FINAL DATA QUALITY REPORT FOR THE AQUATIC LIFE USE STRESSOR STUDY FOR: BUCKEYE BROOK WATERSHED AND TRIBUTARIES TO WARWICK POND

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Code of Federal Regulations (CFR). Document that codifies all rules of the executive departments and agencies of the federal government. It is divided into fifty volumes, known as titles. Title 40 of the CFR (referenced as 40 CFR) lists all environmental regulations

Designated uses are those uses specified in water quality standards for each waterbody or segment whether or not they are being attained. In no case shall assimilation or transport of pollutants be considered a designated use.

Loading capacity means the maximum amount of loading that a surface water can receive without violating water quality standards.

Margin of Safety (MOS). Because bacteria levels are variable, it is possible that the specified reductions may not be adequate to allow water quality to meet standards. To account for this uncertainty, an additional reduction in bacteria levels beyond the required numeric bacteria concentration is specified. This can be achieved using conservative assumptions, an explicitly allocated reduction, such as a level 10% below the standard, or a combination of both techniques.

Natural background conditions are all prevailing dynamic environmental conditions in a waterbody or segment thereof, other than those human-made or human-induced.

Nonpoint Source (NPS). Any discharge of pollutants that does not meet the definition of Point Source in section 502.(14) of the Clean Water Act and these regulations. Such sources are diffuse, and often associated with land-use practices, and carry pollutants to the waters of the State, including but not limited to, non-channelized land runoff, drainage, or snowmelt; atmospheric deposition; precipitation; and seepage.

Point source means any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation or vessel, or other floating craft, from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture.

Primary contact recreational activities are those activities in which there is prolonged and intimate contact by the human body with the water, involving considerable risk of ingesting water, such as swimming, diving, water skiing and surfing.

Rhode Island Pollutant Discharge Elimination System (RIPDES). The Rhode Island system for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing point source discharge permits and imposing and enforcing pretreatment requirements pursuant to Title 46, Chapter 12 of the General Laws of Rhode Island and the Clean Water Act.

Runoff means water that drains from an area as surface flow.

Secondary contact recreational activities are those activities in which there is minimal contact by the human body with the water, and the probability of ingestion of the water is minimal, such as boating and fishing.

Storm water means precipitation-induced runoff.

Surface waters are any waters of the state that are not groundwaters.

Total Maximum Daily Load (TMDL). The amount of a pollutant that may be discharged into a waterbody and still maintain water quality standards. The TMDL is the sum of the individual wasteload allocations for point sources and the load allocations for nonpoint sources and natural background taking into account a margin of safety.

Wasteload allocation means the portion of a receiving water's loading capacity that is allocated to its point sources of pollution.

Water quality criteria means the elements of the State water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports a particular use.

Water quality standard means provisions of State or Federal law, which consist of designated use(s) and water quality criteria for the waters of the State. Water Quality Standards also consist of an antidegradation policy.

1.0 INTRODUCTION

1.1 Purpose

The State of Rhode Island Department of Environmental Management (RIDEM) has identified water quality impairments in Buckeye Brook. Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) requires States to assess water quality conditions of the state's waters and develop biennial reports describing the water quality conditions, identify and list impaired waters (those waters that do not meet water quality standards with existing required technology-based pollution controls alone) in the state's 303(d) list, and develop Total Maximum Daily Loads (TMDL's) for each listed waterbody and each cause of impairment. Buckeye Brook was first placed on the state's 303d List in 1998 as impaired for Fish and Wildlife Habitat (Aquatic Life Use). The purpose of this study was to: further characterize the biological condition impairment of Buckeye Brook (through macroinvertebrate and periphyton sampling); document water quality conditions; identify potential contributing pollution sources or stressors; and support development of a TMDL to address the fish and wildlife habitat impairment.

1.2 Study Area

The focus of the Aquatic Life Use Stressor Study was the portion of the watershed that includes the mainstem stream system for Buckeye Brook as well as the tributaries to Warwick Pond located in the northern part of the watershed. Prior to the 2014 303(d) listing, the Tributaries to Warwick Pond were included as part of the Buckeye Brook waterbody assessment unit ID. The new listings show a separate waterbody ID for the stream system north of Warwick Pond. Figure 1 shows the two water body assessment unit IDs where the field work for this TMDL was conducted and Table 1shows the waterbody IDs with their current water quality addressed by the biodiversity TMDL.

1.3 Water Quality Impairments

Buckeye Brook was first placed on the state's 303(d) List in 1998 as impaired for Fish and Wildlife Habitat (Aquatic Life Use) based upon macroinvertebrate sampling conducted by RIDEM's contractor, Roger Williams University. Subsequent sampling conducted by ESS, Inc. as part of RIDEM's Wadeable Stream Biomonitoring and Habitat Assessment Program, confirmed Buckeye Brook's impairment (ESS, 2002). Samples were collected annually at a station located at Old Warwick Avenue in Warwick, Rhode Island 2002-2005.

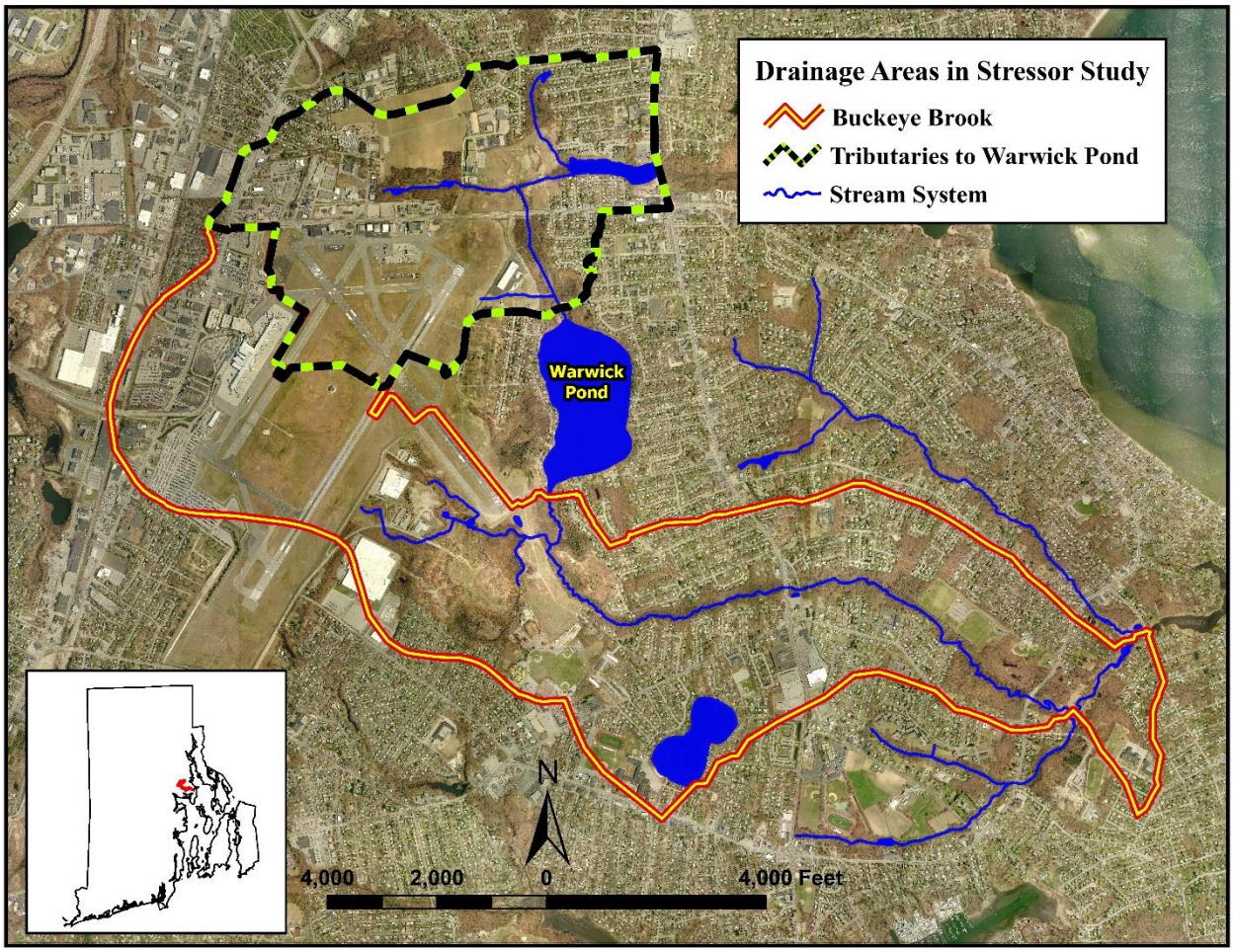

Figure 1 Watershed Drainage Areas

Buckeye Brook pathogen impairments were added to the state's 303(d) List in 2006. RIDEM completed a water quality investigation and TMDL addressing these pathogen impairments, which was approved by US EPA in December 2008. Also in 2008, DEM commenced the Aquatic Life Use Stressor Study of Buckeye Brook and Tributary to Warwick Pond. Results of this study led to the additional listing of metals and dissolved oxygen impairments on the 2014 303(d) List.

Table 1 Water Quality Impairments Subject to the Biodiversity TMDL

Waterbody ID Number	Waterbody Description	Water Quality Classification	Water Quality Impairment
R10007024R-01	Buckeye Brook, Warwick, RI	B	Benthic-Macroinvertebrate Bioassessments, Dissolved Cadmium, Copper, and Lead, and Total Iron, Dissolved Oxygen
R10007024R-05	Tributaries to Warwick Pond	B	Benthic-Macroinvertebrate Bioassessments, Dissolved Cadmium, Total Iron

1.4 Applicable Water Quality Standards

As stated in 40 CFR 131.2, "[water quality] standards serve the dual purposes of 1) establishing the water quality goals for a specific waterbody and 2) serving as the regulatory basis for the establishment of water-quality based treatment controls and strategies beyond the technology-based levels of treatment required by section 301(b) and 306 of the Act." The primary aim of a TMDL is to bring a waterbody back into compliance with applicable water quality regulations.

Therefore, it is important to know exactly which regulations apply to the waterbody for which a TMDL is developed. The regulations, which are specifically applicable to the impairments that caused Buckeye Brook and its tributaries to be listed on the State's 303(d) list, are listed below.

1.4.1 Waterbody Class and Designated Use

The Water Quality Regulations (RIDEM, 2018) describes the water use classification in § 1.9. All surface waters shall be assigned to a class that is defined by the designated uses, which are the most sensitive, and therefore, governing water uses which it is intended to protect. Surface waters may be suitable for other beneficial uses, but shall be regulated to protect and enhance the designated uses. In no case shall waste assimilation or waste transport be considered a designated use.

§ 1.9(E)(3) states that all freshwaters hydrologically connected to and upstream of Class B, B1, SB, SB1, C, or SC waters shall be Class B unless otherwise identified in the regulations. Buckeye Brook is listed as Class B.

The following excerpt from § 1.9(B)(3) of the Regulations describes Class B freshwaters and their designated uses:

These waters are designated for fish and wildlife habitat and primary and secondary contact recreational activities. They shall be suitable for compatible industrial processes and cooling, hydropower, aquacultural uses, navigation, and irrigation and other agricultural uses. These waters shall have good aesthetic value.

2.0 RIDEM AQUATIC LIFE USE STRESSOR STUDY

The state's 2012 Integrated Water Quality Monitoring and Assessment Report 305(b) and 303(d) list identified Buckeye Brook (at that time, inclusive of northern tributaries to Warwick Pond) as non-supporting for fish and wildlife habitat. The cause of the impairment is attributed to the poor comparability of bioassessment metrics evaluating these brooks' benthic-macroinvertebrate community and habitat to a reference site. The Rhode Island Department of Environmental Management conducted a sampling project to characterize the geographic extent and severity of the Buckeye Brook Aquatic Life Use (AQLU) impairment and to identify potential causes and/or pollution sources contributing to the impairment. Water quality and/or benthic biological samples were collected from nine sites in the Buckeye Brook watershed over the course of four surveys from July 2008 through February 2011 that consisted of dry weather and wet weather surveys, one of which was during a winter deicing event.

2.1 Methodology

2.1.1 Stations

Eight stations were selected in the two watersheds for the surveys. Three stations were located on airport property, two on tributaries to Warwick Pond and three on the Buckeye Brook stream system. A ninth station for Adamsville Brook in Adamsville, RI was used as a biological reference site by the ESS Group, Inc. Table 2 lists the stations as well as their location, description, type of sampling conducted, and the reasoning or purpose of the selection. Figure 2 shows the location of the sampling stations within the watershed,.

2.1.2 Parameters

Samples were collected four times for water quality, with biological and toxicity sampling conducted during the second dry weather survey. The water quality samples were analyzed for dissolved trace metals that included Arsenic (As), Copper (Cu), Cadmium (Cd), Manganese (Mn), Lead (Pb) and Zinc (Zn) as well as Total Iron (Fe). Other constituents included Hardness as $CaCO_3$, five-day Biological Oxygen Demand (BOD_5), Chloride (Cl), Ammonia-Nitrogen (NH_3-N), Nitrate+Nitrite-Nitrogen (NO_2+NO_3-N), Total Kjeldahl Nitrogen (TKN), Total Phosphorus (TP), Total Suspended Solids (TSS), Total Organic Carbon (TOC), pH, and Propylene Glycol. All water quality and toxicity samples were collected by RIDEM staff.

The water quality analyses, with some exceptions were conducted at the RI State Health Laboratories in Providence, RI. ESS Laboratories in Cranston, RI conducted the NH3-N, TKN, TOC and Propylene Glycol analysis. Field measurements consisting of dissolved oxygen (D.O.), temperature in degrees centigrade (° C), and specific conductance in microsiemens per centimeter (µS/cm) were measured by RIDEM staff the field using an YSI-85 meter. Field data was collected during all sampling events. All constituents listed were analyzed for all surveys with the exception of TOC, which was only analyzed for the second dry weather survey when biological sampling was conducted, and Propylene Glycol, which was analyzed for the wet surveys only. The toxicity samples collected by RIDEM staff were delivered to the EPA Region

1 Laboratory at Chelmsford, MA where the toxicity testing was conducted by the laboratory staff. A Two Species – 7 Day Chronic Toxicity Test was done for *Ceriodaphnia dubia* (daphnid) and the *Pimephales promelas* (fathead minnow). Toxicity sampling was conducted during the first dry weather and winter wet weather surveys. Toxicity sampling runs were conducted every other day to collect water to replenish the specimen tank. The Quality Assurance Project Plan (QAPP) is available on the RIDEM website at; http://www.dem.ri.gov/pubs/qapp/buckbio.pdf

Table 2 Biodiversity Sampling Station Locations and Description

Station ID	Location	Description	Type	Purpose
BB00	Unidentified tribs to Warwick Pond above Airport Road	In-stream: Upstream of Airport Road culvert	Water Quality, Biological, CPOM, FPOM, TOC	Background sample of stream away from airport and landfill influence
BB02	Warwick Pond Tributary @ Lakeshore Drive	In-Stream, Downstream of culverts under Lakeshore Dr.	Water Quality, Toxicity, Biological, CPOM, FPOM, TOC	Brackets airport Outfalls 002 and 003 with background site BB00
BB03	Buckeye Brook @ Lakeshore Drive	In-stream, Exit of Warwick Pond	Water Quality, Toxicity	Separates Warwick Pond from confluence of airport Outfalls 008 and 009 with Buckeye Bk
BB04	Buckeye Brook @ Rufus Road	In-stream: Downstream of confluence of Buckeye Brook and airport outfall flows	Water Quality, Toxicity, Biological, CPOM, FPOM, TOC	Samples the brook after the confluence of all airport outfalls and the landfill
BB05A	Buckeye Brook downstream of Old Warwick Avenue	In-stream and approximately 1000 ft downstream of the ESS Biological Monitoring Site	Water Quality, Toxicity, Biological, CPOM, FPOM, TOC	To compare the 2008-09 monitoring results to the ESS biomonitoring at BB05 located at Old Warwick Avenue where several stormwater outfalls are located
OF08	Discharge point of outfall 008	TF Green Airport Outfall 008 discharge	Water Quality, Habitat Assessment, Toxicity	Isolates Outfall 008 flows from landfill influence
TA01	Stream from Truk-Away Landfill	In-stream, prior to confluence with stream from Outfall 008	Water Quality, Habitat Assessment, Toxicity	Isolates landfill stream from outfall stream coming from airport
AP01	Confluence of channels downstream of outfall 008 and landfill	In-stream, prior to discharge into Buckeye Brook upstream of airport service road.	Biological, CPOM, FPOM, TOC	Evaluates biological community in stream downstream of landfill and airport and other upstream areas
Adamsville Brook	@ USGS Gage off Route 81 in Little Compton, RI	In-stream sampling	Macroinvertebrate	Biological Reference Site

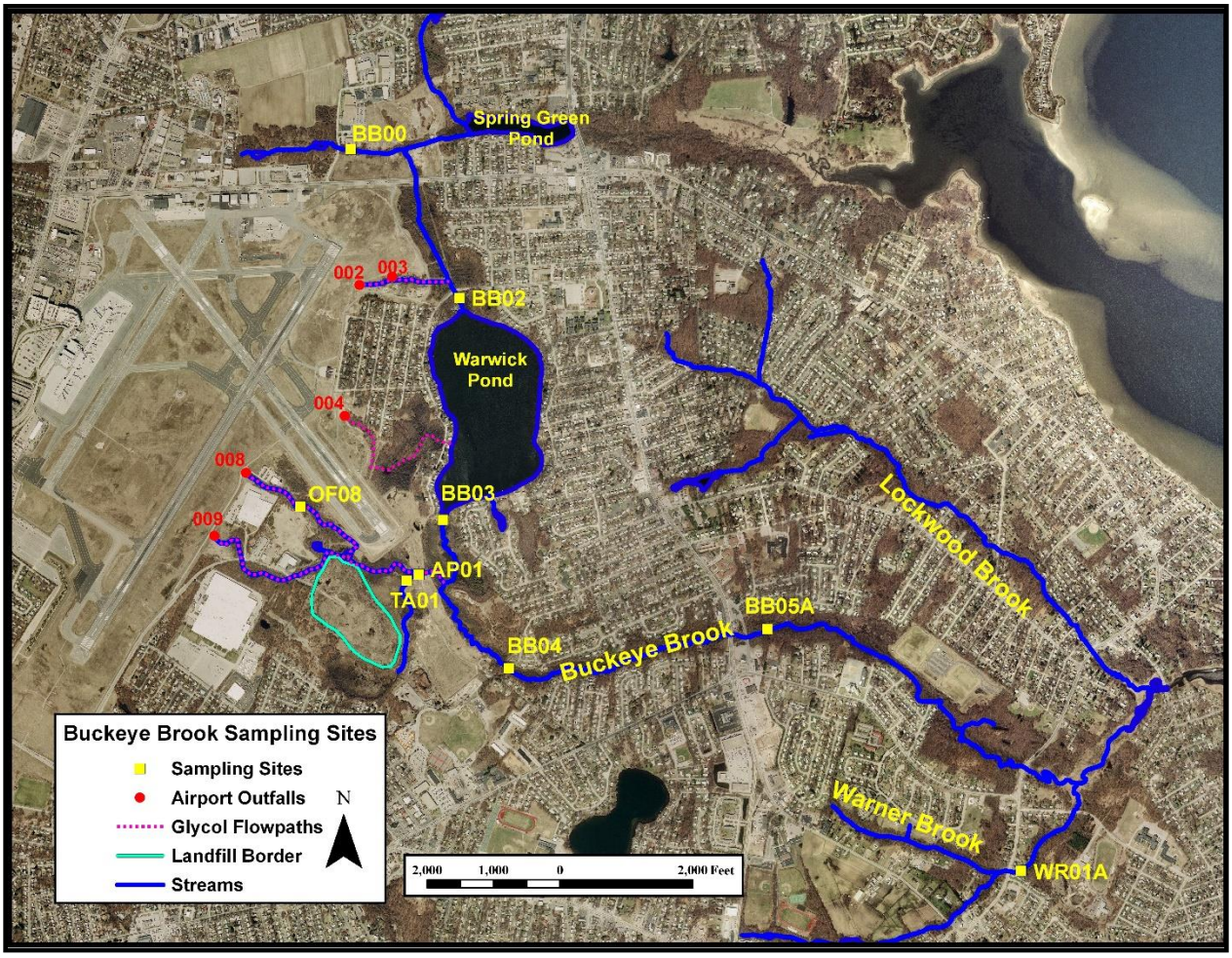

Figure 2 Sampling Sites for Aquatic Life Use Stressor Study

Biological sampling was done by ESS Group, Inc. and accompanied by RIDEM staff at selected stations. The biological survey included a combination of any or all of the following: Macroinvertebrate sampling, Periphyton sampling, Stream Habitat Assessments, CPOM (coarse particulate organic matter >1mm), and FPOM (fine particulate organic matter, less than 1mm and more than .05 mm).

2.2 Dry Weather Surveys

The first dry weather survey was on July 16, 2008 where single grab samples were collected at eight stations for water quality analysis. Station AP01 was not sampled for the first dry weather survey since it was located downstream of Stations OF08 and TA01, and represented the total of these latter two stations. This survey was the first toxicity sampling event for the watershed and water samples were collected and transported to EPA Region 1 Laboratory at Chelmsford, MA for toxicity tests. The first set of toxicity samples were collected along with the water chemistry samples on July 16th, and additional toxicity water samples only were collected on July 18th and

July 20th that were used to replenish the water for the 2-species toxicity test. Table 3 shows the dates of the biodiversity dry weather surveys and the type of sampling that took place during those events.

ESS Group, Inc. accompanied RIDEM personnel for the second dry weather survey on September 10, 2008 and collected biodiversity samples for selected stations as noted in Table 3. During the second dry survey, grab samples were collected for water quality chemical analysis from all stations except BB03. This station was not a viable candidate for biodiversity sampling and following the recommendation by ESS Group, it was decided to skip this station for the second dry survey.

Table 3 Dry Weather Biodiversity Sampling Dates and Sample Type

Station	BB00	BB02	BB03	BB04	BB05A	OF08	TA01	AP01
DW01 July 16-20, 2008	Chem	Chem, Tox	Chem, Tox	Chem, Tox	Chem, Tox	Chem, Tox	Chem, Tox	NS
DW02 September 10, 2008	Chem, Bio	Chem, Bio	NS	Chem, Bio	Chem, Bio	Bio	Bio	Chem, Bio

Notes: Chem – Water Quality Chemistry samples; Tox – Toxicity samples; Bio – Biodiversity samples; NS – Not Sampled

Upon further review of climatic conditions preceeding the sampling event, it was subsequently determined that the samples collected on September 20, 2008 (DW02) were representative of wet weather conditions.

Section 3.1.2 identified the specific testing and analysis that was conducted for all sample types during all the surveys for Buckeye Brook as well as the laboratories that did the analysis.

2.3 Wet Weather Surveys

Two wet weather studies were conducted, the first from December 9-11, 2008 and a second from February 1-8, 2011. The first wet survey in December 2008 was during a rainfall event with an average high temperature of 53°F and a total precipitation of 2.27 inches recorded at T.F. Green Airport. The survey consisted of three runs, a pre-storm on December 9th to check baseline conditions in the brook, and two more survey runs on consecutive days. A fourth run was planned on December 12th, however, between the end of the December 11th run until the planned start of the last run, 3.56 inches of rainfall was recorded at T.F. Green Airport, and it was decided to terminate the survey at three sampling runs. During this event, the samples were analyzed for water chemistry only. A total of eight stations were sampled during the first wet weather event. AP01 was not sampled as it was downstream of TA01 and OF08, and represented the total of the two upstream stations. Table 4 shows the dates of the wet weather surveys and the type of sampling conducted.

The second wet weather survey was a winter survey in February 1-8, 2011. The purpose of this survey was to collect water quality and toxicity samples during a winter storm when de-icing and anti-icing solutions were being applied to departing aircraft at T.F. Green Airport. The winter survey proved to be a difficult storm to capture due to the constraints imposed by the EPA laboratory for sample drop-off times and dates when the lab would be available to provide the toxicity analysis. Additionally, the unpredictability of the weather patterns to provide a discrete storm that provided a worst-case scenario to collect runoff from deicing operations was also a challenge. For these reasons, the second wet weather survey was not completed until February of 2011. During this survey, approximately 6 inches of snowfall was recorded at the airport and the average temperature ranged from 20° to 38°F. The survey consisted of four runs, a prestorm on February 1st, Run 1 at the start of the storm (2/3/11), Run 2 (2/6/11) and a final Run 3 (2/8/11).

Table 4 Wet Weather Biodiversity Sampling Stations Dates and Sample Type

Station	BB00	BB02	BB03	BB04	BB05A	OF08	TA01	AP01
DW1 July 16-21, 2008	**Chem**	**Chem, Tox**	**Chem, Tox**	**Chem, Tox**	**Chem, Tox**	**Chem, Tox**	**Chem, Tox**	**NS**
DW2 September 10, 2008	**Chem, Bio**	**Chem, Bio**	**NS**	**Chem, Bio**	**Chem, Bio**	**Bio**	**Bio**	**Chem, Bio**
DW3 December 9, 2008	**Chem**	**Chem**	**Chem**	**Chem**	**Chem**	**Chem**	**Chem**	**NS**
DW4 February 1, 2011	**Chem, Tox**	**Chem, Tox**	**Chem, Tox**	**Chem, Tox**	**Chem**	**Chem, Tox**	**Chem, Tox**	**NS**

Notes: Chem – Water Quality Chemistry samples; Tox – Toxicity samples; NS – Not Sampled

Two stations sampled during the first toxicity survey were swapped for the winter survey at the suggestion of the EPA laboratory staff. Station BB05A was not sampled for toxicity and Station BB00 was added. As show in Figure 3.1, BB05A was located downstream of Station BB04, and any suspected pollutants being discharged from the airport stations would be in the sample collected at BB04. Station BB00 also provided another station that would not have been directly influenced by airport de-icing operations or by runoff from the landfill. Its location north of Warwick Pond in a wetland area served as neutral background sampling location for the toxicity analysis being conducted by the EPA laboratory in Chelmsford, MA.

2.4 Rhode Island Airport Corporation (RIAC)

RIAC had an annual monitoring requirement (RIPDES Permit RI0021598) to capture a wet weather storm during a frozen precipitation event (i.e. snow, sleet, freezing rain) during the annual deicing season (October 1 – March 31) at the T.F. Green Airport while aircraft deicing was occurring. Locations to be sampled included the stormwater outfalls that discharged to the

Buckeye Brook stream system both above and below Warwick Pond. These included airport outfalls 002, 003 and 008 (RIDEM Station OF08). Receiving water sample sites included the northern Tributaries to Warwick Pond at the pond's inlet (BB02), the exit of Warwick Pond (BB03), Buckeye Brook at West Shore Road (BB07) and Buckeye Brook at Tidewater Drive (BB08). Flows from airport outfalls 002 and 003 entered the tributary stream approximately 200 feet above Warwick Pond inlet, while the flow from airport outfall 008 (OF08) entered Buckeye Brook approximately 0.25 miles downstream of the exit of Warwick Pond (BB03). The next two sampling stations are located 1.8 miles (BB07) and 2.4 miles (BB08) downstream from the confluence of Buckeye Brook and OF08.

Constituents sampled at the airport outfalls by RIAC that were common to the biodiversity study included Arsenic, Copper, Iron, Manganese, Zinc, BOD_5, TOC, TSS, and propylene glycol. The receiving waters were sampled for BOD_5, TSS, chloride, and propylene glycol. The sampling frequency for the airport outfalls (002, 003, and 008) was every hour for the first 12 hours of the storm, while the RIAC Buckeye Brook sites were sampled every four hours for a period of 48 hours. The RIAC sampling for the airport and stream stations commenced on February 1st at 1000 and continued until 1054 on February 3, 2011. Although the data from the 2011 RIAC sampling event is not used in the analysis for the TMDL, it is presented alongside the RIDEM data as a comparison.

2.5 Quality Assurance

All water samples for laboratory analysis were collected in pre-cleaned containers supplied by the RI Department of Health Laboratory in Providence, RI and preserved as specified in the sampling plan (RIDEM 2008), and transported to the laboratory on the day of collection. Toxicity sample containers were supplied by the EPA Lab in Chelmsford, MA and the water collected transported to the laboratory by the RIDEM sampling crew on the day of collection.

Field sampling and measurement protocols followed those specified in the QAPP sampling plan (RIDEM, 2008) for *in-situ* temperature, dissolved oxygen, and specific conductance. All meters were calibrated and post-calibrated per manufacturer's instructions.

Replicate samples were collected to assess total field and laboratory variation. Replicate and blank samples were introduced in the field and submitted with the routine batches of samples to the laboratory. Field duplicates and trip blanks were labeled as "Dup1DW01 or TB DW01". This was done to insure that the laboratories did not know what station was selected for the duplicate sample. Field notes were used to confirm the location where the duplicate sample was taken. Table 5 summarizes the parameters, methods, accuracy, precision, bias, and reporting limits for sample measurements.

2.5.1 Evaluation of Data Quality

Data collected during this study were evaluated to determine whether data quality assurance/quality control (QA/QC) objectives for the project were met. Data were evaluated

according to the measurement performance criteria described in Section 18 and 19 of the approved QA plan.

Analytical Laboratory Precision

Analytical laboratory precision was determined by calculating the relative percent difference (RPD) between the initial laboratory result and the laboratory duplicate. The criterion used to assess measurement performance for precision for each parameter is given in Table 5and Laboratory precision results are provided in Table 6 and Table 7.

With the exception of samples described below, all samples were delivered to the Rhode Island Department of Health Laboratory (RIDOH) located in Providence, RI. Ammonia, Total Kjeldahl Nitrogen, Total Organic Carbon, and Propylene Glycol samples were taken for analysis to the ESS Laboratory, located in Cranston, RI. Water collected for toxicity testing was delivered to the EPA Region 1 Laboratory in Chelmsford, MA.

The temperature of the coolers delivered to the RIDOH for all surveys ranged from 3.5 to 4.6 degrees Celsius. The sampling plan required a cooler temperature not to exceed 4 degrees Celsius, however since the maximum temperature of the coolers only exceeded this by a maximum of 0.6 degrees it was considered acceptable. Holding times for all parameters were met during all surveys.

Field Accuracy

Field accuracy was determined by calculating the relative percent difference (RPD) between the original field sample and the field duplicate. The criterion used to assess measurement performance for field accuracy for each parameter is given in Table 5. The QAPP specified that field duplicates were to be analyzed for 10% of samples (or at least once per batch). Table 8 shows the parameters and whether the field accuracy results for the duplicate stations were acceptable or not acceptable. Those parameters that did not meet the performance criteria were not used for analysis. The detailed field accuracy data is presented in Appendix A.

Table 5 Accuracy, Precision, Bias, and Reporting Limits for Sample Measurements.

Analysis	Method	Accuracy	Precision	Bias Contamination	Achievable Limits
Field					
Water Temperature	YSI-85	± 0.2°C	N/A	N/A	N/A
Dissolved Oxygen	YSI-85	N/A	N/A	5	1 mg/L
Specific Conductivity	YSI-85	N/A	N/A	5	1 µmhos/cm
Laboratory					
Ammonia Nitrogen (NH_3-N)*	EPA 350.1	< 30% RPD	< 20% RPD	< 0.10 mg/L	0.10 mg/L
Nitrate Nitrogen (NO_3-NO_2-N)*	EPA 353.2	< 30% RPD	< 20% RPD	< 0.05 mg/L	0.05 mg/L
Total Kjeldahl Nitrogen (TKN)*	EPA 351.2	< 30% RPD	< 20% RPD	< 0.20 mg/L	0.20 mg/L
Total Phosphorus (TP)	SM4500-P-E	< 30% RPD	< 20% RPD	< 0.02 mg/L	0.02 mg/L
Chloride (Cl)	EPA 300	< 30% RPD	< 20% RPD	< 0.20 mg/L	0.20 mg/L
Hardness (as $CaCO_3$)	SM3500-D	< 30% RPD	< 20% RPD	< 1.0 mg/L	1.0 mg/L
Total Organic Carbon (TOC)*	EPA 9060 Mod	< 30% RPD	< 20% RPD	< 30 mg/Kg	30 mg/Kg
5-Day Biological Oxygen Demand (BOD_5)	SM5210B	< 30% RPD	< 20% RPD	< 1.0 mg/L	1.0 mg/L
pH	EPA 150.1	< 30% RPD	< 20% RPD	<0.10 pH Unit	0.10 pH Unit
Total Suspended Solids (TSS)	SM2540D	< 30% RPD	< 20% RPD	< 0.10 mg/L	1.0 mg/L
Propylene Glycol	Modified ASTM E202	< 30% RPD	< 30% RPD	<10 mg/L	20 mg/L
Dissolved Zinc (Zn)	EPA 200.8	<30% RPD	< 20% RPD	<20.0 µg/L	**
Dissolved Metals (As, Cd, Cu, Mn, Pb)	EPA 200.8	< 30% RPD	< 20% RPD	< 1.0 µg/L	**
Total Iron (Fe)	EPA 200.8	< 30% RPD	< 20% RPD	< 10.0 µg/L	**

* Analysis by ESS Laboratory; ** Reporting Limits (µg/L) are: As (0.15), Cd (0.06), Cu (0.30), Fe (10), Mn (1.8), Pb (0.07), Zn (6.46)

Table 6 Laboratory precision results for Ammonia-Nitrogen.

Station	Date	Original Result (mg/l)	Lab Dup (mg/l)	Mean	Difference	RPD (%)	Acceptable Y or N
Trip Blank	7/16/08	ND	ND	ND	0	0	Y
DW2 Dup	9/10/09	0.20	0.19	0.195	0.01	5	Y
BB03	12/9/08	0.29	0.27	0.28	0.02	7	Y
BB00	12/10/08	0.15	0.18	0.165	0.03	18	Y
*	12/11/08						
BB00	2/1/11	0.28	0.30	0.29	0.02	7	Y
TA01	2/3/11	1.14	1.22	1.18	0.08	7	Y
Trip Blank	2/8/11	ND	ND	ND	0	0	Y

*If cells are blank then no duplicate was analyzed for that parameter for that date.

Table 7 Laboratory precision results for Total Kjeldahl Nitrogen.

Station	Date	Original Result (mg/l)	Lab Dup (mg/l)	Mean	Difference	RPD (%)	Acceptable Y or N
OF08	7/16/08	ND	ND	ND	0	0	Y
*	9/10/09						
*	12/9/08						
*	12/10/08						
*	12/11/08						
*	2/1/11						
*	2/3/11						
TA01	2/6/11	2.33	2.30	2.315	0.03	1	Y
*	2/8/11						

*If cells are blank then no duplicate was analyzed for that parameter for that date

Those parameters that did not meet the performance criteria were not used for analysis. Exceptions to the performance criteria were:

- The Wet Weather Survey 1 sample for BOD_5 and the field duplicate at BB02 had a calculated relative percent difference of 40%. These data were qualified as (J) since the relative percent differences exceeded the DQO of 30%, however the data was considered to be usable for analysis purposes.

- The Wet Weather Survey 2 sample for Dissolved Cadmium and the field duplicate at BB04 had a calculated relative percent difference of 40%. These data were qualified as (J) since the relative percent differences exceeded the DQO of 30%, however the data was considered to be usable for analysis purposes.

Table 8 Field Accuracy Results

Constituent	BB05A 9/10/2008	BB02 12/9/2008	BB03 2/6/2011	BB04 2/8/2011
Ammonia Nitrogen (mg/L)	Y	Y	Y	Y
BOD_5 (mg/L)	Y	**J**	**N**	Y
Chloride (mg/L)	Y	Y	Y	Y
Hardness (mg/L)	Y	Y	Y	Y
Nitrate Nitrogen (mg/L)	Y	Y	Y	Y
pH	Y	Y	Y	Y
TKN (mg/L)	Y	NC	Y	Y
Total Phosphorus (mg/L)	Y	NC	NC	Y
TSS (mg/L)	**N**	NC	**N**	**N**
Arsenic (As) (µg/L)	**N**	Y	Y	Y
Cadmium (Cd) (µg/L)	NC	Y	NC	**J**
Copper (Cu) (µg/L)	Y	Y	Y	Y
Iron (Fe) (µg/L)	Y	Y	Y	Y
Lead (Pb) (µg/L)	NC	**N**	Y	NC
Manganese (Mn) (µg/L)	Y	Y	Y	Y
Zinc (Zn) (µg/L)	Y	**N**	Y	NC

J= RPD exceeded DQO however data was considered to be usable,
NC= Not Calculated due to one or both samples below detection limits.

Analytical Bias

Analytical bias was evaluated using method blanks, laboratory check standards (LCS), and matrix spikes. Table 9 shows the limits for the data quality checks for ESS Laboratories in Cranston, RI. Each of these control samples were run once per batch. Method blanks for all nutrient and propylene glycol analysis were below quantitation limits and Table 10 contain the matrix spike results for the biodiversity survey data analyzed by ESS Laboratories

Table 9 Measurements of Analytical Bias and Data Quality Objectives

Parameter	LCS DQO	Method Blank DQO	Matrix Spike DQO
Ammonia Nitrogen	± 10%	< QL	± 25%
Total Kjeldahl Nitrogen	± 20%	< QL	± 25%
Total Organic Carbon	± 10%	< QL	± 25%
Propylene Glycol	± 40%	< QL	± 25%

Method blanks for all nutrient and propylene glycol analysis done at ESS Laboratories were below quantitation limits. Method blanks for all metals analyzed at the RIDOH were below reporting limits (RL). A review of LCS and QCS, method blank, and matrix spike results, analytical bias was considered acceptable for all parameters for the biodiversity study for Buckeye Brook.

Table 10 Matrix Spike Data Quality Objective Results.

Date	Parameter	% Recovery	Acceptable Limits	Qualifier
7/16/08	Ammonia Nitrogen	93	75-125	J- acceptable
	Total Kjeldahl Nitrogen	108	75-125	J- acceptable
9/10/08	Ammonia Nitrogen	78	75-125	J- acceptable
	Total Organic Carbon	107	80-120	J- acceptable
12/9/08	Ammonia Nitrogen	94	75-125	J- acceptable
12/10-11/08	Ammonia Nitrogen	90	75-125	J- acceptable
2/1/11	Ammonia Nitrogen	94	75-125	J- acceptable
2/3/11	Ammonia Nitrogen	104	75-125	J- acceptable
2/6/11	Total Kjeldahl Nitrogen	103	75-125	J- acceptable
	Ammonia Nitrogen	104	75-125	J- acceptable
2/8/11	Ammonia Nitrogen	91	75-125	J- acceptable

Field Bias

Trip-blank samples were submitted to determine bias from contamination in the bottles or during transportation into the field and to the lab. Trip blank contamination was suspected when measured values exceeded the corresponding reporting limits. During Dry Survey 1, several field blanks had reported values that were above detection. The constituents include, hardness (RL=1.0 mg/L, Reported Value 36 mg/L), Dissolved Cadmium (RL=0.06 µg/L, Reported Value 0.13 µg/L), Dissolved Copper (RL=0.30 µg/L, Reported Value 19.9 µg/L), Dissolved Lead (RL=0.07 µg/L, Reported Value 0.49 µg/L), Dissolved Manganese (RL=0.43 µg/L, Reported Value 0.96 µg/L), and Dissolved Zinc (RL=6.46 µg/L, Reported Value 15.2 µg/L). The trip blank measurement values for the remaining surveys were below reporting limits except for a trip blank for dissolved Cadmium in Wet Weather Run 3 (2/8/2011) (Appendix B).

Addtitionally, the samples collected on 7/16/2008 (dry weather survey 1) for dissolved metals analysis were collected in an acid washed bottle but preserved prior to filtration for dissolved fraction. The data was based on an aliquot removed from the nutrient collection bottle to filter for dissolved metals, and therefore, the dissolved metals aliquot analyzed was not collected in an acid washed bottle. The results from this date are show with “R” (i.e. rejected), and the results will not be used in the TMDL in Table 11.

Data Completeness

Data are considered to be complete if the data collected are considered to be usable. For all parameters, the QAPP sets a goal of 100%. For the most part, this was accomplished and nearly all of the data collected were considered usable for TMDL assessment analysis. The samples listed below were not acceptable and will not be utilized in any analysis as these results significantly failed to meet field accuracy data quality objectives and could not be qualified:

- Dissolved Arsenic and TSS sample collected at BB05A on 9/10/2008
- Following samples collected at BB02 on 12/9/2008
- Dissolved Lead and Dissolved Zinc
- TSS sample collected at BB03 on 2/6/2011, and
- TSS sample collected at BB04 on 2/8/2011.
- Metals and hardness data from 7/16/2008
    a. Hardness (RL=1.0 mg/L, Reported Value 36 mg/L), Dissolved Cadmium (RL=0.06 µg/L, Reported Value 0.13 µg/L), Dissolved Copper (RL=0.30 µg/L, Reported Value 19.9 µg/L), Dissolved Lead (RL=0.07 µg/L, Reported Value 0.49 µg/L), and Dissolved Zinc (RL=6.46 µg/L, Reported Value 15.2 µg/L)
- Dissolved Cadmium from Wet Weather Run 3 (2/8/2011) (RL=0.05µg/L, Reported Value 0.08µg/L)

Table 11 Buckeye Brook Chemistry Data for Dry Weather Surveys

Dissolved Oxygen (mg/L)

Survey Type	DW1*			DW2	DW3	DW4	WW1		WW2			Mean
Station	7/16/08	7/18/08	7/21/08	9/10/08	12/9/08	2/1/11	12/10/08	12/11/08	2/3/11	2/6/11	2/8/11	
BB00	4.24	4.58	5.18	4.52	9.75	16.85	8.11	9.23	12.32	11.52	10.38	8.79
BB02	7.55	7.33	7.07	6.41	9.45	10.93	7.63	9.58	10.87	11.14	10.24	8.93
BB03	9.03	6.93	6.67	NS	9.37	14.84	12.17	12.12	14.87	14.55	12.44	11.30
TA01	3.41	2.55	3.05	NS	1.38	6.53	4.93	5.05	4.93	4.84	5.13	4.18
OF08	9.29	8.9	8.85	NS	7.2	13	9.02	10.45	9.94	12.03	10.91	9.96
AP01				3.68								3.68
BB04	4.95	2.95	2.7	4.83	8.71	11.42	7.41	7.55	11.47	9.78	9.67	7.40
BB05A	5.39	4.82	4.8	6.01	10.24	10.12	7.27	8.57	11.3	9.84	10.91	8.12

Temperature (°C)

Survey Type	DW1*			DW2	DW3	DW4	WW1		WW2			Mean
Station	7/16/08	7/18/08	7/21/08	9/10/08	12/9/08	2/1/11	12/10/08	12/11/08	2/3/11	2/6/11	2/8/11	
BB00	18.6	20.1	22.0	16.0	2.6	0.4	11.2	7.1	1.6	1.9	3.4	9.5
BB02	21.3	27.3	27.8	17.6	4.6	0.8	11.7	8.0	3.1	4.0	4.3	11.9
BB03	29.2	18.3	20.0	NS	2.8	2.1	5.2	5.0	2.2	2.6	2.6	9.0
TA01	17.5	17.9	18.9	NS	0.9	0.3	6.9	5.1	1.0	0.7	0.8	7.0
OF08	14.7	14.7	15.0	NS	11.2	7.8	13.09	8.0	7.5	4.7	6.1	10.3
AP01				16.7								16.7
BB04	26.5	23.2	24.5	21.0	2.7	0.9	8.7	6.4	2.5	2.3	2.9	11.1
BB05A	24.5	23.2	24.6	19.8	2.5	0.1	9.5	6.5	0.3	1.5	2.3	10.4

Specific Conductance (µS/cm)

Survey Type	DW1*			DW2	DW3	DW4	WW1		WW2			Mean
Station	7/16/08	7/18/08	7/21/08	9/10/08	12/9/08	2/1/11	12/10/08	12/11/08	2/3/11	2/6/11	2/8/11	
BB00	359	395	386	370	399	444	366	378	501	378	390	397
BB02	301	270	271	262	286	370	339	505	693	505	882	426
BB03	272	304	300	NS	218	219	218	214	210	214	195	236
TA01	416	417	415	NS	472	86	265	284	353	448	482	364
OF08	322	337	338	NS	268	333	207	91	624	456	1920	490
AP01				277								277
BB04	346	356	360	245	284	295	331	491	605	491	450	387
BB05A	344	343	349	241	279	308	292	688	760	688	498	435

NS = Not Sampled

*One chemistry sample was collected for DW1 on 7/16/2008. Toxicity testing required field visits, and field data was collected at time of field visit.

Table 11 Buckeye Brook Chemistry Data for Dry Weather Surveys (Cont.)

Station	BOD_5 (mg/L)				
	7/16/08	9/10/08	12/9/08	2/1/11	Mean
BB00	2	1	<1.0	1	1.0
BB02	1	1	2	3	1.8
BB03	4	NS	1	1	2.0
TA01	4	NS	2	2	2.7
OF08	4	NS	5	20	9.7
AP01	NS	1	NS	NS	1.0
BB04	4	1	6	5	4.0
BB05A	3	1	6	4	3.5

Station	Chloride (mg/L)				
	7/16/08	9/10/08	12/9/08	2/1/11	Mean
BB00	92.2	76.2	80.4	98.9	86.9
BB02	56.1	46.9	46.6	81.4	57.8
BB03	46.9	NS	33.8	40.4	40.4
TA01	46.2	NS	44.5	52.5	47.7
OF08	79.0	NS	51.7	74.6	68.4
AP01	NS	39.7	NS	NS	39.7
BB04	62.1	39.2	44.0	53.6	49.7
BB05A	59.2	38.6	44.7	55.3	49.5

Station	TSS (mg/L)				
	7/16/08	9/10/08	12/9/08	2/1/11	Mean
BB00	0	1	<1.0	3	1.0
BB02	1	4	4	4	3.3
BB03	3	NS	2	1	2.0
TA01	39	NS	5	37	27.0
OF08	0	NS	<1.0	2	0.7
AP01	NS	5	NS	NS	5.0
BB04	1	4	6	2	3.3
BB05A	0	**R**	**4**	**5**	3.0

Station	pH				
	7/16/08	9/10/08	12/9/08	2/1/11	Mean
BB00	7.66	6.55	6.67	6.08	6.74
BB02	7.39	6.9	7.23	6.48	7.00
BB03	9.22	NS	7.76	7.06	8.01
TA01	7.41	NS	7.18	6.45	7.01
OF08	7.22	NS	7.21	6.93	7.12
AP01	NS	7.06	NS	NS	7.06
BB04	7.33	7.01	7.05	6.76	7.04
BB05A	7.53	7.13	7.44	6.81	7.23

Station	Hardness (mg/L)				
	7/16/08	9/10/08	12/9/08	2/1/11	Mean
BB00	R	40	51	59.4	50.1
BB02	R	41	52	49.9	47.6
BB03	R	NS	51	53.7	52.4
TA01	R	NS	98	96.6	97.3
OF08	R	NS	42	45.3	43.7
AP01	NS	43	NS	NS	43.0
BB04	R	45	58	59.1	54.0
BB05A	R	44	57	30.4	43.8

Station	Total Phosphorus (mg/L)				
	7/16/08	9/10/08	12/9/08	2/1/11	Mean
BB00	0.03	0.03	<0.02	0.03	0.02
BB02	0.02	<0.02	<0.02	0.03	0.01
BB03	0.02	NS	<0.02	0.03	0.02
TA01	0.19	NS	0.2	0.23	0.21
OF08	<0.02	NS	<0.02	0.02	0.01
AP01	NS	0.09	NS	NS	0.09
BB04	0.03	0.03	<0.02	0.04	0.03
BB05A	0.03	0.03	0.03	0.04	0.03

Station	TKN (mg/L)				
	7/16/08	9/10/08	12/9/08	2/1/11	Mean
BB00	0.55	0.52	0.37	1.19	0.66
BB02	ND	0.43	ND	1.07	0.38
BB03	0.26	NS	0.31	1.18	0.58
TA01	2.79	NS	7.28	2.80	4.29
OF08	ND	NS	ND	0.87	0.29
AP01	NS	2.07	NS	NS	2.07
BB04	0.88	0.71	0.80	1.63	1.01
BB05A	0.23	0.61	0.82	1.74	0.85

Station	Ammonia-N (mg/L)				
	7/16/08	9/10/08	12/9/08	2/1/11	Mean
BB00	0.40	0.31	0.26	0.28	0.31
BB02	0.13	0.16	0.14	0.22	0.16
BB03	0.13	NS	0.29	0.15	0.19
TA01	2.72	NS	5.87	1.99	3.53
OF08	0.13	NS	ND	0.13	0.09
AP01	NS	1.71	NS	NS	1.71
BB04	0.85	0.30	0.85	0.74	0.69
BB05A	0.23	0.21	0.75	0.66	0.46

Station	Nitrate- N (mg/L)				
	7/16/08	9/10/08	12/9/08	2/1/11	Mean
BB00	0.78	0.82	1.53	1.65	1.20
BB02	1.90	1.16	1.59	1.79	1.61
BB03	<0.05	NS	0.34	0.35	0.23
TA01	<0.05	NS	<0.05	<0.05	<0.05
OF08	0.67	NS	0.79	0.53	0.66
AP01	NS	0.41	NS	NS	0.41
BB04	0.24	<0.05	0.34	0.32	0.23
BB05A	1.01	0.26	0.64	0.42	0.58

Station	Arsenic (µg/L)				
	7/16/08	9/10/08	12/9/08	2/1/11	Mean
BB00	0.38	0.29	0.50	0.14	0.33
BB02	0.27	0.42	0.46	0.21	0.34
BB03	0.66	NS	0.67	0.27	0.53
TA01	1.87	NS	1.80	0.24	1.30
OF08	0.39	NS	1.36	0.67	0.81
AP01	NS	0.97	NS	NS	0.97
BB04	0.61	0.82	0.94	0.24	0.65
BB05A	0.33	**R**	0.62	0.17	0.37

Table 11 Buckeye Brook Chemistry Data for Dry Weather Surveys (Cont)

Station	Cadmium (µg/L)					Copper (µg/L)				
	7/16/08	9/10/08	12/9/08	2/1/11	Mean	7/16/08	9/10/08	12/9/08	2/1/11	Mean
BB00	R	0.08	0.40	0.26	0.25	R	2.1	1.8	1.33	1.74
BB02	R	0.11	0.18	0.09	0.13	R	1.19	1.03	1.3	1.17
BB03	R	NS	0.15	<0.05	0.08	R	NS	0.98	2.94	1.96
TA01	R	NS	0.58	0.09	0.34	R	NS	2.01	1.4	1.71
OF08	R	NS	0.17	0.06	0.12	R	NS	0.74	1.03	0.89
AP01	NS	<0.06	NS	NS	<0.06	NS	1.08	NS	NS	1.08
BB04	R	<0.06	0.11	0.14	0.08	R	1.24	1.21	1.52	1.32
BB05A	R	<0.06	0.31	0.05	0.12	R	1.68	3.24	2.51	2.48

Station	Lead (µg/L)					Manganese (µg/L)				
	7/16/08	9/10/08	12/9/08	2/1/11	Mean	7/16/08	9/10/08	12/9/08	2/1/11	Mean
BB00	R	<0.07	0.27	0.09	0.12	637	732	932	768	767
BB02	R	<0.07	R	0.11	0.15	469	448	796	858	643
BB03	R	NS	0.18	0.29	0..24	12	NS	220	393	208
TA01	R	NS	1.51	0.73	1.12	988	NS	1,197	1,247	1,144
OF08	R	NS	0.08	<0.08	0.04	880	NS	962	1,599	1,147
AP01	NS	<0.07	NS	NS	<0.07	NS	505	NS	NS	505
BB04	R	0.18	0.61	1.50	0.76	335	142	321	663	365
BB05A	R	<0.07	0.66	0.37	0.34	321	203	613	724	465

Station	Total Iron (µg/L)					Zinc (µg/L)				
	7/16/08	9/10/08	12/9/08	2/1/11	Mean	7/16/08	9/10/08	12/9/08	2/1/11	Mean
BB00	732	522	654	741	662	R	28.2	24.9	4.5	19.2
BB02	648	824	1,185	1,989	1,162	R	13.9	R	<1.12	9.1
BB03	186	NS	308	432	309	R	NS	6.9	2.0	4.5
TA01	11,586	NS	19,180	9,088	13,285	R	NS	27.2	3.4	15.3
OF08	2,844	NS	4,334	3,954	3,711	R	NS	10.5	2.9	6.7
AP01	NS	3,008	NS	NS	3,008	NS	10.4	NS	NS	10.4
BB04	2,078	1,258	3,112	1,892	2,085	R	7.1	12.2	6.0	8.5
BB05A	1,347	1,439	1,112	1,010	1,227	R	7.8	9.9	4.1	7.3

Station	TOC (mg/L)		
	7/16/08	9/10/08	Mean
BB00	NA	1,900	
BB02	NA	580	
BB03	NA	NS	
TA01	NA	NS	
OF08	NA	NS	
AP01	NA	17,000	
BB04	NA	1,700	
BB05A	NA	2,500	

Propylene Glycol (mg/L)		
12/9/08	2/1/11	Mean
ND	ND	
ND	ND	
---	ND	
ND	---	
ND	ND	
NS	NS	
ND	ND	
ND	ND	

Table 12 Buckeye Brook Chemistry Data for Wet Weather 1 (December 10-11, 2008)

Station	BOD_5 (mg/L)			Chloride (mg/L)			TSS (mg/L)			pH		
	Run 1	Run 2	Mean	Run 1	Run 2	Mean	Run 1	Run 2	Mean	Run 1	Run 2	Mean
BB00	2	2	2.0	77.8	54.6	66.2	3	7	5.0	6.15	6.52	6.34
BB02	6	3	4.5	70.8	31.0	50.9	9	8	8.5	6.30	6.58	6.44
BB03	2	3	2.5	33.8	33.7	33.8	9	3	6.0	7.29	7.46	7.38
TA01	2	5	3.5	29.6	34.3	32.0	9	40	24.5	6.80	6.99	6.90
OF08	6	6	6.0	47.1	14.7	30.9	9	8	8.5	6.47	6.72	6.60
BB04	5	9	7.0	22.7	38.5	30.6	10	6	8.0	6.60	6.89	6.75
BB05A	5	7	6.0	47.6	35.8	41.7	8	9	8.5	6.90	7.18	7.04

Station	Hardness (mg/L)			Total Phosphorus(mg/L)			TKN (mg/L)			Ammonia-N (mg/L)		
	Run 1	Run 2	Mean	Run 1	Run 2	Mean	Run 1	Run 2	Mean	Run 1	Run 2	Mean
BB00	44	37	40.5	0.03	0.04	0.04	ND	ND		0.15	0.16	0.16
BB02	32	24	28.0	0.05	0.03	0.04	ND	ND		0.14	0.11	0.13
BB03	42	52	47.0	0.03	0.03	0.03	0.25	0.36	0.31	0.30	0.26	0.28
TA01	45	50	47.5	0.24	0.92	0.58	31.1	5.26	18.18	2.68	3.12	2.90
OF08	15	15	15.0	0.11	0.07	0.09	ND	ND		0.13	ND	0.07
BB04	53	45	49.0	0.03	0.04	0.04	0.96	0.66	0.81	1.02	0.64	0.83
BB05A	52	44	48.0	0.04	0.04	0.04	0.75	0.49	0.62	0.66	0.44	0.55

Station	Nitrate-N (mg/L)			Arsenic (µg/L)			Cadmium (µg/L)			Copper (µg/L)		
	Run 1	Run 2	Mean	Run 1	Run 2	Mean	Run 1	Run 2	Mean	Run 1	Run 2	Mean
BB00	1.07	0.98	1.03	0.28	0.38	0.33	0.17	0.16	0.17	2.04	2.22	2.13
BB02	0.83	<0.05	0.42	0.24	0.53	0.39	0.22	0.39	0.31	3.37	2.19	2.78
BB03	0.34	0.36	0.35	0.96	0.81	0.89	<0.06	<0.06	<0.06	0.89	0.72	0.81
TA01	0.10	0.09	0.10	0.88	1.41	1.15	0.08	0.09	0.09	1.04	1.83	1.44
OF08	0.30	0.31	0.31	0.66	0.62	0.64	0.19	0.19	0.19	4.26	2.66	3.46
BB04	0.30	0.30	0.30	0.52	0.65	0.59	<0.06	<0.06	<0.06	0.90	0.88	0.89
BB05A	0.56	0.46	0.51	0.62	0.40	0.51	0.29	<0.06	0.15	1.56	1.63	1.60

Station	Lead (µg/L)			Manganese (µg/L)			Total Iron (µg/L)			Zinc (µg/L)		
	Run 1	Run 2	Mean	Run 1	Run 2	Mean	Run 1	Run 2	Mean	Run 1	Run 2	Mean
BB00	0.30	0.49	0.40	821	598	710	897	1,082	990	25.48	27.19	26.34
BB02	0.78	0.49	0.64	382	387	385	1,377	1,419	1,398	28.71	24.48	26.60
BB03	<0.07	0.18	0.09	199	176	188	296	470	383	<6.46	<6.46	<6.46
TA01	0.94	1.70	1.32	489	389	439	4,725	18,912	11,819	9.18	21.8	15.49
OF08	1.08	0.20	0.64	228	176	202	2,049	1,726	1,888	33.51	26.17	29.84
BB04	<0.07	<0.07	<0.07	634	528	581	2,385	3,287	2,836	7.09	8.25	7.67
BB05A	0.24	0.22	0.23	365	382	374	1,991	1,423	1,707	20.64	25.43	23.04

Station	Propylene Glycol (mg/L)		
	Run 1	Run 2	Mean
BB00	ND	ND	
BB02	ND	ND	
BB03	---	---	---
TA01	---	---	---
OF08	ND	ND	
BB04	ND	ND	
BB05	ND	ND	

Sampling Dates: Run 1-12/10/08; Run 2- 12/11/08; ND = Non Detect; R=Rejected because data did not meet data quality objectives

Table 12 Buckeye Brook Chemistry Data for Wet Weather 2 (February 3-8, 2011)

Station	BOD_5 (mg/L)				Chloride (mg/L)				TSS (mg/L)				pH			
	Run 1	Run 2	Run 3	Mean	Run 1	Run 2	Run 3	Mean	Run 1	Run 2	Run 3	Mean	Run 1	Run 2	Run 3	Mean
BB00	2	2	<1.0	1.3	136	91.0	88.0	105.0	13	8	28	16.3	6.38	6.18	6.58	6.38
BB02	15	15	14	14.7	175	119	233	175.7	2	3	12	5.7	6.62	6.52	7.21	6.78
BB03	1	R	<1.0	0.5	39.0	29.8	33.8	34.2	2	R	<1.0	1.0	7.31	6.81	6.89	7.00
TA01	4	14	4	7.3	49.8	81.0	89.6	73.5	14	7	30	17.0	7.27	6.48	6.78	6.84
OF08	15	15	15	15.0	168	113	544	275.0	2	1	4	2.3	6.89	6.46	6.67	6.67
BB04	15	15	15	15.0	150	106	94.6	116.9	6	<1.0	R	3.0	6.80	6.66	7.13	6.86
BB05A	15	14	11	13.3	203	156	93.6	150.9	<1.0	7	4	3.7	7.07	6.72	6.98	6.92

Station	Hardness (mg/L				Total Phosphorus (mg/L)				TKN (mg/L)				Ammonia-N (mg/L			
	Run 1	Run 2	Run 3	Mean	Run 1	Run 2	Run 3	Mean	Run 1	Run 2	Run 3	Mean	Run 1	Run 2	Run 3	Mean
BB00	52.2	32.3	43.4	42.6	0.09	0.06	0.03	0.06	1.03	1.06	1.15	1.08	0.21	0.26	0.25	0.24
BB02	41.0	28.4	34.4	34.6	0.04	0.04	0.05	0.04	1.33	1.34	1.42	1.36	0.20	0.18	0.18	0.19
BB03	79.2	43.8	35.2	52.7	<0.02	<0.02	0.03	0.01	1.22	1.21	1.16	1.20	ND	0.16	0.2	0.12
TA01	42.7	62.2	77.4	60.8	0.18	0.22	0.45	0.28	2.47	2.33	3.07	2.62	1.14	1.44	1.38	1.32
OF08	33.0	16.2	24.2	24.5	0.03	0.02	0.04	0.03	1.10	1.05	1.22	1.12	ND	0.11	ND	0.04
BB04	56.8	40.4	50.7	49.3	0.03	0.03	0.03	0.03	2.21	1.57	1.57	1.78	0.64	0.62	0.53	0.60
BB05A	59.0	36.2	44.4	46.5	0.02	0.04	0.03	0.03	1.86	1.53	1.43	1.61	0.62	0.53	0.45	0.53

Station	Nitrate-N (mg/L)				Arsenic (µg/L)				Cadmium (µg/L)				Copper (µg/L)			
	Run 1	Run 2	Run 3	Mean	Run 1	Run 2	Run 3	Mean	Run 1	Run 2	Run 3	Mean	Run 1	Run 2	Run 3	Mean
BB00	1.66	0.97	1.36	1.33	0.26	0.38	0.27	0.30	0.21	0.09	R	0.15	2.16	2.17	1.53	1.95
BB02	1.64	0.92	1.01	1.19	0.37	0.52	0.41	0.43	0.14	0.12	R	0.13	2.32	4.05	3.32	3.23
BB03	0.36	0.32	0.33	0.34	0.35	0.57	0.44	0.45	<0.05	<0.05	R	<0.05	1.05	1.63	0.81	1.16
TA01	<0.05	0.14	0.10	0.08	0.61	0.49	0.55	0.55	<0.05	<0.05	R	<0.05	1.48	1.34	1.36	1.39
OF08	0.51	0.39	0.43	0.44	0.37	0.64	0.48	0.50	0.10	<0.05	R	0.05	1.74	3.59	4.22	3.18
BB04	0.31	0.26	0.34	0.30	0.30	0.35	0.25	0.30	<0.05	<0.05	R	<0.05	1.71	2.35	1.46	1.84
BB05A	0.39	0.30	0.38	0.36	0.27	0.24	0.62	0.38	0.06	<0.05	R	0.03	8.48	2.02	1.26	3.92

Station	Lead (µg/L)				Manganese (µg/L)				Total Iron (µg/L)				Zinc (µg/L)			
	Run 1	Run 2	Run 3	Mean	Run 1	Run 2	Run 3	Mean	Run 1	Run 2	Run 3	Mean	Run 1	Run 2	Run 3	Mean
BB00	0.16	1.28	0.16	0.53	810	512	726	683	2,307	948	648	1,301	17.51	21.13	5.55	14.73
BB02	0.35	0.51	0.17	0.34	1,169	481	526	725	1,747	1,475	2,403	1,875	13.6	22.6	<1.13	12.07
BB03	0.10	0.33	<0.08	0.14	467	433	391	430	449	462	1,617	843	1.15	1.94	<1.13	1.03
TA01	0.19	0.22	0.37	0.26	1,012	689	835	845	4,976	1,250	3,693	3,306	1.44	1.91	<1.13	1.12
OF08	2.62	0.22	0.11	0.98	945	383	494	607	2,454	1,928	2,441	2,274	10.29	15.4	9.26	11.65
BB04	0.13	0.38	<0.08	0.17	713	555	550	606	3,112	1,605	1,799	2,172	<1.13	3.3	<1.13	1.10
BB05A	0.53	0.15	0.20	0.29	723	713	398	611	1,168	981	1,172	1,107	14.86	2.68	<1.13	5.85

Station	Propylene Glycol (mg/L)			
	Run 1	Run 2	Run 3	Mean
BB00	ND	ND	ND	ND
BB02	45	44	45	45
BB03	ND	ND	ND	ND
TA01	---	---	---	---
OF08	99	34	105	79
BB04	23	ND	21	15
BB05A	---	---	---	---

Sampling Dates: Run 1-02/03/11; Run 2- 02/06/11; Run 3- 02/08/11; ND = Non Detect; R=Rejected because data did not meet data quality objectives.

2.6 Biological Field Survey

The Biological Field survey for the two watersheds was conducted on September 10, 2008 to further characterize the extent and severity of the impairment while bracketing potential stressors from outfalls and tributaries to Warwick Pond and Buckeye Brook. Table 13 lists those stations selected for biological sampling, their locations and the type of assessment that was conducted by ESS Group, Inc. (ESS). Stations that were tested for toxicity are listed in Table 3 and Table 4 for the dry and wet weather events.

Table 13 Stations Sampled by ESS in September, 2008

Station	Location	Assessments Conducted
Tributaries to Warwick Pond (RI0007024R-05)		
BB00	northern Tributary to Warwick Pond above Airport Road	Habitat Periphyton/Macroinvertebrate CPOM/FPOM
BB02	northern Tributary to Warwick Pond at Lakeshore Drive	Habitat Periphyton/Macroinvertebrate CPOM/FPOM
Buckeye Brook Watershed (RI0007024R-01)		
BB04	Buckeye Brook at Rufus Road	Habitat Periphyton/Macroinvertebrate CPOM/FPOM
BB05A	Buckeye Brook downstream of Old Warwick Avenue	Habitat Periphyton/Macroinvertebrate CPOM/FPOM
TA01	Unnamed tributary channel from Truk-Away Landfill	Habitat
OF08	Unnamed tributary channel from T.F. Green Airport Outfall 008	Habitat
AP01	Downstream channel combining flows from OF08 and TA01	Habitat Periphyton/Macroinvertebrate CPOM/FPOM
Adamsville Bk Reference Site	At the USGS Gage off of Route 81 in Little Compton, RI	Macroinvertebrate

Macroinvertebrates and periphyton are useful in biological monitoring because of the wide range of tolerances among taxa to various physical, chemical, and biological stressors. Coarse particulate organic matter (CPOM) and fine particulate organic matter (FPOM) were evaluated to assess the potential contribution of carbon availability and processing on observed patterns in the biological community. An evaluation of habitat quality is critical to any assessment as habitat and biological diversity in streams are closely linked. Habitat incorporates all aspects of physical

and chemical constituents along with the biotic interactions. The presence of an altered habitat structure is considered one of the major stressors of aquatic systems.

2.7 Aquatic Toxicity Study

Two of the four surveys conducted for the biodiversity study had stations that were tested for aquatic toxicity by the EPA Laboratory in Chelmsford, MA. The section below will summarize the results of the dry and wet weather toxicity study. The full report is available at RIDEM upon request.

2.7.1 Dry Weather Toxicity Study

The dry weather toxicity survey was conducted from July 16-21, 2008 on six of the nine stations that were sampled during the biodiversity study for Buckeye Brook. The first sampling run on July 16, 2008 collected field data (Dissolved Oxygen, Specific Conductivity, and Temperature), chemistry and toxicity samples at the northern tributary station BB02, and at the Buckeye Brook stations BB03, BB04, BB05A, as well as the Truk-Away landfill (TA01) and airport (OF08) stations. Two other sampling runs were conducted every other day to collect water samples to replenish the water used in the toxicity tests at the EPA laboratory. This ensured that the water used in the toxicity tests would be fresh throughout the 7-day testing period.

2.7.2 Wet Weather Toxicity Study

The second toxicity study was conducted during a winter, deicing conditions. Four sampling runs were conducted over a period of eight days starting February 1, 2011. Field measurements and chemistry samples were collected for all stations on every run, while toxicity sampling was only conducted at Stations BB00, BB02, BB03, BB04, OF08, and TA01 for the last three runs of the storm event. A summary of the results from the winter toxicity survey is given below.

The test acceptability criteria (TAC) and nonlethal variability limits (PMSDs) were met for *Pimephales promelas* (fathead minnow). TAC for the *Ceriodaphnia dubia* (daphnid) was met for the survival endpoint, however the test TAC for reproduction fell below criteria.

Pimephales promelas (fathead minnow)
Filamentous floc that developed in the test sample leading to the distinct possibility that the reduction in survival for BB02 may have been due to a physical impairment, rather than a true chemical effect. The survival rate for BB02 was 48% below the control sample, while all other stations were not affected.

There was a statistically significant reduction in biomass observed for Stations BB02, BB04, OF08, and TA01, while Stations BB00 and BB03 showed no signs of growth impairment. However, interpretation of the results for the stations showing growth impairment was difficult base solely upon the test findings due in part to difficulties maintaining dissolved oxygen levels

throughout the test period. While dissolved oxygen levels for these samples dropped below the minimum 4 mg/L but it may have been more a physical entrainment issue caused by the filamentous floc that contributed to the reduction in growth. Station BB02 had the largest biomass deficit below the control sample at 64%, with stations BB04 at 22%, TA01 at 20% and OF08 at 34% below the control for the wet weather survey. The dissolved oxygen sags that occurred during the toxicity test may have been influenced by the propylene glycol levels for these samples. The mean glycol at BB02 was 45 mg/L and the associated BOD_5 demand was 16.3 mg/L. OF08 and BB04 had mean glycol values of 79 mg/L and 22 mg/L respectively, with the BOD_5 levels at 16.3 mg/L and 11.8 mg/L respectively.

Ceriodaphnia dubia (daphnid)
No significant effect on survival was observed for any sample stations for *Ceriodaphnia dubia*. The test failed to meet reproduction criteria. However, due to the difficulties capturing a winter storm event that met the parameters that occurred in this storm and the associated cost that would be incurred in doing so, the laboratory staff made the following observations in order to glean as much information from this test.

"The TAC are measured on the laboratory control organisms to evaluate, at least in part, test organism health. The laboratory controls represent the test organisms in the absence of any stressors. Therefore, it would be assumed that, barring lab personnel performance issues, any improvement in health would be reflected across all test exposures. The current neonate production data indicates a maximum reduction in production at 10% is associated with sample location at BB02. All other neonate production is equal to or greater than the laboratory control response."

The laboratory staff stated that if the test organism health was improved and the test did meet TAC or it was redone, a finding of no significant difference in reproduction for any of the samples would be the same. Therefore, it was decided to accept the results of the testing conducted on the *C. dubia* for this storm event.

In summary, the fathead minnow survival rate was not significantly impacted at any station except BB02 during the wet weather de-icing study. The reduced survival rate for BB02 was not a toxic response but likely due to a physical impairment from the filamentous floc in the sample. There was a significant difference in biomass growth for the minnow at stations BB02, BB04, TA01, and OF08 which may again be connected to the filamentous floc that developed in the test sample. The dissolved oxygen sag observed in the samples could be in response to the propylene glycol which uses oxygen during the degradation process.

The daphnid survival rate was not affected for the toxicity testing but the reproduction data failed to meet test criteria. Again the dissolved oxygen levels in the test samples may have been the cause of the low reproduction

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APPENDIX A

Dry Weather 1 Field Accuracy Results (July 16, 2008)

Constituent	WR01A[1]	Field Dup	Mean	Difference	Relative Percent Difference	Acceptable Y or N
Ammonia Nitrogen (mg/L)	0.25	0.37	0.31	0.12	39%	**N**
BOD_5 (mg/L)	4.0	3.0	3.5	1.0	29%	Y
Chloride (mg/L)	107	107	107	0.0	0%	Y
Hardness (mg/L)	148	58	103	90	87%	**N**
Nitrate Nitrogen (mg/L)	3.08	2.99	3.0	0.09	3%	Y
pH	7.49	7.28	7.4	0.21	3%	Y
TKN (mg/L)	0.47	0.52	0.50	0.05	10%	Y
Total Phosphorus (mg/L)	0.05	0.11	0.08	0.06	75%	**N**
TSS (mg/L)	1.0	2.0	1.5	1.0	67%	**J**
Arsenic (As) (µg/L)	0.26	0.28	0.27	0.02	7%	Y
Cadmium (Cd) (µg/L)	ND	0.07	NC	NC	NC	
Copper (Cu) (µg/L)	1.81	4.69	3.25	2.88	89%	**N**
Iron (Fe) (µg/L)	810	1,696	1,253	886	71%	**N**
Lead (Pb) (µg/L)	0.27	1.64	0.96	1.37	143%	**N**
Manganese (Mn) (µg/L)	621	621	621	0.0	0%	Y
Zinc (Zn) (µg/L)	19.2	30.4	24.8	11.2	45%	**N**

ND= non-detect, **NC**= not calculated. **J**= RPD exceeded DQO however data was considered to be usable.

Dry Weather 2 Field Accuracy Results (September 10, 2008)

Constituent	BB05A	Field Dup	Mean	Difference	Relative Percent Difference	Acceptable Y or N
Ammonia Nitrogen (mg/L)	0.21	0.20	0.21	0.01	5%	Y
BOD_5 (mg/L)	1.0	1.0	1.0	0.0	0%	Y
Chloride (mg/L)	38.6	38.9	38.8	0.3	1%	Y
Hardness (mg/L)	44	44	44	0	0%	Y
Nitrate Nitrogen (mg/L)	0.26	0.22	0.2	0.04	17%	Y
pH	7.13	7.4	7.3	0.27	4%	Y
TKN (mg/L)	0.61	0.54	0.58	0.07	12%	Y
Total Phosphorus (mg/L)	0.03	0.03	0.03	0	0%	Y
TSS (mg/L)	7.0	4.0	5.5	3.0	55%	**N**
Arsenic (As) (µg/L)	0.65	0.15	0.4	0.5	125%	**N**
Cadmium (Cd) (µg/L)	ND	ND	NC	NC	NC	
Copper (Cu) (µg/L)	1.68	1.38	1.53	0.3	20%	Y
Iron (Fe) (µg/L)	1,439	1,331	1,385	108	8%	Y
Lead (Pb) (µg/L)	ND	ND	NC	NC	NC	
Manganese (Mn) (µg/L)	203	177	190	26.0	14%	Y
Zinc (Zn) (µg/L)	7.8	6.5	7.15	1.3	18%	Y

ND= non-detect, **NC**= not calculated.

[1] WR01A was dropped from the final TMDL development

Wet Weather 1 Field Accuracy Results (December 9, 2008)

Constituent	BB02	Field Dup	Mean	Difference	Relative Percent Difference	Acceptable Y or N
Ammonia Nitrogen (mg/L)	0.14	0.13	0.135	0.01	7%	Y
BOD_5 (mg/L)	6.0	4.0	5.0	2.0	40%	**J**
Chloride (mg/L)	46.6	46.1	46.35	0.5	1%	Y
Hardness (mg/L)	52	52	52	0	0%	Y
Nitrate Nitrogen (mg/L)	1.59	1.57	1.58	0.02	1%	Y
pH	7.23	7.14	7.19	0.09	1%	Y
TKN (mg/L)	ND	ND	NC	NC	NC	
Total Phosphorus (mg/L)	ND	ND	NC	NC	NC	
TSS (mg/L)	4.0	ND	NC	NC	NC	
Arsenic (As) (µg/L)	0.46	0.56	0.51	0.1	20%	Y
Cadmium (Cd) (µg/L)	0.18	0.19	0.19	0.01	5%	Y
Copper (Cu) (µg/L)	1.03	0.93	0.98	0.1	10%	Y
Iron (Fe) (µg/L)	1,185	1,290	1,238	105	8%	Y
Lead (Pb) (µg/L)	0.34	1.06	0.7	0.72	103%	**N**
Manganese (Mn) (µg/L)	796	785	791	11	1%	Y
Zinc (Zn) (µg/L)	13.3	27.1	20.2	13.8	68%	**N**

ND= non-detect, **NC**= not calculated. **J**= RPD exceeded DQO however data was considered to be usable.

Wet Weather 2 Field Accuracy Results (Run 2 February 6, 2011)

Constituent	BB03	Field Dup	Mean	Difference	Relative Percent Difference	Acceptable Y or N
Ammonia Nitrogen (mg/L)	0.16	0.2	0.18	0.04	22%	Y
BOD_5 (mg/L)	1.0	2.0	1.5	1.0	67%	**N**
Chloride (mg/L)	29.8	31.9	30.9	2.1	7%	Y
Hardness (mg/L)	43.8	44.7	44.3	0.9	2%	Y
Nitrate Nitrogen (mg/L)	0.32	0.35	0.34	0.03	9%	Y
pH	6.81	6.79	6.8	0.02	0%	Y
TKN (mg/L)	1.21	1.04	1.13	0.17	15%	Y
Total Phosphorus (mg/L)	0.03	ND	NC	NC	NC	
TSS (mg/L)	31.6	4.0	17.8	27.6	155%	**N**
Arsenic (As) (µg/L)	0.57	0.49	0.53	0.08	15%	Y
Cadmium (Cd) (µg/L)	ND	ND	NC	NC	NC	
Copper (Cu) (µg/L)	1.63	1.99	1.81	0.36	20%	Y
Iron (Fe) (µg/L)	462	393	428	69	16%	Y
Lead (Pb) (µg/L)	0.33	0.3	0.32	0.03	10%	Y
Manganese (Mn) (µg/L)	433	434	434	1	0%	Y
Zinc (Zn) (µg/L)	1.9	1.8	1.85	0.1	5%	Y

ND= non-detect, **NC**= not calculated.

Wet Weather 2 Field Accuracy Results (Run 3 February 8, 2011)

Constituent	BB04	Field Dup	Mean	Difference	Relative Percent Difference	Acceptable Y or N
Ammonia Nitrogen (mg/L)	0.53	0.51	0.52	0.02	4%	Y
BOD_5 (mg/L)	15.0	14.0	14.5	1.0	7%	Y
Chloride (mg/L)	94.6	93.7	94.2	0.9	1%	Y
Hardness (mg/L)	50.7	48.7	49.7	2.0	4%	Y
Nitrate Nitrogen (mg/L)	0.34	0.34	0.34	0	0%	Y
pH	7.13	7.26	7.195	0.13	2%	Y
TKN (mg/L)	1.57	1.53	1.55	0.04	3%	Y
Total Phosphorus (mg/L)	0.03	0.03	0.03	0	0%	Y
TSS (mg/L)	7.0	2.0	4.5	5.0	111%	**N**
Arsenic (As) (µg/L)	0.25	0.33	0.29	0.08	28%	Y
Cadmium (Cd) (µg/L)	0.06	0.09	0.075	0.03	40%	**J**
Copper (Cu) (µg/L)	1.46	1.65	1.555	0.19	12%	Y
Iron (Fe) (µg/L)	1,799	1,822	1,811	23	1%	Y
Lead (Pb) (µg/L)	ND	ND	NC	NC	NC	
Manganese (Mn) (µg/L)	550	562	556	12	2%	Y
Zinc (Zn) (µg/L)	ND	ND	NC	NC	NC	

ND= non-detect, **NC**= not calculated. **J**= RPD exceeded DQO however data was considered to be usable.

APPENDIX B

Dry Weather Trip Blanks

Parameter	DW1 7/16/08	DW2 9/10/08	DW3 12/9/08	DW4 2/1/11
Total Organic Carbon (mg/Kg)	NA	NA	NA	NA
BOD_5 (mg/L)	<1	1.00	<1	1.0
TSS (mg/L)	0.0	1.00	<1	1
Chloride (mg/L)	<0.20	<0.02	<0.20	<0.20
Total Kjeldahl Nitrogen (mg/L)	ND	ND	ND	0.34
Ammonia as N (mg/L)	ND	ND	ND	ND
Lead (µg/L)	0.49	<0.07	<0.07	<0.08
Zinc (µg/L)	15.2	9.2	<6.46	<1.13
Manganese (µg/L)	0.96	0.8	0.16	0.38
Hardness as $CaCO_3$ (mg/L)	36.0	<1.0	<1	0.01
Copper (µg/L)	19.90	<0.30	<0.30	<0.13
Cadmium (µg/L)	0.13	<0.06	<0.06	0.08
Total Iron (µg/L)	<10	<10	56.3	0.99
Total Phosphorus (mg/L)	<0.02	<0.02	<0.05	<0.02
pH (NTU)	7.11	7.16	5.61	5.56
Nitrate as as N (NO_2+NO_3-N) mg/L	<0.05	<0.05	<0.05	<0.05
Arsenic (µg/L)	<0.15	<0.15	<0.15	<0.10
Proplyene Glycol (mg/L)	---	---	---	NS

Wet Weather Trip Blanks

Parameter	Wet Weather 1		Wet Weather 2		
	Run 1 12/10/08	Run 2 12/11/08	Run 1 02/03/11	Run 2 02/06/11	Run 3 02/08/11
Total Organic Carbon (mg/Kg)	NS	NS	NS	NS	NS
BOD_5 (mg/L)	NS	NS	NS	NS	<1
TSS (mg/L)	NS	NS	NS	NS	0
Chloride (mg/L)	NS	NS	NS	NS	<0.20
Total Kjeldahl Nitrogen (mg/L)	NS	NS	NS	NS	0.34
Ammonia as N (mg/L)	NS	NS	NS	NS	ND
Lead (µg/L)	NS	NS	NS	NS	<0.08
Zinc (µg/L)	NS	NS	NS	NS	<1.13
Manganese (µg/L)	NS	NS	NS	NS	0.38
Hardness as $CaCO_3$ (mg/L)	NS	NS	NS	NS	0.01
Copper (µg/L)	NS	NS	NS	NS	<0.13
Cadmium (µg/L)	NS	NS	NS	NS	0.08
Total Iron (µg/L)	NS	NS	NS	NS	0.99
Total Phosphorus (mg/L)	NS	NS	NS	NS	<0.02
pH (NTU)	NS	NS	NS	NS	5.56
Nitrate as as N (NO_2+NO_3-N) mg/L	NS	NS	NS	NS	<0.05
Arsenic (µg/L)	NS	NS	NS	NS	<0.10
Proplyene Glycol (mg/L)	NS	NS	NS	NS	ND