Tier 1 Preliminary Evaluation of Pollutant Sources to the Impounded Reaches of Five Dams in the Neuse River Basin, North Carolina

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Executive Summary:

Impounded reaches behind dams can trap and accumulate sediments through time. In some cases, those sediments can accumulate contaminants, and at high concentrations those contaminants can have adverse toxicological effects in-place as well as upon movement downstream. We used the framework of the U.S. Environmental Protection Agency / U.S. Army Corps of Engineers technical guidance manual on disposal of dredged material in inland waters to evaluate the potential for sediment contamination within the impoundments created by five small dams on the Neuse River and tributaries in Wake, Wayne, Wilson, and Lenoir Counties, North Carolina. A tier 1 review of existing information on pollutant sources and sinks, similar to an initial environmental audit, was conducted. This report presents the methods, results, and recommendations from the tier 1 assessment.

Review of existing information (State and federal databases on pollutant sources, previous environmental assessments, and limited analytical chemistry data for Neuse River and Crabtree Creek, Little River, Contentnea Creek and Southwest Creek) indicated no known significant organic or inorganic pollutant problems in a one-mile assessment area surrounding the impounded reaches of each dam.

Much of the assessment area for the dams on Little River, Contentnea Creek and Southwest Creek remains in an undeveloped rural character (forestry and small farms). No issues of concern were identified during the database or file reviews for these dams' assessment areas, and their current breached condition makes them very ineffective sediment traps. No further sediment characterization work is recommended at these three sites unless confirmatory sampling (expected to show only background levels of pollutants) is desired.

The assessment areas for Milburnie dam on the Neuse River and Lassiter Mill dam on Crabtree Creek are urbanized and are in watersheds with known water quality degradation. Two large municipal and one industrial facility having documented controlled or uncontrolled releases of pollutants were identified within the assessment area of Milburnie dam. Highway run-off is a concern for the assessment areas of both Milburnie dam and Lassiter Mill dam, and biological monitoring data indicate impairment of the benthic communities in these two watersheds, attributed to urbanization influence. If sediment disturbing activities are proposed at these assessment areas, they warrant additional data collection (i.e., a tier 2 assessment), with an emphasis on heavy metals and hydrocarbons (markers of urban run-off and other sources). Also, additional review of the implications of low level PCB contamination in Crabtree Creek should be conducted if further work is proposed at that facility. The U.S. Fish and Wildlife Service is available to help with these next steps.

Preface

To assess the the potential for sediment contamination at five dams in North Carolina's Neuse River basin, the U.S. Fish and Wildlife Service assisted the U.S. Army Corps of Engineers (Wilmington District) in a review of existing information on potential pollutant sources to sediments behind the dams. The work was completed by Sara Ward (Ecologist / Environmental Contaminant Specialist) and Tom Augspurger (Ecologist / Environmental Contaminant Specialist) in the U.S. Fish and Wildlife Service's Raleigh Field Office and was funded through a transfer agreement between the U.S. Fish and Wildlife Service and the U.S. Army Corps of Engineers.

This final report addresses peer review comments received on a July 2008 draft. Review comments were received from natural resource specialists with U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, North Carolina Division of Waste Management, and North Carolina Division of Water Quality.

Questions, comments, and suggestions related to this report are encouraged. Inquires can be directed to the U.S. Fish and Wildlife Service at the following address:

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Introduction

Impoundments are well recognized stressors to many species of riverine fishes, amphibians, mussels, crayfishes, and insects (Richter et al. 1997). Neves et al. (1997) and Watters (2000) reviewed effects of impoundments on freshwater mollusks, noting flow changes, population fragmentation, water quality problems and sediment issues. Dams also alter normal nutrient dynamics of riverine systems (Freeman et al 2003) and can degrade water quality within the impounded reach as well as downstream (Arnwine et al. 2006). Removal of dams has re-established important anadromous fish runs in North Carolina and has restored habitat and improved water quality for a variety of species. One issue among the many to consider in evaluating the risks and benefits of dam removal is the chemical nature of the sediments accumulated behind the dam. Impounded reaches behind some dams accumulate silt and detritus through time, and both organic and inorganic contaminants have a strong affinity for the silt and organic fraction of sediments (Anderson et al. 1987; Rodgers et al. 1987). In addition to their potential in-place effects, contaminated sediments can impair surface waters and associated aquatic life upon mobilization and transfer of water-soluble pollutants to the water column.

The degree of the concern is a function of site-specific pollutant loading based on age of the dam, dominant landuses, pollutants discharged into the watershed, and extent of watershed development. While there is no sediment evaluation protocol specific to dams, the issue is very similar to evaluating sediments proposed for dredging and disposal. The U.S. Environmental Protection Agency and U.S. Army Corps of Engineers (USEPA/USACE 1998) have a guidance manual on disposal of dredged sediments which recommends a phased approach to sediment evaluation. The phases start with a 'tier 1' assessment of the potential for sediment contamination to be an issue warranting any further consideration.

This report documents the U.S. Fish and Wildlife Service's (Service) tier 1 evaluation of potential pollutant sources to impoundments created by five Neuse River basin dams (Figure 1). Our work started with a reconnaissance of each dam to examine adjacent land uses and make a qualitative assessment on the degree to which they could trap sediments of concern; the five structures are described below:

Bridges Lake Dam (Milburnie Dam), Wake County, Neuse River (Figure 2)

Milburnie dam has a small hydroelectric plant and is relatively undeveloped immediately upstream but extensively developed (US1 and US401 corridors) further upstream. The dam is about 13-feet tall and creates a significant impoundment on the Neuse River. The dam is intact and capable of retaining sediments. No instream assessment was conducted to determine the magnitude of accumulated sediments. It is noted that the upstream Falls Lake dam has impounded the Neuse River since 1983; the size of that structure makes it an efficient sediment trap for inputs to the upper Neuse River system.

Lassiter Mill Dam, Wake County, Crabtree Creek (Figure 3)

Lassiter Mill is an historic structure within the City limits of Raleigh. The surrounding land use is now suburban homes, but the Crabtree Valley Mall and other commercial development along US70 are within the upstream assessment area. The dam is intact and capable of retaining sediments; however its low height is such that significant sediment movement through the system during high flows would be expected. No instream assessment was conducted to determine the magnitude of accumulated sediments.

Unnamed Dam, Wilson County, Contentnea Creek near Wilson (Figure 4)

The unnamed dam on Contentnea Creek is located between Buckhorn dam and Wiggins Mill dam. This dam has been breached but still creates an impoundment during low flows. The only sediment trapping likely to be a concern appears to be along the left bank near the dam (away from the breached area of the dam which is on the right bank). The riparian corridor near the dam is very well vegetated with mature forest cover. No instream assessment was conducted to determine the magnitude of accumulated sediments.

Unnamed Dam, Wayne County, Little River near Goldsboro (Figure 5)

The unnamed dam on Little River is near Goldsboro's water treatment plant. It has been breached but still impounds water at low flows. It appears that not enough of an impoundment remains to be concerned with sediment mobilization downstream following any dam-debris removal or complete dam removal (i.e., sediments likely have been and will continue to move downstream through the remaining impoundment via the breach).

Kellys Millpond Dam, Lenoir County, Southwest Creek (Figure 6)

Kellys Pond is an old millpond and the dam is now mostly breached, but much of the mill structure remains. The lake formerly formed by the dam is now a wetland and floodplain of Southwest Creek. The channel upstream from the dam is abut 80% vegetated (emergent and scrub-shrub vegetation) with about 20% of the banks still exposed and erosive. It appears that not enough of an impoundment remains to be concerned with sediment mobilization downstream following any debris removal or dam removal (i.e., sediments likely have been and will continue to move downstream through the remaining impoundment via the breach).

Municipal, industrial, and agricultural interests in each watershed are potential pollution sources that warrant an assessment of the potential for sediment contamination behind the dams. Tier 1 is a review of existing information on pollutant sources and sinks, similar to an initial environmental audit; no new data are collected but existing data, records, files, and reports are reviewed and synthesized. This remainder of this report presents the methods, results, and recommendations from the tier 1 assessment.

Figure 1. Locations of five dams in North Carolina's Neuse River basin that were the subject of this assessment

Figure 2. Bridges Lake (Milburnie) Dam, Wake County, Neuse River (USFWS photo)

Figure 3. Lassiter Mill Dam, Wake County, Crabtree Creek
(http://raleighnature.com/2008/06/29/lassiter-mill-and-raleigh-mill-history/)

Figure 4. Unnamed Dam, Wilson County, Contentnea Creek near Wilson (USFWS photo)

Figure 5. Unnamed Dam, Wayne County, Little River near Goldsboro (USACE photo)

Figure 6a. Kellys Millpond Dam (downstream), Lenoir County, Southwest Creek (USFWS photo)

Figure 6b. Kellys Millpond Dam (upstream), Lenoir County, Southwest Creek (USFWS photo)

Methods

There are no regulations or standards that dictate the approach to be used in evaluating potential sediment contamination at dam sites. However, there are pertinent well-established procedures aimed at guiding evaluation of the potential for contaminant-related impacts from sediments proposed for dredging. The joint U.S. Environmental Protection Agency and U.S. Army Corps of Engineers technical guidance manual on evaluation of dredged sediment was used to guide our evaluation of dam sediment contamination potential with additional guidance from recent sediment assessment manuals (MacDonald and Ingersoll 2002a, 2002b).

The USEPA/USACE Inland Testing Manual employs a tiered approach to evaluation of the potential for contaminated sediment impacts. Evaluations start with a tier 1 assessment (using readily available existing information to assess the potential for a contaminated sediment concern) and proceeding in a step-wise fashion through tiers 2 (surface water and sediment chemistry), tier 3 (toxicity and bioaccumulation testing) and tier 4 (case-specific lab and field testing) only to the extent necessary to address the issue. In other words, all assessments start with tier 1; they may end there or proceed to higher tiers if additional data are needed to guide the management decision. In general, absence of pollutant sources would indicate little need for aggressive work to characterize any potential contaminants. Likewise, any proposed sampling should be guided by identification of specific issues identified in the tier 1 review.

Our tier 1 assessment started with database searches to examine the potential for contaminant inputs to the impounded reaches. We chose an assessment area defined as the stream-reach impounded by each structure, plus a one-mile buffer laterally and upstream. This approach is consistent with the American Society of Testing and Materials *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process* (ASTM 2005).

We examined databases and files maintained by State and federal natural resource management agencies. Databases reviewed included *BasinPro8*, a product of the North Carolina Center for Geographic Information and Analysis (NCCGIA), the USEPA's *Envirofacts Database* (facilities with air and water waste discharge permits, solid or hazardous waste sites, and facilities handling hazardous materials), and databases administered by the North Carolina Division of Water Quality (NCDWQ) and North Carolina Division of Waste Management (NCDWM). Data layers related to pollutant sources were reviewed within *BasinPro8* for our assessment area. Data within *Envirofacts* and State databases were searched for Wake, Wayne, Wilson and Lenoir Counties with sites then screened-in or screened-out for further review based on specific location information. Collectively, these mapping tools and databases retrieved known information from the following primary sources (with the administrative contact listed in parentheses):

National Priorities List (Superfund Sites)	(USEPA)
Inactive Hazardous Waste Sites	(NCDWM)
Old Landfills	(NCDWM)
Active Solid Waste Permits	(NCDWM)
CERCLIS Sites (known or suspected unregulated waste sites)	(USEPA)
Resource Conservation and Recovery Act Sites (hazardous waste generation, transport, disposal)	(USEPA)

National Pollutant Discharge Elimination System Sites (NPDES, surface water discharge sites)	(NCDWQ)
Sewage Sludge Land Application Sites	(USEPA)
Underground Storage Tanks	(NCDWQ)
Aerometric Information Retrieval System (AIRS)	(USEPA)
Toxic Release Inventory	(USEPA)

A geographic information systems (GIS) map was made for each dam assessment area which notes the proximity of pollutant sources to the impoundments behind the dams. For facilities located within the one-mile assessment area, individual State files were reviewed at NCDWM or NCDWQ. Some major sites located outside the buffer were also considered. File reviews gathered information on pollutants discharged from the facilities, potential contaminant pathways from facilities to the rivers or creeks upstream of the dams, and environmental monitoring data for the facilities.

We reviewed environmental studies for this portion of the Neuse River basin prepared by others (NCDWQ, Service, U.S. Geological Survey [USGS], and others) with an emphasis on water and sediment chemistry. We also conducted a reconnaissance of each site. A final component of the assessment was the peer review comments we received on a July 2008 draft report; the input received from U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, North Carolina Division of Waste Management, and North Carolina Division of Water Quality reviews was incorporated into this final report.

Results

Database Searches and GIS Maps

Figures 7a through 7e depict potential pollutant sources identified using *BasinPro* software within the one mile assessment area on either side of the watercourses upstream of each dam.

Table 1 is a list of the major (discharge ≥ 0.5 million gallons per day [MGD]) National Pollutant Discharge Elimination System (NPDES) point sources of discharged treated municipal or industrial effluent. Only two major dischargers (Burlington Industries/Riverplace II LLC [NC0001376] and Wake Forest Wastewater Treatment Plant [also known as Smith Creek Wastewater Treatment Plant NC0030759]) were identified within the one-mile buffer of the project sites, and both these facilities discharge to the main stem of the Neuse River upstream of Milburnie dam. No major discharges were located in the assessment area of the other dams. Three minor NPDES facilities were identified upstream of Milburnie dam (River Mill Wastewater Treatment Plant [NC0056278], Neuse Crossing Wastewater Treatment Plant [NC0064408], and Riverwalk Mobile Home Park Wastewater Treatment Plant [NC0039292]). These small discharges were not further considered due to their small size and the nature of the discharges. There were no minor discharges identified for the other four assessment areas.

Figures 7a through 7e also identify the locations of known or suspected hazardous waste sites. These facilities (listed in Table 2) were further evaluated by reviewing their files at NCDWM.

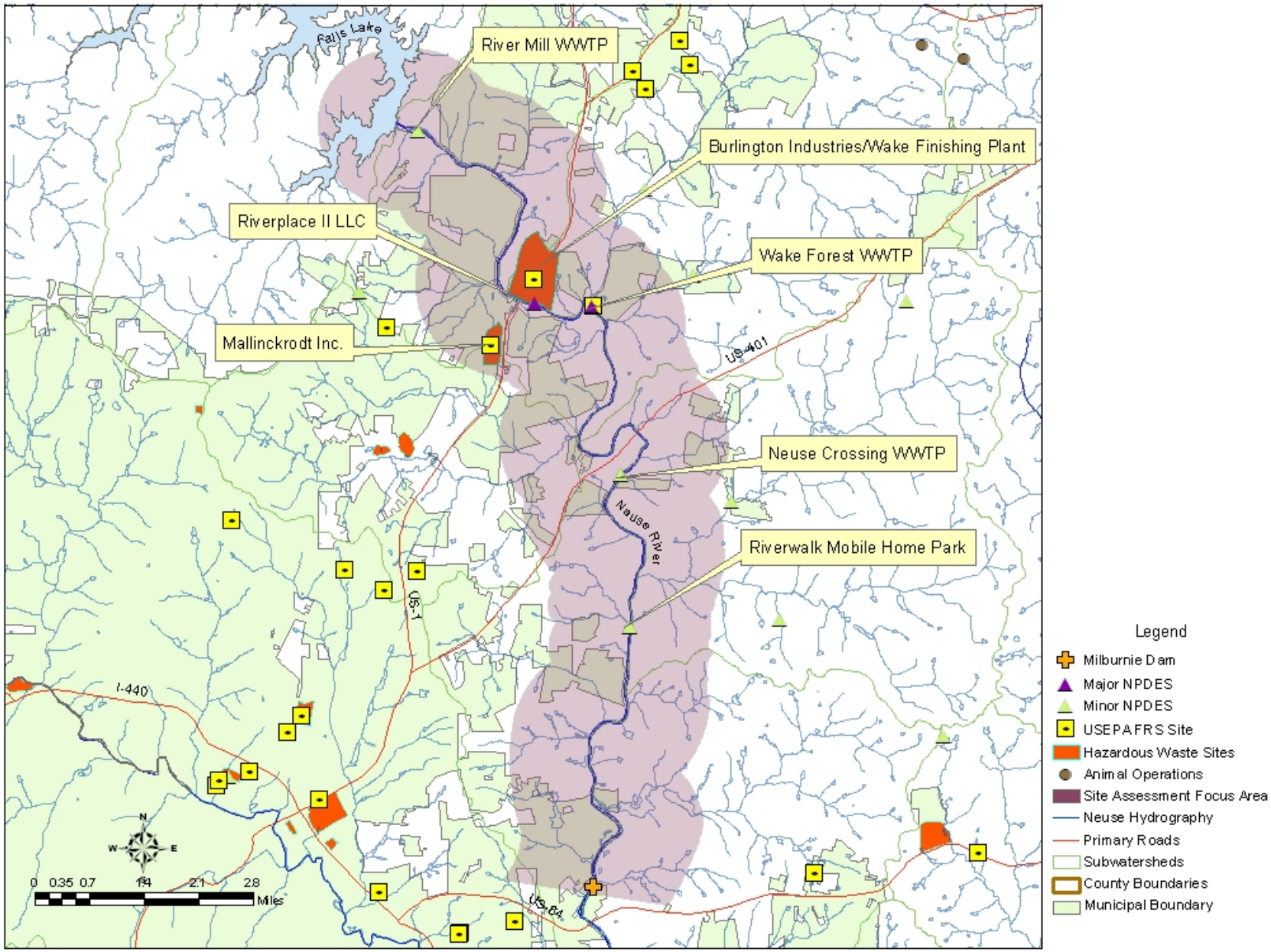

Figure 7a. Sites identified in NCCGIA's *BasinPro* software in and near buffer of Milburnie Dam impounded area

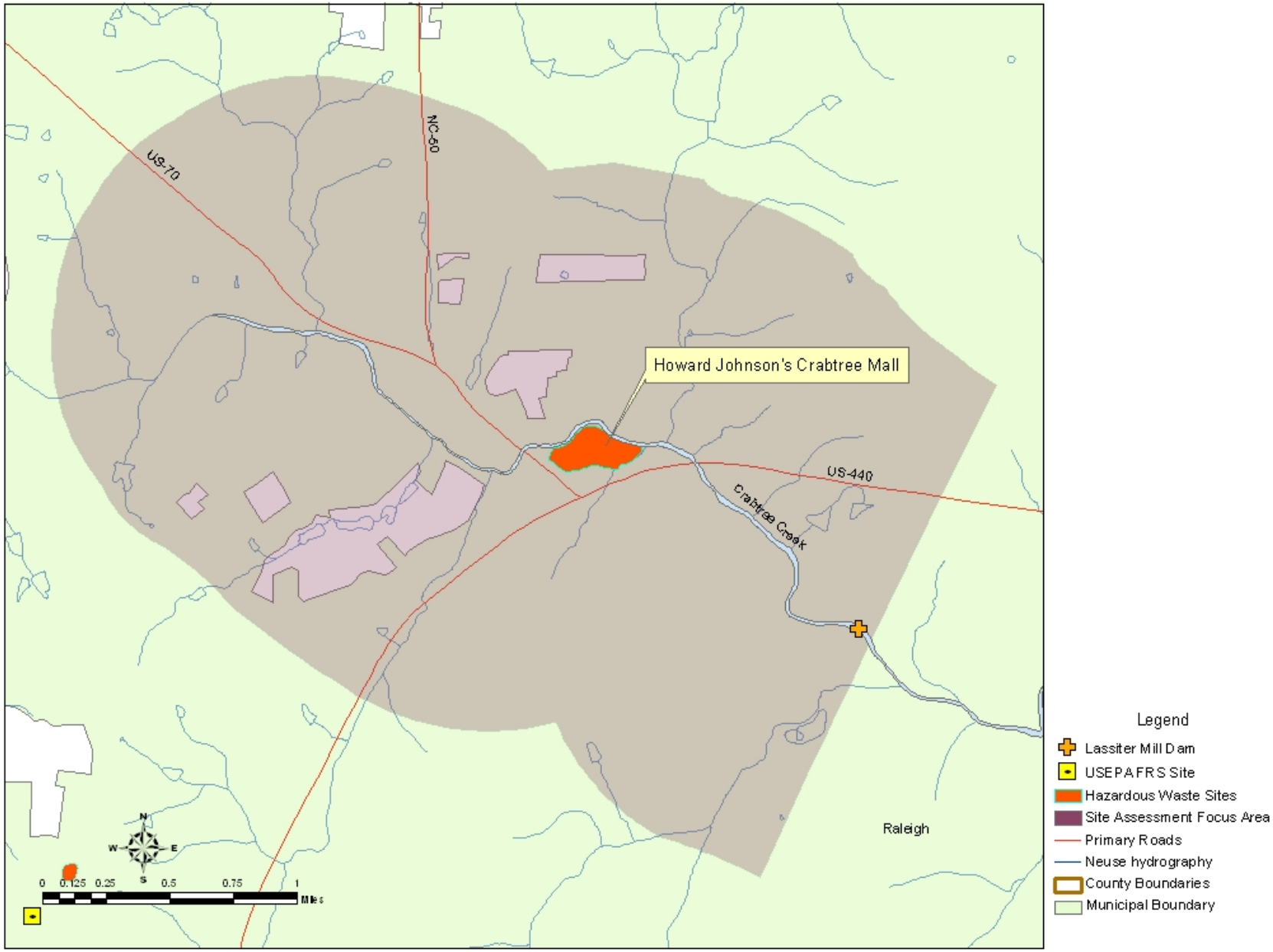

Figure 7b. Sites identified in NCCGIA's *BasinPro* software in and near buffer of Lassiter Mill Dam impounded area

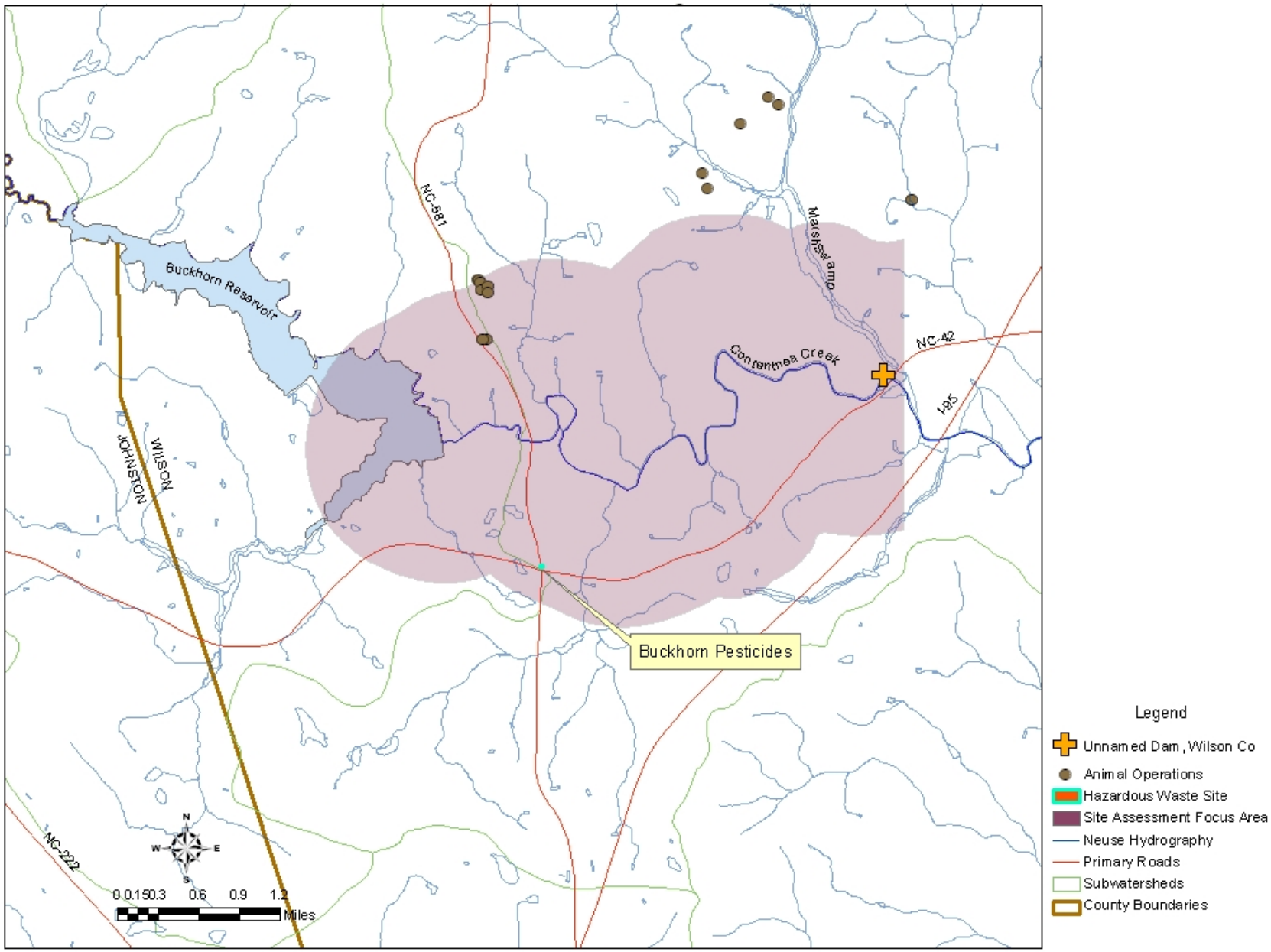

Figure 7c. Sites identified in NCCGIA's *BasinPro* software in and near buffer of Contentnea Creek unnamed dam impounded area

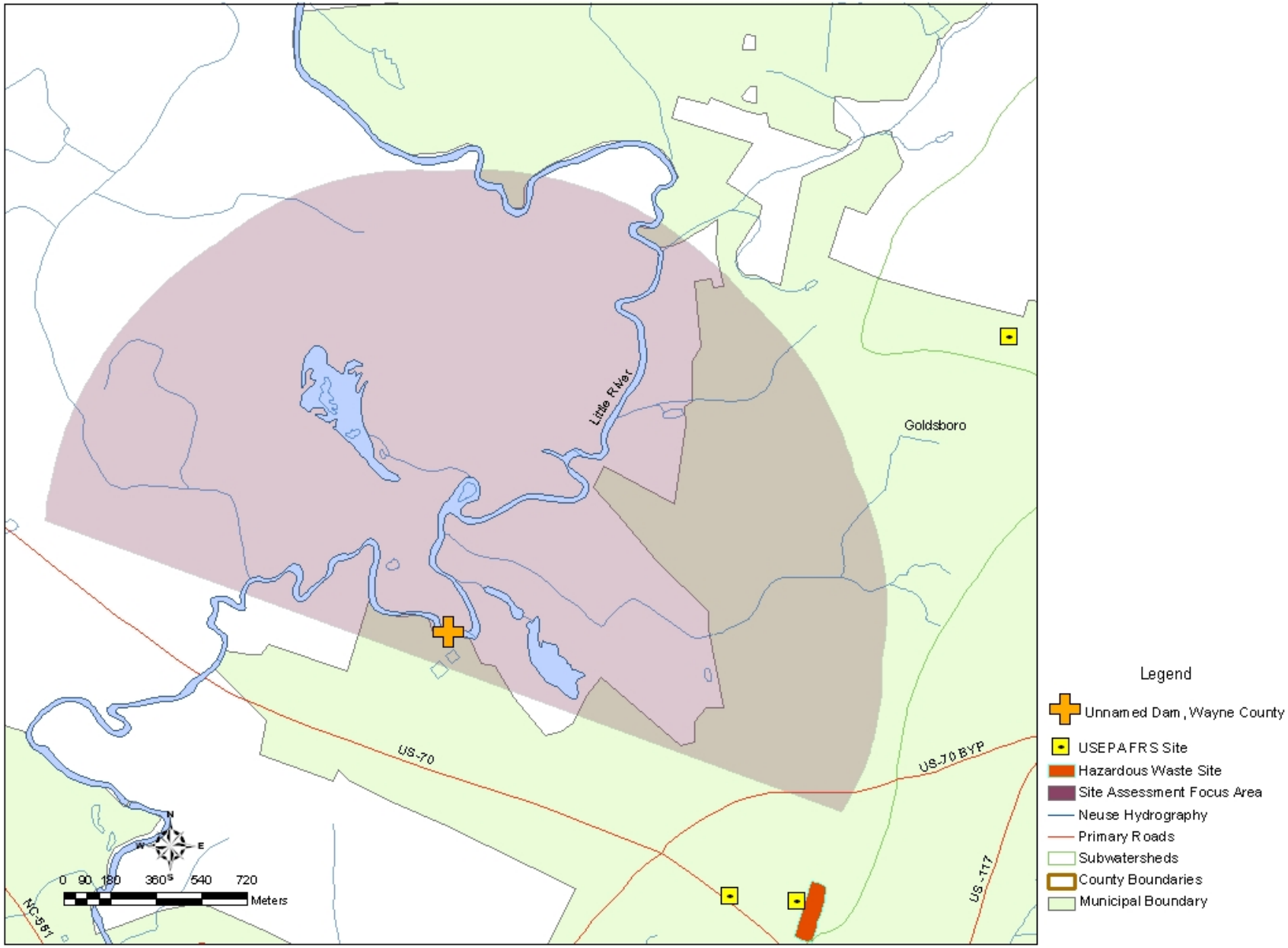

Figure 7d. Sites identified in NCCGIA's *BasinPro* software in and near buffer of Little River unnamed dam impounded area

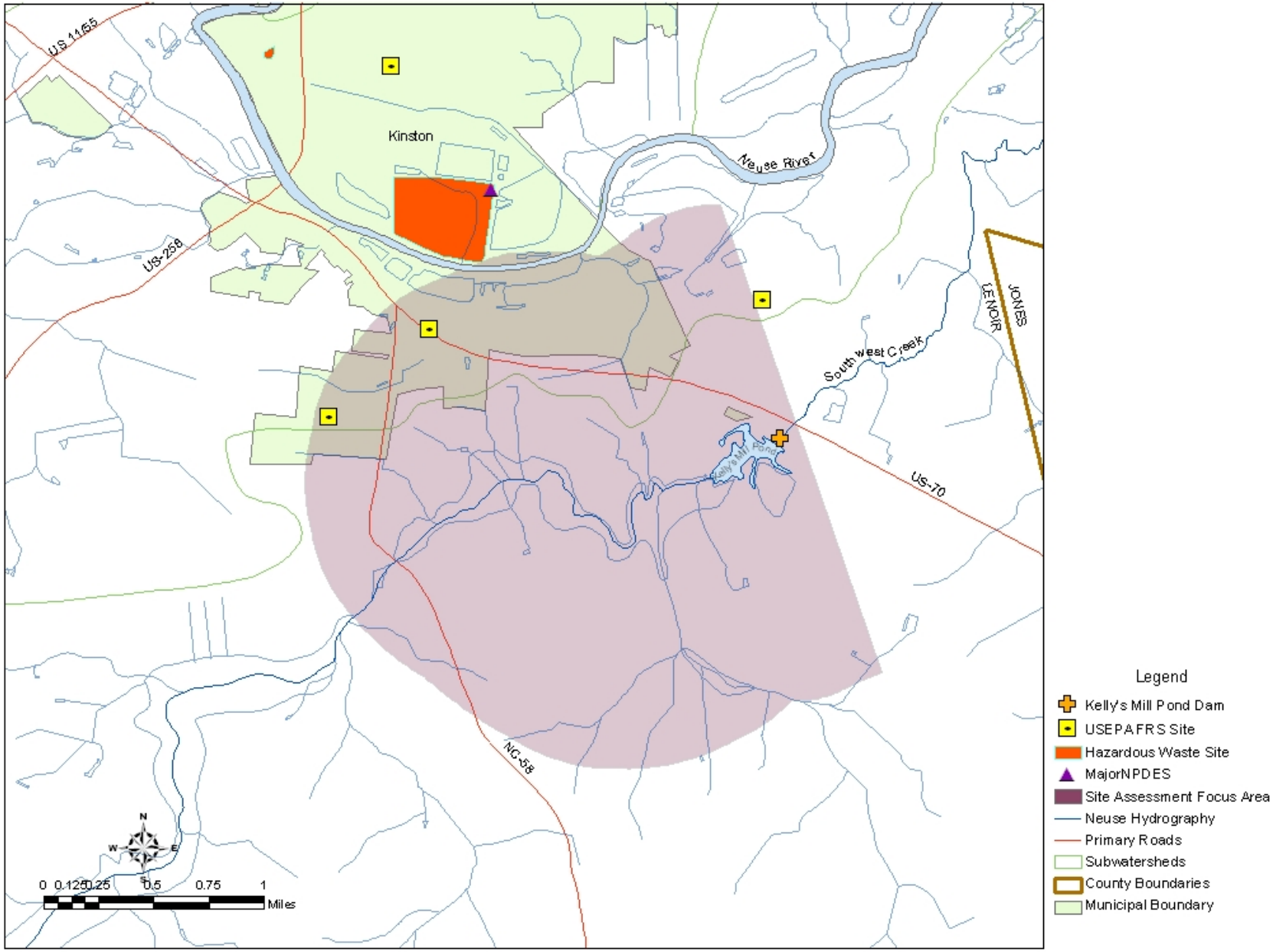

Figure 7e. Sites identified in NCCGIA's *BasinPro* software in and near buffer of Kellys Mill Pond Dam impounded area

Table 1. Major dischargers to Milburnie dam impounded reach assessment area permitted under the National Pollutant Discharge Elimination System (NPDES). There were no major discharges into the assessment areas of the other four dams.

Dam	Facility	Permit number	Discharge (MGD)[1,2]
Milburnie	Burlington Industries/Wake Finishing Plant (Riverplace II LLC)	NC0001376	5.0
	Wake Forrest (or Smith Creek) WWTP	NC0030759	6.0

[1] Permitted discharge volume, in Million Gallons per Day (MGD)
[2] Source: NCDWQ 2008: http://h2o.enr.state.nc.us/NPDES/PublicNotices.html (accessed 03/26/08)

Table 2. Known or suspected hazardous waste sites in the Neuse River basin dam assessment areas identified using NCCGIA *BasinPro* software and State and federal databases

Facility	Site number	Type of Facility[1]
Lassiter Mill Dam		
Howard Johnson's/Crabtree Valley Mall	NCD980845903	HSDS
Arrow Drive – Crabtree Creek	NONCD0001170	IHWS
Milburnie Dam		
Burlington Industries/Wake Finishing Plant (Riverplace II LLC)	NCD980557664	HSDS, IHWS, TRI, RCRIS
Mallinckrodt Inc.	NCD980729297	HSDS, TRI, RCRIS, AIRS
RC Motor Company	NONCD0002377	IHWS
Weavexx Corp	NONCD0002701	IHWS
Unnamed Dam, Wilson Co		
Buckhorn Pesticides	NCD980845119	HSDS, IHWS
Unnamed Dam, Wayne Co	None	
Kellys Mill Pond Dam	None	

[1] IHWS (Inactive Hazardous Waste Site Inventory)
HSDS (Hazardous Substance Disposal Site from NCCGIA *BasinPro8* software
TRI (Toxic Release Inventory database)
AIRS (Aerometric Information Retrieval System)
CERCLIS (Comprehensive Environmental Response, Compensation and Liability Information System)
RCRIS (Resource Conservation and Recovery Act Information System)

Individual Site Reviews - National Pollutant Discharge Elimination System (NPDES) Facilities

To further evaluate facilities identified as potential pollutant sources of concern by the database searches, individual NPDES permits were reviewed for the two major dischargers to the Neuse River within the Milburnie dam assessment area. There were no major discharges into the assessment areas of the other four dams.

The Burlington Industries/Wake Finishing Plant (Riverplace II, LLC) wastewater treatment facility [NC0001376] discharged up to 5 million gallons per day (MGD) of knitted fabric dyeing and finishing operation wastewater to the Neuse River. The plant was built in 1948 and closed in 1996 when Burlington Industries closed its knitted fabric operations. It was sold to an investment group, Riverplace LLC in 1999. The facility has had an NPDES permit to discharge since 1979. While the current NPDES permit has expired (1999), it is listed as pending review / renewal in the NCDWQ database. Records reviewed indicate there was no discharge from December 2006 through January 2007, with only discharges during five months dating back to August 2004 (all at much less than 1 MGD). Quarterly chronic whole effluent toxicity tests were performed historically, and the facility passed 18 of 19 tests between 1992 and 1996 (NCDWQ 1996). Effluent toxicity testing was not required in more recent years due to the low discharge volume. The waste stream was a signficant source to the Neuse River because, at 5 MGD, it would represent 12% of the base flow during a 7Q10 (lowest stream flow for seven consecutive days that would be expected to occur once in ten years) low flow event.

The Wake Forest (or Smith Creek) wastewater treatment plant [NC0030759] is permitted to discharge up to 6 MGD of treated municipal wastewater to the Neuse River. The Smith Creek plant was constructed in 1976 by the Town of Wake Forest and transferred to Raleigh in July 2005. The facility was originally permitted in 1981 and most recently re-permitted in January 2008. While having received permits to discharge 6 MGD, the facility is currently operating at much lower flows under a provision in their permit for 2.4 MGD release until needed expansion. The facility has had 14 compliance inspections over the past decade with no violations. Chronic whole effluent toxicity tests are also performed, and the facility has typically been in compliance, passing 67 of 70 tests between 1996 and 2005 (NCDWQ 1996, 2001, 2008).

Hazardous Waste Sites

To further evaluate the facilities identified as potential pollutant sources of concern by the database searches, file reviews were conducted on June 5, 2008. Four sites are included in NCCGIA's *BasinPro8* dataset for hazardous substance disposal sites (HSDS) (Table 2) within our assessment areas, of which, two (Burlington Industries and Buckhorn Pesticides) are also listed on the State's Inactive Hazardous Waste Site Inventory (IHWS). Three additional sites (Arrow Drive – Crabtree Creek [NONCD0001170], RC Motor Company [NONCD0002377], and Weavexx Corporation [NONCD0002701]) are also included on the IHWS Inventory and are found within the area of interest (although they were not listed in the NCCGIA's *BasinPro8* dataset and are therefore not depicted in Figures 2a through 2e). A summary of each site preliminarily identified as a concern is provided here.

The Howard Johnson's/Crabtree Valley Mall (NCD980845903) site was a solid waste disposal area on the south side of Crabtree Creek, located at the intersection of US70 and I-440 (Raleigh Beltline). Site inventory information provided by the City of Raleigh (1985) indicated the site originally comprised of 16-acres of "low and swampy" land and was used between about 1959 and 1968 for disposal of household wastes and yard wastes. In the early 1970's the hotel (originally Howard Johnson's and now Holiday Inn) was built on top of the fill with about 5 acres of the filled area now under parking lot pavement. Test borings at the site in 1985 revealed trash such as glass, cloth, paper, plastic, wood and metal fragments mixed with soil. A sample from Crabtree Creek indicated low levels of metals, and a groundwater sample taken by NCDWM in the early 1980's revealed low levels of arsenic and phenol. The site was assigned a low priority for follow-up. Site characterization sampling in 1995 and 1996 indicated no concerns with leachate production of site soils but did evidence arsenic, cadmium, chromium, lead, benzene and chlorobenzene slightly above State groundwater standards. Low groundwater exceedences, the developed nature of the site, and the lack of evidence of hazardous waste disposal at the facility all factored into a recommendation that no further action be taken at the site following the most recent review (GeoTechnologies, Inc. 1999). The USEPA and NCDMW have generally concurred with that assessment, and a the site was given a "no further action" status by the USEPA in 1992 and NCDWM in 1999 (NCDENR 1999). Based on the nature of wastes disposed at the site and the results of several previous characterizations, the site does not warrant specific follow-up in the dam evaluation.

The Burlington Industries (NCD980557664) site is a 260-acre textile plant. Waste issues reportedly include a landfill for operational wastes prior to the 1980s. Fly ash, alum sludge, and sewage sludge were deposited at a small (130,000 square feet) area onsite adjacent to US1. The site previously contained a wastewater treatment system, dismantled prior to 1970, which was reported by plant staff to have received additional plant wastes after it was abandoned. The facility drained to the Neuse River. A separate issue at the facility was a ravine where 10 to 15 55-gallon drums of unidentified textile wastes were buried, as reported to USEPA by the plant environmental management. A NCDWM preliminary assessment (1987) and site investigation (1989) of both areas, including analyses of Neuse River sediment samples near the waste treatment system outfall and soils from the drum site found no pollutants at levels of concern. Follow-up sampling was performed in 1992 and no groundwater contamination in excess of State standards was found. The site was given a "no further action" status by the USEPA (USEPA 1995). Following a review of all site data, Waters Edge Environmental petitioned the State for a "no further action status" in 2005 which was granted in 2007 (NCDENR 2007). The site does not warrant specific follow-up in the dam evaluation.

Mallinckrodt Inc. (NCD980729297) (NCD042091975) is a 613-acre parcel with about 35-acres consisting of a specialty chemical facility that has been active since 1966. The facility is a major producer of acetyl para-aminophenol (APAP), para-aminophenol (PAP) and acetaminophen, and they have hazardous waste permits for aniline still bottoms from industrial boilers fed with aniline-liquid tar. Other products used in bulk include nitrobenzene, hydrogen, sulfuric acid and ammonia with ammonium sulfate as a production byproduct. The facility land-applies some wastewater residuals and discharges stormwater from a surface water collection pond under an NPDES permit. The facility is within the assessment area of Milburnie dam, but there are no known in-stream concerns. Groundwater beneath the facility ultimately discharges to the Neuse

River. The site's listing on the hazardous site index is related to historic on-site tannin production pits (active from 1966 to 1972 and filled-in in 1973). The pits contained acetone, methyl isobutyl ketone, acetic acid, toluene, isopropanol, ethanol and sodium hydroxide. On-site waste disposal (surface wastewater treatment basins – closed since the early 1990s when waste treatment moved to aboveground tanks) and an on-site landfill are other concerns. Site files at NCDWM indicate a long history of site assessment work on small portions of the overall site. Most recent analytical data indicate minimal shallow groundwater contamination from the former tannin pits and no concerns with the bedrock aquifer. However, extremely high concentrations of a variety of compounds were found in the transition zone between the upper and deep aquifer (Solutions-IES, 2005) most likely from a source other than the former tannin beds (perhaps the manufacturing area or former waste treatment ponds). Groundwater contamination discharges to some surface water features draining ultimately to the Neuse River, and these surface water features showed some inorganic chemical contaminants. Site-wide, the contaminants in groundwater that exceed State water quality standards are acetone, methyl isobutyl ketone, methyl ethyl ketone, phenol, methyl phenol, formaldehyde, benzoic acid, benzene, toluene, ethyl benzene, xylene, PCE, 1-2, DCA, 1,2-DCP, dichloromethane, chloroform, aniline, 2-nitrobenzene, n-nitrosodimethylamine, ammonia, sulfate, nitrate and chloride. While not site-wide, shallow and deep groundwater has been impacted by these pollutants. These exceedences of State standards will require corrective measures to be assessed, but the majority of the site contamination is within the site boundary. Due to the known contamination at the site and the uncertain extent to which surface water may have been impacted by waste disposal and spills through the years, the sediments adjacent to the site area recommended for additional assessment.

Weavexx Corporation (NONCD0002701) is the only facility for which records were retrieved which is not mapped in Figure 2. It is located north of the intersection of US1 and US1 Alternate, about 2.6 miles south of the town of Wake Forest. Operations at this facility ceased in 2003, and the extent of hazardous waste issues appears limited to a particular manufacturing area which has been remediated (removal of concrete slab, soil excavation and removal, confirmatory sampling (AWARE Environmental Inc., 2005)). The extent of contamination appears to have been defined and addressed and no off-site concerns were expected. The site does not need any specific follow-up relative to the dam evaluation.

Buckhorn Pesticides (NCD980845119) was an emergency soil and debris removal site following a March 1985 fire at an old storage building housing containers of DDT, endrin, dieldrin, parathion, and malathion (NCDENR 1985). Twenty-one soil samples taken in 1985 showed significant soil contamination near the building, and USEPA removed 175 cubic yards of soil following the fire. The site remains on the States IHWS list based on its history. Because the site has been remediated and is 1,500 feet from Buckhorn Creek (nearest surface water), it does not warrant follow-up in the dam evaluation.

Inquiries with the NCDWM Central Files did not locate site-specific information on Arrow Drive – Crabtree Creek [NONCD0001170] or RC Motor Company [NONCD0002377]. No additional information is available on these sites at present.

Searches for records within Wake, Wayne, Wilson, and Lenoir Counties also identified several facilities which were in the vicinity, but outside the assessment area and therefore not of concern in this assessment (e.g., Kinston Demolition Landfill [NCD075588913] which is near Southwest Creek and the Kellys Millpond assessment area but is located north of the Neuse River, and therefore, isolated from the assessment area; also, Westinghouse Meter and Light [NCD003195963], near the Milburnie dam and Lassiter Mill dam assessment areas but in the Crabtree Creek watershed downstream of Lassiter Mill dam).

One site that is outside the assessment areas does need to be discussed. The Ward Transformer Company, Inc. site (EPA ID: NCD003202603) is a Superfund site north of Aviation Parkway near Raleigh Durham International Airport which manufactures and services transformers and other electrical equipment. The site is contaminated with polychlorinated biphenyls (PCBs) from historic operations. Site drainage is to an unnamed tributary to Little Brier Creek, and Little Brier Creek flows to Brier Creek Reservoir, Lake Crabtree, and Crabtree Creek. While well upstream of Lassiter Mill dam assessment area, the potential for passing migratory fish above Lassiter Mill makes review of PCB data from Crabtree Creek pertinent.

Contractors collected sediment upstream of Lassiter Mill dam as part of a remedial assessment of contamination originating from the Ward site. The sediment sampling effort primarily focused on unnamed tributaries to Brier Creek and Little Brier Creek as well as Brier Creek Reservoir; however, several samples collected between November 2003 and March 2006 provide additional information about the potential for PCB contamination to have migrated downstream of Lake Crabtree. Two samples were collected from Brier Creek (between Brier Creek Reservoir and Lake Crabtree) corresponding to a maximum Aroclor 1260 concentration of 0.28 mg/kg (SD-66) in surface sediment. This sample consisted of predominantly (60%) fine silt and sand (31%) with limited clay present. Seven grab samples were collected from the vicinity of the relic Brier Creek and Crabtree Creek stream channel/floodplain (now submerged in Lake Crabtree) to further assess the potential for downstream contaminant transport. Maximum Aroclor 1260 (0.48 mg/kg) and PCB Congener TEQ concentrations (1,100 ng/kg, mammal) were found in surface sediment in a single sample (SD-39). A total of 12 sediment samples were collected in Crabtree Creek between Lake Crabtree and Crabtree Creek's confluence with the Neuse River. Descriptive information regarding the sample matrix was not available for four samples collected in 2004. Surface sediment Aroclor 1260 concentrations were less than 0.063 mg/kg in all samples. Subsequent sampling (n = 7) indicated a maximum Aroclor 1260 concentration of 0.049 mg/kg. Sample consistency was characterized as follows: 50 to 95 percent sand material with limited silt (five to 48 percent) and clay (one to six percent). While these concentrations are low, it is not clear that sediment depositional areas have been sampled for worst case scenario. Additional risk assessment evaluations should be explored to address impacts to moving fish upstream if that is envisioned.

Aerometric Information Retrieval System (AIRS) Facilities

Of the 334 facilities included in the AIRS database for Wake County, five in Raleigh are in the vicinity of the Milburnie and Lassiter Mill dam sites and are included in the NC Division of Air Quality's emission inventory as Title V (large emitters of one or more priority air pollutants)

facilities: Cargill, City of Raleigh Wilders Grove Landfill, Evergreen Packaging, North Carolina State University Central Heat Plant, and North Wake County Landfill Facility. Of these facilities, several are designated as major sources of the following hazardous air pollutants (HAPs) based on exceeding annual emissions thresholds reported in the 2004) toxic air pollutant point source emissions reports (NCDENR 2006): hexane and glycol ethers.

Five of 79 AIRS facilities in Wilson County are located near the unnamed dam site on Contentnea Creek and are considered Title V sources (Alliance One International Co., Inc, Bridgestone/Firestone Inc., Carolina Classic Manufacturing Inc., Kencraft Manufacturing Inc., and Saint Gobain Containers). The HAPs released in excess of thresholds defined for major HAP sources include hexane, methyl isobutyl ketone, methylene chloride, sulfuric acid, toluene, styrene, and methyl methacrylate.

Of the 70 AIRS facilities in Wayne County, three are found in Goldsboro near the unnamed Wayne County dam site (Cooper Standard Automotive – Fedelon Trail, Franklin Baking Company, and Progress Energy H.F. Lee Plant). The HAPs released at these facilities in excess of major source thresholds include butadiene, acetophenone, glycol ethers, methanol, toluene, acetaldehyde, hydrogen chloride, hydrogen fluoride, selenium, and sulfuric acid. Although not above HAP thresholds for major source designation, mercury compounds were released in significant quantities (105 pounds) from the Progress Energy facility.

Two AIRS facilities (Masterbrand Cabinets Inc. and UNIFI Kinston, LLC) of the 44 found in Lenoir County were located in Kinston near the Kellys Millpond dam and HAPs released in excess of thresholds defined for major sources include ethyl acetate, ethyl benzene, methanol, toluene, xylene, acetaldehyde, acetic acid, dioxane, ethylene glycol, hydrogen chloride, and hydrogen fluoride. Based on the HAP releases in counties where the impounded reaches of the five dams occur, there appears to be potential for localized influence of VOCs and metals (Unnamed Wayne County dam site) emissions on surface water resources via deposition.

Underground Storage Tank (UST) Incidents

The UST database identified 1647 incidents of releases in Wake County. Of these releases, ten impacted surface waters within a one-mile radius of the impounded reach for Lassiter Mill dam: Amaco Station #825, Han Dee Hugo #47, Exxon 4-0010 North Hills, Carolina Country Club, Browning Ferris Industries (or BFI Waste Industries), William Doucette Residence, Flink Property, Brooks Elementary School, Exxon 4-6215 Crabtree Valley, and Exxon 4-3001 Avery Upchurch. No incidents were reported to impact the site assessment area for the Milburnie dam.

The UST database identified 467 incidences of releases in Wayne County, of which, one reportedly impacted surface water and was located within one mile of the Little River. In Wilson County, 332 UST incidents are included in the database, and of the five affecting surface water, none were located in the site assessment area for the unnamed Wilson County dam on Contentnea Creek. Twenty one (of 430) UST incidents were reported to impact surface waters in Lenoir County; however, none were within the site assessment area for Kellys Millpond dam.

Reports and Other Data – Surface Water

Water quality information was available from the NCDWQ's basinwide assessment reports (NCDWQ 1996, 2001, 2006) and basinwide water quality management plans (NCDWQ 2002, 2008). Overall results of biological and chemical monitoring indicate main stem Neuse River water quality ratings of good-fair (relatively low in the State's rating system) in the Milburnie dam assessment area since the early 1980s. Water quality ratings of poor to good-fair were assigned for Crabtree Creek upstream of Lassiter Mill dam in 2000 and 2005. Water quality was not rated in the assessment areas for the remaining three dams (unnamed dams in Wilson and Wayne Counties and Kellys Millpond dam) (NCDWQ 2006).

Water chemistry is monitored in the assessment area of three of the Neuse River basin dams by NCDWQ at several stations:

Milburnie Dam

J1890000 Neuse River near Falls Lake, Wake County
J2330000 Neuse River at SR 2215, Wake County
J2360000 Milburnie Dam, Wake County

Lassiter Mill Dam
J2850000 Crabtree Creek near SR 1795, Wake County
J3000000 Crabtree Creek near SR 1649, Wake County
J3210000 Lassiter Mill Dam, Wake County

Unnamed Dam, Wilson County
J6740000 Contentnea Creek near Lucama, Wilson County

Common elemental contaminants included in monitoring at these sites include arsenic, cadmium, chromium, copper, iron, lead, manganese, nickel and mercury. Concentrations for most of these metals were at or below detection limits (NCDWQ 2008). Copper and iron concentrations frequently exceed the State action level of 7 µg/L (ppb) and 1 mg/L (ppm), respectively (http://www.epa.gov/storet/). Impacts of urbanization are noted from both the Neuse River upstream of Milburnie dam and several stations in Crabtree Creek (NCDWQ 1996, 2001, 2006).

Reports and Other Data - Sediments

No sediment data for the impounded reaches were located. Some regional sediment quality overviews were helpful (Childress and Treece 1996, Skrobialowski 1996, Woodside and Simerl 1996), but these USGS publications were largely summaries that lacked site-specific data. We worked with the USGS Water Resources office in Raleigh to retrieve data for individual stations from their database; of 843 Albemarle-Pamlico area sediment sample site results retrieved from their database (covering a period from December 1991 to August 2002), only one station, sampled a single time, overlapped with our assessment areas. A December 1992 sample of sediments from Crabtree Creek at US 1 in Raleigh contained arsenic (4.4 ug/g dry weight),

cadmium (0.3 ug/g dry weight), chromium (59 ug/g dry weight), copper (36 ug/g dry weight), lead (51 ug/g dry weight), mercury (0.05 ug/g dry weight), nickel (20 ug/g dry weight), and zinc (130 ug/g dry weight). Of these values, the threshold effects concentrations (TECs) reported by MacDonald et al (2000) are exceeded for chromium (TEC = 43.4 ug/g dry weight), copper (TEC = 31.6 ug/g dry weight), lead (TEC = 35.8 ug/g dry eight), and zinc (TEC = 121 ug/g dry weight). The TECs are not criteria or standards, they represent best professional judgment of the authors and cooperators on concentrations of contaminants in whole sediment below which adverse effects to sensitive aquatic organisms are not expected to occur. Exceedences of the TECs indicate these heavy metals may merit additional attention in evaluation of this urban watershed. None of the Crabtree Creek values exceed the probable effects concentrations (PECs, or concentrations of contaminants in whole sediment above which adverse effects to sediment-dwelling organisms may be expected) reported by MacDonald et al (2000).

Another source of actual sediment data retrieved was for the Little River near Lowell Dam from the Service's previous sediment study there (U.S. Fish and Wildlife Service 2005a,b). The Service collected and analyzed sediments for elemental contaminants and polycyclic aromatic hydrocarbons. Eighty-eight percent of all elemental contaminant results were less than TECs at this site well up-stream of the un-named Little River dam near Goldsboro. No samples exceeded the PECs.

Reviews

Review comments on a July 2008 draft version of this report were received from the NCDWM and NCDWQ. The NCDWM staff indicated agreement with our methodology, noting that the databases we searched include all those inventories maintained by NCDWM that contain sites relevant to the study. Because those databases may not include all sites currently in NCDWM inventories, they canvassed other solid and hazardous waste staff to inquire whether or not there are newer sites of consequence located in the five drainage areas, and found none.

The NCDWQ's review concurred with the findings in our draft report. They noted in particular the need for additional consideration of PCBs at Lassiter Mill dam if any sediment-disturbing work is proposed there. They noted also that the recommended follow-up work at Milburnie dam was appropriate because of the developed nature of, and discharges into, the watershed. In addition to the facilities we reviewed, NCDWQ notes that impacts from extensive development, a salvage yard, and landfills may have contributed to pollution of the Neuse River sediments in the upstream area. The NCDWQ concurred with the recommended focus on heavy metals and hydrocarbons.

Summary and Recommendations

Collectively, these data indicate no known major organic or inorganic pollutant problems in the one-mile assessment area surrounding the impounded reaches of the dams.

Much of the assessment area for the dams on Little River, Contentnea Creek and Southwest

Creek remains in an undeveloped rural character (forestry and small farms). No issues of concern were identified during the database or file reviews for these dams' assessment areas, and their current breached condition makes them very ineffective sediment traps. No further sediment characterization work is recommended at these three sites unless confirmatory sampling (expected to show only background levels of pollutants) is desired.

The assessment areas for Milburnie and Lassiter Mill dams are urbanized with known water quality degradation. Two large municipal and one industrial facility having documented controlled or uncontrolled releases of pollutants were identified within the assessment area of Milburnie dam. Highway run-off is a concern for the assessment areas of both Milburnie and Lassiter Mill dams, and biological monitoring data indicate impairment of the benthic communities in these two watersheds, attributed to urbanization influence. There were no sediment sample results available for the impounded reaches making a direct assessment difficult, so new data area needed. If sediment disturbing activities are proposed at these assessment areas, they warrant additional data collection (i.e., a tier 2 assessment), with an emphasis on heavy metals and hydrocarbons (markers of urban run-off and other sources). Also, additional review of the implications of low level PCB contamination in Crabtree Creek should be conducted if further work is proposed at that facility.

The Service is available to assist the USACE and partners in developing and implementing a sampling and analysis plan for the impounded reach of Milburnie. Elemental contaminants and polycyclic aromatic hydrocarbons (PAHs) should be evaluated in all samples. These classes of compounds include many common pollutants, are good markers of urbanization, and have consensus-based freshwater effects sediment quality guidelines (MacDonald et al. 2000, USEPA 2000b) with which to evaluate the results. While North Carolina has no sediment quality standards or guidelines, the consensus based guidelines have been widely used elsewhere. The State of Florida recommended these for use as guidance in many of their programs, including evaluation of dredged material and risk assessment of contaminated sites (MacDonald et al. 2003). In a review by experts on sediment assessment, application of such sediment quality guidelines was found to offer good utility in site assessment (Wenning and Ingersoll 2002). Sample results can also be compared to bioaccumulation-based sediment quality guidelines (Ingersoll et al. 1997). This approach would have the advantage of evaluating pollutants of concern with pre-defined criteria upon which to gage the significance of results. All samples should also be analyzed for total organic carbon and grain size to aid in interpretation of results. Because of the history of mixed waste discharged upstream of Milburnie dam, sediment toxicity tests with sensitive freshwater organisms should be conducted along with the sediment chemistry. Recommended toxicity tests include the 28-day *Hyallela azteca* (freshwater amphipod) survival and growth assay with bulk sediment, and the 48-hour *Ceriodaphnia dubia* (freshwater cladoceran) survival bioassay with sediment elutriate. This battery would help evaluate the toxicity of sediments, both in-place and upon re-suspension. Each assay has established protocols and contract labs routinely run these assays (*H. azteca* survival and growth assay with bulk sediment by USEPA 2000a, ASTM 2007 and the elutriate tests with *C. dubia* via USEPA 1993).

References

Anderson, J., W. Birge, J. Gentile, J. Lake, J. Rodgers, Jr. and R. Swartz. 1987. Biological effects, bioaccumulation, and ecotoxicology of sediment associated chemicals. Pages 276-296 *in* K.L. Dickson, A.W. Maki and W.A. Brungs, eds. *Fate and Effects of Sediment-bound Chemicals in Aquatic Systems*. Pergamon Press, Toronto.

Arnwine, D.H., K.J. Sparks and R.R. James. 2006. Probabilistic monitoring of streams below small impoundments in Tennessee. Tennessee Department of Environment and Conservation, Division of Water Pollution Control, Nashville, TN.

ASTM International. 2005. Standard practice for environmental site assessments: Phase I environmental site assessment Process (E1527-05). *ASTM International Annual Book of Standards*, West Conshohocken, PA.

ASTM International. 2007. Standard test method for measuring the toxicity of sediment-associated contaminants with freshwater invertebrates (E1706-05). *ASTM Annual Book of Standards*, Vol. 11.06, West Conshohocken, PA.

AWARE Environmental, Inc. 2005. Soil remediation documentation report. Hot oil room / finishing machine area. Weavexx Corporation, Wake Forest, North Carolina. AWARE, Charlotte, NC.

Childress, C.J.O. and M.W. Treece, Jr. 1996. Water and bed-material quality of selected streams and reservoirs in the Research Triangle area of North Carolina, 1988-94. U.S. Geological Survey Water-Resources Investigations Report 95-4282.

City of Raleigh. 1985. Letter from W.L. Baird, Public Works Director, to G. Nicholson, NCDENR, NCDWM, Solid and Hazardous Waste Branch re: two closed-out Raleigh solid waste sites. Raleigh, NC.

GeoTechnologies, Inc. 1999. Proposed remedial action plan Howard Johnson/Crabtree Landfill Site. Project No 1-95-0856-EA.

Freeman, M.C., C.M. Pringle, E.A. Greathouse and B.J. Freeman. 2003. Ecosystem-level consequences of migratory faunal depletion caused by dams. *American Fisheries Society Symposium* 35: 255-266.

Ingersoll, C.G., T. Dillon and R.G. Biddinger (eds). 1997. *Ecological Risk Assessment of Contaminated Sediment*. SETAC Press, Pensacola, FL.

MacDonald, D.D., C.G. Ingersoll and T.A. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. *Arch. Environ. Contam. Toxicol.* 39: 20-31.

MacDonald, D.D. and C.G. Ingersoll. 2002a. A guidance manual to support the assessment of contaminated sediments in freshwater ecosystems. Volume I - An ecosystem-based framework for assessing and managing contaminated sediments. EPA-905-B02-001-A. USEPA, Great Lakes National Program Office, Chicago, IL.

MacDonald, D.D. and C.G. Ingersoll. 2002b. A guidance manual to support the assessment of contaminated sediments in freshwater ecosystems. Volume II - Design and implementation of sediment quality investigations. EPA-905-B02-001-B. USEPA, Great Lakes National Program Office, Chicago, IL.

MacDonald, D.D., C.G. Ingersoll, D.E. Smorong, R.A. Lindskoog, G. Sloane and T. Biernacki. 2003. Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters. Florida Department of Environmental Protection. Tallahassee, FL.

Neves, R.J., A.E. Bogan, J.D. Williams, S.A. Ahlstedt and P.W. Hartfield. 1997. Status of mollusks in the southeastern United States: A downward spiral of diversity. Pages 31-85 *in* G.W. Benz and D.E. Collins, eds. *Aquatic Fauna in Peril: The Southeastern Perspective*. Special Publication 1, Southeast Aquatic Research Institute, Lenz Designs and Communications, Decatur, GA.

North Carolina Department of the Environment and Natural Resources. 1985. Letter from L.E. Bramble, Solid and Hazardous Waste Management Branch to D. Bland, USEPA, Atlanta, GA. NC Division of Waste Management, Raleigh, NC.

North Carolina Department of the Environment and Natural Resources. 1999. Letter from J.W. Walch, Inactive Hazardous Sites Branch to F. Holmes, Hobby Properties, Inc. re. Howard Johnsons/Crabtree landfill Site. NC Division of Waste Management, Raleigh, NC.

North Carolina Department of the Environment and Natural Resources. 2007. Memorandum from K. Snavely, Inactive Hazardous Sites Branch to File re: Burlington Mills, Wake Finishing Plant. NC Division of Waste Management, Raleigh, NC.

North Carolina Division of Water Quality. 1993. Neuse River basinwide water quality management plan. Planning Branch, Water Quality Section, Raleigh, NC.

North Carolina Division of Water Quality. 1996. Basinwide assessment report: Neuse River basin. Environmental Sciences Branch, Water Quality Section, Raleigh, NC.

North Carolina Division of Water Quality. 2001. Basinwide assessment report: Neuse River basin. Environmental Sciences Branch, Water Quality Section, Raleigh, NC.

North Carolina Division of Water Quality. 2002. Neuse River basinwide water quality management plan. Planning Branch, Water Quality Section, Raleigh, NC.

North Carolina Division of Water Quality. 2006. Basinwide assessment report: Neuse River basin. Environmental Sciences Branch, Water Quality Section, Raleigh, NC.

North Carolina Division of Water Quality. 2008. Neuse River basinwide water quality management plan. Planning Branch, Water Quality Section, Raleigh, NC.

Richter, B.D., D.P. Braun, M.A. Mendelson and L.L. Master. 1997. Threats to imperiled freshwater fauna. *Conserv. Biol.* 11: 1081-1093.

Rodgers, J.H. Jr., K.L. Dickson, F.Y. Saleh, and C.A. Staples. 1987. Bioavailability of sediment-bound chemicals to aquatic organisms - some theory, evidence and research needs. *in* K.L. Dickson, A.W. Maki and W.A. Brungs, eds. *Fate and Effects of Sediment-Bound Chemicals in Aquatic Systems*. Pergamon Press, Toronto.

Skrobialowski, S.C. 1996. Water-quality assessment of the Albemarle-Pamlico drainage basin, North Carolina and Virginia. A summary of selected trace element, nutrient, and pesticide data for bed sediments, 1969-90. U.S. Geological Survey Water-Resources Investigations Report 96-4104.

Solutions-IES, Inc. 2005. Phase II RCRA Facility Investigation Report. Mallinkrodt Inc. Raleigh Pharmaceutical Plant. Raleigh, NC.

U.S. Environmental Protection Agency. 1993. Assessment and remediation of contaminated sediments (ARCS) program. Biological and chemical assessment of contaminated Great Lakes sediment. EPA 905/R-93/006, Chicago, IL.

U.S. Environmental Protection Agency. 1995. Letter from C. Gurley, Site Assessment Section, to P. DeRosa, NCDWM CERCLA Branch re: Site Inspection Prioritizations. USEPA, Atlanta, GA.

U.S. Environmental Protection Agency/U.S. Army Corps of Engineers. 1998. Evaluation of dredged material proposed for discharge in waters of the U.S. - Testing Manual. EPA-823-B-98-004, Washington, DC.

U.S. Environmental Protection Agency. 2000a. Methods for measuring the toxicity and bioaccumulation of sediment-associated contaminants with freshwater invertebrates, second edition, EPA/600/R-99/064, Washington, DC.

U.S. Environmental Protection Agency. 2000b. Prediction of sediment toxicity using consensus-based freshwater sediment quality guidelines. EPA 905/R-00/007, Chicago, IL.

U.S. Fish and Wildlife Service. 2004. *Draft Tier 1 Preliminary Evaluation of Sediments within the Lowell Dam Impounded Reach, Johnston County, North Carolina*. USFWS, Raleigh Field Office, Raleigh, NC.

U.S. Fish and Wildlife Service. 2005. *Draft Preliminary Evaluation of Sediment Chemistry Data (Tier 2) for Little River near Lowell Dam*. USFWS, Raleigh Field Office, Raleigh, NC.

Watters, G.T. 2000. Freshwater mussels and water quality: A review of the effects of hydrologic and instream habitat alterations. Proceedings of the First Freshwater Mollusk Conservation Society Symposium, 1999. Pages 261-274. Ohio Biological Survey.

Wenning, R.J. and C.G. Ingersoll. 2002. Summary of SETAC Pellston Workshop on Use of Sediment Quality Guidelines and Related Tools for the Assessment of Contaminated Sediments; 17-22 August 2002; Fairmont, Montana, USA. Society of Environmental Toxicology and Chemistry (SETAC), Pensacola, FL.

Woodside, M.D. and B.R. Simerl. 1996. Water-quality assessment of the Albemarle-Pamlico Basin, North Carolina and Virginia-Chemical analyses of organic compounds and inorganic constituents in streambed sediment, 1992-93. U.S. Geological Survey Open-File Report 96-103.