# Standard Practice for Washing and Cleaning Concrete Bridge Decks and Substructure Bridge Seats including Bridge Bearings and Expansion Joints to Prevent Structural Deterioration

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Ryan Burgdorfer
Jeffrey Berman
Charles Roeder

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# STANDARD PRACTICE FOR WASHING AND CLEANING CONCRETE BRIDGE DECKS AND SUBSTRUCTURE BRIDGE SEATS INCLUDING BRIDGE BEARINGS AND EXPANSION JOINTS TO PREVENT STRUCTURAL DETERIORATION

by

Ryan Burgdorfer
Graduate Research Assistant

Jeffrey W. Berman
Associate Professor

Charles W. Roeder
Professor

Department of Civil and Environmental Engineering
University of Washington, Box 352700
Seattle, Washington 98195

**Washington State Transportation Center (TRAC)**
University of Washington, Box 354802
University District Building
1107 NE 45th Street, Suite 535
Seattle, Washington 98105-4631

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15. SUPPLEMENTARY NOTES

This study is a supplement to a previous study of bridge washing practices that focused on steel superstructures. This study examined the perceived costs and benefits of routine washing of both steel and concrete bridges, with emphasis on substructure seats and bridge decks, by exploring current practices around the U.S. A literature review was conducted in order to learn more about these elements and their failure mechanisms. Then a nationwide survey was conducted with state DOTs around the U.S. regarding the washing practices of decks, expansion joints, and bearings. A follow-up survey was conducted soon afterward to collect more detailed information. A summary of the common washing practices is given in conclusion.

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# Executive Summary

## Objectives

The objective of this study is to determine standard practices for Departments of Transportation for routine maintenance washing of bridges, with emphasis placed on decks, expansion joints, bearings, and substructure seats.

## Background

Thirty years ago when the environmental rules changed the Washington Department of Transportation (WSDOT) stopped annual cleaning of steel truss bridges. Some cleaning was done after this time only to assist inspection crews or to determine what the cost would be to hand clean a steel truss bridge. WSDOT is investigating the procedures and benefits of washing programs focusing on bridge decks, expansion joints, and bearings. A similar study focusing on steel bridge decks and steel girders was conducted in 2012 that will help to determine the benefits and environmental impacts of a regular bridge washing program. This supplemental report builds on the previous one to identify current bridge washing practices around the country and the potential impacts on bridge performance life and annual cost. A focus of the current effort is to determine current practices for bridge cleaning for a range of bridge types, with a focus on decks and substructures.

## Research Activities

A literature review was conducted to gather information from previous studies on the washing of bridge decks, expansion joints, bearings and substructure seats and gain general knowledge on the corrosion of steel, failure modes of each element, and environmental considerations.

To gather information on the state of practice of washing decks, expansion joints, substructure seats and bearings across the United States a general survey was sent out to state transportation agencies. This was used to determine which states have bridge washing programs and what the typical washing frequencies are. A smaller number of states were contacted again with a more intensive survey to gain more insight into the general practices of the washing programs or why a program is not used. The responses received were analyzed in order to develop a state of practice for each element.

## Conclusions

From the initial survey and information from the follow-up surveys there is a common method of cleaning for those states that do have washing programs. The bridge deck is swept first to remove and collect dry debris. This debris collection also applies to the bearing and seat area. The next step is power washing, which begins with the bridge deck and then moves downward from the expansion joints to the bearings. The expansion joints are flushed out from the top of the deck or side of the bridge (depending on the type of expansion joint and accessibility of the side of the bridge) to remove debris. Then the bearings, bearing seat, and the area surrounding the bearings are sprayed. After the initial collection of debris there is little effort to contain runoff from the washing process. The other methods that are less common are performed due to environmental concerns or restrictions. They involve the collection of all runoff during the washing process (both liquid and solid). These methods are costly and are not performed very often.

Nationwide, there are some geographic trends in washing program and frequency that are logical considering the different climates of various regions of the U.S. For example, washing programs are not common in the southwest since deicing salts are not used but washing programs are common in the northeast. However, there are also states where their practice is counter to those geographic trends.

There appears to be little information on the ability of regular washing programs to impact the performance life or corrosion performance of bridge decks, expansion joints, and bearings. The information available has used anecdotal assumptions to demonstrate that benefits are likely but the data to support those assumptions is absent. It is recommended that such studies be carried out to determine the cost effectiveness of bridge washing for various bridge types in various geographic regions of the U.S.

# Section 1 Introduction and Motivation

This research aims to investigate the state of practice for bridge washing programs with a focus on bridge decks, expansion joints, substructure seats, and bearings. For almost thirty years since the change in environmental regulations, the Washington State Department of Transportation (WSDOT) has not cleaned bridges. During this time period the only cleaning that bridges received was the cleaning that was part of the contract to paint steel bridges. There was some spot cleaning that occurred to facilitate inspection or repairs.

A parallel research project has investigated washing practices for steel bridges and proposed a framework for long term study of the economic benefits. A pilot steel truss bridge washing study was implemented by WSDOT in 2008 to determine the benefits and environmental impacts of such a program and the recommendations of the parallel research project were to expand that study to cover a statistically significant number of bridges. The program washed bridges annually with no manual removal of debris since the volume of debris is likely to be considerably less than what currently accumulates over the longer interval between washings, resulting in less material washed into waterways. The areas washed in this pilot study were the bridge decks and the steel superstructure of steel bridges. The original study included four bridges and was expanded in 2011 to include more bridges to make the results more statistically meaningful.

In general, bridge washing programs vary across the country and there have been no studies to identify the current state-of-practice. It is assumed that bridge washing will have positive benefits for improving the paint life of steel bridges and for improving the life of bridge decks, bearings, and expansion joints but there is no data to support this and the current practice of Departments of Transportation (DOTs) across the country is unknown.

The objectives of this research are to extend the previous study of nationwide bridge washing programs that focused on steel bridges to investigate current practices for washing of bridges in general, with an emphasis on the bridge components that are known to have high maintenance costs: decks, expansion joints, substructure seats and bearings. The outcome of this research is a state of practice document that summarizes national trends in bridge washing and highlights some specific cases of interest either because those states have a rigorous washing program or because they do not.

To accomplish the research objective above, a literature review was conducted on washing programs for decks, expansion joints, substructure seats and bearings and the effects on performance life and corrosion. Notably, the literature available on these topics is sparse. Applicable summaries of the literature obtained are given in this report.

The literature review was followed by a survey of various DOTs conducted to collect pertinent data regarding washing practices and information on bridge inventory including the types of decks, expansion joints, and bearings in use. The responses were compiled and summarized for the purposes of this report. More detailed follow-up surveys were sent to DOTs with and without washing programs to better understand their specific washing practices and the reasoning behind them. These responses are also summarized here and provide a more detailed insight into washing practices that may be of help to DOTs. The result is a summary of the bridge washing state of practice at the end of this document that focuses on issues related to decks, joints, and bearings.

# Section 2 Literature Review

## Expansion Joints

There are many different types of expansion joints and bearings in use in the United States today. This includes very old joints and bearings that have been on a bridge for decades as well as new innovative joints and bearings that are installed on new bridges or to replace damaged elements.

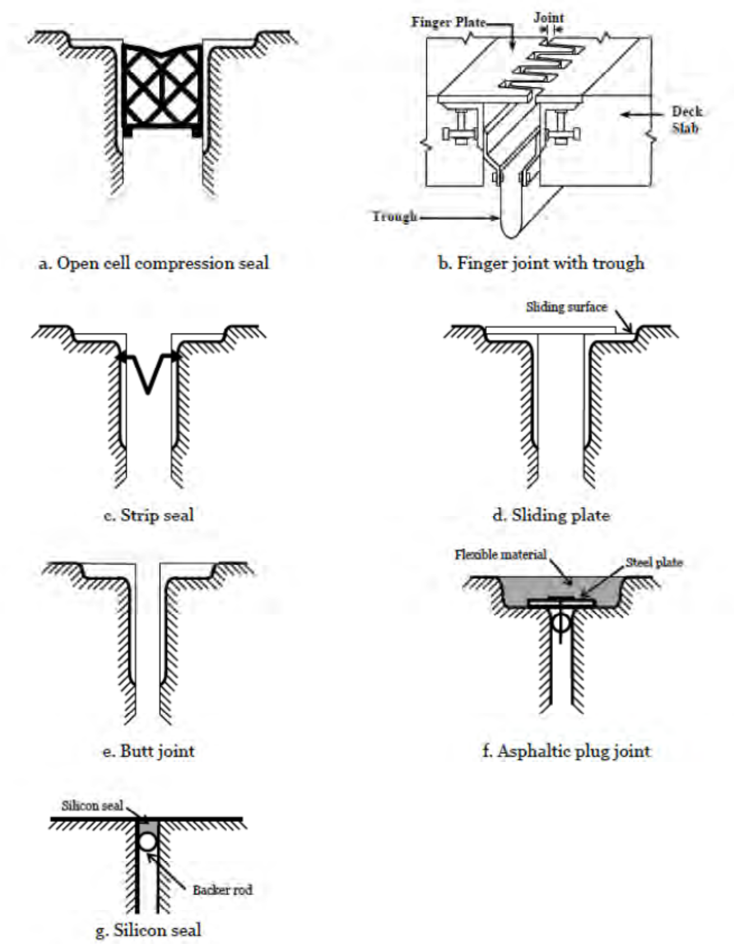



**Figure 1.** Types of expansion joints (FHWA/NHI, 1995)

Older expansion joints can include finger joints, sliding plate joints, and butt joints as shown in Figure 1b, 1d, and 1e. These joints are made out of metal and are normally open joints, meaning they allow water to flow freely through them and onto the bridge components below. However, they can also be installed with a metal or rubber trough as seen in Figure 1b. A trough funnels the water and debris through the joint out to the side of the bridge so that it doesn't collect on components below the expansion joint. These older metal joints need to be replaced as they get damaged over the years due to failures from traffic loading, being hit by snow removal trucks, poor connection with the asphalt overlay, or other problems that arise throughout the life of the bridge.

Newer expansion joints are more like the types seen in Figure 1a, 1c, 1f, and 1g. These normally include a rubber component held in place by friction between the two bridge slabs or some type of anchor into the slabs on either side of the joint. These joints have received mixed reviews regarding their lifetime performance. If the rubber is anchored at the sides, the seal is difficult to replace when broken. If the rubber is held in place by compression, they have been known to pop out of the crack after time or if installed incorrectly.

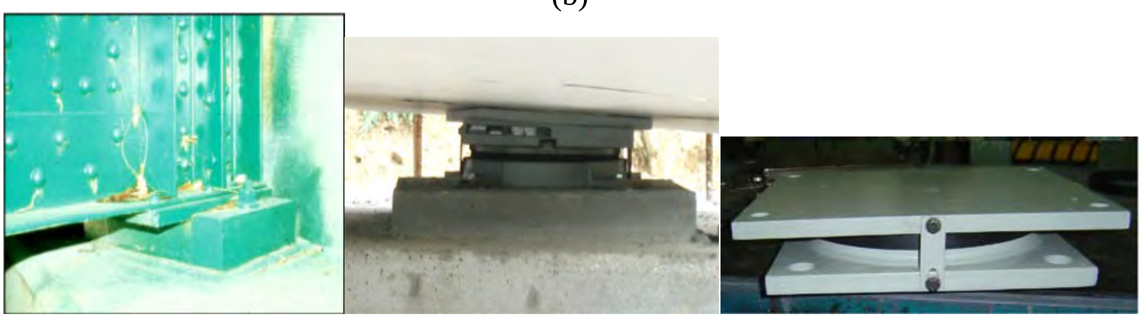
**Bearings**

There are also many types of bridge bearings currently in use. Some examples are shown in Figure 2.

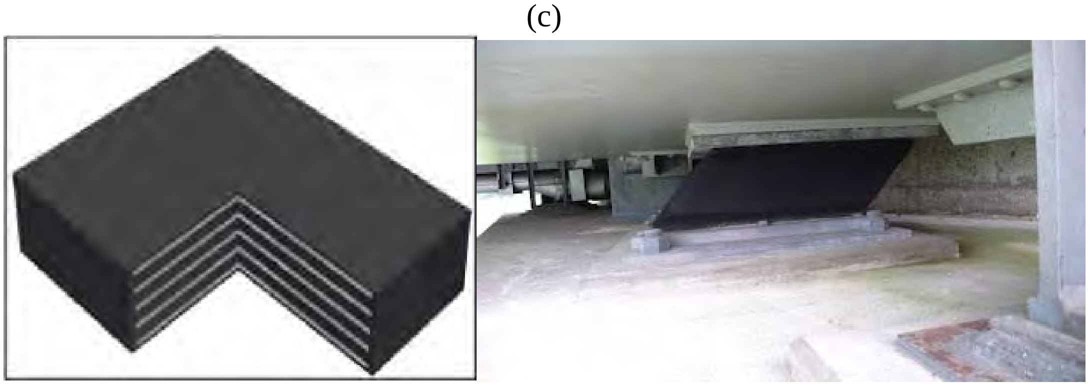
The bearings shown in Figure 2 have been in use for many years. Older bridges typically have bearings made completely of steel as shown in Figures 2a and 2b. Most often they will be painted to prevent rust formation. However, water and debris funnel down to these areas through normal use and aid in the formation of rust. It is especially difficult to keep rust from propagating on older pin bearings because there are many small spaces inside the bearing that are hard to protect from moisture. Rockers bearings also have a tendency to tip over if the bridge thermally expands more than expected or if they are not installed correctly. These mechanical bearings are occasionally used in newer bridges, but elastomeric bearings, pot bearings, disk bearings, and PTFE sliding surfaces are more common.

(a)

(b)



(c)



(d)

**Figure 2.** a) Rocker and roller bearings, b) Pin bearings, c) Sliding plate and pot bearings, d) Elastomeric bearings

Shown in Figure 2d are elastomeric bearings. Elastomeric bearings are made from sheets of metal encased in a very strong rubber. These are most commonly used today as they are beneficial in resisting rust formation as well as able to maintain vertical load capacity while moving in many lateral directions.

**FHWA/NHI, Course 13061 "LRFD Design of Highway Bridges" (1995): Chapter 14 – Joints and Bearings**

This document is a chapter from an FHWA/NHI course prepared in 1995 that outlines the LRFD design of highway bridges. This chapter describes different types of joints and bearings, problems associated with them, and their proper selection and design. Both bearings and expansion joints are less likely to have the same service life as the entire bridge due to the increased demands placed upon them (FHWA/NHI, 1995).

Bridge bearings are often located in areas that have the potential to collect large amounts of dirt, debris, and moisture or standing water. This normally leads to problems with corrosion and deterioration. In the past, bearings have also been incorrectly chosen or placed which has also led to problems. For these reasons, bearings should be designed to provide the maximum possible protection against the accumulation of dirt, debris, and moisture (FHWA/NHI, 1995). Corrosion has become a major problem with older mechanical bearings. In this case mechanical bearings refers to roller, rocker, and pin connection bearings. Corrosion can be a significant problem in these bearings partly because any paint applied to them can easily be damaged by the rolling or friction actions from sliding. This is further aggravated by high contact stresses and the possible accumulation of moisture. Nested groups of roller bearings are especially susceptible to corrosion or deterioration because there are a greater number of moving parts that are all in close proximity to each other.

Expansion joints are designed to connect bridge sections in order to make the bridge deck continuous but still allow for thermal movement of the bridge. Expansion joints can play a large role in the protection of bearings and the superstructure of the bridge by stopping water and debris from funneling down to these areas. Leaking joints can occur due to wear, damage, or poor detailing or installation. These should be designed so that they can be effectively replaced in the future.  Open joints perform well with movement but they allow a large amount of moisture through to the structure and substructure.  This moisture has the potential to contain large amounts of de-icing salts which can expedite corrosion and deterioration.  This deterioration can be controlled with frequent cleaning and maintenance (FHWA/NHI, 1995). Due to the need for maintenance, there is a strong push towards sealed expansion joints.  These often have mixed performance, are expensive to install, and can still leak after a short service time. Dirt and debris often collect in expansion joints and if not regularly cleaned, can restrict the movement capacity of the joint and lead to structural damage if they freeze during winter months.  Elastomeric drainage troughs have been instituted under open joints to drain water away from structural elements (FHWA/NHI, 1995).  These troughs also have a tendency to collect debris and require cleaning to prevent excess buildup which can lead to standing water. This can freeze in the winter and lead to damage of the trough.  It is also the possible that the weight of the debris may punch through the elastomer.  Metal drainage troughs have also had mixed success.  There is no concern over debris breaking through the trough but cleaning of these can be an issue if they aren't designed well (FHWA/NHI, 1995).  Integral construction has been implemented to eliminate the need for expansion joints. However, integral construction can be limited by bridge length, skew, types of piles, soil conditions, and other conditions.

**Ramey and Wright (1997)**

Ramey and Wright completed a survey for the American Society of Civil Engineers (ASCE) in 1997.  This survey was sent to state and county engineers in the state of Alabama. The point of this survey was to poll bridge and maintenance engineers around the state to determine common bridge problems and possible solutions (Ramey and Wright, 1997).  Ninety surveys were sent out and 46 responses were received.  In addition to the survey, the writers visited bridges around the state and interviewed 2 of the most knowledgeable bridge engineers in Alabama at the time.

From the responses to the survey, three bridge components were routinely considered to give weak performance.  These were expansion joints, bearings, and truss members.  As truss bridges are less common in new bridge construction, more focus was put on expansion joints and bearing assemblies. One of the popular solutions to overall bridge durability and longevity was to provide more funds for bridge maintenance activities (Ramey and Wright, 1997).

From the inspection of bridges around the state, certain aspects of failure were noticed on certain bridge components. A common damaging problem for sealed expansion joints was found to be the collection of debris which then clogs the joint. The bridge can then be damaged when it tries to expand or contract. Open joints cause problems as well (Ramey and Wright, 1997). The water passing through open joints onto the superstructure and substructure below can cause premature failure of these components. Improper drainage can cause significant damage as well. This can cause pools of water to form on elements beneath the deck including bent caps, abutment seats, and lower flanges (Ramey and Wright, 1997). Standing water can lead to premature failures by causing scaling, delamination, or spalling.

This study concluded that additional attention to certain phases of a bridge's design life will aid in the longevity of the bridge. Some of these elements which require special attention are stream stability (how the stream bed interacts with the bridge piers), flooding, ease of inspection and maintenance, debris removal from bridges, fatigue stress concentrations, construction quality, expansion joint assemblies, and bearing devices (Ramey and Wright, 1997).

**Oregon Department of Transportation (2003)**

In 2003 the Oregon Department of Transportation (ODOT) performed a study on the effects of washing on the reduction of chlorides on bridge decks. ODOT performed field tests on a selected bridge and laboratory tests using mortar slab specimens. The bridge was split into 5 sections, and each section was washed with a different washing frequency and duration (ODOT, 2003). One section was the control in that it was not washed. In the lab, eight mortar slabs were cast with the same mixture. Four of the slabs were subjected to salt water ponding on the surface and four were sprayed once a week with a saltwater solution to simulate marine exposure. The eight slabs were then placed in pairs, one ponded slab with one unponded slab, and each pair was washed with a different frequency (once/day, once/week, and once/month). This experiment lasted for 25 months in order to create a chloride profile for each slab (ODOT, 2003).

In the lab experiment, ponded slabs showed a decrease in chloride content for a washing frequency of once per day and washing frequencies of once per week or month showed essentially no changes in the chloride profile. Unwashed slabs, although having a higher salt concentration initially overall, showed decrease in chloride levels. For the slabs sprayed with salt water once a week, all washing frequencies reduced the chloride content with the most significant reduction seen with a frequency of once per day. Based on the results, ODOT has determined that the effect of washing on the reduction of chloride content on the surface of concrete is inconclusive and therefore a bridge washing cycle of once or twice per year are unlikely to have a significant effect (ODOT, 2003). However, it was determined that washing reduces the absorption of chloride ions into the concrete.

The laboratory experiment was continued for 2 years to verify the results and conclusions drawn in this report (ODOT, 2003). The long term results of the field study were not included in this document.

**NCHRP: "Bridge Deck Joint Performance," Synthesis Report 319 (2003)**

A study by the National Cooperative Highway Research Program (NCHRP) in 2003 entitled "Bridge Deck Joint Performance" polled the United States and Canada to develop a state-of-the practice for commonly used expansion joints. The study first describes the many different types of open and closed expansion joints and the positives and negatives associated with each of them. It states that closed joints are becoming more desirable due to the larger amount of de-icing salts used to make the roadways safer (NCHRP, 2003). Salts accelerate the corrosion of steel elements and, given an open expansion joint, have a tendency to fall through the expansion joint and pile up on flanges, bearings, and bridge seats. Closed joints are designed to stop this debris from falling through the expansion joint and therefore stop the buildup of salts on these structural elements.

According to the poll results given in this study, a high priority for many of the agencies that responded is to develop bridge designs that eliminate expansion joints completely (NCHRP, 2003). Out of a total of 49 responses, only ten agencies replied that they have an expansion joint maintenance program. The agencies that responded positively considered the program to be cost effective. Of the agencies that don't have a program but were spoken to further, the consensus was that a maintenance program would be cost-efficient but they just don't have enough funding to start such a program (NCHRP, 2003). Practically all responses stated that their expansion joints commonly collect debris and roughly 80 percent attributed adverse effects in performance to this accumulation.

One of the conclusions that this report came to was that preventive maintenance extends the service life of expansion joints (NCHRP, 2003). It is not cost effective to disregard a proper maintenance program. This preventive maintenance includes washing decks, clearing drains, removing debris, and fixing small problems before they become larger ones.

**"Corrosion Protection of Steel Bridges," Steel Bridge Design Handbook. Publication No. FHWA-IF-12-052, Vol. 19.**

The geographical location of a bridge has been shown to have a significant effect on the severity or frequency of corrosion. A study performed by the FHWA in 2012 details the proper methods to design corrosion protection. It describes the different factors normally affecting the seriousness of corrosion and different methods to combat these variables. One factor, which has a significant bearing in this study, is the surrounding environment of the structure. The FHWA classifies the environments of highway bridges as Mild, Industrial, Moderate, and Severe. These are useful in determining the type of corrosion protection to use on a bridge system. The environments are described as follows:

- Mild (Rural): Little to no exposure to natural airborne and applied deicing salts. Low pollution in the form of sulfur dioxide, low relative humidity, absence of chemical fumes, usually an interior (inland) location.
- Industrial: High sulfur dioxide or other potentially corrosive airborne pollutants, moderate or high humidity. This classification has become less important in recent years as long-term corrosion data shows the corrosive effects of airborne pollutants has diminished with the implementation of clean stack gas regulations. This atmospheric classification is still a consideration directly downwind of known corrosive process stream contaminants.

- Moderate: Some (occasional) exposure to airborne salts or deicing salt runoff.
- Severe (Marine): High salt content from proximity to seacoast or from deicing salt, high humidity and moisture (FHWA, Steel Bridge Design Handbook, 2012).

The most important of these 4 designations are Moderate and Severe. Distinguishing between these two environments is the difference between under or over designing the corrosive resistance of the bridge.

The FHWA report also references the effect of consistent moisture on a steel surface whether it comes from the atmosphere or from splash zones. Steel surfaces that are consistently wet have a higher rate of corrosion than steels that have a routine wet/dry cycle. This wet/dry cycle is essential in the formation of a protective corrosion film on weathering steel (FHWA, Steel Bridge Design Handbook, 2012). Steel that is not allowed a proper cycle will continue to corrode through its lifetime. For this reason, designs that create pockets or dips for water to collect should be avoided.

The distance of a bridge from a coast is a significant issue in corrosion assessment. These regions can be exposed to a large frequency of airborne salts depending on their proximity to the coastline. This becomes one of the dividing lines between a Moderate and Severe environment (FHWA, Steel Bridge Design Handbook, 2012). Moving inland, the chance of exposure to airborne salts diminishes significantly however is still quite possible due to the spray from passing trucks. For this reason, the main dividing line between Moderate and Severe away from a coastline depends on how frequently de-icing salts are used and the ability to keep them off of steel surfaces. If salts are routinely adhering to the steel surface the corrosivity increases dramatically (FHWA, Steel Bridge Design Handbook, 2012). This can be seen on steel above the deck located in splash zones.

**Oladimeji (2012)**

Oladimeji completed a master’s thesis for the Department of Architecture and the Built Environment at KTH Royal Institute of Technology in Sweden in 2012 titled “Bridge Bearings: Merits, Demerits, Practical Issues, Maintenance and Extensive Surveys on Bridge Bearings.”

This is a comprehensive report on all aspects surrounding bridge bearings including the different types, which types are more effective in certain situations, maintenance, monitoring, and two surveys to agencies around the world. One survey was sent to transportation agencies worldwide while the other survey was sent to companies that manufacture the bearings commonly used.

Bearings require proper maintenance if they are expected to perform for the entirety of their expected life (Oladimeji, 2012). This preventive maintenance is normally cleaning, painting, lubrication, inspection, monitoring, sealing deck joints, or all of these. It is stated frequently in this paper that the life span of the bridge is normally greater than the expected life span of the bearings. Therefore it is desirable to obtain the maximum service life from bearings so that they need to be replaced as infrequently as possible. Preventive maintenance will help to prevent failure of the bearing. In this case failure is defined as any behavior that prevents the bearing from performing its desired function. This can happen when debris or rust prohibits the movement of a bearing which can add stresses to the bridge that lead to failure (Oladimeji, 2012). Cleaning of these elements can entail painting with rust removal paints, solvent cleaning with mineral spirits, wire brushing, pickling with acids, flame cleaning, sand blasting, or water jetting. In areas that use deicers, it is recommended that bearings be cleaned after the winter season to keep salts off of the bearing surface.

The first survey sent out by Oladimeji was sent to transportation agencies around the world. The paper gathered the following findings which are pertinent to this research and report:

- 51 percent of agencies replied that elastomeric bearings were the easiest to maintain
- The most frequent maintenance activity performed is inspection of the bearing
- Agencies reported a high percentage of bearing replacement. Oladimeji drew the conclusion that this is because only 25 percent responded that they clean bearings regularly.
- 56 percent of bearings that were replaced had a life span of less than 30 years
- A low level of information is recorded about bridge bearings in bridge management systems

In general, the maintenance of bridge bearings was found to be less than adequate in frequency and thoroughness (Oladimeji, 2012).

In its conclusion, the paper stated that steel is the oldest type and most replaced bearing. Proper maintenance of these elements increases their durability by combatting corrosion, the main contributor to bearing deterioration (Oladimeji, 2012). Maintenance of bearings includes cleaning, painting, inspection, lubrication, and the sealing of deck joints.

**Summary**

From this review it appears that bearings and expansion joints frequently collect salt and debris from the roadways. This collection often leads to deterioration of performance and eventually failure if not remedied. This happens due to corrosion from road salts or from the solid debris interfering with the functionality of the element. Failure due to these issues most often occurs before the joint or bearing has reached its full design life. Therefore, it is possible that untended joints and bearings will be required to be replaced multiple times during the life of the bridge.

The Oregon DOT study on bridge decks was quite descriptive. It was shown that washing does little to diminish the salt content on the surface of the concrete but is useful in stopping the absorption of chlorides down into the concrete. All of the reviewed literature recommended that expansion joints and bearings be monitored, washed on a routine basis, and designed so that they collect a minimum amount of debris despite the lack of direct studies demonstrating their benefits.

# Section 3 Nationwide Survey

The first phase of research obtained information using a preliminary survey of transportation agencies and DOT's about washing programs in use for bridge decks, expansion joints, substructure seats and bearings. This preliminary survey sought information to determine if they had a consistent program for each element, the general types of these elements in use in each state (i.e. old expansion joints, mechanical bearings etc.), the frequency of cleaning, and, if applicable, reasons why states do not use a regular washing program. An encompassing survey was sent out to state DOT's and various other agencies in charge of transportation or bridge maintenance. The questions were as follows:

1. How frequently are steel and/or concrete bridge deck surfaces, expansion joints, and/or bridge bearings cleaned?
2. If these are not cleaned, what are the reasons?
3. Are bridges cleaned before inspection?
4. Are bearings and expansion joints cleaned specifically before inspection?
5. What is your DOT's percentage of steel vs. concrete bridges?
6. What percentage of your DOT's bridges utilize mechanical bearing (i.e. not elastomeric)?
7. Is the paint condition of bearings recorded?
8. Is the corrosion of bearings recorded?
9. How many open expansion joints does your DOT employ vs. sealed joints?
10. What percentage of your state's bridge decks utilizes mechanical expansion joints (i.e. finger joints, sliding plates, etc.)?
11. Does cleaning focus on any other areas such as stiffeners, diaphragms, or truss joints?
12. Has your state performed studies on the cleaning of bearings or joints that might be helpful?
13. Please provide the name, title, and contact information that we may talk with more extensively about these issues.

Responses were received from 34 state DOTs and one thruway agency. In some cases multiple individuals from the same agency responded, resulting in 42 total individual responses. In those cases the responses were combined and generally the information was not conflicting. The responses to the first question, involving the frequency of washing each element, are shown in the figures below. Some of the other questions, mainly 6, 7, 10, and 11, were used to better formulate the questions to be asked in the follow-up survey.

Figure 3 shows how often bridge decks, expansion joints, and bearings are washed based on the responses received. From these results it seems that the majority of states either wash frequently or they don't wash at all. Surprisingly, very few states responded that they clean decks, expansion joints, and bearings specifically before inspection. When they are cleaned before inspection it appears most often to be by request of the inspector. No transportation agencies indicated that they had performed studies on the cleaning of decks, bearings or expansion joints to determine the impact on component life.

Table 1 presents a summary of all preliminary survey responses. This consolidates the data into one simple table and allows for easier comparison between regions.

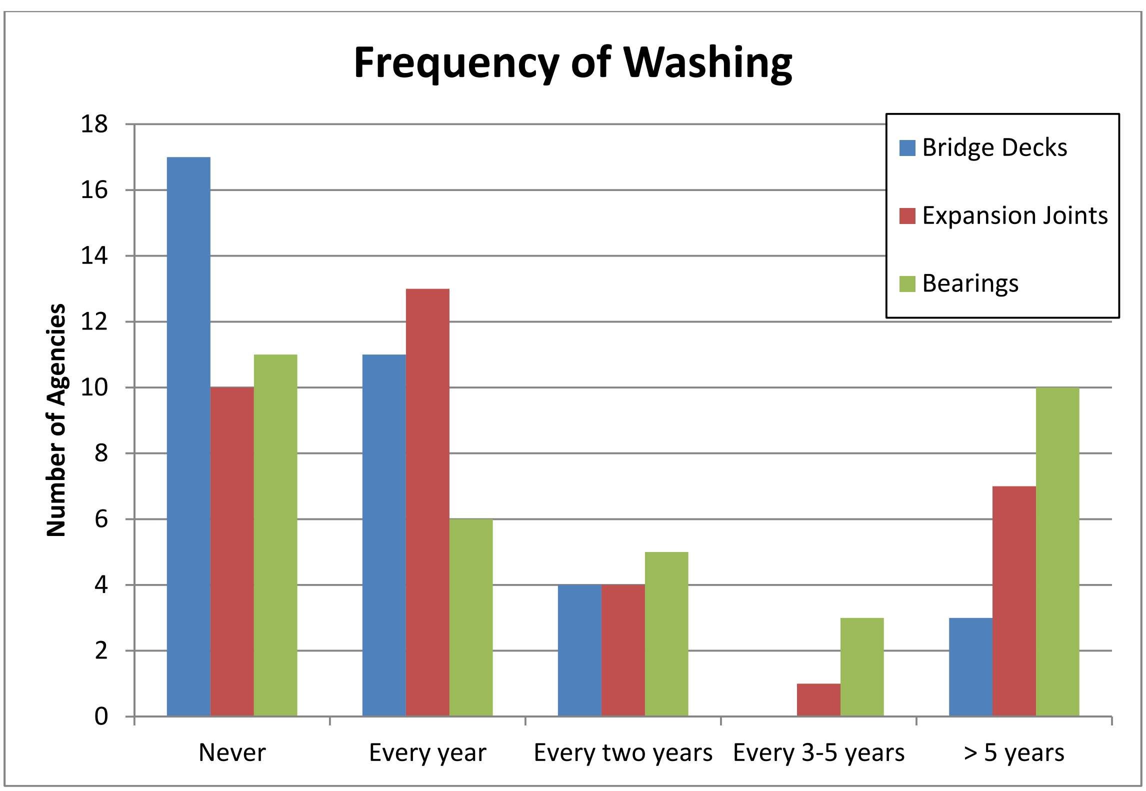



**Figure 3.** Preliminary survey responses

**Table 1.** Summary of preliminary responses

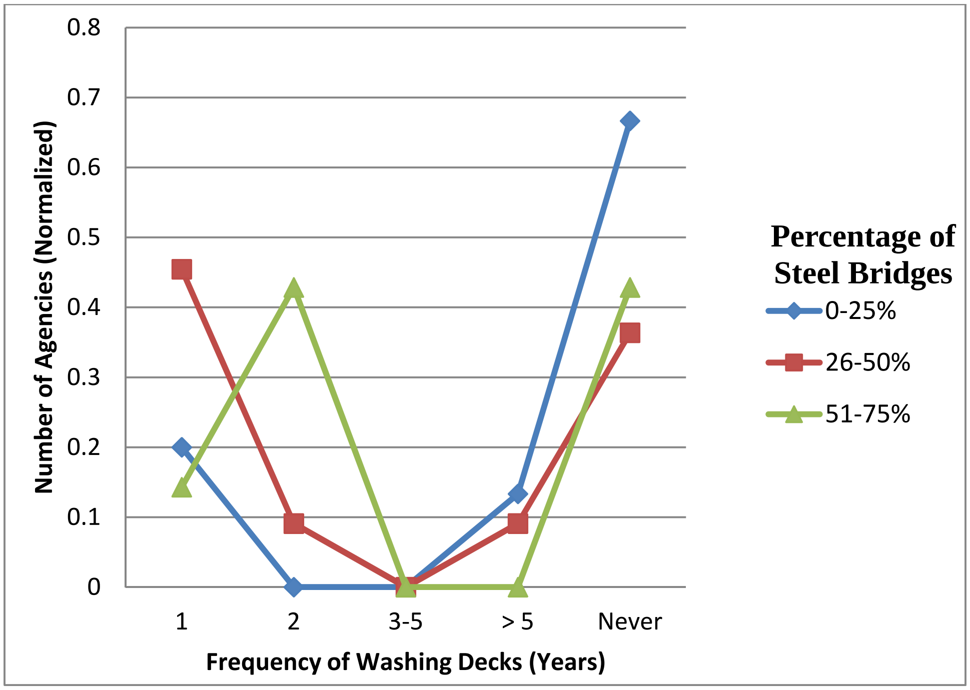
| | Deck Washing | Expansion Joint Washing | Bearing Washing | Steel Bridges | Mechanical Bearings | Older Expansion Joints |
|---|---|---|---|---|---|---|
| | Frequency (Years) | | | Percentage | | |
| | Northwest | | | | | |
| Oregon | > 5 | 1 | 2 | 0-25 | 26-50 | 0-25 |
| Washington | Never | Never | Never | 0-25 | 0-25 | 51-75 |
| Wyoming | Never | 1 | 3-5 | 26-50 | 26-50 | 0-25 |
| | Southwest | | | | | |
| Arizona | Never | > 5 | > 5 | 0-25 | 0-25 | 0-25 |
| California | Never | 1 | 1 | 26-50 | 51-75 | 26-50 |
| Colorado | Never | Never | 2 | 0-25 | 26-50 | 0-25 |
| Hawaii | Never | Never | Never | 0-25 | 0-25 | 0-25 |
| Nevada | Never | Never | Never | 0-25 | 0-25 | 0-25 |
| Texas | Never | > 5 | Never | 0-25 | 0-25 | 0-25 |
| Utah | 1 | 1 | > 5 | 26-50 | 51-75 | 0-25 |
| | Midwest | | | | | |
| Illinois | Never | Never | Never | 26-50 | | 0-25 |
| Indiana | 1 | 1 | 1 | 26-50 | 51-75 | 26-50 |
| Iowa | > 5 | > 5 | > 5 | 0-25 | 26-50 | 0-25 |
| Michigan | Never | Never | Never | 51-75 | 51-75 | 0-25 |
| Minnesota | 1 | 1 | 1 | 0-25 | 0-25 | 0-25 |
| Missouri | 1 | > 5 | > 5 | 51-75 | 51-75 | 26-50 |
| North Dakota | 1 | 1 | 1 | 0-25 | 0-25 | 0-25 |
| Oklahoma | Never | > 5 | Never | 26-50 | 26-50 | 0-25 |
| South Dakota | 1 | 1 | > 5 | 26-50 | 51-75 | 0-25 |
| | Southeast | | | | | |
| Alabama | Never | > 5 | > 5 | 0-25 | 0-25 | 0-25 |
| Delaware | Never | Never | Never | 51-75 | 51-75 | 0-25 |
| Florida | Never | Never | Never | 0-25 | 0-25 | 0-25 |
| Georgia | Never | 3-5 | > 5 | 0-25 | 0-25 | 0-25 |
| Kentucky | > 5 | > 5 | > 5 | 26-50 | 26-50 | 0-25 |
| Maryland | Never | Never | Never | 51-75 | 51-75 | 26-50 |
| North Carolina | 1 | 1 | > 5 | 0-25 | 0-25 | 0-25 |
| Tennessee | Never | Never | Never | 0-25 | 0-25 | 0-25 |
| Virginia | 1 | 1 | 2 | 26-50 | 0-25 | 0-25 |
| West Virginia | 2 | 2 | 3-5 | 51-75 | 51-75 | 51-75 |
| | Northeast | | | | | |
| Maine | 1 | 1 | 1 | 51-75 | 51-75 | 26-50 |
| New Hampshire | 2 | 2 | 2 | 51-75 | 26-50 | 0-25 |
| New York | 2 | 2 | 2 | 51-75 | 26-50 | 0-25 |
| Pennsylvania | 1 | 1 | 3-5 | 26-50 | 51-75 | |
| Vermont | 2 | 2 | 2 | 26-50 | 51-75 | 0-25 |

It can be seen that the regions that wash bridge decks the most are the Northeast and the Midwest. This is most likely related to the climate of these regions, which varies greatly over the year and includes severe winter weather. Because of the winter conditions in these states they need to use deicers to manage safety in their transportation systems. The regions that have fewer washing programs are located in the Northwest, Southwest, and Southeast. The majority of these regions do not experience the same type harsh winters as that of their counterparts and therefore, on average, don't need as extensive of a program. This trend holds true for expansion joint and bearing washing programs. In most cases this is because states will wash expansion joints and bearings in the process of washing the bridge deck.

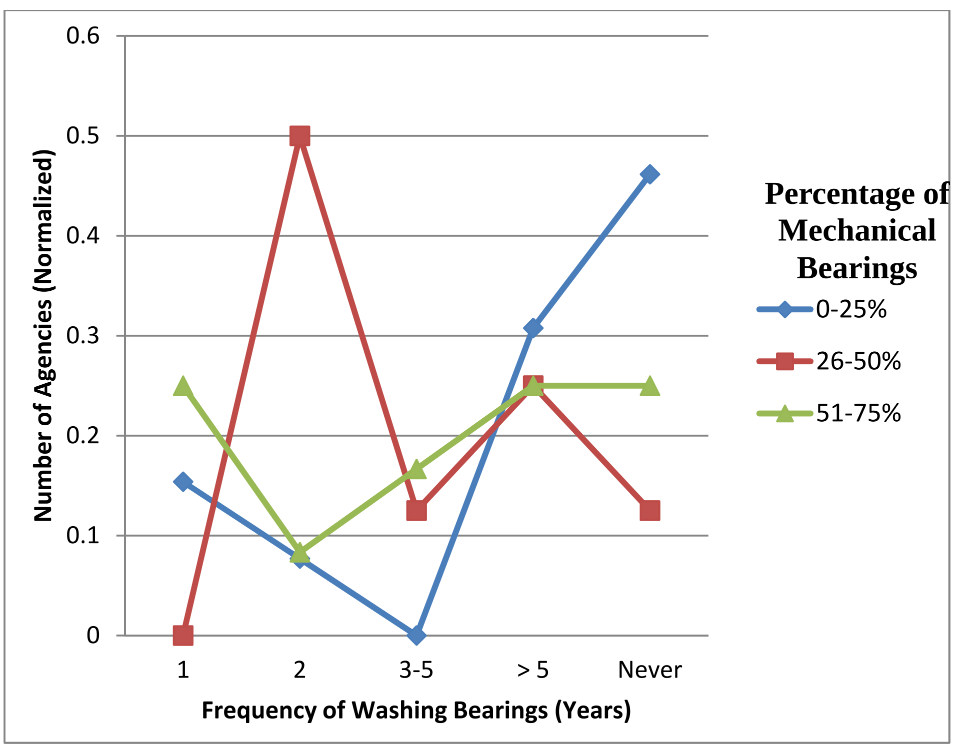
The table also shows that the cleaning of expansion joints and bearings is given higher priority than bridge decks in all regions. This is likely attributed to the low life expectancy of bearings and joints and the difficulty in their repair.

With a few notable exceptions (Michigan and Illinois for example), it does seem that states with larger proportions of steel bridges, older expansion joints and mechanical bearings wash those elements more frequently. The following figures are formulated from the information contained in Table 1. They show the frequency of washing the different bridge elements versus the percentage of steel bridges, mechanical bearings, and older expansion joints present in the state. Because there are different numbers of states containing different percentages of each type of element the numbers are normalized as described below to allow for equal comparison.

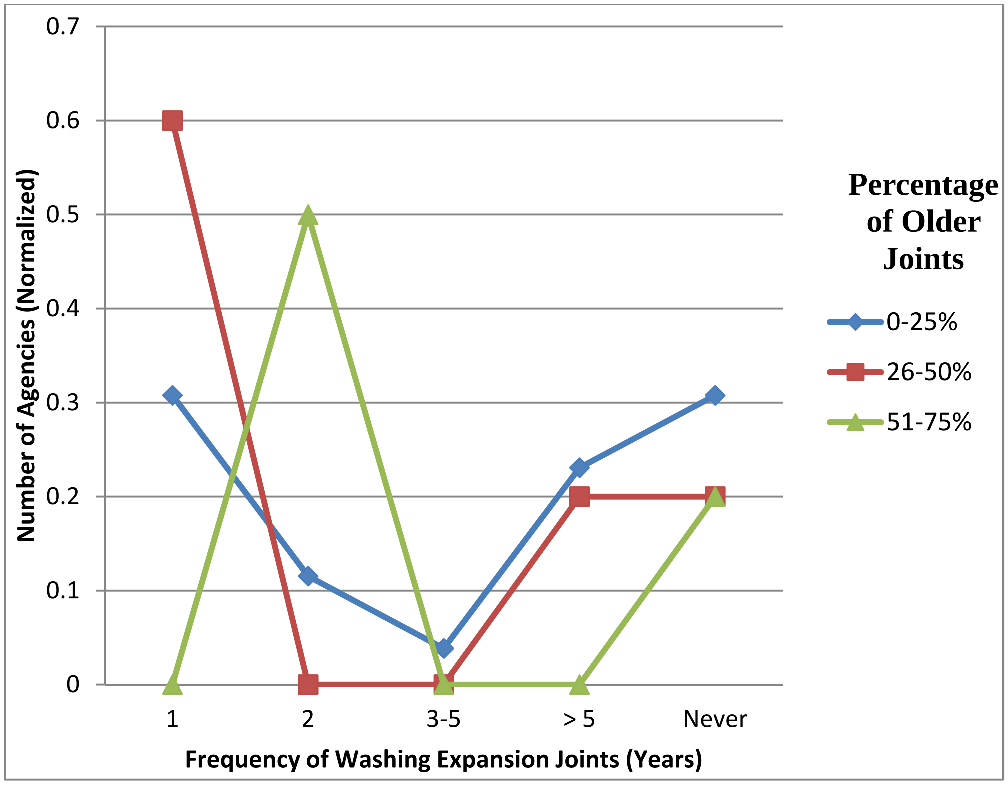
Figure 4 graphically represents selected data from Table 1. In each figure the lines represent data from agencies that reported various percentages of their bridge inventories with certain characteristics. For example, in Figure 4a, the lines represent data from states that reported 0-25 percent, 25-50 percent, and 50-75 percent of their bridge inventory being steel. The horizontal axis is the reported frequency of washing specific bridge elements. The vertical axis is the number of agencies that reported a given frequency of washing, normalized by the total number of agencies that reported the same percentages of bridge inventory characteristics. For example, from Figure 4c, the red line with box markers indicates that 60 percent of the agencies reporting that between 26 percent and 50 percent of their bridge inventory has older expansion joints reported washing those joints every year.




(a)




(b)




(c)

**Figure 4.** a) Frequency of washing bridge decks, b) Frequency of washing bearings, c) Frequency of washing expansion joints

Figure 4a shows the frequency of washing bridge decks organized by the percentage of steel bridges in the state's inventory. The figure shows that, in general, the states with larger percentages of steel bridges tend to wash their decks more frequently. The converse also appears to be true, i.e., that states that have fewer steel bridges appear to wash bridges less frequently. These trends appear to be consistent for the high and low percentages of bridge inventory with mechanical bearings and older expansion joints as well. Note that in all cases, the sample size is small so the lines can be erratic. The three graphs shown in Figure 4 are those that indicate these trends in the clearest manner (i.e., washing of bridge decks vs. percentage of steel bridges, washing of expansion joints vs. percentage of older joints, washing of bearings vs. percentage of mechanical bearings). Additional combinations of data are plotted in Appendix 1. These graphs show in all cases that if a state has a low percentage of steel bridges, mechanical bearings, and older expansion joints then it is less likely to have a washing program for decks, expansion joints, and bearings. States with a higher percentage of these steel bridges, mechanical bearings, and older expansion joints are normally more likely to have a frequent washing program.

There are also some regional correlations that may be related to climate that are highlighted in the following figures that visualize the data in GIS maps of the U.S. and the accompanying discussion.

Figure 5 shows the geographic distribution of bridge deck washing frequency. From this figure there are some regional trends and also some regional outliers that can be identified. The Pacific Northwest washes decks infrequently if at all. The need for washing in this area is likely small due to the year round mild climate. However, mountainous regions and the proximity to salt laden air would suggest a slight benefit from a washing program.

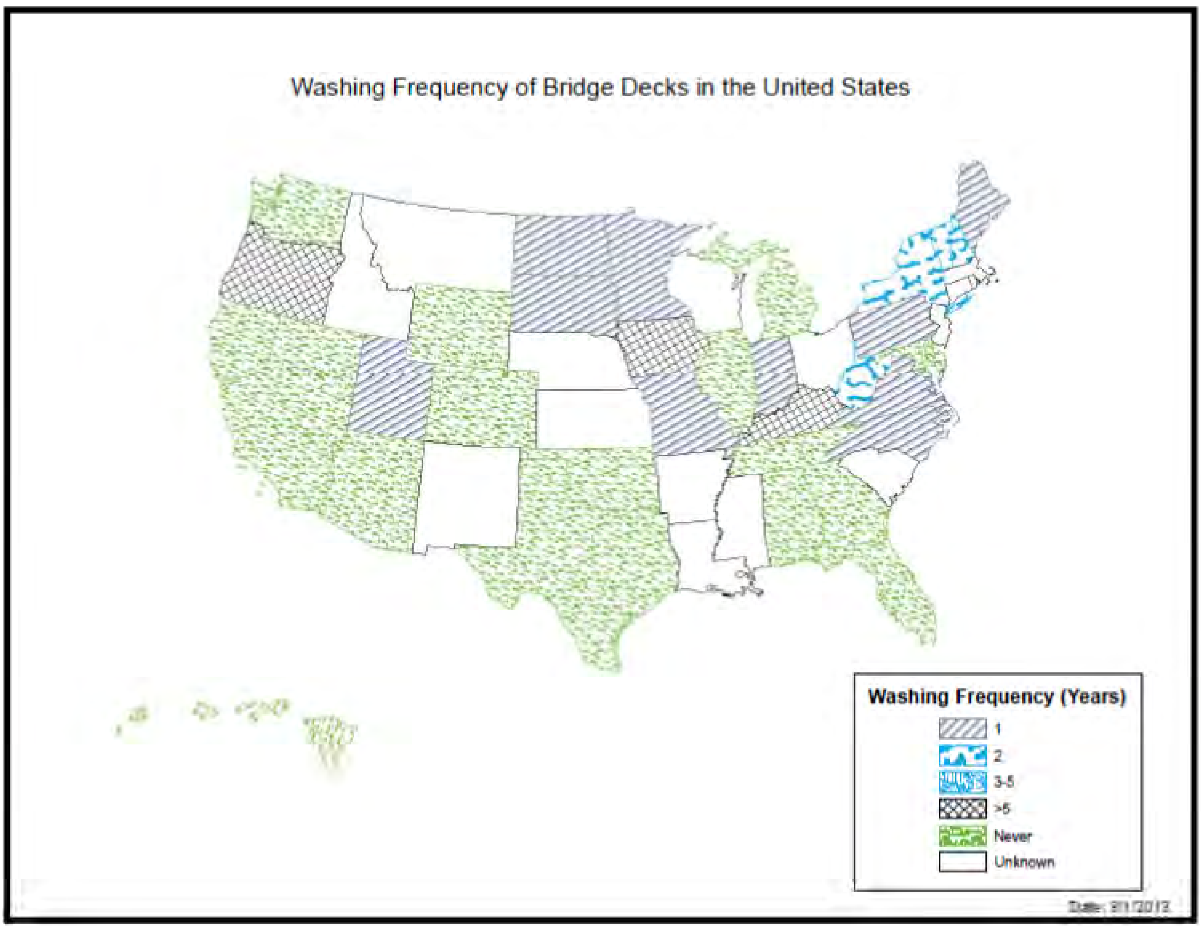



**Figure 5.** U.S. map of states that wash bridge decks

Deck washing is not typically performed the Pacific Southwest, except for Utah. This makes sense because the climate these states experience is very dry and arid, except for parts of California. Corrosion related deterioration of the deck due to deicer application is not generally a concern in these types of environments. Parts of California have climates that are more prone to corrosion due to their proximity to the ocean; but as shown, California does not employ a bridge deck washing program.

In the Midwest, the frequency of washing decreases moving from the northern states to the south. Northern Midwest states obviously have a highly variable climate with warm, humid summers and cold winters. Most of these states frequently use deicers on their roads in order to control snow buildup and create safer transport. This constant wet-dry cycle with the addition of salt creates a very corrosive environment. Therefore, it makes sense that a majority of states report washing bridge decks once a year. The more interesting question is why some of the states don't wash decks more often. Most notably Illinois and Michigan are states without deck washing programs that are bordered by states that do regularly wash decks. Illinois and Michigan have similar climates and use some form of deicers on the roadways as well, similar to the states that border them. The reasons why these states do not employ a deck washing program will be explored in the follow-up survey described later.

The east coast of the U.S. washes decks frequently with a few exceptions. The Northern states without deck washing programs responded to the preliminary survey that environmental regulations prevent them from washing decks. Being on/near a coast creates moisture and salt laden air that would make it beneficial to wash on a regular basis. Couple this with the fact that the Northeast states also experience a cyclical warm and cold climate with relatively harsh winters and heavy use of deicers. As expected, washing frequency appears to decrease moving South along the coast line.

For the most part, all of the information stated here can be extrapolated to a discussion of Figures 6 and 7, which show the results the results for bearing and expansion joint washing frequency.

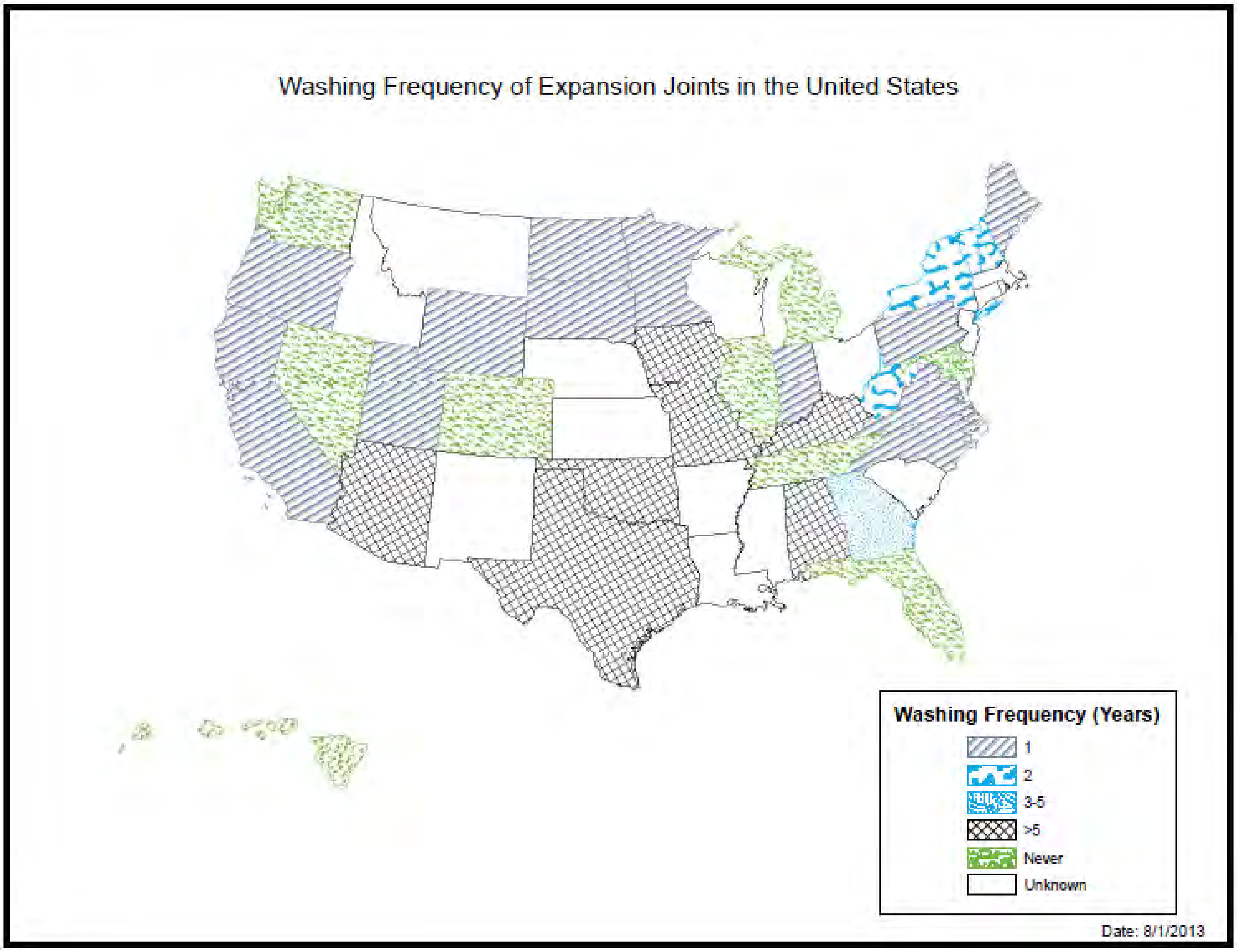



**Figure 6.** U.S. map of states that clean expansion joints

Figure 6 shows the geographic distribution of survey responses for expansion joint cleaning. In general, the responses are similar to those shown in Figure 5 with the exception that some states that indicated that they do not wash decks indicated that they do clean expansion joints, including Texas, Oklahoma, and Georgia among others. This indicates perhaps that state DOTs recognize that expansion joints require additional maintenance to improve their life span and that debris build up in expansion joints happens even in regions with mild climates.

Despite the larger number of states that clean expansion joints relative to decks there are still regional discrepancies. For example, the responses from the Pacific Northwest are split. Oregon cleans expansion joints every year whereas Washington does not have an established program to clean expansion joints at all. This disparity raises questions due to the climate and traffic similarities of these two states.

In the Pacific Southwest both California and Arizona, states that did not have deck washing programs, regularly clean expansion joints. Clearly in this region the DOTs seem to recognize that expansion joint issues are not limited to locations with cold weather, snow and deicer use. Utah, which had a deck washing program as well, reported an annual program to remove debris from expansion joints.

Survey results for expansion joint cleaning in the Midwest and the Northeast mirrored the deck washing results.

The most striking difference between the survey results for deck washing and expansion joint cleaning are in the responses of states in the South and Southeast. As noted above, several states in these regions reported that they did not wash bridge decks but that they do have an expansion joint cleaning program. These include Texas, Georgia, Oklahoma, and Alabama. While these states reported that these programs result in relatively infrequent cleaning, i.e., every five years or so, the results do seem to indicate that cleaning expansion joints is a higher priority than deck washing for many states.

Figure 7 shows the DOT responses to the question regarding the frequency at which they wash bridge bearings. The responses are similar to those reported for cleaning expansion joints. Comparing figures 5, 6 and 7 and examining the data in Table 1 shows that most states that wash bearings also wash expansion joints and decks. However, some of the states that reported cleaning expansion joints did not report washing bearings, possibly indicating that maintenance of bearings is seen as a less important problem. This is the case for some southern states, including Texas and Oklahoma that do not have severe winter weather and heavy use of deicers.

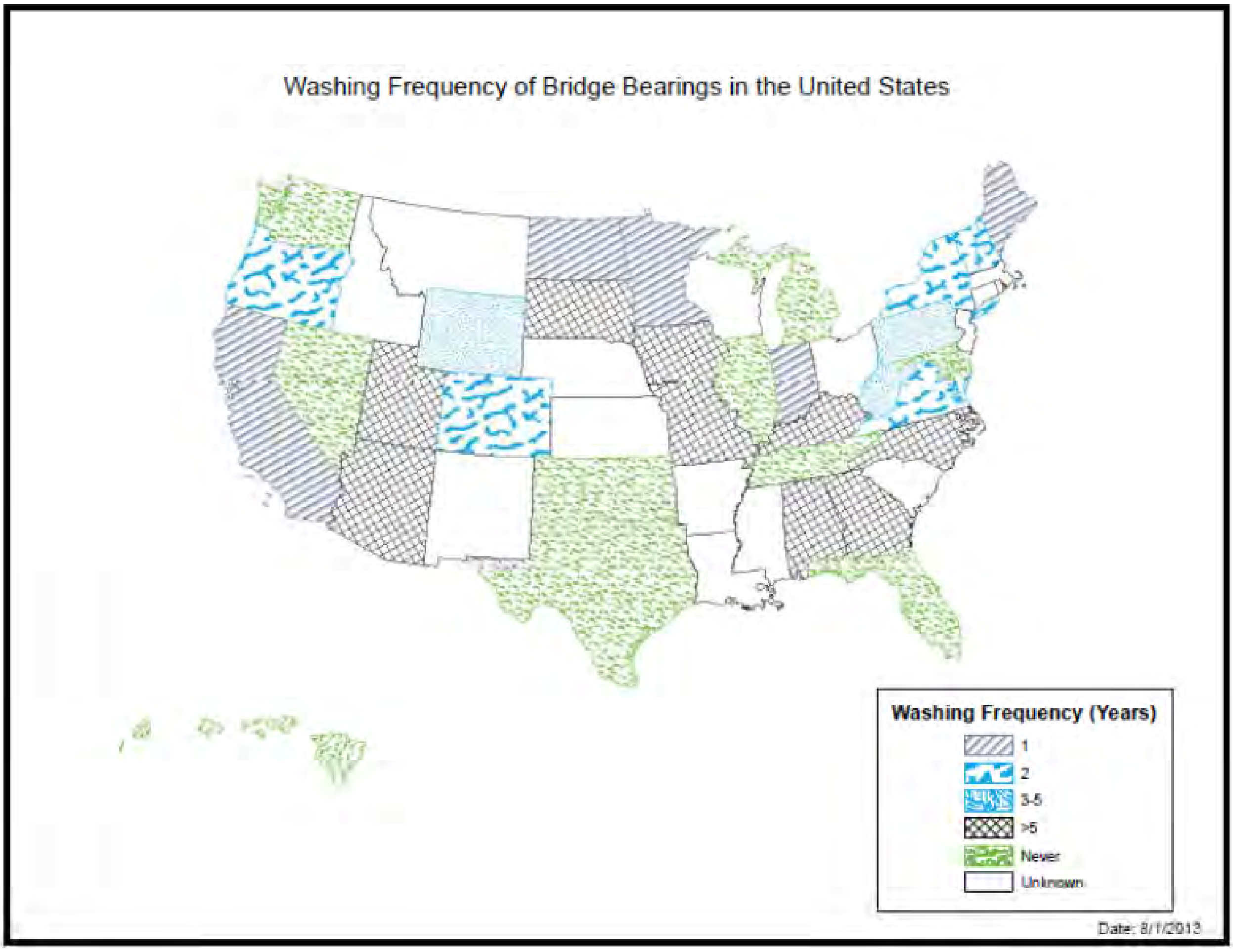



**Figure 7.** U.S. map of states that wash bearings

Figure 8 shows the estimated percentage of steel bridges in states across the United States. Of the 35 responses received, fourteen states have 0-25 percent of their bridge inventory being steel, thirteen states have 26-50 percent, seven states have 51-75 percent, and one agency contains 76-100 percent. As the figure shows, most of the states with larger proportions of steel bridges are in the Northeast and Midwest, which is logical as the steel industry has historically been concentrated in these regions. These are also regions that reported more rigorous washing programs for all elements in general.

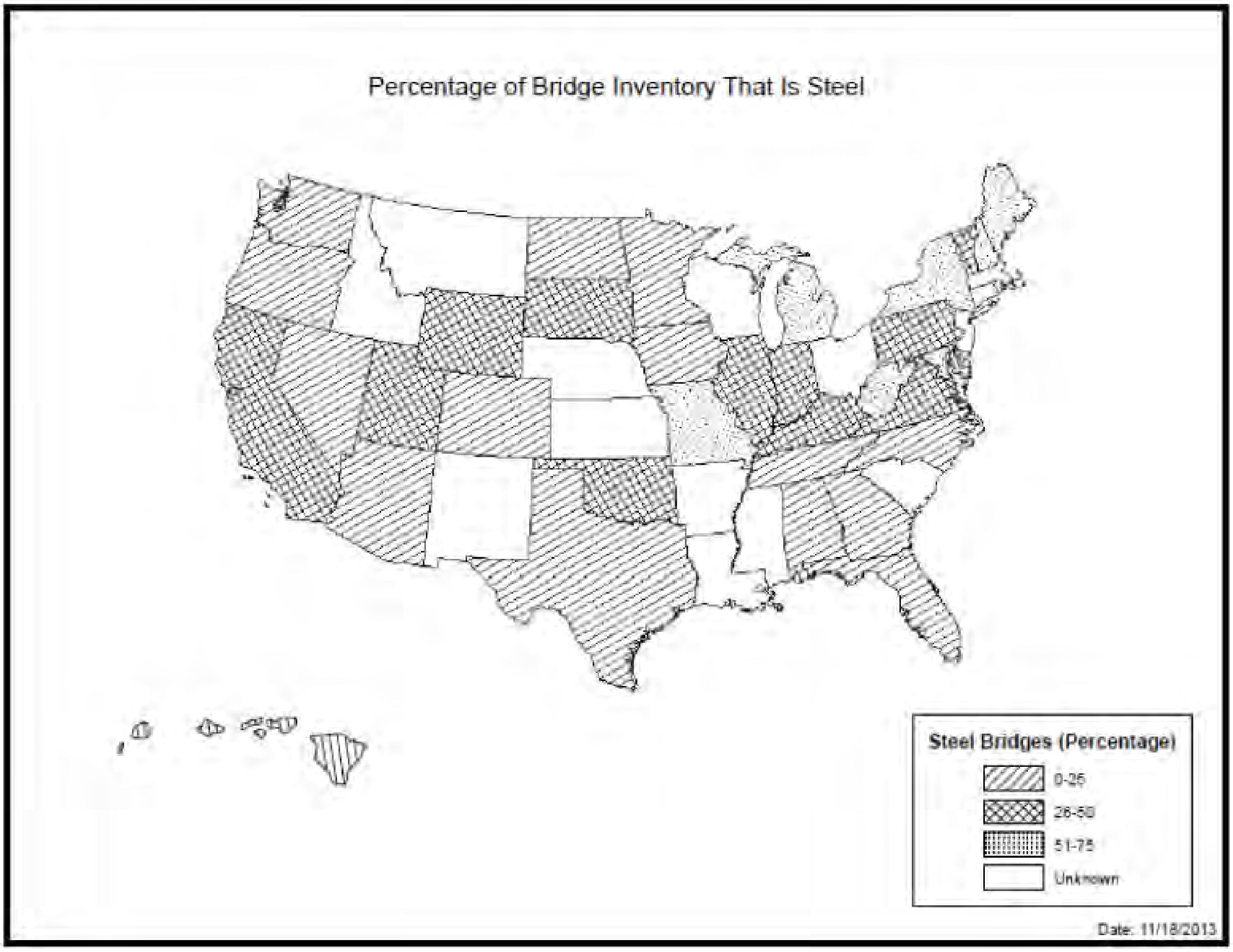



**Figure 8.** Percentage of bridge inventory that is steel across the U.S.

Figure 9 shows the estimated percentage of mechanical steel bearings in the states across the U.S. Thirteen states responded that they had 0-25 percent, eight states have 26-50 percent, twelve states have 51-76 percent, and one agency has 76-100 percent. The geographical distribution of older mechanical bearings across the U.S. appears to be more random than the distribution of steel bridges since many older concrete bridges also use mechanical bearings. As mechanical steel bearings are an older design, in most cases they are being replaced with newer bearings (typically elastomeric bearings) once they reach the end of their functional life span. As shown previously in Figure 4b, there is also a trend that mechanical bearings are washed more frequently in states that have higher percentages of those bearings in their bridge inventory.

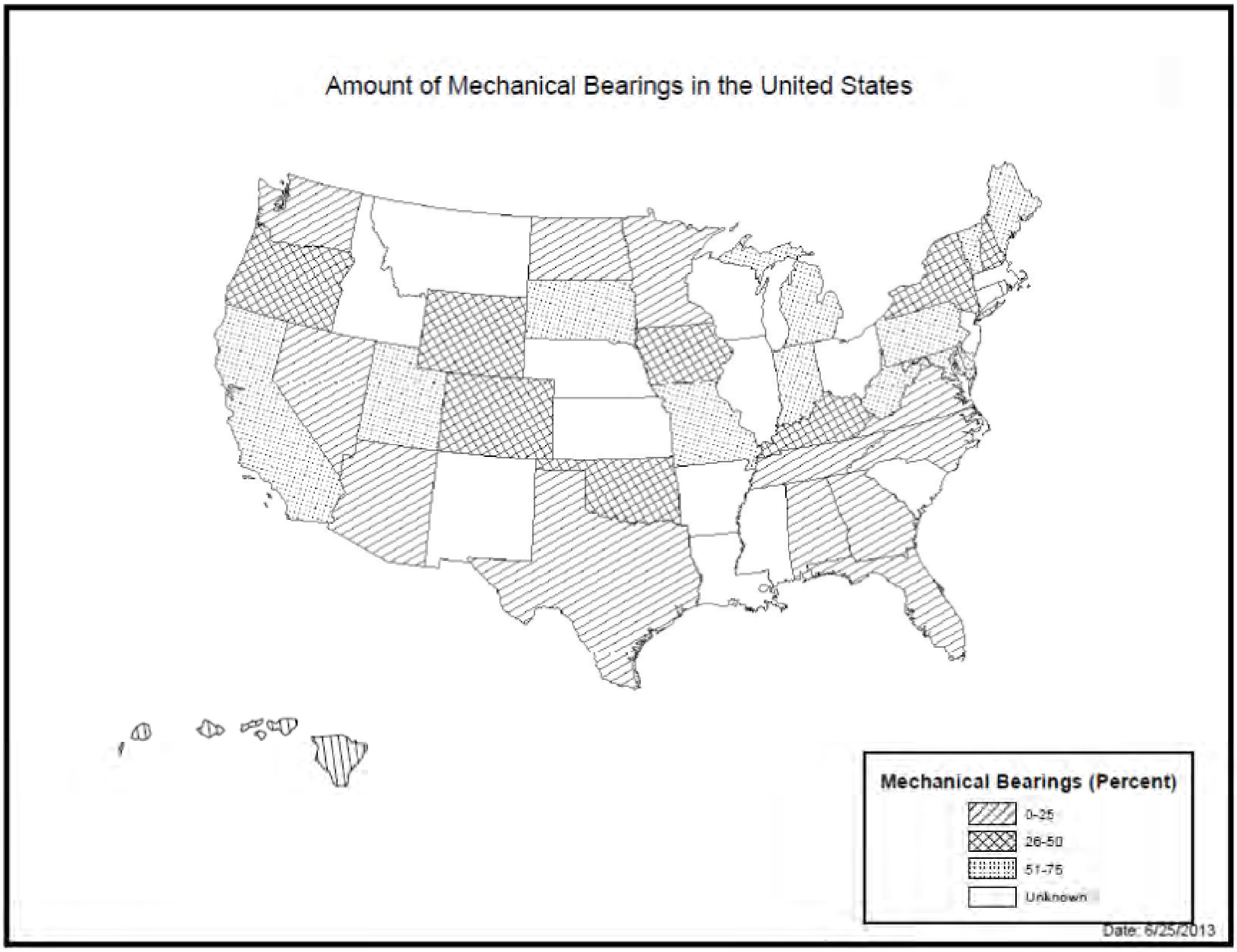



**Figure 9.** Percentage of bridge inventory that has mechanical bearings

Figure .10 shows the estimated percentage of older expansion joints in use across the U.S. Older expansion joints in this case refer to finger joints, sliding plates, or other older design expansion joints. Twenty-five states responded that they have 0-25 percent, five states have 26-50 percent, two states have 51-75 percent, and zero states have 76-100 percent. As noted above, more states perform cleaning of expansion joints than wash bridge decks or bearings. Newer joints do not eliminate maintenance concerns and do still require cleaning. However, as shown previously in Figure 4c, when states have a higher percentage of older expansion joints in their inventory they are generally cleaned more often overall.

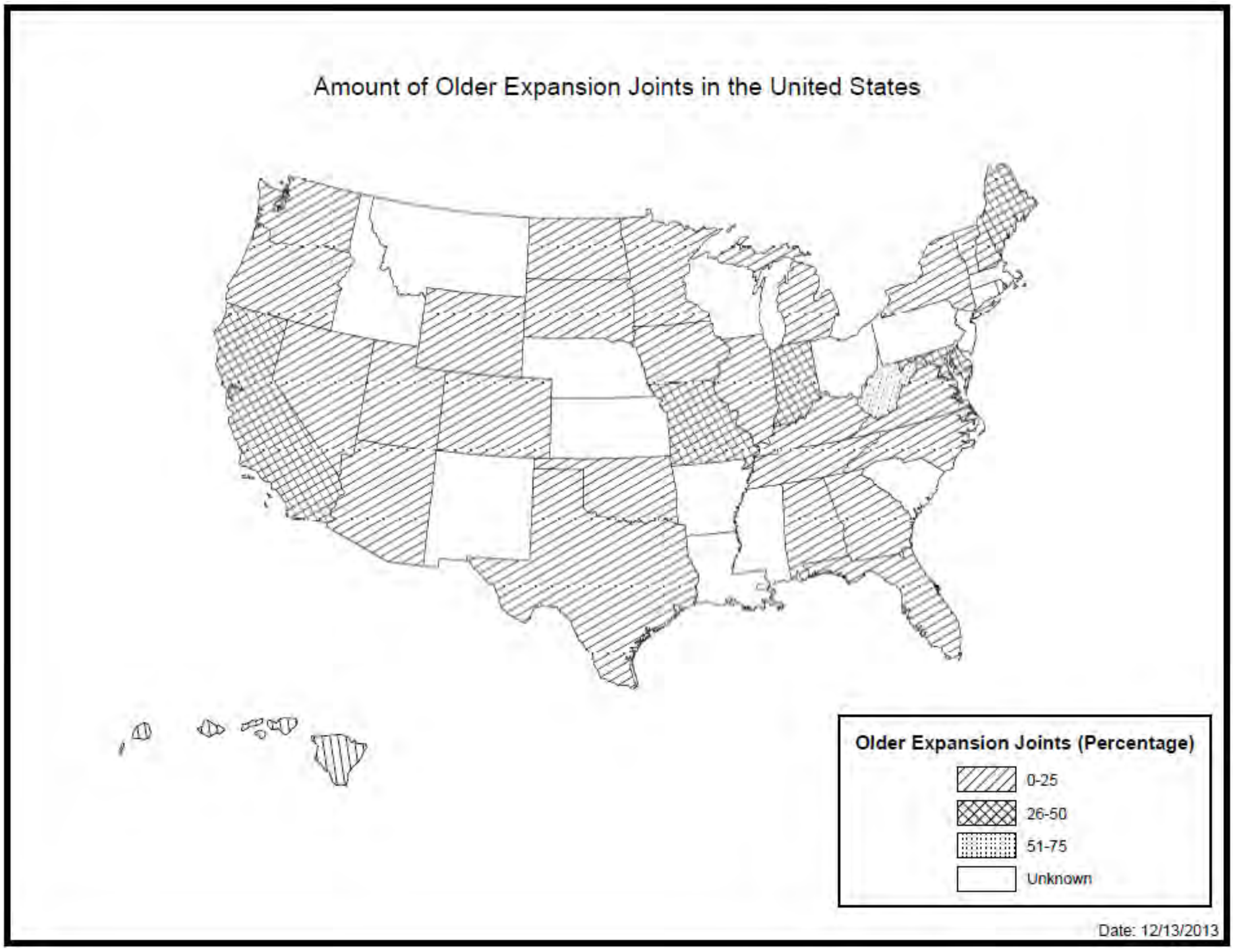



**Figure 10.** Percentage of bridge inventory with older expansion joints

Figure 11 shows the distribution of open expansion joints across the U.S. Twenty-five states responded that they have 0-25 percent, four states have 26-50 percent, three states have 51-75 percent, and zero states have 76-100 percent. The distribution appears similar to the distribution of older expansion joints shown in Figure 10.

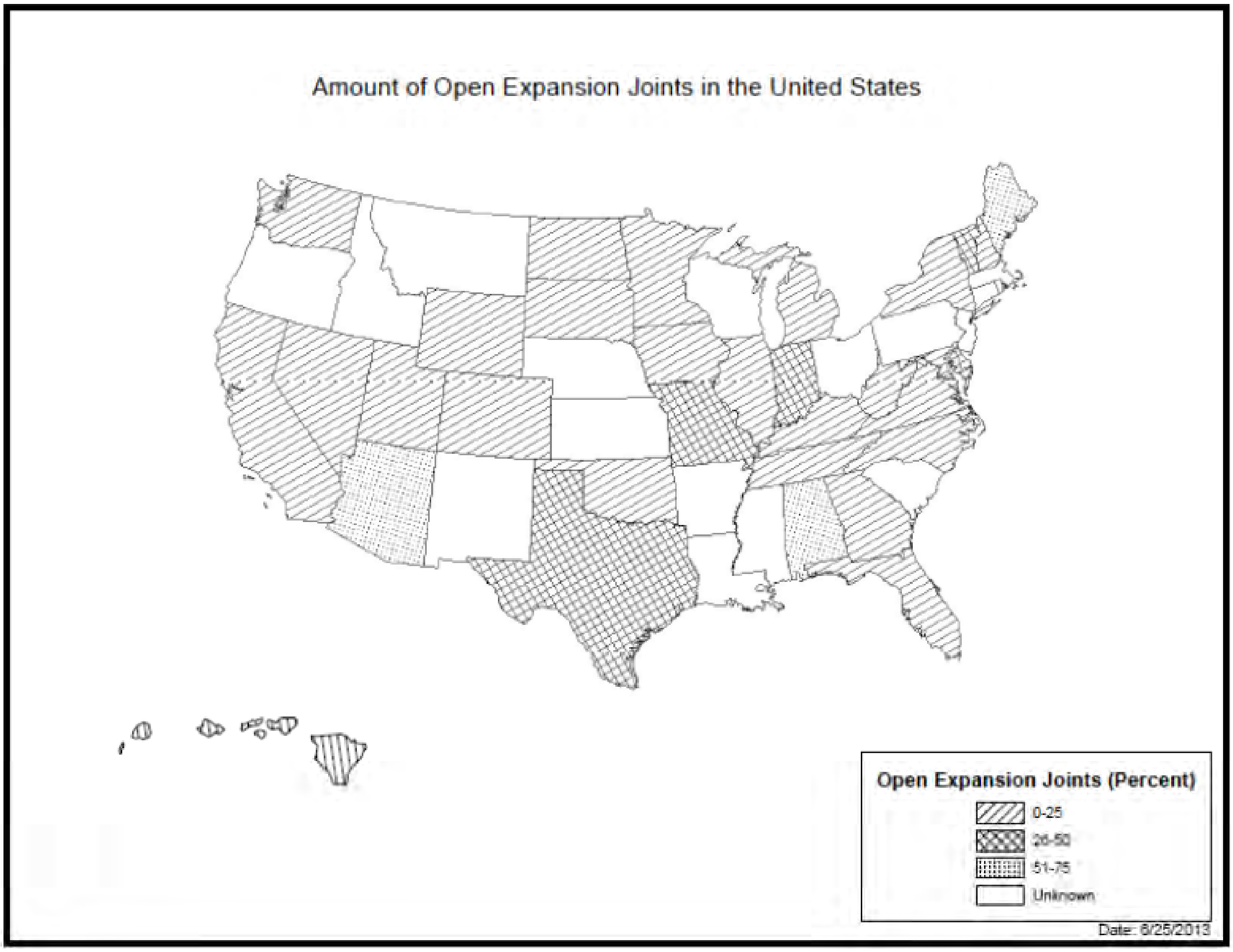



**Figure 11.** Percentage of bridge inventory with open expansion joints

The preliminary survey also collected data on how states track paint condition and corrosion data for mechanical steel bearings. Out of the 35 responses, 25 agencies actively collect data on the paint condition of steel bearings and 26 agencies record the corrosion of steel bearings. This is valuable information that can help determine whether bearings need to be replaced. Future studies could collect this data investigate correlations between bearing washing programs and bearing paint life and deterioration.

# Section 4 Follow-up Survey

Detailed follow-up surveys were sent to individual states after analyzing the preliminary survey responses. Each transportation agency was asked specific questions depending on their response to the preliminary survey. The objective was to determine the state-of-practice for washing decks, joints, substructure seats and bearings and also to determine why some states do not wash these elements regularly. Agencies selected for the follow-up survey were contacted either by phone or e-mail and their responses were collected manually as opposed to using an online system as was used for the preliminary survey. In each case, the follow-up survey contained more in-depth questions pertaining to the details of the respective programs. Replies to the follow-up questions were gathered from 18 agencies. Two agencies on the east coast were visited to discuss their programs but it was found that the information obtained was not significantly more detailed than that provided in the survey. The responses below are organized into two categories: agencies that do not have cleaning programs (or have very limited programs) and agencies that do have regular cleaning programs.

## 4.1 Agencies with Limited or No Deck, Bearing and Joint Cleaning Programs

***Arizona Department of Transportation***

In the preliminary survey, the Arizona Department of Transportation (ADOT) responded that they never wash bridge decks and that expansion joints and bearings are cleaned on a frequency of greater than every 5 years. In the follow-up survey ADOT indicated that the reason for this is that they have higher priority needs. These elements are cleaned on a case by case basis (paint condition and corrosion data are recorded for bearings) when there is a need identified by the bridge inspectors. There is no established washing policy or procedure.

This response does not come as a surprise since Arizona has a climate that is not conducive to corrosion growth and the states around it tend not to frequently clean these elements. There is also very little chance of highly corrosive substances such as deicers being used on a regular basis.

*Georgia Department of Transportation*

The Georgia Department of Transportation (GDOT) replied that they never wash bridge decks, expansion joints are washed every three to five years, and that bridge bearings are washed at a frequency greater than five years in the preliminary survey. In the follow-up questions GDOT indicated that the reason for this is that they have determined washing is not really needed in their state. Occasionally, contracts are let for re-sealing expansion joints and during this process the joints are cleaned and re-sealed. This occurs roughly every ten years for typical bridges.

*Iowa Department of Transportation*

The Iowa Department of Transportation (Iowa DOT) replied that they clean bearings, decks, and expansion joints less frequently than once every 5 years. In the follow-up survey they indicated that insufficient funds and resources to maintain this type of program is the primary reason for the long interval between cleanings. Iowa DOT indicated that when these elements are cleaned it is on a case by case basis and that there are no written procedures. However, there is a general process that is followed for expansion joints and bridge decks.

For expansion joints, debris is first manually removed and disposed of. Then the joint is washed/flushed with water with no attempt to collect or filter the run-off. The process is similar for bridge decks, where debris is first manually removed and disposed of and then the deck is washed/flushed with water with no collection or filtration of the run-off. Typically, only the shoulder of the bridge deck is washed but this is once again on a case by case basis.

Given that Iowa DOT reported a reasonably large percentage of mechanical bearings in use (26-50 percent), that it is has a variable climate with harsh winters, and uses chemical deicers they were asked why these elements are not washed more often. The representative of Iowa DOT responded that the larger, more complicated structures are washed annually in order to remove chlorides distributed over the winter. Other bridges are not washed as often and seasonal rains are counted on to remove chlorides. Iowa DOT also tries to employ designs that protect and shelter more sensitive areas, such as bearings, to prohibit corrosive materials or standing water from collecting.

### *Maryland Department of Transportation*

The Maryland Department of Transportation (MDOT) indicated in the preliminary survey that they never wash decks, expansion joints, or bearings. They also indicated that they have a larger than average percentage of steel bridges, mechanical bearings, and older expansion joints in use. Given these responses, the states climate, use of deicers, and proximity to salt water they were selected for a follow-up survey to determine why these elements are not cleaned.

MDOT indicated that they had a complete bridge washing program in the past but had to eliminate it due to restrictive environmental regulations to maintain the integrity of Chesapeake Bay. Any run-off from any washing activity is considered hazardous waste. This requires that all run-off from washing (water, debris, etc.) be collected regardless of whether the run-off falls into a river or ground below the bridge. The cost of having to collect all solid and liquid run-offs from all bridge washing activities is too large so MDOT no longer has a bridge washing program. Instead MDOT has been using more pre-emptive design-based measures to stop or limit the exposure of water and debris to bearings and expansion joints to eliminate the need for power washing. Still, MDOT indicated that they have had replacement issues in the past and that corrosion is a significant problem with steel loss.

### *Michigan Department of Transportation*

The Michigan Department of Transportation (MDOT) reported in the preliminary survey that they do not wash bridge decks, expansion joints, or bearings. In the preliminary survey they noted that only one district in Michigan washes decks and expansion joints but it does not specifically wash bearings. MDOT also reported a larger than average percentage of steel bridges and mechanical bearings. Since Michigan also has a harsh winter climate requiring the use of deicers and it is surrounded by states that frequently clean bridges they were selected for a follow-up survey.

In the follow-up, MDOT responded that they had a specification for washing superstructures for 10 years. This program was discontinued due to environmental regulations that were enacted. Water run-off from the washing process now has to be collected and treated. The cost of having to collect solids via dry cleaning in addition to the liquid run-off from washing is too prohibitive. These regulations have also affected the downspout design on all bridges. Downspouts can no longer free drain and must distribute water to collector pipes. Currently MDOT washes only movable bascule bridges or lift spans. These are washed every year.

MDOT reported having to replace many expansion joints, mostly on older bridges. They now have an agency focus on designing continuous superstructure members to eliminate this issue. MDOT reported not having regular problems with bearings although there have been corrosion and deterioration issues with older rockers or H-seats.

***Oklahoma Department of Transportation***

The Oklahoma Department of Transportation (ODOT) responded in the preliminary survey that they never wash bridge decks or bearings and that expansion joints are washed at a frequency greater than every 5 years. In the follow-up survey ODOT cited a lack of sufficient resources to routinely maintain a statewide washing program as the primary reason for the lack of a comprehensive bridge washing program. Even though Oklahoma is in the southern part of the country there is still the potential for some winter weather and ODOT indicated that they do use deicers in the winter.

In the follow-up survey, ODOT indicated that there have recently been internal discussions regarding preventive maintenance in the state. However, to implement a bridge washing program the maintenance engineers indicated that ODOT must overcome hurdles such as a lack of funding, concern over environmental impacts, and reluctant senior staff. ODOT indicated that they have had to replace significant bridge members in the past due to section loss, including many steel rocker bearings.

***Tennessee Department of Transportation***

In the preliminary survey, the Tennessee Department of Transportation (TDOT) indicated that they never wash bridge decks, expansion joints, or bearings and cited the reason being that TDOT has higher priority needs.

In the follow-up survey, a representative of TDOT stated that environmental regulations are also very strict. In order to have a washing program and stay in compliance with regulations, TDOT would have to collect all solid and liquid runoff during the washing process because many bridges in Tennessee still have lead paint. The TDOT official indicated there have been problems in the past with discoloration of the water below bridges that had been washed and where the runoff was not collected, resulting in rules prohibiting bridge washing runoff from reaching waterways. Cost is also a factor as TDOT contracts out cleaning for each individual bridge. TDOT indicated that they do not see significant return on the investment of a washing program.

TDOT does use deicers during winter but not as heavily as more northern states. There have not been many problems with expansion joints in the past as TDOT has been using strip seals for the past 20 years and indicated that they seem to work well. Problems with expansion joints have been limited to older joints. Occasionally, maintenance will need to clean and paint bearings due to rust on an as needed basis.

## 4.2 Agencies with Regular Deck, Bearing or Joint Cleaning Programs

***California Department of Transportation***

The California Department of Transportation (CalTrans) responded to the preliminary survey that they never wash bridge decks but they do clean expansion joints and bridge bearings every year. In the follow-up survey, CalTrans indicated that they do not wash bridge decks because of environmental restrictions. CalTrans also reported a larger than average percentage of steel bridges, mechanical bearings, and older expansion joints.

The follow-up survey inquired about specific cleaning methods used for expansion joints and bearings. In both cases no water is used; presumably do to the same environmental regulations that prevent deck washing. Bearings are required to be cleaned by hand and debris is collected and removed. Bearings are cleaned on a somewhat as-needed basis and not all bearings of a particular bridge are washed at the same time.

Expansion joints are dry cleaned as well but a vacuum process is used. All various types of expansion joints are cleaned in the interest of preservation of seals, joint openings and removing debris that might cause the joints to lock.

***Maine Department of Transportation***

The Maine Department of Transportation (MaineDOT) replied that they wash bridge decks, expansion joints, and bearings every year. They also reported a larger than average percentage of steel bridges, mechanical bearings, older expansion joints, and open expansion joints in their inventory. MaineDOT's procedures for washing these elements are outlined in MaineDOT's Bridge Maintenance Standards, excerpts of which are provided in Appendix B.

Bridge decks are first cleaned with hand shovels, street brooms, power brooms, or a combination of these methods. This removes any maintenance sand and other debris from the bridge deck and the area in between the faces of the guardrails on the approach slabs. Twenty-five feet of the approach sections are cleaned in this manner as well. The debris is removed and disposed of in accordance with set policies. Debris that is located outside of the faces of the guardrails at the approach slabs is uniformly deposited onto the side slope. This is done using hand shovels or a Bobcat. After this initial dry cleaning process, the decks are washed/flushed based on the following established order of priority: truss bridges/bottom chords, open grid decks, ferry service transfer bridges, bridges with open joints. This is the recommended order of priority and can be changed by Bridge Maintenance Managers based on the amount of winter salt applications at each bridge. This flushing process focuses on the deck, underneath bridge rail posts, rail components, bridge drains, joints, gutters, parapets, backwalls, and bridge seats. In this way expansion joints and bearings are cleaned in the same process as the bridge decks.

MaineDOT stated that they have a history of extended life of bridge curbs and rail due to cleaning on an annual basis. They also believe washing to be of benefit to beam ends that can adversely affect a bridge more than the bearings. These elements are cleaned in the spring during high watershed times, an agreement made with the Maine environmental regulation agency.

There is no systematic training program associated with these procedures but they are addressed in a section of MaineDOT's Bridge College 101 (available at http://tsp2bridge.pavementpreservation.org/northeast-nebpp/annual-meetings/2012-2/). Other manuals used by MaineDOT can be seen in Figure B-1 in Appendix B.

***Minnesota Department of Transportation***

In the preliminary survey the Minnesota Department of Transportation (MnDOT) responded that they clean decks, expansion joints, and bearings every year except for bridges with high traffic volumes which are washed less frequently. MnDOT was selected for a follow-up survey because they have a seemingly rigorous bridge washing program and a harsh winter climate where deicers are used typical of many mid-western states. In the follow-up, MnDOT provided information on their bridge washing methods as outlined in their Bridge Maintenance Manual. They indicated that the manual is currently being updated.

MnDOT uses a top down approach when cleaning these bridges, including the elements of primary interest here. This means that the deck is washed first, then the expansion joints, and then the bearings. The decks are typically swept first before flushing. Bridge maintenance supervisors establish water loading points on the bridge before cleaning. Washing starts at the high side of the bridge using a tanker truck or a tank mounted on a truck that has a high pressure water pump system and water is directed towards catch basins or drains. During this process the drains are cleaned out as well. Some bridges are cleaned with more care. These are typically Fracture Critical bridges, many of them truss bridges, and on these the lower chord and its components are cleaned thoroughly. MnDOT indicated that they feel this program is important given the high concentration of chlorides used each winter. The agency feels that regular washing helps to extend service life, gives bridge inspectors a better chance to spot deficiencies, and makes the surface more prepared for preventive maintenance projects.

Expansion joints are flushed from one side of the bridge to the other using the same flushing system as that used to clean the deck. This is done on all joints and sometimes special care is given to open or finger joints to remove accumulated materials on pier caps. All joints are washed on a bridge at one time, normally in the spring. Some districts will occasionally use an air compressor to blow out collected debris in the fall season as well. Expansion joints are cleaned due to the possibility of accumulated debris hindering the joint's function as well as causing potential damage to the expansion joint glands. Flushing of the joints also provides inspectors a chance to inspect the integrity of the joint and the glands. MnDOT indicated that their opinion is that washing expansion joints adds to their functional life.

After the deck and expansion joints have been washed, the same equipment is used to flush out the bearings, bridge seats, and other super or sub structure elements provided they are accessible from the slope. If other equipment is needed to reach these areas then they are cleaned at a different time. All bearings are washed but more effort is spent on steel bearings than elastomeric bearings. MnDOT employs a program that is very serious about removing snow and ice resulting in heavy use of sand and deicers. It is a point of emphasis that bridge maintenance crews must make sure that all chlorides and sand are removed from the bearings and bearing areas.

MnDOT washes all of their bridges in the spring to remove winter accumulations of salt and debris from structural bridge elements since they accelerate corrosion and can cause scaling of concrete. The total effort varies from bridge to bridge due to different conditions experienced that year and physical characteristics. Bridge seats, expansion bearings, diaphragms below finger and plate expansion joints, and elements exposed to traffic spray are all prone to large collections of dirt and debris and are therefore washed diligently.

A training program for these maintenance practices exists at MnDOT and manuals can be found at http://www.dot.state.mn.us/bridge/. This program was adopted to ensure that proper maintenance procedures are applied statewide. There are three phases: Phase 1 focuses on learning about the different structural components and MnDOT's cleaning strategies, phases 2 and 3 include hands-on training to prepare maintenance crews for field activities. MnDOT reported that this program keeps the maintenance performed year to year consistent, effective, and efficient.

### *Missouri Department of Transportation*

In the preliminary survey, the Missouri Department of Transportation (MoDOT) indicated that they wash bridge decks every year, yet expansion joints and bearings are washed at a frequency greater than 5 years. This is surprising given that Missouri does experience winter climates and reported a larger than average percentage of steel bridges, mechanical bearings, older expansion joints, and open expansion joints. However, the preliminary survey indicated that few of the states surrounding Missouri have routine washing programs for joints and bearings. MoDOT was contacted with a follow-up survey.

MoDOT will dry clean deck via sweeping and brushing prior to washing on an as needed basis. This normally occurs when there is an abundance of debris that would otherwise be washed into the environment below. After this process, or in lieu of it, the deck is sprayed with a pressure hose. While there is no specific washing program for expansion joints and bearings individually, the spraying process employed often includes decks, drainage systems, drain basins, piers, abutments, lower chords, and expansion joints. This work varies on a case by case basis based on the available resources and time constraints.

Bearings also have a painting specification on an as needed basis. This is normally performed when corrosion exceeds a certain threshold. Paint scale, pack rust, and other surface rust are removed by scraping or other abrasion methods and then the bearing is primed and painted.

The maintenance manual for MoDOT can be found at [http://epg.modot.org/index.php?title=Category:771_Bridge_Preventative_Maintenance_Guidelines](http://epg.modot.org/index.php?title=Category:771_Bridge_Preventative_Maintenance_Guidelines). A copy is also shown in Figure B-2 located in Appendix B.

*New York State Department of Transportation*

The New York State Department of Transportation (NYSDOT) indicated in the preliminary survey that they wash bridge decks, expansion joints, and bearings at a frequency of once every two years and was selected for the follow-up survey. NYSDOT indicated they use a manual which came into effect in 2008 that details how maintenance workers should carry out bridge washing and was the primary focus of the follow-up survey and investigation. It can be found at https://www.dot.ny.gov/portal/pls/portal/mexis_app.pa_ei_eb_admin_app.show_pdf?id=6797. The manual used for maintenance is shown in Appendix B, Figure B-3.

The manual specifies the procedures for the cleaning of the entire bridge as a whole and does not contain extensive detail regarding decks, bearings and joints. However, NYSDOT indicated that the processes are similar and the manual does require that all bridge surfaces be cleaned. Debris is swept, shoveled, and disposed of offsite before pressure washing. If metal shovels are causing damage to the surface then the workers must switch to using plastic. The debris from the bridge must not be deposited into any wetland, stream, other water body, bridge drainage system, or traffic lanes. All paint is considered harmful so the pressure washing process must not cause any damage to paint or other coatings nor harm any of the masonry beneath bearings. The water must be drawn from an on-site source and may not affect the source in any way. This is accomplished by requiring screens on intake hoses and that any equipment (i.e., pumps) introduced into the source be steam cleaned. During a certain time period washing cannot be performed within 3 feet of a birds nest as they might be occupied by protected species. Scuppers, troughs, and downspouts are required to allow unimpeded water flow. The engineer can require the contractor to clean these again if they are not free flowing.

NYSDOT indicated that they employ this washing program for multiple reasons. For the deck the purpose is to ensure drainage during precipitation. Cleaning of the deck removes debris that could otherwise get lodged in drains or expansion joints and possibly pose a safety hazard. For the superstructure the purpose is to remove the buildup of salts. For the substructure the purpose it is to remove debris and salts from bearing areas. This is especially important near leaking expansion joints. NYSDOT noted that the washing program also allows inspectors to see maintenance issues more clearly and that it is a process that requires few resources and can be completed quickly. The bulk of the effort by contractors is spent on washing the bridge deck because it is more convenient and no scaffolding or other access equipment is needed.

There is no training program for these procedures but there is a series of Powerpoint slides assembled by NYSDOT that addresses environmental concerns during bridge maintenance. The slides are not required to be viewed.

***Pennsylvania Department of Transportation***

In the preliminary survey, the Pennsylvania Department of Transportation (PennDOT) indicated that they wash bridge decks and expansion joints every year while bearings are washed every three to five years. They also replied that they have a larger than average percentage of steel bridges and mechanical bearings. PennDOT has a written Bridge Maintenance Manual which documents how to clean, maintain, and repair different bridge elements. Chosen pages from this manual are copied in Appendix B, Figure B-4. The entire manual can be found at ftp://ftp.dot.state.pa.us/public/PubsForms/Publications/PUB%2055.pdf. The follow-up survey focused on gathering information about their bridge cleaning methods.

Bridge decks are generally washed after winter operations but environmental concerns prevent the cleaning of bridges that span stocked trout streams between the months of April to June. Additional deck cleaning may be performed during the winter if there is heavy use of deicers. The deck cleaning process involves sweeping, collecting and removing loose materials from the entire deck surface. Then the remaining dirt and debris is removed by flushing with water. The water for flushing is obtained from the water below the bridge where possible. Expansion joints are also flushed out during the deck washing process. When possible, compressed air is used to clear debris from strip seal glands and compression joints. During this process the amount of debris entering the water below is minimized but the debris is not collected in all cases.

Bridge bearings are also cleaned after winter operations but less frequently. The area underneath expansion joints and finger joints is also a focus when the bearings are cleaned, which helps to keep the bearing seats free of debris. The area underneath the joints is scraped, brushed, or chipped and the accumulated debris is collected and disposed of. The bearings, bearing seats, and the area 5 feet on either side of these are flushed with pressurized water. The water source should be the water below the bridge wherever possible. Then, ideally, the bridge is jacked up so that the bearing can be removed, disassembled, cleaned, and lubricated.

***South Dakota Department of Transportation***

The South Dakota Department of Transportation (SDDOT) indicated in the preliminary survey that they wash bridge decks, expansion joints, and bearings every year. SDDOT also indicated that they have a larger than average proportion of steel mechanical bearings. South Dakota also has harsh winters and uses deicing chemicals.

SDDOT uses the same procedures to clean bridge decks, expansion joints, and bearings, which are outlined in the SDDOT Maintenance Manual (link not available but some procedures are described in the SDDOT Structures Manual http://www.sddot.com/resources/Manuals/StructuresManual.pdf). This manual covers complete bridge maintenance and also describes the general cleaning of all bridge members, including trusses and girders. All bridge elements are power washed once a year to remove dirt, sand, gravel, deicing chemicals, and other debris. This is done in the spring months after winter deicing. SDDOT indicated in the follow-up survey that the reason for employing a bridge washing program is to put an emphasis on the removal of winter deicers from bridge surfaces.

They also indicated that there is no formal training program for these procedures but some training is done within the individual state maintenance units.

***Vermont Agency of Transportation***

In the preliminary survey, the Vermont Agency of Transportation (VTrans) indicated that they wash decks, expansion joints, and bearings at a frequency of once every two years. In the follow-up survey VTrans stated that, more specifically, all bridges are swept every year and half of the state's bridges are cleaned every year. VTrans also specifies the washing of an entire bridge instead of each element individually. Their bridge washing program has been in place since the 1970s.

The follow-up survey indicated that there are multiple washing crews across the state, one for each district but they all use the same procedure. First, the bridge deck is swept using hand tools and machinery. Then the deck, curbs, and guardrails are sprayed with high pressure spray used for finger joints and troughs underneath them. This pushes all salt and sand under the bridge. Then scuppers and drains are flushed out. After this the crews move to washing the underside of the bridge. This might require the use of a Servilift or service truck to reach the underside. The washing area moves from the abutments and beam ends down to the bearings and seats. VTrans defines the *Splash Zone* to be abutments, bearings, pier caps, wing walls, and head walls. All Splash Zones that are exposed to salt or other deicing chemicals are washed in this fashion. In this way the bridge decks, expansion joints, and bearings are cleaned all at once.

VTrans indicated that they employ a washing program because of the damages caused by sand, salt, and other de-icing chemicals. For this reason, their washing procedure emphasizes the Splash Zones of all bridges. VTrans has observed permanent damages arise when salt/sand has been allowed to remain on bridge elements for long periods of time.

VTrans also has a training program for bridge washing. The program entails approximately two days of classroom and hands on training, allowing employees who wish to run a bridge washing crew the opportunity to do so.

***Virginia Department of Transportation***

The Virginia Department of Transportation (VDOT) indicated in the preliminary survey that they wash bridge decks and expansion joints every year and bridge bearings and seats every other year. VDOT also has a manual available online that details the washing practices used across the state (http://www.extranet.vdot.state.va.us/locdes/electronic%20pubs/Bridge%20Manuals/VolumeV-Part2/Chapter32.pdf). Selected pages are in shown Appendix B, Figure B-5. There is no separate specified process for the cleaning of expansion joints which are simply washed in the process of washing the bridge deck.

In the follow-up survey VDOT provided additional information regarding their cleaning practices. VDOT's policy is that every bridge deck is washed every year. Concrete bridge decks that do not have an asphalt overlay are swept or broomed to remove solid debris which is collected and disposed of.  The deck is then pressure washed.  In addition to the roadway surface, expansion joints, sidewalks, curbs, parapet walls, drainage grates, downspouts, and scuppers are /flushed during the pressure washing process.  Any bridge with an asphalt overlay, metal deck, timber deck, or slab deck is cleaned by sweeping but pressure washing is not used on these surfaces.

Bearings are similar in that the solid debris is swept, collected and disposed of from the bearing and bearing area first.  After this pressure washing is performed on the seat, bearing area, and 5 feet of the beam ends.  Then any bearing lubrication that is necessary is done.

VDOT indicated that they employ a washing program because they believe it is an important part of the bridge preservation program.  This is also a recommended procedure in FHWA's Bridge Preservation Guide.  There is no formal training program for these procedures but they are discussed quarterly in a meeting between VDOT's District Bridge Maintenance Program Managers.

***West Virginia Department of Transportation***

The West Virginia Department of Transportation (WVDOT) indicated in the preliminary survey that they wash bridge decks and expansion joints every other year and wash bearings every three to five years.  However, they commented that some districts within West Virginia do not wash bridges due to environmental reasons.  WVDOT also reported a larger than average percentage of steel bridges, mechanical bearings, and older expansion joints in their statewide bridge inventory.

In the follow-up survey, WVDOT indicated that they do not have written procedures for the washing of bridge decks, expansion joints, or bearings.  The primary goal of the WVDOT bridge washing procedure is to remove dirt and salts that accumulate during the winter from the bridge surface.  WVDOT indicated that they believe the washing program to be beneficial in extending the service life of bridges. Expansion joints are cleaned at the same time as the bridge decks by flushing out debris with water. When the bearings are cleaned WVDOT also cleans the beam ends around the bearing areas and the underside of expansion joints.

### *Wyoming Department of Transportation*

In the preliminary survey, the Wyoming Department of Transportation (WYDOT) indicated that they washed expansion joints every year, bearings every 3 to 5 years, and that they never wash bridge decks. However in the follow-up survey, WYDOT indicated that some form of bridge deck cleaning is performed annually, typically involving sweeping or blowing the surface and occasionally flushing with water. WYDOT also reported a larger than average percentage of steel bridges and mechanical bearings across the state in the preliminary survey.

In the follow-up survey, WYDOT indicated that they have a Maintenance Manual. However, the manual simply specifies that all expansion joints, compression joints, and bearing assemblies are to be cleaned and inspected on an annual basis and does not specify specific procedures (WYDOT, 2003). The Maintenance Manual states that: “Expansion devices, sealed compression joints and bearing assemblies shall be cleaned and inspected for proper operation on an annual basis. Any faulty seal, joint, or bearing shall be replaced as soon as deemed possible” (WYDOT, 2003). This page is shown in Appendix B, Figure B-6. While WYDOT does not meet the annual cleaning objectives for all bridge elements they do regularly clean them because the organization feels it is a good business practice and adds to the life of the structural elements. WYDOT also indicated that bridge washing makes it easier for inspectors to get an accurate condition assessment. WYDOT does not have a training program for bridge washing procedures.

## 4.3 Summary of Follow-Up Survey Data

Tables 2 and 3 summarize the responses from the follow-up survey. Table 2 contains information from states that do not utilize a washing program and Table 3 summarizes the programs of states that do utilize a washing program

**Table 2.** States with limited or no deck, bearing, and joint cleaning programs

| | Reason | Comments | Instead |
|---|---|---|---|
| Arizona | Higher priority needs | | |
| Georgia | Washing not needed | Expansion joints occasionally cleaned and resealed | |
| Iowa | Insufficient funds to maintain a program | Large structures are annually cleaned, Other bridges cleaned on a case by case basis | |
| Maryland | Environmental regulations | Previously had a program, Environmental regulations made it too costly, Have had replacement issues | Use pre-emptive design methods |
| Michigan | Environmental regulations | Previously had a program, Environmental regulations made it too costly, Wash moving bridges and bascule bridges annually, Have had replacement issues | Continuous superstructure design |
| Oklahoma | Lack of sufficient resources | Have had internal discussions on preventive maintenance, Have had problems with section loss | |
| Tennessee | Higher priority needs, Environmental restrictions | Many bridges still have lead paint, Do not see a significant return on investment with a washing program | |

**Table 3.** States with deck, expansion joint, and/or bearing washing program

| | Washed | Dry Cleaning of Deck Prior to Flushing | Method of Expansion Joint Cleaning | Method of Bearing Cleaning | Training Program | Manual | DOT Employees or Contracted Cleaning | Reason | Comments |
|---|---|---|---|---|---|---|---|---|---|
| California | Expansion Joints, Bearings | Don't wash | Debris is hand collected or vacuumed | Debris is hand collected or vacuumed | | | DOT Employees | | Don't wash decks due to environmental regulations |
| Maine | Decks, Expansion joints, Bearings | Yes | Dry debris is collected as well, Then flushing of bridge joints | Dry debris is collected as well, Then flushing of bearing area | | Yes | DOT Employees | | Have a history of extended life of bridge curbs and rails due to cleaning |
| Minnesota | Decks, Expansion joints, Bearings | Yes | Joints are flushed with a high pressure hose from the side of the bridge, Sometimes an air compressor is used | Bearings, bridge seats, and and other sub structure elements are pressure washed if accessible from the slope | Yes | Yes | DOT Employees | Washing is important due to the high amount of chlorides used, Extends service life | All bridges washed in spring to remove chlorides from the winter, Washed using a top down approach |
| Missouri | Decks | As needed | Don't wash | Scraped and repainted on an as needed basis | No | Yes | DOT Employees | | Although there is no procedure for joints or bearings the joints are 45ormally washed in the process of spraying the deck, Procedure changed on case by case basis |
| New York | Decks, Expansion joints, Bearings | Yes | Flushed out with a pressure hose | Flushed out with a pressure hose | No | Yes | DOT Employees | Ensure proper drainage, Washes away collected salts, Allows inspectors to see surfaces better | Water for washing must be drawn from a local source, Process must be stopped if it is causing paint to flake off |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Pennsylvania | Decks, Expansion joints, Bearings | Yes | Flushed with a pressure hose along with the deck, In some cases compressed air is used | Bearings, Bearing seats and 5’ surrounding this area is flushed with pressure hose, Underneath expansion joints are washed at this time as well | | Yes | DOT Employees | | Water for washing must be drawn from a local source, When possible bearings are removed, cleaned, lubricated, and reinstalled, Additional washings may be scheduled if there are heavy use of deicers |
| South Dakota | Decks, Expansion joints, Bearings | | Washed with a pressure hose | Washed with a pressure hose | No | Yes | DOT Employees | To ensure removal of winter deicers | Washing performed in the spring after winter deicing |
| Vermont | Decks, Expansion joints, Bearings | Yes | Power washed along with the deck | Bearings and Bearing seats washed with a pressure hose | Yes | | DOT Employees | Because of damages caused by sand and deicers | Half of Vt’s bridges are washed one year and the other half are washed the next year, Splash zones are washed as well |
| Virginia | Decks, Expansion joints, Bearings Seats | Yes | Expansion joints flushed with a pressure hose along with the deck | Bearings and 5 feet surrounding the bearing area is washed in with a pressure hose | | Yes | Contracted Cleaning | Important part of the bridge preservation program sponsored by FHWA | Asphalt, timber, slab, and metal decks are only swept |
| West Virginia | Decks, Expansion joints, Bearings | Yes | Debris is flushed from expansion joints with water | Bearings, 5 feet surrounding bearing areas, and underside of expansion joints are flushed out with water | No | No | DOT Employees | Beneficial in extending the service life of bridges | Some districts within WV don’t wash bridges due to environmental restrictions |
| Wyoming | Expansion Joints, Bearings | As needed | Brushing and occasionally flushing with water | Brushing and occasionally flushing with water | No | Yes | DOT Employees | Good business practice and aids the life of the bridge | |

Examining the survey results provided in Table 2, the most common reasons for not having a program are environmental regulations and insufficient funds/resources. Some of these agencies have put more focus on pre-emptive design to keep moisture and debris away from sensitive elements due to their lack of a program. Most of them will also wash bridges on an as-needed basis. This normally involves, due to environmental regulations, the collection of all debris (both solid and liquid) washed off of the bridge during the process. This method is costly. About half of the states spoken to had a washing program at one point in time but eventually had to cancel it because funding or regulations changed.

Table 3 shows that in the majority of cases, debris is hand collected from the bridge deck before washing is performed. This is to minimize the amount of solid waste washed off of the bridge. Then power washing is used to wash the deck and normally the expansion joints in the process. In some cases the cleaning crew will use compressed air on the expansion joints instead. The joints are washed from the bridge surface or the crews will flush out the joints from the side of the bridge. In most cases debris in the area around the bearings is hand collected before spray washing as well. Some states have a standard procedure to wash the 5 feet of the beam ends surrounding the bearing area and some states do not. The majority of these programs utilize maintenance crews already working for the state instead of choosing to hire outside contractors. Most of the states have a manual but a training program is only implemented by a handful of agencies.

# Section 5 Conclusions and Recommendations

## 5.1 Conclusions and State-of-Practice Summary

From the literature review it is clear that bridge bearings and expansion joints tend to collect debris and salts during normal use of the bridge. If the salts are allowed to remain on steel surfaces they greatly increase the speed of corrosion. The collection of debris can affect the proper function of these elements by restricting movement which can cause damage to the elements themselves or the parts of the bridge they interact with. This debris can either be collected solids or water that has pooled and has the potential to freeze during winter months. A routine cleaning of bearings and expansion joints would help to abate the collection of salt and debris.

The preliminary and follow-up surveys of DOTs showed that there is considerable regional and national variability in bridge washing programs, including the aspects that focus on decks, expansion joints, bearings and substructure seats. For example, some states in regions of severe winter weather do not have washing programs even though they border states that do have relatively aggressive programs. For those states that do have bridge washing programs, there appear to be 2 different common methods used when washing bridge decks, expansion joints and bearings. Each state's selection between these procedures seems to predominantly depend upon the state's environmental regulations.

The first and most common method involves the following steps and is done in many states regardless of the types of decks, expansion joints, or bearings:

1. Sweeping of the bridge deck to collect and dispose of any dry debris.
2. Dry cleaning of the bearings, bearing seat areas, and expansion joints. Again, debris is collected and disposed of.
3. Pressure washing of the bridge deck and expansion joints. Expansion joints are normally cleaned at this time because all of the equipment is already present on the bridge. If the expansion joint is a compression seal then it is washed from the bridge deck, but if it is an open joint with a trough underneath then this is flushed out by spraying the pressure

washer into the side of the trough. If this requires a truck with a lift then this step is completed based on the equipment's availability.

4. Water cleaning of the bearings, bearing seat areas, and 5 feet of the girder ends. This cleaning is not necessarily done at the same time as the bridge decks and expansion joints. Water pressures used vary from state-to-state and no effort is typically made to collect the liquid or solid runoff from the spray washing process.

The second method uses the steps above except that all runoff, liquid and solid, is collected and disposed of in a proper disposal area. State's use this method when allowing the water to runoff uncollected is prohibited by environmental regulations. The costs for collecting liquid runoff from bridge cleaning operations are high and most states that are required to do so wash bridges infrequently.

Common among many states is to include ease of maintenance in their new bridge designs. A key part of these considerations is to design bridge drainage such that runoff does not accumulate in the bearing and seat areas or near girder ends. Additionally, most states indicated that newer expansion joints require less cleaning although cleaning of even newer joints is still occasionally required and part of regular maintenance for many of the surveyed DOTs.

## 5.2 Recommendations

Based on the literature review and current state of practice, it appears that annual washing of decks, bearings, joints and substructure seats can elongate the usable life of those elements and delay the need for replacement. While there is little empirical data to support this, the majority of bridge maintenance engineers indicate that they believe washing to be beneficial and offered experiential evidence. The following recommendations are based the literature review, common practice and the collective experience of the maintenance engineers surveyed:

1. For states where runoff does not need to be collected and winter weather results in significant salt deposits, it is recommended that bridges be washed each spring with the common method described above consisting of dry cleaning of the decks, bearings, joints and substructure seats followed by pressure washing.

2. Where environmental regulations require the runoff be collected it may be cost-prohibitive to have a bridge washing program. In such cases bridge maintenance engineers would have to weigh the costs of the washing program against the costs of future repairs.
3. In regions without winter weather and significant use of deicers it appears that washing of only expansion joints is necessary.

## 5.3 Recommendations for Further Research

The literature review and surveys performed in this research have documented the reasoning behind and standard practices for the washing of bridge components. However, there remains considerable research necessary to document the effectiveness of these programs. Many DOTs indicated that they believe there are long-term benefits to bridge washing, and indeed the literature suggests as much, however it is unclear if the long term costs of such programs are actually offset by deferring bridge and/or component replacement.

It is recommended that a comprehensive study on the cost-effectiveness of bridge washing measures be conducted. Such a study would require relatively long-term monitoring of the condition of bridges in several climate zones. The deterioration of bridges where components such as decks, bearings and expansion joints are regularly washed could be compared to those that are not regularly washed. Combining the deterioration rates with cost data for washing procedures and bridge component or system replacement would enable DOTs to justify the value of their washing programs. A nationwide study using bridges in several climate zones would also provide DOTs with data to make informed decisions about whether their climate is one where washing of key bridge elements is beneficial. The selection of bridges for such a study should be carefully considered. Issues of concern include the minimum number of bridges to provide statistically significant results and similarities in bridge design, coatings, location, daily traffic, and age.

# Section 6 References

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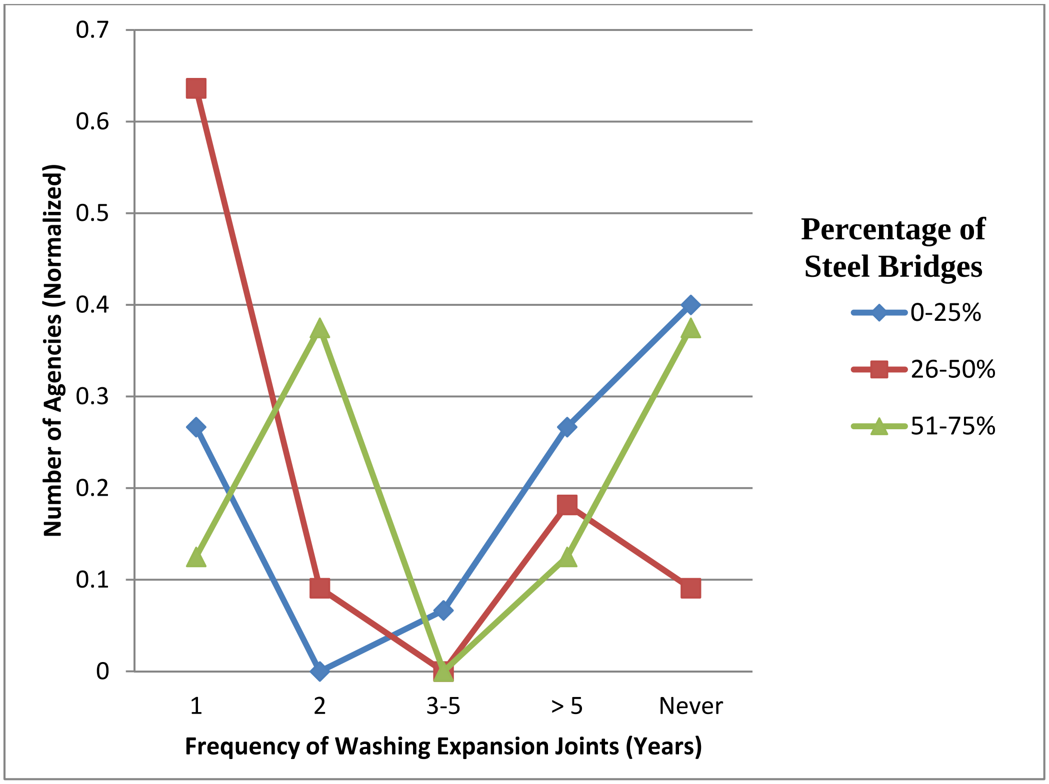
# Appendix A. Initial Survey Graphs

a:

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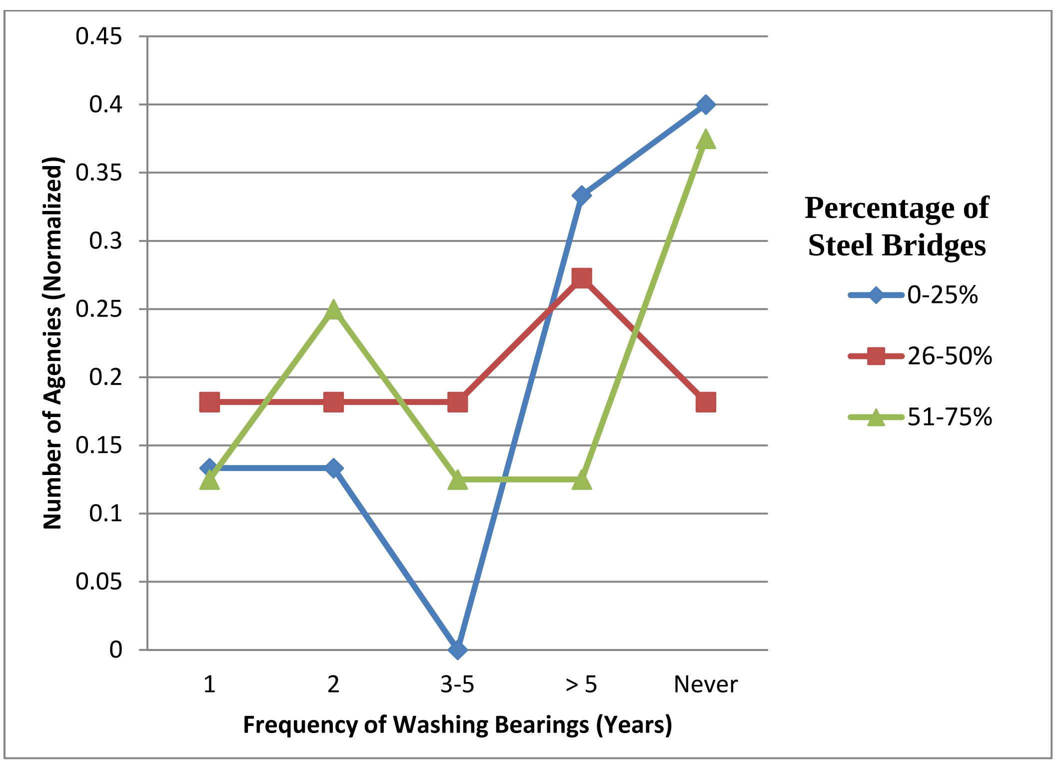
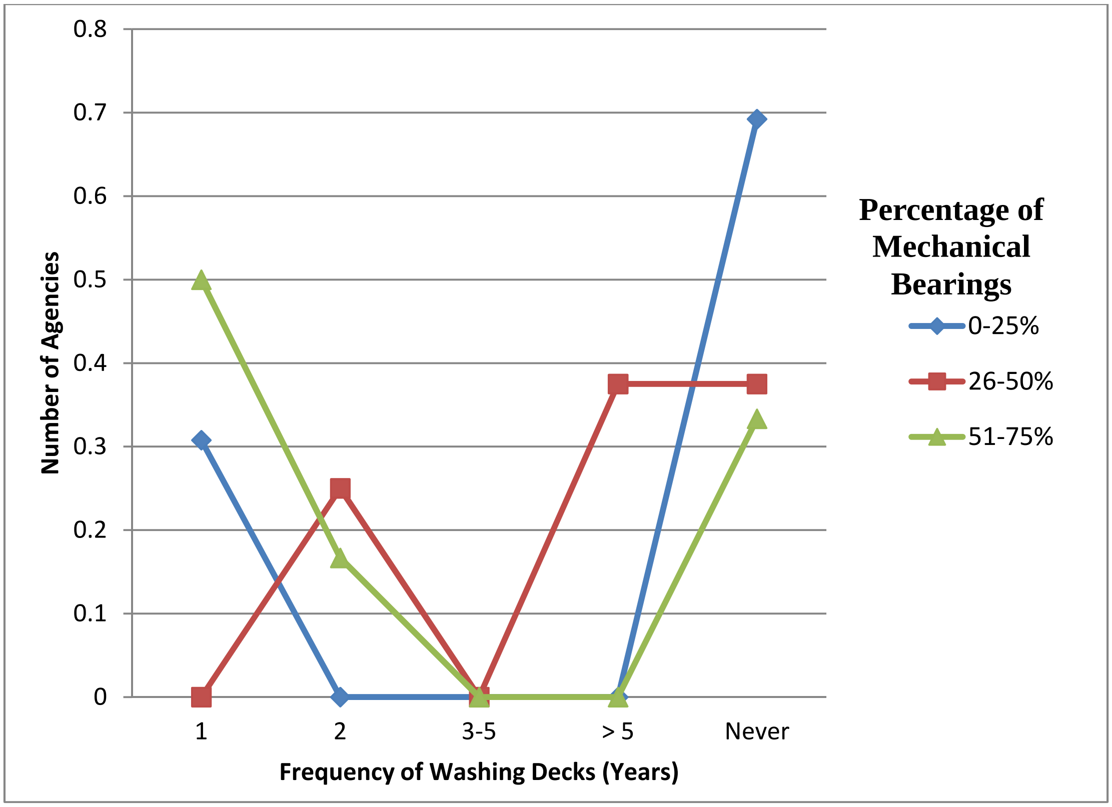
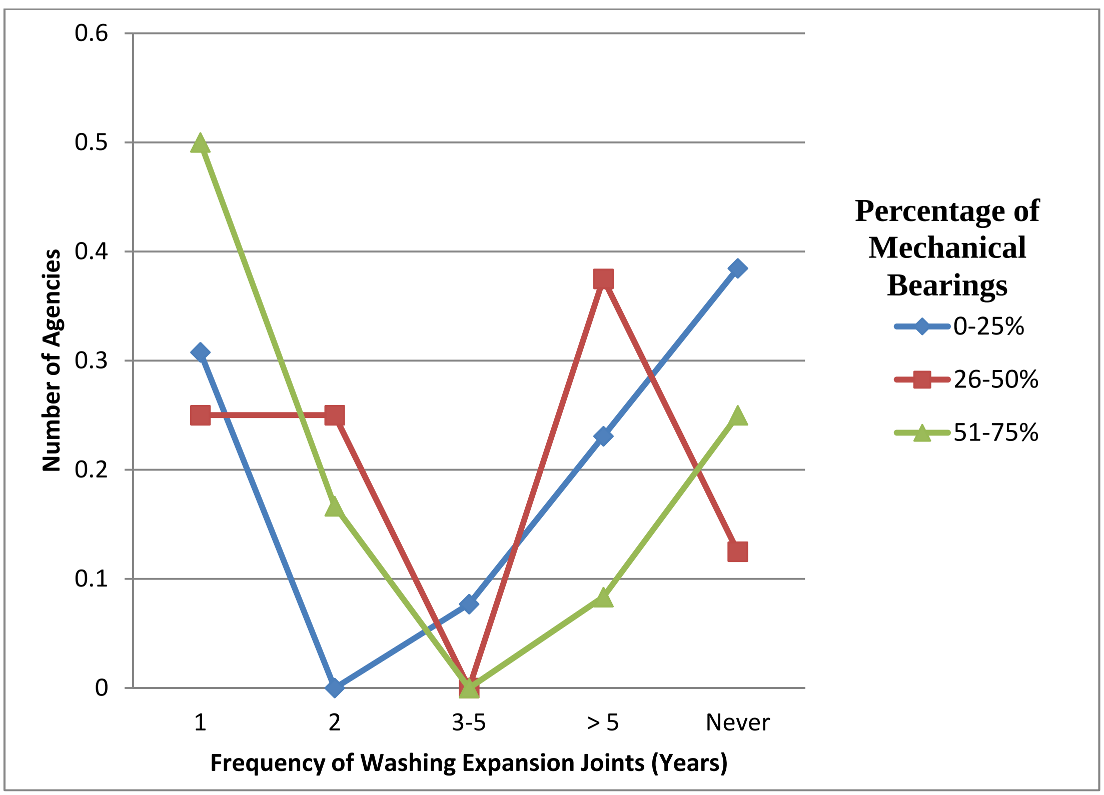


c:



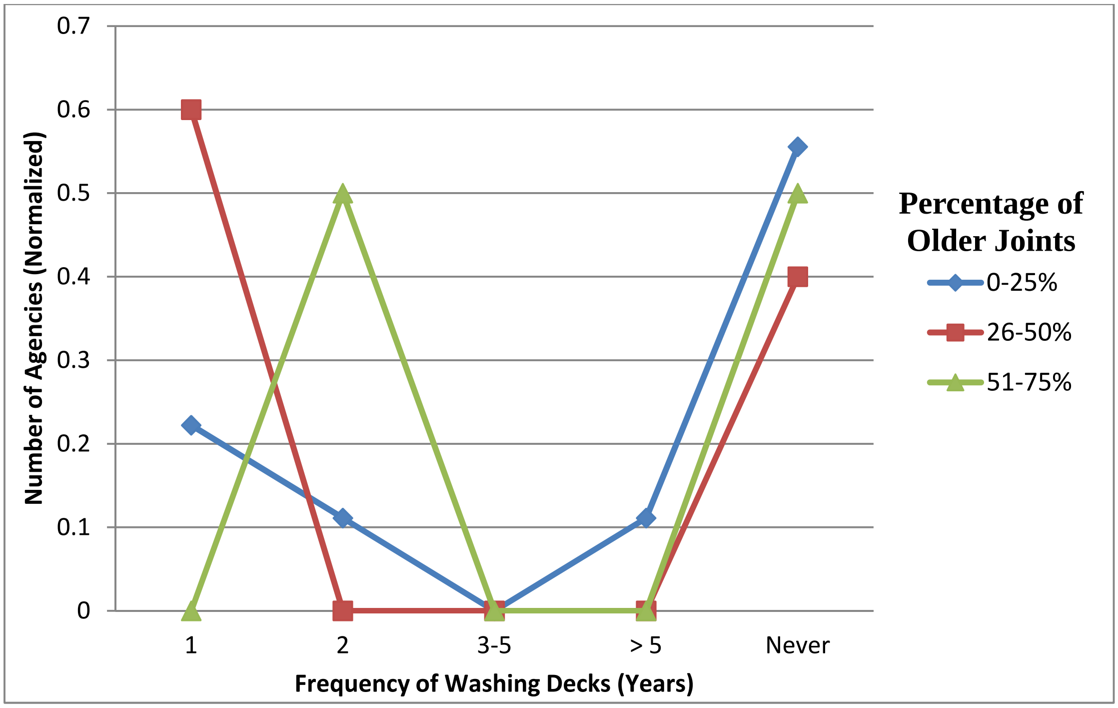
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Number of Agencies
1
2
3-5
> 5
Never
Frequency of Washing Decks (Years)
Percentage of Mechanical Bearings
0-25%
26-50%
51-75%


d:



0.6
0.5
0.4
0.3
0.2
0.1
0
Number of Agencies
1
2
3-5
> 5
Never
Frequency of Washing Expansion Joints (Years)
Percentage of Mechanical Bearings
0-25%
26-50%
51-75%

e:




f:

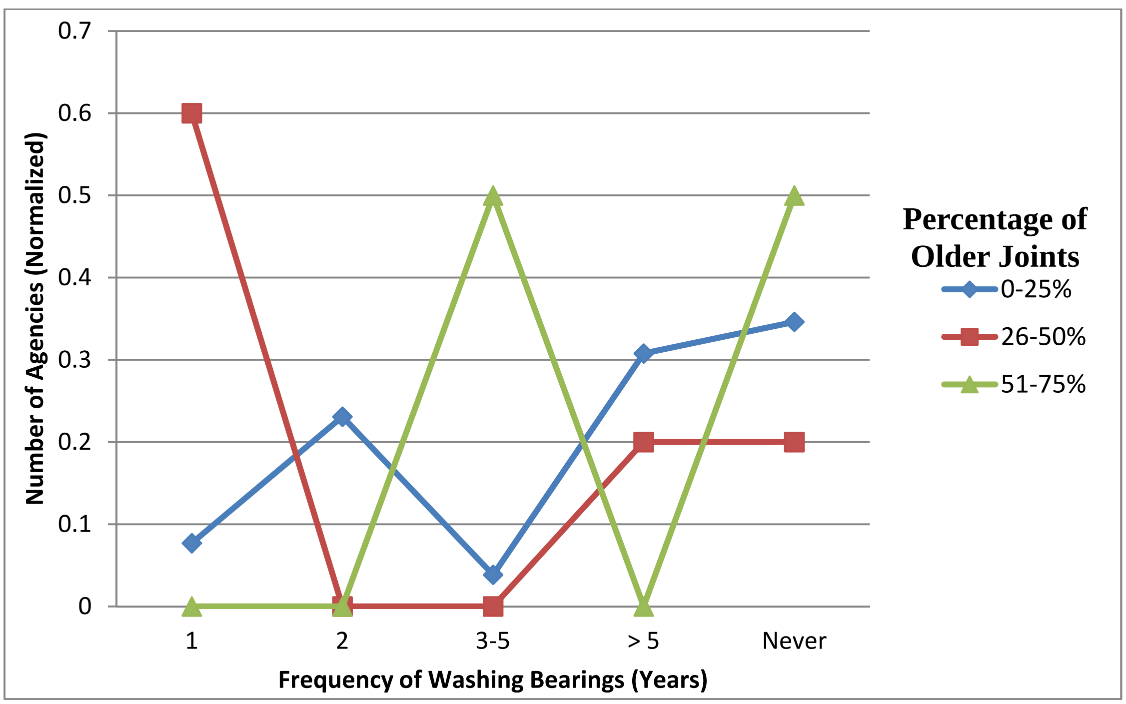



**Figure A-1.** a) Frequency of washing expansion joints, b) Frequency of washing bearings, c) Frequency of washing decks, d) Frequency of washing expansion joints, e) Frequency of washing decks, f) Frequency of washing bearings

# Appendix B. State Manuals

**Date: August 12, 1997**
[Last Revis.: August 4, 1997]
[Orig. Issue: June 27, 1996]

## STATE OF MAINE

**DEPARTMENT OF TRANSPORTATION**
**Bureau of Maintenance and Operations**
**Bridge Maintenance Division**

**Bridge Maintenance Standard:**

**BR 602.1**

**Removal Winter Maintenance Sand/Debris from Bridges**
***( Cleaning Crew )***

**Purpose:**

To establish standard procedures for the annual removal of winter maintenance sand and other debris from bridges with exposed decks. This effort provides for better functioning bridge systems (drainage, expansion/contraction devices, etc.), as well as it reduces the effect that chloride laden winter sand can contribute to the deterioration of concrete and steel surfaces.

**Procedures:**

Traffic control procedures shall be used in accordance with the MDOT Traffic Control Guidebook entitled ***"Work Zone Traffic Control"***, dated **May, 1996**.

Winter sand and other debris shall be removed annually in the spring from bridge roadway and curb surfaces and between faces of guardrail on approach roadway sections using either hand shovels / street brooms or loader / power broom, or both. Approximately 25 feet of approach sections shall be included for cleaning at each bridge site. Sand and debris removed above shall be disposed of in accordance with **Bureau of Maintenance & Operation** policy listed in **Appendix A**, entitled **"Placement of Inert Fill on Private Property"** with attachments entitled **"Guidelines for Giving Ditching and/or Road Sand Material to Private Citizens"** and **"Ditching Material and/or Road Sand Acceptance Agreement"** all dated **May 2, 1997.** Please note that the above **"Guidelines"** attachment really covers policy for disposal consideration first within MDOT ROW or on municipal lots before considering providing to private citizens.

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Printed: 8/14/01

Winter sand / debris lying underneath and behind approach guardrail should be "cut" to the shoulder cross slope grade and uniformly deposited / broadcast out beyond the shoulder break onto a grassy or shrubby side slope. Two methods are commonly employed to do this work as follows:

1. Use of workmen and square-point shovels, or

2. Use of "Bobcat"; Bobcat's bucket is modified by extending and blocking off the ends such that winter sand can be pushed out onto the side slope underneath guardrails between posts.

Other methods may be acceptable that shed cross slope surface water more uniformly onto vegetative buffers such as grassy, mulched, or shrubby slopes.

If winter sand is used to fill embankment erosion holes or gullies immediately adjacent bridges, then <u>one or more</u> of the following erosion control methods shall be <u>used with a grass seed application:</u>

1. Mulch.

2. Erosion control blanket.

3. Silt fence.

Winter sand and other debris lying on bridge seats and slope protection shall be removed with hand tools. Two methods of waste disposal are acceptable:

1. Haul to an approved waste area off-site.

2. Uniformly broadcast winter sand out onto adjacent, well established grassy / shrubby slopes provided drainage paths / ditches are not affected.

***<u>Commentary:</u>***

The above procedure for dispersing winter sand underneath and behind guardrail out onto side slopes results in an almost identical condition that exists for non-guardrail sections of highways where snow plows effectively blade winter sand / debris deposits out beyond the shoulder break. Rarely are any of these winter sand accumulations on side slopes removed on an annual basis. No harm usually results in leaving these deposits. Often times these accumulations are removed in subsequent rehabilitation or repaving projects. Recovery of winter sand underneath and behind guardrail would be very labor and equipment intensive, i.e., expensive.

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Printed: <u>8/14/01</u>

<u>Date: August 12, 1997</u>
[Last Revis.: August 4, 1997]
[Orig. Issue: June 27, 1996]

# STATE OF MAINE

## DEPARTMENT OF TRANSPORTATION
## Bureau of Maintenance and Operations
## Bridge Maintenance Division

## Bridge Maintenance Standard:

## BR 602.2

## Water-Blast Cleaning/Flushing (Washing/Flushing Crew)

### Purpose:

To establish standard procedures for the annual washing / flushing of bridges with exposed decks. This effort may be a separate operation or combined as an activity of the cleaning crew. It is intended to flush away remaining deposits of "chlorides" in concrete and steel surfaces and crevices to allow proper operation of drainage and expansion joints and to prevent corrosion.

### Procedures:

Traffic Control procedures shall be used in accordance with **MDOT Traffic Control Guidebook**, entitled ***"Work Zone Traffic Control"***, dated **May, 1996.**

Inaccessible portions of the following exposed deck bridge structures shall be thoroughly water-blast cleaned / flushed to remove accumulations of salt-laden winter sand / debris:

**Order of Priority**

1 .......... Truss bridges/bottom chords.

2 .......... Open grid decks.

3 .......... Ferry service transfer bridges.

4 .......... Bridges with "open joints".

**Bridge Maintenance Managers** will establish actual priorities based on the above order while <u>also considering the amount of winter salt applications at each bridge site.</u>

In all other respects accessible winter sand / debris deposits on the above exposed structures shall have been removed by the cleaning crew first **(See Bridge Maintenance Standard BR 602.1)**. Insignificant portions of remaining winter sand/debris hidden or otherwise inaccessible, such as underneath bridge rail posts, in rail components, inside bridge drains, in joints, etc., will also be water-blast cleaned / flushed when curbs, gutters, parapets, backwalls, and bridge seats are water-blast cleaned.

Personnel will be careful to keep water-blast spray and back splash directed away from, or otherwise shield, vehicular traffic / pedestrians or use a "spotter".

Any washing / flushing of areas prone to bird infestations or nesting shall be done according to **Bridge Maintenance Standard BR 404 *"Bird Nests"***.

Washing of open grid bridge floors has been reviewed by the **Department of Environmental Protection** (See correspondence regarding this issue in **Appendix A**).

WCE/wce

H:\$Common-MO\BridgeMaintEBB\BridgeStandards\ **BR 602.2**.lwp
Printed: 8/14/01

**Figure B-1.** Maine DOT Manual

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# Category:771 Bridge Preventative Maintenance Guidelines


The cost to repair an existing bridge or construct a new bridge can be very high. Timely scheduled preventive maintenance can extend the life of a bridge structure, and provide the taxpayers a return on the investment that was made in construction of the original structure. To extend the life of the department's bridges, a strategy was developed to emphasize preventive maintenance practices that will preserve the bridges by retarding the rate of deterioration of the bridge components.

The preventive maintenance guidelines for bridges contains work items that can be performed by district personnel at maintenance buildings and some specialty items that can be done by district special crews. The work items are identified in the annual bridge inspection reports. These guidelines will identify the purpose of the work function, provide procedures to be followed, suggest the best time (Bridge Maintenance Calendar) to schedule the work item during the year, mention materials that have been used successfully and address specific safety concerns. Since the type of equipment and size of crews may vary greatly, the guidance does not indicate how each district should perform these work items.

When planning any of the work functions mentioned in these guidelines, supervisors should refer to Traffic Control for Field Operations for proper traffic control signs and devices. The supervisor should also follow the most recent guidelines to notify the district work zone coordinator where work will be performed on a particular day. The Policies, Rules & Regulations - Employee Handbook. shall be followed to ensure the safety of all personnel.

Many of the work functions do not require a lot of material or specialized equipment. By performing these work items in a timely manner, the concrete bridge decks and supporting members can be protected from damage caused by chlorides and water, which can lead to much more costly repairs.

**Figure B-2.** Missouri Online Manual

| To: | New York State Department of Transportation ENGINEERING INSTRUCTION | EI 07-032 |
|---|---|---|

Title: **MAINTENANCE CLEANING AND WASHING OF BRIDGES – US CUSTOMARY**

| Distribution: | | Approved: | |
|---|---|---|---|
| ☒ Manufacturers (18) | ☐ Surveyors (33) | | |
| ☒ Local Govt. (31) | ☒ Consultants (34) | /s/George Christian | 9/12/07 |
| ☒ Agencies (32) | ☒ Contractors (39) | George Christian, Deputy Chief Engineer Structures | Date |
| | ☐ ____________( ) | | |

**ADMINISTRATIVE INFORMATION:**

- This Engineering Instruction (EI) is effective with the letting of 1/10/08.
- EI 02-040 is superseded by this issuance.
- The information transmitted by this issuance will reside in the Special Specifications directory of the Toolbox Server.

**PURPOSE:** The purpose of this EI is to issue updated special specifications for Maintenance Cleaning and Washing of Bridges.

**TECHNICAL INFORMATION:**

- The new special specifications for Maintenance Cleaning and Washing of Bridges have a pay item of 'Each' rather than 'Lump Sum' as appears in the current specifications. This will allow the number of special specifications for bridge washing to be reduced by 95%.
- It is intended that all future bridge washing contracts will be in US Customary units, so no metric specifications are being issued.
- Previously, flaking paint that did not contain lead was considered to be inert, and was permitted to be washed. However, all paint is now considered harmful to the environment, and flaking paint should not be washed at all. This would include all bridges that have a paint rating of 3 or less.
- Guidance for Project Designers:

Item 641.3100nn16 Maintenance Cleaning and Washing of Bridges is the general specification for washing bridges that may contain lead based paints, i.e. those bridges built before 1989. However, it should not be specified to wash bridges with paint ratings of 3 or lower based on the latest Inspection report. Washing structural steel with a paint rating of 3 or lower is likely to dislodge significant amounts of lead based paint. Disturbance of lead based paint must be avoided because the specifications make no provisions for collecting, separating, and disposing of lead based paint chips.

Item 641.3200nn16 may be used to wash all painted bridges under Maintenance Washing of Bridges, Concrete Surfaces, because the structural steel is not washed. Not washing the structural steel avoids the possibility of contamination from lead based paints, but does not remove salts and other debris that promote corrosion of the steel.

Item 641.3300nn16 Maintenance Washing of Bridges, No Lead Based Paint may be used to wash bridges built after 1988. This specification may also be used for bridges built before 1989 if the bridge was de-leaded by removing all the paint and applying a non-lead based paint or if the structural steel was replaced after 1988. However, it should not be specified to wash bridges with paint ratings of 3 or lower based on the latest Inspection report. Washing structural steel with a paint rating of 3 or lower is likely to dislodge significant amounts of paint. Disturbance of paint must be avoided because the specifications make no provisions for collecting, separating, and disposing of paint chips.

Item 641.3400nn16 Maintenance Cleaning and Washing of Weathering Steel Bridges should be used to wash weathering steel bridges, including those which have paint on portions of the steel near bearings.

Bridges that span sensitive streams, including those categorized as CT and CT(s) (i.e. trout streams) are sensitive to thermal shock and other pollutants. These structures should be washed only at times when stream flows are high enough to ameliorate these effects. Therefore, streams that are classified by DEC as CT and CT(s) i.e. trout spawning shall be washed according to a schedule agreed upon with the appropriate Regional office of DEC. In addition, so as to not interfere with DEC's stocking program and the peak fishing season, bridges located at DEC yearling trout stocking sites should not be washed without the cooperation of DEC in scheduling.

The designer must indicate in the proposal all structures for which there will be date restrictions imposed on the Contractor. Information on the location of streams categorized as CT or CT(s) to develop such Special Notes may be obtained from the Regional Environmental Coordinator or the DEC regional office.

Paint condition is an important factor in determining whether painted steel should be washed. The table below describes the paint ratings for non-weathering steel.

**PAINT CONDITION RATINGS**

| Rating | Description |
|---|---|
| 7 | The paint or coating system is in new or like-new condition. |
| 6 | The paint or coating system is in generally good condition with isolated areas requiring touch-up, such as along top flanges adjoining stay-in-place metal deck forms or in roadway splash zones. There may be some thinner areas of paint/coating. Isolated areas of wrinkling due to excessive paint thickness or temperature during application might be observed. |
| 5 | The paint or coating system shows signs of deterioration at isolated locations. Typical signs of deterioration include peeling of the finish coat, bleeding with localized areas of rust staining, alligator crackling, and chalking. |
| 4 | The paint or coating system has localized areas in poor condition. Bleeding of soluble pigments from the undercoat, peeling, minor blistering, and/or light pinpoint rusting may be present. Reconditioning normally would require local sand blasting and touchup. |
| 3 | The paint or coating system is generally in poor condition throughout the structure. Many areas of peeling, blistering, bleeding, chalking, shallow pinpoint rusting, rust undercutting at scratches, and surface scale are common. Reconditioning would require the entire superstructure be sand blasted, cleaned, primed, and re-painted/re-coated. |
| 2 | The paint/coating is often peeling, chalking, and/or bleeding and very widespread. |
| 1 | Large areas have no paint/coating remaining and where present, paint/coating is faded, peeling, and/or chalking. |

In late 1988 the Department changed from lead based paints to an epoxy and polyurethane system for all new painted bridges. It was previously thought that the cured paint is inert, and there are no adverse effects from dropping minor amounts of paint chips into waterways or wetlands or onto the ground. It is now recognized that all paints have potential to contain harmful chemicals, and it is not acceptable to allow these paint chips to contaminate the environment.

The New York State Department of Environmental Conservation (DEC) has established water quality standards, which are contained in Parts 700 through 705 of Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York (6 NYCRR 700-705). These standards include, but are not limited to:

1. There shall be no increase in turbidity that will cause a substantial visible contrast to natural conditions;
2. There shall be no suspended, colloidal and settleable solids that will cause deposition or impair the waters for their best usage; and
3. There shall be no residue from oil and floating substances, visible oil film, globules or grease.

Also, Article 24 of the Environmental Conservation Law (ECL), pursuant to Section 24-0701(2), prohibits any form of pollution in or within 100 feet of state regulated wetlands without a permit.

Many of DOT's bridges span wetlands, streams and other water bodies, and some bridge washing contractors have been cited for water quality violations by regulatory agencies. The primary concerns involved with bridge washing over water bodies with respect to water quality are degradation of trout spawning habitat and decreased fish egg survival due to heavy sediment (sand) loads, and various fish wildlife and invertebrate vitality concerns due to concentrated spot loadings of salt, lead (from lead paint), ammonia (from bird droppings), and thermal discharges.

The Migratory Bird Treaty Act of 1918 made it "...unlawful to pursue, hunt, take, capture or kill; attempt to take, capture or kill; possess, offer to or sell, barter, purchase, deliver or cause to be shipped, exported, imported, transported, carried or received any migratory bird, part, nest, egg or product, manufactured or not. Subject to limitations in the Act, the Secretary of the Interior (Secretary) may adopt regulations determining the extent to which, if at all, hunting, taking, capturing, killing, possessing, selling, purchasing, shipping, transporting or exporting of any migratory bird, part, nest or egg will be allowed..."

The act and amendments now provide that: "Except as otherwise provided in this section, any person, association, partnership, or corporation who shall violate any provisions of said conventions or of this subchapter, or who shall violate or fail to comply with any regulation made pursuant to this subchapter shall be deemed guilty of a misdemeanor and upon conviction thereof shall be fined not more than $15,000 or be imprisoned not more than six months, or both."

Some bridge washing contractors have been cited for intentionally destroying migratory bird nests and fledglings while conducting their operations. Disturbances of occupied nests are unlawful and must be prevented.

- Guidance for Field Personnel: Before washing the bridge, all trash and other debris must be collected from the bridge. All trash and debris, such as paper, rubber, metal, wood and similar materials shall be properly disposed of off-site according to §107-10 Managing Surplus Material & Waste.

If any steel portions of the bridge surface have flaking paint then that portion of the steel surface where flaking paint is present should not be washed. All other portions of the bridge, including the underside, should be washed.

It is very important to note that flaking lead based paint should not be removed from bridges prior to washing. This is due to practical and economical concerns over methods used to collect paint chips. Nonetheless there remain environmental and health concerns over the alternative of non-collection which are being addressed during design by the judicious selection of structures to be included in the contract and the appropriate selection of which of the four bridge washing items to use. Errors in either of these selections can occur and in addition paint condition can continue to deteriorate between the time the bridge was selected for washing and the time the work is actually performed. Therefore it is acknowledged that the Engineer may have to use discretion and field staff should be prepared to exercise judgment regarding which surfaces are to be cleaned. The specifications allow the exercise of that judgment. It should be noted that small amounts of loose lead based paint chips which have settled on the flanges of beams will be considered diminimus with minimal environmental effect, and therefore need not be removed prior to the washing operations.

Contrasted with the need to not remove flaking paint, there is a very real need to remove all loose rust on weathering steel bridges. Loose rust that remains will eventually drop off and trap moisture on the bottom flange of girders causing accelerated deterioration.

- Cost Impact: The changes are not expected to have a significant change in the cost of the work.

**IMPLEMENTATION:** When convenient to do so, these specifications can be used on projects prior to the 1/10/08 effective date.

**TRANSMITTED MATERIALS:**

- Item 641.3100nn16 Maintenance Cleaning and Washing of Bridges
- Item 641.3200nn16 Maintenance Cleaning and Washing of Bridges, Concrete Surfaces
- Item 641.3300nn16 Maintenance Cleaning and Washing of Bridges, No Lead-Based Paint
- Item 641.3400nn16 Maintenance Cleaning and Washing of Bridges of Weathering Steel Bridges

**CONTACT:** Questions or comments regarding this issuance should be directed to Duane Carpenter of the Office of Structures at (518) 457-5715, dcarpenter@dot.state.ny.us.

**Figure B-3.** New York DOT Manual

**SAP ASSEMBLY NUMBER:** 711-7431-01 **BMS2 Flex-Action:** A743101

**ACTIVITY TITLE:** CLEAN/FLUSH DECK

**UNIT OF MEASUREMENT:** EACH BRIDGE

**PROCEDURE:** GENERAL PROCEDURE

**REFERENCES**

None

**SCHEDULING CONSIDERATIONS**

Should be performed at least once annually, after winter maintenance operations have been completed. Additional times based on need. In areas where salt and anti-skid applications are particularly heavy, additional cleanings as weather permits during the winter should be considered. Coordinate cleaning activities with the Pennsylvania Department of Environmental Protection and the Pennsylvania Fish and Boat Commission to minimize flushing activities during periods of heavy use for fishing, boating or other water sports. Avoid bridge cleaning on stocked trout streams from April 10 through June 10. For cleaning activities involving native trout streams, consult with the Pennsylvania Department of Environmental Protection and the Pennsylvania Fish and Boat Commission for spawning periods prior to initiating work.

**WORK AREA**

Entire deck between backs of the abutment backwalls including joints, gutters, curbs, sidewalks, parapets, railings, concrete median strips, and the portions of appurtenances, such as light and sign standards, that can be reached without special lift equipment. Deck joints include both the upper exposed surface attached to the concrete as well as the area beneath the joint that is intended to remove water from the deck, and the top and upper edge of the compression seals joints.

**ACTIVITY DESCRIPTION**

Removing all salt, anti-skid, dirt, debris, and other deleterious material from the work area by brooming, shoveling, or mechanical means. Removing any residual material by flushing, as appropriate for maximum efficiency.

**PROCEDURE DESCRIPTION**

1. Sweep loose material from parapets, railings, and sidewalks onto bridge deck by manual or mechanical means. Utilize mechanical removal devices (i.e., street sweepers) in areas where the equipment is available.
2. Sweep and collect material from the deck. Do not deposit material in drainage facilities or joints. Minimize discharge of loose material, grit and debris into the waters of the Commonwealth.
3. Remove remaining dirt and debris from deck joints and drains. Use high pressure air, or, when necessary, high pressure water, to remove dirt and gravel from strip seal glands and tooth dam troughs and compression joints to ensure water flows freely and that the seals don't get broken. Clean debris and dirt from top and edge of compression joints. Do not touch the seal with the wand nozzle. If using Anti-icing truck tankers, make sure the tanks have been cleaned and are free of salt before using to flush bridge decks.
4. Dispose of collected cleanings at a proper disposal or fill site.
5. Use clean water when flushing the deck. Water should be obtained from the same water body that the bridge being cleaned spans. For small streams, where a significant decrease in stream flow is likely, water may be brought to the site providing it is of equal or better quality than the background stream quality.
6. Minimize the amount of debris entering the water body. For instance, where feasible, cover or plug scuppers to prevent debris and cleaning water from entering the stream. Exercise special care when cleaning bridges over High Quality (HQ) or Exceptional Value (EV) waterways.
7. When cleaning open grid decks flush supporting structural members also.
8. Use temporary silt fencing and other erosion control measures where necessary to prevent stream bank sediments from entering the stream.

**SAP ASSEMBLY NUMBER:** 711-7431-02 **BMS2 Flex-Action:** C743102

**ACTIVITY TITLE:** CLEAN/FLUSH BEARING/BEARING SEAT

**UNIT OF MEASUREMENT:** EACH BRIDGE

**PROCEDURE:** GENERAL PROCEDURE

**REFERENCES**

None

**SCHEDULING CONSIDERATIONS**

Should be performed at least once annually, after winter maintenance operations have been completed, on work areas underneath open joints, finger joints and other floor expansion joints which permit the passage of water carrying salt, anti-skid and other debris. Additional times, as necessary, under open floor joints and under sealed joints to keep bearings and areas around them free of deleterious materials. Coordinate cleaning activities with the Pennsylvania Department of Environmental Protection and the Pennsylvania Fish and Boat Commission to minimize flushing activities during periods of heavy use for fishing, boating or other water sports. Avoid bridge cleaning on stocked trout streams from April 10 through June 10. For cleaning activities involving native trout streams, consult with the Pennsylvania Department of Environmental Protection and the Pennsylvania Fish and Boat Commission for spawning periods prior to initiating work.

**WORK AREA**

All bearings and bearing seats at all piers and abutments.

**ACTIVITY DESCRIPTION**

Removing all salt, anti-skid, dirt, debris and other deleterious material from the work area by scraping, brushing, or by other hand or mechanical means. Removing any residual material by flushing, as appropriate for maximum efficiency.

**PROCEDURE DESCRIPTION**

1. Set up scaffolding or ladders, or position manlift or snooper truck as required.
2. Manually dry clean the bearing and bearing seats, by scraping, brushing or chipping all accumulated debris. Material should be collected and disposed of at a proper disposal or fill site.
3. Remove loose paint by dry brushing. Collect and dispose of at an approved disposal site. Avoid paint chips from entering water bodies.
4. Thoroughly flush all bearings and bearing seats at piers and abutments with pressurized water to remove salt, dirt and debris, that could not be removed by manual cleaning methods.
5. Limit wet cleaning to (5) feet on either side of the joint at the pier, unless debris in other areas require further cleaning. Clean (5) five feet from each abutment.
6. Use clean water when flushing the bearings and bearing seat. Water should be obtained from the same water body that the bridge being cleaned spans. For small streams, where a significant decrease in stream flow is likely, water may be brought to the site providing it is of equal or better quality than the background stream quality.
7. Minimize the amount of debris entering the water body. Exercise special care when cleaning bridges over High Quality (HQ) or Exceptional Value (EV) waterways.
8. Use temporary silt fencing and other erosion control measures where necessary to prevent stream bank sediments from entering the stream.
9. Refer to Chapter 15 for Bearing lubrication. Perform at regular intervals. The work area is all contacted metal surfaces that are not permanently lubricated. Clean contact surfaces, surrounding area of rust, and old lubricant. Place new penetrating spray grease.



**Figure B-4.** Pennsylvania DOT Manual Excerpts

## COMMON FHWA / VDOT BRIDGE RELATED DEFINITIONS (cont'd):

**Bridge Preservation (continued):**

The exact breakdown of maintenance allocations will vary and will depend on the particular condition and needs of the structures in each district. The breakdown for a district may be determined by calculating the unconstrained needs using the Pontis Bridge Management Software, assigning work actions to a program (preventive maintenance, painting, restorative maintenance, rehabilitation/small structure replacement) and calculating the sum for each program.

Small structure replacements funded under Program 604 should be accomplished in accordance with the requirements of the current IIM-S&B-87 - Limitations on the Use of Maintenance Funding for Structure Replacement Projects.

Planned preventive maintenance should be performed on a schedule to be developed for each structure.

The following chart establishes a basis for scheduling planned preventive maintenance activities:

| Preventive Maintenance Activity | | Preferred Cycle (yrs) | System | Unit Of Measure | Eligible for Federal Reimbursement | Activity Description | Criteria |
|---|---|---|---|---|---|---|---|
| 1 | Bridge Deck Washing (Concrete) | 1 | All | SY | Yes | Includes the removal and disposal of debris and pressure washing of the bridge roadway surface, joints, sidewalks, curbs, parapet walls, drainage grates, downspouts, and scuppers. | All concrete decks and slabs that do not have asphalt overlay. |
| 2 | Bridge Deck Sweeping | 1 | All | SY | Yes | Includes the removal and disposal of debris and sweeping of the bridge roadway surface, shoulders, joints, sidewalks, and curb lines. | All concrete decks and slabs with asphalt overlay (not accounted for under the Bridge Deck Washing activity), metal decks, timber decks and slabs. |
| 3 | Seats & Beam Ends Washing | 2 | All | SY | Yes | Includes the removal and disposal of debris and pressure washing of the bridge seat, bearing areas, and 5 feet of beam-ends. Use 3 feet avg. seat width for estimation purposes. | All bridge seat and bearing areas to be cleaned, including abutment seats, pier seats, bearing devices, and the end 5 feet of beams and girders, and end diaphragms. |

## COMMON FHWA / VDOT BRIDGE RELATED DEFINITIONS (cont'd):

**Bridge Preservation (continued):**

| Preventive Maintenance Activity | | Preferred Cycle (yrs) | System | Unit Of Measure | Eligible for Federal Reimbursement | Activity Description | Criteria |
|---|---|---|---|---|---|---|---|
| 7 | Scheduled Replacement of Pourable Joints | 6 | All | LF | Yes | Includes removal of existing joint material, surface preparation and installing new joint material. | In order to avoid double counting, to account for data currency in Pontis, and to be proactive in addressing the needs for this bridge element, only joints that are in good condition will be considered in the PM program. Joints that are not in good condition will be accounted for and addressed in Pontis (BMS). (See explanation at end of table) |
| 8 | Cleaning and Lubricating Bearing Devices | 4 | All | EA | No | Includes removal and disposal of debris, and lubricating moveable bearings. | All bridges w/ moveable type bearings. |
| 9 | Scheduled Installation of Thin Epoxy Concrete Overlay | 15 | All | SY | Yes | Includes installing of new system and/or replacing existing overlay system. | Only concrete bridge decks that are in overall good condition are considered in this program. |
| 10 | Beam Ends Painting | 10 | All | EA | Yes | Includes preparing and over-coating the end 5 feet of painted steel beams or girders that are located under open joints, except for bridges with timber decks.<br>Replace paint system at year 30. | For planning and budgeting purposes in this program, only steel members that are in overall good condition will be considered. Steel members that are not in good condition will be accounted for and addressed in Pontis (BMS). |
| 11 | Removing Debris from Culverts | 5 | All | EA | YES | Includes the removal and disposal of debris that is collected inside and/or at inlets or outlets of culverts. | All culverts except for those scheduled for replacement. |

| | |
|---|---|
| **MAINTENANCE AND REPAIR**<br>**COMMON FHWA / VDOT BRIDGE RELATED DEFINITIONS**<br>**BRIDGE PRESERVATION** | VOL. V - PART 2<br>DATE: 06Feb2012<br>SHEET 11 of 12<br>FILE NO. 32.01-11 |

**Figure B-5.** Virginia DOT Manual Excerpts

**13.06.3 Structure cleaning and inspection**

Expansion devices, sealed compression joints and bearing assemblies shall be cleaned and inspected for proper operation on an annual basis. Any faulty seal, joint, or bearing shall be replaced as soon as deemed possible. All structures will be inspected and recorded every two years to comply with National Bridge Inspection Standards. The inspection personnel for state bridges are normally provided by the field engineering crews. The local bridges are inspected by personnel from the Department's bridge program. The bridge program maintains all inspection records and can be contacted for information on specific structures. *** see Operating policy 18-9 Bridge inventory and inspection program, for more details.**

Handrails, posts, steel columns, steel girders, sign trusses and other portions of any structure that was painted at the time of construction, will be inspected and cleaned. Spot priming and some painting over lead-based paint may be allowed as long as a non-lead paint is used. The District Maintenance Engineer **must** give concurrence prior to any painting. Department employees are not permitted to apply or remove any paints containing lead on a Department structure. ***see SEMM policy 18-18.**

**13.06.4 Welding on Highway structures**

If any structure appears to require repair that would include welding, the District Maintenance Engineer should be contacted prior to performing the repair. The DME shall determine what course of action that should be taken.

Any welders assigned to weld on Department structures, will be qualified by the same testing procedure required by welders on construction projects. These tests conform to American Welding Society's **"Specifications for Welding Highway and Railway Bridges."** The Bridge program can be contacted for the welder certification procedures.

**13.06.5 Collision damage repair**

Revised 2/03 13-16

**Figure B-6.** Wyoming DOT Manual Excerpt