

DRAFT 2022 DELISTING DOCUMENT
WATERBODY IMPAIRMENTS REMOVED FROM THE IMPAIRED WATERS LISTS

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Woonasquatucket River

Rhode Island Department of Environmental Management
Office of Water Resources
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INTRODUCTION

The federal Clean Water Act (CWA) Section 303(d) requires states to biennially identify and list waterbodies that are not expected to meet state water quality standards after the implementation of technology-based controls and required the development of a water quality restoration study known as a total maximum daily load (TMDL). As the state's water pollution control agency, the Office of Water Resources at the Rhode Island Department of Environmental Management (RIDEM) carries out the review of water quality data and information as documented in the state's Consolidated Assessment and Listing Methodology (CALM)¹. As a result of the preparation of the 2022 303(d) List, RIDEM Office of Water Resources developed this document to provide information on impairments that no longer require listing on the Rhode Island List of Impaired Waters, referred to as a delisting. This narrative document explains the decisions made to remove specific waterbody pollutants, primarily based on new data documenting compliance with Rhode Island's Water Quality Standards documented in the Water Quality Regulations.²

¹ Rhode Island DEM Consolidated Assessment and Listing Methodology:
<http://www.dem.ri.gov/programs/benviron/water/quality/pdf/calm22.pdf>

² Rhode Island Water Quality Regulations <https://rules.sos.ri.gov/regulations/part/250-150-05-1>

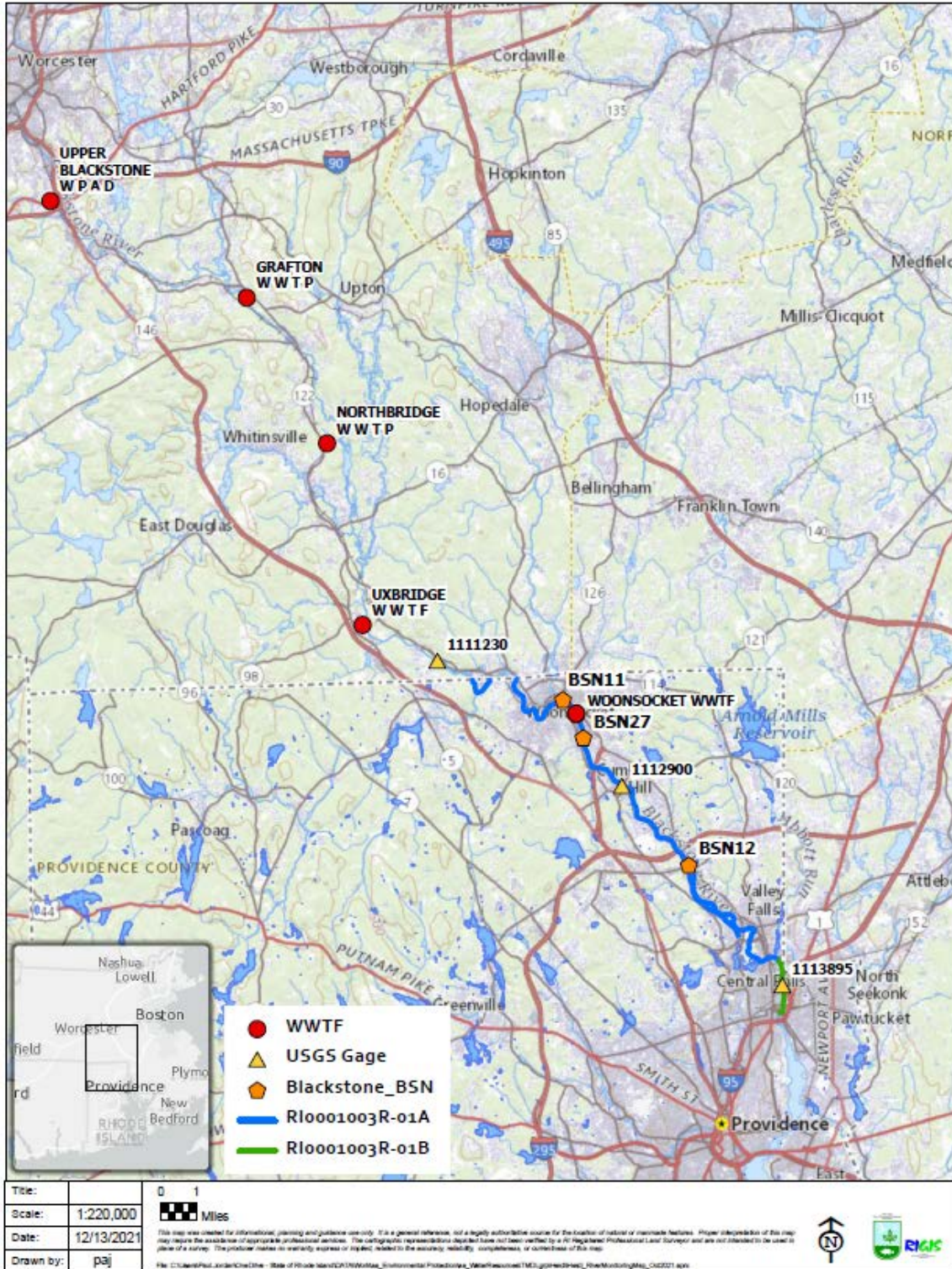
BLACKSTONE RIVER (RI0001003R-01A AND RI0001003R-01B)

- RI0001003R-01A Blackstone River from the MA-RI border to the CSO outfall located at River and Samoset Streets in Central Falls. Woonsocket, North Smithfield, Cumberland, Lincoln and Central Falls
- RI0001003R-01B Blackstone River from the CSO outfall located at River and Samoset Streets in Central Falls to the Slater Mill Dam. Central Falls, Pawtucket.

LEAD

RIDEM is proposing to remove the lead impairment from both Rhode Island segments of the Blackstone River based on new data documenting compliance with water quality standards. RIDEM initially listed the Blackstone River as impaired for lead in 1992. A delisting of the impairment was approved by EPA in 2008 using data collected as part of a RIDEM study to develop a total maximum daily load (TMDL) for several Blackstone River metals impairments. After the delisting, newer USGS data indicated the impairment continued, as described further below, and RIDEM relisted the Blackstone River as impaired for lead in 2010 (RI0001003R-01A) and 2012 (RI0001003R-01B) with a TMDL approved for both segments in 2013. After lead is removed as an impairment in 2022, both Blackstone River segments will remain impaired for Aquatic Life use (cadmium and iron), Primary and Secondary Contact use (enterococcus, fecal coliform), and Fish Consumption use (mercury in fish tissue and PCBs in fish tissue). The upstream Blackstone River (RI0001003R-01A) segment will also remain impaired for Aquatic Life use (non-native aquatic plants), a non-pollutant impairment that does not require the completion of a TMDL.

The following figure shows the Blackstone River from Worcester, Massachusetts to Pawcatuck, Rhode Island with WWTFs and the monitoring stations discussed later in this document labelled. The Rhode Island water segments are also labelled.



Blackstone River with WWTFs and Monitoring Stations

A RIDEM contractor collected dissolved lead samples during dry and wet weather between 2005 and 2006 as part of the Blackstone River TMDL Study. There were no acute lead criteria exceedances during the Blackstone River TMDL dry weather surveys. Chronic criteria were

exceeded once when Blackstone flows were nearly five times higher than the historical mean daily flow for October. This was six days after a peak flow at the Woonsocket USGS gage of 16,360 cfs.

USGS collects quarterly metals samples from two locations in the Rhode Island section of the Blackstone River and at one location in Massachusetts just upstream of the Stateline as shown on the map above. Station 1113895 is located at Roosevelt Street in Pawtucket, RI. Station 1112900 is upstream in Manville, RI and station 1111230 is in Millville, MA. Data collected by USGS (2007 to 2011) at the Manville Dam in Lincoln and Cumberland, RI and at Roosevelt Avenue in Pawtucket, RI exceeded chronic criteria for lead in wet weather. As described in the RIDEM Blackstone River TMDL, the exceedances occurred under a variety of flow conditions with the highest lead concentrations resulting in criteria exceedances occurring during higher flows when the watershed received one to three or more inches of rainfall. The flows associated with these wet weather events ranged between 3,300 to 8,300 ft³/sec.³ In review of this data, RIDEM relisted the Blackstone River for lead as described above.

USGS data shows that lead criteria exceedances criteria continued until 2014. Between 2007 and 2014, there were eight violations each in the chronic lead criteria at the Manville and Roosevelt Street sampling stations. Since six of the eight violations occurred on samples taken within two days of each other at the two stations, there were ten sampling dates with sample violations. Data collected between 2015 and 2021 met the acute criteria at all three stations with one violation in the chronic criteria at the Massachusetts stations in Millville station in 2018. Compared to the TMDL 2007-2011 dataset, the 2015-2021 summary statistics suggest reductions in dissolved lead concentrations across flow conditions. The maximum and mean dissolved lead concentrations are all lower in the recent dataset, while the minimum dissolved lead concentration are all lower in the Rhode Island stations in the recent dataset, indicating a reduction.

RIDEM analyzed the river flow data at Roosevelt Street on days where there was a violation at one or both stations in Rhode Island during the 2007 to 2014 time period. RIDEM found that six of the ten dates with violations had flows between 343 cfs and about 1170 cfs. There were four violations between 2007 and 2014 when flow was greater than 3140 cfs. RIDEM looked at mean daily discharge (cfs) between 10/1/2003 and 4/6/2021 (n=6072) at the Roosevelt Street station and found that the flows on these four days represented percentile flows of 97, 99.7, 99.7, and 99.8 percent. In the 2015 to 2021 dataset, which had no violations in the lead criteria, sampled flows ranged from 120 cfs to 2180 cfs, indicating compliance with the lead criteria at a variety of flows, demonstrating that the Blackstone River meets the water quality criteria across a variety of high and low flows, which allows for periodic (not more than once every three years on average) exceedances of the chronic criteria.

³ RIDEM. 2013. Total Maximum daily Load Analysis for Blackstone River Watershed Pathogen and Trace Metals Impairments. Rhode Island Department of Environmental Management.

The following three tables show the data collected by USGS between 2015 and June 2021 at the three USGS stations. The table for each station also contains the summary statistics for both the most recent USGS data and the data analyzed as part of the TMDL. These statistics are separate the data collected in high and low conditions.

USGS Data at Millville, MA (1111230) and Summary Statistics

Sample Date	Lead (µg/L)	Hardness (mg/L)	Criteria (µg/L)	
			Acute	Chronic
USGS Data (2015-2021)				
03/27/15	0.51	43.2	25.62	1.00
08/12/15	0.30	107.0	69.51	2.71
08/27/15	0.38	98.3	63.39	2.47
09/27/16	0.46	105.0	68.10	2.65
12/19/16	0.42	84.7	53.88	2.10
03/30/17	0.37	48.4	29.07	1.13
06/27/17	0.89	75.7	47.63	1.86
09/28/17	0.53	102.0	65.99	2.57
12/20/17	0.37	61.8	38.10	1.48
03/29/18	0.34	59.9	36.81	1.43
06/29/18	1.09	56.6	34.57	1.35
09/26/18	1.06 ¹	31.9	18.26	0.71
12/20/18	0.26	44.0	26.14	1.02
03/26/19	0.27	43.6	25.88	1.01
06/27/19	0.81	62.0	38.24	1.49
09/26/19	0.40	107.0	69.51	2.71
12/20/19	0.32	49.0	29.47	1.15
06/24/20	0.78	82.7	52.48	2.05
09/24/20	0.65	115.0	75.17	2.93
12/16/20	0.54	50.9	30.74	1.20
03/25/21	0.39	63.0	38.92	1.52
06/23/21	1.00	77.6	48.95	1.91

¹Chronic criteria exceedance

	Lead (µg/L)	Hardness (mg/L)	Criteria (µg/L)	
			Acute	Chronic
USGS 2015 – 2021 Summary Statistics				
Min	0.26	31.90	18.26	0.71
Max	1.09	115.00	75.17	2.93
Mean	0.55	71.33	44.84	1.75
USGS 2015 – 2021 Summary Statistics (Low)				
Min Low	0.30	82.70	52.48	2.05
Max Low	0.78	115.00	75.17	2.93
Mean Low	0.55	102.43	66.31	2.58
USGS 2015 – 2021 Summary Statistics (High)				
Min High	0.26	31.90	18.26	0.71
Max High	1.09	84.70	53.88	2.10
Mean High	0.58	56.82	34.82	1.36
USGS TMDL 2007 – 2021 Summary Statistics				
Min	0.17	21.83	11.76	0.46
Max	3.37	65.00	40.28	1.57
Mean	0.81	44.67	26.67	1.04
USGS TMDL 2007 – 2021 Summary Statistics (Low)				
Min Low	0.38	38.40	22.46	0.87
Max Low	0.76	65.00	40.28	1.57
Mean Low	0.60	54.17	32.97	1.29
USGS TMDL 2007 – 2021 Summary Statistics (High)				
Min High	0.17	21.83	11.76	0.46
Max High	3.37	52.77	31.99	1.25
Mean High	0.90	40.29	23.76	0.93

USGS Data at Manville, RI (1112900) and Summary Statistics

Sample Date	Lead (µg/L)	Hardness (mg/L)	Criteria (µg/L)	
			Acute	Chronic
USDS Data (2015-2021)				
03/23/15	0.35	50.2	30.27	1.18
06/29/15	0.95	59.3	36.4	1.42
09/28/15	0.18	92.7	59.46	2.32
01/04/16	0.35	58.2	35.66	1.39
03/29/16	0.4	52.8	32.01	1.25
06/30/16	0.38	92.9	59.6	2.32
09/27/16	0.34	97.4	62.75	2.45
12/19/16	0.41	57	34.84	1.36
03/29/17	0.33	43.5	25.81	1.01
06/29/17	1.32	65.9	40.9	1.59
09/27/17	0.42	87.5	55.83	2.18
12/19/17	0.47	59.8	36.74	1.43
03/26/18	0.34	48	28.8	1.12
06/26/18	0.45	82.7	52.48	2.05
09/25/18	0.72	54.4	33.09	1.29
12/19/18	0.31	34.1	19.67	0.77
03/27/19	0.29	37.7	22.01	0.86
06/25/19	0.92	47.6	28.53	1.11
09/23/19	0.51	69.5	43.36	1.69
12/18/19	0.45	33.1	19.03	0.74
06/23/20	0.61	73.2	45.91	1.79
09/23/20	0.42	99.1	63.95	2.49
12/14/20	0.48	43.1	25.55	1
03/23/21	0.31	48.4	29.07	1.13
06/24/21	0.95	61.5	37.9	1.48

	Lead (µg/L)	Hardness (mg/L)	Criteria (µg/L)	
			Acute	Chronic
USGS 2015 – 2021 Summary Statistics				
Min	0.18	33.10	19.03	0.74
Max	1.32	99.10	63.95	2.49
Mean	0.51	61.98	38.38	1.50
USGS TMDL 2007 – 2011 Summary Statistics				
Min	0.26	20.27	10.70	0.42
Max	2.58	72.00	45.08	1.76
Mean	0.76	41.38	24.52	0.96
USGS 2015 – 2021 Summary Statistics (Low)				
Min Low	0.34	69.50	43.36	1.69
Max Low	0.61	99.10	63.95	2.49
Mean Low	0.45	86.04	54.84	2.14
USGS TMDL 2007 – 2011 Summary Statistics (Low)				
Min Low	0.26	45.20	26.94	1.05
Max Low	0.64	72.00	45.08	1.76
Mean Low	0.47	58.28	35.75	1.40
USGS 2015 – 2021 Summary Statistics (High)				
Min High	0.18	33.10	19.03	0.74
Max High	1.32	92.70	59.46	2.32
Mean High	0.53	52.63	31.99	1.25
USGS TMDL 2007 – 2011 Summary Statistics (High)				
Min High	0.34	20.27	10.70	0.42
Max High	2.58	45.15	26.91	1.05
Mean High	0.86	35.74	20.78	0.81

USGS Data at Roosevelt Street, RI (1113895) and Summary Statistics

Sample Date	Lead (µg/L)	Hardness (mg/L)	Criteria (µg/L)	
			Acute	Chronic
USDS Data (2015-2021)				
03/24/15	0.5	51.3	31.01	1.21
06/30/15	0.86	65.1	40.35	1.57
09/30/15	0.18	73.4	46.05	1.79
12/28/15	0.51	52.9	32.08	1.25
03/30/16	0.44	60.3	37.08	1.44
06/29/16	0.44	90.4	57.85	2.25
09/28/16	0.2	105	68.1	2.65
12/20/16	0.43	58.3	35.72	1.39
03/29/17	0.33	49.7	29.94	1.17
06/28/17	1.31	63.7	39.39	1.54
09/27/17	0.33	89.2	57.01	2.22
12/19/17	0.39	59.9	36.81	1.43
03/28/18	0.3	49	29.47	1.15
06/27/18	0.19	82.2	52.14	2.03
09/13/18	0.45	60.9	37.49	1.46
12/19/18	0.3	35.5	20.58	0.8
03/27/19	0.27	40	23.51	0.92
06/25/19	1.01	48.3	29	1.13
09/23/19	0.47	75	47.15	1.84
12/18/19	0.41	32.4	18.58	0.72
06/23/20	0.57	71.5	44.74	1.74
09/23/20	0.27	91.5	58.62	2.28
12/14/20	0.58	44.5	26.48	1.03
03/23/21	0.29	49.6	29.87	1.16
06/24/21	0.95	59	36.2	1.41

	Lead (µg/L)	Hardness (mg/L)	Criteria (µg/L)	
			Acute	Chronic
USGS 2015 – 2021 Summary Statistics				
Min	0.18	32.40	18.58	0.72
Max	1.31	105.00	68.10	2.65
Mean	0.48	62.34	38.61	1.50
USGS TMDL 2007 – 2011 Summary Statistics				
Min	0.26	20.27	10.70	0.42
Max	2.58	72.00	45.08	1.76
Mean	0.72	41.38	24.52	0.96
USGS 2015 – 2021 Summary Statistics (Low)				
Min Low	0.19	71.50	44.74	1.74
Max Low	0.57	105.00	68.10	2.65
Mean Low	0.35	86.40	55.09	2.15
USGS 2015 – 2021 Summary Statistics (High)				
Min High	0.18	32.40	18.58	0.72
Max High	1.31	73.40	46.05	1.79
Mean High	0.53	52.99	32.20	1.25
USGS TMDL 2007 – 2011 Summary Statistics (Low)				
Min Low	0.26	45.20	26.94	1.05
Max Low	0.60	72.00	45.08	1.76
Mean Low	0.43	58.28	35.75	1.40
USGS TMDL 2007 – 2011 Summary Statistics (High)				
Min High	0.31	20.27	10.70	0.42
Max High	2.58	45.15	26.91	1.05
Mean High	0.82	35.74	20.78	0.81

Additionally, RIDEM collected dissolved lead as part its dry weather ambient river monitoring program in 2019 at three stations as shown on the map above at BSN11, BSN12, and BSN27. The data met acute and chronic criteria, further demonstrating compliance with water quality criteria throughout the river.

RIDEM Blackstone River ARM Dissolved Lead Results

Sample Date	Lead (µg/L)	Hardness (mg/L)	Criteria (µg/L)	
			Acute	Chronic
BSN11 USGS Gage (Woonsocket 01112500)				
07/25/19	1.03	45.7	27.27	1.06
09/23/19	0.57	66.1	41.03	1.60
10/16/19	0.47	78.2	49.36	1.92
BSN12 George Washington Hwy (Rt. 116)				
07/31/19	0.66	68.0	42.34	1.65
09/23/19	0.48	71.1	44.46	1.73
10/16/19	0.46	69.2	43.16	1.68
BSN27 Bike Path				
07/25/19	0.91	44.6	26.54	1.03
09/23/19	0.32	80.4	50.89	1.98
10/16/19	0.41	73.3	45.98	1.79

There are five municipal wastewater treatment facilities that discharge to the Blackstone River. All facilities monitor for lead at least twice per year. Northbridge (MA) WWTF, Grafton (MA) WWTF and Woonsocket (RI) WWTF have lead permit limits, 0.9µg/L, 1.8µg/L, and 5.4 µg/L, respectively. In data collected between 2015 and 2020, lead results from the Upper Blackstone (MA), Northbridge, and Uxbridge (MA) WWTFs have all been less than 1 µg/L. The Grafton (MA) WWTF exceeded 1 µg/L twice during this time. Data from the Woonsocket WWTF has been less than 1 µg/L since 2019. Data collected between 2015 and 2019 were higher than 1 µg/L, but within permit limits. All available samples analyzed in the 2007 to 2014 timeframe do not indicate that these discharges were contributing to the violations.

While there are no specific actions that can be directly linked to the removal of the lead impairment from the Blackstone River, many restorations activities have occurred in the watershed that likely contribute to the decline in the lead concentrations in the Blackstone River.

BUCKEYE BROOK (RI0007024R-01)

- RI0007024R-01 Buckeye Brook and tributaries. Warwick

DISSOLVED ZINC

RIDEM is proposing to remove the dissolved zinc impairment from Buckeye Brook based on review of the data used to list the dissolved zinc impairment. RIDEM listed Buckeye Brook as impaired for dissolved zinc in the 2018/2020 reporting cycle. In 2021, the data used to list dissolved zinc was reviewed and determined to have failed to meet the quality control requirements of the Buckeye Brook Biodiversity Quality Assurance Project Plan (<http://www.dem.ri.gov/pubs/qapp/buckbio.pdf>). Samples collected on 7/16/2008 for dissolved metals analysis were collected in acid washed bottles but preserved prior to filtration for the dissolved fraction. The data was based on an aliquot removed from the nutrient collection bottle to filter for dissolved metals. Therefore, the dissolved metals aliquot was not collected in an acid washed bottle. Additionally, the trip blank was suspected of contamination because measured values exceeded the corresponding reporting limits. This included both dissolved zinc and hardness analytes. Hardness is required to calculate the hardness-based dissolved zinc criteria as detailed in the Rhode Island Water Quality Regulations. The data review process is also documented in the document *Final Data Quality Report for the Aquatic Life Use Stressor Study for: Buckeye Brook Watershed and Tributaries to Warwick Pond July 2021* (<http://www.dem.ri.gov/programs/benviron/water/quality/rest/pdfs/tmdl-buckeye-aquatic-report.pdf>).

After dissolved zinc is removed as an impairment in 2022, Buckeye Brook will remain impaired for Aquatic Life use (benthic macroinvertebrates bioassessments, cadmium, copper, dissolved oxygen, iron, and lead), and Primary and Secondary Contact use (enterococcus, fecal coliform). TMDL plans have been completed for all these impairments. RIDEM intends to monitor Buckeye Brook as part of RIDEM's ambient river monitoring program.

MAIDFORD RIVER (RI0007035R-02A)

- RI0007035R-02A Maidford River from the headwaters to the water supply diversion near Paradise Ct. Middletown

LEAD

RIDEM is proposing to remove the lead impairment from the Maidford River based on new data documenting compliance with water quality standards. This segment of the Maidford River is listed on RI's 303(d) List of Impaired Waters as not supporting the aquatic life designated use due to lead impairments. This impairment was first listed in RI's 2006 303(d) List based on data collected between 2001 and 2003. After lead is removed as an impairment in 2022, the Maidford River will remain impaired for Aquatic Life use (benthic macroinvertebrates bioassessments, total phosphorus, and turbidity) and Primary and Secondary Contact use (fecal coliform).

Freshwater aquatic life criteria for certain metals are expressed as a function of hardness because hardness can affect the toxicity of these metals. Increasing hardness has the effect of decreasing the toxicity of metals. Ambient hardness values reported in mg/l as CaCO₃ are used to determine applicable acute and chronic metals criteria following US EPA recommended equations provided in §1.26 of RIDEM's Water Quality Regulations (RIDEM 2018).

Seven of twelve samples collected between 2001 and 2003 exceeded the chronic criteria identified using hardness at the time the sample was collected.

RIDEM revisited the segment in 2014, 2018, and 2021 as part of the ambient river monitoring program. No exceedances of acute or chronic criteria were documented. All samples met acute and chronic criteria using the hardness-based criteria. The data, presented below, indicate that the water quality of this segment is meeting the State of Rhode Island's water quality criteria for lead.

While there are no specific actions that can be directly linked to the removal of the lead impairment from the Maidford River, many restorations activities have occurred in the watershed that likely contribute to the decline in the dissolved lead concentrations in the Maidford River.

Maidford River (RI0007035R-02A) Dissolved Lead						
Sample Date	Detection Limit (µg/L)	Quantitation Limit (µg/L)	Concentration (µg/L)	Hardness ¹ (mg/L)	Lead Criteria (µg/L)	
					Acute	Chronic
7/2/2014	0.037	1.0	0.069	60.30	37.080	1.445
8/20/2014	0.037	1.0	<0.037	72.30	42.289	1.765
10/7/2014	0.037	1.0	<0.037	65.10	40.350	1.572
6/18/2018	0.106	0.106	<0.106	72.7	45.564	1.776
7/9/2018	0.106	0.106	<0.106	79.9	50.541	1.969
7/24/2018	0.106	0.106	<0.106	69.2	43.158	1.682
8/16/2018	0.106	0.106	<0.106	78.5	49.571	1.932
9/17/2018	0.106	0.106	<0.106	83.6	53.11	2.07
6/29/2021	0.227	0.227	1.03	63.8	39.463	1.538
8/17/2021	0.227	0.227	<0.227	71.0	44.395	1.730
9/21/2021	0.227	0.227	<0.227	63.2	39.054	1.522

PAWTUXET RIVER MAIN STEM (RI0006017R-03)

- RI0006017R-03 Pawtuxet River from the confluence of the North and South Branches at Riverpoint to the Pawtuxet Cove Dam⁴ at Pawtuxet. West Warwick, Warwick, Cranston

PHOSPHORUS (TOTAL)

RIDEM is proposing to remove the total phosphorus impairment from the Pawtuxet River Main Stem based on new data documenting compliance with water quality standards. RIDEM listed the Pawtuxet River Main Stem as impaired for nutrients in 1994 with the nutrient listing changed to total phosphorus in 2008. The Pawtuxet River Main Stem will remain impaired for Aquatic Life use (non-native aquatic plants), Primary and Secondary Contact use (enterococcus), and Fish Consumption use (mercury in fish tissue). Additionally, a new Aquatic Life use impairment for lead is being added in this 2022 assessment cycle.

The following figure shows the Pawtuxet River Main Stem from the confluence of the North and South Branches of the Pawtuxet River at Riverpoint to Pawtuxet Cove in the Providence River with the three Pawtuxet River WWTFs and the USGS monitoring station labelled.

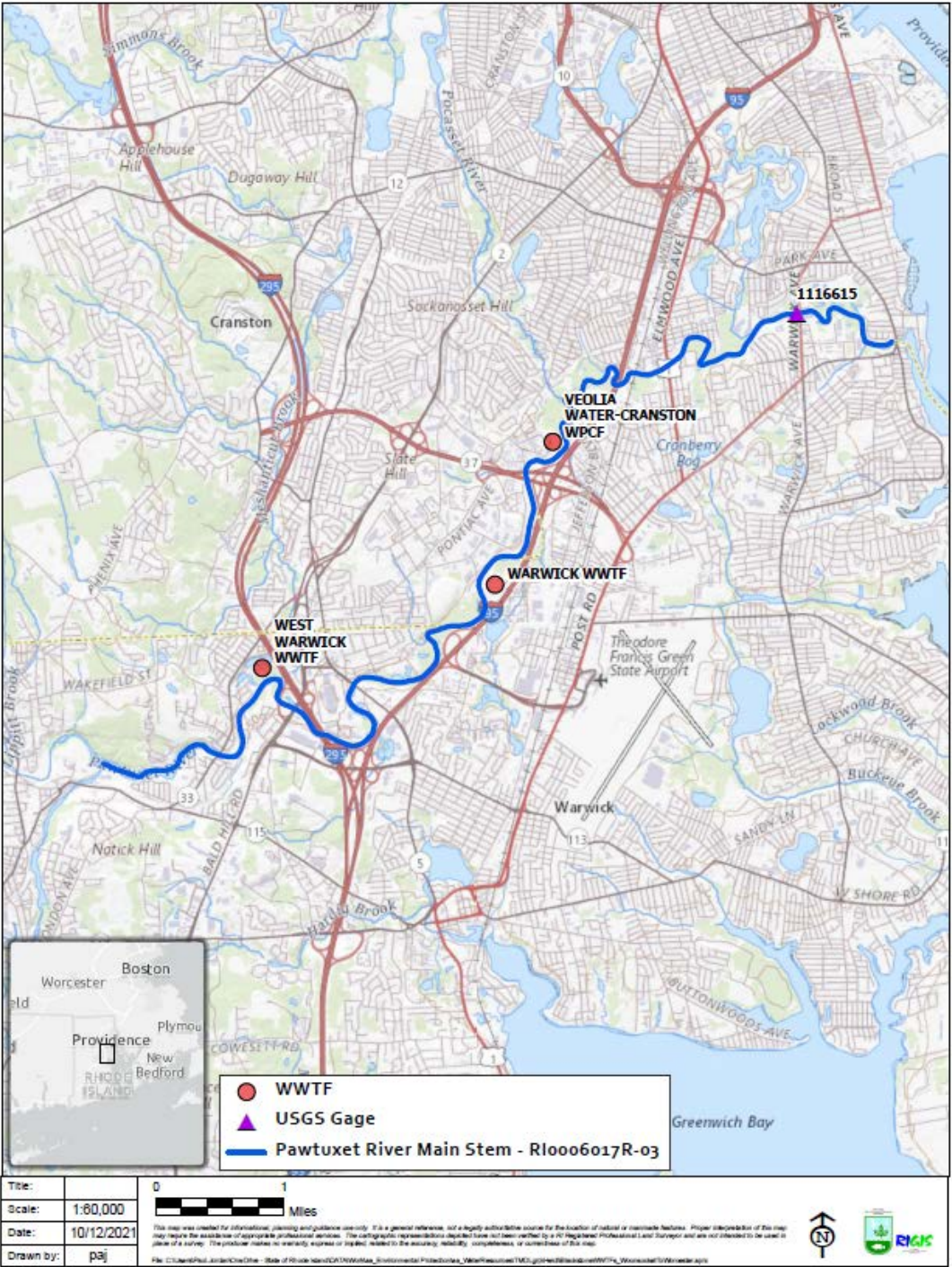
In June 2000, RIDEM reissued RIPDES permits for West Warwick WWTF (RIPDES Permit No. RI0100153), Warwick WWTF (RIPDES Permit No. RI0100234), and Cranston WWTF (RIPDES Permit No. RI0100013). The most significant change to these permits was the addition of seasonal limits for total phosphorus of 1 mg/l and total nitrogen of 8 mg/l. Construction of advanced treatment upgrades was completed at all three municipal wastewater treatment facilities between November 2004 and July 2006. RIDEM was able to remove the Pawtuxet River Main Stem dissolved oxygen impairment in 2008 based on data collected in the summer of 2008 following the upgrades.

In 2008, RIDEM reissued the RIPDES permits for the three WWTFs, lowering the seasonal (May - October) total phosphorus limits to 0.1 mg/L. Construction was complete and permit limits met at all three facilities between October 2016 and July 2018. The following table contains the last six years of phosphorus concentration and load data collected at the WWTFs between May and October.

Pawtuxet River WWTF Seasonal (May-October) Total Phosphorus Concentrations and Loads

	2015		2016		2017		2018		2019		2020	
	mg/L	lb/day	mg/L	lb/day	mg/L	lb/day	mg/L	lb/day	mg/L	lb/day	mg/L	lb/day
Warwick	0.46	17.06	0.37	13.65	0.1	4.08	0.1	3.99	0.1	3.93	0.07	2.59
West Warwick	0.49	17.71	0.07	2.23	0.07	2.98	0.08	3.43	0.08	3.27	0.08	2.90
Cranston	0.53	45.31	0.49	40.13	0.47	26.8	0.08	5.24	0.05	3.42	0.06	3.36

⁴ Pawtuxet Cove Dam was removed in 2011. The waterbody description will be updated in the next update to the Water Quality Regulations,



Pawtuxet River Waterbody Segment with WWTFs and Monitoring Station

The RIDEM water quality regulations contain a narrative nutrient criterion⁵ that specifies nutrient levels should not impair any use. There are many tools that can be used to assess compliance with a narrative nutrient criterion. In the case of the Pawtuxet River Main Stem, RIDEM has opted to use compliance with the dissolved oxygen criteria as demonstrated by the 2008 dissolved oxygen impairment delisting and USGS data collected since the 2008 dissolved oxygen delisting and the significant phosphorus reductions since WWTFs upgrades were completed.

USGS collects monthly nutrient samples from Warwick Avenue⁶. Station 1116617 is located downstream of the three wastewater treatments facilities just before the Pawtuxet River enters Pawtuxet Cove. Total phosphorus concentrations are shown in the table below. The data in the table below show that total phosphorus concentrations have dropped significantly since 2015. While RIDEM does not have a numeric phosphorus criterion for rivers, the 1986 EPA Quality Criteria for Water recommends that a “desired goal for the prevention of plant nuisances in streams or other flowing waters not discharging directly to lakes or impoundments is 100 µg/L total P (Mackenthun, 1973). All annual averages since 2016 have been well-below this threshold. Since upgrades were complete in 2018, there was only one month where phosphorus concentrations exceeded 100 µg/L. The station location is shown in the figure above.

USGS Pawtuxet River at Warwick Avenue Average Total Phosphorus Concentrations (µg/L)

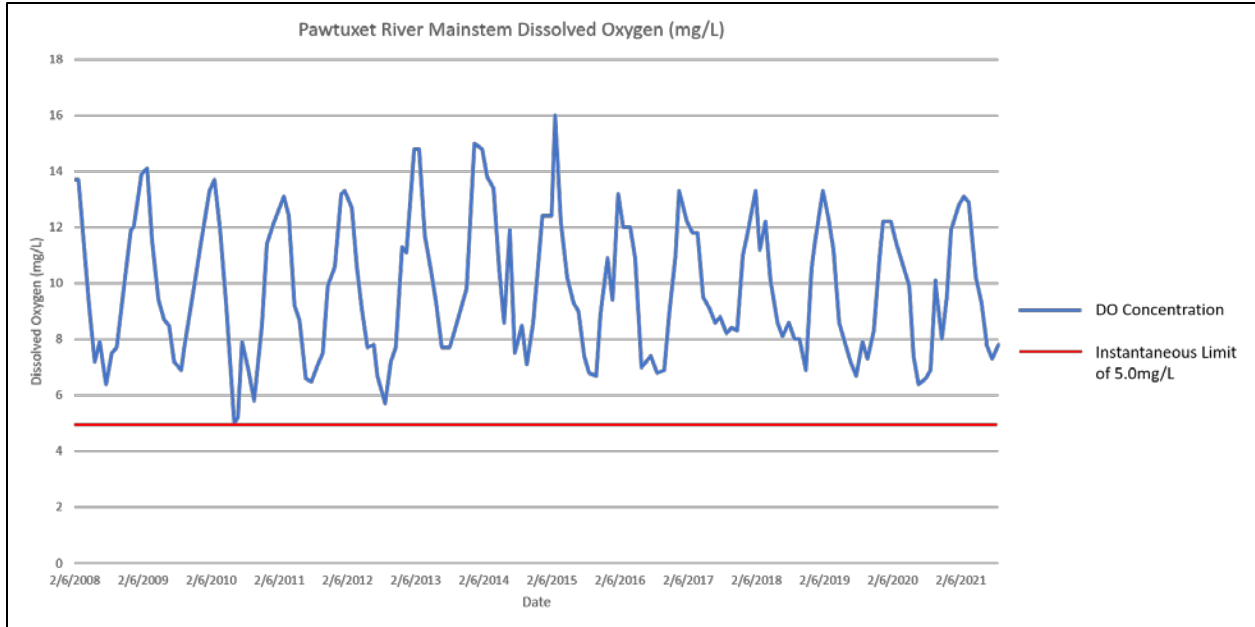
	2015	2016	2017	2018	2019	2020
Annual	95.42	53.42	45.91	31.0	33.58	63.36*
May-Oct	125.33	62.83	40.60	29.67	27.67	28.17
Jan-Apr and Nov-Dec	65.5	44.0	50.33	32.33	39.50	127.25*

*Includes a sample collected on 11/23/2020 at or just before peak flow following a greater than 1 inch rain storm. USGS noted that the river had a lot of organic debris and sediment. The sample was an order of magnitude higher than other samples collected in the previous five years. The only other sample greater than 100 µg/L in the five-year time period was in February 2017 (101 µg/L). The 2020 annual average without this sample would be 35.40 µg/L with a winter average of 50.25 µg/L.

Additionally, instantaneous dissolved oxygen data collected at Station 1116617 demonstrates the dissolved oxygen continues to meet the water quality instantaneous criteria since the 2008 delisting as shown in the Figure below.

⁵ None in such concentration that would impair any usages specifically assigned to said Class, or cause undesirable or nuisance aquatic species associated with cultural eutrophication, nor cause exceedance of the criterion above in a downstream lake, pond, or reservoir. New discharges of wastes containing phosphates will not be permitted into or immediately upstream of lakes or ponds. Phosphates shall be removed from existing discharges to the extent that such removal is or may become technically and reasonably feasible.

⁶ Water quality data collection at USGS 01116500 (Pawtuxet River at Cranston) was discontinued in 2002.



In 2017, the Narragansett Bay Estuary Program (NBEP) released its status and trends report⁷. The report included estimated total phosphorus loads in the Pawtuxet River since the early 1980s. These loads reduced from 403×10^3 lbs/year between 1982 and 1983 to 30×10^3 lbs/year between 2013 and 2015. It is expected that loads will have decreased further since upgrades at all three WWTFs were completed between 2016 and 2017, which were beyond the years available for the NBEP Report at the time of publication. Also released in 2017, a USGS report⁸ analyzed data collected in the Pawtuxet River between 1979 and 2015 and found that total phosphorus concentrations dropped 82% with loads dropping by 76%.

The stringent permitting and compliance with permit requirements are directly linked to the removal of the total phosphorus impairment from the Pawtuxet River Main Stem. Additionally, many restorations activities have occurred in the watershed that likely contribute to the decline in the total phosphorus concentrations in the Pawtuxet River Main Stem.

⁷ Narragansett Bay Estuary Program. 2017. State of Narragansett Bay and Its Watershed (Chapter 8, Nutrient Loading, pages 166-189). Technical Report. Providence, RI. <https://static1.squarespace.com/static/5eea260cea82833324dba1c/t/5faeff989a1aef48f65bd7b9/1605304235902/Chapter-8-Nutrient-Loading.pdf>

⁸ Savoie, J.G., Mullaney, J.R., and Bent, G.C., 2017, Analysis of trends of water quality and streamflow in the Blackstone, Branch, Pawtuxet, and Pawcatuck Rivers, Massachusetts and Rhode Island, 1979 to 2015: U.S. Geological Survey Scientific Investigations Report 2016–5178, 43 p, <https://doi.org/10.3133/sir20165178>.

WOONASQUATUCKET RIVER (RI0002007R-10A)

- RI0002007R-10A Woonasquatucket River headwaters including tributaries to Georgiaville Pond, excluding reservoirs and ponds. North Smithfield, Smithfield

ZINC

RIDEM is proposing to remove the zinc impairment from the Woonasquatucket River based on new data documenting compliance with water quality standards. This segment of the Woonasquatucket River is listed on RI's 303(d) List of Impaired Waters as not supporting the aquatic life designated use due to zinc impairment. EPA approved the RIDEM TMDL for this impairment in July 2007.⁹ After zinc is removed as an impairment in 2022, this segment of the Woonasquatucket River will remain impaired for Primary and Secondary Contact use (fecal coliform). A TMDL has been completed for this impairment.

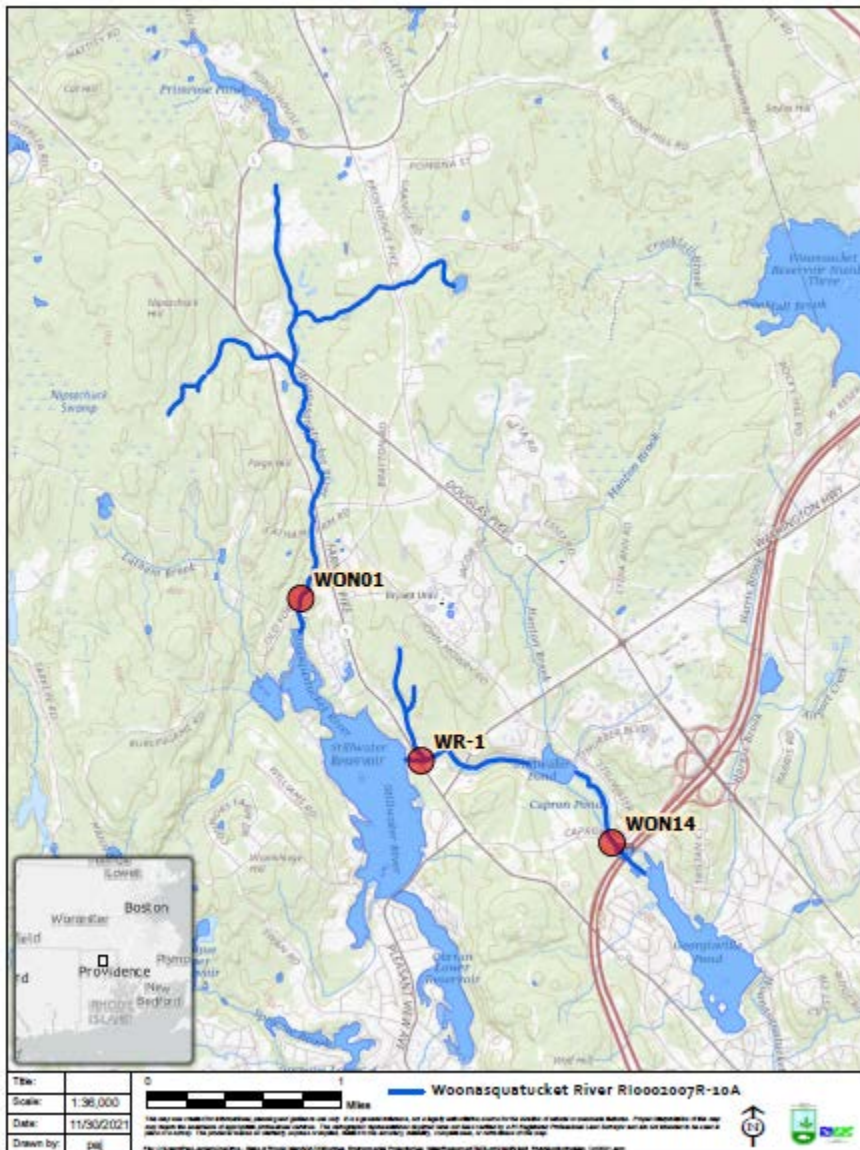
This zinc impairment was first listed in RI's 2006 303(d) List based on data collected during a 2001 wet weather study. Freshwater aquatic life criteria for certain metals are expressed as a function of hardness because hardness can affect the toxicity of these metals. Increasing hardness has the effect of decreasing the toxicity of metals. Ambient hardness values reported in mg/l as CaCO₃ are used to determine applicable acute and chronic metals criteria following US EPA recommended equations provided in §1.26 of RIDEM's Water Quality Regulations (RIDEM 2018).

Data used for the TMDL were collected by RIDEM and a contractor working for RIDEM. The Narragansett Bay Commission also collected data used in the TMDL study but did not collect metals data in this Woonasquatucket River waterbody segment. Allowable acute and chronic criteria were calculated using the lower of the mean dry weather or mean wet weather hardness value. Since hardness data were not collected each time a metals sample was collected, evaluation of each sampling point to its own criteria based on hardness was not possible. The TMDL states that RIDEM used hardness data collected by RIDEM and the Narragansett Bay Commission in 1998 and 2001. The RIDEM TMDL uses a hardness value of 21.8 mg/L as CaCO₃ to calculate an allowable acute criterion of 32.24 µg/L and an allowable chronic criterion of 32.5 µg/L at the single station in this segment located upstream of the Stillwater Reservoir Dam. The result was that one sample (38.4 µg/L) collected during wet weather on 09/21/2001 exceeded the criteria. Dry weather and samples collected during another storm met the criteria. In the TMDL document, a single acute exceedance during a wet weather event was considered likely to exceed again within a three-year period and represents a violation of water quality standards.

The TMDL identified the most likely source of zinc was stormwater runoff from Route 104 in Smithfield which corresponds to station WR-1 (the only TMDL station located in the A segment) and assigned 100% of the wasteload allocation to this source while acknowledging that a business in this vicinity may be an additional source. In order to determine if the violation still

⁹ <http://www.dem.ri.gov/programs/benviron/water/quality/rest/pdfs/woofinal.pdf>

existed, RIDEM resampled this area in its ambient river monitoring dry weather program twice in 2019 and three times in 2021, and RIDOT sampled two wet weather events include pre-storm samples, which are considered dry weather, via a contractor. Samples were collected in the same segment upstream (WON01) and downstream (WON14) of the original impairment as well as at the station sampled during the TMDL study (WR-1). RIDOT also sampled two outfalls during wet weather events, RIDOT outfall WOON188 and an outfall that captures WESCO Oil Inc. (WCO) that were identified as potential sources to WR-1 in the TMDL. A map of in-stream stations is below. The two outfalls are in the vicinity of Route 104 (Farnum Pike) near station WR1.



Woonasquackett River Waterbody Segment and Monitoring Stations

The following tables show the dry and wet weather data results. There is one sample that exceeds the acute and chronic criteria. It is a pre-storm sample that is evaluated as dry weather

at the downstream station and is the only instream sample that was above detection limit. This sample is considered under steady state conditions and a single exceedance is allowable under the Rhode Island Water Quality Regulations “the one-hour average concentration of a pollutant should not exceed the acute criteria more than once every three years on the average.”

Woonasquatucket River (RI0002007R-10A) Dissolved Zinc						
Dry Weather Data						
Sample Date	Detection Limit (µg/L)	Quantitation Limit (µg/L)	Concentration (µg/L)	Hardness (mg/L)	Zinc Criteria (µg/L)	
					Acute	Chronic
WON01 – Old Forge Rd, Smithfield (Mowry Conservation Area)						
9/19/2019	3.08	3.08	<3.08	43.60	58.00	58.47
10/15/2019	3.08	3.08	<3.08	43.80	58.22	58.70
10/13/2020	2.58	2.58	<2.58	53.60	69.08	69.65
6/14/2021	2.39	2.39	<2.39	36.00	49.31	49.71
6/22/2021	2.39	2.39	<2.39	38.00	51.62	52.04
8/30/2021	2.39	2.39	<2.39	30.80	43.20	43.56
9/15/2021	2.39	2.39	<2.39	33.10	45.92	46.30
WR1 – Fornum Pike, Smithfield (Downstream Woonasquatucket Reservoir (Stump Pond))						
10/13/2020	2.58	2.58	<2.58	32.00	44.62	44.99
6/14/2021	2.39	2.39	<2.39	22.00	32.49	32.75
6/22/2021	2.39	2.39	<2.39	24.50	35.59	35.88
8/30/2021	2.39	2.39	<2.39	22.40	32.99	33.26
9/15/2021	2.39	2.39	<2.39	20.90	31.10	31.36
WON14 – Capron Rd Smithfield						
9/19/2019	3.08	3.08	<3.08	35.10	48.26	48.66
10/15/2019	3.08	3.08	<3.08	33.80	46.74	47.12
10/13/2020	2.58	2.58	<2.58	33.50	46.39	46.77
6/14/2021	2.39	2.39	42	24.00	34.97	35.26
6/22/2021	2.39	2.39	<2.39	26.30	37.79	38.10
8/30/2021	2.39	2.39	<2.39	27.30	39.00	39.32
9/15/2021	2.39	2.39	<2.39	22.10	32.61	32.88

Woonasquatucket River (RI0002007R-10A) Dissolved Zinc						
Wet Weather Data						
Sample Date	Detection Limit (µg/L)	Quantitation Limit (µg/L)	Concentration (µg/L)	Hardness (mg/L)	Zinc Criteria (µg/L)	
					Acute	Chronic
STORM 1 – 10/13/2020						
WON01 – Old Forge Rd, Smithfield (Mowry Conservation Area)						
1hr	2.58	2.58	<2.58	49.70	64.80	65.33
4hr	2.58	2.58	<2.58	48.10	63.03	63.54
8hr	2.58	2.58	<2.58	49.10	64.14	64.66
24hr	2.58	2.58	<2.58	50.20	65.35	65.89
WR1 – Fornum Pike, Smithfield (Downstream Woonasquatucket Reservoir (Stump Pond))						
1hr	2.58	2.58	<2.58	32.80	45.57	45.94
4hr	2.58	2.58	<2.58	31.90	44.51	44.87
8hr	2.58	2.58	<2.58	31.00	43.44	43.79
24hr	2.58	2.58	<2.58	30.50	42.85	43.20
WON14 – Capron Rd Smithfield						
1hr	2.58	2.58	<2.58	33.70	46.62	47.01
4hr	2.58	2.58	<2.58	33.20	46.04	46.41
8hr	2.58	2.58	<2.58	32.90	45.69	46.06
24hr	2.58	2.58	<2.58	33.80	46.74	47.12
STORM 2 – 06/14/2021						
WON01 – Old Forge Rd, Smithfield (Mowry Conservation Area)						
1hr	2.39	2.39	<2.39	32.40	45.10	45.47
4hr	2.39	2.39	<2.39	6.62	11.74	11.84
8hr	2.39	2.39	<2.39	31.20	43.68	44.03
24hr	2.39	2.39	<2.39	35.10	48.26	48.66
WR1 – Fornum Pike, Smithfield (Downstream Woonasquatucket Reservoir (Stump Pond))						
1hr	2.39	2.39	<2.39	21.30	31.61	31.87
4hr	2.39	2.39	<2.39	6.62	11.74	11.84
8hr	2.39	2.39	<2.39	22.40	32.99	33.26
24hr	2.39	2.39	<2.39	22.20	32.74	33.00
WON14 – Capron Rd Smithfield						
1hr	2.39	2.39	<2.39	24.20	35.22	35.51
4hr	2.39	2.39	<2.39	6.62	11.74	11.84
8hr	2.39	2.39	<2.39	24.60	35.71	36.00
24hr	2.39	2.39	<2.39	25.70	37.06	37.36

RIDOT's contractor also sampled two outfalls during the wet weather sampling study. All dissolved zinc results were less than the TMDL targets of 32.24 µg/L and 32.5 µg/L for the acute and chronic criteria. For the October 13, 2020 wet weather event, RIDOT's outfall (WOON188) dissolved zinc ranged from 25.30 to 31.10 µg/L and WCO dissolved zinc ranged from 15.24 to

22.33 µg/L. For the June 14, 2021 wet weather event, WOON188 dissolved zinc ranged from 21.70 to 25.00 µg/L and WCO dissolved zinc ranged from 4.94 to 17.00 µg/L.

The data indicate that the water quality of this segment is meeting the State of Rhode Island's water quality criteria for zinc. The one exceedance of the instream acute and chronic criteria is allowable since the Water Quality Regulations allow the criteria to be exceeded once every three years.

While there are no specific actions that can be directly linked to the removal of the dissolved zinc impairment from the Woonasquatucket River, many restoration activities have occurred in the watershed that likely contribute to the decline in the dissolved zinc concentrations in the Woonasquatucket River.