ANALYSIS OF EXISTING DATA AND SHORT-TERM MONITORING PLAN FOR LICK CREEK

D. Line and D. Penrose
NCSU Water Quality Group
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This report summarizes the NCSU Water Quality Group's (NCSU WQG) analysis of existing data and recommendations for short-term monitoring in the Lick Creek (LC) watershed as part of the watershed restoration plan.

ANALYSIS OF EXISTING DATA

A. Biological Data

Watersheds in the Triassic Basin region of North Carolina have very easily erodible parent geologies and the soils tend to be very fine clays with very low permeability. In general, relief and topography within this bowl-like ecoregion is also limited. Therefore, once the landscape is disturbed, these factors are largely responsible for very sandy stream features that have minimal summer base flows. It's also likely that these catchment-wide conditions are a contributor to fair to poor biological health of streams in this ecoregion. Productive instream habitat for benthic insects is often limited to short reaches of sandy riffles and large woody debris or snag habitats. The primary sources of perturbation within the Lick Creek subbasin are the effects of sedimentation and habitat loss, including the effects of very fine clay-like material to the aquatic fauna.

The aquatic insect fauna of Triassic Basin catchments are poorly understood. Biological data from Lick Creek are limited to collections conducted by biologists with Durham Stormwater Services. Surveys conducted at LC1.0LC in 2004 and 2005 resulted in Fair (borderline Poor) bioclassifications (Table 1). Taxa richness for the EPT groups was 7 in 2004 and 6 in 2005. However, these data were collected in the summer during worst-case conditions (low flow/high water temperature). The NC DWQ has noted that bioclassifications for streams within this ecoregion should be used with caution.

Table 1. Biological Monitoring Data from the Lick Creek at LC1.

Year	Total Taxa	Total EPT	EPT Diversity	Biotic Index	Biotic Rating	Bioclass Score	Water Quality Rating
2004	46	7	Fair	7.09	Fair	1.7	Fair
2005	27	6	Poor	7.43	Fair	1.7	Fair

B. Physical and Chemical Data

Monitoring data collected by Durham Stormwater Services are shown in Tables 2 and 3. These data are from in-situ measurements of dissolved oxygen (DO), conductivity (Cond), and pH and the analysis of grab samples collected on the indicated day. Table 2 contains data from grab samples collected from Lick Creek near where it crosses under Southview Road and Table 3 has data from Rocky Branch near where it crosses under Kemp Road.

For the Lick Creek site (Table 1), the median values for each parameter indicate relatively good water quality; however, some of the individual samples point to possible concerns. The levels of DO were low (<4 mg/L) in 4 samples collected during mostly summer months. These low values were likely due to a combination of high water temperature (>23 C) and very low flow causing stagnant water given that the BOD was relatively low also. Conductivity, pH, and BOD values generally were not unusual. The two highest turbidity and TSS levels were recorded for the 10/14/04 and 6/15/06 samples. Both of these samples were collected within 3 days of at least 1.2 inches of rainfall, which indicates that stormwater effects could be significant. Collection of stormwater samples will help confirm this assertion. For nutrients, median concentrations of nitrogen forms were ample for stimulation of excessive algal growth (TKN > 0.3 mg/L and NH_3-N > 0.02 mg/L). The median TP concentration was slightly greater than the concentration (0.05 mg/L) considered by many to be adequate for algal and periphyton growth: however, the dissolved P (diss. P) levels were mostly less than 0.05 mg/L, which was the method detection limit (MDL). The median fecal coliform (FC) level was the same as the NC standard for class C waters of 200 mpn/100 ml; however, several of the levels were much higher than the standard, particularly the 10/14/04 sample. Samples were also analyzed for total and dissolved copper (Cu) and dissolved zinc (Zn); however, only total Cu was found at a level greater than the MDL and that for only 4 of 15 samples. Thus, these metals do not appear to be a concern.

Table 2. Monitoring Data for Lick Creek at LC1.

Date	DO	Cond	pH	Turb	TSS	BOD	TKN	NOx	NH3	org-N	TP	dP	FC
	mg/L			ntu	……..……				mg/L……..			……..….	mpn/100 ml
1/22/04	13.6	120	8.0	na	6	2	0.5	0.10	0.05	0.50	0.05	0.05	25
2/17/04	13.9	100	7.9	24	11		0.5	0.10	0.05	0.50	0.06	0.05	50
3/18/04	12.2	90	7.8	40	32	2	0.5	0.10	0.05	0.50	0.09	0.05	200
4/29/04	8.8	160		17	17	2	0.5	0.10	0.07	0.43	0.05	0.05	115
5/27/04	6.4	160	7.6	25	26	2	0.5	0.10	0.12	0.38	0.08	0.05	310
6/17/04	2.7	170	7.8	20	9	2	0.7	0.10	0.09	0.61	0.08	0.05	150
7/15/04	4.3	140	7.2	112	80	2	0.7	0.10	0.17	0.53	0.18	0.06	327
8/19/04	7.1	110	7.5	51	25	2	0.5	0.10	0.05	0.50	0.11	0.05	246
9/16/04	7.3	160	7.7	21	9	2	0.6	0.10	0.05	0.60	0.09	0.07	540
10/14/04	8.1	70	7.4	153	110	3	0.6	0.10	0.05	0.55	0.21	0.07	17000
11/11/04	8.5	180	7.6	9	2	2	0.5	0.10	0.05	0.50	0.05	0.05	49
12/9/04	10.6	150	7.5	16	7	2	0.5	0.10	0.05	0.50	0.05	0.05	82
1/12/05	9.5	180	7.6	17	7	2	0.5	0.10	0.05	0.50	0.09	0.05	200
2/24/05	9.7	180	7.4	13	7	2	0.5	0.10	0.05	0.50	0.05	0.05	98
3/10/05	11.6	90	7.4	58	32	2	0.5	0.10	0.05	0.50	0.05	0.05	108
4/14/05	10.4	140	7.5	26	na	na	na	na	na	na	na	na	Na
5/19/05	6.5	180	7.2	14	5	2	0.5	0.10	0.12	0.38	0.05	0.05	117

6/16/05	3.1	190	7.4	24	16	2	0.5	0.10	0.11	0.39	0.07	0.06	152
7/14/05	4.1	180	7.2	52	28		0.5	0.10	0.15	0.35	0.07	0.06	160
8/18/05	6.5	130	7.3	126	48	2	0.5	0.10	0.05	0.50	0.06	0.05	727
9/15/05	1.7	220	7.5	54	51		4.5	0.10	3.20	1.30	0.89	0.89	60000
10/13/05	4.6	160	7.3	81	22	2	0.5	0.10	0.05	0.50	0.06	0.05	377
11/10/05	na	na	na	na	na	na	na	na	na	na	na	na	na
12/8/05	12.0	100	7.8	177	77	2	0.5	0.20	0.05	0.50	0.24	0.05	460
1/12/06	11.1	120	7.8	108	312	2	0.5	0.10	0.05	0.50	0.06	0.05	2300
2/9/06	11.3	125	7.6	53	18	2	0.5	0.10	0.05	0.50	0.08	0.06	115
3/16/06	8.4	200	7.5	14	7	2	0.5	0.10	0.05	0.50	0.07	0.05	83
4/6/06	9.5	151	7.5	33	10	2	0.5	0.10	0.05	0.50	0.10	na	60
5/18/06	5.2	180	7.3	21	11	2	0.5	0.10	0.05	0.45	0.07	na	66
6/15/06	8.0	63	7.3	226	167	2	0.5	0.10	0.05	0.45	0.08	na	2400
7/20/06	6.2	155	7.4	36	21	2	0.5	0.20	0.10	0.40	0.06	na	440
8/10/06	5.9	120	7.5	145	47	2	0.5	0.10	0.07	0.43	0.05	na	2000
9/14/06	7.0	123	7.6	51	27	2	0.5	0.10	0.05	0.50	0.05	na	1040
10/12/06	4.8	163	7.5	16	2	2	0.5	0.10	0.05	0.50	0.05	na	344
11/9/06	9.1	80	7.7	96	na	na	na	na	na	na	na	na	na
12/8/06	12.1	110	7.4	34	12	2	0.5	0.10	0.05	0.50	0.09	na	100
Mean	8.0	141	7.5	58	38	2	0.6	0.11	0.16	0.51	0.11	0.09	2741
Median	8.1	150	7.5	35	18	2	0.5	0.10	0.05	0.50	0.07	0.05	200
Max	13.9	220	8.0	226	312	3	4.5	0.20	3.20	1.30	0.89	0.89	60000

Median levels of water quality parameters for the Rocky Branch monitoring site (Table 3) were similar to those of the Lick Creek site, except for perhaps DO. The levels of DO were significantly (according to paired t test) lower than the Lick Creek samples and were particularly low for some samples collected during the summer of each year. These low DO readings were based on only instantaneous samples, but low DO, even over relatively short periods, can be expected to have some impact on the composition of the benthic macroinvertebrate communities. Low DO concentrations are not unusual in piedmont creeks (particularly throughout the Triassic Basin) during warm weather, however, and existing data are not adequate to characterize either how typical these conditions are throughout the Lick Creek drainage or what impacts they may have had on its benthic macroinvertebrate communities, especially without discharge data. The DO and BOD levels along with the nitrogen and phosphorus levels may indicate nutrient enrichment of the stream; however, very low discharge may also have contributed. The median FC level was about the same as the state standard with several exceedances. Samples also analyzed for Cu and Zn. One sample had an elevated level of total Cu, which may be a concern. Continued monitoring of at least these two metals seems to be warranted at this location.

Table 3. Monitoring data from Rocky Branch Creek at Kemp Road.

Date	DO	Cond	pH	Turbidity	TSS	BOD	TKN	NO_2 + NO_3	NH_3	org-N	TP	dP	FC
	mg/L			ntu	……mg/L……..								mpn/100 ml
1/22/04	9.2	110	7.9	na	18	2.0	0.50	0.10	0.05	0.50	0.05	0.05	10
2/17/04	12.9	70	7.9	16	3	na	0.50	0.10	0.05	0.50	0.05	0.05	28
3/18/04	7.8	80	7.7	30	15	2.0	0.50	0.10	0.05	0.50	0.05	0.05	108
4/29/04	2.1	150	0.0	36	21	3.0	0.60	0.10	0.05	0.55	0.08	0.05	13
5/27/04	1.0	150	7.5	153	52	2.0	0.50	0.10	0.34	0.16	0.18	0.05	44

6/17/04	0.0	120	7.2	405	30	5.0	0.50	0.10	0.24	0.26	0.44	0.05	44
7/15/04	2.0	310	6.7	357	3108	7.0	3.30	0.10	2.65	0.65	1.18	0.08	900
8/19/04	5.7	220	7.3	23	na	na	na	na	na	na	na	na	138
9/16/04	3.8	210	7.5	63	na	na	na	na	na	na	na	na	230
10/14/04	7.6	100	7.4	82	na	na	na	na	na	na	na	na	2400
11/11/04	3.7	240	7.1	18	na	na	na	na	na	na	na	na	344
12/9/04	9.0	160	7.4	10	na	na	na	na	na	na	na	na	16
1/12/05	8.9	190	7.5	14	na	na	na	na	na	na	na	na	26
2/24/05	10.3	150	7.2	929	500	3.0	0.60	0.50	0.09	0.51	0.05	0.05	1727
3/10/05	11.5	100	7.3	19	4	2.0	0.50	0.10	0.06	0.44	0.05	0.05	99
4/14/05	6.9	160	7.2	32	na	na	na	na	na	na	na	na	na
5/19/05	3.0	180	7.3	25	16	3.0	0.50	0.10	0.14	0.36	0.05	0.05	72
6/16/05	2.8	180	7.1	43	28	4.0	0.60	0.10	0.46	0.14	0.11	0.07	36
7/14/05	3.4	170	7.0	32	17	6.0	0.50	0.10	0.10	0.40	0.11	0.08	200
8/18/05	2.8	210	7.0	198	81	3.0	0.50	0.10	0.12	0.38	0.06	0.05	12000
9/15/05	1.1	240	7.2	78	327	8.0	1.50	0.10	0.44	1.06	0.33	0.32	82
10/13/05	4.3	140	7.2	319	91	4.0	0.50	0.20	0.49	0.01	0.11	0.09	1080
11/10/05	na	na	na	na	na	na	na	na	na	na	na	na	na
12/8/05	10.2	170	7.6	12	2	2.0	0.50	0.10	0.07	0.43	0.09	0.06	197
1/12/06	9.0	150	7.6	28	50	2.0	0.50	0.10	0.14	0.36	0.05	0.05	410
2/9/06	11.0	154	7.4	9	2	2.0	0.50	0.10	0.05	0.50	0.06	0.05	49
4/6/06	7.0	139	7.4	24	15	2.0	0.50	0.10	0.05	0.50	0.07	0.00	3100
3/16/06	8.8	200	7.2	40	39	2.0	0.50	0.10	0.05	0.50	0.05	0.05	440
5/18/06	0.7	220	7.0	16	4	2.0	1.00	0.10	0.94	0.06	0.06	na	98
6/15/06	8.1	77	7.1	94	23	3.0	0.50	0.10	0.10	0.40	0.07	na	5300
7/20/06	1.0	186	7.1	52	33	7.0	0.70	0.20	0.10	0.60	0.07	na	820
8/10/06	2.6	180	7.5	125	89		1.70	0.10	0.05	1.70	0.06	na	2400
9/14/06	4.7	139	7.6	26	11	2.0	0.60	0.10	0.19	0.41	0.08	na	5900
10/12/06	2.2	202	7.3	21	10	2.0	0.50	0.10	0.08	0.42	0.10	na	66
11/9/06	8.3	120	7.5	51	42	2.0	0.50	0.10	0.05	0.50	0.09	na	1000
12/8/06	9.7	190	7.2	42	24	11.0	3.50	0.10	0.05	3.50	0.05	na	56000
Mean	5.8	165	7.1	101	166	3.6	0.83	0.12	0.26	0.58	0.14	0.07	2805
Median	5.7	160	7.3	34	24	2.5	0.50	0.10	0.10	0.47	0.07	0.05	199
Max	12.9	310	7.9	929	3108	11.0	3.50	0.50	2.65	3.50	1.18	0.32	56000

SHORT TERM MONITORING PLAN

The data collected by Durham Stormwater Services from two sites in the Lick Creek watershed indicate the need for continued and expanded monitoring. The available data were collected during 2004 – 2006 with the frequency of sampling being about once per month. A primary deficiency in the data is that no stream discharge measurements were made. In addition, it appears that pollutant levels may be considerably greater during storm events, thereby making storm event monitoring necessary to document these levels. Further, in order to identify possible sources of pollutants, monitoring throughout the watershed contributing to theses sites is needed. The monitoring described herein will be conducted by NCSU WQG staff during the period January, 2007 through September, 2008.

Storm monitoring and additional baseflow data (nutrients and bacteria) are needed for sampling stations located on the main stem of Lick Creek and on its major tributaries. These

sites will serve as synoptic locations to document current water quality conditions in the Lick Creek and its major subwatersheds. These data will be crucial for comparison of the subwatersheds, the development of a viable long-term monitoring plan, and for subsequent implementation of BMPs and/or restoration efforts in Lick Creek. Additionally, these data may be useful in the development of a TMDL for Lick Creek.

Stream discharge data are needed at several locations during typical flow regimes and, if possible, during storm events to document the potential pollutant loading from the Lick Creek watershed. These data most likely will not be sufficient to isolate individual causes of biological impairment or specific pollution sources, but should provide information to focus these efforts on subwatershed areas.

In order to address the monitoring needs the following monitoring activities are planned for the Lick Creek watershed as outlined in table 4. These are in addition to the ongoing monitoring of Durham Stormwater services at two locations in Lick Creek.

Table 4. Monitoring Elements for the Lick Creek Watershed.

Site #	Location	Measurements	Frequency/ number
1	Lick Creek near Southview Road	Field & laboratory grab sample[1]	monthly
		Laboratory storm sample[1] + discharge	2 storms
		Benthic macroinvertebrates	2x/yr
		Discharge	monthly
2	Martin Branch near SR1902	Field & laboratory grab sample[1]	monthly
		Laboratory storm sample[1] + discharge	2 storms
3	Rocky Branch at Kemp Road	Discharge	monthly
4	Unnamed tributary at SR1905	Field & laboratory grab sample[1]	monthly
		Laboratory storm sample[1] + discharge	2 storms
		Discharge	monthly
5	Unnamed tributary near confluence with Lick Creek	Field & laboratory grab sample[1]	monthly
		Laboratory storm sample[1] + discharge	2 storms
		Discharge	monthly
		Benthic macroinvertebrates	2x/yr
6	Lick Creek upstream of confluence with tributary of #5	Field & laboratory grab sample[1]	monthly
		Laboratory storm sample[1] + discharge	2 storms
		Discharge	monthly
		Benthic macroinvertebrates	2x/yr

[1] Field & laboratory: field=DO, conductivity, and temperature; lab= turbidity, TKN, NH_3-N, NO_{3+2}-N, TP, TSS, FC (e coli). Storm samples will likely not be analyzed for FC. For analysis methods refer to QAPP.