

What is the effectiveness and benefits of bridge deck systems in stormwater management?

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Introduction

Currently there are many stormwater drainage systems in place. Some of the most common seen and used drainage systems are listed below. The one we are focusing on in this study are bridge decks.



Green Roofs

Permeable Pavements



Drains

Bridge Deck



Introduction

Stormwater management is the process in which systems and structures are put into place to reduce rainwater runoff and improve water quality.

Stormwater runoff is managed in a few different models. The model that we will be specifically looking at in this study is the bridge deck runoff models

Bridge decks are the surface of a bridge that are used for vehicles and pedestrians. While bridge decks runoff is completed the same way runoff is by other methods, bridge decks specifically were designed to direct runoff away from roadways by freefall.

This particular method is often implemented due to the improvement it can have for not only water quality and drainage but for traffic as well.

Methods

Samples were collected from each monitoring station from five fixed locations. Samples were collected in various conditions year-round such as during rain, snowmelt runoff, and dry periods. When testing for each particle, flow-proportional samples were used to ensure “fair” results were collected.



Figure 9. A, collection of bridge-deck sediment sample and B, vacuumed strip adjacent to 3-foot ruler after collection of sediment sample on Interstate 90 near Weston (422025071154501). Location of station is shown on figure 1.

Results

18 Characterization of Stormwater Runoff From Bridge Decks in Eastern Massachusetts, 2014–16

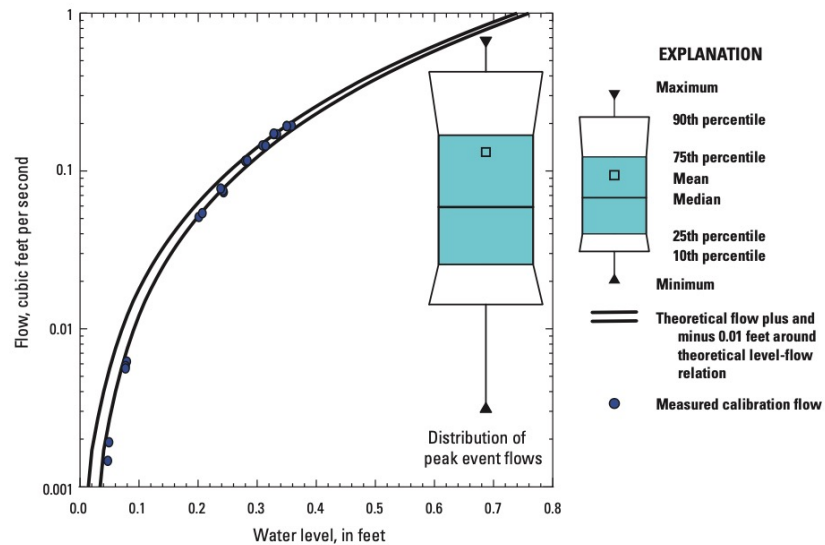


Figure 10. Discrete measurements of pump flow in relation to the theoretical water-level/flow relation (offset by plus or minus 0.01 feet) for the H flume compared to the distribution of peak flows recorded during sampled events at U.S. Geological Survey bridge-deck-monitoring station on State Route 20 near Quinsigamond Village (421247071470201), eastern Massachusetts, 2015–16. Location of station is shown on figure 1.

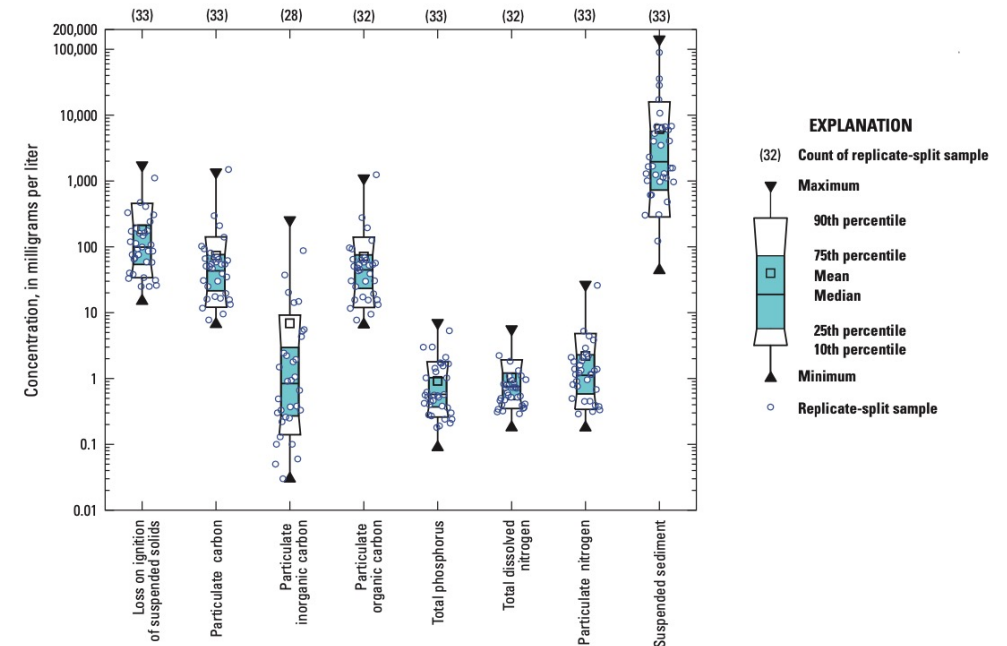


Figure 11. Distribution of concentrations of constituents measured in composite samples of bridge-deck runoff and in concurrent replicate-split samples collected at U.S. Geological Survey bridge-deck-monitoring stations on State Route 2A in Boston (422108071052501), Interstate 90 near Weston (422025071154501), and State Route 20 near Quinsigamond Village (421247071470201) in eastern Massachusetts, 2014–16. Locations of stations are shown on figure 1.

Results

Table 8. Summary of field-blank data and comparison to composite bridge-deck runoff samples, in milligrams per liter, collected at U.S. Geological Survey bridge-deck-monitoring stations on State Route 2A in Boston (422108071052501), Interstate 90 near Weston (422025071154501), and State Route 20 near Quinsigamond Village (421247071470201) in eastern Massachusetts, 2014–16.

[Locations of stations are shown in figure 1. USGS, U.S. Geological Survey; NWQL, National Water Quality Laboratory; <, less than]

Constituent	USGS parameter code	Sample count	NWQL reporting limit	Number of detections in field blanks	Maximum concentration in field blank	Minimum concentration in bridge- deck runoff	Maximum concentration in bridge- deck runoff
Loss on ignition of suspended solids	00535	7	0.5	4	2	19	1,740
Particulate carbon [inorganic plus organic]	00694	10	0.05	4	0.76	6.68	1,360
Particulate organic carbon	00689	8	0.05	2	0.11	6.57	1,100
Particulate inorganic carbon	00688	8	0.03	0	<0.03	<0.03	255
Particulate nitrogen	49570	10	0.030	0	<0.030	0.179	26.7
Total phosphorus	00665	10	0.01	0	<0.01	0.09	7.02
Total dissolved nitrogen	62854	10	0.05	1	0.07	0.18	5.63
Suspended sediment	70331	10	0.5	7	2	44	142,000

Conclusions

In comparison to other bridges in Massachusetts not containing the bridge deck stormwater management systems, the sample yields collected at the three tested bridges were fairly similar. Though the results of the bridge deck and other stormwater management systems were similar, this study concluded best management practice to treat deck-runoff may significantly reduce discharge yield. This practice would help produce the best quality of water.