FY2019 UNRBA Transition Monitoring
November 2018 to March 2019
Supplemental Report

Prepared for

Upper Neuse River Basin Association, NC

Prepared by

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Section 1: Introduction and Background

Falls Lake Reservoir was created by the U.S. Army Corps of Engineers (USACE) when a dam was completed at the Falls of the Neuse River in 1981. The North Carolina Environmental Management Commission (EMC) passed the Falls Lake Nutrient Management Strategy ("the Rules"), requiring two stages of nutrient reductions within the Falls of the Neuse Reservoir watershed (N.C. Rules Review Commission 2010). The Rules establish a Nutrient Management Strategy to be implemented in two stages: Stage I is described in 15NCAC 02B .0275 (4) (a), and Stage II is described in 15NCAC 02B .0275 (4) (b). The Rules recognize there is uncertainty associated with the water quality modeling performed by DWR used to establish the Stage II requirements, and therefore, allow for re-examination of the Stage II nutrient loading reduction requirements after additional data collection, as specified in Section 5(f) of the Rules. The UNRBA Monitoring Program was specifically designed to reduce the uncertainty and to re-examine the scientific assessment and modeling predictions used by DWR to support these rules.

In 2011, the UNRBA began a re-examination process of the regulatory framework for Stage II of the Rules. Full implementation of the nutrient reduction strategy, which is more stringent than any other nutrient strategy implemented in the State, will require extremely costly actions on the part of UNRBA member governments and other regulated parties. In addition, the practical ability to achieve the mandated reductions is uncertain. In light of the financial impact of the Rules and the regional importance of Falls Lake, the UNRBA began examining the technical bases and regulatory framework of Stage II requirements. Local governments within the UNRBA agree that protecting Falls Lake as a water supply and public resource is paramount. The members want to ensure that the rules applied to the watershed sufficiently reflect the lake's beneficial uses. Control requirements should be reasonable, fiscally responsible, and efficaciously improve the water quality of the resource.

In 2014, the UNRBA initiated the Monitoring Plan that described the locations, parameters, frequencies, and other program elements (Cardno 2014b; http://www.unrba.org/monitoring-program). The Monitoring Plan is maintained and updated by the UNRBA monitoring service provider to reflect changes in the program over time. As established in Section 5 (f) of the Falls Lake Nutrient Management Strategy http://portal.ncdenr.org/web/fallslake/home, the UNRBA Monitoring Plan was initially approved by North Carolina Division of Water Resources (DWR) on July 16, 2014. The UNRBA Monitoring Quality Assurance Project Plan (QAPP) was developed specifically for the program to ensure that data are reliable and suitable for consideration for regulatory purposes. The QAPP describes the protocols and methodologies to be followed by field and laboratory staff to ensure data precision and accuracy. The QAPP was initially approved by the North Carolina Division of Water Resources (DWR) on July 30, 2014 and again on January 18, 2017. The final, comprehensive 2019 Annual Monitoring Report can be found online at https://www.unrba.org/monitoring-program.
The UNRBA Transition Monitoring Program began in November 2018 following completion of the full UNRBA Monitoring Program in October 2018. Therefore, this FY2019 Transition Monitoring Supplemental Report includes data collected between November 2018 and March 2019. This supplemental report compares data collected during the FY2019 Transition Monitoring to data collected over the entire monitoring period (August 2014 through March 2019) including Routine and Transitional Monitoring to determine if observations were within previous observed ranges. A subsequent report approved by the UNRBA for FY2020 will include 12 months of data (i.e., the FY2020 Transition Monitoring Report would include data from April 2019 to March 2020).

Section 2: UNRBA Transition Monitoring

The UNRBA Routine Monitoring effort ended in October 2018, completing the intensive water quality data acquisition for the re-examination effort. Beginning in November 2018, a much-reduced "Transition Monitoring" effort was initiated to continue obtaining data from a smaller set of stations. The purpose of the Transition Monitoring is to continue to track water quality conditions at locations on tributaries to Falls Lake that are not monitored by other organizations. The Transition Monitoring program has been authorized by the UNRBA through June 2020. Transition Monitoring continues the monthly sample collection at 12 stations (Table 2-1, Figure 2-1). The Transition Monitoring includes Lake Loading (LL) stations near the mouths of the tributaries to Falls Lake and Jurisdictional Boundary (JB) stations further upstream on the tributaries near municipal boundaries and county lines.

While this reduction in monitoring effort on the part of the UNRBA allows for more resources to be allocated toward modeling and analytical efforts, other entities continue to monitor both Falls Lake and its larger tributaries (e.g., USGS, DWR, City of Durham, CAAE). This means there will still be beneficial data available to the UNRBA into the future for assessment and management purposes. This Transition Monitoring report focuses on reviewing data collected by the UNRBA for the FY2019 Transition Monitoring period.

Table 2-1. UNRBA Transition Monitoring Stations

Name[a] (Station Type[b])	Stream Name	Parameters[c]
FLR-25(JB)	Flat River	TP, TKN, NH3, NO2+NO3,
DPC-23(JB)	Deep River	TP, TKN, NH3, NO2+NO3,
NLR-27(JB)	North Fork Little River	TP, TKN, NH3, NO2+NO3,
SLR-22(JB)	South Fork Little River	TP, TKN, NH3, NO2+NO3,
ENR-49(JB)	Eno River	TP, TKN, NH3, NO2+NO3,
ENR-23(JB)	Eno River	TP, TKN, NH3, NO2+NO3,
LGE-5.1(LL)	Ledge Creek	TP, TKN, NH3, NO2+NO3, TOC
ROB-2.8(LL)	Robertson Creek	TP, TKN, NH3, NO2+NO3, TOC
BDC-2.0(LL)	Beaverdam Creek	TP, TKN, NH3, NO2+NO3, TOC
NLC-2.3(LL)	New Light Creek	TP, TKN, NH3, NO2+NO3, TOC
LBC-2.1 (LL)	Lower Barton Creek	TP, TKN, NH3, NO2+NO3, TOC
HSE-1.7(LL)	Horse Creek	TP, TKN, NH3, NO2+NO3, TOC

[a] Name combines an abbreviation for the stream with the approximate distance from the station to Falls Lake (km).

[b] JB refers to a Jurisdictional Boundary station and LL refers to a Lake Loading station.

[c] TP refers to total phosphorus, TKN to total Kjeldahl nitrogen, NH3 to total ammonia, NO2+NO3 to nitrite plus nitrate, TOC refers to total organic carbon.

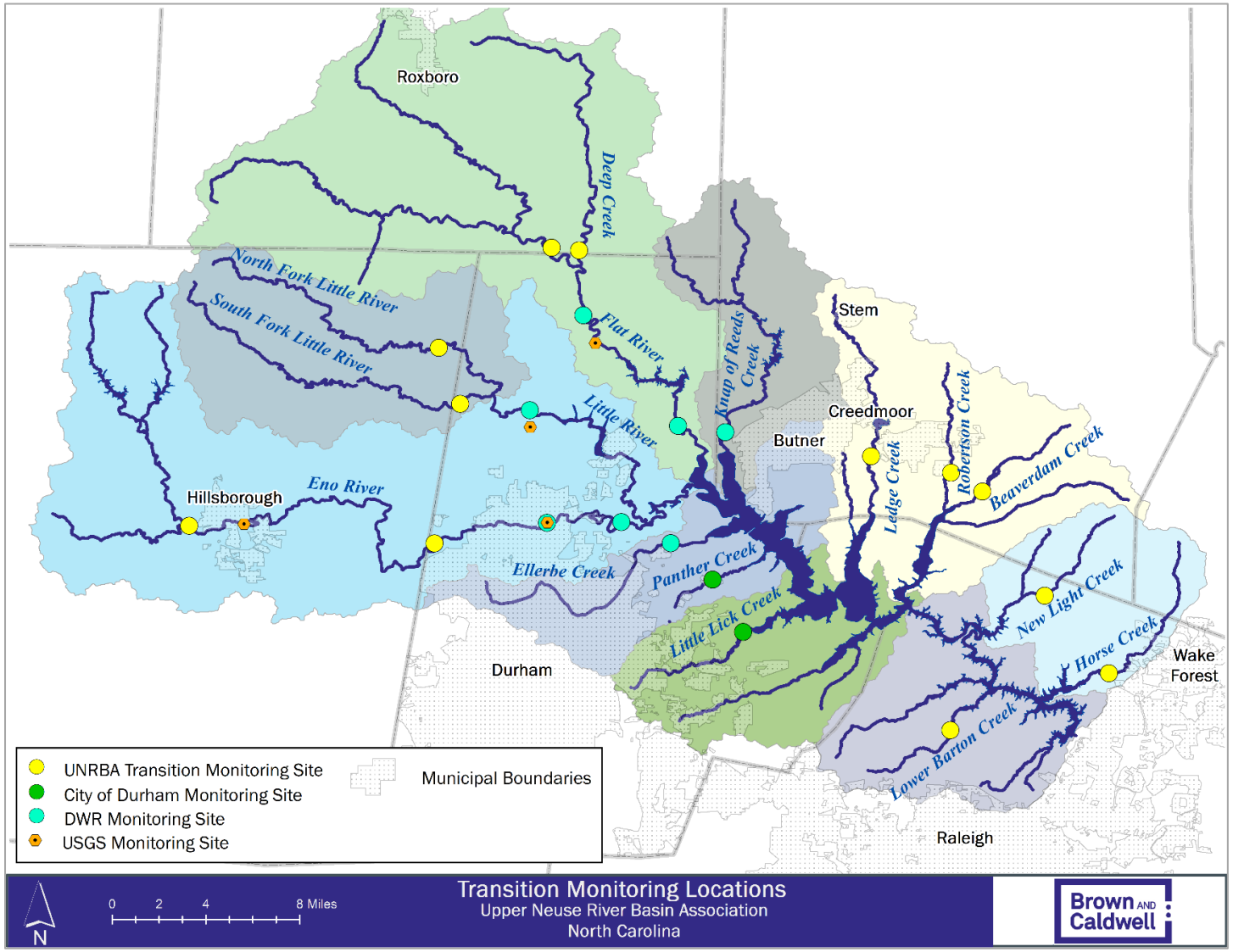

Figure 2-1. Transition Monitoring Stations in the Falls Lake Watershed

Section 3: Results

Table 3-1 and Table 3-2 summarize the data collected under the Transition Monitoring Program for FY2019 (November 2018 to March 2019). The observations collected during the FY2019 Transition Monitoring are similar in distribution to the previous monitoring conducted by the UNRBA as summarized in the UNRBA 2019 Annual Monitoring Report. Transition Monitoring results (November 2018 through March 2019) were compared to data collected over the entire monitoring period (August 2014 through March 2019) including Routine and Transitional Monitoring to determine if observations were within previous observed ranges. Figure 3-1 and Figure 3-2 show the monitoring results using an arithmetic scale and logarithmic scale, respectively for comparison to the figures in the UNRBA 2019 Annual Monitoring Report. Total organic carbon is only collected at LL stations under the Transition Monitoring Program, so JB sites on these figures do not have results for November 2018 to March 2019. Results from samples collected under the Transition Monitoring have a similar distribution to those collected over the entire monitoring period.

Table 3-1. Nutrient Data Summary

Name (Station Type)	Statistic	Total Kjeldahl Nitrogen (mg/L)	Total Nitrate+nitrite (mg/L)	Total Ammonia (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)
FLR-25 (JB)	n	5	5	5	5	5
	Min	0.26	0.40	0.02	0.80	0.01
	Avg	0.50	0.50	0.07	1.00	0.06
	Max	0.79	0.59	0.22	1.19	0.14
DPC-23 (JB)	n	5	5	5	5	5
	Min	0.27	0.35	0.02	0.62	0.01
	Avg	0.44	0.43	0.07	0.87	0.06
	Max	0.69	0.50	0.18	1.08	0.12
NLR-27 (JB)	n	5	5	5	5	5
	Min	0.36	0.28	0.02	0.73	0.04
	Avg	0.53	0.32	0.06	0.85	0.08
	Max	0.69	0.37	0.17	0.97	0.22
SLR-22 (JB)	n	5	5	5	5	5
	Min	0.29	0.63	0.03	0.98	0.03
	Avg	0.46	0.72	0.14	1.18	0.06
	Max	0.73	0.79	0.33	1.36	0.16
ENR-49 (JB)	n	5	5	5	5	5
	Min	0.42	0.31	0.05	0.82	0.02
	Avg	0.54	0.38	0.10	0.92	0.06
	Max	0.82	0.45	0.21	1.13	0.18
ENR-23 (JB)	n	5	5	5	5	5
	Min	0.31	0.37	0.01	0.69	0.01
	Avg	0.44	0.41	0.06	0.85	0.06
	Max	0.76	0.46	0.15	1.13	0.21
LGE-5.1 (LL)	n	5	5	5	5	5
	Min	0.66	0.07	0.02	0.73	0.05
	Avg	0.78	0.10	0.12	0.88	0.07
	Max	1.00	0.13	0.31	1.13	0.14

Table 3-1. Nutrient Data Summary						
Name (Station Type)	Statistic	Total Kjeldahl Nitrogen (mg/L)	Total Nitrate+nitrite (mg/L)	Total Ammonia (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)
ROB-2.8 (LL)	n	5	5	5	5	5
	Min	0.64	0.04	0.04	0.68	0.02
	Avg	0.77	0.05	0.11	0.82	0.06
	Max	0.92	0.10	0.25	0.95	0.09
BDC-2.0 (LL)	n	5	5	5	5	5
	Min	0.49	0.03	0.02	0.53	0.03
	Avg	0.62	0.05	0.09	0.67	0.08
	Max	0.78	0.11	0.20	0.89	0.13
NLC-2.3 (LL)	n	5	5	5	5	5
	Min	0.21	0.23	0.03	0.52	0.01
	Avg	0.35	0.36	0.10	0.71	0.04
	Max	0.56	0.43	0.26	0.99	0.14
LBC-2.1 (LL)	n	5	5	5	5	5
	Min	0.21	0.71	0.05	0.97	0.01
	Avg	0.34	0.83	0.10	1.17	0.03
	Max	0.62	0.99	0.21	1.37	0.11
HSE-1.7 (LL)	n	5	5	5	5	5
	Min	0.23	0.24	0.03	0.50	0.01
	Avg	0.34	0.36	0.08	0.70	0.03
	Max	0.59	0.50	0.17	1.09	0.13

Table 3-2. Total Organic Carbon Data Summary		
Name (Station Type)	Statistic	Total Organic Carbon (mg/L)[a]
LGE-5.1 (LL)	n	5
	Min	7.79
	Avg	9.02
	Max	10.85
ROB-2.8 (LL)	n	5
	Min	8.70
	Avg	10.05
	Max	12.08
BDC-2.0 (LL)	n	5
	Min	8.53
	Avg	9.95
	Max	12.50
NLC-2.3 (LL)	n	5
	Min	1.84
	Avg	3.05
	Max	6.06
LBC-2.1 (LL)	n	5
	Min	2.04
	Avg	3.18
	Max	6.07
HSE-1.7 (LL)	n	5
	Min	2.01
	Avg	3.21
	Max	5.94

[a] *Total organic carbon is not collected at JB stations.*

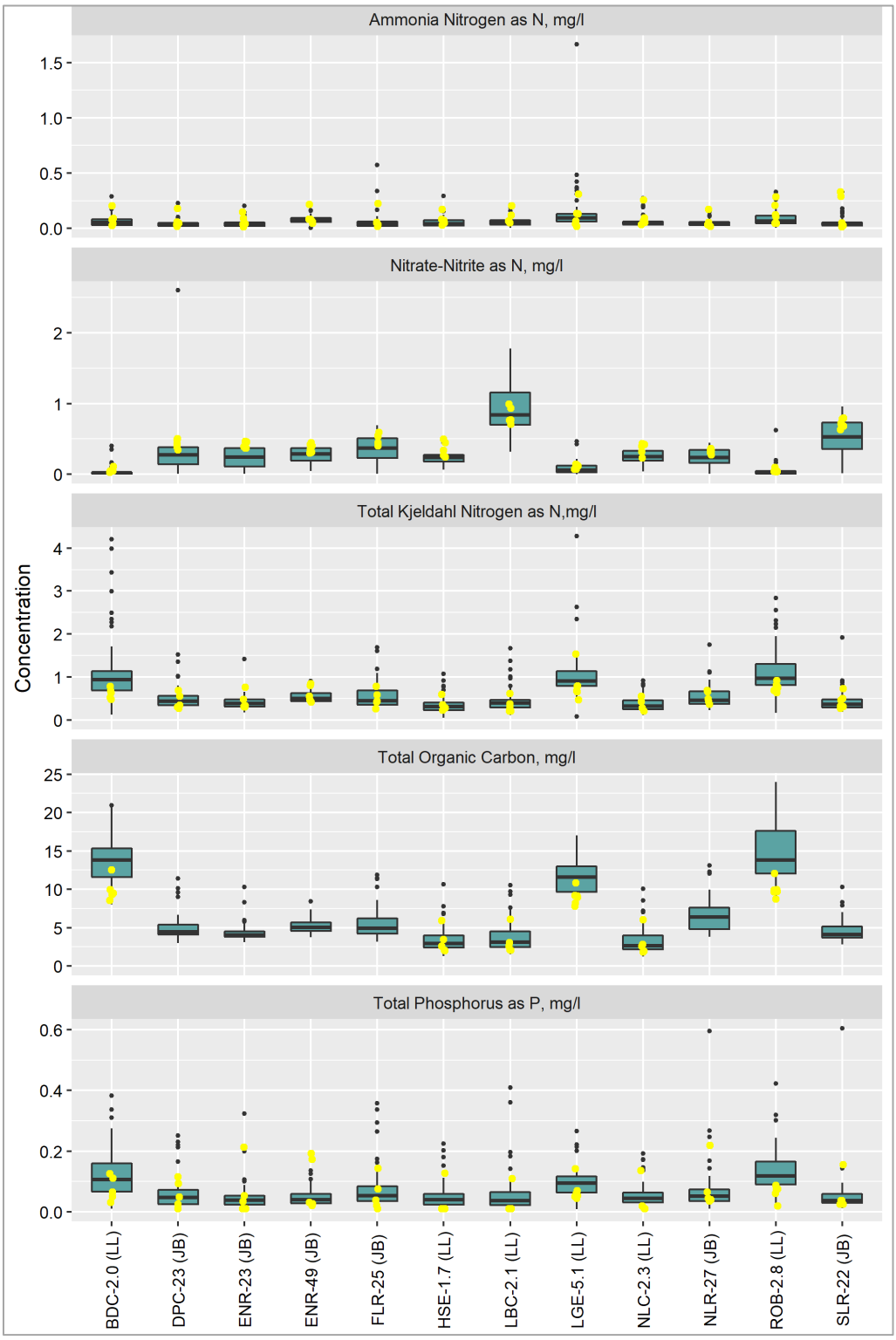

Figure 3-1. Comparison of Transition Monitoring Data Using Arithmetic Scale

Results from the entire monitoring period (August 2014 – March 2019) displayed using boxplots and results from the transition monitoring (November 2018 – March 2019) displayed using yellow points. Total Organic Carbon is not sampled at JB sites.

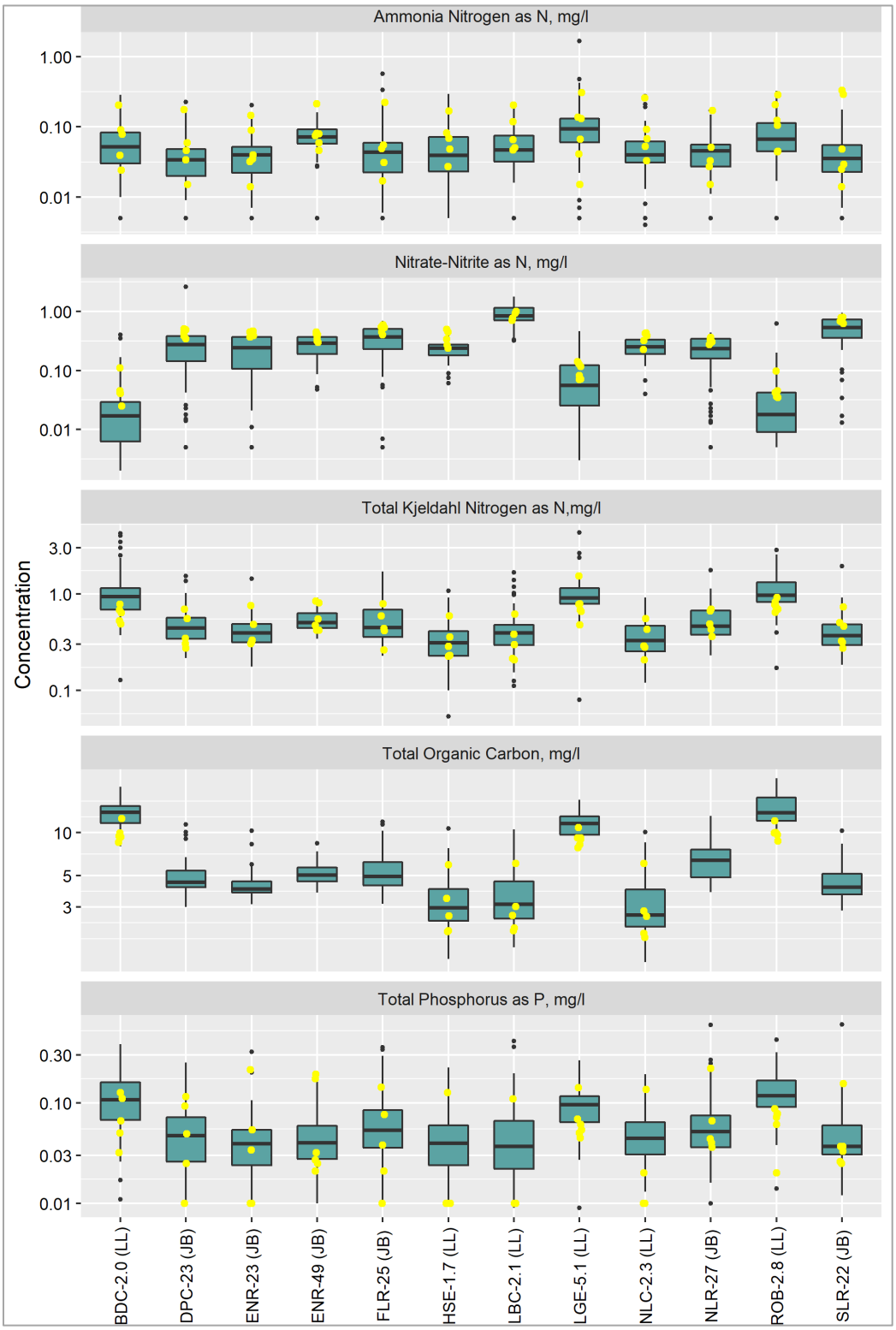

Figure 3-2. Comparison of Transition Monitoring Data Using Logarithmic Scale

Results from the entire monitoring period (August 2014 – March 2019) displayed using boxplots and results from the transition monitoring (November 2018 – March 2019) displayed using yellow points. Total Organic Carbon is not sampled at JB sites.

Section 4: Quality Assurance

All analytical data collected through the UNRBA Transition Monitoring Program are evaluated for compliance with the quality objectives outlined in the UNRBA QAPP. Data accuracy, precision, and completeness reviews are performed following each monitoring event.

4.1 Representativeness and Completeness

Data accuracy, precision, and completeness reviews are performed on a regular basis. Reviews of field and laboratory practices are performed on a routine basis. Since the beginning of the UNRBA Monitoring Program, more than 98 percent of all planned sampling events in which the sampling location had flowing water were completed as planned. The following summarize the representativeness and completeness of the most recent period associated with the Transition Monitoring Program (November 2018 through March 2019).

- There have been no cases of samples where results for Laboratory Control Sample (samples of known concentration analyzed along with field samples) associated with UNRBA data were out of compliance with method criteria.
- 100% percent of all planned sampling events were completed as planned.
- No sets of samples needed to be analyzed outside of specified holding times because of equipment malfunctioning.

4.2 Accuracy, Precision, and Measurement Uncertainty

All environmental measurements are subject to uncertainty owing to a variety of sources which may include sampling (natural heterogeneity in the ecosystem, environmental conditions), preservation and storage conditions, analytical factors (sample processing, equipment errors, purity of reagents and labware, operator error), and computational factors (selection of calibration model, result truncation, and round off). When properly quantified and documented, measurement uncertainty does not imply that data are unreliable or invalid. In fact, clearly documenting the range of values that could reasonably represent each environmental measurement can improve user confidence in data and allow end users to properly evaluate how well the dataset fulfills their intended purpose.

The UNRBA quality assurance project plan specifies accuracy and precision targets based upon specific project goals as well as limits of analytical capabilities. Because these objectives were specified *a priori*, continued evaluation has been necessary to assess the degree to which these targets have been met and to which they have been achievable with samples collected outside of controlled laboratory conditions. The monitoring program was therefore designed to collect the necessary quality assurance samples to calculate and document the true accuracy and precision of the analytical methods under variable field conditions, and these data have been continued to be collected as part of the Transition Monitoring Program. Tables 4-1 and 4-2 present information on the blanks and duplicates collected in the first five months of the Transition Monitoring Program.

None of the field blanks for total nitrate plus nitrite, total Kjeldahl nitrogen, or total phosphorus were above their respective reporting limits. Two out of five of the ammonia blanks were above the ammonia reporting limit of 0.01 mg/L, and the maximum value of the ammonia blanks was 0.02 mg/L. These blank values are in line with those obtained throughout the monitoring program which have been discussed in detail in the final UNRBA Monitoring report. For the Transition Monitoring period, the average ammonia concentration in stream samples was 0.33 mg/L, so even the maximum ammonia blank concentration of 0.02 mg/L was less than seven percent of the average concentration.

Results for field precision of duplicate samples are also in line with those achieved during the UNRBA Monitoring Program. All duplicate pairs for total organic carbon, total phosphorus, and total nitrate plus nitrite were below the target relative percent difference of 30%. Three duplicate pairs for ammonia had relative percent differences (RPD) greater than 30%, however these elevated percent differences were the result of samples with low concentrations of analyte. The average ammonia concentration for samples selected for duplicate analysis was 0.10 mg/L while the overall average of ammonia samples was 0.33 mg/L. One duplicate pair for total Kjeldahl nitrogen had an RPD greater than 30%. Over the entire monitoring program, about 5% of TKN duplicate pairs exceeded the RPD target. With only five duplicate pairs collected so far as part of the Transition Monitoring Program, one elevated pair for TKN is not out of line with previous samples.

Table 4-1. Field Blank Concentrations Greater than the Reporting Limit

Parameter	N[a] (Blanks)	N > RL	Maximum Blank Concentration	Nominal Reporting Limit
Total Organic Carbon, mg/L	0	-	-	1.0
Total Phosphorus as P, mg/L	5	0	0.02	0.02
Total Nitrate-Nitrite as N, mg/L	5	0	0.01	0.01
Total Kjeldahl Nitrogen as N, mg/L	5	0	0.2	0.2
Total Ammonia Nitrogen as N, mg/L	5	2	0.02	0.01

[a] *Total organic carbon is only collected at 6 LL stations, and no TOC blanks were collected. Throughout the entire UNRBA Monitoring Program (2014 – 2018), none of the blanks had TOC concentrations above the reporting limit.*

Table 4-2. Field Duplicate Precision Targets and Number of Duplicate Pairs with RPD Greater than the Target from November 2018 to March 2019

Parameter	RPD Target %	No. of Pairs Collected	N > Target
Total Organic Carbon, mg/L	30	2	0
Total Phosphorus as P, mg/L	30	5	0
Total Nitrate-Nitrite as N, mg/L	30	5	0
Total Kjeldahl Nitrogen as N, mg/L	30	5	1
Total Ammonia Nitrogen as N, mg/L	30	5	3

Section 5: Summary

The UNRBA initiated the Transition Monitoring Program in November 2018 to continue monitoring water quality of selected tributaries to Falls Lake. The purpose of the Transition Monitoring is to continue to track water quality conditions at locations on tributaries to Falls Lake that are not monitored by other organizations. Based on the first five months of Transition Monitoring, conditions in the watershed are similar to previous observations by the UNRBA.

Continuation of the program during the 2020 fiscal year was approved by the UNRBA. The program will be evaluated each year to determine if continuation is appropriate.