APPENDIX J

DEMPSEY BENTON WATER TREATMENT PLANT (WTP)

- USFWS Biological Opinion for the Dempsey Benton WTP
- April 2008 Letter from City of Raleigh to USACE

USFWS Biological Opinion for the Dempsey Benton WTP

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Raleigh Field Office
Post Office Box 33726
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February 23, 2006

Colonel John Pulliam
District Engineer, Wilmington District
U.S. Army Corps of Engineers
Post Office Box 1890
Wilmington, North Carolina 28402-1890

Attn: Jean Manuele

Dear Ms. Manuele:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the proposed Dempsey E. Benton Water Treatment Plant (Project) located in Wake County, North Carolina and its effects on the dwarf wedgemussel (*Alasmidonta heterodon*, DWM) in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 United States Code [U.S.C.] § 1531 *et seq.*) (Act). Your June 20, 2005 request for formal consultation was received on June 21, 2005.

This biological opinion is based on information provided in the June 2005 biological assessment (BA) (ENTRIX, 2005), the June 2005 Draft Environmental Assessment (DEA) (ARCADIS, 2005), telephone conversations, field investigations and other sources of information. A complete administrative record of this consultation is on file at this office.

Consultation History

The Service, through the informal consultation process, has met with representatives from the City of Raleigh (City) and their consultants at Arcadis G&M and Entrix, Inc. regularly since the scoping process was initiated in 2001. Biologists and other representatives with the North Carolina Wildlife Resources Commission (WRC), the North Carolina Natural Heritage Program (NHP) and the North Carolina Division of Water Quality (DWQ) have also been involved in the informal consultation process because of their expertise with the DWM and aquatic resources, in general. Table 1 includes a more detailed history of the consultation process for the proposed project and is adapted here from section 1.2 of the BA.

Table 1. Consultation History, adapted from Table 1-2 of the BA.

Consultation/Scoping Action	Date
Identification of scoping team and compilation of existing Swift Creek flow, biological and water quality data	October 2001
Field visits with agencies	October 2001
Issue Draft Study Plan for Swift Creek Instream Flow Study for review	November 2001
Scoping meeting, technical meeting regarding methods to address mussel habitat, site visit with agencies	November 2001
Consultants compiled comments and recommendations	December 2001 – January 2002
Issue Final Study Plan for Swift Creek Instream Flow Study for review and approval	February 2002
Selected appropriate study reaches	April 2002
Selected and developed habitat suitability criteria in consultation with scoping team	August 2002
Consultants accomplished field work, modeling, and results interpretation modeling	June 2002 – March 2003
Consultants issued Draft Swift Creek Instream Flow Study Report for review and comment	April 2003
Modeling results meeting	July 2003
Development of additional minimum flow alternatives, additional modeling and analyses	August 2003 – February 2004
Swift Creek Instream Flow Study Technical Meeting to review results of additional modeling	March 2004
Development of modified Index C analyses	March 2004
Swift Creek Instream Flow Study Technical Meeting to review modified Index C results	April 2004
Technical meeting to discuss mussel habitat impact analysis and interpretation	August 2004
Project application for Section 404 authorization; U.S. Army Corps of Engineers (USACE) coordination	September – October 2004
Scoping meeting held to reach concurrence on content and scope of BA	October 2004
Refined mussel habitat impact analysis; additional consultation with Service	December – January 2005
Consultation with Service about Refined Mussel Habitat Impact Analysis	January 2005
Issuance of Draft BA for review and comment	February 2005
City provided a response to resource agency review of Draft BA and submittal of Revised Draft BA	May 2005
City provided a response to resource agency review of Revised Draft BA and issuance of Final BA	June 2005
Service received letter from USACE and final BA requesting the initiation of formal consultation	June 21, 2005
Service provided the USACE with a letter stating the BA is complete	July 21, 2005

Table 1. Consultation History, adapted from Table 1-2 of the BA.

Consultation/Scoping Action	Date
and that a BO will be provided by November 3, 2005	

BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

The proposed Dempsey E. Benton Water Treatment Plant Project will be located on an impounded section of Swift Creek known as Lake Benson. Lake Benson is located south of Garner in Wake County, North Carolina. Swift Creek flows in a general northwest to southeast direction from its headwaters between Apex and Cary in Wake County to its confluence with Middle Creek and then shortly downstream, into the Neuse River near Smithfield in Johnston County, North Carolina.

The Project consists of the construction of a new 20 million-gallons-per-day (mgd) water treatment plant and associated ancillary facilities. The proposed Project water withdrawal would average 14-mgd. This Project represents reactivation of Lakes Wheeler and Benson as a water supply source. The lakes were formerly used as a water supply source from 1953 to 1987. The proposed Project would provide the dependability and reliability of a second water supply source for the City of Raleigh and assist in meeting the post-2010 water supply needs of the area. In addition to the City of Raleigh, the service area for the Project would include the Towns of Garner and Rolesville (Figure 1). Although Rolesville is located within the City's service area, no new water lines are planned there in association with the Project, and most of the water supplied to Rolesville would come from the City's existing E.M. Johnson Water Treatment Plant.

Specific elements of the Project would include the following:

- The new water treatment plant (WTP) would be constructed on a 55-acre site near the intersection of Highway 50 and Buffalo Road. The site, which is predominately forested, is bordered by Swift Creek to the south and Mahlers Creek to the east and includes an existing wastewater pumping station for the Town of Garner. The new facility would consist of the main WTP, a chemical bulk-storage facility, finished water storage via a 5 million gallon composite tank, a containment pond for emergency finished water overflow, and a finished water pump station.
- Upgrades and retrofits at the existing raw water pump station adjacent to the Lake Benson Dam would be used to deliver water to the new WTP. The existing antiquated intakes on the upstream side of the dam would be replaced with new intake screens. The existing raw water pump station would be upgraded and retrofitted to house new raw water pumps, existing pump dry wells would be converted into wet wells, motorized controls on the intake control gates would be added, and chemical pretreatment facilities would be constructed. The pretreated water would be pumped under Highway 50 to the proposed WTP via new 36 to 48-inch-diameter water mains.

- A new minimum flow release structure would be constructed in the spillway at Lake Benson Dam near the existing raw water pump station. Also at that location, a work/maintenance platform will be cantilevered over the spillway to allow access to the new valve assembly. The minimum release valve assembly would allow the City to accurately provide minimum flows in Swift Creek as specified in the tiered minimum release schedule.
- At the Lake Wheeler Dam site, the existing water-control tower in the lake would be upgraded. The existing manual, water-level-control valves in the tower would be replaced with a motorized, remotely operated system. Motor and computerized controls would be added to the top of the existing water control tower and covered with a small shed-like structure. A new, 100 foot long concrete foot-bridge would be placed over the lake, from the top of the dam to the tower, to facilitate access. A six inch diameter pipe at Lake Wheeler Dam would provide for continuous release of controlled downstream flows, which would be monitored by a weir and flow meter that would be added to the dam outfall.
- A new 24 inch diameter outfall would be constructed to discharge filter backwash effluent, a treated by-product of the WTP filtration process, to Lake Benson. The discharge point would be located in the narrow, north-reaching arm of Lake Benson just upstream of Buffalo Road. This discharge would represent a new National Pollutant Discharge Elimination System (NPDES) discharge, and would be permitted in accordance with applicable NPDES requirements.
- A second, intermittent discharge would be regulated by the NPDES permitting process. The discharge from an emergency overflow of the finished water clearwell at the WTP site would be routed to a one million gallon capacity, containment pond. The finished water contained in the pond following an emergency overflow event would either be allowed to naturally dechlorinate or be chemically dechlorinated. Once dechlorinated, the discharge would be manually released to Mahler's Creek via sheet flow over grassy terrain.
- New water transmission mains would be constructed to inject water treated at the WTP into the City's existing distribution system. A new 3.6-mile-long, 48-inch-diameter finished water transmission main would be constructed within the existing City of Raleigh water line easement corridor extending from the Lake Benson raw water pump station to north of the US 70 intersection at Mechanical Boulevard. Just north of the US 70 intersection, the finished water transmission main would split into a 36 inch and a 30 inch water main. The 36-inch main would extend approximately 6.7 miles, co-locating within existing roadway easements along Garner Road, Creech Road, Sanderford Road, Rock Quarry Road, and Martin Luther King Jr. Boulevard. The 30 inch transmission main would continue approximately 3.5 miles within the existing City of Raleigh water line easement to an interconnect with an existing 30 inch main at the E.B. Bain Re-Pumping Facility. A 16 inch water main would follow Lake Benson Road from the WTP site to an interconnect with an existing main at Atchison Street.

Table 1-1 of the BA includes a list of federally threatened and endangered species and federal species of concern that could occur within the project area. Of those species that are federally protected (threatened or endangered), the Service, during a meeting on

October 19, 2004, concurred that the Project will have no effect on the Tar River spinymussel *(Elliptio steinstansana),* bald eagle *(Haliaeetus leucocephalus),* red-cockaded woodpecker *(Picoides borealis)* and Michaux's sumac *(Rhus michauxii).* The DWM is federally listed as an endangered species, and a population of the species is known to occur in Swift Creek downstream of Lake Benson. Implementation of the proposed project has the potential to affect the DWM.

Conservation Measures

The City of Raleigh, in consultation with the Service, has agreed to incorporate the following conservation measures into the Project to minimize adverse impacts to DWM, as described in the BA.

Construction Related Effects

- The City agrees to develop site specific Erosion and Sedimentation Control (ESC) Plans for each major activity associated with Project construction. Plans will be approved by Division of Land Resources (DLR) and DLR staff will conduct inspections weekly or after every 0.5 inch rainfall event.
- The site specific ESC Plans will include the following elements to minimize erosion:
  - To the maximum extent possible, fit the development to existing site conditions;
  - Minimization of the extent and duration of bare soil exposure;
  - Protection of disturbed areas from storm water runoff;
  - Stabilization of areas of disturbed soil;
  - Minimization of run-off velocities;
  - Use of traps, barriers, basins or other measures to keep sediments onsite;
  - Inspection and maintenance of control measures; and
  - Restoration / revegetation of the site as soon as practical.

Minimum Flows

- The City will implement a tiered, minimum flow release schedule that will achieve a no greater than ten percent reduction in safe yield, as regulated by the statues of the NC 1995 Dam Safety Rules. Minimum flow releases for Tier 1, Tier 2 and Tier 3 will not exceed 3.0 cubic-feet-per-second (cfs), 2.0 cfs and 1.0 cfs, respectively.
- The City will notify the Service whenever Tier 3 minimum flow releases (1.0 cfs) from Lake Benson Dam are maintained for in excess of seven consecutive days.
- The City will place a maximum threshold on the base withdrawal rate of the Project and limit the frequency of maximum withdrawal rate operation.
  - The base withdrawal rate for the Project is 14 mgd; however, the City will occasionally increase withdrawals to 20 mgd in order for the City's E.M. Johnson WTP to be taken off line to aid maintenance activities at that facility. These short term increases in withdrawal rates at the Lake Benson Dam will be limited to high flow periods when both Lake Wheeler and Lake Benson are full and the total stream flow at Lake Benson Dam is greater than 40 cfs;

therefore, a minimum flow of nine cfs would still flow over the Lake Benson Dam during these increased withdrawal periods.

- The City will operate Lake Benson Dam in a manner that avoids or effectively minimizes rapid reductions in downstream flow.
  - The Project will not induce rapid changes in downstream flows or stream stage. By controlling and managing minimum flow releases at Lake Benson Dam, mussel habitat will be protected against potentially more rapid, natural decreases in flow which would reduce wetted stream area and possibly strand DWM on dry ground or in very shallow water.

Water Quality

- The City will construct a new water intake structure at Lake Benson Dam to aid minor adjustments in the depth of water withdrawals from the reservoir to make sure that the water withdrawn has appropriate temperature and dissolved oxygen (DO) levels for downstream releases to Swift Creek.
  - A new minimum flow release structure will be installed to control the rate of downstream releases to Swift Creek. The new structure will incorporate an aerating nozzle or other turbulent flow feature to make sure that adequate aeration of downstream discharges.
- The City will decommission Indian Creek Overlook and Mill Run Mobile Home Park Waste Water Treatment Plants (WWTP). Both WWTP facilities have recently been cited for non-compliance and their effluent currently discharges into Swift Creek. The wastewater that is now discharged by these facilities into Swift Creek will be rerouted to the City's Neuse River WWTP, substantially reducing the existing load of potential harmful pollutants and improving water quality in Swift Creek.

Land Acquisition

- The City will purchase two greenway corridors in the Swift Creek watershed that are important for water quality and riparian corridor protection. These lands include the following:
  - Steep Hill Creek Corridor, a 300 foot buffer along 7.23 miles of Steep Hill Creek (which drains into Lake Benson) encompassing 516 acres.
  - Lake Wheeler/Lake Benson Corridor, a 300 foot buffer along 4.06 miles of Swift Creek between Lake Wheeler and Lake Benson encompassing 346 acres.

Watershed Protection Measures

- The City has played an important role in the development of new watershed protection measures for the lower Swift Creek watershed in Wake County. These measures will offset the overland pollutants that would originate from new development in the Swift Creek watershed in Wake County. In addition, Johnston County recently expanded the boundaries of its Environmentally Sensitive Area Overlay District in order to protect portions of the lower Swift Creek watershed that occur in Johnston County.

- Wake County, in coordination with the Service and the NC Department of Transportation (NCDOT), has prepared a final draft Resource Conservation Overlay District II (RCOD-II) ordinance for the proposed watershed protection area (see Figure 6-3 in the BA).
  - The RCOD-II increases stream buffers from 50 feet to 100 feet for all perennial streams within the proposed area, as identified by the 1999 Wake County Surface Water Survey Mapping Project. This will protect about 250,000 linear feet of stream channel and 1,032 acres of land adjacent to streams. Restrictions on allowable activities within the 100 foot stream buffer are outlined in Table 2 of the final draft RCOD-II Ordinance.
  - The RCOD-II Ordinance re-codifies Wake County's existing stormwater ordinances as follows:
    - Peak stormwater runoff (one year storm event) leaving any site post-development must be less than ten percent over pre-development conditions.
    - Impervious surfaces in residential districts with no stormwater controls can not occupy more than 15 percent of the total parcel size. Maximum impervious surface coverage for residential districts with stormwater controls must be no greater than 30 percent.
    - New development must not exceed a nitrogen export-loading rate of 3.6 pounds-per-acre-per-year (lbs/ac/yr) unless excess nitrogen loading is offset by a one-time payment to the NC Ecosystem Enhancement Program (EEP). The maximum nitrogen load from residential development must not exceed six lbs/ac/yr.
- The Town of Garner, in coordination with the Service and the NCDOT agreed to continue the use of their current stream buffer standards as outlined in Section 7.2.D. of their Unified Development Ordinance (UDO).
  - According to the UDO, this Watershed Conservation Buffer is required to be an undisturbed buffer, the width of which includes the 100 year floodplain plus an additional 50 feet on streams listed in Section 7.2.D of the UDO. These requirements will provide enhanced protections for a total of about 1,050 acres within the proposed watershed protection area. The Town does not allow development within the 100 year floodplain (319 acres of the total protected acreage). About 73 miles of perennial and intermittent stream channel are already protected by the 50 foot stream buffer requirements, per the Neuse River Buffer Rules, which would encompass about 731 acres of the total protected acreage within the proposed watershed protection area.
  - The Town of Garner Development Standards for Stormwater Management limits the nitrogen export for new development to 3.6 lbs/ac/yr.
    - Residential developers have the option of making a one-time payment to the EEP for nitrogen loading rates in excess of 3.6 lbs/ac/yr but loading rates may not exceed six lbs/ac/yr.
    - New single-family detached residential development is limited to 30 percent impervious surfaces.
    - New multi-family detached residential development is limited to 50 percent impervious surfaces.

    - New non-residential development is limited to 50 percent, though up to 70 percent is allowed with treatment consistent with the Neuse River Nitrogen Rules.
- Johnston County, in coordination with the Service and the NCDOT, has developed protective measures within an Environmentally Sensitive Area Overlay District.
    - Johnston County has agreed to expand the boundaries of its existing Environmentally Sensitive Area Overlay District (District) as defined in its Land Development Code. The expanded boundary will include those portions of the Swift Creek watershed protected by the original District as well as the Little Creek watershed (see Figure 6-3 in the BA).
    - The Environmentally Sensitive Area Ordinance requires a 100 foot buffer on the main stem of little creek from its confluence with Swift Creek to the crossing of the proposed Clayton Bypass.
    - No development (residential or non-residential structures) is allowed within special flood hazard areas within the District
- Johnston County has agreed to modify its Stormwater Management Ordinance to reduce allowable total nitrogen loads from new development within the existing and proposed District.
    - Nitrogen loading contributed by new development must be limited to 3.6 lb/acre/year. Developers of commercial property within the District will have the option of offsetting the nitrogen loading from commercial development by using additional Best Management Practices or by paying into the EEP. When using the offset payment, the total nitrogen loading from a development must not exceed eight lb/acre/year. Residential development may not use the EEP offset option, but must limit nitrogen loading to 3.6 lbs/acre/year.
- Johnston County has agreed to apply impervious surface limitations to the District.
    - Impervious surfaces will be limited to 12 percent for residential development and 50 percent for commercial development.
    - These limits could be increased to 30 and 80 percent, respectively, if payments are made to the Land Dedication Fund or if there is a direct dedication of land, as described in the Johnston County Stormwater Design Manual.

Environmental Monitoring

Stream Flow Gauging

- The City will cooperate with the U.S. Geological Survey (USGS) to provide matching and/or other required funding to sponsor and establish a USGS flow gauging station at an appropriate location on Swift Creek downstream of Lake Benson Dam. The specific details of the flow gauging station (e.g., monitoring details, flow data availability and storage, etc.) will be determined with the USGS in consultation with the Service and the NC Division of Water Resources (DWR).

Mussel Surveys

- The City will fund and / or perform periodic surveys of the Swift Creek mussel and DWM population downstream of Lake Benson Dam.
  - A baseline mussel survey in Swift Creek and Mahler's Creek will be performed following completion of this consultation, but prior to project construction.
  - Additional mussel surveys will be conducted within the Swift Creek watershed downstream of Lake Benson after the project is implemented. Four surveys will be conducted over a period of 20 years (one survey every five years).
  - Mussel survey plans will be coordinated with the Service, WRC and NHP. Staff from these agencies will be invited to participate in the surveys and any data collected from those surveys will be shared with the same agencies.
  - The protocols for these surveys will be developed in consultation with the Service, WRC and NHP.

Water Quality Data Collection

- The City will set up a water quality monitoring station at or near the USGS stream flow gauging station to monitor for temperature, dissolved oxygen, turbidity, pH, and total suspended solids via grab samples on a monthly basis.
- The City will monitor water quality at the raw water intake at Lake Benson Dam on a weekly basis.
- The City will develop and coordinate the details of its water quality monitoring plan with the Service and DWQ.

A complete discussion of the City's mitigation package and conservation measures can be found in Chapter 6 of the BA and in the DEA (Arcadis, 2005).

The action area includes the proposed Project construction footprint in the vicinity of the Lake Benson Dam and the lower Swift Creek watershed including about 15 miles of Swift Creek downstream from the dam at Lake Benson to its confluence with Middle Creek (Figure 2).

STATUS OF THE SPECIES

Species/critical habitat description

The DWM was federally-listed as endangered on March 14, 1990. At one time, this species was recorded from 70 localities in 15 major drainages ranging from North Carolina to New Brunswick, Canada. Currently, there are more than 85 documented locations for DWM (Appendix A). Of these, about 18 are known or are believed to be reproducing populations. At least 31 of these sites are based on less than five individuals or solely on spent shells. The only known occurrence in New Brunswick, Canada (Petticodiac River) appears to be historic. The Swift Creek and Middle Creek DWM populations are the southernmost population of this species. There is no critical habitat designated for this species in North Carolina.

The DWM is the only North American freshwater mussel that has two lateral teeth on its right valve and only one lateral tooth on its left valve. The outer shell is often dark with a greenish cast, though it may be faintly rayed in younger, lighter animals. The anterior end is rounded while the posterior end is lengthened and angular, giving this mussel its characteristic "wedge-shape". The DWM rarely exceeds 1.5 inches long.

Life history, Population dynamics, Status and distribution

The DWM has been found in substrates including firm sand, clay banks, muddy sand, and mixed sand, gravel and cobble. In the southern portion of its range, it is often found buried under logs or root mats in shallow water (Service, 1993). In the northern portion of its range, the dwarf wedgemussel has been found in firm substrates of mixed sand, silt, gravel, cobble, or embedded in clay banks in water depths of a few inches to greater than 20 feet (Fichtel and Smith, 1995; Gabriel, 1995; Gabriel, 1996; Nedeau, et al. 2003).

The reproductive cycle of freshwater mussels appears to be similar for nearly all species. During the spawning period, sperm is discharged by males into the water column, and taken in by females during siphoning. Eggs are fertilized in the gills, which serve as marsupia for larval development to mature glochidia. Upon release into the water column, mature glochidia attach to the buccal cavities, gills and fins of appropriate host fish to encyst and eventually drop off onto the substrate as juvenile mussels.

The DWM is considered to be a long-term brooder. In Virginia, this species spawns in late summer, and becomes gravid in September with glochidia maturing in November (Michaelson, 1993). Michaelson (1993) estimated that DWM release glochidia in North Carolina in April. McLain and Ross (2005) measured the most glochidia during April and May in the Mill River in MA. Host fish for this species include the tessellated darter (*Etheostoma olmstedi*), Johnny darter (*E. nigrum*), and mottled sculpin (*Cottus bairdi*) (Michaelson and Neves 1995).

Human activity has significantly degraded DWM habitat causing a general decline in populations and a reduction in distribution of the species (Michaelson, 1993; Service, 1993). Primary factors responsible for the decline of the DWM include: 1) impoundment of river systems, 2) pollution, 3) alteration of riverbanks, and 4) siltation (Service, 1993).

Damming and channelization of rivers throughout the DWM's range have resulted in the elimination of some of its formerly-occupied habitat. In general, dams and river channelization activities result in the loss or alteration of mussel habitat (Watters, 2001). Immediately upstream of a dam, conditions such as heavy silt deposition, low current and low oxygen levels are not conducive to the maintenance of DWM populations. Immediately downstream of these dams, remaining habitat is subject to daily water level and temperature fluctuations and scour, conditions stressful or intolerable to sensitive DWM.

Domestic and industrial pollution was the primary cause for mussel extirpation at many historic sites. Mussels are known to be sensitive to the adverse effects of heavy metals

and pesticides, and to high levels of nutrients and chlorine. Mussel die-offs have been attributed to chemical spills, agricultural waste run-off and low DO levels (Havlik and Marking, 1987). Some pollutants indirectly impact the mussels; for example, nitrogen and phosphorus cause organic enrichment, and in extreme cases, oxygen depletion.

Siltation, generated by road construction, agriculture, forestry activities, and removal of streambank vegetation, is considered to be an important factor in the decline of many freshwater mussel species, including the DWM. Sediment loads in rivers and streams during periods of high discharge may be abrasive to mollusk shells. Erosion of the outer shell allows acids to reach and corrode underlying shell layers (Harman, 1974). Irritation and clogging of gills and other feeding structures in mussels occurs when suspended sediments are siphoned from the water column (Loar et al., 1980), affecting the mussel's normal activity or even causing death.

Because freshwater mussels are relatively sedentary and cannot move quickly or for long distances, they cannot easily escape when silt is deposited over their habitat. Ellis (1936) found that mussels could not survive in substrate on which silt accumulated to depths over 0.2 – 1.0. He observed dying mussels with large quantities of silt in their gills and mantle cavities and attributed their deaths to interference with feeding and to suffocation. In addition, Ellis determined that siltation from soil erosion reduced light penetration, altered heat exchange in the water, and allowed organic and toxic substances to be carried to the bottom where they were retained for long periods of time. This resulted in further oxygen depletion and possible absorption of these toxicants by mussels (Harman, 1974).

A further probable adverse effect on many mussel species is the impact of sedimentation or pollution on host fish species. Some fish species are vulnerable to changes in light, turbidity and pollutants. Any water quality degradation that affects host fish species may affect mussels.

Most of the DWM populations are small and geographically isolated from each other (Service, 1993). This isolation restricts exchange of genetic material among populations, and reduces genetic variability within populations (Service, 1993). Strayer (1994) conducted a rangewide assessment of the DWM (examining thirteen rivers and streams from New Hampshire to North Carolina. Strayer concluded that all 13 populations of the DWM are vulnerable to loss because of their small range, low population densities, linear ranges, or some combination of the three factors. However, for all but one of the populations studied (Aquia Creek, VA), densities determined by Strayer were large enough so that he did not expect them to be affected by problems such as inbreeding or demographic stochasticity. Nevertheless, Strayer felt that these populations demonstrated lower fertilization rates than other freshwater mussel species, even though there was evidence of reproduction at most sites.

Although not within the action area, surveys for DWM were performed in the upper portions of the Swift and Middle Creek watersheds (i.e., Wake County) in June and July 2004 (CZR, 2004). The survey was performed on behalf of the Cities of Cary, Apex, Holly Springs, and Morrisville, NC. Nineteen sites were sampled in Swift Creek and its

tributaries upstream of Lake Wheeler, totaling 31.5 person-hours of sampling effort. A total of 203 mussels, consisting primarily of *Elliptio spp.*, were collected in upper Swift Creek and its tributaries. However, no DWM were collected in either the upper Swift Creek or upper Middle Creek watersheds (CZR, 2004). Based on the surveys and data described above, it appears that DWM in Swift Creek are restricted to the area downstream of Lake Benson in general, and the area near or downstream of the Wake-Johnston County boundary in particular.

Analysis of the species/critical habitat likely to be affected

The proposed construction, maintenance, operations and conservation measures for the proposed Project have the potential to adversely affect DWM. Potential impacts to DWM and its habitat may result from sedimentation and chemical spills during Project construction and reduced flows that will result from Project operations. These affects are expected to occur far into the future. Project related sedimentation could cause the burial of juvenile and adult mussels. Project related chemical spills or toxic substances could injure or kill all life stages of DWM. Project related flows will be less than what naturally occurs in Swift Creek and may, at certain times of the year, reduce available habitat for DWM and their host fish species. During extremely low flows, DWMs and their host fish may be physically separated by dry areas which would prevent glochidia from attaching to host fish species. The effects of the proposed action on DWM will be considered further in the remaining sections of this opinion.

ENVIRONMENTAL BASELINE

The environmental baseline is a summary of the status and health of the species and/or its habitat in the area affected by the proposed action. As defined in 50 Code of Federal Regulations [CFR] 402.02, "action" means all activities or programs of any kind that are authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas. The "action area" is defined as all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action. The direct and indirect effects of the actions and activities resulting from the federal action must be considered in conjunction with the effects of other past and present federal, state or private activities, as well as the cumulative effects of reasonably certain future state or private activities within the action area.

Description of the Action Area

The action area includes the proposed Project construction footprint in the vicinity of the Lake Benson Dam and the lower Swift Creek basin including about 15 miles of Swift Creek downstream from the dam at Lake Benson to its confluence with Middle Creek (Figure 2). The water treatment plant will occupy about 55 acres of land immediately downstream of the Lake Benson Dam. Swift Creek is within the Upper Neuse River Basin (USGS Hydrologic Unit Code 03020201) and drains parts of southern Wake and western Johnston counties. Not including the Middle Creek basin, the drainage area of Swift Creek is 157 square miles. Due to the presence of various rare species of fish and mussels, Swift Creek is considered a nationally Significant Natural Heritage Area by the NHP.

Status of the species within the Action Area

The DWM was first documented in Swift Creek in 1991 downstream of Lake Benson in Wake and Johnston counties. To date, no DWM have been found upstream of Lake Benson. The WRC and various other state and independent biologists conducted surveys in Swift Creek in 1991, 1992, 1994, 1996, 1997, 1998, 2002 and 2003. The results of those surveys indicate that the catch per unit of effort (CPUE) has never been high and has varied from year to year with no distinguishable trend, similar to results at other DWM locations in the Neuse River Basin. CPUE calculations are based solely on qualitative informal mussel sampling and are simply a means of standardizing data. Data should not be used to make inferences about the mussel population due to unproven assumptions that the samples are representative of the population and due to unknown variances. It is difficult to estimate population size or relative abundance based on qualitative sampling data (Strayer and Smith 2003). In 1991, 0.5 DWM/hr (two DWM total) were found in Swift Creek. Surveyors found one DWM/hr (three DWM) in 1992, four DWM/hr (two DWM) in 1994, three DWM (CPUE unknown) in 1996, 1.3 DWM/hr (11 DWM) in 1997, 1.3 DWM/hr (four DWM) in 1998, 0.86 DWM/hr (three DWM) in 2002 and 0.0088 DWM/hr (one DWM) in 2003. Based on available survey data, the DWM population in Swift Creek appears to be small. The 2003 Project related survey resulted in a very low number of mussels per unit effort (0.0088 DWM/hr) with only one DWM.

Little Creek, a tributary of Swift Creek, was surveyed in 2003 and a total of 0.044 mussels/hr (a total of two DWM) were recorded. The only DWM records from Little Creek were collected in association with NCDOT project surveys for the Clayton Bypass. Surveys were conducted in White Oak Creek, a tributary to Swift Creek about ten miles downstream of the Lake Benson dam, in 1992 and only one mussel/hr (one DWM) was reported. The WRC has no other DWM records from White Oak Creek. While not a part of the action area, a mussel survey was conducted in 1992 in Middle Creek, a nearby stream to Swift Creek and a tributary to Swift Creek near its confluence, and resulted in 0.38 DWM/hr (three DWM). According to the opinions of professional biologists knowledgeable of mussel fauna in Wake and Johnston counties, Swift and Little Creek DWM populations are in decline and Middle and White Oak Creek DWM populations are potentially extirpated (A. Rodgers, WRC, pers. comm., 2005).

The NCDOT and its contractors sampled Swift Creek and four of its tributaries (Little Creek, White Oak Creek, and Copper Branch, and Middle Creek) in 2003 (NCDOT, 2005b) (Table 2). A total of 36 sites were sampled in Swift Creek and 114 person-hours of sampling effort were expended. The sample sites in Swift Creek encompassed the area from Lake Benson Dam to nearly its confluence with Middle Creek, and were concentrated near the Wake-Johnston County boundary. Seven sites were sampled in Little Creek upstream of the SR 1562 bridge in Johnston County, expending about 45 person-hours of sampling effort. Seven sites in White Oak Creek (67 person-hours), and a single site in Copper Branch (12 person-hours) were also sampled during the NCDOT surveys. Despite collections of relatively large numbers of mussels, primarily *Elliptio spp.*, at all sites, only three DWM were collected. Two DWM were collected in Little

Creek, which joins Swift Creek about 13 stream miles downstream of the Wake-Johnston County boundary. Only one, older DWM individual was collected in Swift Creek, about two miles downstream of the Wake-Johnston County line near the State Highway 42 bridge crossing, during this effort.

Table 2. NCDOT DWM Surveys for the Clayton Bypass.

Stream	Number of Sites	Survey Hours	Number of DWMs
Little Creek	7	45	2
White Oak Creek	7	67	0
Copper Branch	1	12	0
Swift Creek*	36	114	1

An asterisk (*) indicates that the stream is within the action area.

Factors affecting the species within the Action Area

The Project area is located just southeast of the City of Raleigh. Suburban growth from Raleigh and the smaller towns of Garner and Clayton is expanding and encroaching into the Swift Creek watershed. Both Garner and Clayton have plans to expand infrastructure such as roads, water lines and sewer lines into the watershed. Residential development, such as single family homes and apartment complexes, and associated shopping centers and other commercial development continue to occur in the watershed. While a portion of the watershed remains forested, much of the undeveloped land is currently in agriculture.

Lawn and agricultural chemicals and road run-off including sediment and petroleum products may further degrade water quality. However, riparian vegetation generally appears to be maintained along the streambank. The Neuse River Basin Buffer Rules, enacted in 1998, protect fifty feet of buffer on each side of perennial streams in the Neuse Basin. Additional buffer protections have been adopted by Wake and Johnston counties and the Town of Garner, and are further described in the Conservation Measures section of this document and Chapter 5 of the BA. However, continual development and the lack of conservation measures will negatively impact the aquatic resources of the Swift Creek watershed, including DWM.

EFFECTS OF THE ACTION

Direct and Indirect Effects

Under section 7(a)(2) of the Act, "effects of the action" refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action. Under section 7, the federal agency is responsible for analyzing these effects. The effects of the proposed action are added to the environmental baseline to determine the future baseline, which serves as the basis for the determination in this Biological Opinion. Indirect effects are defined as those that are caused by the proposed action and are later in time, but still reasonably certain to occur (50 CFR §402.02). The BA includes a complete discussion of the direct and indirect effects of the Project on DWM. However, we believe that those effects described as indirect, such as impacts to flows and water quality, may be more

appropriately considered to be direct effects as they would be part of the normal operation of the Project.

Land Clearing and Disturbance and Sedimentation
Section 5.1 of the BA indicates that land clearing and disturbance activities associated with the construction of the water treatment plant will permanently alter about 55 acres of natural areas, including the dredge and fill of about 0.26 acres of jurisdictional forested wetland. The Lake Wheeler and Lake Benson Dam and pump station upgrades and retrofit areas and the new discharge structure at Lake Benson will, for the most part, occupy areas previously disturbed by the original water withdrawal facilities. The new finished water transmission main will impact about 1.42 acres of jurisdictional wetlands at two locations and cross 15 perennial streams and could increase turbidity and sedimentation in tributaries to Swift Creek. About 15 linear feet of stream banks and stream bottoms will be impacted at each stream crossing and impacts will not exceed the 40 foot wide easement corridor. These effects should be short-term in duration since all disturbed areas will be restored to their natural condition as quickly as possible after the transmission main is installed. The implementation of ESC best management practices (BMPs) should minimize potential impacts. Additional precautions will be taken to minimize direct impacts to water resources that could result from possible construction-related spills of toxic or harmful materials and to control their runoff in the event of a spill. These and other protective measures are further described in section 5.1 of the BA.

Flows
As stated in the BA, instream flow is a major determinant of habitat availability for aquatic species such as DWM. Through scoping with the Service and an interagency group, the potential effects of water withdrawals for the Dempsey E. Benton WTP and the associated changes to the hydrology and aquatic habitat of Swift Creek were identified, and the methods for quantifying these potential effects were agreed upon (ENTRIX, 2001; 2002). The Swift Creek Instream Flow Study (ENTRIX, 2003) and subsequent technical analyses provide the basis for analyzing the effects for water withdrawals on Swift Creek.

As described in the BA (ENTRIX, 2005), a simulated pre-impoundment hydrologic record was assumed to represent the environmental baseline and was used as the basis for evaluation of the proposed action, per request of the agencies involved in the scoping of the Swift Creek Instream Flow Study. This pre-impoundment hydrologic record is referred to hereafter as the "baseline" condition. The hydrologic time series representing the proposed action, or "with Project" condition, was developed with the use of a spreadsheet-based reservoir operations model. This model simulated 60-years of flows in Swift Creek that would result from implementation of the proposed operation of Lakes Wheeler and Benson, the Dempsey E. Benton WTP withdrawals, and the tiered, minimum flow release schedule.

A review of the 500 cfs scale hydrographs presented in Appendix D of the BA indicates that WTP operations will have a slight effect on the high flow regime in Swift Creek. The 10 cfs scale hydrographs, however, indicate that WTP operations will increase the

frequency and duration of stream discharges that are less than 10 cfs, relative to the baseline condition. Project related water withdrawals will considerably increase the amount of time that stream flows in Swift Creek are less than 10 cfs relative to the baseline condition. The median annual frequency of flow events less than 10 cfs is similar for the baseline and with Project conditions (i.e., 7 vs. 9 events, respectively); however, the median annual duration of time spent at flows less than 10 cfs is 56 days under the baseline condition, but 170.5 days under the with Project condition.

There will be little change in the total duration of flows less than 3 cfs between the baseline condition and with Project operation flows. However, the distribution and exceedence of flows less than three cfs will vary.

A comparison of the frequency and duration of flows less than three cfs for each year for a 60-year period of record under the baseline and with Project conditions indicates that in 32 of 60 years there would be no substantial change in the frequency and duration of flows less than three cfs; in 13 of 60 years the frequency and duration of flows less than three cfs relative to the baseline condition would increase; and in 15 of 60 years the with Project condition would reduce the frequency and duration of flows less than three cfs relative to the baseline condition.

The with Project condition will decrease the frequency and reduce the duration of the lowest stream discharges (i.e., flows less than two cfs) relative to the baseline condition. Additionally, the implementation of a minimum flow release under the with Project condition will prevent the occurrence of the lowest, naturally-occurring summer and fall stream discharges (i.e., flows that approached zero cfs in some instances) that occurred in some years under the baseline condition. Low flows often concentrate pollutants which can affect feeding, breeding and overall health of DWM. In addition, reduced flows may expose DWM, making them more vulnerable to predators and dehydration.

Habitat

Dwarf wedgemussel experts familiar with Swift Creek identified two types of habitat important to the survival of the DWM: Shallow Fast Coarse (SFC) and Deep Stream Margin Roots (DSMR). Shallow Fast Coarse habitats are determined largely by the distribution of coarse sand, gravel, and cobble within the stream channel and are limited to riffles and shallow runs of Swift Creek. These areas are typically separated by long stretches of run and pool habitat. Deep Stream Margin Roots habitat includes areas with stable banks and root mats over appropriate sediments.

As described in the BA and supporting technical analyses, two-dimensional (2-D) habitat modeling results were used to identify "patches" of suitable SFC and DSMR habitats and to determine how the area, spatial location, and quality of these patches change with flow.

Mussels are relatively sessile organisms, and depending on the species have a limited range of mobility and cannot rapidly change their physical position in a stream or move in response to changes in the spatial distribution of suitable habitats (Layzer and

Madison, 1995). Consequently, many mussel species tend to occur primarily in stable habitats that persist throughout the year at a range of stream flows. The extent of mussel habitat is therefore constrained by the availability of that habitat during the lowest flow periods of the year, often represented as the July, August, September, and October (JASO) period. Though suitable mussel habitat patches might occur at higher stream flows, those habitat patches that do not overlap with the habitat patches provided at stream flows corresponding to typical JASO low flows could not be used effectively, and as such would not constitute "effective" habitat. In other words, suitable mussel habitat is limited to those portions of the stream that stay wet during the lowest flow periods of the year.

The simulated flow data for Swift Creek were used to help interpret the habitat data and determine how frequently various flow-habitat thresholds might occur. The analysis of DWM habitat effects focused on Swift Creek Reaches 2 and 3, as represented by study Sites 2 and 3, because these portions of Swift Creek include the most suitable habitat for DWM. Table 3 summarizes the changes in the JASO flow regimes between the baseline and with Project conditions.

Table 3. Summary of Flows Occurring During the Summer-Fall Period (JASO) in Swift Creek at Sites 2 and 3.

		Typical JASO Flows (between 25th and 75th percentile)[1]	Low JASO Flows (between 75th and 90th percentile)[2]	Lowest JASO Flows (less than the 90% percentile)[3]
Site 2	Baseline	5.8 – 35.7 cfs	1.8 – 5.8 cfs	0.0 – 1.8 cfs
	With Project	3.9 – 15.1 cfs	2.6 – 3.9 cfs	0.8 – 2.6 cfs
Site 3	Baseline	8.3 – 50.9 cfs	2.5 – 8.3 cfs	0.0 – 2.5 cfs
	With Project	6.4 – 33.8 cfs	3.5 – 6.4 cfs	0.8 – 3.5 cfs

1 Flows in this range occur 50% of the time during JASO months

2 Flows in this range occur 15% of the time, and flows less than these values occur only 10% of the time during JASO months

3 Flows in this range occur only 10% of the time during JASO months

The most obvious and substantial change in the Swift Creek flow regime due to Project operations during the JASO period is the reduction in the middle 50% of flows. Though this constitutes a substantial change in stream flows, the change was determined to be outside the range of flows within which DSMR and SFC effective habitat is particularly sensitive to changes in flow. Example levels of DSMR and SFC habitat corresponding to the flow ranges in Table 3 are presented in Tables 4 and 5, respectively.

Table 4. Summary of Approximate DSMR Habitat Patch Area[1] Occurring During the Summer-Fall Period (JASO) in Swift Creek at Site 2 for the Flows Shown in Table 3.

	Habitat Provided at Typical Summer Flows and occurring 50% of the time during JASO Flows	Habitat Provided at Low Summer Flows and occurring 15% of the time during JASO Flows	Habitat provided at Lowest Summer Flows and occurring 10% of the time during JASO Flows[2]
Baseline	619 – 1,292	240 - 619	<170 - 240
With Project	515 - 854	373 - 515	~170 – 373

1 Habitat area expressed in units of ft^2/1,000 ft of stream

2 Some numbers in this column are listed as < or ~ because the lowest simulated flows were 1 cfs and 0.5 cfs at Sites 2 and 3, respectively. The amount of habitat at near zero flow is expected to be very low or zero.

Table 5. Summary of Approximate SFC Habitat Patch Area[1] Occurring During Summer-Fall Period (JASO) in Swift Creek at Site 3 for the Flows Shown in Table 3.

	Habitat Provided at Typical Summer Flows and occurring 50% of the time during JASO Flows	Habitat Provided at Low Summer Flows and occurring 15% of the time during JASO Flows	Habitat provided at Lowest Summer Flows and occurring 10% of the time during JASO Flows[2]
Baseline	883 – 1,206	433 - 972	<164- 433
With Project	826 –1,206	542 - 826	~240 - 542

1 Habitat area expressed in units of ft^2/1,000 ft of stream

2 Some numbers in this column are listed as < or ~ because the lowest simulated flows were 1 cfs and 0.5 cfs at Sites 2 and 3, respectively. The amount of habitat at near zero flow is expected to be very low or zero.

As shown in Tables 4 and 5, the range of habitats that would be provided under the baseline and Project condition during the common summer flows (those occurring 50% of the time) overlaps considerably. Although the typical JASO flows would change substantially, the spatial change in DSMR and SFC habitat patches and effective DWM habitat are not particularly sensitive to changes in flow in this range. Many of the habitat patches that disappear in the range of the typical (middle 50%) baseline JASO flows would either still persist at the typical Project JASO flows or would not persist in some years or months even under the baseline flows, simply due to the occurrence of natural low flow events.

At lower and less frequent summer-fall flows (flows occurring 15% of the time during JASO months) the difference between the baseline and the Project condition is less pronounced. Though the baseline flows would be greater part of the time, they would also fall lower than the Project flows, which would remain about 1 cfs higher than the baseline flows. The DSMR and SFC habitat values mimic this relationship. For low summer-fall flows occurring about 15% of the time, the DSMR and SFC habitat values would be similar between the two flow regime conditions, and the Project flows would prevent DSMR and SFC habitat values from falling as low as they would under the baseline condition. Finally, at the lowest summer-fall flows (flows occurring about ten percent of the time during JASO months), the Project condition would provide slightly higher flows, and thereby prevent the occurrence of the lowest flows and habitat events observed under the baseline condition.

In summary, in some years, or for some percentage of time in any given year, the baseline flows would maintain somewhat higher levels of effective DWM habitat than the Project flow condition. In other years the amount of DWM effective habitat would be similar between Project and baseline conditions. Less frequently, during critically low-flow periods, the tiered minimum flows provided by the Project would provide protection against the lowest observed flows in Swift Creek, and may provide more protection for critical levels of effective DWM habitats, which are lost at flows less than 1-2 cfs. While Project flows will result in more frequent dewatering of some of the persistent DWM habitats, they will also provide some enhanced protection for those critical, low-flow habitats that would otherwise be dewatered during the most extreme drought periods.

Naturally occurring, prolonged periods of drought may result in various lethal and non-lethal effects on mussels. Under extreme drought conditions, mussels may face increased water temperatures and reduced dissolved oxygen concentrations (hypoxia, or eventually anoxia), increased predation, and emersion or stranding (Johnson et al., 2001). A survey of mussel assemblages was conducted in a number of streams in the Flint River Basin of southwestern Georgia prior to and following a significant drought period (Johnson et al., 2001; Golladay et al., 2005). Sites that ceased flowing during the drought had significant declines in the abundance of stable and endangered species of mussels and in taxa richness. However, sites that maintained some flow during the drought had increases in stable species of mussels and no change in special concern or endangered species through the drought. Mortality of mussels at sites that ceased flowing was associated with reductions in dissolved oxygen concentration, which was highly correlated with water velocity. These results suggest that the value of guaranteed minimum flows in Swift Creek during prolonged periods of drought may be significant for the protection of DWM and other mussels.

The tessellated darter is believed to be the host fish species for DWM in Swift Creek. According to the BA, this species is generalized in its use of stream habitats. Tessellated darters are abundant in Swift Creek where they have been observed using a wide range of habitats including sand-gravel riffles, sandy runs, woody debris in runs and pools, and the margins of shallow pools. It is important that DWM and tessellated darters be in close contact between March and May when glochidia are released in order for them to encyst successfully. Since the DWM are sessile organisms, this is most likely to occur in the SFC or DSMR habitats. Based on the Instream Flow Study (Appendix A of the BA), post Project conditions in Swift Creek during that time of the year will range from a ten percent increase in habitat to an about five percent decrease in habitat. In general, it appears that during the spawning, attachment, encystment, and settling process of DWM reproduction, the Project flow condition would not result in a substantial change in availability of DSMR and SFC habitats over that of the baseline condition. The ecology of tessellated darters, their abundance in Swift Creek, and the habitat versus flow relationships indicate that tessellated darter habitat, contact with DWM during appropriate seasons, and the general host species relationship would not be limited under the Project flow condition.

Water Quality
The Project will result in one new permanent discharge to Lake Benson and two intermittent discharges to Mahler's Creek and Swift Creek.

Filter Backwash
About two to four mgd of treated effluent from the filter backwash process will be discharged into Lake Benson after it is clarified, dechlorinated and disinfected via UV disinfection in order to augment the water supply for drinking water and downstream flows. The DWQ has indicated that this discharge will be subject to NPDES permit conditions and compliance monitoring will make sure that the required NPDES standards are met. No effects to water quality of Lake Benson or Swift Creek or to DWM are expected.

Emergency Treated Water Overflow
Emergency overflows of finished water clearwell may be intermittently discharged to Mahler's Creek, a tributary to Swift Creek. These overflows will only occur in the event of emergencies such as power failure or temporary loss of systems integration. The discharge of finished water will be routed to a one million gallon containment pond on the WTP site. The finished water will be contained in the holding pond to allow natural dechlorination or it will be chemically dechlorinated. The DWQ has indicated that this discharge will be subjected to limits for flow; total suspended solids, pH and total residual chlorine, and that whole effluent toxicity monitoring will be required.

Storm Water Discharges
Storm water discharges may affect water quality and the DWM in Swift Creek during both construction and operation of the proposed Project. Potential impacts resulting from storm water will be minimized by the maintenance of vegetated buffers and the implementation of the erosion and sedimentation control measures.

Nutrients
Project related contributions of nutrients (nitrogen and phosphorus) to Lake Benson and Swift Creek may affect water quality and therefore, DWM in Swift Creek. Since the portion of Swift Creek below Lake Benson is classified as a Nutrient Sensitive Water and has been targeted for development of nutrient management strategies, a total maximum daily load (TMDL) has been developed for the Neuse River Basin, and restrictions on total nitrogen loads have been imposed on many discharges. The DWQ will likely require monitoring of nutrient contributions (total nitrogen, ammonia nitrogen, and total phosphorous) in Project discharges on a monthly basis. The use of treatment additives that may contribute nutrients will be minimized or eliminated in order to reduce impacts to water quality in Swift Creek.

The withdrawal of water from Lake Benson/Swift Creek and the associated tiered, minimum flow regime will increase the frequency and duration of low-flow events in Swift Creek which may affect water temperatures and DO levels and could reduce the assimilative capacity of the stream and concentrate pollutants discharged to Swift Creek via point source discharges.

Seven NPDES-permitted point source discharges occur in the Swift Creek watershed and contribute various forms of phosphorous and nitrogen, biological oxygen demand, residual chlorine, and fecal coliform bacteria that reduce water quality and potentially harm DWM, especially at low flows. If discharges in excess of permitted levels occur concurrently with lower than normal stream flows resulting from Project operations, the water quality in Swift Creek could be negatively affected.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act. Authorization of the proposed Project would not significantly affect growth rate, final land use patterns, or development densities in the Swift Creek watershed, as these are determined, or have been determined, by separate planning and political processes (ARCADIS, 2005). However, it is also correct to state that the additional increment of water supply that would be contributed by the Project is a necessary factor in achieving a normal rate of growth. Such growth, and the associated urbanization and development, could result in cumulative effects to Swift Creek water quality and aquatic habitats, including DWM habitat.

Moderate land development has been occurring and is expected to continue in the Swift Creek watershed for the reasonably foreseeable future (ARCADIS, 2005; NCDOT, 1998). The upper Swift Creek watershed is largely urban, moderately to highly developed, and drains to Lakes Wheeler and Benson, though many non-urban areas, which are largely protected from future development, surround the two lakes (ARCADIS, 2005). The lower Swift Creek watershed is largely rural, and has the greatest development potential, but is also considerably controlled from rapid and uncontrolled development by recent land use planning efforts, growth caps, and new ordinance development (ARCADIS, 2005). The lower Swift watershed also drains directly to the lower Swift Creek section that contains the Swift Creek DWM population. The potential effects of cumulative development in the Swift Creek watershed on the DWM population would be least from the upper watershed and most pronounced in portions of the Swift Creek watershed located downstream of Lake Benson.

The lower Swift Creek watershed is predicted to transition from low and medium density residential areas to higher density land use categories (NCDOT, 2004a). The Little Creek watershed, a tributary to Swift Creek, is predicted to change from rural and agricultural areas to low density residential land uses. Though a number of growth and watershed protection measures and storm water and buffer ordinances are already in place, the level of nutrient yield to Swift Creek would increase in some areas. In other areas of the lower Swift Creek watershed, the conversion of farmland and agricultural use would result in nutrient yield reductions in the Little Creek watershed.

Despite protective measures such as stream buffers, impervious surface limitations and stormwater runoff controls, additional residential, commercial and industrial development in the lower Swift Creek watershed will likely have negative effects on the water quality and aquatic life found in Swift Creek (NCDOT, 2004b). Increasing buffer widths is a watershed protection tool that has been shown to substantially reduce increased pollutant yields associated with development. Increased buffer widths could contribute significantly to the protection of DWM in terms of water quality protection, but would also have other benefits such as stream shading, thermal regime control, bank stabilization, and other ecological functions important to DWM and DWM habitat.

CONCLUSION

After reviewing the current status of the DWM, the environmental baseline for the action area, the effects of the Project and the cumulative effects, it is the Service's biological opinion that the Project is not likely to jeopardize the continued existence of the dwarf wedgemussel. No critical habitat has been designated for this species; therefore, none will be affected.

The non-jeopardy determination is based on the fact the Project will provide more stable low flows and guarantee that Swift Creek flows will not be reduced to less than 1.0 cfs. In addition, the change in effective DWM habitat will be relatively small. The Project also includes measures to protect water quality from existing waste water discharges and local governments have passed ordinances to control indirect and cumulative impacts. The conservation measures included in the project proposal should also ensure that the species will not be jeopardized.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of sections 7(b)(4) and 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be a prohibited taking under the Act, provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the USACE so that they may become binding conditions of any grant or permit issued to the City of Raleigh, as appropriate, for the exemption in section 7(o)(2) to apply. The USACE has a continuing duty to regulate the activity covered by this Incidental Take

Statement. If the USACE (1) fails to assume and implement the terms and conditions or (2) fails to require the City of Raleigh to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. To monitor the impact of incidental take, the USACE or the City of Raleigh must report the progress of the action and its impact on the species to the Service as specified in the Incidental Take Statement [50 CFR §402.14(I)(3)].

AMOUNT OR EXTENT OF TAKE

Incidental Take is not anticipated to occur during Project construction since the Project includes protective ESC Plans and measures to minimize negative construction related impacts to Swift Creek and its tributaries.

The Service anticipates that incidental take of DWM in association with operation of the Project throughout the action area will be difficult to determine. Adequate data are not available to determine the specific number of DWM that may be taken. Additionally, incidental take will likely be difficult to detect and monitor. The best available data do not give precise population counts and detecting a significant change in the population may take years or decades. A substantial portion of the DWM population may occur below the surface of the substrate at any given time, precluding exact mussel counts. Although spent shells may be collected, attributing the cause of mortality may be difficult. Glochidia and juvenile mussels are extremely difficult to sample, therefore it is difficult to document take of either of these life stages. However, the level of incidental take of the DWM can be defined by the loss of all DWMs that may be harmed, harassed or killed under normal project operations (Tier 1, Tier 2 or Tier 3 water withdrawals) within the Action Area (the 15 miles of Swift Creek downstream from the Lake Benson Dam). It is anticipated that incidental take associated with this Project would be most likely to occur in those situations where Project related withdrawals would reduce flows to a level that would de-water effective habitat that would not otherwise be de-watered and that these situations would be most likely to occur at flows less than 1.0 cfs. Therefore, incidental take will be exceeded only if Project related water withdrawals reduce flows within the Action Area to less than 1.0 cfs.

Incidental take, due to Project operations may be in the form of harm, harassment and mortality. DWMs may be harmed, harassed or killed as a result of the increased concentration of harmful chemicals and other toxic substances. DWMs may also be harmed, harassed or killed due to increased exposure causing the potential for desiccation and/or predation. In addition, during periods of low flows, DWM glochidia may die as a result of being separated from host fish species during the critical time period for encystment in those fish. These forms of take may occur repeatedly, but for short durations, throughout the life of the project.

The amount of take anticipated is based on the specific Project operating procedures described in the BA and this biological opinion. Operation of the Project in a different manner may increase the level of harm to DWM through additional adverse habitat

conditions. Therefore, any such changes in Project operation would require reinitiation of consultation.

EFFECT OF THE TAKE

In the accompanying biological opinion, the Service has determined that the level of anticipated take is not likely to result in jeopardy to the DWM. Since critical habitat has not been designated for this species, the proposed Project will not result in the destruction or adverse modification of critical habitat.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to further minimize impacts of incidental take of DWM:

1. The USACE/City must provide in stream flows that are protective of the DWM, including tiered minimum flow release schedule with corresponding reductions in water withdrawal rates, and must monitor and report minimum release flows. The USACE/City must place a maximum threshold on the base withdrawal rate of the Project and limit the frequency of maximum withdrawal rate operation.
2. The USACE/City must design and construct intake, outlet, and minimum flow release structures at the Lake Benson Dam to accurately control the release rate of instantaneous minimum flows and ensure that that water released is of suitable water quality for the DWM and meets North Carolina water quality standards.
3. The USACE/City must fund and perform periodic surveys of Swift Creek mussel and DMW populations downstream of Lake Benson Dam to provide information useful for evaluation and management of the Swift Creek DWM population.
4. The USACE/City must fund and establish a flow gauging station on Swift Creek downstream of the Lake Benson Dam, preferably in cooperation with the U.S. Geological Survey. This flow monitoring station must include monitoring for temperature and dissolved oxygen and the data will be used to assess impacts to DWM.
5. The USACE/City must provide for monitoring of water quality, biological indices, and general stream condition in Swift Creek by adding three stations in Swift Creek to the City's Sampling and Monitoring Program (City of Raleigh, 2005).
6. The USACE/City must decommission Indian Creek Overlook and Mill Run Mobile Home Park WWTPs in order to improve the quality of DWM habitat in Swift Creek.
7. The USACE/City must pursue riparian corridor protection for the Steep Hill Creek and Lake Wheeler to Lake Benson corridors for water quality protection within the Swift Creek watershed. The target acreage for these two tracts is approximately 862 acres. These additional buffers on Swift Creek will protect the watershed from additional pollutant runoff and therefore provide some protection of water quality in DWM habitat downstream.
8. The USACE/City must implement a Public Service Announcement (PSA) plan to encourage water conservation, especially during periods of low rainfall. The resulting reduced water usage is designed to reduce the duration of low flow conditions in DWM habitat.

9. The USACE/City must adopt additional measures to conserve water usage within the City's service area.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the USACE must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary. The terms and conditions associated with the reasonable and prudent measures articulated in this biological opinion will minimize the level of incidental take identified for the DWM.

The following terms and conditions implement reasonable and prudent measure No. 1.

- The USACE/City must place the maximum threshold on the base withdrawal rate of the Project at 14 mgd (22 cfs) with occasional withdrawals up to 20 mgd (31 cfs) in order to facilitate maintenance activities at the City's E. M. Johnson WTP or other emergency operations. The 20-mgd withdrawal rate will be limited to short-term increases in withdrawal rates during periods of higher flows, such that an instantaneous minimum flow release of at least 9 cfs is maintained from Lake Benson Dam for the duration of the increased withdrawal. A 9 cfs instantaneous minimum flow will be maintained at all times when withdrawals exceed 14 mgd.
- The USACE/City must implement a tiered minimum flow release and corresponding water supply withdrawal reductions during periods of low inflow to Lakes Benson and Wheeler. The instantaneous minimum flows and associated withdrawal reductions must be determined according to available reservoir storage, as described in Table 6 below. The tiered minimum flow release would make sure that those areas of persistent DWM habitat that occur now under baseline flow conditions would remain largely wetted and suitable throughout the year.

Table 6. Swift Creek Instantaneous Minimum Release Schedule.

Remaining Available Storage	Minimum Flow Release (cfs)	Reductions in Water Supply Withdrawal*
60% or more	3.0	0%
60% to 30%	2.0	10%
< 30%	1.0	an additional 10% (20% total)

*Water withdrawal reductions based on the average daily withdrawal for the 60 day period immediately prior to the first reduction in the minimum flow release. Reductions must be accomplished within two weeks of the reduction in the minimum flow release.

- The USACE/City must monitor and report on the above-required minimum flow releases, including the 9 cfs required flow and the instantaneous minimum flows made under the tiered minimum flow release schedule. The USACE/City must make releases from the Lake Benson Dam by establishing instrumentation and controls (orifice, weir, or other structure designed for calibrating, adjusting, and

controlling minimum flows) to provide the minimum flows. The release structure will be calibrated and adjusted at a frequency that will provide for accurate operation, at least once per year and preferably prior to a period during which tiered minimum flows are anticipated to begin. The USACE/City must provide the Service with reports documenting the daily minimum flow releases and calibration data, and records of such data will be kept available on site. These reports must be submitted twice per year for the first two years of Project operations and annually thereafter.

- The USACE/City must provide via facsimile prompt notification to the Service's Raleigh Field Office (919-856-4556, or then current facsimile number) whenever Tier 3 (1.0 cfs) minimum flow releases from Lake Benson Dam are initiated. Re-notification of Tier 3 (1.0 cfs) minimum flow releases will not be required more than once in any thirty (30) day period, except in those instances where minimum flow releases are maintained at Tier 3 (1.0 cfs) for more than seven (7) consecutive days or more than seven (7) days within any thirty (30) consecutive day period.
- The USACE/City must include a listing all time periods when the projected operated at Tier 2 or Tier 3 and the duration of each Tier 2 or Tier 3 operation in an Annual Report submitted to the Service's Raleigh Field Office.
- The USACE/City must maintain flows in Swift Creek downstream of Lake Benson Dam during the construction of the Project. As practicable, construction activities would be performed outside of a low flow period, such that a continuous downstream flow would be maintained via flow over the top of Lake Benson Dam. If during construction it becomes necessary to reduce water levels at Lake Benson, such that flow over the crest of the dam ceases, a siphon, portable pump, or other suitable means will be used to maintain a continuous downstream flow to Swift Creek that is consistent with the tiered, instantaneous minimum flow regime. Within 120 days of obtaining all the necessary permits and approvals for Project construction and not less than 45 days prior to the planned initiation of project related withdrawals, the USACE/City must file with the Service's Raleigh Field Office, for review and approval, a Construction Period Flow Plan that addresses instantaneous minimum flow requirements during the construction period.

The following terms and conditions implement reasonable and prudent measure No. 2.

- The USACE/City must design the raw water intake structure from Lake Benson such that adjustments can be made, if necessary, to the depth at which water is withdrawn to make sure that appropriate levels of temperature and dissolved oxygen are maintained in the flows released to downstream. The minimum flow release structure must be operated and/or designed to make sure that North Carolina dissolved oxygen standards (currently 4.0 mg/L instantaneous and at least 5 mg/L) are met at all times.
- On a weekly basis during the period April to November, the USACE/City must monitor and record temperature and dissolved oxygen profile data in Lake Benson adjacent to the intake. Should dissolved oxygen conditions require, the

USACE/City will make adjustments to the intake depth to optimize dissolved oxygen levels.

- The USACE/City must continuously measure dissolved oxygen levels in the water released downstream of the Lake Benson Dam and must notify immediately, via facsimile, the Service's Raleigh Field Office (919-856-4556, or then current facsimile number) whenever the dissolved oxygen levels fall below 5 mg/L. Should monitoring and operational data indicate that further monitoring is unnecessary to meet North Carolina dissolved oxygen standards, the USACE/City may petition the Service to remove this monitoring requirement.

The following terms and conditions implement reasonable and prudent measure No. 3.

- The USACE/City must conduct DWM surveys in Swift Creek, the exact protocols and reporting requirements of which must be developed in coordination with Service, WRC and NHP biologists prior to project construction. All DWM surveys must be supervised by a qualified scientist with previous experience in mussel population assessment techniques and who possesses a degree in fisheries biology, aquatic ecology, or a related field. Additionally, the scientist must also hold the appropriate state and federal permits to conduct such surveys. The qualifications of the proposed DWM survey supervisor will be submitted to the Service's Raleigh Field Office for approval prior to the commencement of any survey.
- Because mussel surveys can only be conducted under certain situations, allowances should be made so that surveys can be conducted during suitable times of the year and under acceptable flow and water clarity conditions. The Service, WRC and NHP biologists must be notified at least one week prior to each survey and will be invited to assist with the surveys. The DWM surveys must be accomplished according to the following schedule:
  (a) An initial baseline mussel survey must be conducted prior to initiation of Project construction. The level of effort expended for each survey must not exceed 250 person-hours.
  (b) A follow-up mussel survey must occur within 12 months following initiation of Project operations, and subsequent surveys must be performed at five year intervals thereafter for a total of 20 years. The level of effort expended for each survey must not exceed 250 person-hours.
  (c) Additional mussel surveys must be promptly performed whenever the minimum flow releases from Lake Benson Dam are maintained at Tier 3 (1.0 cfs) for more than seven (7) consecutive days or more than fourteen (14) days within any thirty (30) consecutive day period. The level of effort for each survey must not exceed 40 person-hours, and no more than one low flow triggered mussel survey would occur in any year. Four (4) such low-flow mussel surveys will be conducted. Following the annual report that includes the fourth low-flow mussel survey results, the City and the Service will determine if further low-flow mussel surveys are warranted.

- The City must submit, to the Service's Raleigh Field Office, a complete report summarizing the results of each mussel survey. The report will be consistent with the protocols developed in consultation with the Service, WRC and NHP biologists, and will describe survey objectives, methods, level of effort, mussels found and identified, catch per unit effort, and other relevant findings or recommendations and should be submitted with the Annual Report for that particular year.
- Any spent DWM shells collected during the surveys must be sent to the NC Museum of Natural Sciences. [Note: the recovery of spent DWM shells does not imply that their mortality is a result of Project operations but rather is a means to correlate potential effects in assessing take.] If freshly-killed DWM are found in the project area, care must be taken in their handling to preserve biological material in the best possible condition (i.e., freezing). In conjunction with the preservation of any dead specimens, the finder has the responsibility to make sure that evidence intrinsic to determining the cause of death of the specimen is not unnecessarily disturbed. The finding of dead specimens does not imply enforcement proceedings pursuant to the Act. The reporting of dead specimens is required to enable the Service to determine if take is reached or exceeded and to make sure that the terms and conditions are appropriate and effective. Upon locating a dead, injured, or sick specimen of an endangered or threatened species, prompt notification must be made to the Service's Raleigh Law Enforcement Office (919-856-4786, or then current phone number) or the Supervisor, Raleigh Field Office (919-856-4520, or then current phone number).
- Should monitoring results indicate that DWM or any other federally listed species are not present in Swift Creek, or if DWM population levels are stable or increasing, the USACE/City may petition the USFWS to remove all or part of the mussel survey requirements.

The following terms and conditions implement reasonable and prudent measure No. 4.

- The USACE/City must independently implement a gauging station or cooperatively fund a USGS gauging station to provide continuous monitoring (at least hourly interval) of stream flows in Swift Creek. The final location of the flow gauging station will be determined in consultation with the Service, USGS, WRC, and the DWR, but it is anticipated that the station will be located at either the North Carolina Highway 50 or Highway 42 bridge crossing.
- All flow and water quality data must be made readily available to the Service, WRC and NHP (e.g., via the USGS or other internet web site) on a daily basis.
- The gauging station must be operational before the start of Project operations (i.e., water supply withdrawals). If the gauging station is not installed and operational by the time Project water supply withdrawals begin, then USACE/City must conduct equivalent flow and water quality monitoring until such time as the gauging station is operational.
- Until constructed, the City must provide and annual update on the progress toward the gauging station installation. This update must be submitted to the Service as part of the Annual Report.

The following terms and condition implements reasonable and prudent measure No. 5.

- The USACE/City must provide for monitoring of water quality, biological monitoring, and general stream condition in Swift Creek by adding three stations in Swift Creek to the City's Sampling and Monitoring Program.
- One of the new sampling locations in Swift Creek will be set up immediately downstream of Lake Benson Dam. The other two locations will be selected in consultation with the Service and the DENR, but it is anticipated that the locations would include one station at the North Carolina Highway 42 bridge crossing and one additional site in Johnston County. Monthly water chemistry sampling and annual benthic macroinvertebrate sampling will be performed at each site, consistent with the City's Sampling and Monitoring Program.
- Consistent with the City's Sampling and Monitoring Program, the USACE/City must provide for field observations and photo-documentation of Swift Creek from the Lake Benson Dam to the confluence with Middle Creek once every two years to identify potential problem areas, or "hot spots" (e.g., sources of excessive sedimentation, illicit discharges, stream buffer violations, etc.).
- The USACE/City shall provide a summary of all water quality monitoring in an Annual Report submitted to the Service by February 28 of the following year.

The following terms and conditions implement reasonable and prudent measure No. 6.

- Upon approval of the Highway 50 Pump Station and prior to initiation of Project operations (i.e., water withdrawals), the City must secure all required permits and approvals for the decommissioning of the two private WWTPs (Indian Creek Overlook and Mill Run Mobile Home Park).
- Both WWTPs must be decommissioned and removed from service within 12 months of initiation of Project water withdrawals.

The following terms and conditions implement reasonable and prudent measure No. 7.

- The USACE/City must pursue protection of riparian areas within the Lake Wheeler to Lake Benson corridor. The corridor includes an approximate 300-foot-buffer along 4.1 miles of Swift Creek between Lake Wheeler and Lake Benson. Adjustments to areas of the corridor are allowable based on land availability, willingness of property owners to negotiate, and parcel boundaries. Protection mechanisms may include land acquisition, conservation easements, purchase by other third parties with protective covenants, and other means that provide protection against development and allow uses appropriate for buffers and green space. The USACE/City must make sure that such protection mechanisms are in place for at least 50% of the land contained within the Lake Wheeler to Lake Benson corridor within 12 months of initiation of Project water withdrawals. Beyond this time frame, the City, in conjunction with Wake County, must continue its efforts in good faith and to the best of its ability to pursue riparian protection for the remaining parcels.

- The USACE/City must pursue protection for the Steep Hill Creek corridor. The corridor includes an approximate 300-foot buffer along 7.2 miles of Steep Hill Creek for water quality protection. Adjustments to areas of the corridor are allowable based on land availability, willingness of property owners to negotiate, and parcel boundaries. Protection mechanisms may include land acquisition, conservation easements, purchase by other third parties with protective covenants, and other means that provide protection against development and allow uses appropriate for buffers and green space. Within 24 months of the initiation of Project water withdrawals, the City, in conjunction with the County, must have exercised all reasonable efforts to purchase or seek conservation easements for parcels within the Steep Hill Creek corridor. Beyond this time frame, the USACE/City, in conjunction with Wake County, must continue its efforts in good faith and to the best of its ability to pursue riparian protection for the remaining parcels.
- Lands within these corridors must be incorporated into the City and County Greenways Program as appropriate and allowable by their ownership, protection status, and conservation easement conditions. As such, these lands will be preserved to the extent possible in greenway corridors per the Wake County Consolidated Open Space Plan (Wake County, 2003).
- The USACE/City shall provide an update on the status of these land protection efforts in the Annual Report.

The following terms and conditions implement reasonable and prudent measure No. 8.

- The USACE/City must design water conservation PSAs in the form of television, radio and newspaper advertisements for implementation during periods of low flow in Swift Creek, as described below.
- Whenever the minimum flow releases from Lake Benson Dam are maintained at Tier 2 (2.0 cfs) for more than fourteen (14) consecutive days or more than fourteen (14) days within any thirty (30) day period, the City must broadcast/publish two of the three forms of PSAs mentioned above. Whenever the minimum flow releases from Lake Benson Dam are maintained at Tier 3 (1.0 cfs) for more than fourteen (14) consecutive days or more than fourteen (14) days within any thirty (30) day period, the City must broadcast/publish all three forms of PSAs mentioned above. All radio and television PSAs must be broadcast between the hours of 5:00 AM and 11:00 PM.

The following terms and conditions implement reasonable and prudent measure No. 9.

- The USACE/City must modify existing water conservation measures or adopt additional measures designed to reduce or minimize the need to operate the Project at the Tier 2 and Tier 3 levels.
- The USACE/City must require that any municipality obtaining finished water from the City's water treatment plants (e.g. Rolesville, Garner, Zebulon, etc.) adopt water conservation measures at least as stringent at those used by the City.

Reporting

With regards to the reporting requirements outlined in the Terms and Conditions above, the Service requests that the City consolidate the submittal of reports to the maximum extent possible. To summarize, an Annual Report (based on the calendar year) should be submitted to the USACE and the Service by February 28 of the following year. This report should contain the following information:

- low flow (Tier 2 and Tier 3) occurrences,
- water quality monitoring data,
- baseline and post project implementation DWM survey results,
- update on the completion of a gauging station (if applicable), and
- update on land acquisition in Lake Wheeler to Lake Benson and Steep Hill Creek corridors (if applicable).

The Construction Period Flow Plan should be provided to the USACE and the Service for review and approval prior to project construction. The DWM population monitoring protocols should be developed in consultation with the Service, WRC and NHP with enough time for the USACE/City to conduct a baseline survey prior to the initiation of project construction.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. The Service believes that incidental take will not be exceeded if the USACE/City is in compliance with all of the reasonable and prudent measures outlined above. Operation of the project in a different manner than described may increase the level of harm to DWM through additional adverse habitat conditions. Therefore such changes in project operation or variances from the operating measures would require reinitiation of consultation and review of the reasonable and prudent measures provided. The federal agency must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The Service recommends that the USACE/City implement the following conservation recommendations for the benefit of the DWM:

1. The City should aid additional research on the effects of flows and DO levels on DWM and their host fish species in order to more appropriately assess Project related impacts. The RPMs of this biological opinion may be revised based on the results of this research.

2. The City should develop educational programs to address DWM and other freshwater mussels and aquatic species and their conservation for the general public. Outreach materials and activities could include fact sheets and articles to be included in water bills and the City's annual water quality report, television programs for the local community television station and student activities to be presented at local schools or field trips to local natural areas.
3. The City should work cooperatively with the local governments in the upper Tar River Basin in Edgecombe, Franklin, Granville, Halifax, Nash, Person, Vance and Warren counties to aid projects that promote water quality and habitat protection for aquatic species, especially the dwarf wedgemussel.
4. The City should work cooperatively with the Service, WRC, NHP, DWQ, DWR and other agencies as part of a Swift Creek aquatic resources team to evaluate data collected through various project related monitoring efforts and ensure the optimum operation of the reservoir for the protection of the DWM, water quality and aquatic communities within Swift Creek.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendation.

REINITIATION NOTICE

This concludes formal consultation on the actions outlined in the USACE's June 20, 2005 initiation request. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary USACE's involvement or control over the action has been retained (or is authorized by law), and if:

1. the amount or extent of incidental take is exceeded;
2. new information reveals consequences of the USACE's action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion;
3. the USACE's action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or
4. a new species is listed or critical habitat designated that may be affected by the action.

In instances where the amount or extent of incidental take is exceeded, formal consultation must be reinitiated immediately.

The Service appreciates the opportunity to work with the USACE in fulfilling our mutual responsibilities under the Endangered Species Act. Please contact Dale Suiter of this office at (919) 856-4520 extension 18 if you have any questions or require additional information.

Sincerely yours,

Pete Benjamin
Ecological Services Supervisor
Raleigh Field Office

cc: USFWS Region 4 Office (Joe Johnston)
USFWS Region 5 Office (Susi vonOettingen)
NC DENR Office of Legislative Affairs (Melba McGee)
NC Natural Heritage Program (Sarah McRae)
NC Wildlife Resources Commission (Shari Bryant)
City of Raleigh (Dale Crisp)
ARCADIS G&M (Mary Sadler)
ENTRIX, Inc. (Erik Dilts)

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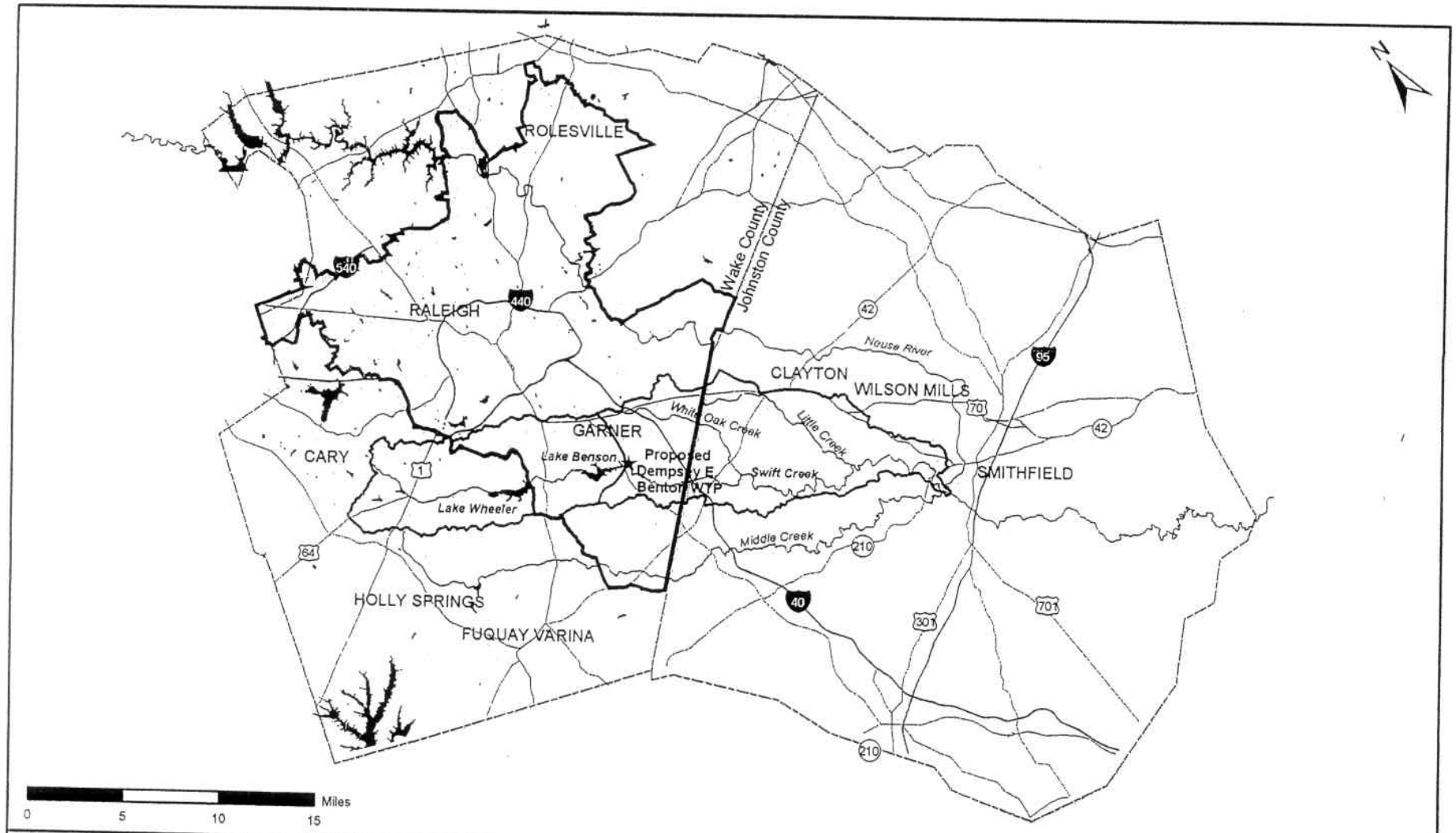
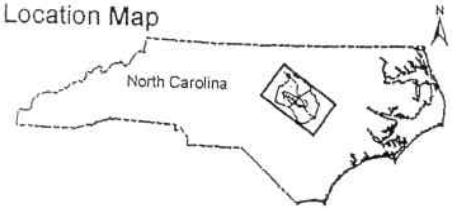


Location Map



Legend

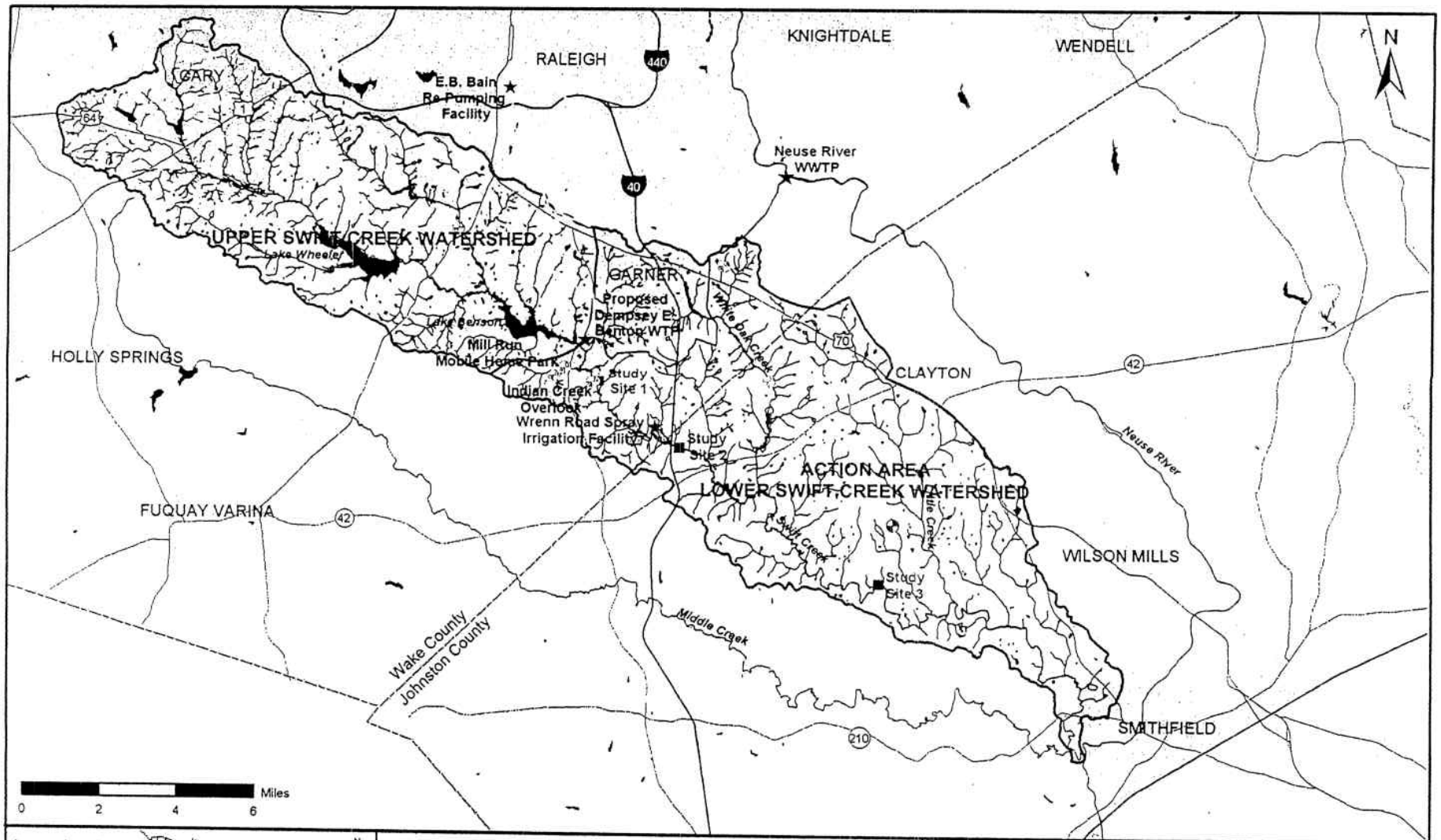
- Project Service Area
- Action Area/Watershed Boundary
- Lakes
- Streams
- Major Roads
- Interstates
- City Limits
- County Boundaries

DEMPSEY E. BENTON
WATER TREATMENT PLANT PROJECT

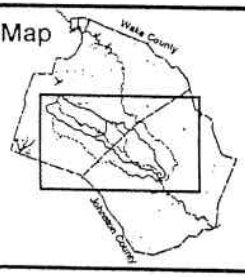
PROJECT AREA

City of Raleigh, NC

Figure 1



Location Map



Legend

- Action Area/Watershed Boundary
- Lakes
- Streams
- Instream Flow Study Sites
- Minor Dischargers
- Major Dischargers
- Finished Water Transmission Main
- Hwy 50 Force Main

DEMPSEY E. BENTON
WATER TREATMENT PLANT PROJECT

ACTION AREA

City of Raleigh, NC

Figure 2

April 2008 Letter from City of Raleigh to USACE

City Of Raleigh
North Carolina

April 17, 2008

Jean Manuele
Field Supervisor
U.S. Army Corps of Engineers
3331 Heritage Trade Drive, Suite 105
Wake Forest, NC 27587

RE: Response to the U.S. Fish and Wildlife Letter Dated March 28, 2008
Alternative Water Source Exchange: Lakes Benson / Wheeler to Neuse River
City of Raleigh Public Utilities Department

Dear Ms. Manuele,

The City of Raleigh submitted an Alternative Water Source Exchange (AWSE) request to the United States Army Corps of Engineers (USACE) in November 2007 due to the on-going record setting drought. A letter from the City on January 25, 2008 to the USACE provided an explanation of the similarities of the water withdrawal action of ASWE as it related to the Dempsey E. Benton Water Treatment Plant (WTP) Project. Additionally, ARCADIS submitted a February 11, 2008 letter to the USACE with the status of the terms and conditions of the Biological Opinion. This letter served as a response to the U.S. Fish and Wildlife Service (USFWS) letter dated March 28, 2008 requesting more information on the ASWE and the implementation of the terms and conditions in the Biological Opinion.

The original AWSE in November and December 2007 included the use of the constructed, but not yet in-service, Highway 50 Pump Station and force main. The City has an obligation to the Town of Garner to commission the Highway 50 Pump Station to wastewater service. This action is expected within the next several weeks. To continue the AWSE, we are proposing a new AWSE method that will convey Lake Benson raw water to Walnut Creek near Wilmington Street. For implementation of this proposal, the City will rehabilitate an existing raw water force main that was used to transmit water from Lake Benson to the E.B. Bain WTP prior to its 1987 decommissioning. In addition to the rehabilitation of the existing main, the construction of a new force main would be required. This new force main was evaluated in the Dempsey E. Benton WTP EA as a finished water main. The City has obtained all of the construction permits necessary to construct the new force main and is ready to bid the project. The new force main would be commissioned to finished water service as soon as the Dempsey E. Benton WTP is operational.

The USFWS March 28, 2008 letter implies that the City has not moved forward with the terms and conditions of the Biological Opinion. This is an unfair and unreasonable assumption. Time is necessary for many of the terms and conditions to be planned, developed, executed, and then documented. Furthermore, the City fails to understand why our commitment to implementing the terms and conditions

in the Biological Opinion is even in question. The Dempsey E. Benton WTP was bid on October 31, 2006. The City has been working toward the goal of meeting the terms and conditions by the 2010 deadline (where applicable) since the project was bid.

The following are clarifications regarding the status of the terms and conditions of the Biological Opinion:

Reasonable and Prudent Measure #1 – Minimum Flow Release

Water is currently released from Lake Benson dam into a concrete flume located at the existing raw water pump station. The release is controlled using one of two existing 4-foot square, cast iron sluice gates (one upper gate and one lower gate). The gates were installed in 1953 during construction of the original dam and pump station. Having been out of service since the pump station was taken offline in 1987, repairs were planned for the gates during construction of the Dempsey E. Benton WTP. During the implementation of the 2007 AWSE, the gates were identified as the most reliable means for the controlled release operation. The City retained a commercial diving contractor to make necessary repairs to be able to open, close, and modulate the gates. Repair work began in early October, 2007 and was completed by mid November. The operator stem brackets were replaced and several thimble seat wedges were repaired or replaced.

In order to measure the minimum flow release, a temporary 90° V-notch weir was installed in the concrete flume downstream of the sluice gates. The weir was constructed of four by four pressure-treated lumber with a metal leading edge fabricated from 3/8-inch steel flat bar. Once installed, silicone was used to seal any major leaks. The bottom of the notch is located at 4.5 feet above the flume. The height of the notch is 1.5 feet.

The stage, or height over the weir, is measured using an ultrasonic level transducer by Milltronics. The transducer is mounted underneath an elevated concrete walkway directly above the flume. It is positioned 25 feet upstream of the weir. The level is monitored and reported using a Hydroranger 200 Flow and Level Monitoring System also manufactured by Milltronics. The transducer was calibrated by taking a zero level reading when still water level was exactly at the bottom of the notch. Stage measurements reported by the monitoring system were then verified up to a flow rate of 5 cfs using a survey rod.

The V-notch weir is widely accepted as an accurate and precise way to measure flow rates within the range of the tiered minimum flow release of 1 to 3 cubic feet per second (cfs). The weir has the added advantage of an operator being able to easily and reliably confirm instrumentation readings by directly measuring the height of water over the weir using a staff gage.

The stage-discharge relationship for the V-notch weir is as follows:

$$Q = C\left(\frac{8}{15}\right)\tan\left(\frac{\theta}{2}\right)\sqrt{2g}H^{\frac{5}{2}}$$

Where:

Q = weir discharge (cfs) θ = notch angle

C = empirical weir discharge coefficient g = acceleration due to gravity (ft/sec^2)

H = head over weir (ft)

In practice, for a 90° V-notch weir this equation resolves to the following simplified form: $Q = 2.5H^{2.5}$

On two days during the initial AWSE, the minimum flow release dipped below the Tier 1 flow rate of 3 cfs; those days were November 21 and November 27, 2007. The initial AWSE commenced on

November 21, 2007. During the first few hours of startup there was a learning curve in which the City determined how to successfully operate the sluice gate given the sensitivity to flow adjustment in addition to operator training on how to use the monitoring system. The calibration sheet is provided in Attachment A.

The November 27 event was attributed to subtle gate instability coupled with a lag in operator response time. Initial operation was manual due to the repair schedule for the gates. Flow rate readings were taken at fifteen minute intervals and transmitted to E.M. Johnson WTP located 25 miles north of Lake Benson. Operators would respond to a low reading by driving to Lake Benson and adjusting the gate. Due to the size of the gate opening in comparison with the relatively modest flow rate of 3 cfs, infinitesimally small adjustments cause large changes in flow (e.g., gate adjustment was highly sensitive). Upon inspection of the 20 foot gate stem it was determined that there was "slack" in the stem from minor deflection caused by the binding on the stem guides. As slack released on its own over time, the gate closed enough to choke down on the flow rate. Once discovered, this condition was compensated for by operating the release at a higher flow rate to provide a time buffer for the operators to respond to changes in the flow rate.

In mid February the City was able to install a motor on the lower gate's actuator. Modulation is now automated via the level monitoring system. This has resulted in a very steady and reliable minimum flow release. Plans for the permanent minimum flow release structure remain unchanged and will go online upon completion of the WTP.

It should be pointed out to the USFWS that the City has released minimum flow downstream continuously since the 2007 AWSE ended even though the City has been under no obligation to do so. These flow records may be found in Attachment B of this correspondence.

Regarding the City's commitment to operate Lake Benson Dam in a manner that avoids or effectively minimizes rapid reductions in downstream flow, it is our understanding that this technical issue has already been studied extensively in the Biological Assessment and the Biological Opinion for this project. Both documents concluded that the 14 million gallon per day (mgd) base withdrawal will not cause rapid reductions in downstream flow and the minimum release schedule is protective of DWM. The City questions why this technical issue is being raised.

Reasonable and Prudent Measure #2 – Water Quality Standards

The City of Raleigh is in the process of installing a temporary online (and therefore continuous) dissolved oxygen (DO) meter at the temporary transfer pump. The Dempsey E. Benton WTP construction project includes modifications to the dam to provide for continuous DO monitoring. The USFWS will be informed of the meter installation as soon as installed. The DO results will be reported to the USFWS on a bi-weekly basis after installation.

It should be noted that the minimum release overflow provides 4.5 feet of cascade aeration. The water then flows 18 feet along a roughened concrete flume prior to being introduced into the plunge pool downstream of the dam. This provides a significant amount of aeration with respect to flow rate. If the release flow DO level approaches 4 mg/l, then provision will be made to increase the effectiveness of the cascade aeration by installing additional steps downstream of the minimum release weir. The upper gate also provides flexibility to change the depth of water withdrawal, if necessary.

The DO concentrations in Lake Benson were monitored but not reported to the USFWS in the ARCADIS February 11, 2008 letter. Grab samples were collected at the boat dock near the headwaters of the Lake. These results are provided in Attachment C. The weekly DO profile in Lake Benson started on April 4, 2008 and will continue until the end of November 2008.

Reasonable and Prudent Measure #3 – Dwarf Wedgemussel Surveys

It is the City's intent to submit the Swift Creek mussel survey via the Sampling and Monitoring Program Report. The City wishes to submit a complete report to the agencies to avoid confusion over the multitude of pieces and parts. If the USFWS would like an advance copy of the final Swift Creek mussel survey report, please contact Mary Sadler with ARCADIS. It should be noted that by the time the ARCADIS February 11, 2008 report was distributed, the Swift Creek mussel survey report had not been received by ARCADIS. ARCADIS received the final Swift Creek mussel survey report (published by Catena) on March 20, 2008. It should be noted that correspondence with The Catena Group began in early November 2007 regarding the status of both the Swift Creek and Little River mussel survey reports.

It was our understanding that the ARCADIS February 11, 2008 report served as the "Annual Report" to the USFWS. The letter is entitled, "Status of Terms and Conditions in Biological Opinion for the Dempsey E. Benton WTP." The ARCADIS February 11, 2008 letter served to update the USFWS on the status of the terms and conditions. We apologize for any confusion in terminology.

Additionally, the ARCADIS February 11, 2008 letter explains why the Sampling and Monitoring Program Report has not yet been published. The City wishes to submit a complete report to the agencies. Benthic survey report data was not received by Pennington until February 5, 2008. The 2007 Lower Neuse Basin Association (LNBA) water quality data was not received until April 7, 2008. The Fish Community Survey Report was received April 8, 2008.

Reasonable and Prudent Measure #4 – Installation of Gaging Station

We assumed, albeit incorrectly, from previous conversations with the USFWS regarding the gaging station that the preferred location was the Highway 42 Bridge crossing. In the effort to jump start this effort (per the USACE request to update the USFWS on the status of the terms and conditions in January 2008), the City moved forward with the gaging station based on our understanding of the intent of this term and condition. We apologize for any confusion this caused. USGS did reconnaissance at the Highway 42 Bridge Crossing and determined that access was not suitable. The closest suitable downstream site was Barber Mill Road.

Until the gaging station is installed, the City will monitor minimum releases as described above. Water quality data is being monitored upstream of Lake Benson dam. Water quality data will be monitored downstream of Lake Benson dam via the Sampling and Monitoring Program. The LNBA is currently negotiating a contract with the City of Raleigh to include the new monitoring points in the LNBA sampling and monitoring effort. We expect that monitoring at these sites will begin in early summer 2008.

Reasonable and Prudent Measure #5 – Swift Creek Water Quality Monitoring

The March 2006 Sampling and Monitoring Program included the three sites in question in the Swift Creek watershed. The USFWS and DENR agencies were aware of the development of the Sampling and Monitoring Program prior to the development of the Biological Opinion. The Sampling and Monitoring Program was developed in late 2005. A draft Sampling and Monitoring Program Plan was distributed in January 2006 to Dale Suiter, Shari Bryant, David Cox, and Sarah McRae. It was our understanding that the Swift Creek sites in the Sampling and Monitoring Program were being incorporated into the Biological Opinion. The Sampling and Monitoring Program was approved by DENR in early March 2006. The Final Biological Opinion was issued on February 23, 2006. At least twelve drafts of the Biological Opinion were issued, starting in October 2005. The first draft in the ARCADIS file is Biological Opinion Draft #4 (October 2006) just as the Sampling and Monitoring Program was being formulated. The nearer-to-final Biological Opinion Draft #8 (January 2006) contains conditions as stated in the Sampling and Monitoring Program.

The water quality and benthic monitoring site immediately downstream of the dam was re-located by DWQ. During extensive field reconnaissance with DWQ, DWQ requested that the site be moved one-half mile downstream since appropriate benthic sampling sites were not present upstream of the re-located sampling point. The re-located site is downstream of Mahler's creek. Re-locating this site will not significantly affect water quality results. Re-locating the site will provide meaningful benthic data. It was the City's intent that the data be defensible for incorporation into the state's basinwide sampling program in the Neuse River Basin.

It was our understanding that the USFWS understood that the Sampling and Monitoring Program would take at least a year to develop and set up the program. The Dempsey E. Benton WTP Project was publically bid on October 31, 2006. Bids were formally received in November 2006. The City and ARCADIS held a kick-off meeting with DWQ on October 17, 2006.

The following is a timeline of events related to the Sampling and Monitoring Program:

- Mussel survey plan meeting with USFWS October 10, 2006.
- DWQ and ARCADIS field reconnaissance for refinement of benthic sites in March 2007. Benthic data was collected in July 2007. Report from Pennington received February 5, 2008.
- Water quality data is currently collected per the Sampling and Monitoring Program except for the seven new stations. The seven new stations could not be numbered by DWQ until the benthic locations were approved since the City agreed to take benthic and water quality at the same locations.
    - The seven new stations were officially numbered by DWQ in late October 2007.
    - LNBA was contacted in early February 2008 about commencement of the monitoring and collection of the data from 2000 to 2007.
    - The City/LNBA contract is currently being modified to add the new stations.
    - It is anticipated that sampling at the seven new stations will begin in early summer 2008.
- The Catena Group report on the fish community survey was received April 8, 2008.
- The photo-documentation studies were completed by September 2007 as stated in the ARCADIS February 11, 2008 letter.
- ARCADIS expects a Sampling and Monitoring Program Report to be issued by April 30, 2008.

Reasonable and Prudent Measure #6 – Mobile Home Package Plants

The City has exceeded expectations regarding the Mill Run Mobile Home Park. The City has approved a new development for this site, and as such, the Mill Run WWTP package plant has been removed from service permanently. The new development will connect to the City's wastewater collection system.

The City is in the process of removing the Indian Creek WWTP, as stated in the ARCADIS February 11, 2008 letter. Final design of a new pump station and force main is expected to be complete by September 2008 and the project bid for construction in October 2008. Construction is anticipated to be complete by fall 2009. It was our understanding that this term and condition in the Biological Opinion required the removal of the package plant within one year of project operation. The City expects to exceed this schedule by more than one year.

The City understands the USFWS concern over low flow in Swift Creek coupled with wastewater discharges from the Indian Creek WWTP. However, the City must remind the USFWS that the City does not own the Indian Creek WWTP and as such may not legally force the owner on any plant operational issues. The City is legally moving forward with the process of replacing this package plant with a pump station, a process which takes time to complete (planning, engineering, obtaining permits, obtaining easements, and obtaining legally acceptable bids). Furthermore, it would be anticipated that the City's minimum flow release since November 2007 would offset impacts to mussels regarding historically present low flows, as documented in the Biological Assessment and Biological Opinion.

Reasonable and Prudent Measure #7 – Stream Buffer Protection

The City would like to clarify the Reasonable and Prudent Measure #7 in the Biological Opinion. This term and condition for the land between Lakes Benson and Wheeler states, "The USACE/City must make sure that protection mechanisms are in place for at least 50 percent of the land contained within Lake Wheeler to Lake Benson within 12 months of initiation of Project water withdrawals." The property acquisition and/or conservation easement status along Swift Creek between Lakes Benson and Wheeler is nearly complete. The City, in partnership with Wake County, has preserved all but 34.32 acres of property out of the 346 acres (e.g. 311.8 acres already protected). The 311.8 acres is greater than 50 percent of land acquisition as required by the Biological Opinion term and condition. As of early 2006, 16.7 acres were being negotiated with property owners and the County had been unable to acquire 17.62 acres where property owners are unwilling to sell. In 2007, an additional 2.89 acres were protected, for a total of 314.69 protected acres. Nine property owners (1 to 4 acre parcels) have indicated that they will not participate in the greenway program at this time. The County intends to pursue these nine property owners over the next several years for purchase or conservation easements. The Wake County Board of Commissioners will not condemn properties for open space, so the acquisition of the remaining 17.62 acres is wholly dependent on the property owner's willingness to participate in the program. Hence, the Biological Opinion contains language that the City, in conjunction with the County, must continue good faith efforts to pursue riparian protection of the remaining parcels.

The term and condition for the Steep Hill Creek corridor states, "The USACE/City must pursue protection for the Steep Hill Creek corridor…Adjustments to areas of the corridor are allowable based on land availability, willingness of property owners to negotiate, and parcel boundaries." The County has purchased one 65.36 acre property (the Old Ventures Property) in conjunction with the Ecosystem Enhancement Program. The Old Ventures Property is a significant floodplain conservation easement. The County is currently negotiating conservation easements with the largest land owner, NC State University, and this process is taking longer than expected. The County has indicated that they wish to have fully negotiated with the University prior to pursuing the other land owners along the corridor. Additionally, the County only expects to pursue a handful of landowners per year along this 7.1 mile corridor due to the magnitude of the effort and the balancing of resources among other open space property acquisitions in the County. The County is committed to moving forward with the Steep Hill Creek corridor, but exact time frame for completion of this effort is unknown at this time.

Reasonable and Prudent Measure #8 – Public Service Announcements

The City would like to clarify the Reasonable and Prudent Measure #8 in the Biological Opinion. This term and condition states that broadcast two of three forms of Public Service Announcements (PSA) is required whenever the minimum flow releases from Lake Benson dam are maintained at Tier 2 for more than <u>fourteen</u> <u>consecutive</u> days. The City has maintained a Tier 1 flow release (with the exception of two one-day independent excursions, as previously explained) through November 2007 at the start of the AWSE.

However, the City has been active in regard to public broadcasting of water conservation announcements. Regarding television and radio media, the City has sponsored a water conservation contest on all four Clear Channel radio stations. This contest will conclude on May 1, 2008. Additionally, the City has been running radio ads on the aforementioned stations which describe common water conservation tips. This two month long ad campaign has cost the City $29,000. We have also been running water conservation programs on RTN (Raleigh Television Network) and have recently obtained permission to run the Governor's commercials on our network.

Furthermore, Attachment D contains information regarding the City's public relations effort for increased water conservation.

Reasonable and Prudent Measure #9 – Water Conservation Measures

The City has been proactive in water resource management action during this exceptional drought, and we have implemented the most stringent water conservation measures and implemented them sooner than any water system in the Neuse River Basin and possibly in the entire state. Attachment E provides a chronology of the drought and the actions taken the City. The water supply percentages, shown in bold text, are as reported to the City by the USACE. Milestone dates are indicated in the chronology when the City took action to enforce the mandated water use restrictions to its customers. The staff recommendations were actually made in advance of these milestone dates.

The City does not implement "triggers" for mandatory water restrictions. Rather, the Water Use Monitoring Ordinance recommends percentage threshold values as guidance. The water use monitoring thresholds are:

a) Over 70% available water supply capacity – every day mandatory water conservation restrictions and voluntary water use measures and best management practices are in effect.
b) 70% or lower available – stage 1 mandatory water conservation restrictions and rules <u>may</u> be necessary
c) 50% or lower available – stage 2 mandatory water conservation restrictions and rules <u>may</u> be necessary.

These monitoring thresholds are designed to allow staff to monitor the full range of factors regarding water supply (e.g. storage, expected rainfall, water use projections, etc.). Water use restrictions <u>may</u> be recommended by the Public Utilities Director for approval by the City Council at any time that the available water supply capacity does not meet or exceed the projected water usage amount during the projection period, based on the current water demand average.

Attachment F contains the City's Water Conservation Ordinance as updated by the City in May 2007. This Ordinance implements permanent year round water conservation measures. The ordinance became effective on July 2, 2007.

Reporting

The USFWS requested in the Biological Opinion that the annual reporting requirement be consolidated to the extent possible. It was our understanding that the ARCADIS February 11, 2008 letter served as the Annual Report with the exception of the data that will be published in a complete Sampling and Monitoring Program Report. As mentioned previously, the City also wishes to submit a complete report to the agencies to avoid confusion.

In regards to correspondence with the USFWS in 2007, ARCADIS sent a letter (dated January 17, 2007) in which the USFWS was apprised of the status of the Biological Opinion term and condition with respect

to the mussel surveys. This documentation provided an explanation as to why the mussel survey did not immediately start after the July 2007 Finding of No Significant Impact (FONSI) was issued for the Dempsey E. Benton WTP Project. A reply from USFWS was never received regarding this correspondence. Additionally, ARCADIS (Mary Sadler) contacted the USFWS in January 2007 via email regarding the USFWS opinion on the submittal of a 2007 Annual Report. The Sampling and Monitoring Program was in the beginning stages of development and therefore there was not much information to report other than the status of the mussel surveys which were communicated to the USFWS in the January 17, 2007 letter. A response from the USFWS was never received.

The complete Sampling and Monitoring Program document will be sent to the USFWS and the USACE as soon as all the data is received and ARCADIS has had the opportunity to incorporate the missing data into the report.

Conclusion

We sincerely hope that this correspondence resolves much of the USFWS concern regarding the City's implementation of the terms and conditions of the Biological Opinion. We would be happy to meet with your staff to discuss the new AWSE proposal and clarify any remaining issues. We appreciate your time and attention to this important issue.

Sincerely,

Dale Crisp, PE
Raleigh Public Utilities Director

cc: J. Russell Allen, Raleigh City Manager
Robert Massengill, City of Raleigh Assistant Director
Perry Allen, City of Raleigh Construction Project Manager
T.J. Lynch, City of Raleigh Wastewater Treatment Plants Superintendent
John Garland, City of Raleigh Water Treatment Plants Superintendent
Colonel John Pulliam, Wilmington District, USACE
Terry Brown, Wilmington District, USACE
James Shern, Raleigh District, USACE
Dale Suiter, U.S. Fish and Wildlife Service
Pete Benjamin, U.S. Fish and Wildlife Service
Coleen Sullins, Division of Water Quality, DENR
Tom Fransen, Division of Water Resources, DENR
John Morris, Director, Division of Water Resources, DENR
Dan McLawhorn, City of Raleigh Associate Attorney
Mary Sadler, ARCADIS
Whit Wheeler, ARCADIS

ATTACHMENT A

CALIBRATION SHEET FOR MINIMUM FLOW RELEASE

CITI, LLC.
Instrumentation Calibration Report

Instrument Name and Service	Serial Number
Lake Benson Release Flow meter	PBD/U9151191

Manufacturer	Model Number
Milltronics	Hydroranger 200

Tag Number	Loop Number
FIT-101	

Output Range	Zero Setting
0-12 CFS	0 CFS

Units:	Input	Desired Output	Actual Output
	CFS	mA	mA
	0.00	4.0	4.0
	4.00	9.33	9.30
	8.00	14.66	14.6

Position of Switches, Jumpers	Alarm Settings
N/A	N/A

Damping Setting	Noise Reduction
50 Secs	N/A

Primary Device Size	Calibration Factor
XPS=10	

Comments

ULM measures level on a 90 deg. V notch weir. where 1.873 ft = 12 CFS

Settings:
p001 = 6, p002 = 1, p003 = 2, p004 = 102, p005 = 4, p006= 9.53, p007 = 1.873, p065 = 16.4, p600 =1, p601 = 2.5. p602 = 01 90, p603 = 1.873, p604 = 12.002, p605 = 0, p606 =1, p607 =3, p608 =4, p253=50, p710 =50, p704 = 2

Calibrated By	Date
Leonardo Jurado	02/15/2008

Location

Lake Benson

Engineer's Signature

ATTACHMENT B

MINIMUM FLOW RELEASES FROM LAKE BENSON DAM SINCE NOVEMBER 21, 2007

Lake Benson Minimum Flow Release
Alternative Water Source Exchange

Date	Average Minimum Flow Release, cfs
November 21, 2007	2.3
November 22, 2007	3.5
November 23, 2007	3.4
November 24, 2007	3.2
November 25, 2007	3.6
November 26, 2007	3.4
November 27, 2007	2.9
November 28, 2007	4.0
November 29, 2007	3.8
November 30, 2007	3.7
December 1, 2007	3.6
December 2, 2007	3.8
December 3, 2007	3.6
December 4, 2007	3.5
December 5, 2007	3.2
December 6, 2007	3.2
December 7, 2007	3.4
December 8, 2007	3.3
December 9, 2007	3.7
December 10, 2007	3.5
December 11, 2007	3.6
December 12, 2007	3.5
December 13, 2007	3.6
December 14, 2007	3.5
December 15, 2007	3.6
December 16, 2007	3.7
December 17, 2007	3.2
December 18, 2007	3.3
December 19, 2007	3.7
December 20, 2007	3.7
December 21, 2007	3.9
December 22, 2007	3.6
December 23, 2007	3.4
December 24, 2007	3.8
December 25, 2007	3.7
December 26, 2007	3.9
December 27, 2007	3.7
December 28, 2007	3.6
December 29, 2007	3.6
December 30, 2007	3.8
December 31, 2007	3.7

Lake Benson Minimum Flow Release
Alternative Water Source Exchange

Date	Average Minimum Flow Release, cfs
January 1, 2008	3.5
January 2, 2008	3.5
January 3, 2008	3.5
January 4, 2008	3.2
January 5, 2008	3.1
January 6, 2008	3.1
January 7, 2008	4.5
January 8, 2008	4.6
January 9, 2008	4.0
January 10, 2008	3.5
January 11, 2008	3.5
January 12, 2008	3.6
January 13, 2008	4.0
January 14, 2008	3.5
January 15, 2008	3.8
January 16, 2008	3.9
January 17, 2008	3.9
January 18, 2008	3.8
January 19, 2008	3.8
January 20, 2008	3.7
January 21, 2008	3.7
January 22, 2008	3.8
January 23, 2008	3.6
January 24, 2008	3.8
January 25, 2008	3.5
January 26, 2008	3.9
January 27, 2008	3.7
January 28, 2008	3.5
January 29, 2008	3.2
January 30, 2008	4.1
January 31, 2008	4.2
February 1, 2008	4.3
February 2, 2008	4.1
February 3, 2008	3.6
February 4, 2008	3.6
February 5, 2008	3.5
February 6, 2008	3.6
February 7, 2008	3.7
February 8, 2008	4.0
February 9, 2008	4.0
February 10, 2008	3.8

Lake Benson Minimum Flow Release
Alternative Water Source Exchange

Date	Average Minimum Flow Release, cfs
February 11, 2008	3.7
February 12, 2008	3.5
February 13, 2008	3.7
February 14, 2008	4.1
February 15, 2008	3.6
February 16, 2008	3.5
February 17, 2008	3.5
February 18, 2008	3.5
February 19, 2008	3.5
February 20, 2008	3.5
February 21, 2008	3.5
February 22, 2008	3.5
February 23, 2008	3.5
February 24, 2008	3.5
February 25, 2008	3.5
February 26, 2008	3.5
February 27, 2008	3.5
February 28, 2008	3.5
February 29, 2008	3.5
March 1, 2008	3.5
March 2, 2008	3.5
March 3, 2008	3.5
March 4, 2008	3.5
March 5, 2008	3.5
March 6, 2008	3.5
March 7, 2008	3.5
March 8, 2008	3.5
March 9, 2008	3.5
March 10, 2008	3.5
March 11, 2008	3.5
March 12, 2008	3.5
March 13, 2008	3.5
March 14, 2008	3.5
March 15, 2008	3.5
March 16, 2008	3.5
March 17, 2008	3.5
March 18, 2008	3.5
March 19, 2008	3.5
March 20, 2008	3.5
March 21, 2008	3.5
March 22, 2008	3.5

Lake Benson Minimum Flow Release
Alternative Water Source Exchange

Date	Average Minimum Flow Release, cfs
March 23, 2008	3.6
March 24, 2008	3.6
March 25, 2008	3.5
March 26, 2008	3.5
March 27, 2008	3.5
March 28, 2008	3.5
March 29, 2008	3.5
March 30, 2008	3.5
March 31, 2008	3.5
April 1, 2008	3.5
April 2, 2008	3.5
April 3, 2008	3.6
April 4, 2008	3.5
April 5, 2008	3.5
April 6, 2008	3.5
April 7, 2008	3.5
April 8, 2008	3.5
April 9, 2008	3.2
April 10, 2008	3.5
April 11, 2008	3.5
April 12, 2008	3.5
April 13, 2008	3.5
April 14, 2008	3.5

ATTACHMENT C

DISSOLVED OXYGEN CONCENTRATIONS AND OTHER WATER QUALITY SAMPLING IN LAKE BENSON

NCDEH Laboratory ID: 37604
EPA Laboratory ID: NC115
DWQ Laboratory ID: 426

City Of Raleigh
North Carolina

Water Transfer Study

Location: Lake Benson

Collection Date	pH, units	Dissolved Oxygen, mg/L	Fecal Coliform, cfu/ml	TOC, mg/L	Alkalinity,mg/L as $CaCO_3$	Total Phosphorus, mg/L	Nitrate +Nitrite mg/L as N	TKN, mg/L	Total Nitrogen, mg/L	Ammonia, mg/L as N	Temp, °C	TSS, mg/L	Turbidity, NTU
11/5/2007	6.65	9.25	20	8.6248	n/a	<0.05	0.03	0.64	0.67	<0.02	15.8	---	---
11/6/2007	8.31	6.9	24	7.4016	23.3	<0.05	0.03	0.72	0.75	<0.02	17.8	---	---
11/7/2007	6.54	8	16	7.4409	23.4	<0.05	0.03	0.73	0.76	<0.02	15.7	---	---
11/8/2007	6.24	6.9	34	7.7551	23.4	0.07	0.03	1.08	1.11	<0.02	14.9	---	---
11/9/2007	7.62	6.8	25	7.9773	23.4	<0.05	0.03	0.6	0.63	0.02	14.2	---	---
11/15/2007	6.74	9.63	---	6.65	31.5	<0.05	0.02	0.9	0.92	<0.02	14.9	---	11.9
11/26/2007	6.66	9.27	12	6.97	30.3	0.12	<0.02	0.58	0.58	<0.02	12.1	---	7.92
12/6/2007	6.56	12.25	55	8.8186	22.9	<0.05	<0.02	1.37	1.37	<0.02	7	---	8.62
12/13/2007	6.25	9.4	14	7.7525	24.3	<0.05	<0.02	1.36	1.36	0.03	14.7	---	12.2
12/20/2007	6.55	11.15	608	6.3982	22.4	0.05	<0.02	0.71	0.71	0.03	7.9	---	14.2
12/27/2007	5.71	10.21	1174	9.1525	21.2	<0.05	0.05	<0.25	0.05	<0.02	9.5	9	13
1/3/2008	6.57	10.55	715	6.5872	16.65	0.12	0.12	0.56	0.68	<0.04	5.4	14	24.9
1/10/2008	6.71	10.63	125	10.9069	17.6	0.11	0.07	1.07	1.14	0.05	11.2	12	18.6
1/17/2008	6.22	11.6	22	10.599	21.3	0.11	<0.04	0.61	0.61	<0.04	7.5	11	11.6
1/24/2008	6.18	13.65	27	12.6058	21.7	0.11	<0.04	0.61	0.61	<0.04	5.8	10	10.3
1/31/2008	6.37	12.25	***	11.1739	20.4	<0.04	0.38	0.61	0.99	0.09	6.9	17	11.2
2/7/2008	6.5	10.65	***	***	20.7	***	***	***	***	***	13.3	12	10.4
Average	**6.61**	**9.95**	**205.07**	**8.55**	**23.10**	**0.10**	**0.08**	**0.81**	**0.80**	**0.03**	**11.45**	**12.14**	**12.90**
Min	**5.71**	**6.80**	**12.00**	**6.40**	**16.65**	**0.05**	**0.02**	**0.56**	**0.05**	**0.02**	**5.40**	**9.00**	**7.92**
Max	**8.31**	**13.65**	**1,174.00**	**12.61**	**31.50**	**0.12**	**0.38**	**1.37**	**1.37**	**0.05**	**17.80**	**17.00**	**24.90**

*** pending ---No Data

Report prepared by: Martesa Parham, Chemist
Approved By: Larry McMillan, Laboratory Supervisor

City Of Raleigh
North Carolina

NCDEH Laboratory ID: 37604
EPA Laboratory ID: NC115
DWQ Laboratory ID: 426

Water Transfer Study

Location: Neuse River

Collection Date	pH, units	Dissolved Oxygen, mg/L	Fecal Coliform, cfu/ml	TOC, mg/L	Alkalinity, mg/L as $CaCO_3$	Total Phosphorus, mg/L	Nitrate +Nitrite mg/L as N	TKN, mg/L	Total Nitrogen, mg/L	Ammonia, mg/L as N	Temp, °C	TSS, mg/L	Turbidity, NTU
11/26/2007	6.47	9.5	105	6.9567	39.7	1.4	0.22	0.52	0.74	0.06	10	---	4.95
12/6/2007	6.56	11.73	145	7.1275	36.8	0.05	0.31	0.58	0.89	0.13	7.3	---	3.88
12/13/2007	6.28	9.84	60	6.4213	37.5	<0.05	0.26	0.71	0.97	<0.02	13.7	---	5.1
12/20/2007	6.23	12.25	177	11.1618	35	0.06	0.32	0.43	0.75	0.09	5	---	5.64
12/27/2007	5.68	10.91	164	13.4413	23.8	0.06	0.34	0.73	1.07	0.06	7.2	29	6.52
1/3/2008	6.45	12.38	132	13.8996	27.4	0.05	0.46	0.62	1.08	0.04	3.1	5	17.1
1/10/2008	6.23	10.4	55	11.0739	30.8	0.07	0.34	0.8	1.14	0.06	11.4	12	9.82
1/17/2008	6.34	13.39	78	15.1092	32.3	0.04	0.4	0.63	1.03	<0.04	5.3	6	7.35
1/24/2008	6.39	13	38	6.6001	35.9	0.04	0.4	0.61	1.01	<0.04	6.5	5	7.46
1/31/2008	6.53	11.96	***	5.2445	34	<0.04	<0.04	0.47	0.47	<0.04	7	5	7.01
2/7/2008	6.29	9.63	***	***	30.5	***	***	***	***	***	13.5	8	8.71
Average	**6.31**	**11.36**	**106.00**	**9.70**	**33.24**	**0.22**	**0.34**	**0.61**	**0.96**	**0.07**	**8.18**	**10.00**	**7.59**
Min	**5.68**	**9.50**	**38.00**	**5.24**	**23.80**	**0.04**	**0.22**	**0.43**	**0.74**	**0.04**	**3.10**	**5.00**	**3.88**
Max	**6.56**	**13.39**	**177.00**	**15.11**	**39.70**	**1.40**	**0.46**	**0.80**	**1.14**	**0.13**	**13.70**	**29.00**	**17.10**

***-pending
---No Data

Report prepared by: Martesa Parham, Chemist

Approved By: Larry McMillan, Laboratory Supervisor

ATTACHMENT D

CITY OF RALEIGH PUBLIC RELATION EFFORTS FOR INCREASED WATER CONSERVATION

CITY OF RALEIGH EDUCATION AND DROUGHT UPDATE EFFORTS

Per the request of the Public Works Committee, Public Utilities Staff have prepared a brief outline of recent educational and informational efforts which have been designed to inform our customers about water conservation and changes in water use rules.

On May 25, 2007, the City of Raleigh mailed out a post card and magnet to all of our customers. Please see the attached copies of said post card and magnet. The post card and magnet were intended to inform the public about our new 'Everyday Rules' (i.e. alternate day irrigation) and provide a helpful reminder of the schedule that they could post on a metal kitchen appliance.

Similarly, on August 22nd, the City of Raleigh issued a letter to all of our customers describing the implementation of Stage 1 water conservation rules. Please see the attached Stage 1 letter for more information. Again, the letter was intended to inform the public about the new Stage 1 rules and what water use activities they would affect.

Subsequently, as the drought continued to worsen, the Raleigh City Council voted to amend the Stage 1 rules so that no irrigation from hose end sprinklers or in-ground irrigation systems would be permitted starting on October 23rd, 20007. In response to this amendment, the Public Utilities Department once again sent out a letter to all of our customers describing these changes on October 16th, 2007. Please see the attached Amended Stage 1 letter for more information.

In addition to the direct mailers and magnets, the Public Utilities Department's water conservation specialist (Ed Buchan) has been involved in numerous educational/outreach programs since starting in January of 2007. Some examples are listed below:

- Visiting local schools, children's clubs, churches, and libraries to present water conservation tips and information. Mr. Buchan is usually conducting these presentations several times per week.
- Visiting CAC's to discuss water conservation and water supply issue. Mr. Buchan has visited nearly all the local CAC chapters and has presented directly to all the CAC chair members.
- Presenting water conservation and water supply information to various organizations such as Green Industry Council workshops, Hotel/Restaurant workshops, Lions Club meetings, Rotary Club meetings, local engineer's workshops, Daughters of the Confederacy meetings, NCSU environmental education classes, etc.
- Distribute water conservation information and shower timers at an annual arts festival in Moore Square called Artsplosure.
- Distribute water conservation information and shower timers at the City's annual street festival called 'Raleigh Wide Open'.
- Distributed water conservation information and shower timers at Meredith College's Environmental Awareness Day.

In addition, probably the most valuable educational effort the Public Utilities Dept. conducts is the annual 'Waterfest' which is held at either the Neuse River Water Plant or the EM Johnson drinking water plant. During this 3 day event, over 5,000 local school children (ages K-8) are exposed to numerous water conservation activities and learn about how drinking water is produced and how waste water is treated. This has been ongoing effort for the last 14 years, and continues to be a popular event among schools and parents. Regarding television and radio media, the City of Raleigh has sponsored a water conservation contest on all 4 Clear Channel radio stations, and this contest will conclude on May 1st. Additionally, the City has been running radio ads on the aforementioned stations which describe common water conservation tips. This 2 month long ad campaign has cost the City $29,000. We have also been running water conservation programs on RTN (Raleigh Television Network) and have recently obtained permission to run the Governor's commercials on our network.

City of Raleigh
Public Utilities Department
P. O. Box 590
Raleigh, North Carolina 27602

Prsrt Std
U.S. Postage
PAID
Raleigh, NC
Permit #813

Every Day Irrigation Rules
Year-Round Schedule

Effective July 2nd, 2007

S	M	T	W	T	F	S
EVEN	2	ODD	EVEN	ODD	EVEN	ODD

For automatic, non-automatic, and hose end sprinklers (e.g. impact, soaker hoses, single stream, and multi steam type sprinklers).

ODD addresses can irrigate: Tuesday, Thursday, & Saturday.

EVEN addresses can irrigate: Wednesday, Friday, & Sunday.

Other water uses such as City certified automatic spray irrigation systems, hand held hoses, drip irrigation, new landscape establishment permits, swimming pool filling and operation, vehicle washing, and pressure washing shall be allowed 7 days a week.

City of Raleigh
Public Utilities Department
919.857.4540
www.raleighnc.gov

WATER USE IT WISELY

EVERY DAY IRRIGATION RULES

Effective July 2nd, 2007

For automatic, non-automatic, and hose end sprinklers (e. g. impact, soaker hoses, single stream, and multi stream type sprinklers) using City of Raleigh water.

ODD addresses can irrigate on: **Tuesday, Thursday, and Saturday**

EVEN addresses can irrigate on: **Wednesday, Friday, and Sunday**

Other water uses such as City certified automatic spray irrgation systems, hand held hoses, drip irrigation, new landscape establishment permits, swimming pool filling and operation, vehicle washing, and pressure washing shall be allowed 7 days a week.

City of Raleigh
Public Utilities Department
919.857.4540
www.raleighnc.gov

WATER USE IT WISELY.

City Of Raleigh
North Carolina

October 16, 2007

Dear Raleigh Water Customer:

The City of Raleigh has received additional information from the National Weather Service and North Carolina Climatology Office staff on the current long term weather forecast for the fall and early winter that indicated the drought conditions N.C. has been experiencing over the past few months will very likely continue. That information along with the high water demand the City has been experiencing during this same time period on days where irrigation is permitted under the Stage 1 water conservation plan water use restrictions and the current water level in Falls Lake lead the City to proceed to implement the Stage 1 **Amended** water conservation plan water use restrictions, effective on Tuesday, October 23, 2007.

Please refer to the City's web page at www.raleighnc.gov for complete information on all water uses restricted under Stage 1 **Amended** Water Conservation Plan, but the chart below is a quick summary of how significant water uses are affected for the typical customer:

WATER USES	USE REGULATIONS
Lawn and landscape irrigation in ground automatic/non-automatic systems	Prohibited
Lawn and landscape irrigation by garden hose-end sprinklers	Prohibited
Lawn and landscape irrigation by hand held hose	Two days per week irrigation with odd property addresses on Tuesday & Saturday and even addresses on Wednesday & Sunday only between hours of 6:00 am till 10:00 am again from 6:00 pm till 10:00 pm on same day
Vehicle Washing at residence	Prohibited
Pressure Washing at residence by owner	Permitted on Saturday & Sunday Only

The Stage 1 Amended water use restrictions apply to all City of Raleigh water customers.

The first violation of the Stage 1 mandatory water use restrictions is a $200 fine, and a second violation will result in a $1,000 fine. A third violation will result in interruption of the customer's water service from the City.

The City had hoped to avoid having to implement further water use restrictions by implementing the Stage 1 Water Conservation Plan mandatory water use restrictions August 28, 2007 and by pro-actively implementing permanent, year-round lawn irrigation water use restrictions back on July 2, 2007. However, the extreme nature of the current drought and the forecast the dry conditions will continue for the remainder of year made it necessary that these additional water use restrictions be put into effect in order to insure the City has adequate water supply for public health and safety purposes till the drought ends.

If you have any questions regarding the Stage 1 **Amended** Water Conservation Plan measures, please contact Ed Buchan, Raleigh Water Conservation Education Specialist at (919) 857-4540.

Sincerely,

H. Dale Crisp

H. Dale Crisp, P.E.
Raleigh Public Utilities Director

City Of Raleigh

North Carolina

August 22, 2007

Dear Raleigh Water Customer:

The City of Raleigh received information at the North Carolina Drought Advisory Council meeting on August 21st from the National Weather Service and North Carolina Climatology Office staff on the current long term weather forecast for the fall and early winter that indicated the drought conditions North Carolina has been experiencing over the past two months will very likely continue. That information, along with the high water demand the City has been experiencing during this same time period, and the current water level in Falls Lake lead the City to proceed to implement the Stage 1 Water Conservation Plan water use restrictions, effective on Tuesday, August 28, 2007.

Please refer to the City's web page at www.raleighnc.gov for complete information on all water uses restricted under Stage 1 Water Conservation Plan, the chart below is a quick summary of how significant water uses are affect the typical customer:

WATER USES	USE REGULATIONS
Lawn & landscape irrigation in ground automatic/non-automatic systems	*One day per week irrigation with odd property addresses on Tuesday and even addresses on Wednesday and only between hours of 12:00 AM till 10:00 AM*
Lawn & landscape irrigation by garden hose-end sprinklers	*One day per week irrigation with odd property addresses on Tuesday and even addresses on Wednesday and only between hours of 6:00 AM till 10:00 AM and again from 6:00 PM till 10:00 PM on the same day.*
Lawn & landscape irrigation by hand held hose	*Two days per week irrigation with odd property addresses on Tuesday and Saturday and even addresses on Wednesday and Sunday only between hours of 6:00 AM till 10:00 AM and again from 6:00 PM till 10:00 PM on the same day*
Vehicle Washing at residence	*Permitted on Saturday and Sunday Only*
Pressure Washing at residence by owner	*Permitted on Saturday and Sunday Only*

The Stage 1 water use restrictions apply to all City of Raleigh water customers.

The first violation of the Stage 1 mandatory water use restrictions is a $200 fine, and a second violation will result in a $1,000 fine. A third violation will result in interruption of the customer's water service from the City.

The City had hoped to avoid having to implement the Stage 1 Water Conservation Plan mandatory water use restrictions this summer season by pro-actively implementing permanent, year-round lawn irrigation water use restrictions back on July 2, 2007. However, the extreme nature of the current drought and very high temperatures we are experiencing in North Carolina this summer and the forecast the dry conditions will continue for the remainder of year made it necessary that these water use restrictions be put into effect in order to insure the City has adequate water supply for public health and safety purposes until the drought ends.

If you have any questions regarding the Stage 1 Water Conservation Plan measures, please contact Ed Buchan, Raleigh Water Conservation Education Specialist at (919) 857-4540.

Sincerely,

H. Dale Crisp

H. Dale Crisp, P.E.
Raleigh Public Utilities Director

ATTENTION RALEIGH WATER CUSTOMER

February 8, 2008

Dear Raleigh Water Customer:

The City of Raleigh received information on February 5th from the National Weather Service staff regarding the current long term weather forecast. According to this report, the severe drought conditions central North Carolina has been experiencing over the past eight months will very likely continue for the next 3 to 6 months. With the current, unprecedented low water level in Falls Lake for this time of the year, the City must now proceed to implement Stage 2 Mandatory Water Use restrictions of the City's Water Conservation Plan. The Stage 2 restrictions were approved by the Raleigh City Council on February 5th to be effective at **12:01 AM Friday, February 15, 2008.**

Please refer to the City's web page at www.raleighnc.gov for complete detailed information on all water uses restricted under Stage 2 Water Conservation Plan. The chart below is a quick summary of water use restrictions for the typical customers:

TYPE OF WATER USE	STAGE 2 IMPACT
Automatic & Non-Automatic spray irrigation systems	PROHIBITED
Certified automatic spray irrigation system and certified golf course alternative systems	PROHIBITED
Hose end sprinklers (e.g. single stream, multi-stream, and impact type sprinklers)	PROHIBITED
Hand held hose irrigation	PROHIBITED
Drip irrigation	PROHIBITED
Swimming Pool filling	PROHIBITED *OK to add minimal water to maintain sanitary conditions.*
Vehicle Washing	PROHIBITED *City Certified water conserving commercial vehicles washes may continue to operate*
Washing homes, buildings, roads, driveways, sidewalks, decks and other such outdoor surfaces, includes pressure washing and street / parking lot cleaning	PROHIBITED *Maybe permitted for rare circumstances necessary to maintain sanitary conditions and protect public health.*

The Stage 2 water use restrictions apply to all City of Raleigh water customers.

The first violation of the Stage 2 mandatory water use restrictions will result in a $1,000 fine and a second violation will result in the interruption of water service from the City of Raleigh.

If you have questions regarding the Stage 2 Water Use Restrictions,
please contact our staff in Public Utilities **(919) 857-4540**
or by e-mail: **waterconservation@ci.raleigh.nc.us.**

ATTACHMENT E

CHRONOLOGOGY OF WATER SUPPLY AND WATER USE RESTRICTIONS

CHRONOLOGY OF RALEIGH WATER SUPPLY MILESTONES AND WATER USE MANAGEMENT INITIATIVES IN 2007 AND 2008

May 15, 2007	City Council approves revisions to Water Conservation Plan including implementation of permanent year round lawn irrigation restrictions on July 2, 2007.
May 25, 2007	Falls Lake drops below full (i.e. **100%**) water supply pool level of 251.5 feet MSL. Falls Lake level is 251.46 feet MSL.
July 2, 2007	City implements so called "Odd / Even" Year Round Lawn Irrigation Permanent Water Use Restrictions limiting irrigation to only 3 days per week for all customers. Falls Lake level is 250.17 feet MSL and the water supply pool remaining is **86%**. Drought conditions rated as "Moderate" in Triangle area of state.
July 10, 2007	Raleigh Public Utilities produces first water supply status report. Falls Lake level is 249.65 feet MSL and the water supply pool remaining is **81%**. Drought conditions rated as "Moderate" in Triangle area of state.
August 7, 2007	City staff recommend City Council provide City Manager authority to implement Stage 1 Mandatory Water Use Restrictions if needed prior to their next meeting on Sept. 5th. City Council approves staff recommendation for Stage 1 implementation authority. Falls Lake level is 248.38 feet MSL and the water supply pool remaining is **69%**. Drought conditions rated as "Moderate" in Triangle area of state.
August 9, 2007	New all-time record water demand set at 77.0 MGD.
August 21, 2007	NC Drought Council meeting where DWR and NWS staff indicate "Exceptional" drought status in majority of the state including the Triangle area and predict drought to persist through fall and winter. City Manager authorizes implementation of Stage 1 Mandatory Water Use Restriction Ordinance.
August 28, 2007	City implements Stage 1 Mandatory Water Use Restriction Ordinance - limits irrigation to 1 day per week, plus other water use restrictions. Water use in system drops by an average of 19%. Falls Lake level is 246.94 feet MSL and the water supply pool remaining is **59%**. Drought conditions rated as

	"Exceptional".
September, 2007	No tropical storms occur during peak month of the season despite previous predictions from NWS of active season and a total of only 2.2 inches of rain received at RDU weather station.
October 23, 2007	City implements Amended Stage 1 Mandatory Water Use Restriction Ordinance – prohibits lawn irrigation totally. Water use in system drops by an average of 24%. Falls Lake level is 242.83 feet MSL and the water supply pool remaining is **33%**. Drought conditions rated as "Exceptional".
October 24 – 26, 2007	Triangle area receives 3 day rain event (total of 4.4 inches). Falls Lake level rises from new record low of 242.75 feet MSL to 251.95 feet MSL.
November, 2007	Total of 0.48 inches of rain received for entire month – driest November in 80 years of recorded weather history.
December 25 – 26, 2007	New record low level reached for Falls Lake at 241.52 feet MSL.
December 26 – 30, 2007	Multiple rain events occur raising Falls Lake level by 1.5 feet to 243.10 feet MSL.
February 5, 2008	City Council approves implementing Stage 2 Water Use Restriction Ordinance on February 15th. Stage 2 prohibits use of water for powerwashing, pool filling and vehicle washing, plus other water use restrictions.
February 15, 2008	Stage 2 Water Use Restriction Ordinance implemented. Falls Lake level is 243.36 feet MSL and the water supply pool remaining is **32%**. Drought conditions rated as "Exceptional".
March, 2008	Above normal rainfall experienced during March. Lake level begins to rise significantly during the month recovering to 249.85 feet MSL by April 1, 2008.
April 5, 2008	Falls Lake completely refills to 251.5 feet MSL at 6 PM EDST.
April 7, 2008	Raleigh rescinds Stage 2 mandatory water conservation ordinance and returns to Stage 1 water use restrictions.

ATTACHMENT F

WATER CONSERVATION ORDINANCE, EFFECTIVE JULY 2, 2007

ORDINANCE NO. (2007) - 235

AN ORDINANCE TO AMEND PART 8 CHAPTER 2 ARTICLE E, THE WATER CONSERVATION ORDINANCE OF THE RALEIGH CITY CODE

NOW THEREFORE BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF RALEIGH, NORTH CAROLINA THAT:

Section 1. Repeal, rewrite and re-enact Part 8, Chapter 2 Article E of the Raleigh City Code to read as follows:

"ARTICLE E.
WATER CONSERVATION PLAN

Sec. 8-2161. Purpose and Intent.

It is the purpose and intent of this Article to assure that available water resources are put to reasonable beneficial uses to avoid depletion of the *city* water supply during a *water shortage* and to ensure that demand does not exceed the *City's* capacity for water treatment and distribution. This Article *shall* be liberally construed to implement such purpose and intent.

Sec. 8-2162. Objective.

The objectives of the Water Conservation policy are to establish a program that will educate *consumers* of the importance of water conservation, set goals for reduction of water use on a day to day basis and during times of drought, and reduce per capita water consumption in a manner that is fair and equitable to all *consumers*/users.

Sec. 8-2163. Definitions.

As used in this Article, the following terms *shall* have the meanings provided in this section unless the context clearly indicates otherwise.

Approved (or Approval). Approved or approval means certified in writing by the Public Utilities Director as an acceptable water *conservation device*, program or methodology for the purpose of water conservation.

Available water supply. The total amount of water that is available to the *City* in the water supply pool(s). The U.S. Army Corps of Engineers will determine this amount for Falls Lake once the water level in Falls Lake drops below 251.5 feet Mean Sea Level.

Automatic spray irrigation system. Any installed irrigation system that can be programmed to operate during certain times and/or conditions and which is connect to the *City's public water supply system.*

BMP. Best Management Practice.

Certified automatic spray irrigation. A *City* approved irrigation system that is connected to uses the *City's public water supply system* and is designed to minimize water use.

Certified conservation user. A certified *conservation* user is a consumer who complies with the City of Raleigh water *conservation* program.

City. City in this Article means the City of Raleigh.

City reuse water. Effluent water from *City* facilities, including the *City* E.M. Johnson Water Treatment Plant, Smith Creek Wastewater Treatment Plant, Little Creek Wastewater Treatment Plant and/or Neuse River Wastewater Treatment Plant, which meets or exceeds the minimum quality requirements of the current North Carolina Reuse and Reclaimed Water Quality Standards.

Conservation (or conserve). Conservation or conserve means any beneficial reduction in water loss, waste, or use.

Conservation device. An *approved water conservation* device, properly installed within a private plumbing or distribution system, to improve water use efficiency within the City water supply system.

Conservation program. A program that identifies the uses of water within residential users, industry groups, commercial and/or industrial applications, which focuses on *BMPs* to reduce the consumption of water. The program will be submitted to Public Utilities for review and *approval.* Each *conservation program* should be updated as required by the Public Utilities Director. All *certified conservation* users should be publicly recognized as water savers.

Consumer. Any *person,* business, corporation, institution, resident or industry responsible for any *property* at which water from the City of Raleigh *public water supply* is received. In the absence of other parties or the failure of other parties to accept the responsibilities herein set forth, the *owner* of record of the *real property shall* be ultimately responsible.

Hand held hose. Any hose that is connected to the City's *public water supply system* and held in the hand during irrigation use.

Hose end sprinkler. An irrigation device that is connected to the City's *public water supply system* and is not designed to be held in the hand during use. Examples are: single stream, multi-stream, and impact type sprinklers.

Hydrant meter. A water meter specifically designed, fabricated and leased from the City of Raleigh Public Utilities Department for *consumers* to purchase water from the *City* from fire hydrants in accordance with the *City's* Hydrant Meter Program.

Major water user. A water customer who uses 100,000 gallons per day (GPD) or more per account as determined on either an annual or an average day during the *City* seasonal water demand period.

Non-Automatic Spray Irrigation System. Any installed irrigation system that is connected to the City's *public water supply system* and which is operated manually.

On-site reuse water. On-site reuse water is effluent water from an individual on-site wastewater system which meets or exceeds the minimum requirements of the current North Carolina Reuse and Reclaimed Water Quality Standards.

Potable water. Potable water is the water from the *public water supply system* of the *City* which meets or exceeds the minimum requirements of the current Federal and North Carolina Safe Drinking Water Act.

Projection period. The remaining number of days in the calendar year from the date of the water supply projection, plus sixty (60) days.

Public water supply. The water supply of the *City*, and its customers for general use and which supply is recognized as the public water supply of the *City* by the North Carolina Department of Environment and Natural Resources.

Rain sensor (or rain-sensing device or rain shutoff device): A sensor system that automatically adjusts the schedule for or shuts off an irrigation system before or during rainfall.

Reuse water. *City reuse water and/or on-site reuse water.*

Seasonal demand period. The period of time from April 1st through November 30th.

Water demand average. The average daily amount of water pumped from the *City* water plant(s) for the previous thirty (30) day period.

Water shortage. A "water shortage" *shall* exist when the demands and requirements of water customers served by the *City* cannot be satisfied without depleting the water supply to or below a critical level, the level at which the continued availability of water for human consumption, sanitation and fire protection is jeopardized.

Sec. 8-2164. COMPLIANCE WITH FEDERAL AND STATE LAW.

The *City* will comply with the Federal Safe Drinking Water Act, the North Carolina Drinking Water Act, and North Carolina State Building Code, which pertain to water *conservation* and establish an effective on-going program to control use of *public water supply.*

Sec. 8-2165. UNLAWFUL WATER USES.

It *shall* be unlawful for any for any *person* to use water in violation of this Article or any of the mandatory water use restriction ordinances *approved* by the Raleigh City Council. It *shall* also be unlawful for any *person* to use *potable water* from the *public water* system, if reuse water from the City *reuse water* supply system is equally available to the same location and the water use does not require *potable water* quality.

Sec. 8-2166. INSPECTION OF PROPERTY.

It *shall* be the duty, upon request of the Public Utilities Director, for designated Public Utilities Department staff to observe and determine if the uses of water by Raleigh water supply system customers are compliant with the provisions of this Article.

Sec. 8-2167. RIGHT OF ACCESS.

The Public Utilities Director, or designated staff, *shall* have the right to enter, at a reasonable time, any property served by a connection to the *City public water supply* for the purpose of performing the duties of this Article. In cases in which the *property owner*, managing agent, or tenant chooses not to provide such access, the Public Utilities Director or authorized staff *may* obtain a warrant an inspect or *may* in accordance with applicable law interrupt water service to the *property*.

Sec. 8-2168. WATER METERING AND WATER USE AUDITS.

Water use restrictions *shall* apply to all *City* water supply system customers, including all *City* departments and *City* owned facilities. All permanent water service to customers *shall* be metered and billed based on the *City's* current water and sewer rate ordinance. All temporary water service to customers *shall* be provided through the *City's hydrant meter* program or other water accountability method *approved* by the Public Utilities Director. Water use audits will be conducted by designated Public Utilities staff when determined to be necessary by the Public Utilities Director on any water customer account to determine if water usage *may* be reduced by the customer.

Sec. 8-2169. LANDSCAPE WATER CONSERVATION.

After application of this Article, all new permanent in-ground irrigation systems *shall* be individually metered. Such systems must either have: (1) an *approved* programmable controller for adjustment of irrigation frequency and intensity and (2) a *rain sensor*, or other *approved conservation device*, for automatic shut-off in accordance with Raleigh standards or be approved under the requirements of the latest conservation certification program of the *City* for automatic in-ground irrigation systems. Any automatic in-ground irrigation system that is not certified by the Public Utilities Director *shall* comply with the mandatory water conservation requirements of Section 8-2175(c).

Sec. 8-2170. MAJOR WATER USERS.

All *major water users* are required to develop a *conservation program* and an emergency water usage reduction plan to focus on reducing water consumption, to include *BMPs* or policy for their specific uses of water in their business/commercial applications or manufacturing processes. The program *shall* be designed to reduce water consumption comparable to the overall reduction achieved by the every day, Stage 1, and Stage 2 mandatory water *conservation* ordinances. The *Conservation program shall* be submitted to Public Utilities for review and *approval* within one-hundred and eighty (180) days of notification by the *City*. Programs *shall* be implemented in accordance with the implementation of the *City's* water *conservation* ordinances. Each *conservation program shall* be updated by the *major water user* as required by the Public Utilities Director. All *certified conservation users* will be publicly recognized as water savers.

Sec. 8-2171. VEHICLE WASH FACILITIES.

All vehicle wash facilities that desire to be *approved shall* comply with the requirements of the latest conservation certification program of the *City* for vehicle wash facilities. Any vehicle wash facility that is not certified by the Public Utilities Director *shall* be closed during Stage 2 mandatory water conservation restrictions and rules until it is in compliance with the requirements of the *conservation certification program* or until the Stage 2 mandatory water conservation restrictions and rules are repealed. All certified vehicle wash facilities, following certification, *shall* display at entrance of the facility the approved for water conservation placard issued by the Public Utilities Department at all times.

Sec. 8-2172. WATER USE MONITORING.

The Public Utilities Director and designated staff are responsible for monitoring water usage from the public water system and the amount of public water supply that is available to the *City* on a continuous basis. The Public Utilities Director will implement the water use restrictions under this Article to ensure that the City has sufficient water supply available at all times. Water use restrictions *may* be recommended by the Public Utilities Director for approval by the *City Council* at any time that the *available water supply* capacity does not meet or exceed the projected water usage amount during the *projection period*, based on the then current *water demand average*. Water use monitoring thresholds are:

a) Over 70% available water supply capacity – every day mandatory water conservation restrictions and voluntary water use measures and best management practices are in effect.
b) 70% or lower available - stage 1 mandatory water conservation restrictions and rules may be necessary
c) 50% or lower available – stage 2 mandatory water conservation restrictions and rules may be necessary.

Sec. 8-2173. EDUCATION.

The Public Utilities Director and designated staff are responsible for developing and maintaining a comprehensive water *conservation* education program to implement voluntary adoption of *City*

water *conservation* best management practices. The City of Raleigh Public Utilities Department Water Conservation Plan authorized under this Article serves as the principal text for the water *conservation* education program and *shall* be fully incorporated into the Raleigh Public Utilities Handbook ('the Handbook") along with other water *conservation* information. The Handbook *shall* include detailed descriptions of the Certified Landscape Irrigation Auditing Program, the Conservation Certification Program for the Professional Vehicle Wash Industry, the Water Wise Certification Program, the civil penalty matrix and the Major Water Users Conservation Program. The Handbook shall also include technical standards for the water *conservation* equipment and materials specified by the *City.*

Sec. 8-2174. CONSERVATION WATER RATE.

The *City* water consumption rate ordinance will be annually reviewed by the Public Utilities staff to ensure that unit price values and the rate ordinance structure recommended to City Council provides an economic incentive for water *conservation.*

Sec. 8-2175. MANDATORY WATER USE RESTRICTIONS.

It *shall* be unlawful for any *person* to use water from the *public water supply system* of the *City* in violations of the following mandatory water c*onservation* restrictions:

(a) All Stage 1 mandatory water conservation restrictions and rules as set forth by any ordinance adopted by the City Council.

(b) All Stage 2 mandatory water conservation restrictions and rules as set forth by any ordinance adopted by the City Council.

(c) Every day mandatory water conservation restrictions

(1) To use water from City of Raleigh *public water supply* for *automatic and non-automatic irrigation systems* and for *hose end sprinklers* except:

a. *Properties* with **ODD** numbered addresses *may* water lawns and landscapes only on **TUESDAY, THURSDAY and SATURDAY**.

b. Properties with **EVEN** numbered addresses *may* water lawns and landscapes only on **WEDNESDAY, FRIDAY** and **SUNDAY**.

No *automatic or non-automatic irrigation systems* or *hose end sprinklers shall* be operated on **MONDAY.**

Notwithstanding the limitations of subsections a and b above, City *certified automatic irrigation system* installations *approved* pursuant to section 8-2169 *may* be operated on the days and at times determined by the system controller sensors for weather, soil and other conditions in order to maximize the efficiency of water use and minimize the consumption of water or as necessary for testing and

calibration of the system controller. But no *certified automatic irrigation system* approved by the *City may* operate during a Stage 1 water conservation restriction period except in conformity with applicable Stage 1 requirements. A placard issued by the City's Public Utilities Department *shall* be displayed on the street yard of the *property*.

(2) Violations of Section 8-2175(c) *may* be punished by any of the means available to the City pursuant to N.C.G.S. 160A-175. A written warning will be issued for the first violation of 8-2175(c). A civil penalty of $50.00 *shall* be assessed for the second violation of Section 8-2175(c) and a third violation *shall r*esult in a civil penalty of $200.00. A fourth violation will result in interruption of water service to the offending customer. The City will issue written notification to the customer and occupant of intent to interrupt water service and twenty-four (24) hours later will interrupt water service. If water service has been interrupted due to repeat violation of Section 8-2175(c), service will not be re-instated until the Public Utilities Director has determined that the risk to the City water supply has been alleviated or the Public Utilities Director is otherwise assured of compliance.

Sec. 8-2176. VOLUNTARY WATER USE MEASURES

All *consumers* are encouraged to adopt the following best management practices to *conserve water*:

(a) Outdoor Water Uses:

1. Check for plumbing leaks. A single dripping faucet can waste hundreds, even thousands, of gallons per year. Most water leaks are easy to detect and repair with basic plumbing skills and a few simple tools.

2. Have soil tested by the North Carolina Department of Agronomy/Soil Testing Section. Most yards in this region are composed of granite soils. They need lime more than they need fertilizer.

3. Plant native trees and shrubs. The North Carolina State University Cooperative Extension Service has excellent suggestions for home gardeners. Use mulch around shrubs and garden plants to reduce evaporation. Mix the turf areas with shaded areas to reduce irrigation demands.

4. Let the grass grow taller in hot weather by raising your lawn mower cutting height. Longer grass blades help shade each other, reduce evaporation, and inhibit weed growth.

5. Water slowly and thoroughly during cool, windless hours to prevent water loss from evaporation.

6. Be attentive if using a hose and sprinkler, consider setting an alarm or the oven timer as a reminder to move the hose and sprinkler as needed.

7. Use a rain gauge. One inch of water per week will keep lawns green throughout the summer.

8. Water should be applied slowly to achieve deep penetration and prevent water run-off. Do not water impervious surfaces such as streets, parking lots, driveways and sidewalks.

9. Install a drip irrigation system for watering gardens, trees, and shrubs. Drip systems are very efficient because they provide a slow, steady trickle of water to plants at their roots through a network of hidden pipes and hoses.

10. Use properly treated reuse water for irrigation as an alternative water source. Raleigh's water conservation rules do not regulate the amount of reuse water and therefore any amount can be used during any mandatory water conservation stage. Contact the Raleigh Public Utilities Department for information regarding reuse water availability.

11. Capture rain water in cisterns and rain barrels. The average rainfall in the Raleigh area is about 48 inches per year. Run-off from the roof of a typical 2,500 square foot home is about 75,000 gallons a year. Raleigh encourages customers to capture rainwater and use it on the landscape.

12. Consider the amount of water being used and look for ways to use less whenever possibly. Do not leave water running - use spring loaded or other automatic shut-off devices on hoses or outdoor faucets.

13 Use commercial vehicle washing facilities, especially those which have been certified by Raleigh as water conserving facilities, instead of washing vehicles at home.

14. Use a broom or blower to remove dust, dirt, leaves and other debris from sidewalks, driveways, porches and decks rather than water.

(b) Indoor Water Uses:

1. Thaw frozen food in your refrigerator or microwave instead of using running water. Wash fruits and vegetables with a vegetable brush in a basin or bowl instead of using running water.

2. Scrape or wipe, rather than rinse, dishes before loading into the dishwasher. Wash only full loads. Consider replacing old dishwasher with a water and energy saving model.

3. Wash only full loads of laundry or use the appropriate water level or load size selection on the washing machine. Presoak heavily soiled items. Use detergent sparingly in order to avoid rinsing more than normal cycle. Consider purchasing a high efficiency washing machine to save laundry water and energy.

4. Install low-flow toilets, faucet aerators, and low-flow showerheads.

5. Leaky toilet can waste 200 gallons of water per day. To detect leaks in a toilet, add a few drops of food coloring to the tank water. Do not flush. Wait a few minutes. The toilet is leaking if the colored water appears in the bowl.

6. Commercial and industrial customers not otherwise regulated as a *major water user* should review their water uses and should consider implementing industry specific best management water conservation practices.

7. Check for leaks in toilets, faucets, shower heads and any other plumbing fixtures and repair these leaks immediately.

Sec. 8-2177. ENFORCEMENT.

(a) Penalty.

Violation of any provision of this Article *may* subject the offender to a civil penalty to be recovered by the *City* in a civil action in the nature of debt if the offender does not pay the penalty within thirty (30) days after the assessment has become final by exhaustion of the appeal process established by this section, or by failure to appeal the assessment and will be subject to temporary water service interruption.

Except as otherwise provided in this Article and in mandatory water use restriction ordinances, the civil penalty for violation of any provision of this Article *shall* not exceed one thousand dollars ($1,000.00) per day for each day of continuous violation, or a cumulative or single civil penalty of twenty-five thousand dollars ($25,000.00). The civil penalty for willful violation of any provision of this Article *shall* not exceed five thousand dollars ($5,000.00) per day for each day of a continuous violation, or a cumulative or single civil penalty of twenty five thousand dollars ($25,000.00).

(b) Assessment.

Any civil penalty *shall* be assessed by the Public Utilities Director, and *shall* be based upon the reasonable estimated cost of correcting the cited violation, the magnitude of the potential risk posed to the public health, safety and welfare by the violation, and the cost of the public safety or other emergency response caused by the violation. The Public Utilities Director *shall* serve written notice of the civil penalty assessment on the offender and set out with reasonable care the basis of the amount so assessed.

(c) Equitable relief.

The provisions of this Article may be enforced by an appropriate equitable remedy, including a mandatory or prohibitory injunction, issuing from a court of competent jurisdiction.

(d) Enforcement option.

The penalties and enforcement provisions established by this Article *may* be applied in addition to or in lieu of the penalties established by other sections of this Code and applicable ordinances.

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RESERVED."

Section 2. All laws and clauses of laws in conflict herewith are hereby repealed to the extent of said conflict.

Section 3. If this ordinance or application thereof to any person or circumstance is held invalid, such invalidity shall not affect other provisions or applications of the ordinance which can be given separate effect and to this end the provisions of this ordinance are declared to be severable.

Section 4. This ordinance shall be enforced as provided in N.C.G.S. 160A-175 or as provided in the Raleigh City Code. All criminal sanctions shall be the maximum allowed by law notwithstanding the fifty dollar limit in G.S. 14-4(a) or similar limitations.

Section 5. This ordinance shall become effective on July 2, 2007.

Adopted: May 15, 2007

Effective: July 2, 2007

Distribution: Department Heads

This Ordinance was prepared by the City Attorney's office