrete in which the tendons are stressed after the concrete has been cast and hardens The concrete is cast with ducts and the reinforcement is then threaded through the ducts, stressed (stretched) after the concrete cures.
112. Prestressed:	Applying forces to a structure to deform it in such a way that it will withstand its working loads more effectively. The reinforcement is stressed in concrete prior to the application of the live load.
113. Pretensioned:	A method of prestressing concrete in which the strands are stressed before the concrete is placed. Strands are released after the concrete has hardened, inducing internal compression into the concrete.
114. Program manager (PM):	The individual in charge of the program that has been assigned or delegated the duties and responsibilities for bridge inspection, reporting, and inventory. Refer to Section 2.1.
115. Purchase order (PO):	A commercial document used to request someone to supply something in return for payment and providing specifications and quantities.
116. Quality Assurance (QA):	The required procedures to sample and measure the adequacy of quality control procedures.
117. Quality Control (QC):	The systematic procedures that RIDOT and inspection Consultant follow to maintain the overall quality of a bridge inspection at or above a specified level. These procedures include, but are not limited to, the qualifications of staff, quality of field inspections, staff training, validation of data collected and entered into the Bridge Management System (BMS), and identification/resolution of data errors.
118. Redundancy:	The capability of a bridge structural system to carry loads after damage to or the failure of one or more of its members.
119. Reinforcing bar:	Mild steel (non-prestressed) reinforcing steel, also known as reinforcement bars. Most commonly placed transverse to the longitudinal centerline of the prestressed member for use as shear reinforcement or parallel to the longitudinal centerline for use as temperature and shrinkage reinforcement.

120. Relief joints: Joints between the rigid concrete approach pavement and approach slab that are designed to absorb the thermal expansion and contraction stresses produced by the approach pavement, which if left unchecked, could induce overturning forces in the abutment backwall. The joints are filled with bituminous material and vary in length up to 15 feet (5 m). Bituminous concrete overlays (particularly if freshly laid) may hide the relief joint from view. However, they are typically marked by cracking or saw cut joints, transverse to the roadway, at the relief joint/approach pavement and relief joint/approach slab interfaces.

121. Repaired area: Areas of the deck that have been repaired using an approved concrete mix, and approved repair details, which are sound and functioning as designed. Pop-outs on the underside of a deck that do not extend above the lower layer of reinforcement, and are coated with a protective epoxy type coating, should be considered permanent repairs. Any nonpermanent repairs, such as bituminous patches, are not considered a repaired area.

122. Return wall: Approach embankment supporting wall component which is orientated +/- 90 degrees to the abutment stem and/or approximately in-line with the approach roadway. Return walls are inspected up to a minimum of 25 feet from the abutment or to the end of the approach slab (if present). See Figure D-1 for different examples of return walls.

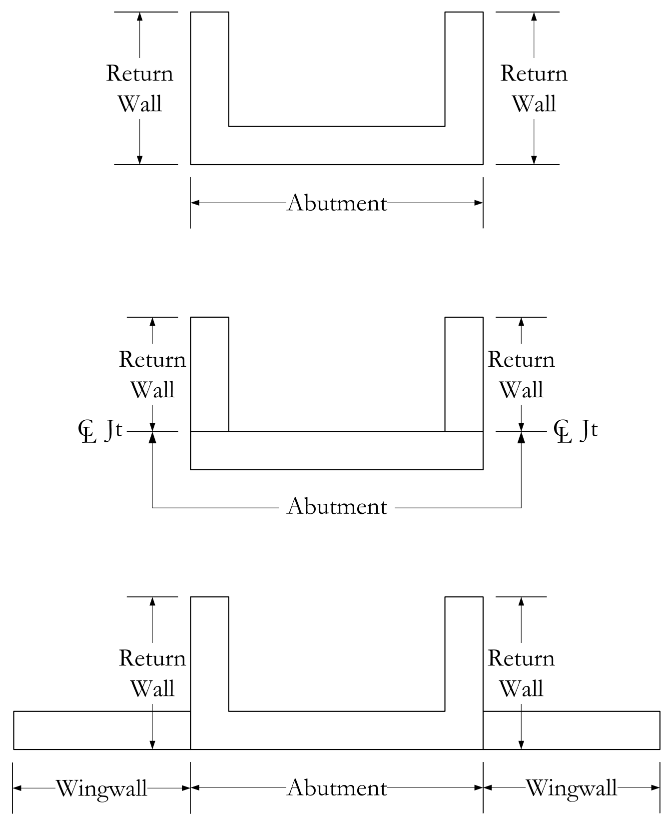

Figure D-6.12-1
Return walls

123. RIDOT: Rhode Island Department of Transportation. (Referred to as the State or the Department.)

124. Riprap: Layers or facings of properly sized and graded rock or broken concrete placed to protect a structure or embankment from erosion.

125. Safety 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 spalling concrete or concrete hanging down over traffic or pedestrians, missing section(s) of bridge railing or barrier, etc.

126. Scaling:	The gradual and continuing loss of mortar and aggregate over an area due to the chemical breakdown of the cement bond.
127. Scour critical:	A bridge whose foundation(s) has been determined to be unstable for the anticipated scour conditions.
128. Scour:	The removal of material from the streambed or streambank as a result of the erosive action of streamflow.
129. Shakes:	Separations of the wood fibers parallel to the grain between the annual growth rings.
130. SI&A:	Structure Inventory and Appraisal.
131. SIP:	Stay-in-place (referring to formwork; SIP forms).
132. Slope protection:	The placement of geotextiles, wire mesh, paving, revetment, plantings, or other materials on the existing channel embankments.
133. Spall:	A depression in concrete caused by a separation of a portion of the surface concrete.
134. Splits:	Advanced checks that extend completely through the piece of wood.
135. Spurs:	Linear structures, design with properly sized and placed rocks, which protect the streambank by reducing the flow velocity, inducing settlement to be deposited, and redirecting the flow.
136. Strain:	The measure of deformation and denotes the amount an object deforms with respect to its original dimension.
137. Strand:	Fabricated by twisting wires together, the seven-wire strand is the most common type of prestressing steel in the United States.
138. Streambanks:	The sloped sides of the channel.
139. Streambed:	The bottom of the channel.
140. Streamflow:	The water, suspended sediment, and any debris moving through the channel.
141. Stress:	The force per unit area and denotes the intensity of an internal force.
142. Stringer:	A longitudinal beam spanning between transverse floorbeams and supporting a bridge deck.

143. Structural cracks (prestressed): Cracks, other than temperature and shrinkage cracks, that depending on their location, length, width and orientation to the member being rated, indicate the possibility of one or more of the following: a reduction in prestressing force within the steel tendons, an over stressing condition of the concrete and/or mild reinforcing steel, a reduction in the structural integrity of the member, an immediate need for further investigation. These cracks may allow water and contaminant infiltration that may cause an increased rate of deterioration of the prestressing tendons and debonding of the concrete, possibly reducing the capacity of the member. The width of the cracks may indicate the progressive level of the over stressing condition. Cracks that form in member compression zones or at bearing interfaces indicating excessive compressive stresses, may be accompanied by crushing of the concrete around the cracks and may lead to nonductile failure of the member. Cracks in prestressed tension zones, indicating a relaxing of the prestressing tendons or excessive tensile stresses in the concrete, may occur at tendon anchorages and/or locations of maximum live load bending moment. They may be hairline to narrow in width and under extreme conditions, may open and close with vehicular live load application. Cracks that are diagonal in orientation to the member indicate over stress in shear. Longitudinal cracking along bottom flanges of box beams, especially when accompanied by rust staining.

144. Structural cracks (reinf.): Cracks, other than temperature and shrinkage cracks, that depending on their location, length, width and orientation to the member being rated, indicate the possibility of one or more of the following: an over stressed condition of the concrete and/or reinforcing steel, a reduction in the structural integrity of the member, or an immediate need for further investigation. These cracks may allow water and contaminant infiltration with subsequent corrosion of the reinforcing steel and delamination of the concrete possibly reducing the capacity of the member. The width of the cracks may indicate the progressive level of the over stress condition. Cracks that form in member compression zones or at bearing interfaces, indicating excessive compressive stresses, may be accompanied by crushing of the concrete around the cracks and may lead to non-ductile failure of the member. Cracks in tension zones, indicating excessive tensile stresses, may visibly open and close with application of live load. Cracks that are diagonal in orientation to the member indicate over stress in shear.

145. 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 affects the structural integrity of the bridge or determined as substantially endangering the load-carrying capacity of the bridge.
146. Structural redundancy:	A bridge having continuity of the load path from span to span.
147. Substructure:	The bridge component that supports the bridge superstructure.
148. Superstructure:	The bridge component that supports highway or other traffic loads and transfers the loads to the substructure and then foundations.
149. Surface breakdown:	See scaling.
150. Tack weld:	Small welds commonly used to temporarily hold pieces in position during fabrication or construction.
151. Triaxial constraint:	Three-dimensional stress state, which reduces the apparent ductility of the material which prevents yielding and redistribution of local stress concentrations.
152. Team leader:	The individual responsible for planning, preparing, and performing the inspections of individual bridges. Refer to Section 2.3.
153. Tendon:	A high strength cable, strand, wire or bar used for prestressing (pretensioning or post-tensioning).
154. TRB:	Transportation Research Board.
155. TTC:	Temporary traffic control (also referred to as Maintenance and Protection of Traffic (MPT)).
156. Undermining:	The scouring away of stream and supporting foundation material from beneath the substructure footing.
157. Waterway area:	The entire area beneath the bridge which is available to pass flood flows.
158. Wear:	Gradual removal of surface mortar due to friction.

159. Wingwall: Approach embankment supporting wall component which is orientated at an obvious angle less than 90 degrees to the abutment stem and not in-line with the approach roadway. See Figure D-2 for different examples of wingwalls.

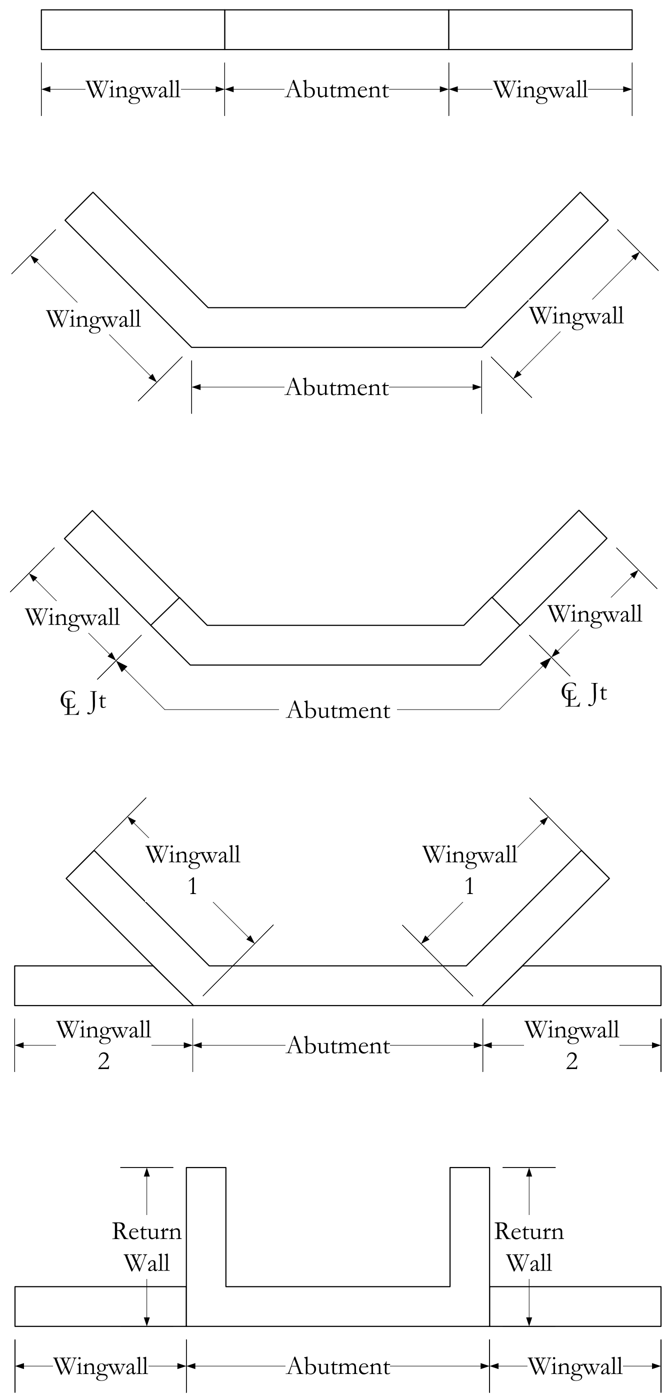

Figure D-6.12-2
Wingwalls

160. Wire: Single wires or parallel wire cables. Parallel wire cables are commonly used in post-tensioning.

161. Yield strength: The stress level at which plastic deformation begins.

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Appendix E – Traffic Safety Feature Coding

For structures that are on the National Highway System (or NHS structures), the appraisal of SI&A Item 36 is based on comparing the traffic safety features in place at the bridge site to current national standards set by regulation, so that an evaluation of their adequacy can be made. For those structures not on the NHS (or non-NHS structures), the procedure is the same but compared to current RIDOT standards. The coding of SI&A Item 104 can be used in determining whether or not a bridge carries an NHS or non-NHS roadway. Item 104 is coded 1 if the bridge carries an NHS roadway and coded 0 if the bridge carries a non-NHS roadway. If a traffic safety feature segment meets standards for NHS roadways, then it can be presumed to meet standards for non-NHS roadways. For trailing edge traffic safety features 36B, 36C, and 36D, code N if no hazards exist within the clear zone.

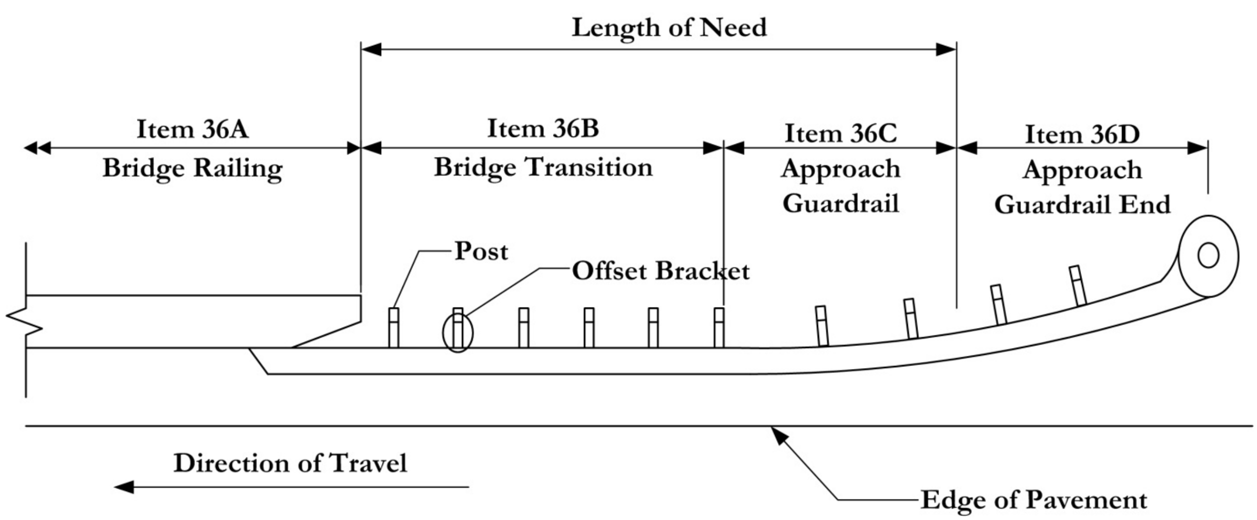

Figure E-1
Schematic of Traffic Safety Features

Traffic Safety Feature Segment 36A – Bridge Railings

When evaluating the bridge railing systems, consider the full length of all bridge railings and if any portions of those railings do not meet standards, then Item 36A is coded 0. For acceptable types of bridge railings, refer to Figure E-2.

Bridge railing retrofit – Code 1 if:

- Open concrete bridge rail with W-beam or Thrie beam across entire bridge (with or without pedestals posts or blocked out)
- Open horizontal metal bridge rail with W-beam or Thrie beam across entire bridge (with or without pedestal posts or blocked out)
- Combination or Solid Concrete Bridge Rail with Safety Walk and with W-Beam or Thrie beam across entire bridge (with or without pedestal posts or blocked out)
- Combination or Solid Concrete Bridge Rail with Safety Walks less than 6 inches wide

Description	RI Bridge Standard Drawing Number	Concrete Height (inches)	Steel Height (inches)	Total Railing Height (inches)	Open or Solid Concrete	Open or Solid Steel	Comment
Sloped concrete safety barrier w/ granite curb and bituminous wearing surface	10.10	35	0	35	Solid	No steel	
Sloped concrete safety barrier w/ bituminous wearing surface	10.10	35	0	35	Solid	No steel	Crash tested - meets requirements of AASHTO service TL-4
Vertical concrete parapet and one bar aluminum railing combo w/ sidewalk and bituminous wearing surface	10.10, 10.20	28	14	42	Solid	Open (1 rail)	
Four bar steel bridge rail w/ sidewalk and bituminous wearing surface	10.10, 10.22, 10.23	0	42	42	No concrete	Open (4 rails)	Crash tested - meets requirements of AASHTO service TL-4, 5 foot minimum sidewalk, max post spacing is 8 feet
Sloped concrete safety barrier w/ granite curb and concrete wearing surface	10.11	32	0	32	Solid	No steel	
Sloped concrete safety barrier w/ concrete wearing surface	10.11	32	0	32	Solid	No steel	Crash tested - meets requirements of AASHTO service PL-2
Vertical concrete parapet and one bar aluminum railing combo w/ sidewalk and concrete wearing surface	10.11, 10.20	28	14	42	Solid	Open (1 rail)	
Four bar steel bridge rail w/ sidewalk and concrete wearing surface	10.11, 10.22, 10.23	0	42	42	No concrete	Open (4 rails)	Crash tested - meets requirements of AASHTO service PL-2, 5 foot minimum sidewalk, max post spacing is 8 feet
Four bar steel bridge rail	10.20	0	42	42	No concrete	Open (4 rails)	Max post spacing is 8 feet
Baldwin four bar ornamental rail	10.21	0	45.25	45.25	No concrete	Open (4 rails)	Max post spacing is 8 feet
Two bar steel bridge rail w/ granite curb	10.30, 10.31, 10.32	7	27	34	No concrete railing (curb only)	Open (2 rails)	Crash tested - meets requirements of AASHTO service TL-4, max post spacing is 8 feet
Vertical concrete parapet and two bar steel bridge rail	10.35, 10.36	24	26	50	Solid	Open (2 rails)	Crash tested - meets requirements of AASHTO service TL-4, max post spacing is 7'-6"
Timber rail	Applicable AASHTO Standards	N/A	N/A	32	N/A	N/A	Timber rails that have been designed in accordance with AASHTO and considered "crash worthy" by RIDOT (for non-NHS bridges)

Figure E-2
Types of Acceptable Bridge Railings in Rhode Island

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Traffic Safety Feature Segment 36B – Bridge Transitions

When evaluating the bridge transitions, one must consider all four corner treatments and determine if each corner meets or does not meet the standards. If any of the corners do not meet the standards, then Item 36B is coded 0. If some of the corners meet the standards and others are not applicable or not required, then Item 36B is coded 1. On a dual direction road with undivided traffic, all four corners are considered as leading edges.

NHS

Jersey shape transition - Code 1

F-shape transition – Code 1

Vertical shape transition – Code 1

Semi-rigid transitional rail system consisting of sufficiently stiffened W-beam, box-beam, or thrie-beam rail, strong posts with wood/plastic block-outs, and rub-rail to prevent potential snagging as applicable (rub-rail not required for bridge rails with less than 15 inches of exposed concrete or metal below the transition rail) – Code 1

All others – Code 0

Non-NHS

Semi-rigid transitional rail system as noted above with steel block-outs – Code 1

The below deficient conditions would cause the transition to not comply with RIDOT standards and therefore cause a coding of 0:

- Details which create a "bump-out" (or snag-point) condition at either the leading or trailing edges
- Bull nose element
- Greater than 5 inches of exposed concrete or metal bridge rail above transition (see Figure E-4)
- Greater than 15 inches exposed concrete or metal bridge rail below transition (see Figure E-10)
- Three-cable or two-cable leading into or trailing from bridge on a dual direction road
- Box beam without a pocket in the parapet to receive it causing a blunt edge or snag potential

Traffic Safety Feature Segment 36C – Approach Guardrail (Non-NHS and NHS)

When evaluating the bridge approach guardrail, one must consider all four corner treatments and determine if each corner meets or does not meet the standards. If any of the corners do not meet the standards, then Item 36C is coded 0. If some of the corners meet the standards and others are not applicable or not required, then Item 36C is coded 1.

All of the current standards include a strength transition. Therefore if the bridge transition meets standards then assume the approach rail has been crash tested in accordance with the latest standards – Code 1

Weak post guardrail system – Code 0

No approach rail – Code 0

Traffic Safety Feature Segment 36D – Approach Guardrail End (Non-NHS and NHS)

When evaluating the bridge approach guardrail end, one must consider all four corner treatments and determine if each corner meets or does not meet the standards. If any of the corners do not meet the standards, then Item 36D is coded 0. If some of the corners meet the standards and others are not applicable or not required, then Item 36D is coded 1. On dual directional road with undivided traffic, all four corners are considered as leading edges. Systems which are continuous with the highway guardrail system are coded N.

Leading edge anchors are required to be placed outside the design clear zone. Refer to Figure E-3 and using either the 85 percent speed or 10 mph over the posted speed and the ADT, find the clear zone distance.

- If the leading edge anchor is inside this dimension as measured from the edge of the travel way and does not meet standards, then Code 0.
- If the leading edge anchor is outside or at this dimension as measured from the edge of the travel way, then Code 1.
- Trailing edge anchors on single direction roadways need not be measured. For dual direction roadways, measure distance from the double yellow line on the trailing edge. If the distance is equal to or greater than the clear zone, Code 1, if not Code 0.

Design Speed	Design ADT	Foreslopes			Backslopes		
		1V:6H or flatter	1V:5H or 1V:4H	1V: 3H	1V: 3H	1V:5H to 1V:4H	1V:6H or flatter
40 mph or less	Under 750	7 – 10	7 – 10	**	7 – 10	7 – 10	7 – 10
	750 – 1500	10 – 12	12 – 14	**	10 – 12	10 – 12	10 – 12
	1500 – 6000	12 – 14	14 – 16	**	12 – 14	12 – 14	12 – 14
	Over 6000	14 – 16	16 – 18	**	14 – 16	14 – 16	14 – 16
45 – 50 mph	Under 750	10 – 12	12 – 14	**	8 – 10	8 – 10	10 – 12
	750 – 1500	14 – 16	16 – 20	**	10 – 12	12 – 14	14 – 16
	1500 – 6000	16 – 18	20 – 26	**	12 – 14	14 – 16	16 – 18
	Over 6000	20 – 22	24 – 28	**	14 – 16	18 – 20	20 – 22
55 mph	Under 750	12 – 14	14 – 18	**	8 – 10	10 – 12	10 – 12
	750 – 1500	16 – 18	20 – 24	**	10 – 12	14 – 16	16 – 18
	1500 – 6000	20 – 22	24 – 30	**	14 – 16	16 – 18	20 – 22
	Over 6000	22 – 24	26 – 32*	**	16 – 18	20 – 22	22 – 24
60 mph	Under 750	16 – 18	20 – 24	**	10 – 12	12 – 14	14 – 16
	750 – 1500	20 – 24	26 – 32*	**	12 – 14	16 – 18	20 – 22
	1500 – 6000	26 – 30	32 – 40*	**	14 – 18	18 – 22	24 – 26
	Over 6000	30 – 32*	36 – 44*	**	20 – 22	24 – 26	26 – 28
65 – 70 mph	Under 750	18 – 20	20 – 26	**	10 – 12	14 – 16	14 – 16
	750 – 1500	24 – 26	28 – 36*	**	12 – 16	18 – 20	20 – 22
	1500 – 6000	28 – 32*	34 – 42 *	**	16 – 20	22 – 24	26 – 28
	Over 6000	30 – 34*	38 – 46 *	**	22 – 24	26 – 30	28 – 30

Notes:

1. *All distances are measured from the edge of the traveled way, unless it is on the opposite side of a dual direction roadway, in which case, the distance should be measured from the double yellow line (line separating directions of travel).*
2. *The values in the table apply to all facilities both urban and rural.*

** Where a site specific investigation indicates a high probability of continuing crashes, or such occurrences are indicated by crash history, the designer may provide clear-zone di stances greater than the clear-zone shown in the table above. Clear zones may be limited to 30 feet for practicality and to provide a consistent roadway template if previous experience with similar projects or designs indicates satisfactory performance.*

***Since recovery is less likely on the unshielded, traversable 1Y:3H slopes, fixed objects should not be present in the vicinity of the toe of these slopes. Recovery of high-speed vehicles that encroach beyond the edge of the shoulder may be expected to occur beyond the toe of slope. Determination of the width of the recovery area at the toe of slope should take into consideration right-of-way availability, environmental concerns, economic factors, safety needs, and crash histories. Also, the distance between the edge of the through traveled lane and the beginning of the 1V:3H slope should influence the recovery area provided at the toe of slope.*

Reference: Table 3.1 of the AASHTO Roadside Design Guide, 3rd edition

Figure E-3
Recommended Clear Zone Distances (feet)

Sound judgment is to be utilized when Coding Traffic Safety Features. To support this effort, Coding of Items 36A-36D is provided for NHS and non-NHS roadways on the subsequent pages. The examples listed are provided for guidance only. They are not to be considered all inclusive or comprehensive.

NHS

36A – Code 1 (open concrete bridge rail with W-beam retrofit across entire bridge)

If leading edge:
36B – Code 0 (steel block-outs, greater than 5 inches vertical exposed concrete at end posts)
36C – Code 0 (steel block-outs)

If trailing edge: (with hazards in clear zone)
36B – Code 0 (steel block-outs)
36C – Code 0 (steel block-outs)

Figure E-4: Open Concrete Rail with W-beam Retrofit and Metal Beam Approach Rail

36A – Code 1 (combination rail greater than 42 inches high)

If leading edge:
36B – Code 1 (less than 15 inches of exposed vertical concrete below transition rail and less than 5 inches of exposed vertical concrete above transition rail)

If trailing edge: (with hazards in clear zone)
36B – Code 0 (snag point exists)

Figure E-5: Combination Bridge Rail with Metal Beam Approach Rail

NHS

Figure E-6: Solid Concrete Bridge Rail with Thrie Beam Approach Rail

36A – Code 1 (greater than 32 inch high concrete safety shape)

If leading edge:
36B – Code 1 (Thrie beam with plastic block-outs)
36C – Code 1 (plastic block-outs)
36D – Code N (continuous with highway rail, guardrail end safety feature is not required)

If trailing edge: (with hazards in clear zone)
36B – Code 1 (Thrie beam with plastic block-outs)
36C – Code 1 (plastic block-outs)
36D – Code N (continuous with highway rail, guardrail end safety feature is not required)

Figure E-7: Solid Concrete Bridge Rail

36A – Code 1 (greater than 32 inch high concrete safety shape)

NHS

36A – Code 1 (greater than 32 inch high concrete safety shape)

If leading edge:
36B – Code 0 (steel block-outs, greater than 5 inches of exposed vertical concrete above transition rail)

If trailing edge: (with hazards in clear zone)
36B – Code 0 (steel block-outs)

Figure E-8: Solid Concrete Bridge Rail with Metal Beam Approach Rail

36A – Code 1 (combination rail with retrofit greater than 42 inches high)

If leading edge:
36B – Code 0 (steel block-outs, greater than 5 inches of exposed vertical concrete above transition rail)

If trailing edge: (with hazards in clear zone)
36B – Code 0 (steel block-outs)

Figure E-9: Combination Bridge Rail with W-Beam Retrofit and Metal Beam Approach Rail

NHS

36A – Code 0 (combination rail with safety walk greater than 6 inches wide)

If leading edge:
36B – Code 0 (steel block-outs, greater than 15 inches of exposed vertical concrete below transition rail and weak posts)

If trailing edge: (with hazards in clear zone)
36B – Code 0 (steel block-outs and weak posts)

Figure E-10: Combination Bridge Rail with Safety Walk

36A – Code 1 (greater than 32 inch high concrete safety shape)

If leading edge:
36B – Code 1 (Thrie beam rail, plastic block-outs)

If trailing edge: (with hazards in clear zone)
36B – Code 1 (Thrie beam rail, with end shoe treatment element)

Figure E-11: Solid Concrete Bridge Rail with Thrie Beam Approach Rail

Non-NHS

36A – Code 0 (open concrete bridge rail)

If leading edge:
36B – Code 0 (no transition, blunt end condition)
36C – Code 0 (no guardrail)
36D – Code 0 (no end treatment)

If trailing edge: (with hazards in clear zone)
36B – Code 0
36C – Code 0
36D – Code N (guardrail end safety feature is not required)

Figure E-12: Open Concrete Rail

36A – Code 0 (timber bridge rail less than 32 inches high)

Figure E-13: Timber Bridge Rail

Non-NHS

36A – Code 1 (timber bridge rail greater than 32 inches high and approved by RIDOT)

Figure E-14: Timber Bridge Rail

36A – Code 1 (timber bridge rail greater than 32 inches high and approved by RIDOT)

Figure E-15: Timber Bridge Rail

Non-NHS

Figure E-16: Open W-Beam Bridge Railing

36A – Code 0 (open W-beam metal beam rail across the entire bridge)

If leading edge:
36B – Code 0 (weak post guardrail system)
36C – Code 0 (weak post guardrail system)
36D – Code 0 (guiderail end treatment within the design clear zone)

If trailing edge: (N/A)

(Note: All corners in example would be considered leading edge since dual-direction road way)

Figure E-17: Open Concrete Bridge Rail with Metal Beam Approach Rail

36A – Code 0 (open concrete bridge rail)

If leading edge:
36B – Code 0 (greater than 5 inches of exposed vertical concrete above transition rail)
36C – Code 0 (post spacing exceeds standards)

If trailing edge: (with hazards in clear zone)
36B – Code 1
36C – Code 0 (post spacing exceeds standards)

Non-NHS

Figure E-18: Open W-Beam Bridge Railing

36A – Code 0 (open W-beam metal beam rail across the entire bridge)

If leading edge:
36B – Code 1
36C – Code 1 (post spacing matches standards)
36D – Code 0 (guardrail end treatment within design clear zone)

If trailing edge: (with hazards in clear zone)
36B – Code 1 (decreased post spacing)
36C – Code 1 (post spacing matches standards)
36D – Code 0 (guardrail end treatment within design clear zone)

Figure E-19: Open Metal Bridge Railing with Approach Metal Beam Rail

36A – Code 0 (metal fence railing)

If leading edge:
36B – Code 0 (not attached to railing)

If trailing edge: (with hazards in clear zone)
36B – Code 0 (not attached to railing)

Non-NHS

36A – Code 1 (greater than 42 inch four bar steel bridge)

Figure E-20: Metal Three Bar Bridge Rail with Sidewalk

36A – Code 1 (combination rail greater than 42 inches high)

Figure E-21: Combination Bridge Rail with Sidewalk

Non-NHS

Figure E-22: Solid Concrete Bridge Rail with Timber Approach Rail

36A – Code 1 (greater than 32 inch concrete barrier)

If leading edge:
36B – Code 0 (greater than 5 inches of exposed vertical concrete above transition rail)
36C – Code 1 (timber guardrail greater than 32 inches high and approved by RIDOT)

If trailing edge: (with hazards in clear zone)
36B – Code 1 (timber transition greater than 32 inches high and approved by RIDOT)
36C – Code 1 (timber guardrail greater than 32 inches high and approved by RIDOT)

Figure E-23: Open Metal Bridge Rail

36A – Code 0 (less than 32 inches in height)

Non-NHS

36A – Code 1 (combination rail greater than 42 inches high)

Figure E-24: Combination Bridge Rail

36A – Code 1 (metal railing greater than 42 inches tall)

Figure E-25: Metal Bridge Rail with Concrete Rail Base and with Sidewalk

Non-NHS

Figure E-26: Four-Bar Steel Bridge Rail with Metal Beam Approach Rail

36A – Code 1 (four-bar steel bridge rail)

If leading edge:
36B – Code 1 (less than 15 inches exposed vertical concrete below and less than 5 inches of exposed vertical concrete above transition rail)
36C – Code 1
36D – Code 0 (guardrail end treatment within design clear zone)

If trailing edge: (with hazards in clear zone)
36B – Code 1
36C – Code 1
36D – Code 0 (guardrail end anchor within design clear zone) Code N (guardrail end anchor is outside the design clear zone)

Figure E-27: Combination Bridge Rail with Metal Beam Approach Rail

36A – Code 1 (concrete and aluminum greater than 42-inches high)

If leading edge:
36B – Code 1 (less than 15 inches of exposed vertical concrete below transition rail and less than 5 inches of exposed vertical concrete above transition rail)

If trailing edge: (with hazards in clear zone)
36B – Code 1

Non-NHS

36A – Code 1 (two-bar steel bridge rail with a minimum height of 34 inches)

Figure E-28: Two-bar Steel Bridge Rail with Concrete Rail Base and Fence

Figure E-29: Baldwin 4-Bar Ornamental Steel Bridge Rail

36A – Code 1 (four-bar steel rail)

<u>If leading edge:</u>
36B – Code 0 (no transition, blunt end condition)
36C – Code 0 (no approach guardrail)
36D – Code 0 (no end treatment)

<u>If trailing edge:</u> (with hazards in clear zone)
36B – Code 0 (no transition, blunt end condition)
36C – Code 0 (no approach guardrail)
36D – Code 0 (no end treatment)

Note: Utility pole does not affect traffic safety feature coding

Non-NHS

36A – Code 0 (3-bar steel rail)

If leading edge:
36B – Code 0 (not connected to railing, blunt end condition)

If trailing edge: (with hazards in clear zone)
36B – Code 0 (not connected to railing, blunt end condition)

Figure E-30: Three-Bar Steel Bridge with Metal Beam Approach Rail

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Appendix F – Fatigue Sensitive Details

The following is a compilation of common fatigue sensitive details found on steel superstructure bridges that are most susceptible to fatigue cracking. They are taken from the Manual for Inspecting Bridges for Fatigue Damage Conditions written for the Pennsylvania Department of Transportation. The location of the fatigue crack shown in each detail represents the location where the crack is most likely to occur. This does not mean, however, that it is the only possible location. Inspectors are to scrutinize the entire area prone to fatigue for the existence of cracks.

General notes about fatigue cracks:

- Fracture of steel members due to fatigue is a three step process that involves fatigue crack initiation, crack propagation (slow growth) and brittle fracture (rapid growth).

- High residual tensile stresses can develop in the weld metal due to the rapid heating and subsequent cooling during the welding process. These residual stresses can often exceed the service stresses due to dead and live load. As a result, the net tensile stress in the weld metal of tension members or in tension zones can exceed the net tensile stress in the base metal. In compression members or in compression zones, weld metal can have net tensile stress even though adjacent base metal is in compression.

- Fatigue cracks in welds on compression members or in compression zones, generally do not propagate by fatigue crack growth. Their presence, however, are not to be overlooked or ignored.

- Fatigue cracks generally initiate at an internal flaw within the weld or weldment produced during the welding process. Welds that are perpendicular to applied bending or axial stress are more susceptible to fatigue cracking than those parallel to applied stress.

- Oxide dust (Ableeding rust) forms within the fatigue crack due to abrasion of adjacent sides of the crack during flexure action. The presence of oxide dust in a line along a connection or around a fastener is a general indicator of the presence of a fatigue crack.

- The absence of paint cracks does not preclude the presence of fatigue cracks. Fatigue cracks can propagate from 1/4 to 1/2 of the plate thickness before the paint film cracks.

- Cleaning a suspect area by means of grinding or sand blasting may result in smearing the surface of the crack giving erroneous evidence as to the presence or extent of the crack. Care is to be exercised when cleaning the area under investigation to avoid smearing.

Fatigue Damage in Welded Details

1. Fatigue cracks in main members

a. Ends of welded cover plates

- Cracks typically occur at the toe of the fillet weld where it attaches the cover plate to the flange.
- Details with flange thicknesses of greater than 0.8 inches are more prone to fatigue cracking.
- In transverse end welds (weld "B"), multiple cracks may initiate and join to become one large crack increasing the possibility of brittle fracture.
- In details without transverse end welds, cracks typically develop and propagate from the end of the longitudinal weld (weld "A") into the flange plate.

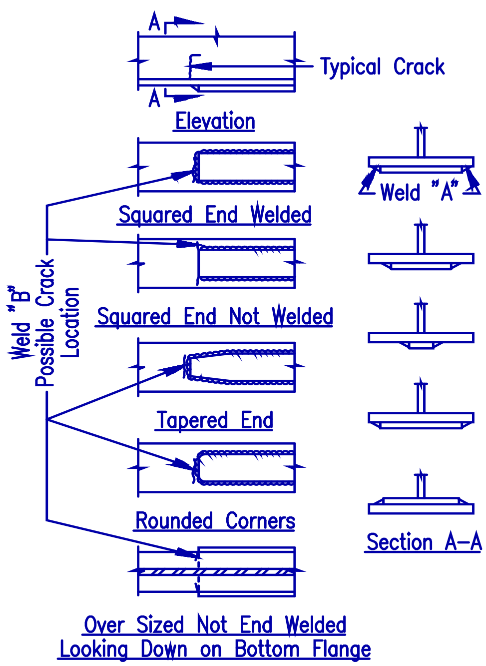

Figure F-1
Schematics of the Different Ends of Welded Cover Plates

b. Transverse groove welds in flange plates

- Cracks at these locations are often not detectable through visual methods prior to brittle fracture. Other forms of NDT, such as Ultra-sonic testing, may have to be employed to evaluate these details.

- Due to improved methods of non-destructive testing during fabrication, fatigue problems are not expected at this location on newer structures (1980+).

- Tension flanges fabricated with this detail prior to 1970 or by electroslag methods are highly susceptible to fatigue cracking.

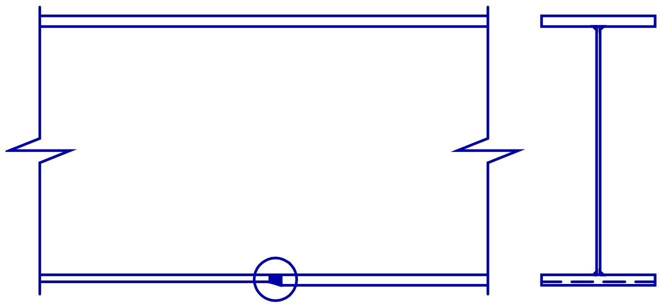

Figure F-2
Schematics of a Transverse Groove Weld in a Flange Plate

c. Butt welds in longitudinal stiffeners

- Cracks may initiate in the butt weld between the plates or at the intersection of the butt weld and stiffener longitudinal fillet weld.

- Cracks may propagate through the longitudinal stiffener fillet weld into the girder web or longitudinal stiffener plate.

- Longitudinal stiffeners in compression zones of girders have low fatigue susceptibility.

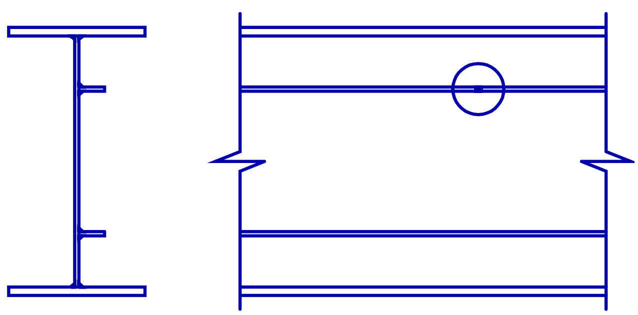

Figure F-3
Schematics of a Butt Weld in a Longitudinal Stiffener

d. Web Plates with Cutouts and Filler Welds

- Girder bottom flanges from adjacent spans connected via splice plate through the web of the transverse cross girder may be welded on one or both sides of the web of the cross girder.

- Fatigue cracks may occur in the cross girder web at the toe of the fillet weld connecting the splice plate to the cross girder. Both sides of the cross girder web are to be checked.

- Found primarily on newer bridges (1970+), this detail is likely to develop fatigue cracks.

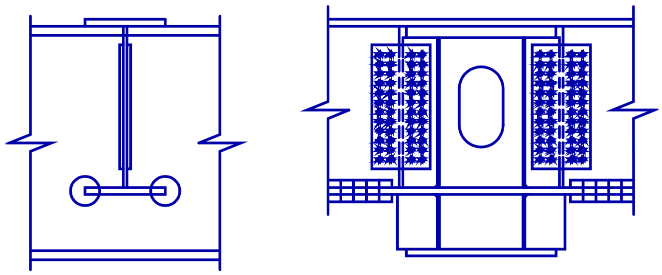

Figure F-4
Schematics of Web Plates with Cutouts and Filler Welds

e. Intersecting groove welds in insert plates

- Insert plates may occur over large areas, such as over piers, to increase haunch depth or as web repair plates (any size) occurring at any location on the girder.

- Cracks may initiate at the intersection of the longitudinal and transverse groove weld and may propagate into the web or flange of the girder.

- Particular attention is paid to welds that are perpendicular to the applied bending or axial stress.

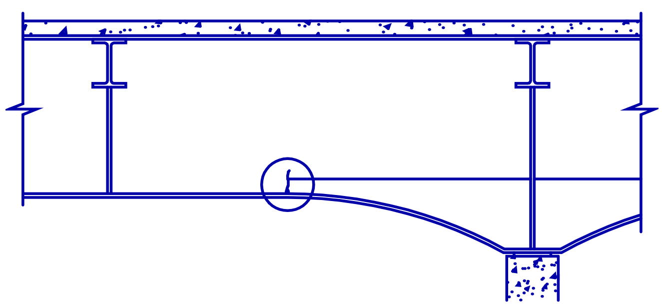

Figure F-5
Schematic of a Crack in an Intersecting Groove Weld in an Insert Plate

f. Mis-drilled holes filled with weld material and plug welds

- Misplaced holes in the tension zone of superstructure members that are filled with weld metal or plug welded serve as potential fatigue crack locations.

- Rough, un-ground welds are indicators that weld quality is poor and fatigue crack probability is high.

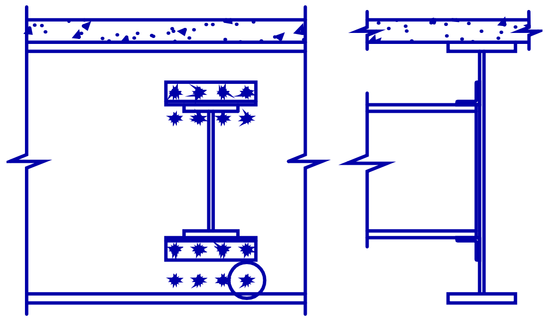

Figure F-6
Schematics of Mis-drilled Holes with Weld Material and Plug Welds

g. Butt welded and tack welded backup bars

- Backup bars used in the groove weld process are often made continuous through butt welds and are usually held in place during the welding process using tack welds. These butt welds and tack welds are sources of low quality welds and the possibility of fatigue cracks at these locations is high.

- Fatigue cracks that initiate at butt welds or tack welds can propagate into the main member base metal via the full penetration groove weld. These cracks may be transverse to the direction of computed stress, which significantly increases the potential for brittle fracture of the member.

- If back up bars are orientated transversely to the direction of computed stress and not removed after the welding process, the probability of fatigue crack initiation is increased.

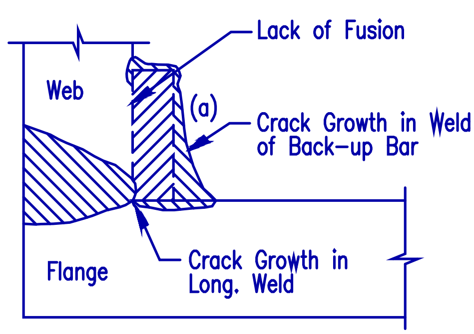

Figure F-7
Schematic of Crack in a Welded Backup Bar

2. Fatigue cracks in members at connections and attachments

a. Cut short flanges, coped beam ends and blocked flange plates

- Coping, blocking and shortening of member flanges, can cause a significant reduction in member stiffness and the process of flame cutting may induce high residual tensile stresses.

- Rough surface finish, dings, and gouges as well as sharp re-entrant corners without transitions at the copes or blocks make these areas highly susceptible to fatigue cracking. Fatigue cracks in these details are most likely to initiate at the re-entrant corner.

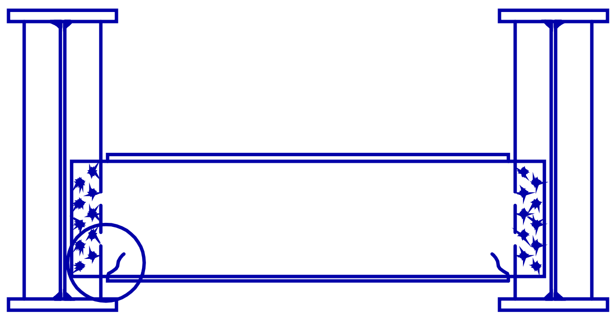

Figure F-8
Schematic of Cracks at Member Connections

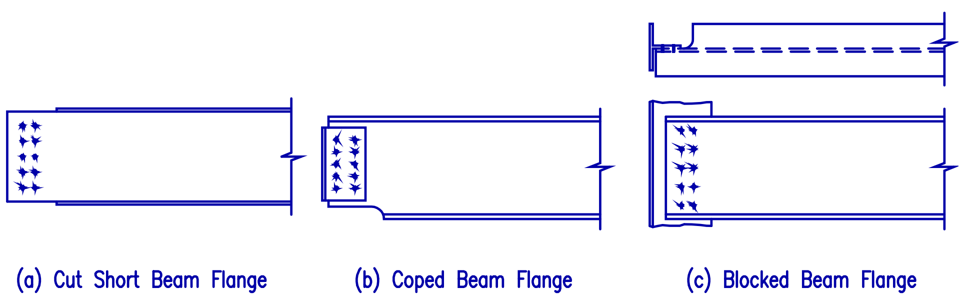

Figure F-9
Schematic of Cut Short Beam Flange, Coped Beam Flange and Blocked Beam Flange

b. Welded rigid connections of cross girders at bents

- Cross girder top and bottom flanges pass through the column web plate and are welded to the column walls parallel to the cross girder (weld "A").

- The cross girder flanges are also connected to the transverse column web plate with welds that often incorporate backup bars (weld "B"). These welds and backup bars are transverse to the direction of stress in the cross girder and are highly susceptible to fatigue cracking.

- Cracks are most likely to form at the intersection of welds "A" and "B".

- Similar welds connecting the compression flange with the column web plate are checked for fatigue cracks.

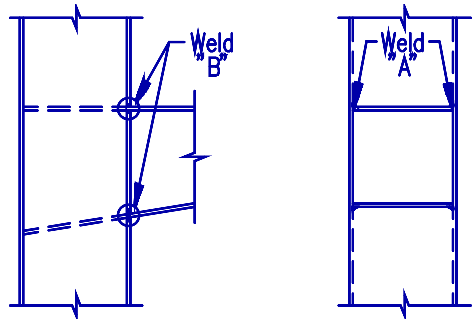

Figure F-10
Schematics of Welds at Rigid Connections

c. Welded flange attachments

- Attachments may be butt welded to the edge of the flange or overlap the top or bottom surface of the flange and be attached with fillet welds.
- Unless the detail provides for a gradual change in geometry at the flange to plate intersection, it is highly prone to fatigue cracks. Cracks typically initiate at the weld terminations.
- All welds to tension flanges, such as brackets for anchoring catwalk hangers, drainage pipes, utilities, etc., are examined closely.

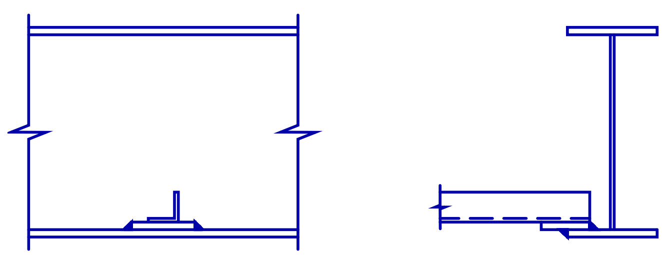

Figure F-11
Schematics of Welded Flange Attachments

d. Intersecting welds at gussets and diaphragms

- The longitudinal horizontal weld between the gusset plate and the web, and the transverse horizontal weld between the gusset plate and the diaphragm connection plate, intersect the vertical weld between the diaphragm connection plate and the web, creating a detail highly prone to fatigue cracking.

- Defects generally originate in the weld between the gusset plate and diaphragm connection plate.

- Other possible locations where intersecting welds may cause fatigue problems are at interior plate diaphragms of box girders, intersections of longitudinal and transverse stiffener plates, diaphragm connection plates on girder webs, floorbeam end bracket connections to girder web and flanges etc.

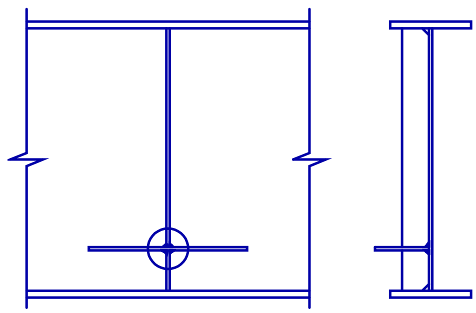

Figure F-12
Schematics of Intersecting Welds at a Gusset Plate and Diaphragm

3. Fatigue damage due to out-of-plane or transverse forces and deflection

a. Girder webs at floorbeam and diaphragm connections

- In negative moment regions, where the top flange is rigidly embedded in the concrete deck and the floorbeam or diaphragm connection plate is not connected to the top flange, out-of-plane fatigue cracks may develop in the web gap region between the longitudinal flange to web weld and the top of the floorbeam or diaphragm connection plate

- Look for horizontal cracks in the web of the girder at the top of the floorbeam connection plate. These cracks may propagate as an upside down "U" along the upper ends of the fillet welds of the connection plate (figure "A"). Cracks may also show in the girder web along the toe of the flange to web fillet weld on the opposite side of the floorbeam connection (figure "B")

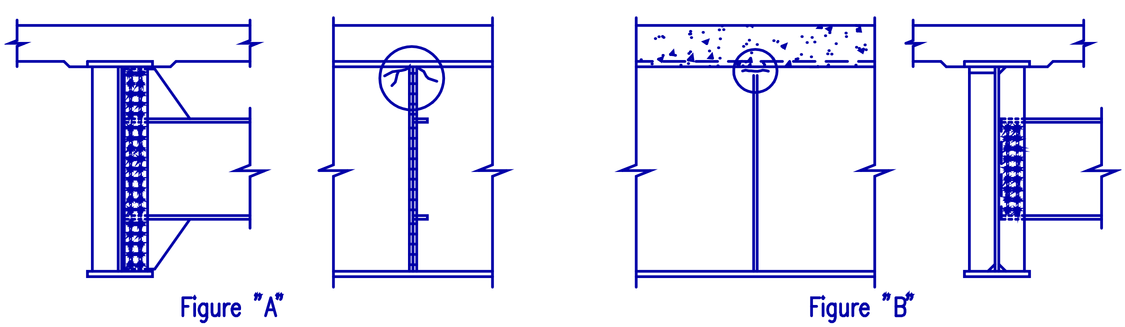

Figure F-13
Schematics of Fillet Weld at Connection Plate and Floorbeam Connection

- In areas of positive moment where the floorbeam or diaphragm connection plate is not connected to the bottom flange, fatigue problems as described above may develop. The flange in these areas is not restrained against lateral movement. This reduces, but not eliminates, the effects of out-of-plane bending (figure "D").

- Floorbeam and diaphragm connections at bearing areas may experience this fatigue problem as the bottom flange is restrained against lateral movement by its connection to the bearing (figure "C").

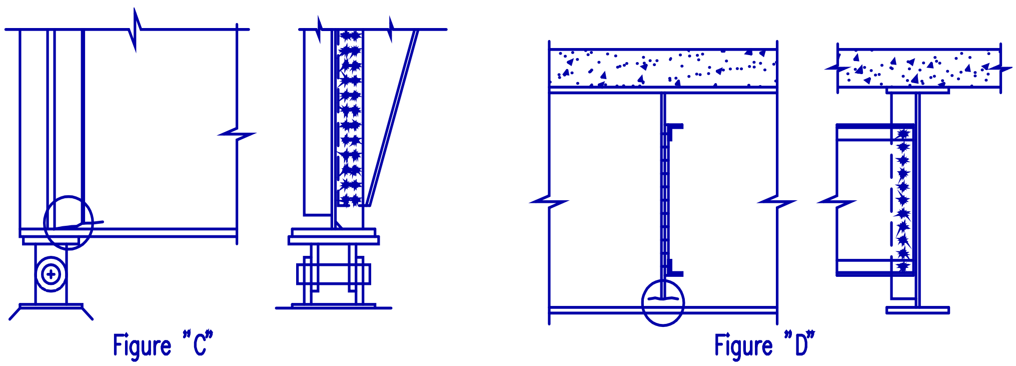

Figure F-14
Schematics of Floorbeam and Diaphragm Connections

- Highly skewed bridges with diaphragms and floorbeam connections perpendicular to the girders and bridges with staggered diaphragms, have increased probability of developing fatigue cracks because of large differential deflections between adjacent girders.

b. Ends of diaphragm connection plates

- When the diaphragm connection plate is welded to the flange of the girder, fatigue cracks may develop along the weld to the flange (figure "A").

- This fatigue crack may propagate along the weld through the connection plate and completely sever the connection plate creating a detail.

- Where diaphragms are connected to the connection plate via small gusset plates (figure "B"), fatigue cracks may develop in the ends of the weld connecting the gusset plate to the connection plate.

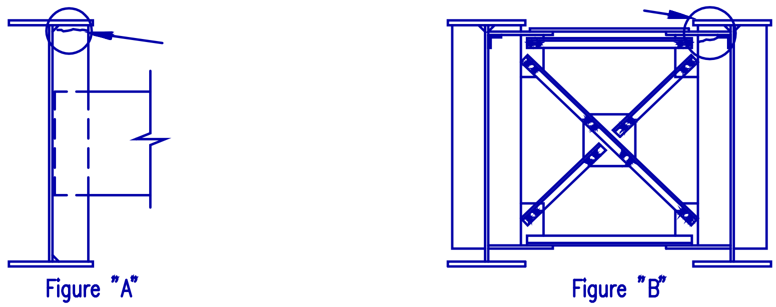

Figure F-15
Schematics of the Connection at the Ends of Diaphragms

c. Box girder webs

- Webs of box girders at unattached ends of diaphragm connection plates are susceptible to the same kind of out-of-plane deflections and fatigue cracking that occurs in longitudinal girder webs.

- The occurrence of fatigue cracks at locations described for longitudinal girders are expected to be higher in all box girder types, especially curved box girders and those subject to torsional forces.

d. Lateral gusset plate connections at floorbeam or diaphragm connections

- Unequal lateral forces from bracing members introduce lateral deflection and twisting in the girder web in the direction perpendicular to the web.

- When the gusset plate is not rigidly attached to the floorbeam or diaphragm connection plate, fatigue cracks may develop as described below:
    - o At either end of the weld connecting the gusset plate to the web. However, the crack is more likely to develop at the end closest to the web gap.
    - o Along the girder web at the toe of the fillet weld connecting the transverse stiffener to the girder web on the opposite side of the floorbeam or diaphragm connection.

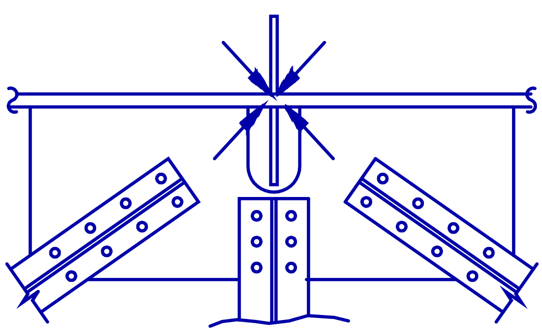

Figure F-16
Schematic of a Lateral Gusset Plate Connection

e. Floorbeam and cantilever bracket connections to girders

- Where stringers are supported on top of the floorbeam and tie plates connect the floorbeam and cantilever bracket top flanges, displacement induced fatigue cracks may develop in the floorbeam or cantilever bracket webs along the top flange fillet at the connection with the girder.

- Displacement induced fatigue cracks may develop in similar types of details at connections to tied arch girders and to truss bridge lower chord panel points when the stringers are placed above the floorbeams and cantilever brackets.

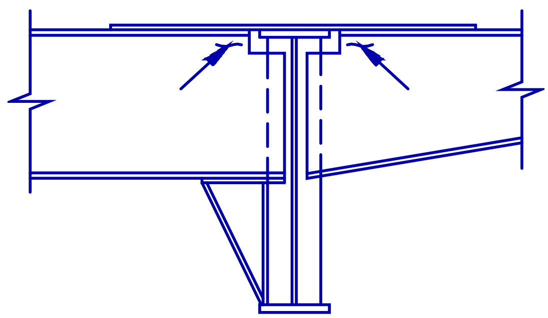

Figure F-17
Schematic of a Connection Floorbeam and Cantilever Bracket to Girder

<u>**Fatigue Damage in Riveted and Bolted Bridges**</u>

4. Fatigue damage to end connections

a. Cracking (prying) of rivets and bolts

- In simple connections, rivets and bolts are subject to prying action. Those furthest away from the centroid of the connection are most susceptible to fatigue cracking. Missing bolt or rivet heads, oxide dust around the bolt or rivet head, a small gap between the fastener and the connection angle and a dull sound when the head is tapped are evidence of fatigue damage.

- Fatigue cracking may occur along the fillet of the connection angle generally initiating at the bottom end of the connection angle and propagating upward along the fillet.

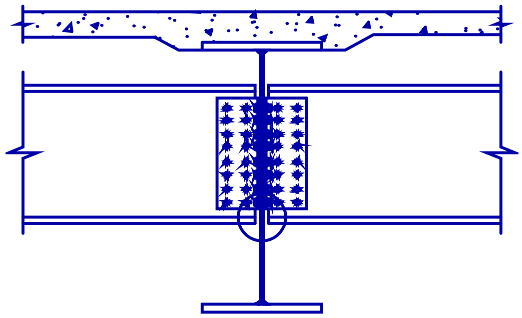

Figure F-18
Schematic of a Rivet Connection of a Floorbeam and Girder

b. Girder webs at floorbeam connections

- Girder webs are susceptible to fatigue cracking when girder stiffeners on the opposite side of the floorbeam connection are offset from the connection.

- Fatigue cracking may occur in the unstiffened region between the floorbeam seat angle or clip angle, and the girder stiffener, due to out-of-plane bending caused by the floorbeam end moment.

- Bridges with relatively deep girders, subject to frequent heavy loads are more susceptible to fatigue cracking in this area.

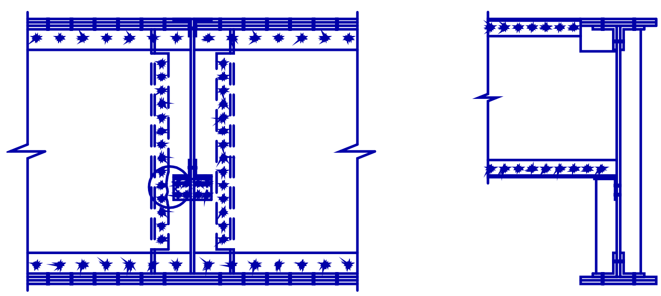

Figure F-19
Schematic of a Connection of a Floorbeam and Girder

c. Floorbeam and cantilever bracket connections to girders

- Similar fatigue cracks as described in the section for welded members, may develop in riveted or bolted floorbeam and cantilever bracket connections.

- Tie plates that are rigidly attached to a girder flange are subject to significant horizontal bending stresses due to the relative displacement between the girder and floorbeam and cantilever bracket. Fatigue cracks may develop at the rivets or bolts closest to the girder.

- Tack welds used to aid construction in this area increase the likelihood of fatigue damage.

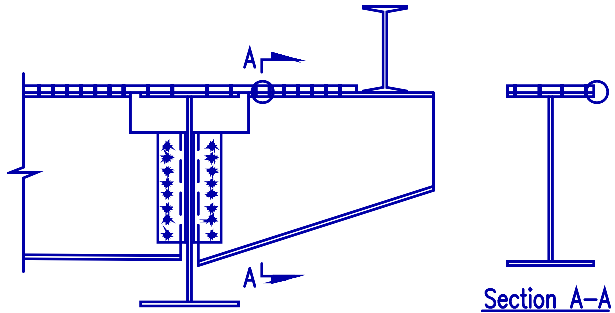

Figure F-20
Schematic of a Floorbeam/Cantilever Bracket Connection to Girder

d. Diaphragm connections to girders

- Differential deflections between girders produce forces within the diaphragm that pull or push the diaphragm member against the connection angle.
- Fatigue cracks may develop in the leg of the connection angle that is parallel with the girder in the area between the fillet of the angle and the first line of fasteners, or in the fastener below the head.
- If the connection angle does not overlap the flange angle and there is a small gap between the two angles, a fatigue crack may develop in the web of the girder in this gap.

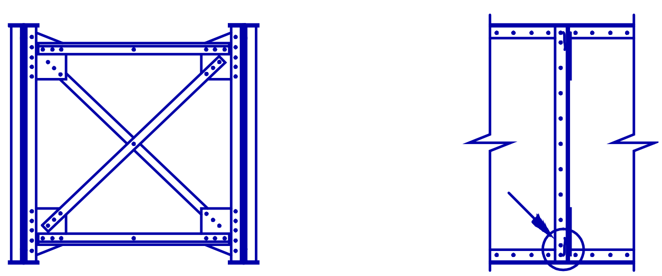

Figure F-21
Schematic of Diaphragm Connections to Girders

e. Truss tension members

- One of the primary accelerants of fatigue damage in truss members, such as built up lower chord members, vertical hangers, or diagonal eyebars, is the buildup of corrosion that prevents rotation of pinned connections.

- "Frozen" pin connections prevent the chord members, hangers and eyebars from rotating properly and bending stresses are introduced into the members.

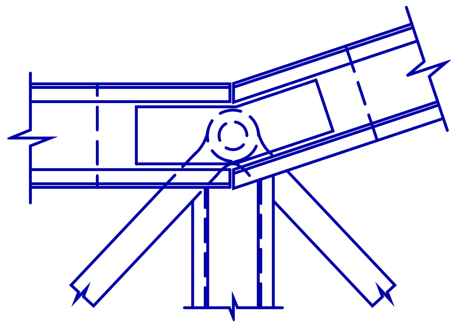

Figure F-22
Schematic of Eyebar Connections on Truss Members

- Fatigue cracks may develop at rivet holes or other points of stress concentration.

- Tack welds used to position and align elements during construction, create weld defects and residual stresses. All tack welds on tension members are examined closely.

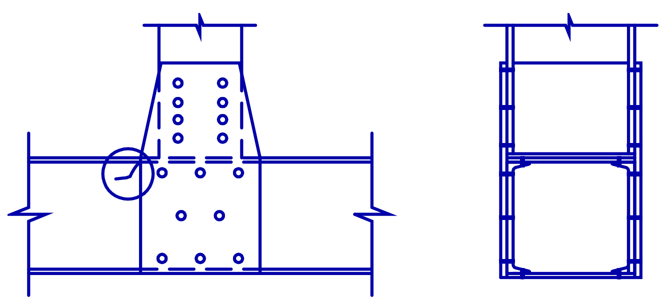

Figure F-23
Schematic of Gusset Plate on Truss Members