North Carolina Division of Water Quality
Water Quality Section
Environmental Sciences Branch

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M E M O R A N D U M

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Through: Jimmie Overton
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From: Kurt Trumbower

Subject: 2004 Stressor Surveys – Neuse River Basin
Perry Creek – subbasin 030402
Core Creek – subbasin 030408
South Flat River – subbasin 030401
Knap of Reeds Creek – subbasin 030401

Four watershed surveys with field measurements and water quality sampling were performed during May of 2004 on selected waters in the Neuse River Basin identified as biologically impaired based on benthic macroinvertebrates. A report of the results is attached for your review and use. Maps of all survey areas are attached at the end of this report in Appendix 1. Physical data is attached in Appendix 2 and chemical data is attached in Appendix 3. Microtoxicity sampling results performed at the historic biologically impaired station in each watershed will be discussed in a later memorandum from Sandy Mort of the Aquatic Toxicology Unit.

Please feel free to contact Kurt at 919-733-6510 if you have any questions or desire additional information.

cc: Darlene Kucken
Ken Schuster, RRO
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Perry Creek

Visual Observations

The Perry Creek watershed was surveyed on May 5, 2004. A map of the watershed is attached in Appendix 1 and photographs of each of the sampling stations are attached at the end of this report. Visual observations of the watershed revealed large suburban and urban areas associated with the City of Raleigh. A golf course and residential areas are present in the upstream portion of the watershed. The area surrounding Greshams Lake is surrounded by heavy commercial development including several businesses, a landfill, and a cement operation. Algae and greenish/turbid water, along with a small sheen of oil on the surface was observed at the drain from the lake. Evidence of sedimentation was seen at several stations with sandy creek bottoms, sandbars, and other indicators of sedimentation. This was especially prevalent at the most downstream stations including the historical biologically impaired station, Perry Creek at Perry Creek Road. Road construction with land clearing was in progress near this station with sedimentation fences in place. Stream bank erosion was also observed at several stations. At the two most upstream stations, Perry Creek at Rainwater Road (station PC1) and Perry Creek at Litchford Road (station PC2), the creek bottom was rocky in nature. Periphyton was observed on the rocks at these stations. Periphyton was also observed on the rocks at Perry Creek at the power line off Jacqueline Lane (PC3).

At the unnamed tributary to Perry Creek at Fox Road, debris from previously higher flows was observed trapped at the bridge culvert, although this tributary is fairly small. At the unnamed tributary to Perry Creek at Berkshire Downs Drive, grassed yards were located right next to the creek with no riparian area. Stream bank erosion was noticed at this station. Turbid water was observed at the unnamed tributary to Perry Creek downstream of I-540. A shopping mall and storm water pond is located upstream of this tributary. Water clarity was fairly good at most other stations. Sewer lines, manholes, and storm water drains were observed near several stations although no indications of leaking sewer lines were found.

Physical and Chemical Characteristics

Physical measurements were collected at each of the sampling stations and are included in Appendix 2. These measurements indicated violations of the Division of Water Quality standard for pH of a range between 6.0 and 9.0 s.u.. The violations were found at station PC4 (5.8 s.u.), station PC5 (5.7 s.u.), and station PC6 (5.7 s.u.). Conductivity values were highest at Perry Creek at the Power Line off Jacqueline Lane (station PC3). The high conductivity value found at this station (169 umhos/cm) was traced upstream to the drain from Greshams Lake where a conductivity value of 162 umhos/cm was found. At stations upstream of Greshams Lake, conductivity values were lower. As mentioned previously, the area surrounding Greshams Lake is heavily industrialized.

Chemical samples were collected at several stations in the watershed and results are included in Appendix 3. Nutrients samples were taken at four stations (PC1, PC2, drain from Greshams Lake, and PC3) in the Perry Creek watershed due to the presence of either periphyton or algae and also at the historical biologically impaired station Perry Creek at Perry Creek Road (station PC7). High nutrient values were generally found at every station indicating nutrient enrichment in the watershed. The highest ammonia and total kjeldahl nitrogen values were found at the drain from Greshams Lake, where algae was observed. Higher nitrite + nitrate values were found at Perry Creek at Litchford Road (station PC2) and Perry Creek at Perry Creek Road (station PC7) than at the other stations.

Water column metals samples taken at three stations (PC2, PC3, and PC7) indicated elevated values for aluminum, iron, and manganese but this is not unusual due to the presence of these metals in local soil types. Additionally, the iron levels at stations PC3 and PC7 were above the action level water quality standard but this standard is only applicable to dischargers and there are no dischargers present near these stations. A sediment metals sample taken at Perry Creek at Perry Creek Road (station PC7) indicated similar results with naturally high aluminum, iron,

and manganese values. The sediment metals values found at station PC7 were typical of those found in historical sediment metals samples collected throughout the state with analyses performed by the NC DWQ Chemistry Laboratory (Roy Byrd, NCDWQ Laboratory Section, personal communication). None of the sediment metals values found were above the hazardous waste site screening values used by the Environmental Protection Agency[1]. These values are used to determine if there is a need to conduct further investigations at the sites. Sediment pesticides and organics results from the station PC7 indicated 2 unidentified chlorinated pesticides. Unidentified peaks are compounds that are detected in the pesticides and organics sample that are not present in the laboratory sample library of approximately 125 pesticides and organics. Microtoxicity sediment samples were collected at station PC7 and will be discussed in a later memorandum from Sandy Mort of the Aquatic Toxicology Unit. A five-day biochemical oxygen demand sample taken at Perry Creek at Perry Creek Road was low and below the laboratory reporting limit of 2.0 mg/L indicating no problems with oxygen demanding wastes.

Summary

The high amount of impervious area associated with the urban development present in the watershed of Perry Creek that is located in the City of Raleigh contributes to rapid and significant increases in stream flow after a rainfall event. The stream bank erosion and sedimentation associated with these events contributes to habitat degradation that would be associated with biological impairment. Additionally, nutrient enrichment associated with the commercial development around Greshams Lake, possible leaking sewer lines, and the golf course and residential areas present in the watershed may also contribute to biological impairment by causing algal activity and the resulting lowered dissolved oxygen levels.

[1] USEPA. 2001. Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment. Originally published November 1995. Website version last updated September 27, 2004: http://www.epa.gov/region4/waste/ots/ecolbul.htm

Station PC1: Perry Creek at Rainwater Road (upstream view)

Station PC2: Perry Creek at Litchford Road (upstream view)

Drain from Greshams Lake (upstream view)

Station PC3: Perry Creek at Power Line off Jacqueline Lane (downstream view)

Station PC4: Unnamed Tributary to Perry Creek downstream of I-540 (upstream view)

Station PC5: Unnamed Tributary to Perry Creek at Fox Road (upstream view)

Station PC6: Unnamed Tributary to Perry Creek at Berkshire Down Drive (upstream view)

Station PC7: Perry Creek at Perry Creek Road (upstream view)

Core Creek

Visual Observations

The Core Creek watershed was surveyed on May 11, 2004. A map of the watershed is attached in Appendix 1 and photographs of each of the sampling stations are attached at the end of this report. Numerous agricultural fields were observed throughout the watershed. Some of these fields appeared freshly planted. Some houses and farms were also observed throughout the watershed with the most residential development located in the Cove City area. Some horses in pastures were observed at a few areas in the watershed and a cattle animal operation was observed between stations CC1 and CC2 in the upstream portion of the watershed. The cattle operation itself was not visited to determine if cattle had direct access to the creek. Evidence of stream bank erosion and previous higher flows (disturbed vegetation on the stream banks) was observed at several stations. These stations included Core Creek at SR1239 upstream and downstream (stations CC1 and CC2) and Core Creek at SR 1001 (station CC3). The stream banks at these stations were a mixture of sand and vegetation. The water at all stations appeared to be murky and a tannic and reddish brown color. Good flow was present at all stations except the most downstream stations, Core Creek at SR1245 (station CC4) and Core Creek at NC55 (station CC5). The lowest visible flow conditions were noted at Core Creek at SR 1245 (station CC4). The creek at this location had the greatest width of all stations and some areas of aquatic weeds were noticed that also probably contributed to lower flow conditions. Periphyton on the rocks in the creek was observed at Core Creek at SR 1239 upstream (station CC1) while some algae was noticed on the sides of the creek at Core Creek at SR 1245 (station CC4).

Physical and Chemical Characteristics

Physical measurements were collected at each of the sampling stations and are included in Appendix 2. These measurements indicated a low dissolved oxygen value of 4.6 mg/L at Core Creek at SR 1245 (station CC4). This dissolved oxygen value was, however, above the North Carolina surface water quality standard of an instantaneous value of 4.0 mg/L. The low dissolved oxygen value may have been due to the lower stream flow velocity noted at this station. The creek was the widest here of any stations and areas of aquatic weeds were observed. These factors may have contributed to the lower velocity. An increase in conductivity was seen at Core Creek at SR 1239 downstream (station CC2) from the value found upstream at Core Creek at SR 1239 upstream (station CC1). A cattle farm with a lagoon was observed in the upstream area of the watershed downstream of Core Creek at SR 1239 upstream (station CC1). Animal waste originating from this farm may be the reason for the higher conductivity values found downstream although no direct observance of animal waste in the stream was noticed.

Chemical samples were collected at several stations in the watershed and results are included in Appendix 3. Nutrient samples were taken at the historical biologically impaired station, Core Creek at NC 55 (station CC5) and also at Core Creek at SR 1239 upstream (station CC1) and Core Creek at SR 1245 (station CC4). The nutrient samples were collected at stations CC1 and CC4 because of the presence of periphyton on the rocks. Nutrient values at every station were present in high amounts indicating enrichment possibly from fertilizers used on the agricultural fields in the area. A five-day biochemical oxygen demand sample was taken at the historical biologically impaired station (CC5) and the value found was low and below the reporting limit of 2.0 mg/L.

A water column metals sample taken at station CC5 indicated high values for aluminum and iron but this is expected due to high naturally occurring amounts of these metals in local soil types. The iron value of 1100 ug/L was above the state water quality standard but this standard is designed as an action level for dischargers and there are no dischargers in the immediate vicinity of this station. A sediment metals sample was also taken at station CC5 and the results indicated high amounts of aluminum, iron, and manganese also due to the presence of these metals in the local soils. The sediment metals values found at station CC5 were typical of those

found in historical sediment metals samples collected throughout the state with analyses performed by the NC DWQ Chemistry Laboratory (Roy Byrd, NCDWQ Laboratory Section, personal communication). There were no sediment metals values found above the hazardous waste site screening values used by the Environmental Protection Agency. The sediment pesticides and organics sample taken at station CC5 revealed some unidentified peaks for chlorinated pesticides, organophosphate pesticides, and semi-volatile organics. Unidentified peaks are compounds that are detected in the pesticides and organics sample that are not present in the laboratory sample library of approximately 125 pesticides and organics. Other semi-volatile organics found included benzene acetic acid, alkanes, and hexadecanoic acid. These pesticides and organics may have been related to fish kills in the Core Creek area on April 23, 2003 and May 3, 2003. A subsequent investigation of these fish kills conducted by the Neuse River Rapid Response Team found toxic pesticides in the creek. The Neuse River Rapid Response Team performed sampling for toxic compounds until August of 2003, when toxin levels had decreased and remained similar in subsequent sampling and fish were observed in the area again. No dead fish were observed during the 2004 Core Creek Stressor Study and small fish were observed swimming at several stations. None of the pesticides and organic values found at station CC5 on May 11, 2004 exceeded the EPA hazardous waste site screening values. Microtoxicity sediment samples were collected at station CC5 and will be discussed in a later memorandum from Sandy Mort of the Aquatic Toxicology Unit.

Summary

The numerous agricultural fields located in the watershed of Core Creek contribute to significant sedimentation of Core Creek due to nonpoint source runoff after a rainfall event. The resulting habitat degradation contributes to biological impairment. Additionally, nutrient inputs from farmland and a few animal operations probably contribute to nutrient enrichment and subsequent biological impairment. Some pesticides and organics present in the sediment due to events in 2003 may also play a role, although biological impairment of the benthic macroinvertebrates was present before these events occurred.

Station CC1: Core Creek at SR 1239 upstream (downstream view)

Station CC2: Core Creek at SR 1239 downstream (downstream view)

Station CC3: Core Creek at SR 1001 (downstream view)

Station CC4: Core Creek at SR 1245 (upstream view)

Station CC5: Core Creek at NC 55 (downstream view)

South Flat River

Visual Observations

The South Flat River watershed was surveyed on May 13, 2004. A map of the watershed is attached in Appendix 1 and photographs of each of the sampling stations are attached at the end of this report. Many agricultural fields were observed throughout the small watershed located near the headwaters. Some of these fields were freshly planted with crops, especially tobacco. Some houses and farms were also observed in this area as well as numerous small farm ponds. There were a few horses in pastures, as well as some areas where logging had been performed and some forested areas. The South Flat River was narrow and very shallow (just a few inches deep) at all of the upstream stations. The water at these upstream stations appeared muddy although low flow conditions were present. The water was especially muddy at the historical biologically impaired station, South Flat River at SR 1109 (station FR1). Water clarity was much better at the most downstream station, the South Flat River at Hwy 157 (station FR4) where the river was much wider due to the confluence of Bushy Fork Creek upstream. The stream bottom at all stations appeared to be a mixture of gravel, mud, sand and rocks. A large sandbar was present at the South Flat River at Hwy 157 (station FR4). Periphyton was observed on the rocks at all stations except the most downstream station, South Flat River at Hwy 157 (station FR4). Fish were observed swimming in the South Flat River at Hwy 157 (station FR4).

Physical and Chemical Characteristics

Physical measurements were collected at each of the sampling stations and are included in Appendix 2. These measurements indicated low dissolved oxygen values at the historical biologically impaired station, South Flat River at SR 1109 (station FR1) and the South Flat River at SR1111 (station FR2). These dissolved oxygen values were 4.5 mg/L and 4.9 mg/L respectively. The dissolved oxygen values, however, were above the Division of Water Quality standard of an instantaneous value of 4.0 mg/L. The low dissolved oxygen values may have been due to stagnant water from the low stream flow velocities noted at these stations. Conductivity values were consistently higher at the upstream stations possibly also due to the stagnant conditions present.

Chemical samples were collected at several stations in the watershed and results are included in Appendix 3. Nutrient samples were taken at the historical biologically impaired station, South Flat River at SR 1109 (station FR1) and also downstream at South Flat River at SR1111 (station FR2) and South Flat River at SR 1112 (station FR3). The nutrient samples taken at stations FR2 and FR3 were collected because of periphyton observed on the rocks at these stations. Nutrient concentrations at all stations were present in high amounts indicating possible enrichment from fertilizers used on agricultural fields in the area. A five-day biochemical oxygen demand collected at station FR1 indicated a low biochemical oxygen demand of 2.7 mg/L.

A turbidity sample was collected at station FR1 due to the presence of muddy water. The turbidity value found of 20 NTU was within the state standard for turbidity. A water column metals sample was taken at the South Flat River at SR 1109 (station FR1). Metals analyses indicated elevated aluminum, iron, and manganese concentrations but this is due to naturally high amounts of these metals in local soil types. The iron value of 3300 ug/L found at this station was well above the state water quality standard but this standard is designed as an action level for dischargers and there are no dischargers in the vicinity of this station. A sediment metals sample taken at this station also showed elevated amounts of aluminum, iron, and manganese, also due to natural conditions. The sediment metals values found at station FR1 were typical of those found in historical sediment metals samples collected throughout the state with analyses performed by the NC DWQ Laboratory (Roy Byrd, NCDWQ Laboratory Section, personal communication). No sediment metals values were above the EPA hazardous waste site screening values. A sediment pesticides and organics sample was also taken at station FR1. The results indicated some unidentified peaks for chlorinated pesticides, organophosphate pesticides, and semi-volatile compounds. Unidentified peaks are compounds that are detected in

the pesticides and organics sample that are not present in the laboratory sample library of approximately 125 pesticides and organics. These may have been present due to the use of pesticides on the agricultural fields upstream. Microtoxicity sediment samples were collected at station FR1 and will be discussed in a later memorandum from Sandy Mort of the Aquatic Toxicology Unit.

Summary

Non point source runoff from the numerous agricultural fields located in the upstream area of the South Flat River watershed probably contributes to significant sedimentation of the South Flat River after a rainfall event. The resulting habitat degradation would cause biological impairment. Additionally, runoff of fertilizers and pesticides used on these fields may also contribute to nutrient enrichment and biological impairment. Low flow conditions in the upstream section of the watershed and the resulting lower dissolved oxygen levels may also play a role in the biological impairment of this portion of the watershed.

Station FR1: South Flat River at SR 1109 (upstream view)

Station FR2: South Flat River at SR 1111 (upstream view)

Station FR3: South Flat River at SR 1112 (downstream view)

Station FR4: South Flat River at Hwy 157 (downstream view)

Knap of Reeds Creek

Visual Observations

The Knap of Reeds Creek watershed was surveyed on May 19, 2004. A map of the watershed is attached in Appendix 1 and photographs of each of the sampling stations are attached at the end of this report. Urban development associated with the Town of Butner is located in most of the Knap of Reeds watershed. These areas included large prison and mental health facilities. A North Carolina State University research dairy farm is present near the upstream unnamed tributary to Knap of Reeds Creek at SR 1004 (station KR3). Periphyton was observed on the rocks at this station indicating possible nutrient inputs from animal waste associated with the cows located in the pastureland immediately upstream. In a conversation with Buster Towell of the Division of Water Quality's Raleigh Regional Office, it was discovered that cows have direct access to the creek here and that there have been historic water quality problems because of the dairy farm. Evidence of sedimentation was seen at Picture Creek at SR 1239 (station KR2) with a large sandbar just downstream of the bridge, although this tributary was fairly small. Stream bank erosion was observed at the downstream unnamed tributary to Knap of Reeds Creek at SR 1004 (station KR5). A grassy area associated with the Federal Prison is located on the side of the stream in this area and a large land clearing operation, possibly expansion of the Prison, was observed upstream.

Some algae was observed at the bridge culvert at this station and the water was fairly turbid most likely due to the land clearing activities upstream. Low flow conditions were observed at all stations in Knap of Reeds Creek upstream of the John Umstead wastewater treatment plant with a large amount of surface trash and debris present at Knap of Reeds Creek at SR 1120 (station KR4). A wildlife impoundment is located just downstream of this station and, along with the lack of rainfall in the recent past and the upstream dam on Holt Reservoir, probably contributed to the stagnant conditions observed in Knap of Reeds Creek. A large inactive landfill and a trash dumping station was observed in the area adjacent to a tributary to Picture Creek upstream of Picture Creek at SR 1239 (station KR2). Water clarity was much better at the most upstream station, Knap of Reeds Creek at SR 1121 (station KR1) than at stations in Knap of Reeds Creek downstream. A large amount of rocks are present in the creek and fish were observed swimming at this station. This station is just downstream of Holt Reservoir.

Physical and Chemical Characteristics

Physical measurements were collected at each of the sampling stations and are included in Appendix 2. These measurements indicated low dissolved oxygen at Knap of Reeds Creek at SR 1121 (station KR1), Knap of Reeds Creek at SR 1120 (station KR4), and Knap of Reeds Creek 100 feet upstream of the John Umstead WWTP outfall (station KR6). The dissolved oxygen values found at stations KR4 and KR6 (3.0 mg/L and 2.7 mg/L respectively) were below the state surface water quality standard for dissolved oxygen. This standard reads that dissolved oxygen shall not be less than an instantaneous value of 4.0 mg/L. The low dissolved oxygen values were probably due to the low flow and stagnant conditions noticed at these stations because of a lack of recent rainfall and the dams of Holt Reservoir and the waterfowl impoundment. Conductivity values were very high (547 umhos/cm) at Knap of Reeds Creek 450 feet downstream of the John Umstead WWTP (station KR 7) probably because of the wastewater discharge. Upstream of the wastewater discharge at stations KR4 and KR6, conductivity was somewhat high probably due to the stagnant, low flow conditions present. Conductivity values were also very high (333 umhos/cm) at Picture Creek at SR 1239 (station KR2). The most likely cause of this high conductivity was materials leeching out of a now closed landfill located upstream near one of the tributaries to Picture Creek. Conductivity in this tributary (unnamed tributary to Picture Creek at SR 1112) was 621 umhos/cm. The conductivity value further away from the landfill at Picture Creek at SR 1112 was also high (360 umhos/com) and possibly indicated groundwater contamination in this area by the landfill. In a conversation with Larry Rose of the N.C. Division of Waste Management, Solid Waste Section, it was learned that this landfill is unlined. Mr. Rose also mentioned that surface water monitoring performed in the creek

near the landfill has not indicated any problems but that groundwater contamination, especially with volatile organics, is present in the area due to the landfill. Monitoring is continuing and additional groundwater monitoring wells are being installed. A low pH value was found at the upstream unnamed tributary to Knap of Reeds Creek at SR 1004 (station KR3). This value (5.9 s.u.) was slightly outside of the surface water quality standard of a range between 6.0 s.u. and 9.0 s.u. for pH.

Chemical samples were collected at several stations in the watershed and results are included in Appendix 3. Nutrient samples were taken at several stations in the Knap of Reeds Creek watershed. Results indicated nutrient enrichment at Knap of Reeds Creek at SR 1120 (station KR4) and Knap of Reeds Creek 450 feet downstream of the John Umstead WWTP outfall (station KR7). As mentioned previously, stagnant conditions and a large amount of surface debris were present at Knap of Reeds Creek at SR 1120 (station KR4) which could explain the high nutrient levels present. Nutrient levels were very high at station KR7 due to the wastewater discharge immediately upstream. A review of the wastewater treatment plant self-monitoring effluent nutrients data collected on May 18, 2004 (the day before the stressor study was conducted) indicated very high total nitrogen and total phosphorus values of 12.0 mg/L and 1.73 mg/L respectively. A biochemical oxygen demand sample take at Knap of Reeds Creek downstream of the WWTP (station KR7) indicated a low BOD value with no cause for concern.

Water column metals samples taken at Picture Creek at SR 1239 (station KR2) and Knap of Reeds Creek downstream of the WWTP outfall (station KR7) indicated high values for aluminum, iron, and manganese due to naturally occurring high levels of these metals in local soil types. Copper and zinc were also detected downstream of the WWTP (station KR7) probably due to industrial dischargers to the WWTP although levels found were within water quality standards action levels. A sediment metals sample taken downstream of the WWTP outfall (station KR7) also indicated high aluminum, iron, and manganese because of high naturally occurring levels of these metals in the local soils. With the exception of chromium, the sediment metals found were consistent with historic values found in sediment metals analyses performed on samples collected throughout the state (Roy Byrd, NC DWQ Laboratory Section, Chemistry Laboratory, personal communication). According to Mr. Byrd, the sediment chromium value of 46 mg/kg was much higher than sediment chromium values usually found. The high sediment chromium value may have been due to the discharge of the John Umstead WWTP upstream and metal plating industrial components of this discharge. None of the sediment metals values found at station KR7 were above the EPA hazardous waste site screening values. A sediment pesticides and organics sample taken at Knap of Reeds Creek downstream of the WWTP (station KR7) indicated 3 unidentified pesticide peaks. Unidentified peaks are compounds that are detected in the pesticides and organics sample that are not present in the laboratory sample library of approximately 125 pesticides and organics. Microtoxicity sediment samples were collected at station KR7 and will be discussed in a later memorandum from Sandy Mort of the Aquatic Toxicology Unit. A review of compliance and enforcement records for the John Umstead WWTP revealed that there have been numerous historic permit limit violations for chlorine and the Town of Butner has been repeatedly fined by the Division of Water Quality for these violations.

Summary

The low flow conditions and resulting low dissolved oxygen levels of Knap of Reeds Creek due to the Holt Reservoir and the waterfowl impoundment located downstream probably cause biological impairment. Additionally, nutrient inputs from various sources present in this watershed such as the dairy farm, nonpoint source runoff from the Town of Butner and the wastewater treatment plant also probably contribute. Sedimentation due to the impervious area associated with the Town of Butner and the resulting high flows after a rainfall as well as materials leeching out from the landfill in the headwaters of Picture Creek may also play a role in the biological impairment of Knap of Reeds Creek.

Station KR1: Knap of Reeds Creek at SR 1121 (downstream view)

Station KR2: Picture Creek at SR 1239 (downstream view)

Station KR3: Upstream Unnamed Tributary to Knap of Reeds Creek at SR 1004 (upstream view)

Station KR4: Knap of Reeds Creek at SR 1120 (downstream side of bridge)

Station KR5: Downstream Unnamed Tributary to Knap of Reeds Creek at SR 1004 (upstream view)

Station KR6: Knap of Reeds Creek 100 ft. upstream of John Umstead WWTP (downstream view)

Station KR7: Knap of Reeds Creek 450 ft. downstream of John Umstead WWTP (upstream view)

Appendix 1. Stressor Survey Maps

Map 1. Perry Creek

Map 2. Core Creek

Map 3. South Flat River

Map 4. Knap of Reeds Creek

Appendix 2. Physical Data for 2004 Neuse River Basin Bioimpaired Sites

Station Number	Location	Time	T°C	DO (mg/L)	pH (s.u.)	Conductivity (umhos/cm²)	% Saturation
Perry Creek 030402 May 5, 2004							
PC1.	Perry Creek at Rainwater Road	1325	18.6	7.4	6.4	96	79.2
PC2.	Perry Creek at Litchford Road (SR 2012)	1310	18.7	7.9	6.1	109	84.7
-	Drain from Greshams Lake	1400	24.3	7.8	6.2	162	93.8
PC3.	Perry Creek at Power Line off Jacqueline Lane	1135	19.8	7.2	6.0	169	78.8
PC4.	Unnamed Tributary to Perry Creek downstream of Interstate 540	1130	15.8	8.5	5.8	101	85.8
PC5.	Unnamed Tributary to Perry Creek at Fox Road	1200	16.8	8.1	5.7	97	83.5
PC6.	Unnamed Tributary to Perry Creek at Berkshire Downs Drive (SR 3514)	1110	16.2	8.4	5.7	107	86.0
PC7.	Perry Creek at Perry Creek Road (SR 2006, benthos site) Mid-channel depth= 0.93 ft. Mid-channel velocity=0.67 ft/sec	0950	15.3	8.5	6.0	128	84.9
Core Creek 030408 May 11, 2004							
CC1.	Core Creek at SR 1239 (upstream)	1220	20.2	7.4	6.3	72	81.7
CC2.	Core Creek at SR 1239 (downstream)	1215	21.7	7.4	6.9	121	84.2
CC3.	Core Creek at SR 1001	1200	22.4	7.3	6.7	126	84.2
CC4.	Core Creek at SR 1245	1130	23.2	4.6	6.4	121	53.8
CC5.	Core Creek at NC 55 (benthos site) Mid-channel depth=2.8 ft. Mid-channel velocity=0.20 ft/sec	1000	21.7	5.7	7.3	115	64.8
South Flat River 030401 May 13, 2004							
FR1.	South Flat River at SR 1109 (benthos site) Mid-channel depth=1.1 ft. Mid-channel velocity=0.05 ft/sec	0900	18.9	4.5	6.9	122	48.4
FR2.	South Flat River at SR 1111	1020	19.9	4.9	7.1	126	53.8
FR3.	South Flat River at SR 1112	1050	20.5	7.0	7.1	121	77.8
FR4.	South Flat River at Hwy 157	1110	20.2	7.2	7.1	99	53.8
Knap of Reeds Creek 030401 May 19, 2004							
KR1.	Knap of Reeds Creek at SR 1121	1205	23.9	4.6	6.0	91	54.6
KR2.	Picture Creek at SR 1239	1220	22.4	6.1	6.4	333	70.3
KR3.	Upstream Unnamed Tributary to Knap of Reeds Creek at SR 1004	1145	21.0	6.8	5.9	103	76.3
KR4.	Knap of Reeds Creek at SR 1120	1110	22.4	3.0	6.2	189	34.6
KR5.	Downstream Unnamed Tributary to Knap of Reeds Creek at SR 1004	1130	21.8	7.5	6.0	117	85.5
KR6.	Knap of Reeds Creek 100 ft. upstream of Butner WWTP outfall (benthos site)	1040	22.2	2.7	6.2	157	31.0
KR7.	Knap of Reeds Creek 450 ft. downstream of Butner WWTP outfall (benthos site) Mid-channel depth=1.2 ft. Mid-channel velocity=0.32 ft/sec	0920	23.5	6.2	6.5	547	73.0

Appendix 3. Neuse River Basin Chemical and Toxicological Data*

Station Number	Location	NH3 as N (mg/L)	TKN as N (mg/L)	Nox as N (mg/L)	TP as P (mg/L)	BOD5 (mg/L)
Perry Creek 030402 May 5, 2004						
PC1	Perry Creek at Rainwater Road	0.03	0.28	0.25	0.06	NA
PC2.	Perry Creek at Litchford Road (SR 2012)	0.06	0.37	0.48	0.07	NA
	Drain from Greshams Lake	0.29	0.71	0.15	0.05	NA
PC3.	Perry Creek at Power Line off Jacqueline Lane	0.18	0.62	0.33	0.06	NA
PC7.	Perry Creek at Perry Creek Road (SR 2006, benthos site)	0.07	0.33	0.48	0.04	<2.0

Station Number	Location	Al (ug/L)	As (ug/L)	Cd (ug/L)	Cr (ug/L)	Cu (ug/L)	Fe (ug/L)	Pb (ug/L)	Mn (ug/L)	Ni (ug/L)	Zn (ug/L)
PC2.	Perry Creek at Litchford Road (SR 2012)	120	<10	<2.0	<25	<2.0	680	<10	100	<10	<10
PC3.	Perry Creek at Power Line off Jacqueline Lane	640	<10	<2.0	<25	<2.0	1100	<10	360	<10	<10
PC7.	Perry Creek at Perry Creek Road (SR 2006, benthos site)	930	<10	<2.0	<25	<2.0	1200	<10	180	<10	<10

Station Number	Location	Sed. Al (mg/Kg)	Sed. As (mg/Kg)	Sed. Cd (mg/Kg)	Sed. Cr (mg/Kg)	Sed. Cu (mg/Kg)	Sed. Fe (mg/Kg)	Sed. Pb (mg/Kg)	Sed Mn (mg/Kg)	Sed. Ni (mg/Kg)	Sed. Zn (mg/Kg)
PC7.	Perry Creek at Perry Creek Road (SR 2006, benthos site)	1200	0.33	<0.20	2.2	2.4	4100	2.3	280	0.71	12

Station Number	Location	Sediment Pesticides and Organics
PC7.	Perry Creek at Perry Creek Road (benthos site)	2 unidentified chlorinated pesticide peaks

Station Number	Location	NH3 as N (mg/L)	TKN as N (mg/L)	Nox as N (mg/L)	TP as P (mg/L)	BOD5 (mg/L)
Core Creek 030408 May 11, 2004						
CC1.	Core Creek at SR 1239 (upstream)	0.13	0.97	0.14	0.09	NA
CC4.	Core Creek at SR 1245	0.16	0.78	0.36	0.12	NA
CC5.	Core Creek at NC 55 (benthos site)	0.12	0.66	0.50	0.14	<2.0

Station Number	Location	Al (ug/L)	As (ug/L)	Cd (ug/L)	Cr (ug/L)	Cu (ug/L)	Fe (ug/L)	Pb (ug/L)	Mn (ug/L)	Ni (ug/L)	Zn (ug/L)
CC5.	Core Creek at NC 55 (benthos site)	640	<10	<2.0	<25	<2.0	1100	<10	40	<10	13

Station Number	Location	Sed. Al (mg/Kg)	Sed. As (mg/Kg)	Sed. Cd (mg/Kg)	Sed. Cr (mg/Kg)	Sed. Cu (mg/Kg)	Sed. Fe (mg/Kg)	Sed. Pb (mg/Kg)	Sed. Mn (mg/Kg)	Sed. Ni (mg/Kg)	Sed. Zn (mg/Kg)
CC5.	Core Creek at NC 55 (benthos site)	4800	0.68	<0.2	4.2	1.2	3300	9.4	45	1.3	9.0

Station Number	Location	Sediment Pesticides and Organics
CC5.	Core Creek at NC 55 (benthos site)	2 unidentified chlorinated pesticide peaks 1 unidentified organophosphate pesticide peak

Other Semi-Volatiles compounds	Concentration (ug/kg-estimated)
Benzene acetic acid C8.H8.O2	290
Unidentified	270
Unidentified	590
Unidentified	270
Unidentified	270
Unidentified	610
Alkane	220
Unidentified	950
Unidentified	390
Unidentified	260
Alkane	590
Unidentified	1700
Unidentified	1300
Unidentified	280
Unidentified	940
Unidentified	580
Alkane	280
Unidentified	420
Alkane	1200
Unidentified	230
Unidentified	370
Unidentified	400
Alkane	500
Unidentified	310
Unidentified	390
Unidentified	270
Unidentified	210
Unidentified	250
Alkane	460
Hexadecanoic acid C16.H32.O2	670

Station Number	Location	NH3 as N (mg/L)	TKN as N (mg/L)	Nox as N (mg/L)	TP as P (mg/L)	BOD5 (mg/L)	Turb. (NTU)
South Flat River 030401 May 13, 2004							
FR1.	South Flat River at SR 1109 (benthos site)	0.13	0.61	0.08	0.12	2.7	20
FR2.	South Flat River at SR 1111	0.13	0.66	0.18	0.08	NA	NA
FR3.	South Flat River at SR 1112	0.08	0.47	0.34	0.06	NA	NA

Station Number	Location	Al (ug/L)	As (ug/L)	Cd (ug/L)	Cr (ug/L)	Cu (ug/L)	Fe (ug/L)	Pb (ug/L)	Mn (ug/L)	Ni (ug/L)	Zn (ug/L)
FR1.	South Flat River at SR 1109 (benthos site)	390	<10	<2.0	<25	<2.0	3300	<10	960	<10	<10

Station Number	Location	Sed. Al (mg/Kg)	Sed. As (mg/Kg)	Sed. Cd (mg/Kg)	Sed. Cr (mg/Kg)	Sed. Cu (mg/Kg)	Sed. Fe (mg/Kg)	Sed. Pb (mg/Kg))	Sed. Mn (mg/Kg)	Sed. Ni (mg/Kg)	Sed. Zn (mg/Kg)
FR1.	South Flat River at SR 1109 (benthos site)	3100	0.56	<0.2	8.2	3.6	5000	7.3	180	1.9	10

Station Number	Location	Sediment Pesticides and Organics
FR1.	South Flat River at SR 1109	2 unidentified chlorinated pesticide peaks 1 unidentified organophosphate pesticide peak

Other Semi-Volatiles compounds	Concentration (ug/kg-estimated)
Unidentified	180
Unidentified	270
Alkane	160
Unidentified	930
Unidentified	580
Alkane	200
Unidentified	170
Unidentified	230
Unidentified	2400
Alkane	590
Unidentified	150
Unidentified	340
Unidentified	1000
Unidentified	260
Unidentified	400
Unidentified	200
Unidentified	170
Unidentified	260
Unidentified	300
Unidentified	6300

Station Number	Location	NH3 as N (mg/L)	TKN as N (mg/L)	NOx as N (mg/L)	TP as P (mg/L)	BOD5 (mg/L)
Knap of Reeds Creek 030401 May 19, 2004						
KR2.	Picture Creek at SR 1239	0.02	0.38	0.10	0.03	NA
KR3.	Upstream Unnamed Tributary to Knap of Reeds Creek at SR 1004	0.03	0.28	0.18	0.06	NA
KR4.	Knap of Reeds Creek at SR 1120	0.13	0.57	0.09	0.19	NA
KR5.	Downstream Unnamed Tributary to Knap of Reeds Creek at SR 1004	0.03	0.29	<0.02	0.10	NA
KR7.	Knap of Reeds Creek 450 ft. downstream of Butner WWTP outfall (benthos site)	0.08	1.1	8.1	1.4	<2.0

Station Number	Location	Al (ug/L)	As (ug/L)	Cd (ug/L)	Cr (ug/L)	Cu (ug/L)	Fe (ug/L)	Pb (ug/L)	Mn (ug/L)	Ni (ug/L)	Zn (ug/L)
KR2.	Picture Creek at SR 1239	56	<10	<2.0	<25	<2.0	590	<10	290	<10	<10
KR7.	Knap of Reeds Creek 450 ft. downstream of Butner WWTP outfall (benthos site)	55	<10	<2.0	<25	5.4	630	<10	300	<10	25

Station Number	Location	Sed. Al (mg/Kg)	Sed. As (mg/Kg)	Sed. Cd (mg/Kg)	Sed. Cr (mg/Kg)	Sed. Cu (mg/Kg)	Sed. Fe (mg/Kg)	Sed. Pb (mg/Kg)	Sed. Mn (mg/Kg)	Sed. Ni (mg/Kg)	Sed. Zn (mg/Kg)
KR7.	Knap of Reeds Creek 450 ft. downstream of Butner WWTP outfall (benthos site)	1500	0.86	<0.20	46	2.9	9500	3.5	160	2.8	14

Station Number	Location	Sediment Pesticides and Organics
KR7.	Knap of Reeds Creek 450 ft. downstream of Butner WWTP outfall (benthos site)	2 unidentified chlorinated pesticide peaks 1 unidentified organophosphate pesticide peak